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User's Guide for RAM - Second Edition

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USER'S GUIDE FOR RAM -- SECOND EDITION

by

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AFFILIATION

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PREFACE

An area of research within the Meteorology and Assessment Division is development, evaluation, validation, and application of models for air quality simulation, photochemistry, and meteorology. The models must be able to describe air quality and atmospheric processes affecting the dispersion of airborne pollutants on scales ranging from local to global. Within the Division, the Environmental Operations Branch adapts and evaluates new and existing meteorological dispersion models and statistical technique models, tailors effective models for recurring user application, and makes these models available through EPA's User's Network for Applied Modeling of Air Pollution (UNAMAP) system.

RAM is a Gaussian-plume model for predicting short-term (one hour to one day) air pollution levels in the near field of multiple point and area source facilities. The model has been upgraded to include a default option which initializes parameters for cases when the model is to be used in a regulatory mode.

Although attempts are made to thoroughly check computer programs with a wide variety of input data, errors are occasionally found. Revisions may be obtained as they are issued by completing and returning the form on the last page of this guide.

The first three sections of this document are directed to managers and project directors who wish to evaluate the applicability of the model to their needs. Sections 4, 5, 6, 7, and 10 are directed to engineers, meteorologists, and other scientists who are required to become familiar with the details of the model. Finally, Sections 8 through 11 are directed to persons responsible for implementing and executing the program.

Comments and suggestions regarding this publication should be directed to:

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Technical questions regarding use of the model should be directed to (919) 541-4564. Users within the Federal Government may call FTS 629-4564. Copies of the user's guide are available from the National Technical Information Service (NTIS), Springfield, VA 22161.

The magnetic tape containing FORTRAN source code for RAM is contained (along with other dispersion models) in UNAMAP (Version 6) (U. S. EPA, 1986), which is available from Computer Products, NTIS, Springfield, VA 22161 (phone number: (703) 487-4763). The NTIS accession number of UNAMAP (Version 6) is PB86-222 361/AS.

ABSTRACT

RAM is an air quality model based on the Gaussian-plume simplification of the diffusion equation which assumes time independence in the input meteorology and concentration. The model is primarily used to determine short-term (one hour to one day) concentrations from point and area sources. A maximum of 250 point sources and 100 area sources can be considered to yield pollutant concentrations at a maximum of 180 receptors. The simulation is done using hourly meteorological data for periods ranging from one hour to one year. A default option is available in the model for regulatory applications. Use of this option automatically sets certain parameters to preassigned values for consistency with the "Guideline on Air Quality Models (Revised)" (EPA, 1986).

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ACKNOWLEDGMENTS

The authors wish to express their appreciation to Russell Lee for helpful comments regarding aspects of the work presented here. Special mention is made to Mr. John Crouch who assembled and corrected the text. Most of the text presented in this document was excerpted from publications dealing with RAM and MPTER over the past few years.

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EXECUTIVE SUMMARY

The RAM algorithm is a Gaussian-plume dispersion model that calculates short-term pollutant concentrations from multiple point and/or area sources at a user-specified receptor grid in level or gently rolling terrain. Pollutants considered are relatively non-reactive, such as sulfur dioxide and suspended particulates. Both urban and rural situations can be simulated. In the rural mode, the model uses the Pasquill-Gifford dispersion parameters; in the urban mode, those proposed by Briggs based on the work of Pooler-McElroy are used. Plume rise is calculated following the methods of Briggs and both buoyancy rise and momentum rise are included. For point sources, concentrations are determined using distance crosswind and distance upwind from the receptor to each source. For area sources, the narrow plume simplification of Gifford and Hanna is used with the modification that the area sources are not at ground level, but have an effective height.

Inputs to the model are a set of options selected by the user, source parameters, meteorological data, and receptor information. Using the hourly meteorology, concentrations are calculated for receptor locations either specified by the user or generated by the program. Emissions and source parameters for point or area sources are required inputs. The meteorological data base, and hence the simulation, can vary from one hour to one year. Concentrations for 5 averaging periods can be computed. For long-term runs such as a year, a high-five tabulation can be obtained to determine the highest and second highest concentrations at each receptor for each of five averaging periods. Receptors can be specified by the user or they can be generated by the program. If they are input by the user, receptor name as well as coordinates may be provided on input.

For model execution, the user specifies parameters and options needed for the application. Required parameters are type of pollutant, number of sources, averaging period(s), power-law wind-profile exponents, and whether the urban or rural mode is to be used. Options are included for the treatment

of stack-tip downwash, gradual plume rise, and buoyancy-induced dispersion. The user also specifies types of sources and those that are significant, receptor configuration, characteristics of emission sources, and meteorological inputs. Whether the run is part of a segmented run, outputs desired, and use of the default feature are also specified by the user. The default feature sets parameters and options for regulatory application; final plume rise and momentum plume rise are used as are buoyancy-induced dispersion and stack-tip downwash. Calm wind conditions are treated following the "Calms Processor (CALMPRO) User's Guide" (U. S. EPA, 1984).

Both point and area sources are considered by the model. Their particulars can be included in the run stream or they can be read from disk or tape files. Source coordinates and parameters must be given, as well as emission rates. A total of 250 point sources and 100 area sources are permitted. Of these, up to 25 point sources and 10 area sources can be labeled significant to obtain their contribution at a receptor separately.

As with the data on emissions, the meteorology can be read as part of the input stream, from a file processed by the program RAMMET, or from a file having the format of RAMMET. Surface parameters and mixing height must be present for each simulation hour; the meteorological file is of a variable length from one hour to one year.

Receptors can be specified by the user or they can be generated by the model. If they are input by the user, receptor name as well as coordinates may be provided. If generated by the program, the user selects whether a polar coordinate grid of 180 receptors (36 radials by 5 distances) or a honeycomb receptor configuration is desired. Also, when significant sources are specified, the model selects two receptors downwind of each source where maxima are likely to occur. A total of 180 receptors are permitted.

On output, the model produces printed and disk or tape files. The printed output lists the options and source information including a ranking according to source height; those selected by the user as significant are properly identified. Receptors are next listed with their appropriate coordinates. This is followed by the meteorological parameters as input by the user. Model-calculated concentrations are tabulated by receptor. Various other output files can be obtained.

SECTION 1

INTRODUCTION

The RAM system is based on the Gaussian-plume equation which assumes steady state; it includes dispersion algorithms for both urban and rural situations. The algorithm can be used for short-term (one hour to one day) determination of urban air quality resulting from pollutants released from multiple point and area sources.

The algorithm was first described by Novak and Turner (1976). It is applicable to locations with level or gently rolling terrain where a single wind vector for each hour is a reasonable approximation of the flow over the source area considered. A single mixing height and a single stability class for each hour are assumed representative of the area. The use of RAM is restricted to relatively non-reactive pollutants and is usually applied to sulfur dioxide and total suspended particulates.

Emission information required of point sources consists of source coordinates, emission rate, physical height, stack diameter, stack gas exit velocity, and stack gas temperature. Emission information required of area source squares consists of south-west corner coordinates, source side length, total area emission rate, and effective area source height. Output consists of calculated air pollutant concentrations at each receptor for hourly averaging times and a longer averaging time specified by the user. Contributions to the concentration in the two categories -- point sources and area sources -- are also given on output. The contributions to the concentration from specific point and area sources can be obtained at the option of the user.

Computations are performed hour by hour as if the atmosphere had achieved steady-state condition. Therefore, errors will occur where there is a gradual buildup (or decrease) in concentrations from hour to hour, such as under light wind conditions. Also, with light wind conditions, the definition of wind direction is likely to be inaccurate; variations in the wind flow from location to location in the area are quite probable.

Briggs' plume-rise equations are used to estimate effective height of point sources. Concentrations from the point sources are determined using distance crosswind and distance upwind from the receptor to each source.

Considerable time is saved in calculating concentrations from area sources by using a narrow plume simplification which considers sources at various distances on a line directly upwind from the receptor to be representative in the crosswind direction of the sources at those distances affecting the receptor. Area source sizes are used as given in the emission inventory in lieu of creating an inventory of uniform elements.

Options are available to allow the use of four different types of receptor locations:

- those with coordinates input by the user,
- those with coordinates determined by RAM and are downwind of significant point and area sources where maxima are likely to occur,
- those with coordinates determined by RAM to give good area coverage of a specific portion of the region, and
- those with coordinates determined by RAM to radially circle a designated point; radial distances are supplied by the user.

Options are also available to limit the output produced.

Urban planners may use RAM to determine the effects of new source locations and control strategies upon short-term air quality. If the input meteorological parameter values can be forecast with sufficient accuracy, control agency officials may use RAM to predict ambient air quality levels, primarily over the 24-hour averaging time, to locate mobile air sampling units, and to assist with emission reduction tactics. Diurnal and day-to-day emission variations must be considered in the source inventory input to the model, especially for control tactics. For most of these uses, the optional feature to assist in locating concentration maxima should be used. Computations are organized so that execution of the program is rapid, thus real-time computations are feasible.

This document is divided into three parts, each directed to a different reader: managers, dispersion meteorologists, and computer specialists. The first three sections are aimed at managers and project directors who wish to evaluate the applicability of the model to their needs. Sections 4, 5, 6, 7, and 10 are directed to dispersion meteorologists or engineers who are required to become familiar with details of the model. Finally, Sections 8 through 11 are directed toward persons responsible for implementing and executing the program. A listing of the FORTRAN source statements is included in Appendix A.

SECTION 2
DATA-REQUIREMENTS CHECKLIST

Model Options

RAM requires data on options, sources, meteorology, and receptors. The user must indicate which of the following options are to be used.

- stack-tip downwash
- gradual plume rise
- buoyancy-induced dispersion
- input of point and area sources
- emissions from a previous run of RAM
- meteorological data on card-image records
- input of hourly point and area source emissions
- specification of significant point and area sources
- input of receptors by specifying coordinates
- option for RAM to generate receptors downwind of significant point and area sources
- option for RAM to generate a honeycomb array of receptors
- input of radial distances to generate a polar coordinate receptor array.

The following are options to omit certain outputs. A number of these options should be used or the program will generate large quantities of printed information.

- point source list
- area source list and map
- emissions with height table
- resultant meteorological data summary for the averaging period
- all hourly output (point, area, summaries)
- hourly point contribution

- meteorological data on hourly point contributions
- plume height and distance to final rise on hourly point contributions
- hourly area contributions
- meteorological data on hourly area contributions
- hourly summary
- meteorological data on hourly summary
- all averaging period output
- point averaging period contributions
- area averaging period contributions
- averaging period summary
- average concentrations and high-five table.

The following options can also affect the amount of output.

- use of a default option
- use of parts of segmented runs
- output of partial concentrations to disk or tape
- output of hourly concentrations to disk or tape
- output of averaging period concentrations to a file
- output of averaging period concentrations to card-image records.

Meteorological Data

The meteorological data required for the model are:

- power-law wind profile exponents for each stability class
- anemometer height
- stability class at the hour of measurement
- wind speed
- air temperature
- wind direction
- mixing height.

Source Emissions Data

The information required of the emissions sources is:

- coordinates of the point source
- emission rate for sulfur dioxide
- emission rate for suspended particulates
- physical stack height
- stack gas temperature
- stack exit diameter
- stack gas exit velocity
- coordinates of SW corner of area source
- side length of area source.

The user may also specify up to 25 point sources and up to 10 area sources as being significant (i.e. sources for which additional information is output).

Receptor Data

The user may also choose to input the coordinates of the receptors (up to 180) or enter one to five radial distances, in which case, RAM will generate 36 receptors for each distance entered. If the user specifies the array boundaries, RAM can also generate its own honeycomb array of receptors. Additionally, RAM can generate receptors downwind of significant point or area sources if the significant source option is used.

SECTION 3

FEATURES AND LIMITATIONS

USES

RAM is primarily a short-term (one hour to one day) urban or rural algorithm used to estimate air quality from point and area sources.

Effects of either control strategies or tactics for specific short-term periods may be examined by users. The expected effect of a proposed source or sources can also be determined. The spatial variation in air quality throughout the urban/rural area, or in a portion of the area, for specific periods can be evaluated readily.

In a forecast or predictive mode such as over a 24-hour period, the algorithm can assist in locating mobile or portable air samplers and can assist with emission reduction tactics. Successful use of RAM in the forecast mode is contingent on the validity of the algorithm assumptions and the ability to accurately forecast both the input meteorological parameter values and the input emission parameter values.

The model has the following added features:

- urban dispersion coefficients recommended by Briggs -- see Figure 7 and Table 8 of Gifford (1976),
- wind-profile exponents for urban and rural situations,
- optional treatment of calm conditions following methods developed by the EPA (1984),
- stack-tip downwash using the algorithm of Briggs (1974),
- momentum-plume rise to treat momentum-dominated plumes as suggested by Briggs (1969),
- buoyancy-induced dispersion following the method of Pasquill (1976), and a

- default option, primarily for regulatory application of the model.

These features were added to satisfy the requirements outlined in "Guideline on Air Quality Models (Revised)" (EPA, 1986). The default option is designed as a convenience for the user to help avoid inadvertent errors in setting the appropriate switches for regulatory use. The reader is cautioned to refer to the current regulatory guidance contained in the "Guideline on Air Quality Models".

Urban and Rural Modes

The urban dispersion parameter values are those recommended by Briggs and included in Figure 7 and Table 8 of Gifford (1976). They have been coded in a subroutine which yields dispersion coefficients as functions of atmospheric stability and downwind distance. Separate urban and rural default wind-profile exponents are used in the model. These exponents are used by the model when the user exercises the default option or when they have not been provided on input. The rural exponents correspond to a surface roughness of about 0.1 meters; the urban exponents result from a roughness of about 1 meter (plus urban heat release influences). For a more detailed discussion of wind profiles, the reader is referred to Irwin (1979).

ALGORITHM ASSUMPTIONS

Gaussian Plumes

Calculations of concentrations from point sources are made for emissions diluted according to the mean wind speed, assuming that the time-averaged plumes over 1-hour periods have Gaussian (normal) distributions perpendicular to the plume centerline in the horizontal and vertical.

Narrow Plume Simplification

Calculations of concentrations from area sources are made by considering that area sources at various distances on a line directly upwind from the receptor are representative of the sources at those distances that affect the receptor. This assumption is best fulfilled by gradual rather than abrupt changes in area emission rates from adjacent area sources. The narrow plume simplification is considered in more detail in the next section.

Meteorological Conditions Representative of the Region

The meteorological input for each hour consists of a value for each of the five parameters: wind direction, wind speed, temperature, stability class, and mixing height, all of which should be representative of the entire region containing the sources and receptors. Mixing height is required only if the atmospheric stability is neutral or unstable.

Steady-state

Calculations are made as if the atmosphere had reached a steady state. Concentrations for a given hour are calculated independently of conditions for the previous hour(s).

Concentration, Sum of Contributions

The total concentration for a given hour for a particular receptor is the sum of the estimated contributions from each source.

Vertical Stability

Except for stable layers aloft, which inhibit vertical dispersion, the atmosphere is treated as a single layer in the vertical with the same rate of vertical dispersion throughout the layer. Complete eddy reflection is assumed both from the ground and from the stable layer aloft given by the mixing layer.

Mixing Height

If vertical temperature soundings are available from a representative location, they should be used with hourly surface temperatures to estimate hourly mixing heights for periods with neutral or unstable stratification. If National Weather Service hourly data are used in the model, two values of mixing height per day are required. These are the maximum and minimum mixing heights as defined by Holzworth (1972). The preprocessor program RAMMET provides a crude interpolation to obtain hourly mixing heights; however, this interpolation does not consider hourly surface temperatures.

Wind Speeds and Directions

Wind speeds and directions should be hourly averages (National Weather Service hourly observations are not really hourly averages, but are averages of a few minutes at the time of the observation, usually 5 to 10 minutes prior to the hour). Input winds should be representative of the entire region. In addition to input winds, the user is required to give the anemometer height.

The increase of wind speed with height is included, based upon a power-law wind profile. The exponent is dependent upon the stability classification and surface roughness. (See Irwin, 1979) For any given hour, winds at various heights above ground are likely to deviate considerably from this climatological mean profile. If user-defined exponents are not supplied, default exponents are used by the model.

There is no inclusion of directional shear with height. This means that the direction of flow is assumed to be the same at all levels over the region. The taller the effective height of the emission, the larger the expected error in the direction of plume transport. Although the effects of surface friction are such that wind direction usually veers (turns clockwise) with height, the thermal effects (in response to the horizontal temperature gradient in the region) may cause increased veering or can overcome the effect of friction and cause backing (turning counterclockwise with height).

National Weather Service observations report wind to the nearest 10°. In order to avoid unrealistic results that would occur from having the wind come from exactly the same direction hour after hour, the program RAMMET, which processes the meteorological data, uses random numbers from 0 to 9 to add from -4° to +5° to the reported wind direction. The purpose of this is to prevent an extreme overestimate of concentration at a point downwind of a source during a period of steady wind when sequential observations show the same direction. Rather than allow the plume centerline to remain in exactly the same position for several hours, the alteration allows for some variation of the plume centerline within the 10° sector. Although this can in no way simulate the actual sequence of hourly events (wind direction to 1° accuracy cannot be obtained from wind direction reported to the nearest 10°), such alterations can be expected to result in concentrations over a period of record to be more representative than those obtained using winds to only the

10° increments reported. (Sensitivity tests of this alteration for single sources have indicated that, where a few hours of unstable conditions are critical to producing high concentrations, the resulting concentrations are extremely sensitive to the exact sequence of random numbers used, such as two wind directions 1° apart versus two wind directions 9° apart. Differences of 24-hour concentrations from a single source by 40 to 50 percent have appeared in the sensitivity tests due to the alteration.) It is, therefore, important to use accurate wind information as input to RAM.

Dispersion Parameter Values

The dispersion parameter values representative for urban areas are those recommended by Briggs and included in Figure 7 and Table 8 of Gifford (1976).

The dispersion parameter values representative for open countryside are the Pasquill-Gifford curves (Pasquill, 1961; Gifford, 1960) which appear in the Workbook of Atmospheric Dispersion Estimates (Turner, 1970). The subroutines used to determine the open countryside parameter values are the same as in the UNAMAP programs MPTER and PTPLU (Pierce and Turner, 1980; Pierce et al., 1982, Chico and Catalano, 1986).

Plume Rise

Plume rise from point sources is calculated using the methods of Briggs (1969, 1971, 1972, 1974, 1975). Although the plume rise from point sources is usually dominated by buoyancy, plume rise due to momentum is also taken into account. Merging of nearby buoyant plumes is not considered. Stack-tip downwash is considered, but building downwash is not.

The variation of effective height of emission from area sources as a function of wind speed is thought to be an important factor in properly simulating dispersion in urban areas. Since this effect is seldom considered in the compilation of urban area emission inventories, it is difficult to have the appropriate parameters to estimate this effect; however, it can be approximated in RAM. The methodology used is explained in Section 5.

Emission Inventories

For similar meteorological conditions, the contribution to the concentration at a receptor from a source is directly proportional to the emission rate from that source. It is imperative, therefore, to have emissions expressed accurately. Many air pollutant sources vary emissions with time, such as by hour of the day or weekdays versus weekends, and attempts should be made to include these variations. For facilities with detailed emission inventories, hourly emissions can be determined external to RAM and entered via a separate file. Hourly exit velocities are calculated within RAM in proportion to annual exit velocities as hourly emissions are to annual emissions.

Removal or Chemical Reactions

Transformations of a pollutant primarily as a function of time resulting in loss of that pollutant throughout the entire depth of each plume can be approximated by RAM. This is accomplished by an exponential decrease with travel time from the source. The input parameter is the time expected to lose 50% (half-life) of the emitted pollutant. RAM does not have the capability to change this parameter value during a given run. If the loss to be simulated takes place through the whole plume without dependence upon concentration, then the exponential loss may provide a reasonable simulatior if the loss rate is realistic. However, if the loss mechanism is selective, such as impaction with features on the ground, reactions with materials on the ground, or dependence on the concentration in a given small parcel of air (requiring consideration of contributions from all sources to this parcel), the loss mechanism built into RAM will not be adequate.

Topographic Influences

RAM is designed for application over level or gently rolling terrain where the assumption of a flat plane used in the algorithm is reasonable. Dispersion parameters for the urban algorithms, are representative of surface roughness over urban areas ($z_0 \approx 1m$). Dispersion parameters for the rural algorithms are representative of surface roughness over rural areas ($z_0 \approx 0.1$ m). The algorithms in RAM have no topographical influences incorporated, and some difficulties might be expected in attempting to use the model in terrain situations. Under unstable conditions, plumes may tend to rise over terrain obstructions; under stable conditions, leveled-off plumes may remain at nearly the same mean sea level height, but may be expected to alter the plume path in response to the terrain features, resulting in a different wind direction locally than that specified for the region.

Fumigation

Fumigation is a transient phenomenon that eliminates the inversion layer containing a stable plume from below, causing mixing of pollutants downward and resulting in uniform concentrations with height beneath the original plume centerline. This phenomenon is not included in the calculations made by RAM. Conditions specified for each hour are calculated as if a steady state had been achieved.

Default Option

A default option is a feature of the model which facilitates compliance with regulatory requirements. For either rural or urban situations, exercising this option overrides other user-input selections and results in the following:

- final plume rise is used (gradual or transitional plume rise is not used for plume height, but it is used to calculate the magnitude of the buoyancy-induced dispersion),
- buoyancy-induced dispersion is used,
- stack-tip downwash is considered,
- default urban or rural wind-profile exponents are used as given in Table 1,
- default vertical potential temperature gradients for stable conditions are used,
- a decay half-life of four hours for SO_2 in urban mode is used, otherwise no decay,
- momentum-plume rise is calculated, and
- calms are treated according to methods developed by the EPA (1984). These are discussed next.

Optional Treatment of Calm Conditions

When the default option is exercised, calm conditions are handled according to methods developed by EPA. A calm hour is indicated in the preprocessed meteorological data as an hour with a wind speed of 1.0 m/sec and a wind direction the same as the previous hour. When a calm is detected in the meteorological data, the concentrations at all receptors are set to zero. When calculating a multiple hour average concentration, the sum of the hourly concentrations is divided by the number of hours less the number of calm hours, provided that the divisor used in calculating the average is never permitted to be less than 75 percent of the averaging time being considered. This results in the following:

- 3-hour averages are always determined by dividing the sum of the hourly contributions by 3 (i.e., no change from prior methods);
- 8-hour averages are calculated by dividing the sum of the hourly contributions by the number of non-calm hours or 6, whichever is greater;
- 24-hour averages are determined by dividing the sum of the hourly contributions by the number of non-calm hours or 18, whichever is greater; and
- period of record averages are calculated by dividing the sum of all the hourly contributions by the number of non-calm hours during the period of record.

This calms procedure is not available in RAM outside of the default option. If not using the default, calms are treated as 1.0 m/s winds.

Summary

The closer the situation to be simulated agrees with the assumptions stated above, the greater the expectation of reasonable results. The narrow plume simplification is most reasonable for situations where there are no great variations in area emission rates for adjacent area sources.

The higher the effective height of a point source, the greater is the chance for poor results since actual directional shear in the atmosphere, not included in the algorithm, will cause plumes to move in directions different from the direction input to the model. Also, the higher the source height, the greater is the potential for encountering layers in the atmosphere having dispersion characteristics different from those being used. As stated above, it is necessary to properly consider variations in emissions.

Reliable meteorological inputs are also necessary. The light wind situation is most likely to violate assumptions, since variations in the flow over the region are likely to occur, and the slower transport may cause buildup of pollutants from hour to hour. Unfortunately, these are the conditions that are likely to be associated with maximum 3-hour and 24-hour concentrations in urban areas. These light wind situations do not conform to the assumptions of Gaussian steady-state models. The calms processing segment in RAM takes into account these deficiencies by calculating averages for periods longer than three hours in such a way that persistent light wind conditions do not cause a gross overestimate of concentrations at a given receptor.

RAM is not appropriate for making concentration estimates for topographic complications. The greater the departure from relatively flat terrain conditions, the greater the departure from the assumptions of the algorithm.

RAM is most applicable for pollutants that are quite stable chemically and physically. A general loss of pollutant with time can be accounted for by the algorithm. Selective removal or reaction at the plume-ground interface or dependence upon concentration levels may not be well handled by RAM.

SECTION 4

BASIS FOR RAM

The basis for RAM is also discussed in Novak and Turner (1976) which is included in Appendix B. The user may select use of either urban or rural parameters. The urban dispersion parameters σ_y and σ_z are those suggested by Briggs and reported by Gifford (1976). The urban σ's are functions of distance between source and receptor and of atmospheric stability class where the class is specified by open country conditions.

The dispersion parameters for rural conditions are those of Pasquill-Gifford (Pasquill, 1961; Gifford, 1960), as used in the UNAMAP programs PTPLU, CRSTER, and MPTER. These values are equivalent to the dispersion parameter values given in Figures 3-2 and 3-3 of the Workbook of Atmospheric Dispersion Estimates (Turner, 1970).

DILUTION BY THE WIND

Emissions from continuous sources are assumed to be stretched along the direction of the wind by the speed of the wind. Thus the stronger the wind, the greater the dilution of the emitted plume. To approximate the increase in wind speeds with height from point of measurement to stack top, a power-law increase with height is used. The exponent used is a function of stability.

DISPERSION RESULTS IN GAUSSIAN-DISTRIBUTED CROSS SECTIONS

The time-averaged concentration distributions through a dispersed plume resulting from a continuous emission from a point source or an area element are considered to be Gaussian in both the horizontal and vertical directions. Modification of the vertical distribution by eddy reflection at the ground or at a stable layer aloft is considered. This eddy reflection is calculated by a "folding back" of the portion of the distribution that would extend beyond the barrier if it were absent. This is equivalent to a virtual-image source beneath the ground (or above the stable layer).

STEADY-STATE CONDITIONS

Concentration estimates are made for each simulated hourly period using the mean meteorological conditions for that hour as if a steady-state condition had been achieved. Steady-state Gaussian plume equations are used for point sources, and the integrations of these equations are used for area sources.

SECTION 5

TECHNICAL DESCRIPTION

CONCENTRATION SUM OF INDIVIDUAL CONTRIBUTIONS

The total concentration of a pollutant at a receptor is taken as the sum of the individual concentration estimates from each point and area source affecting that receptor, that is, concentrations are additive. Concentration estimates for averaging time longer than one hour are determined by linearly averaging the hourly concentrations during the period.

WIND SPEED

In RAM the input wind speed data must include the height above ground of the measurements, and may include the exponents for the wind profile. If no exponents are given in the input, the values in Table 1 are used. The wind speed at the physical stack height h is calculated from:

$$u(h) = u \ (h/h_a)^p \qquad (1)$$

where u is the input wind speed for this hour, h is the height of wind measurement, and the exponent p, for the wind profile, is a function of stability. If u(h) is determined to be less than 1 m/s, it is set equal to 1 m/s.

TABLE 1. EXPONENTS FOR WIND PROFILES

Stability class	URBAN (RAM) exponent	RURAL (RAMR) exponent
A	0.15	0.07
B	0.15	0.07
C	0.20	0.10
D	0.25	0.15
E	0.30	0.35
F	0.30	0.55

PLUME RISE FOR POINT SOURCES

The use of the methods of Briggs to estimate plume rise and effective height of emission are discussed below.

First, actual or estimated wind speed at stack top, u(h), is assumed to be available.

Stack Downwash

To consider stack downwash, the physical stack height is modified following Briggs (1973, p. 4). The h' is found from

$$h' = h + 2\{[v_s/u(h)] - 1.5\}d \text{ for } v_s < 1.5\, u(h), \tag{2}$$

$$h' = h \text{ for } v_s \geq 1.5\, u\,(h),$$

where h is physical stack height (meters), v_s is stack gas velocity (meters per second), and d is inside stack-top diameter (meters). This h' is used throughout the remainder of the plume height computation. If stack downwash is not considered, h' = h in the following equations.

Buoyancy Flux

For most plume rise situations, the values of the Briggs buoyancy flux parameter, F (m^4/s^3) is needed. The following equation is equivalent to Briggs' (1975, p. 63) Eq. 12:

$$F = (g\, v_s\, d^2\, \Delta T)/(4\, T_s), \tag{3}$$

where g is the acceleration of gravity, 9.806 m/s^2, $\Delta T = T_s - T$, T_s is stack gas temperature (Kelvin), and T is ambient air temperature (Kelvin) at stack top.

Unstable or Neutral: Crossover Between Momentum and Buoyancy

For cases with stack gas temperature greater than or equal to ambient air temperature, it must be determined whether the plume rise is dominated by momentum or buoyancy. The crossover temperature difference $(\Delta T)_c$ is determined for 1) F less than 55 or 2) F greater than or equal to 55. If the difference between stack gas temperature and ambient air temperature, ΔT, exceeds or equals the $(\Delta T)_c$, plume rise is assumed to be buoyancy dominated; if the difference is less than $(\Delta T)_c$, plume rise is assumed to be momentum dominated (see below).

The crossover temperature difference is found by setting Briggs' (1969, p. 59) Eq. 5.2 equal to the combination of Briggs (1971, p 1031) Eqs. 6 and 7 and solving for ΔT. For F less than 55,

$$(\Delta T)_c = 0.0297 \, v_s^{1/3} \, T_s/d^{2/3}. \tag{4}$$

For F equal to or greater than 55,

$$(\Delta T)_c = 0.00575 \, v_s^{2/3} \, T_s/d^{1/3}. \tag{5}$$

Unstable or Neutral: Buoyancy Rise

For situations where ΔT exceeds or is equal to $(\Delta T)_c$ as determined above, buoyancy is assumed to dominate. The distance to final rise x_f (in kilometers) is detemined from the equivalent of Briggs' (1971, p. 1031) Eq. 7, and the distance to final rise is assumed to be 3.5x*, where x* is the distance at which atmospheric turbulence begins to dominant entrainment. For F less than 55,

$$x_f = 0.049 \, F^{5/8}. \tag{6}$$

For F equal to or greater than 55,

$$x_f = 0.119 \, F^{2/5}. \tag{7}$$

The plume height, H (in meters), is determined from the equivalent of the combination of Briggs' (1971, p. 1031) Eqs. 6 and 7. For F less than 55,

$$H = h' + 21.425\ F^{3/4}/u(h). \quad (8)$$

For F equal to or greater than 55,

$$H = h' + 38.71\ F^{3/5}/u(h). \quad (9)$$

Unstable or Neutral: Momentum Rise

For situations where the stack gas temperature is less than the ambient air temperature, it is assumed that the plume rise is dominated by momentum. Also if ΔT is less than $(\Delta T)_c$ from Eq. 4 or 5, it is assumed that the plume rise is dominated by momentum. The plume height is calculated from Briggs' (1969, p. 59) Eq. 5.2:

$$H = h' + 3\ d\ v_s/u(h). \quad (10)$$

Briggs (1969) suggests that this equation is most applicable when v_s/u is greater than 4. Since momentum rise occurs quite close to the point of release, the distance to final rise is set equal to zero.

Stability Parameter

For stable situations, the stability parameter s is calculated from the equation (Briggs, 1971, p. 1031):

$$s = g(\partial\theta/\partial z)/T \quad (11)$$

where θ is potential temperature. As an approximation, for stability class E (or 5), $\partial\theta/\partial z$ is taken as 0.02 K/m, and for stability class F (or 6), $\partial\theta/\partial z$ is taken as 0.035 K/m.

Stable: Crossover Between Momentum and Buoyancy

For cases with stack gas temperature greater than or equal to ambient air temperature, it must be determined whether the plume rise is dominated by momentum or buoyancy. The crossover temperature difference $(\Delta T)_c$ is found by setting Briggs' (1975, p.96) Eq. 59 equal to Briggs' (1969, p. 59) Eq. 4.28, and solving for ΔT. The result is

$$(\Delta T)_c = 0.019582\ v_s\ T\ s^{1/2}. \tag{12}$$

if the difference between stack gas temperature and ambient air temperature (ΔT) exceeds or equals $(\Delta T)_c$, the plume rise id assumed to be buoyancy dominated; if ΔT is less than $(\Delta T)_c$, the plume rise is assumed to be momentum dominated.

Stable: Buoyancy Rise

For situations where ΔT is greater than or equal to $(\Delta T)_c$, buoyancy is assumed to dominate. The distance to final rise (in kilometers) is determined by the equivalent of a combination of Briggs' (1975, p. 96) Eqs. 48 and 59:

$$x_f = 0.0020715\ u(h)\ s^{-1/2}. \tag{13}$$

The plume height is determined by the equivalent of Briggs' (1975, p. 96) Eq. 59:

$$H = h' + 2.6\{F/[u(h)\ s]\}^{1/3}. \tag{14}$$

The stable buoyancy rise for calm conditions (Briggs, 1975, pp. 81-82 is also evaluated:

$$H = h' + 4\ F^{1/4}\ s^{-3/8}. \tag{15}$$

The lower of the two values obtained from Eqs. 14 and 15 is taken as the final effective height.

Stable: Momentum Rise

When the stack gas temperature is less than the ambient air temperature, it is assumed that the plume rise is dominated by momentum. If ΔT is less than $(\Delta T)_c$ as determined by Eq. 12, it is also assumed that the plume rise is dominated by momentum. The plume height is calculated from Briggs' (1969, p. 59) Eq. 4.28:

$$H = h' + 1.5\{(v_s^2\ d^2\ T)/[4\ T_s\ u(h)]\}^{1/3}\ s^{-1/6}. \qquad (16)$$

The equation for unstable or neutral momentum rise (10) is also evaluated. The lower result of these two equations is used as the resulting plume height.

All Conditions: Distance Less than Distance to Final Rise (Gradual Rise)

Where gradual rise is to be estimated for unstable, neutral or stable conditions, if the distance upwind from receptor to source x (in kilometers), is less than the distance to final rise, the equivalent of Briggs' (1971, p. 1030) Eq. 2 is used to determine height:

$$H = h' + (160\ F^{1/3}\ x^{2/3})/u(h). \qquad (17)$$

This height is used only for buoyancy-dominated conditions; should it exceed the final rise for the appropriate condition, the final rise is substituted instead.

General

In working throught the receptors to determine concentrations for a given hour, the first time a source is found to lie upwind of a receptor, the following quantities are determined and stored for that source: u(h), h', F, H, and x_f. These quantities are then used each time this source is encountered during this hour without recalculation. Only if the upwind receptor-source distance is less than x_f is the effective plume height determined for each occurrence by the last equation mentioned.

BUOYANCY-INDUCED DISPERSION FOR POINT SOURCES

For strongly buoyant plumes, entrainment as the plume ascends through the ambient air contributes to both vertical and horizontal spread, Pasquill (1976) suggests that this induced dispersion, σ_{zo}, can be approximated by the plume rise divided by 3.5.

$$\sigma_{zo} = \Delta h/3.5 \tag{18}$$

where Δh is either the gradual plume rise as calculated by Eq. 5 for distances less than the distance to final rise, or the final rise for distances greater than that distance. The effective dispersion can then be determined by adding variances:

$$\sigma_{ze} = (\sigma_{zo}^2 + \sigma_z^2)^{1/2}, \tag{19}$$

where σ_{ze} is th effective dispersion, and σ_z is the dispersion due to ambient turbulence levels. At the distance of final rise and beyond, the induced dispersion is constant, based on the height of final rise. At distances closer to the source, gradual-plume rise is used to determine the induced dispersion.

Since in the initial growth phases of release, the plume is nearly symmetrical about its centerline, buoyancy-induced dispersion in the horizontal direction, σ_{yo}, equal to that in the vertical direction, is used,

$$\sigma_{yo} = \Delta h/3.5 \tag{20}$$

To yield an effective lateral dispersion value, σ_{ye}, this expression is combined with that for dispersion due to ambient turbulence:

$$\sigma_{ye} = (\sigma_{yo}^2 + \sigma_y^2)^{1/2}. \tag{21}$$

EFFLUENT RISE FOR AREA SOURCES

RAM can include in effective height with wind speed for area sources. The input area souve height, H_A, is assumed to be the average physical height of the area source plus the effluent rise with a wind speed of 5 m/s. The user specifies the fraction, f, of the input height that represents the physical height, h_p. This fraction is the same for all area sources in the inventory.

$$h_p = f\ H_A \tag{22}$$

The difference is the effluent rise for a wind speed of 5 m/s

$$\Delta H\ (u = 5) + H_A - h_p \tag{23}$$

If f = 1, there is no rise and the input height is the effective height for all wind speeds. For any wind speed, u, the rise is assumed to be inversely proportional to wind speed and, is determined from:

$$\Delta H\ (u) = \frac{5(H_A - h_p)}{u}, \tag{24}$$

and the effecive height is:

$$H_e\ (u) = h_p + \Delta H(u). \tag{25}$$

CONCENTRATION FORMULAS

Concentrations from Point Sources

The upwind distance x of the point source from the receptor and the crosswind distance, y, of the point source from the receptor are calculated as part of estimates for each source-receptor pair for each simulated hour. Both dispersion parameter values σ_y and σ_z are determined as functions of this upwind distance x and stability class. Figure 1 shows the coordinate system used.

The terms below are used in the equations that follow.

$$g_1 = \exp\left(-0.5y^2/\sigma_y^2\right)$$

$$g_2 = \exp\left[-0.5(z - H)^2/\sigma_z^2\right] + \exp\left[-0.5(z + H)^2/\sigma_z^2\right]$$

$$g_3 = \sum_{N=-\infty}^{\infty} \left\{\exp\left[-0.5(z - H + 2NL)^2/\sigma_z^2\right] + \exp\left[-0.5(z + H + 2NL)^2/\sigma_z^2\right]\right\}$$

(This infinite series converges rapidly and evaluation with N varying from -4 to +4 is usually sufficient.) where

- H = effective height of emissions, meters
- L = mixing height, the top of the unstable layer, meters
- y = crosswind distance, meters
- z = receptor height above ground, meters
- σ_y = standard deviation of plume concentration distribution in the horizontal, meters
- σ_z = standard deviation of plume concentration distribution in the vertical, meters

One of three equations is used to estimate concentrations under various conditions of stability and mixing height. The equation

$$\chi_p = Qg_1g_2/\left(2\pi\sigma_y\sigma_z u\right) \qquad (26)$$

is used for stable conditions or for unlimited mixing where,

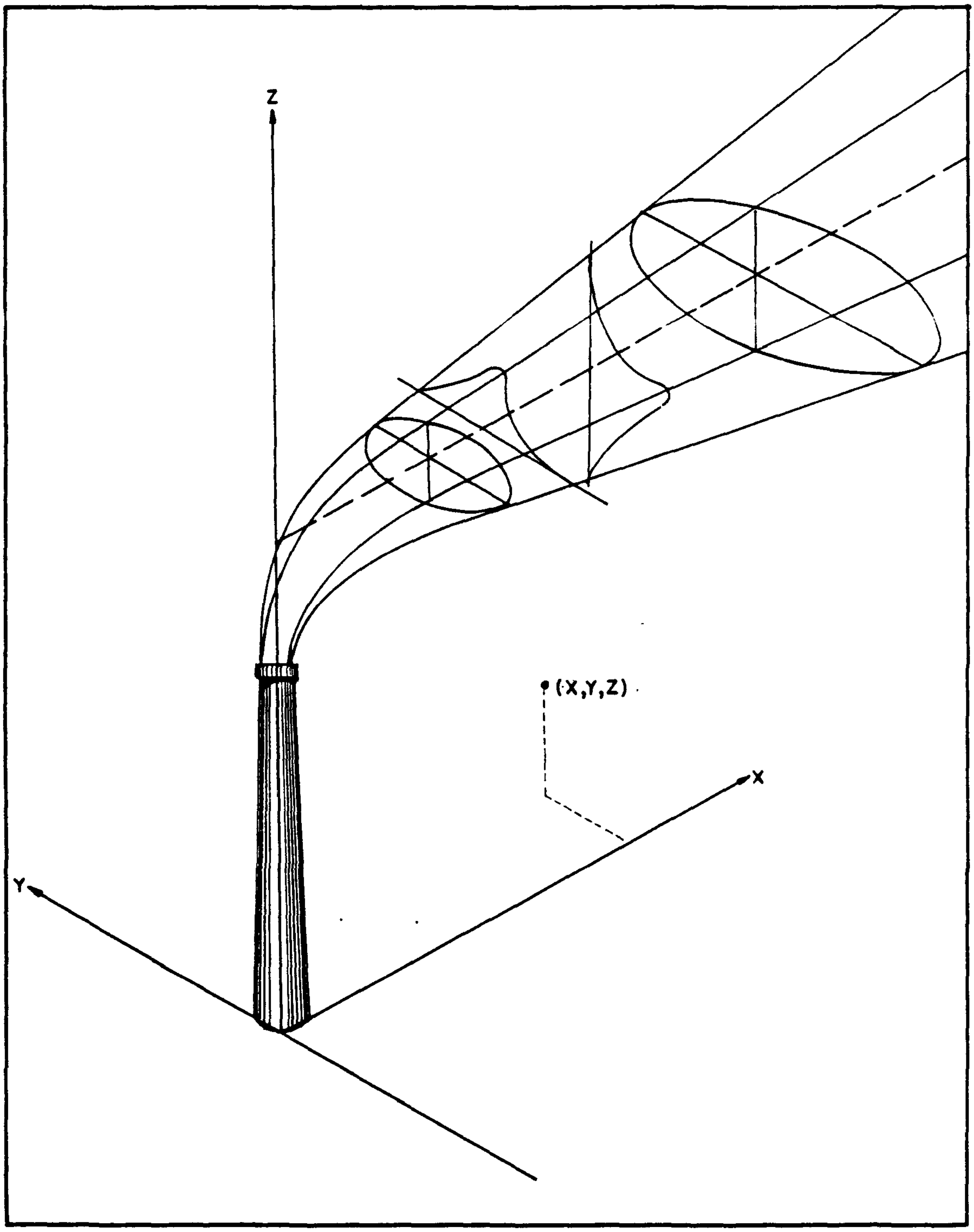

Figure 1. Coordinate system showing Gaussian distributions in the horizontal and vertical.

χ_p = ground-level concentration from a single point source, g/m^3, and

Q = point source emission rate, g/sec.

In this equation, eddy reflection at the ground is assumed. For unstable or neutral conditions where vertical dispersion is great enough that uniform mixing is assured ($\sigma_z \geq 1.6L$) beneath an elevated inversion, the following equation is used.

$$\chi_p = Qg_1/ \sigma_y Lu(2\pi)^{1/2} \tag{27}$$

(If H or z is above the mixing height, $\chi_p = 0$.)

For unstable or neutral conditions where uniform mixing is not assured ($\sigma_z < 1.6L$), the following equation is used.

$$\chi_p = Qg_1g_3/(2\pi\sigma_y\sigma_z u) \tag{28}$$

This equation incorporates multiple eddy reflections from the ground and the base of the stable layer aloft.

Concentrations from Area Sources

The total concentration at a receptor from the two-dimensional area source distribution is calculated using the narrow plume simplification discussed by Gifford and Hanna (1971). Figure 2 shows a configuration of area sources and map array scheme. This simplification is assumed because the upwind zone of influence affecting a receptor (an upwind oriented point source plume) is normally quite narrow in comparison with the characteristic length scale for appreciable changes in the magnitude of the area-source emission rate itself. Under these circumstances the two-dimensional integral that expresses the total area-source contribution to concentration at a receptor can be replaced approximately by a one-dimensional integral. This integral involves only:

- knowledge of the distribution of the area-source emission rates along the line in the direction of the upwind azimuth from the receptor location,
- the meteorologically dependent function that specifies the crosswind-integrated concentration in the Gaussian plume from a point source.

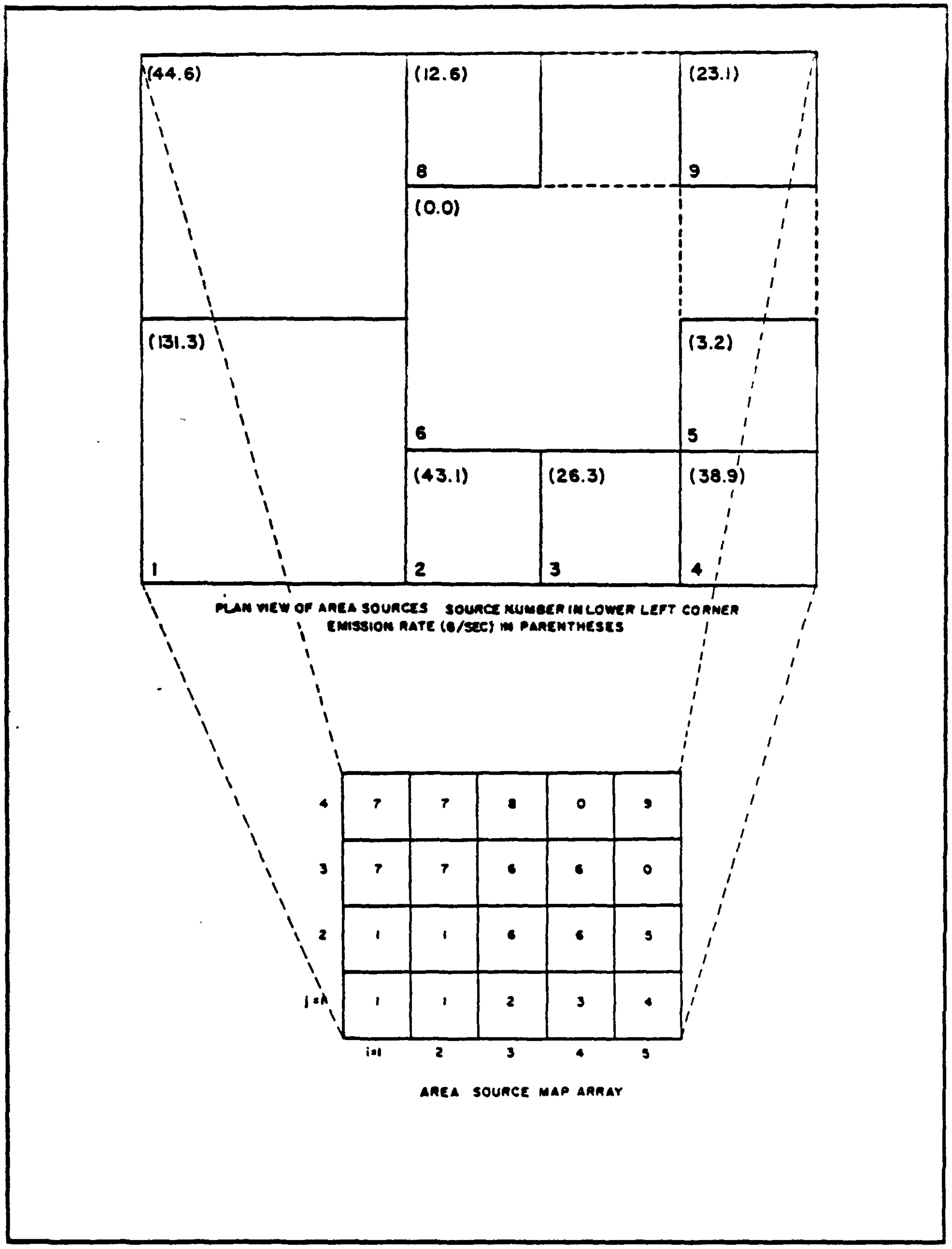

Figure 2. Configuration of area sources and area source map array.

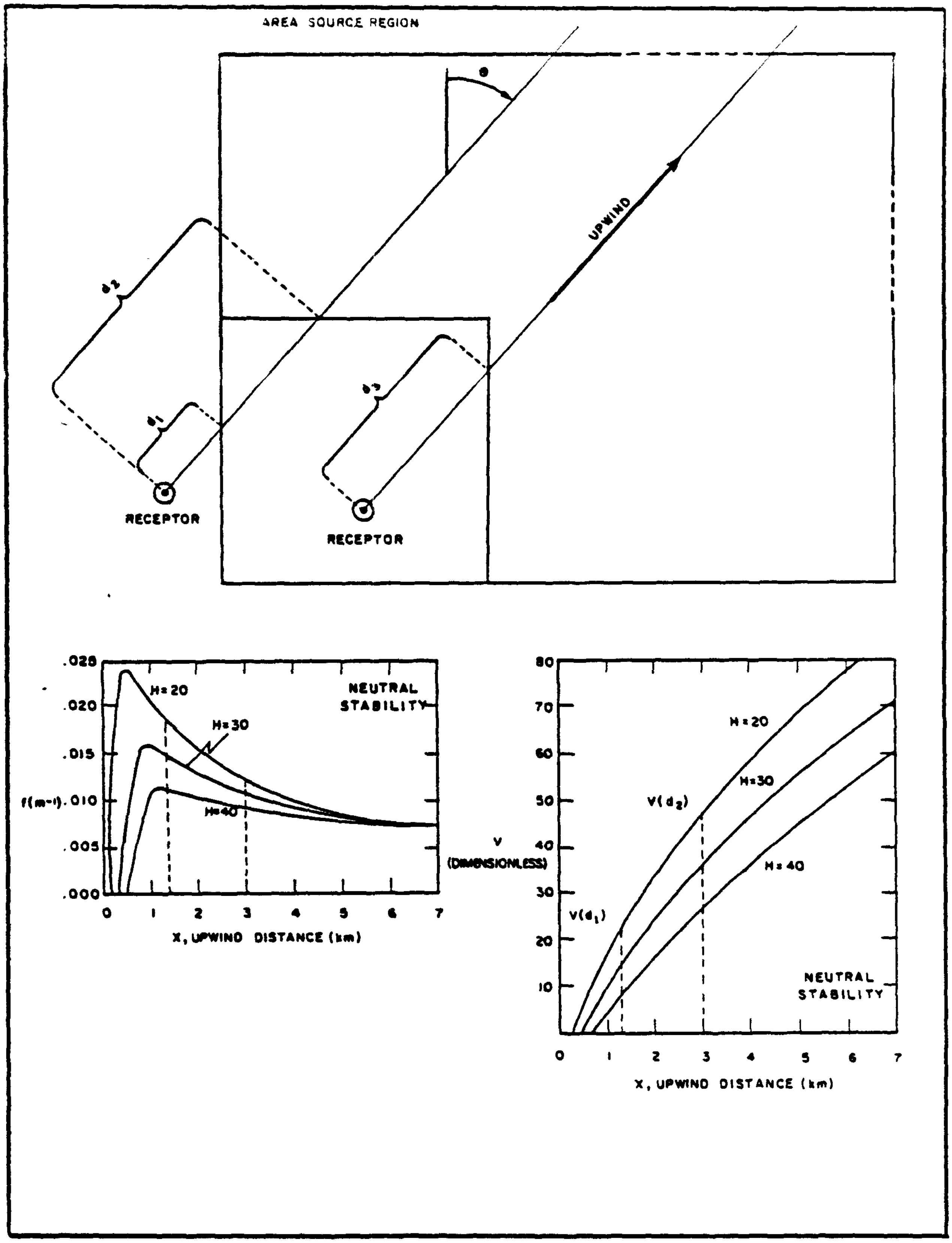

Figure 3. Features of area source estimates.

In using this area source technique, Gifford and Hanna assumed area-source emissions at ground level, allowing integration upwind to be accomplished analytically. In RAM the area sources are allowed to have an effective height, requiring the integration to be accomplished numerically. Figure 3 depicts features of the area source calculations. Equations used to perform the calculations are given in Appendix B. Internal tables of integrations for one to three effective area source heights are calculated at the beginning of each simulated hour using the specific meteorological conditions for that hour. The total concentration from all area sources is determined by performing the integration piecewise over each source in the upwind direction from the receptor until the farthest boundary of the source region is reached.

SECTION 6
VERIFICATION RUN

The example provided in this section serves to verify results of the run; it is expected that the user will implement the model and compare outputs with those given here. A more elaborate example showing uses of the model is given in Section 10. Figure 4 shows the job setup and order of statements. Figure 5 shows the run stream for model execution. Beyond the job control language, there are three title records which are followed by three records containing constants and options for the run. The option record is followed by one record that specifies anemometer height and power-law exponents for six stability categories to extrapolate wind speed to the height of pollutant release. This is followed by source parameters and emissions for 12 point sources and 15 area sources. Significant sources are listed next and are followed by user-specified receptors and meteorology. One averaging period of two hours is specified for the pollutant sulfur dioxide in an urban setting. Concentration contributions from five point sources and ten area sources are desired. The option record indicates that information on point and area sources is present in the input stream. Also, meteorological data is entered via the input stream. Significant source information is specified on input for point sources only. Receptors are specified on input and receptors downwind of significant point and area sources are required. Also, a honeycomb receptor grid is desired. All printed output is needed except average concentrations and high-five tables. The default option (for regulatory application of the model) and printed output to disk or tape are not desired.

Model output can be separated into three sections as shown in Figure 6. The first echoes the options used in the run. Source information for point and area sources are given next with corresponding ranking in order of source significance. A tabulation according to source height is given for the pollutant along with a cumulative fraction for both point and area sources. Significant point and area sources are listed next, followed by receptor

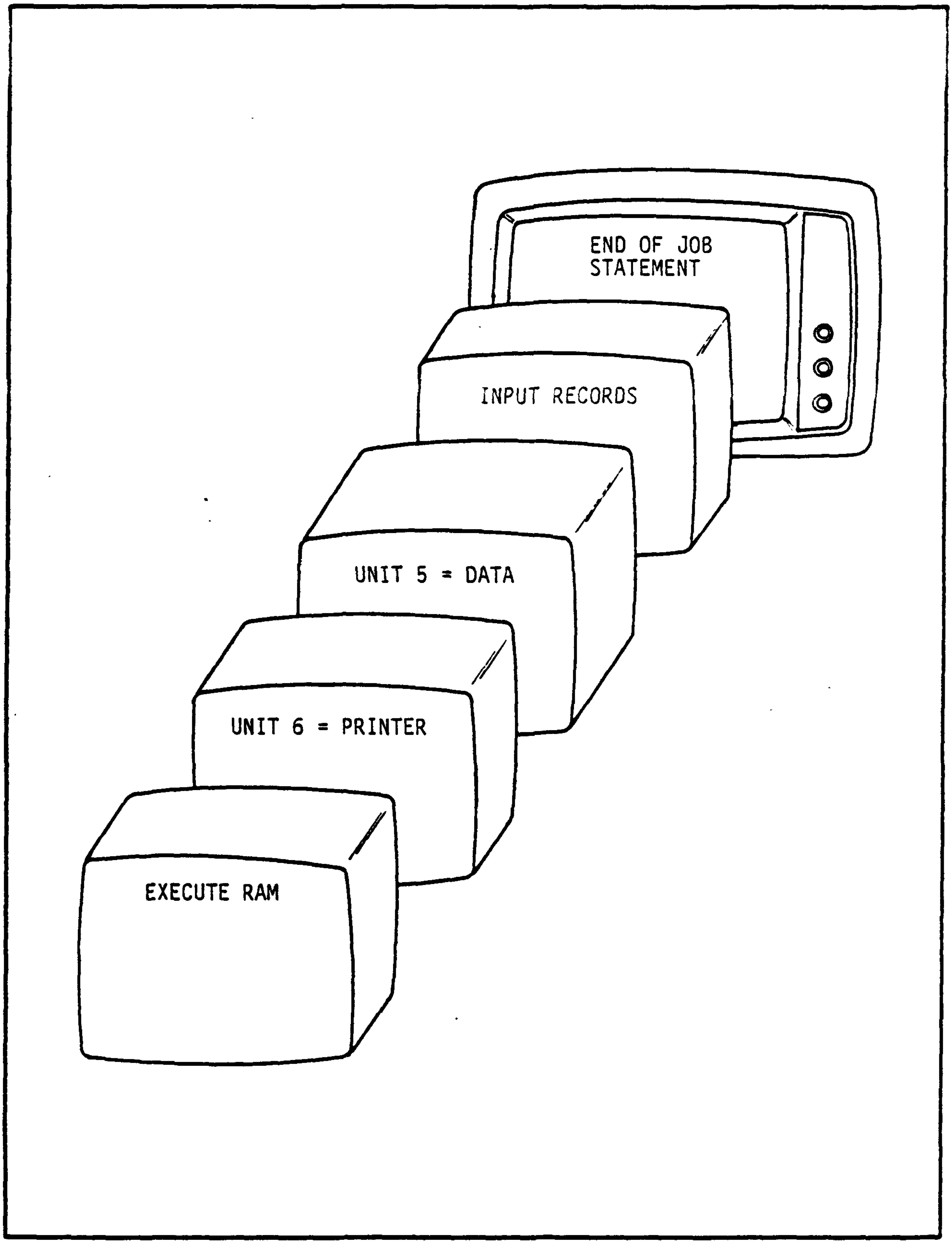

Figure 4. Sample job stream for RAM .

information on user-specified receptors. The meteorological parameters input by the user in record type 18 are listed by the input hour. The next tabulation gives coordinates of two receptors where maxima are expected to occur for each significant point source, either selected by the user or generated by RAM.

Only one significant receptor is given for each area source. If selected by the user, the honeycomb receptor grid generated by RAM is listed next. The locations of significant and honeycomb receptors are averaging-period dependent.

The next section of the output gives concentrations by hour of simulation. First, tables are given for the significant sources; then a summary is given for all sources for the hour. In the example here, the user exercised the option to obtain a concentration summary for the averaging period (two hours), which is provided at the end of the run.

The area source emission inventory has one source defined with a zero emission rate. This is area source 6. Time is saved in executing RAM by specifying areas of zero emission within the area source region that are larger than the smallest area source squares, with squares as large as possible. Note that point sources and receptor locations can be placed anywhere without regard to whether they are inside or outside the area source region.

The input information on area heights of emissions may be confusing to the user. Area source heights may be expected to vary with wind speed, but little information pertaining to this is included in most emission inventories. If the area source emission heights are to remain constant throughout the run with no variation in wind speed, the first variable on card type 10, the fraction of the area source height that is physical height, should be entered as 1. If the user wants to vary the area source height with wind speed, the area source heights should represent the effective emission height from each area at a wind speed of 5 m/sec. The fraction entered as the first variable on card type 10 should approximate as closely as possible the average physical height of each area source when the fraction is multiplied by the input area source height. To most effectively use this feature, the fact that both physical and effective heights are of interest should be known when preparing the emission inventory.

If the height of the emission is the effective height of the area source at a wind speed of 5 m/sec, and if the physical height of the source is a set fraction of this value, which is the same for all sources, it will be possible to consider the variation of effective height of an area source with wind speed in RAM. Otherwise, the fraction will be 1.0, and it will be assumed that the input height of emission is the effective height for all wind speeds.

```
@RUN,R/R 12DBT/70,XXXXXXXXXXX/XXX,EOB/SIMRTDBT
@ASG,A EOBRAM.
@BRKPT PRINT$/EOBRAM
@ASG,A EOB*RAM.                                          *************************
@XQT EOB*RAM.SOURCE                                      * Constants and Options *
TEST RUN: Lucille Bender                                 *************************
EMISSIONS: TEST CITY, 1973
SFC MET DATA: TEST CITY 1973;        UPPER AIR: TEST CITY 1973
73,001,01,1,2,3,1,5,10,0,1.609344,2.,0.,14400.
0004110100103111109000000000000000000170000004567890
10.,0.15,0.15,0.2,0.25,0.4,0.6
PLANT 1     579.50  4406.75 232.365 13.335  82.9    513.1   3.5     13.7
PLANT 2     575.25  4405.25 150.465 57.005  76.2    464.3   3.2     12.5
PLANT 3     571.25  4407.00  19.005  3.255  25.9    477.6   1.0     15.8
PLANT 4     571.75  4402.25  81.060 28.350  40.8    499.8   2.8     17.6
PLANT 5     579.50  4403.25  26.145  5.145  18.3    533.2   0.6     14.7
PLANT 6     567.14  4400.89   2.56   0.     26.5    505.    1.04    3.81
PLANT 7     564.70  4407.50  36.43   0.     48.8    464.    3.05    18.6
PLANT 8     577.45  4401.35  33.64   0.     26.5    428.    1.68    5.02
PLANT 9     576.75  4400.70  38.8    0.      6.     654.     .79    24.89
PLANT 10    580.10  4412.00 299.5    0.     93.     405.    4.88    12.59
PLANT 11    583.0   4400.90  16.74   0.     18.1    506.    1.37    4.23
PLANT 12    574.0   4398.00 226.2    0.     93.6    483.    4.88    12.59
ENDP
AONE        570.     4400.    4.       1.25    0.0     10.
ATWO        574.     4400.    2.       3.05    0.0     10.
ATHREE      576.     4400.    2.       6.25    0.0     12.   **********
AFOUR       578.     4400.    2.       8.85    0.0     15.   * Source *
AFIVE       578.     4402.    2.       3.15    0.0     10.   *  Data  *
ASIX        574.     4402.    4.       0.00    0.0     0.    **********
ASEVEN      570.     4404.    4.       4.25    0.0     15.
AEIGHT      574.     4406.    2.       2.60    0.0     10.
ANINE       578.     4406.    2.       3.10    0.0     12.
ATEN        580.     4406.    2.       2.76    0.0     20.
AELEVEN     582.     4406.    2.        .83    0.0     20.
ATWELVE     580.     4404.    2.       1.66    0.0     20.
ATHIRTEEN   582.     4404.    2.       1.90    0.0     20.
AFOURTEEN   580.     4402.    2.        .51    0.0     20.
AFIFTEEN    582.     4402.    2.       1.48    0.0     20.
ENDA
 1  7                                *************************
.75, 25., 3, 11.,15.,20.   <--      * Significant Sources *
13., 17.                             *************************
RECEP 1    566.00   4405.0                       *************
RECEP 2    564.00   4401.5   <----------         * Receptors *
ENDR                                             *************
2., 570., 580., 4400., 4408.
73,1,1,4,6.17,269.82,33.0,429.11
73,1,2,4,4.63,271.48,23.0,401.7  <--
@BRKPT PRINT$                            ***************
@FREE EOBRAM.                            * Meteorology *
@SYM,U EOBRAM,,FD04PR                    ***************
@FIN
@@
@@
@@
```

Figure 5. Run stream for the verification run.

```
                                        OUTPUT FROM URBAN RAM (VERSION 85364)
                                        AN AIR QUALITY DISPERSION MODEL IN
                                        SECTION 1. GUIDELINE MODELS
                                        IN UNAMAP (VERSION 6) DEC 86
                                        SOURCE: FILE 5 ON UNAMAP MAGNETIC TAPE FROM NTIS.

(1)  TEST RUN: LUCILLE BENDER
     EMISSIONS: TEST CITY, 1973
     TWO HOURS MET DATA READ IN ON UNIT FIVE.

                              GENERAL INPUT INFORMATION

     THIS IS THE URBAN VERSION(81352) OF RAM FOR THE POLLUTANT S02  FOR   1   2-HOUR PERIODS.
     CONCENTRATION ESTIMATES BEGIN ON HOUR- 1, JULIAN DAY-  1, YEAR-1973.
     UNITS - THERE ARE      2.0000000 USER UNITS(INPUT UNITS) PER SMALLEST AREA SOURCE SQUARE SIDE LENGTH(INTERNAL UNIT)
     CONONE - THERE ARE     1.6093440 KILOMETERS PER USER UNIT
     CONTWO - IT IS CALCULATED THAT THERE ARE     3.2186880 KILOMETERS PER SMALLEST AREA SOURCE SQUARE SIDE LENGTH(INTERNAL UNIT)
     RECEPTOR HEIGHT IS       .0000000 METERS

     A HALF-LIFE OF   14400.00 (SECONDS) HAS BEEN ASSUMED  BY THE USER.

     OPTION       OPTION LIST                  OPTION SPECIFICATION : 0= IGNORE OPTION
                                                                      1= USE OPTION
                           TECHNICAL OPTIONS
          1       NO STACK DOWNWASH                                   0
          2       NO GRADUAL PLUME RISE.                              0
          3       USE BOUYANCY INDUCED DISPERSION                     0
          4       NOT USED THIS VERSION                               4

                           INPUT OPTIONS
          5       WILL YOU INPUT POINT SOURCES?                       1
          6       WILL YOU INPUT AREA SOURCES?                        1
          7       WILL YOU USE EMISSIONS FROM PREVIOUS RUN? (UNIT 9)  0
          8       MET.DATA ON CARDS? (FROM UNIT 11 OTHERWISE)         1
          9       READ HOURLY PT. SOURCE' EMISSIONS (UNIT 15).        0
         10       READ HOURLY AREA SOURCE EMISSIONS (UNIT 16).        0    ***************************
         11       SPECIFY   SIGNIF PT. SOURCES.                       1    * Options specified by the *
         12       SPECIFY SIGNIF. AREA SOURCES.                       0    * user are echoed here     *
         13       NOT USED THIS VERSION                               3    ***************************

                           RECEPTOR OPTIONS
         14       WILL YOU ENTER RECEPTORS BY SPECIFYING COORDINATES?  1
         15       DO YOU WANT RAM TO GENERATE RECEPTORS DOWNWIND
                   OF SIGNIF. PT. SOURCES? (WILL DO SO BY AVG-PERIOD)  1
         16       DO YOU WANT RAM TO GENERATE RECEPTORS DOWNWIND
                  OF SIGNIF. AREA SOURCES?(WILL DO SO BY AVG-PERIOD)   1
         17       DO YOU WANT RAM TO GENERATE A HONEYCOMB ARRAY OF
                  RECEPTORS TO COVER A SPECIFIC AREA?                  1
         18       WILL YOU INPUT RADIAL DISTANCES(UP TO 5) TO GENERATE
                  A POLAR COORDINATE RECEPTOR ARRAY
                  (36 RECEPTORS FOR EACH DISTANCE)                     0
         19       NOT USED THIS  VERSION                               9

                           PRINTED OUTPUT OPTIONS
         20       DELETE POINT SOURCE LIST                             0
         21       DELETE AREA SOURCE LIST AND MAP                      0
         22       DELETE EMISSIONS WITH HEIGHT TABLE                   0
```

Figure 6. Printed output for the verification run.

23	DELETE RESULANT MET. DATA SUMMARY FOR AVERAGING PERIOD	0
24	DELETE ALL HOURLY OUTPUT (PT.,AREA,& SUMMARIES)	0
25	DELETE HOURLY POINT CONTRIBUTIONS	0
26	DELETE MET. DATA ON HR. PT. CONTRIB.	0
27	DELETE PLUME HT. AND DIST. TO FINAL RISE ON HR. PT. CONTRIB.	0
28	DELETE HOURLY AREA CONTRIBUTIONS	0
29	DELETE MET. DATA ON HR. AREA CONTRIB.	0
30	DELETE HOURLY SUMMARY.	0
31	DELETE MET. 'DATA ON HOURLY SUMMARY.	0
32	DELETE ALL AVG-PERIOD OUTPUT.	0
33	DELETE POINT AVG-PERIOD CONTRIBUTIONS.	0
34	DELETE AREA AVG-PERIOD CONTRIBUTIONS.	0
35	DELETE AVG-PERIOD SUMMARY.	0
36	DELETE AVERAGE CONCENTRATIONS & HI-FIVE TABLE.	1
37	NOT USED THIS VERSION.	7
	DEFAULT OPTION.	
38	SET DEFAULT OPTION.	0
	OTHER CONTROL AND OUTPUT OPTIONS:	
39	RUN IS PART OF A SEGMENTED RUN.	0
40	WRITE PARTIAL CONC.TO DISK OR TAPE (UNIT 10).	0
41	WRITE HOURLY CONC.TO DISK OR TAPE (UNIT 12).	0
42	WRITE AVG-PERIOD CONC.TO DISK OR TAPE (UNIT 13).	0
43	PUNCH AVERAGING-PERIOD CONC. ON CARDS (UNIT 1).	0
44	NOT USED THIS VERSION.	4
45	NOT USED THIS VERSION.	5
46	NOT USED THIS VERSION.	6
47	NOT USED THIS VERSION.	7
48	NOT USED THIS VERSION.	8
49	NOT USED THIS VERSION.	9
50	NOT USED THIS VERSION.	0

POINT SOURCE INFORMATION

(2)

SOURCE	EAST COORD (USER UNITS)	NORTH COORD (USER UNITS)	SO2(G/SEC) EMISSIONS	PART(G/SEC) EMISSIONS	STACK HT(M)	STACK TEMP(K)	STACK DIAM(M)	STACK VEL(M/SEC)	POTEN. IMPACT (MICRO G/M**3)	EFF HT(M)	BUOY FLUX F M**4/S**3
1 PLANT 1	579.500	4406.750	232.365	13.335	82.90	513.10	3.50	13.70	155.805	370.460	176.487
2 PLANT 2	575.250	4405.250	150.465	57.005	76.20	464.30	3.20	12.50	144.901	299.488	115.773
3 PLANT 3	571.250	4407.000	19.005	3.255	25.90	477.60	1.00	15.80	199.064	80.256	14.971
4 PLANT 4	571.750	4402.250	81.060	28.350	40.80	499.80	2.80	17.60	82.104	291.015	139.965
5 PLANT 5	579.500	4403.250	26.145	5.145	18.30	533.20	.60	14.70	818.139	45.144	5.834
6 PLANT 6	567.140	4400.890	2.560	.000	26.50	505.00	1.04	3.81	72.298	47.606	4.241
7 PLANT 7	564.700	4407.500	36.430	.000	48.80	464.00	3.05	18.60	31.988	316.174	156.325
8 PLANT 8	577.450	4401.350	33.640	.000	26.50	428.00	1.68	5.02	461.534	69.507	10.956
9 PLANT 9	576.750	4400.700	33.800	.000	6.00	654.00	.79	24.89	448.911	76.111	21.021
10 PLANT 10	583.100	4412.000	299.500	.000	93.00	405.00	4.83	12.59	171.832	405.998	203.266
11 PLANT 11	583.000	4400.900	16.740	.000	18.10	506.00	1.37	4.23	339.308	52.635	8.193
12 PLANT 12	574.000	4393.000	226.200	.000	93.60	483.00	4.88	12.59	97.496	480.294	289.141

SIGNIFICANT SO2 POINT SOURCES

RANK	CHI-MAX (MICROGRAMS/M**3)	SOURCE NO.
1	818.14	5

Point and area source data are tabulated in the order the sources were entered. They are then ranked in order of their potential impact.

Figure 6. continued

2	461.53	8
3	448.91	9
4	389.31	11
5	199.06	3
6	171.83	10
7	155.81	1
8	144.90	2
9	97.50	12
10	82.10	4
11	72.30	6
12	31.99	7

AREA SOURCE INFORMATION

SOURCE	EAST COORD (USER UNITS)	NORTH COORD (USER UNITS)	SO2 EMISSIONS (GRAMS/M**2/SEC)	PART EMISSIONS (GRAMS/M**2/SEC)	SIDE LENGTH (USER UNITS)	EFFECTIVE HEIGHT (METERS)	SIGNIFICANCE (G/M/SEC)
1 AONE	570.000	4400.000	3.0164-008	.0000	4.000	10.000	1.9418-004
2 ATWO	574.000	4400.000	2.9440-007	.0000	2.000	10.000	9.4759-004
3 ATHREE	576.000	4400.000	6.0328-007	.0000	2.000	12.000	1.9418-003
4 AFOUR	578.000	4400.000	8.5425-007	.0000	2.000	15.000	2.7496-003
5 AFIVE	578.000	4402.000	3.0406-007	.0000	2.000	10.000	9.7866-004
6 ASIX	574.000	4402.000	.0000	.0000	4.000	.000	.0000
7 ASEVEN	570.000	4404.000	1.0256-007	.0000	4.000	15.000	6.6021-004
8 AEIGHT	574.000	4406.000	2.5097-007	.0000	2.000	10.000	8.0778-004
9 ANINE	578.000	4406.000	2.9923-007	.0000	2.000	12.000	9.6313-004
10 ATEN	580.000	4406.000	2.6641-007	.0000	2.000	20.000	8.5749-004
11 AELEVEN	582.000	4406.000	8.0116-008	.0000	2.000	20.000	2.5787-004
12 ATWELVE	580.000	4404.000	1.6023-007	.0000	2.000	20.000	5.1574-004
13 ATHIRTEEN	582.000	4404.000	1.8340-007	.0000	2.000	20.000	5.9030-004
14 AFOURTEEN	580.000	4402.000	4.9228-008	.0000	2.000	20.000	1.5845-004
15 AFIFTEEN	582.000	4402.000	1.4286-007	.0000	2.000	20.000	4.5981-004

AREA SOURCE MAP ARRAY (IA)

```
4    7  7  8  0  9 10 11
3    7  7  6  6  0 12 13
2    1  1  6  6  5 14 15
1    1  1  2  3  4  0  0

     1  2  3  4  5  6  7
```

The relative location of the sources in the array is shown in this map

THE ORIGIN IN INTERNAL UNITS IS (284.00,   2199.00)
THE SIZE OF THE AREA SOURCE ARRAY IS (7,   4)
RMIN= 285.00 RMAX= 292.00 SMIN= 2200.00 SMAX= 2204.00   (IN INTERNAL UNITS)

SIGNIFICANT SO2 AREA SOURCES

RANK	Q*LENGTH (G/M/SEC)	SOURCE NO.
1	2.7496-003	4
2	1.9418-003	3
3	9.7866-004	5
4	9.6313-004	9
5	9.4759-004	2

This ranking lists the area sources in their order of emission significance

Figure 6. continued

```
      6        8.5749-004      10
      7        8.0778-004       8
      8        6.6021-004       7
      9        5.9030-004      13
     10        5.1574-004      12

   TOTAL S02  EMISSION AND CUMULATIVE FRACTION ACCORDING TO HEIGHT

            TOTAL POINT   CUMULATIVE      TOTAL AREA    CUMULATIVE
  HEIGHT(M) EMISSIONS(G/S)  FRACTION      EMISSIONS(G/S)  FRACTION

   0 -  5        .00          .000            .00          .000
   6 - 10      38.80          .033          10.05          .241
  11 - 15        .00          .033          22.45          .780
  16 - 20      42.88          .070           9.14         1.000
  21 - 25        .00          .070            .00         1.000
  26 - 30      55.20          .118            .00         1.000
  31 - 35        .00          .118            .00         1.000
  36 - 40        .00          .118            .00         1.000
  41 - 45      81.06          .187            .00         1.000
  46 - 50      36.43          .219            .00         1.000
  51 - 55        .00          .219            .00         1.000
  56 - 60        .00          .219            .00         1.000
  61 - 65        .00          .219            .00         1.000
  66 - 70        .00          .219            .00         1.000
  71 - 75        .00          .219            .00         1.000
  76 - 80     150.47          .348            .00         1.000
  81 - 85     232.36          .548            .00         1.000
  86 - 90        .00          .548            .00         1.000
  91 - 95     525.70         1.000            .00         1.000
  96 -100        .00         1.000            .00         1.000

  TOTAL      1162.91                        41.64

                  ADDITIONAL INFORMATION ON SOURCES.
                 POINT SOURCE INFORMATION

   EMISSION INFORMATION FOR   12 (NPT) POINT SOURCES HAS BEEN INPUT
   5 SIGNIFICANT POINT SOURCES (NSIGP) ARE TO BE USED FOR THIS RUN


   USER SPECIFIED    1 (NPT) SIGNIFICANT POINT SOURCES AS LISTED BY POINT SOURCE NUMBER:
      7
  THE ORDER OF SIGNIFICANCE (IMPS) FOR 25 OR LESS POINT SOURCES USED IN THIS RUN AS LISTED BY POINT SOURCE NUMBER:
      7    5    8    9   11

                 AREA SOURCE INFORMATION

  EMISSION INFORMATION FOR   15 (NAS) AREA SOURCES HAVE BEEN DETERMINED BY RAM
  10 SIGNIFICANT AREA SOURCES (NSIGA) ARE TO BE USED FOR THIS RUN
  NUMBER OF AREA HEIGHT CLASSES (NHTS)= 3
  REPRESENTATIVE AREA SOURCE HEIGHTS FOR EACH HEIGHT CLASS (HINT) IN METERS =     11.00     15.00     20.00
  BREAK POINT HEIGHT BETWEEN THE AREA HEIGHT CLASSES (BPH) IN METERS =     13.00     17.00
   FRACTION OF AREA SOURCE HEIGHT WHICH IS PHYSICAL HEIGHT (FH) =       .750
  LIMIT OF DISTANCE FOR AREA SOURCE INTEGRATION TABLES (XLIM) IN USER UNITS =     25.000
  BOUNDARIES OF THE AREA SOURCE GRID IN USER UNITS:
     RMIN=   570.000     RMAX=   584.000     SMIN=  4400.000     SMAX=  4408.000
```

For the pollutant selected, the emissions are listed cumulatively by source height

Figure 6. continued

```
SIZE(IRSIZE X ISSIZE) OF  AREA SOURCE MAP ARRAY(IA) IN INTERNAL UNITS =  7 EAST-WEST 'BY   4 NORTH-SOUTH
                  THE ORDER OF SIGNIFICANCE (IMAS) FOR 10 OR LESS  AREA SOURCE IS LISTED BY  AREA SOURCE NUMBER:
    4    3    5    9    2   10    8    7   13   12

                  RECEPTOR INFORMATION

RECEPTOR     IDENTIFICATION  EAST      NORTH
                             COORD     COORD
                              (USER UNITS)
  1 I          RECEP 1       566.000  4405.000
  2 I          RECEP 2       564.000  4401.500
```

Receptors input by the user (letter I following the receptor number) are listed here

Figure 6. continued

INPUT MET DATA FOR 2-HR PERIOD STARTING AT HOUR: 1, YEAR 73, JULIAN DAY 1

HOUR	THETA (DEG)	SPEED (M/S)	MIXING HEIGHT(M)	TEMP (DEG-K)	STABILITY CLASS
1	33.00	6.17	429.11	269.82	4
2	23.00	4.63	401.70	271.48	4

Meteorological data found in the run stream are listed if option 8 is exercised

RESULTANT MET CONDITIONS

WIND DIRECTION= 28.71   RESULTANT WIND SPEED= 5.38
AVERAGE WIND SPEED= 5.40   AVERAGE TEMP= 270.65
WIND PERSISTENCE= .996   MODAL STABILITY= 4

SIGNIFICANT POINT RECEPTORS

RECEPTOR #	EAST	NORTH	PREDICTED MAX CONC. (MICROGRAMS/M**3)	MAX. DIST (KM)	EFF. HT (M)	U(PHY HT) (M/SEC)
3 P 7	564.431	4407.008	39.39	.902	156.385	8.026
4 P 7	564.161	4406.517		1.804	156.385	8.026
5 P 5	579.451	4403.160	839.47	.166	32.007	6.281
6 P 5	579.401	4403.069		.331	32.007	6.281
7 P 8	577.376	4401.214	448.58	.249	47.506	6.890
8 P 8	577.301	4401.078		.499	47.506	6.890
9 P 9	576.668	4400.550	619.39	.276	52.296	4.753
10 P 9	576.585	4400.400		.551	52.296	4.753
11 P 11	582.944	4400.798	427.63	.187	35.952	6.263
12 P 11	582.888	4400.696		.374	35.952	6.263

Two receptors are given for each significant point source

SIGNIFICANT AREA SOURCE RECEPTORS

RECEPTOR #	EAST	NORTH
13 A 4	578.420	4399.941
14 A 3	576.426	4399.953
15 A 5	578.431	4401.961
16 A 9	578.426	4405.953
17 A 2	574.431	4399.961
18 A 10	580.409	4405.920
19 A 8	574.431	4405.961
20 A 7	570.872	4403.941
21 A 13	582.409	4403.920
22 A 12	580.409	4403.920

One receptor is given for each significant area source in this case generated by the program

GENERATED HONEYCOMB RECEPTORS

THE AREA TO BE COVERED BY HONEYCOMB RECEPTORS IS BOUNDED BY:
RMIN= 570.000 RMAX= 580.000 SMIN= 4400.000 SMAX= 4408.000

DISTANCE BETWEEN HONEYCOMB RECEPTORS(GRIDSP) IN USER UNITS= 2.000

RECEPTOR	EAST	NORTH
23 H	572.000	4400.866
24 H	574.000	4400.866
25 H	530.000	4400.866
26 H	571.000	4402.598

If requested in the options, a grid of equally-spaced receptors is generated by the program in a honeycomb pattern

Figure 6. continued

27	H	573.000	4402.598
28	H	575.000	4402.598
29	H	577.000	4402.598
30	H	572.000	4404.330
31	H	574.000	4404.330
32	H	576.000	4404.330
33	H	578.000	4404.330
34	H	571.000	4406.062
35	H	573.000	4406.062
36	H	577.000	4406.062
37	H	572.000	4407.794
38	H	574.000	4407.794
39	H	576.000	4407.794
40	H	578.000	4407.794
41	H	580.000	4407.794

PLEASE NOTE: THE RECEPTOR NUMBERS AND LOCATIONS GENERATED FOR THIS AVERAGING TIME PERIOD ARE DIFFERENT FROM THOSE GENERATED FOR THE PRECEEDING AVERAGING PERIOD.

Figure 6. continued

(3)

TEST RUN: LUCILLE BENDER
EMISSIONS: TEST CITY, 1973
TWO HOURS MET DATA READ IN ON UNIT FIVE.

SO2 CONTRIBUTION(MICROGRAMS/M**3) FROM SIGNIFICANT POINT SOURCES 73/ 1 : HOUR 1

HOUR	THETA (DEG)	SPEED (M/S)	MIXING HEIGHT(M)	TEMP (K)	STAB~LITY CLASS
1	33.00	6.17	429.11	269.82	4

ANEMOM HT: 10.00 PL: .25

	1	2	3	4	5	6	7	8	9	10
FINAL HT (M)	169.06	144.92	48.67	132.04	30.33	33.08	143.20	42.06	46.58	187.32
FINAL HT (M)	31.28	205.53								
DIST FIN HT (KM)	.981	.838	.286	.896	.156	.129	.945	.242	.342	1.075
DIST FIN HT (KM)	.195	1.202								

RANK	1	2	3	4	5	TOTAL SIGNIF POINT	TOTAL ALL POINT SOURCES
SOURCE #	7	5	8	9	11		
RECEP #							
1	.000	.000	.000	.000	.030	.000	.000
2	.000	.000	.000	.000	.000	.000	.000
3	35.799	.000	.000	.000	.000	35.799	35.799
4	18.203	.000	.000	.000	.000	18.203	18.203
5	.000	723.757	.000	.000	.000	723.757	723.757
6	.000	368.049	.000	.000	.000	368.049	368.049
7	.000	.357	431.406	.000	.000	431.762	432.202
8	.000	.464	204.270	.000	.000	204.734	205.191
9	.000	.137	7.947	701.982	.000	710.066	712.682
10	.000	.181	9.385	281.595	.000	291.161	293.761
11	.000	.000	.000	.000	433.349	433.349	433.349
12	.000	.000	.000	.000	194.826	194.826	194.826
13	.000	.084	.000	.000	.000	.084	.084
14	.000	.536	13.504	35.822	.000	49.862	51.679
15	.000	7.930	.000	.000	.000	7.980	7.980
16	.000	.000	.000	.000	.000	.000	.754
17	.000	.000	.000	.000	.000	.000	13.839
18	.000	.000	.000	.000	.000	.000	.030
19	.000	.000	.000	.000	.000	.000	.563
20	.000	.000	.000	.000	.000	.000	.000
21	.000	.000	.000	.000	.000	.000	.000
22	.000	.000	.000	.000	.000	.000	.000
23	.000	.000	.000	.000	.000	.000	26.205
24	.000	.000	.000	.000	.000	.000	8.605
25	.000	.030	.000	.000	.000	.000	.000
26	.000	.000	.000	.000	.000	.000	.021
27	.000	.000	.000	.000	.000	.000	19.452
28	.000	.000	.000	.000	.000	.000	9.412
29	.000	.030	.000	.000	.000	.000	29.513
30	.000	.000	.000	.000	.000	.000	.003
31	.000	.000	.000	.000	.000	.000	7.[illegible]18
32	.000	.000	.000	.000	.000	.000	10 [illegible]3
33	.000	.000	.000	.000	.000	.000	45 [illegible]

As requested in the options, concentrations are tabulated for those sources labelled significant

Figure 6. continued

34	.000	.000	.000	.000	.000	.000	.820
35	.000	.000	.000	.000	.000	.000	.000
36	.000	.000	.000	.000	.000	.000	12.956
37	.000	.000	.000	.000	.000	.000	.000
38	.000	.000	.000	.000	.000	.000	.000
39	.000	.000	.000	.000	.000	.000	.942
40	.000	.000	.000	.000	.000	.000	15.210
41	.000	.000	.000	.000	.000	.000	.000

Figure 6. continued

TEST RUN: LUCILLE BENDER
EMISSIONS: TEST CITY, 1973
TWO HOURS MET DATA READ IN ON UNIT FIVE.

SO2 CONTRIBUTION(MICROGRAMS/M**3) FROM SIGNIFICANT AREA SOURCES 73/ 1 : HOUR 1

HOUR	THETA (DEG)	SPEED (M/S)	MIXING HEIGHT(M)	TEMP (K)	STABILITY CLASS
1	33.00	6.17	429.11	269.82	4

ANEMOM HT: 10.00 PL: .25

AREA HTS: 10.588, 14.201, 18.661; SEPARATION HTS: 12.400, 15.991

RANK	1	2	3	4	5	6	7	8	9	10	TOTAL SIGNIF AREA	TOTAL ALL AREA SOURCES
SOURCE #	4	3	5	9	2	10	8	7	13	12		
RECEP #												
1	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
2	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
3	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
4	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
5	.000	.000	.999	.000	.000	.181	.000	.000	.000	.242	1.421	1.467
6	.000	.000	1.032	.000	.000	.179	.000	.000	.000	.235	1.447	1.493
7	.000	1.847	.485	.000	.000	.323	.000	.000	.000	.074	2.728	2.728
8	.000	1.957	.473	.000	.000	.322	.000	.000	.000	.076	2.828	2.828
9	.000	2.288	.321	.000	.000	.320	.000	.000	.000	.031	2.960	2.960
10	.000	2.365	.325	.000	.000	.319	.000	.000	.000	.033	3.043	3.043
11	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.048
12	.000	.000	.030	.000	.000	.000	.000	.000	.000	.000	.000	.045
13	2.962	.000	.088	.000	.000	.000	.000	.000	.061	.143	3.254	3.400
14	.000	2.352	.367	.000	.000	.317	.000	.000	.000	.053	3.089	3.089
15	.097	.000	1.276	.000	.000	.238	.000	.000	.000	.164	1.775	1.801
16	.000	.000	.000	1.166	.000	.000	.000	.000	.000	.000	1.166	1.166
17	.000	.000	.000	.399	1.235	.000	.000	.000	.000	.000	1.634	1.634
18	.000	.000	.000	.000	.000	.798	.000	.000	.000	.049	.846	.876
19	.000	.000	.000	.000	.000	.000	1.053	.000	.000	.000	1.053	1.053
20	.000	.000	.000	.000	.000	.000	.000	.495	.000	.000	.495	.512
21	.000	.000	.000	.000	.000	.000	.000	.000	.549	.000	.549	.612
22	.000	.000	.000	.000	.000	.065	.000	.000	.000	.480	.544	.641
23	.000	.000	.000	.000	.000	.000	.183	.000	.000	.000	.183	.342
24	.000	.000	.000	.195	1.075	.000	.000	.000	.000	.000	1.270	1.270
25	.000	.000	.000	.000	.000	.000	.000	.000	.227	.000	.227	.349
26	.000	.000	.000	.000	.000	.000	.141	.229	.000	.000	.371	.489
27	.000	.000	.000	.000	.000	.000	.224	.012	.000	.000	.235	.354
28	.000	.000	.000	.161	.000	.000	.000	.000	.000	.000	.161	.161
29	.000	.000	.000	.255	.000	.128	.000	.000	.000	.000	.382	.382
30	.000	.000	.000	.000	.000	.000	.110	.460	.000	.000	.570	.570
31	.000	.000	.000	.000	.000	.000	.275	.000	.000	.000	.275	.275
32	.000	.000	.000	.125	.000	.000	.000	.000	.000	.000	.125	.125
33	.000	.000	.000	.314	.000	.099	.000	.000	.000	.000	.412	.412
34	.000	.000	.000	.000	.000	.000	.000	.379	.000	.000	.379	.379
35	.000	.000	.000	.000	.000	.000	.084	.348	.000	.000	.432	.432
36	.000	.000	.000	.096	.000	.000	.000	.000	.000	.000	.096	[illegible]
37	.000	.000	.000	.000	.000	.000	.000	.134	.000	.000	.134	[illegible]
38	.000	.000	.000	.000	.000	.000	.436	.000	.000	.000	.436	[illegible]

Figure 6. continued

39	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
40	.000	.000	.000	.497	.000	.000	.000	.000	.000	.000	.497	.497
41	.000	.000	.000	.000	.000	.264	.000	.000	.000	.000	.264	.264

Figure 6. continued

TEST RUN: LUCILLE BENDER
EMISSIONS: TEST CITY, 1973
TWO HOURS MET DATA READ IN ON UNIT FIVE.

SO2 SUMMARY CONCENTRATION TABLE(MICROGRAMS/M**3) 73/ 1 : HOUR 1

HOUR	THETA (DEG)	SPEED (M/S)	MIXING HEIGHT(M)	TEMP (K)	STABILITY CLASS
1	33.00	6.17	429.11	269.82	4

ANEMOM HT: 10.00 PL: .25

AREA HTS: 10.588, 14.201, 18.661; SEPARATION HTS: 12.400, 15.991

RECEPTOR NO.		EAST	NORTH	TOTAL FROM SIGNIF POINT SOURCES	TOTAL FROM ALL POINT SOURCES	TOTAL FROM SIGNIF AREA SOURCES	TOTAL FROM ALL AREA SOURCES	TOTAL FROM ALL SOURCES	CONCENTRATION RANK
1 I 0	RECEP 1	566.000	4405.000	.0000	.0000	.0000	.0000	.0000	41
2 I 0	RECEP 2	564.000	4401.500	.0000	.0000	.0000	.0000	.0000	40
3 P 7		564.431	4407.008	35.7987	35.7987	.0000	.0000	35.7987	11
4 P 7		564.161	4406.517	18.2026	18.2026	.0000	.0000	18.2026	15
5 P 5		579.451	4403.160	723.7571	723.7571	1.4215	1.4667	725.2238	1
6 P 5		579.401	4403.069	368.0487	368.0487	1.4465	1.4929	369.5415	5
7 P 8		577.376	4401.214	431.7621	432.2024	2.7281	2.7281	434.9305	3
8 P 8		577.301	4401.078	204.7343	205.1913	2.8280	2.8280	208.0193	7
9 P 9		576.668	4400.550	710.0658	712.6823	2.9602	2.9602	715.6425	2
10 P 9		576.585	4400.400	291.1613	293.7612	3.0427	3.0427	296.8038	6
11 P 11		582.944	4400.798	433.3493	433.3493	.0000	.0483	433.3975	4
12 P 11		582.858	4400.696	194.8263	194.8263	.0000	.0445	194.8708	8
13 A 4		578.420	4399.941	.0837	.0837	3.2543	3.4000	3.4837	24
14 A 3		576.426	4399.953	49.8623	51.6786	3.0888	3.0888	54.7674	9
15 A 5		578.431	4401.961	7.9795	7.9803	1.7745	1.8009	9.7811	21
16 A 9		578.426	4405.953	.0000	.7536	1.1665	1.1665	1.9200	25
17 A 2		574.431	4399.961	.0000	13.8389	1.6338	1.6338	15.4727	17
18 A 10		580.409	4405.920	.0000	.0000	.8464	.8464	.8464	29
19 A 8		574.431	4405.961	.0000	.5625	1.0529	1.0529	1.6154	26
20 A 7		570.872	4403.941	.0000	.0000	.4950	.5121	.5121	33
21 A 13		582.409	4403.920	.0000	.0000	.5493	.6120	.6120	31
22 A 12		530.409	4403.920	.0000	.0000	.5444	.6414	.6414	30
23 H 0		572.000	4400.866	.0000	26.2047	.1834	.3421	26.5468	13
24 H 0		574.000	4400.866	.0000	8.6048	1.2702	1.2702	9.8749	20
25 H 0		530.000	4400.866	.0000	.0000	.2272	.3489	.3489	37
26 H 0		571.000	4402.598	.0000	.0214	.3706	.4890	.5104	34
27 H 0		573.000	4402.598	.0000	19.4521	.2353	.3536	19.8057	14
28 H 0		575.000	4402.598	.0000	9.4123	.1610	.1610	9.5734	22
29 H 0		577.000	4402.598	.0000	29.5180	.3822	.3822	29.9002	12
30 H 0		572.000	4404.330	.0000	.0028	.5696	.5696	.5724	32
31 H 0		574.000	4404.330	.0000	7.2180	.2753	.2753	7.4933	23
32 H 0		576.000	4404.330	.0000	10.9682	.1248	.1248	11.0931	19
33 H 0		578.000	4404.330	.0000	45.5482	.4121	.4121	45.9603	10
34 H 0		571.000	4406.062	.0000	.8200	.3788	.3788	1.1988	27
35 H 0		573.000	4406.062	.0000	.0001	.4319	.4319	.4320	36
36 H 0		577.000	4406.062	.0000	12.9563	.0959	.0959	13.0522	18
37 H 0		572.000	4407.794	.0000	.0000	.1342	.1342	.1342	39
38 H 0		574.000	4407.794	.0000	.0000	.4364	.4364	.4364	35
39 H 0		576.000	4407.794	.0000	.9420	.0000	.0000	.9420	28
40 H 0		578.000	4407.794	.0000	15.2102	.4971	.4971	15.7073	16
41 H 0		580.000	4407.794	.0000	.0000	.2645	.2645	.2645	38

Summary concentrations for each hour are given per option 30

TEST RUN: LUCILLE BENDER
EMISSIONS: TEST CITY, 1973
TWO HOURS MET DATA READ IN ON UNIT FIVE.

SO2 CONTRIBUTION(MICROGRAMS/M**3) FROM SIGNIFICANT POINT SOURCES 73/ 1 : HOUR 2

HOUR	THETA (DEG)	SPEED (M/S)	MIXING HEIGHT(M)	TEMP (K)	STABILITY CLASS
2	23.00	4.63	401.70	271.48	4

ANEMOM HT: 10.00 PL: .25

	1	2	3	4	5	6	7	8	9	10
FINAL HT (M)	199.03	169.69	56.06	161.86	34.25	36.25	173.95	48.72	59.91	222.05
FINAL HT (M)	36.91	246.37								
DIST FIN HT (KM)	.978	.835	.285	.894	.156	.128	.941	.240	.341	1.070
DIST FIN HT (KM)	.194	1.198								

RANK	1	2	3	4	5	TOTAL SIGNIF POINT	TOTAL ALL POINT SOURCES
SOURCE #	7	5	8	9	11		
RECEP #							
1	.000	.000	.000	.000	.000	.000	.000
2	.003	.000	.000	.000	.000	.003	.003
3	29.231	.000	.000	.000	.000	29.231	29.231
4	18.745	.000	.000	.000	.000	18.745	18.745
5	.000	684.939	.000	.000	.000	684.939	684.941
6	.000	417.785	.000	.000	.000	417.785	417.788
7	.000	.001	399.482	.000	.000	399.483	435.730
8	.000	.001	228.979	.000	.000	228.980	265.410
9	.000	.000	.297	571.809	.000	572.106	609.730
10	.000	.000	.484	294.201	.000	294.685	331.675
11	.000	.000	.000	.000	394.135	394.135	394.135
12	.000	.000	.000	.000	217.816	217.816	217.816
13	.000	5.793	.000	.000	.000	5.793	5.853
14	.000	.001	2.253	104.778	.000	107.032	143.421
15	.000	.555	.000	.000	.000	.555	3.605
16	.000	.000	.000	.000	.000	.000	8.777
17	.000	.000	.000	.000	.000	.000	22.261
18	.000	.000	.000	.000	.000	.000	.000
19	.000	.000	.000	.000	.000	.000	.000
20	.000	.000	.000	.000	.000	.000	.067
21	.000	.000	.000	.000	.000	.000	.000
22	.000	.000	.000	.000	.000	.000	.000
23	.000	.000	.000	.000	.000	.000	.190
24	.000	.000	.000	.000	.000	.000	14.746
25	.000	.000	.000	.000	.000	.000	.000
26	.000	.000	.000	.000	.000	.000	.031
27	.000	.000	.000	.000	.000	.000	.102
28	.000	.000	.000	.000	.000	.000	8.552
29	.000	.000	.000	.000	.000	.000	22.515
30	.000	.000	.000	.000	.000	.000	.000
31	.000	.000	.000	.000	.000	.000	.001
32	.000	.000	.000	.000	.000	.000	13.845
33	.000	.000	.000	.000	.000	.000	22.552

Figure 6. continued

34	.000	.000	.000	.000	.000	.000	14.716
35	.000	.000	.000	.000	.000	.000	.000
36	.000	.000	.000	.000	.000	.000	23.870
37	.000	.000	.000	.000	.000	.000	.000
38	.000	.000	.000	.000	.000	.000	.000
39	.000	.000	.000	.000	.000	.000	.000
40	.000	.000	.000	.000	.000	.000	43.276
41	.000	.000	.000	.000	.000	.000	.001

Figure 6. continued

TEST RUN: LUCILLE BENDER
EMISSIONS: TEST CITY, 1973
TWO HOURS MET DATA READ IN ON UNIT FIVE.

SO2 CONTRIBUTION(MICROGRAMS/M**3) FROM SIGNIFICANT AREA SOURCES 73/ 1 : HOUR 2

HOUR	THETA (DEG)	SPEED (M/S)	MIXING HEIGHT(M)	TEMP (K)	STABILITY CLASS
2	23.00	4.63	401.70	271.48	4

ANEMOM HT: 10.00 PL: .25

AREA HTS: 11.366, 15.182, 19.879; SEPARATION HTS: 13.282, 17.069

RANK	1	2	3	4	5	6	7	8	9	10	TOTAL SIGNIF AREA	TOTAL ALL AREA SOURCES
SOURCE #	4	3	5	9	2	10	8	7	13	12		
RECEP #												
1	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
2	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
3	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
4	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
5	.000	.000	1.255	.000	.000	.425	.000	.000	.000	.220	1.901	1.901
6	.000	.000	1.304	.000	.000	.425	.000	.000	.000	.212	1.941	1.941
7	.000	2.319	.412	.363	.000	.123	.000	.000	.000	.000	3.217	3.217
8	.000	2.463	.391	.373	.000	.114	.000	.000	.000	.000	3.341	3.341
9	.000	2.894	.090	.511	.000	.000	.000	.000	.000	.000	3.495	3.495
10	.000	2.995	.077	.509	.000	.000	.000	.000	.000	.000	3.581	3.581
11	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.170
12	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.169
13	3.831	.000	.489	.000	.000	.403	.000	.000	.000	.251	4.973	4.987
14	.000	3.050	.097	.505	.000	.000	.000	.000	.000	.000	3.652	3.652
15	.073	.000	1.648	.000	.000	.417	.000	.000	.000	.044	2.182	2.182
16	.000	.000	.000	1.513	.000	.000	.000	.000	.000	.000	1.513	1.513
17	.000	.000	.000	.000	1.596	.000	.000	.000	.000	.000	1.596	1.596
18	.000	.000	.000	.000	.000	1.030	.000	.000	.000	.047	1.077	1.077
19	.000	.000	.000	.000	.000	.000	1.361	.000	.000	.000	1.361	1.361
20	.000	.000	.000	.000	.000	.000	.000	.639	.000	.000	.639	.657
21	.000	.000	.000	.000	.000	.000	.000	.000	.709	.000	.709	.830
22	.000	.000	.000	.000	.000	.364	.000	.000	.000	.620	.984	1.019
23	.000	.000	.000	.000	.000	.000	.451	.138	.000	.000	.589	.792
24	.000	.000	.000	.000	1.356	.000	.000	.000	.000	.000	1.356	1.356
25	.000	.000	.000	.000	.000	.000	.000	.000	.061	.201	.262	.474
26	.000	.000	.000	.000	.000	.000	.000	.362	.000	.000	.362	.512
27	.000	.000	.000	.000	.000	.000	.466	.095	.000	.000	.561	.711
28	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
29	.000	.000	.000	.531	.000	.000	.000	.000	.000	.000	.531	.531
30	.000	.000	.000	.000	.000	.000	.000	.636	.000	.000	.636	.636
31	.000	.000	.000	.000	.000	.000	.494	.000	.000	.000	.494	.494
32	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
33	.000	.000	.000	.563	.000	.000	.000	.000	.000	.000	.563	.563
34	.000	.000	.000	.000	.000	.000	.000	.479	.000	.000	.479	.479
35	.000	.000	.000	.000	.000	.000	.000	.479	.000	.000	.479	.479
36	.000	.000	.000	.000	.000	.000	.000	.000	000	.000	.000	.000
37	.000	.000	.000	.000	.000	.000	.000	.159	.000	.000	.159	.159
38	.000	.000	.000	.000	.000	.000	.526	.000	.000	.000	.526	.526

Figure 6. continued

39	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
40	.000	.000	.000	.599	.000	.000	.000	.000	.000	.000	.599	.599
41	.000	.000	.000	.000	.000	.307	.000	.000	.000	.000	.307	.307

Figure 6. continued

TEST RUN: LUCILLE BENDER
EMISSIONS: TEST CITY, 1973
TWO HOURS MET DATA READ IN ON UNIT FIVE.

SO2 SUMMARY CONCENTRATION TABLE(MICROGRAMS/M**3) 73/ 1 : HOUR 2

HOUR	THETA (DEG)	SPEED (M/S)	MIXING HEIGHT(M)	TEMP (K)	STABILITY CLASS
2	23.00	4.63	401.70	271.48	4

ANEMOM HT: 10.00 PL: .25

AREA HTS: 11.366, 15.182, 19.879; SEPARATION HTS: 13.282, 17.069

RECEPTOR NO.		EAST	NORTH	TOTAL FROM SIGNIF POINT SOURCES	TOTAL FROM ALL POINT SOURCES	TOTAL FROM SIGNIF AREA SOURCES	TOTAL FROM ALL AREA SOURCES	TOTAL FROM ALL SOURCES	CONCENTRATION RANK
1 I 0	RECEP 1	566.000	4405.000	.0000	.0000	.0000	.0000	.0000	41
2 I 0	RECEP 2	564.000	4401.500	.0025	.0025	.0000	.0000	.0025	39
3 P 7		564.431	4407.008	29.2308	29.2308	.0000	.0000	29.2308	11
4 P 7		564.161	4406.517	18.7447	18.7447	.0000	.0000	18.7447	16
5 P 5		579.451	4403.160	684.9385	684.9407	1.9007	1.9007	686.8414	1
6 P 5		579.401	4403.069	417.7846	417.7882	1.9407	1.9407	419.7289	4
7 P 8		577.376	4401.214	399.4826	435.7305	3.2174	3.2174	438.9479	3
8 P 8		577.301	4401.078	228.9802	265.4095	3.3406	3.3406	268.7501	7
9 P 9		576.668	4400.550	572.1059	609.7302	3.4947	3.4947	613.2249	2
10 P 9		576.585	4400.400	294.6850	331.6750	3.5814	3.5814	335.2564	6
11 P 11		582.944	4400.798	394.1352	394.1352	.0000	.1700	394.3052	5
12 P 11		582.888	4400.696	217.8158	217.8158	.0000	.1692	217.9850	8
13 A 4		578.420	4399.941	5.7934	5.8530	4.9734	4.9866	10.8396	20
14 A 3		576.426	4399.953	107.0322	143.4206	3.6524	3.6524	147.0729	9
15 A 5		578.431	4401.961	.5552	3.6050	2.1820	2.1820	5.7870	23
16 A 9		578.426	4405.953	.0000	8.7774	1.5130	1.5130	10.2905	21
17 A 2		574.431	4399.961	.0000	22.2611	1.5960	1.5960	23.8571	13
18 A 10		580.409	4405.920	.0000	.0000	1.0770	1.0770	1.0770	25
19 A 8		574.431	4405.961	.0000	.0000	1.3605	1.3605	1.3605	24
20 A 7		570.872	4403.941	.0000	.0670	.6390	.6566	.7236	30
21 A 13		582.409	4403.920	.0000	.0000	.7092	.8604	.8604	28
22 A 12		580.409	4403.920	.0000	.0000	.9336	1.0191	1.0191	26
23 H 0		572.000	4400.366	.0000	.1903	.5889	.7921	.9825	27
24 H 0		574.000	4400.866	.0000	14.7456	1.3561	1.3561	16.1017	17
25 H 0		580.000	4400.866	.0000	.0000	.2621	.4738	.4738	36
26 H 0		571.000	4402.598	.0000	.0005	.3618	.5115	.5120	33
27 H 0		573.000	4402.598	.0000	.1024	.5611	.7108	.8131	29
28 H 0		575.000	4402.598	.0000	8.5524	.0000	.0000	8.5524	22
29 H 0		577.000	4402.598	.0000	22.5152	.5312	.5312	23.0464	15
30 H 0		572.000	4404.330	.0000	.0000	.6356	.6356	.6356	31
31 H 0		574.000	4404.330	.0000	.0011	.4943	.4943	.4955	34
32 H 0		576.000	4404.330	.0000	13.8445	.0000	.0000	13.8445	19
33 H 0		578.000	4404.330	.0000	22.5524	.5631	.5631	23.1156	14
34 H 0		571.000	4406.062	.0000	14.7163	.4789	.4789	15.1952	18
35 H 0		573.000	4406.062	.0000	.0000	.4789	.4789	.4789	35
36 H 0		577.000	4406.062	.0000	23.8704	.0000	.0000	23.8704	12
37 H 0		572.000	4407.794	.0000	.0000	.1591	.1591	.1591	38
38 H 0		574.000	4407.794	.0000	.0000	.5260	.5260	.5260	32
39 H 0		576.000	4407.794	.0000	.0001	.0000	.0000	.0001	40
40 H 0		578.000	4407.794	.0000	43.2758	.5992	.5992	43.8750	10
41 H 0		580.000	4407.794	.0000	.0013	.3073	.3073	.3086	37

Figure 6. continued

TEST RUN: LUCILLE BENDER
EMISSIONS: TEST CITY, 1973
TWO HOURS MET DATA READ IN ON UNIT FIVE.

2-HOUR AVERAGE SO2 CONTRIBUTION(MICROGRAMS/M**3) FROM SIGNIFICANT POINT SOURCES 73/ 1 START HOUR: 1

ANEMOM HT: 10. PL: A- .15 B- .15C- .20 D- .25 E- .40 F- .60

RANK	1	2	3	4	5	TOTAL SIGNIF POINT	TOTAL ALL POINT SOURCES
SOURCE #	7	5	8	9	11		
RECEP #							
1	.000	.000	.000	.000	.000	.000	.000
2	.001	.000	.000	.000	.000	.001	.001
3	32.515	.000	.000	.000	.000	32.515	32.515
4	18.474	.000	.000	.000	.000	18.474	18.474
5	.000	704.348	.000	.000	.000	704.348	704.349
6	.000	392.917	.000	.000	.000	392.917	392.918
7	.000	.179	415.444	.000	.000	415.622	433.966
8	.000	.233	216.625	.000	.000	216.857	235.300
9	.000	.069	4.122	636.895	.000	641.086	661.206
10	.000	.091	4.934	287.898	.000	292.923	312.718
11	.000	.000	.000	.000	413.742	413.742	413.742
12	.000	.000	.000	.000	206.321	206.321	206.321
13	.000	2.939	.000	.000	.000	2.939	2.968
14	.000	.268	7.879	70.300	.000	78.447	97.550
15	.000	4.267	.000	.000	.000	4.267	5.793
16	.000	.000	.000	.000	.000	.000	4.765
17	.000	.000	.000	.000	.000	.000	18.050
18	.000	.000	.000	.000	.000	.000	.000
19	.000	.000	.000	.000	.000	.000	.281
20	.000	.000	.000	.000	.000	.000	.034
21	.000	.000	.000	.000	.000	.000	.000
22	.000	.000	.000	.000	.000	.000	.000
23	.000	.000	.000	.000	.000	.000	13.193
24	.000	.000	.000	.000	.000	.000	11.675
25	.000	.000	.000	.000	.000	.000	.000
26	.000	.000	.000	.000	.000	.000	.011
27	.000	.000	.000	.000	.000	.000	9.777
28	.000	.000	.000	.000	.000	.000	8.902
29	.000	.000	.000	.000	.000	.000	26.017
30	.000	.000	.000	.000	.000	.000	.001
31	.000	.000	.000	.000	.000	.000	3.610
32	.000	.000	.000	.000	.000	.000	12.406
33	.000	.000	.000	.000	.000	.000	34.050
34	.000	.000	.000	.000	.000	.000	7.768
35	.000	.000	.000	.000	.000	.000	.000
36	.000	.000	.000	.000	.000	.000	18.413
37	.000	.000	.000	.000	.000	.000	.000
38	.000	.000	.000	.000	.000	.000	.000
39	.000	.000	.000	.000	.000	.000	.471
40	.000	.000	.000	.000	.000	.000	29.243
41	.000	.000	.000	.000	.000	.000	.001

As requested in option 33, point source contributions for the averaging period are listed here

Figure 6. continued

TEST RUN: LUCILLE BENDER
EMISSIONS: TEST CITY, 1973
TWO HOURS MET DATA READ IN ON UNIT FIVE.

2-HOUR AVERAGE SO2 CONTRIBUTION(MICROGRAMS/M**3) FROM SIGNIFICANT AREA SOURCES 73/ 1 START HOUR: 1

ANEMOM HT: 10. PL: A- .15 B- .15 C- .20 D- .25 E- .40 F- .60

RANK	1	2	3	4	5	6	7	8	9	10	TOTAL SIGNIF AREA	TOTAL ALL AREA SOURCES
SOURCE #	4	3	5	9	2	10	8	7	13	12		
RECEP #												
1	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
2	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
3	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
4	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
5	.000	.000	1.127	.000	.000	.303	.000	.000	.000	.231	1.661	1.684
6	.000	.000	1.168	.000	.000	.302	.000	.000	.000	.224	1.694	1.717
7	.000	2.083	.448	.182	.000	.223	.000	.000	.000	.037	2.973	2.973
8	.000	2.210	.432	.186	.000	.218	.000	.000	.000	.038	3.084	3.084
9	.000	2.591	.206	.255	.000	.160	.000	.000	.000	.016	3.227	3.227
10	.000	2.680	.201	.255	.000	.160	.000	.000	.000	.017	3.312	3.312
11	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.109
12	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.107
13	3.397	.000	.289	.000	.000	.202	.000	.000	.030	.197	4.114	4.193
14	.000	2.701	.232	.252	.000	.159	.000	.000	.000	.026	3.371	3.371
15	.085	.000	1.462	.000	.000	.328	.000	.000	.000	.104	1.978	1.991
16	.000	.000	.000	1.340	.000	.000	.000	.000	.000	.000	1.340	1.340
17	.000	.000	.000	.199	1.416	.000	.000	.000	.000	.000	1.615	1.615
18	.000	.000	.000	.000	.000	.914	.000	.000	.000	.048	.962	.962
19	.000	.000	.000	.000	.000	.000	1.207	.000	.000	.000	1.207	1.207
20	.000	.000	.000	.000	.000	.000	.000	.567	.000	.000	.567	.584
21	.000	.000	.000	.000	.000	.000	.000	.000	.629	.000	.629	.736
22	.000	.000	.000	.000	.000	.214	.000	.000	.000	.550	.764	.830
23	.000	.000	.000	.000	.000	.000	.317	.069	.000	.000	.386	.567
24	.000	.000	.000	.098	1.215	.000	.000	.000	.000	.000	1.313	1.313
25	.000	.000	.000	.000	.000	.000	.000	.000	.144	.101	.245	.411
26	.000	.000	.000	.000	.000	.000	.071	.296	.000	.000	.366	.500
27	.000	.000	.000	.000	.000	.000	.345	.053	.000	.000	.398	.532
28	.000	.000	.000	.081	.000	.000	.000	.000	.000	.000	.081	.081
29	.000	.000	.000	.393	.000	.064	.000	.000	.000	.000	.457	.457
30	.000	.000	.000	.000	.000	.000	.055	.548	.000	.000	.603	.603
31	.000	.000	.000	.000	.000	.000	.385	.000	.000	.000	.385	.385
32	.000	.000	.000	.062	.000	.000	.000	.000	.000	.000	.062	.062
33	.000	.000	.000	.438	.000	.049	.000	.000	.000	.000	.438	.488
34	.000	.000	.000	.000	.000	.000	.000	.429	.000	.000	.429	.429
35	.000	.000	.000	.000	.000	.000	.042	.413	.000	.000	.455	.455
36	.000	.000	.000	.048	.000	.000	.000	.000	.000	.000	.048	.048
37	.000	.000	.000	.000	.000	.000	.000	.147	.000	.000	.147	[illegible]
38	.000	.000	.000	.000	.000	.000	.481	.000	.000	.000	.481	.481
39	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
40	.000	.000	.000	.548	.000	.000	.000	.000	.000	.000	.548	.548
41	.000	.000	.000	.000	.000	.286	.000	.000	.000	.000	.286	[illegible]

Figure 6. continued

TEST RUN: LUCILLE BENDER
EMISSIONS: TEST CITY, 1973
TWO HOURS MET DATA READ IN ON UNIT FIVE.

2-HOUR AVERAGE SO2 SUMMARY CONCENTRATION TABLE(MICROGRAMS/M**3) 73/ 1 START HOUR: 1

ANEMOM HT: 10. PL: A- .15 B- .15 C- .20 D- .25 E- .40 F- .60

RECEPTOR NO.		EAST	NORTH	TOTAL FROM SIGNIF POINT SOURCES	TOTAL FROM ALL POINT SOURCES	TOTAL FROM SIGNIF AREA SOURCES	TOTAL FROM ALL AREA SOURCES	TOTAL FROM ALL SOURCES	CONCENTRATION RANK
1 I 0	RECEP 1	566.000	4405.000	.0000	.0000	.0000	.0000	.0000	41
2 I 0	RECEP 2	564.000	4401.500	.0013	.0013	.0000	.0000	.0013	40
3 P 7		564.431	4407.008	32.5148	32.5148	.0000	.0000	32.5148	11
4 P 7		564.161	4406.517	18.4737	18.4737	.0000	.0000	18.4737	15
5 P 5		579.451	4403.160	704.3478	704.3489	1.6611	1.6837	706.0326	1
6 P 5		579.401	4403.069	392.9156	392.9184	1.6936	1.7168	394.6352	5
7 P 8		577.376	4401.214	415.6223	433.9664	2.9728	2.9728	436.9392	3
8 P 8		577.301	4401.078	216.8572	235.3004	3.0843	3.0843	238.3847	7
9 P 9		576.668	4400.550	641.0858	661.2062	3.2274	3.2274	664.4337	2
10 P 9		576.585	4400.400	292.9232	312.7181	3.3120	3.3120	316.0301	6
11 P 11		582.944	4400.798	413.7422	413.7422	.0000	.1091	413.8514	4
12 P 11		582.888	4400.696	206.3210	206.3210	.0000	.1069	206.4279	8
13 A 4		578.420	4399.941	2.9385	2.9683	4.1139	4.1933	7.1616	24
14 A 3		576.426	4399.953	78.4472	97.5496	3.3706	3.3706	100.9202	9
15 A 5		578.431	4401.961	4.2674	5.7926	1.9783	1.9914	7.7841	23
16 A 9		578.426	4405.953	.0000	4.7655	1.3397	1.3397	6.1052	25
17 A 2		574.431	4399.961	.0000	18.0500	1.6149	1.6149	19.6649	14
18 A 10		580.409	4405.920	.0000	.0000	.9617	.9617	.9617	28
19 A 8		574.431	4405.961	.0000	.2813	1.2067	1.2067	1.4880	27
20 A 7		570.872	4403.941	.0000	.0335	.5670	.5843	.6179	31
21 A 13		582.409	4403.920	.0000	.0000	.6292	.7362	.7362	30
22 A 12		580.409	4403.920	.0000	.0000	.7640	.8303	.8303	29
23 H 0		572.000	4400.866	.0000	13.1975	.3962	.5671	13.7646	17
24 H 0		574.000	4400.865	.0000	11.6752	1.3131	1.3131	12.9883	18
25 H 0		580.000	4400.866	.0000	.0000	.2447	.4113	.4113	37
26 H 0		571.000	4402.598	.0000	.0110	.3662	.5002	.5112	33
27 H 0		573.000	4402.598	.0000	9.7772	.3982	.5322	10.3094	20
28 H 0		575.000	4402.593	.0000	8.9824	.0805	.0805	9.0629	21
29 H 0		577.000	4402.598	.0000	26.0166	.4567	.4567	26.4733	13
30 H 0		572.000	4404.330	.0000	.0014	.6026	.6026	.6040	32
31 H 0		574.000	4404.330	.0000	3.6096	.3848	.3848	3.9944	26
32 H 0		576.000	4404.330	.0000	12.4064	.0624	.0624	12.4688	19
33 H 0		578.000	4404.330	.0000	34.0503	.4876	.4876	34.5379	10
34 H 0		571.000	4406.062	.0000	7.7681	.4289	.4289	8.1970	22
35 H 0		573.000	4406.062	.0000	.0301	.4554	.4554	.4555	36
36 H 0		577.000	4406.062	.0000	18.4134	.0479	.0479	18.4613	16
37 H 0		572.000	4407.794	.0000	.0000	.1466	.1466	.1466	39
38 H 0		574.000	4407.794	.0000	.0000	.4812	.4812	.4812	34
39 H 0		576.000	4407.794	.0000	.4711	.0000	.0000	.4711	35
40 H 0		578.000	4407.794	.0000	29.2430	.5482	.5482	29.7912	12
41 H 0		580.000	4407.794	.0000	.0007	.2859	.2859	.2865	33

THIS RUN HAS TERMINATED NORMALLY.

A summary is provided for all sources for the averaging period at the end of the run

SECTION 7

USES OF RAM

RAM simulates pollutants from point and area sources in urban or rural settings over periods of one hour to one year. The meteorological data can be entered on cards, with one card for each simulated hour, or on magnetic media by using option 8. General emission information can also be on the input stream or from disk or tape files using option 9 or 10.

Point and area sources are specified by options 5 and 6. The locations of receptors may be specified by the user (option 14).

The use of options 15 and 16 to locate additional receptors downwind of significant point and area sources assists in determining locations of maximum concentration. Since the resultant wind vector for the averaging period selected is used to determine the direction of these receptors from the sources, averaging times that contain significant wind shifts may result in misleading averages. The user should note that when options 15 and 16 are used to locate receptors downwind from significant sources, the locations for these receptors will shift for each averaging period, dependent upon the resultant meteorological conditions for each period. Therefore, receptors with the same numbers will be at different locations for different averaging times.

If the user desires to cover a specific area so that pollutant patterns are discerned, option 17 can be used to place additional receptors. The pattern used is such that adjacent receptors are equidistant; this is referred to as a honeycomb pattern. The distance between receptors is selected by the user as are the boundaries of the area covered. If the boundaries are entered as zeros, the boundaries are set to coincide with the boundaries of the area source map array. Since the honeycomb receptors are set for each averaging time, they may be different from one averaging time to another. The model can be executed for an hour without receptors downwind of significant sources in order to obtain a list of receptors for good area coverage. Their coordinates can then be input for a longer period run where it is desired to have receptors in fixed positions.

It should be noted that concentration gradients may be very steep, especially those due to point source plumes. Therefore, the addition of more receptors will result in a more complex concentration pattern and some hot spots. The user, when searching for maximum concentrations, must decide on receptor spacing commensurate with resources, analysis time, and the purpose of the project before including additional receptors.

For the typical run, hourly output would be desired, so option 24 should be set for hourly output. If option 24 is not set, no hourly output is printed. The use of option 40 to write partial concentrations onto a disk file should be used only if additional computer analysis is intended using the individual contributions of sources upon particular receptors. Computer programs to perform this analysis must be written by the individual user to suit his or her purpose.

Option 30 is checked only if option 24 is used to obtain hourly summaries. The use of option 30 will print a summary page for each hour. This summary provides the total concentration for each receptor, the contribution to the concentration from all point sources, the contribution to the concentration from all area sources, the contribution from all the significant point sources combined, and the contribution from all the significant area sources. Information that will be obtained by using option 24, but not option 30, are the contributions to the concentrations at each of the receptors from each of the significant sources. The maximum of 10 significant area sources results in an additional page of output per simulated hour. The maximum of 25 significant point sources results in three additional pages of output per simulated hour (one page for every 10 significant point sources or fraction thereof). Unless the concentration contributions are specifically needed for analysis of contributions from particular sources, option 30 should be zero to reduce the quantity of output.

Option 8 would be set to one to enter meteorological data as part of the run stream rather than reading an external file using unit 11. Options 9 and 10 are set to one to enter hourly emissions. If the contribution at a receptor from particular sources is of interest, and if these particular sources are not high enough to be included in the significant source list from RAM, options 11 and 12 may be used to specify the sources of interest. If option 11 or 12 is used to obtain concentration contributions for the averaging time, it is desirable to leave option 30 off to obtain hourly output.

Option 41 or 42 would not usually be employed unless concentrations at each receptor are required for further analysis or are to be used with graphics software to produce concentration isopleth maps.

SECTION 8

COMPUTER ASPECTS OF THE MODEL

STRUCTURE OF RAM

RAM consists of three sections: preprocessing subroutines, main logic, and output subroutines. Actual source code for the program is included in Appendix A.

Figure 7 is a system flowchart for the model. Inputs are assumed to be from disk files; outputs either go to disk or printer. Options and program control are read from FORTRAN unit 5; processing is then controlled through specifications in this file. If so specified in the control file, meteorology and emissions can be obtained from units 11, 15, and 16, respectively. The program uses two temporary files for intermediate work, but they are not temporary in the JCL sense, i.e., they are not deleted at the end of the job step and should be deleted by the user when they are no longer needed. As the program calculates concentrations, they are averaged and written to units 1, 10, 12, and 13 as noted in the option list. Tabular output is written to unit 6 which is usually the default for printed files.

Section I (page A-22) contains preprocessing subroutines to initialize variables. These subroutines are called to determine dispersion parameter values as functions of stability class and source-receptor distance. The data produced are coefficients and exponents for the various ranges of effective height of emission and are used to determine maximum $\chi u/Q$ (relative concentration normalized for wind speed) for point sources and distance to maximum concentration for point and area sources as functions of stability class and effective height of emission.

Section J-K (pages A-25 - A-31) process the emission data. Their principal task is to set up the area source map array. The area source map array provides correspondence between locations (referred to by coordinates) and area source

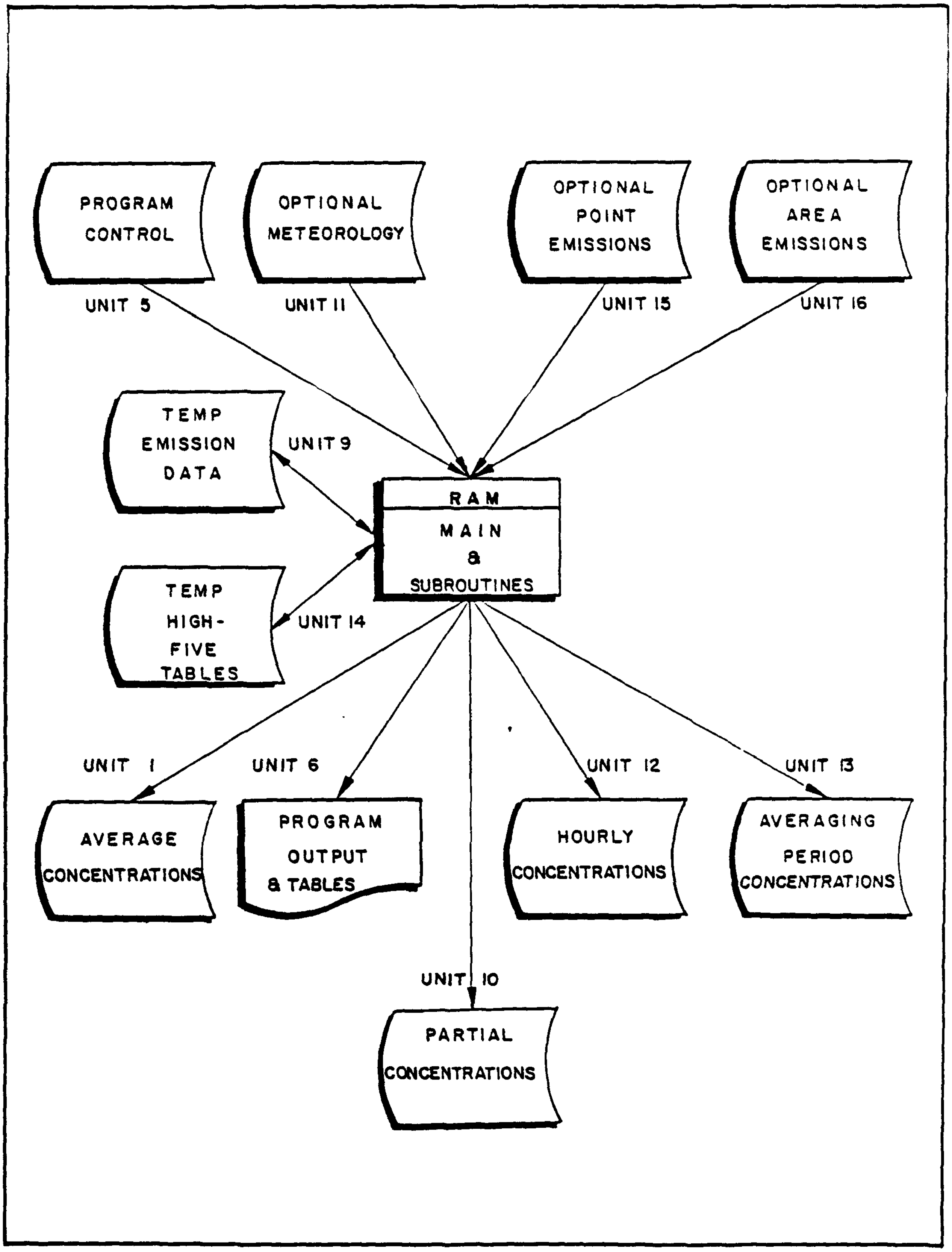

Figure 7. System flow for the model.

number. Other tasks, such as ranking sources according to set criteria, are also accomplished.

RAM expects hourly meteorological input data, including mixing height and stability class. This and other values can be entered in the input stream or from a preprocessed file. The auxiliary program RAMMET can process raw meteorological data into the needed format using hourly surface data and mixing heights from the National Climatic Data Center. Input consists of one year of surface data (one observation per hour) and one maximum and one minimum mixing height per day. RAMMET determines hourly stability and performs interpolations to estimate hourly mixing heights. The output data are organized to produce a single record for each day.

The output subroutines are OUTPT and OUTAV. OUTPT provides hourly concentrations in micrograms per cubic meter, including the contributions from significant point sources along with a summary table. OUTAV provides the same information for the averaging period.

PROGRAM MODULES

The main structure is given in Figure 8. After initialization, the flow is governed by three loops: calendar days, averaging time, and hours. A minimum of one hour and a maximum of 8,784 hours can be processed by the model. A brief description of the main program and subroutines follows.

MAIN - The main program determines $\chi u/Q$ maxima and distance to the point of maximum for point sources as functions of stability class and effective height of emissions. Coefficients and exponents relating these two parameters to effective height of emission are determined for various stability and effective height range combinations. These coefficients and exponents, as well as ones for determining the distance of the maximum concentration downwind from the edge of an area source, are calculated for use in the emissions module which processes emission inventory information for later use. An important aspect of this is the construction of the area source map array which allows a correspondence between any location in the area source region and the number of the area source at that location. All source coordinates in units convenient to the user (user units)

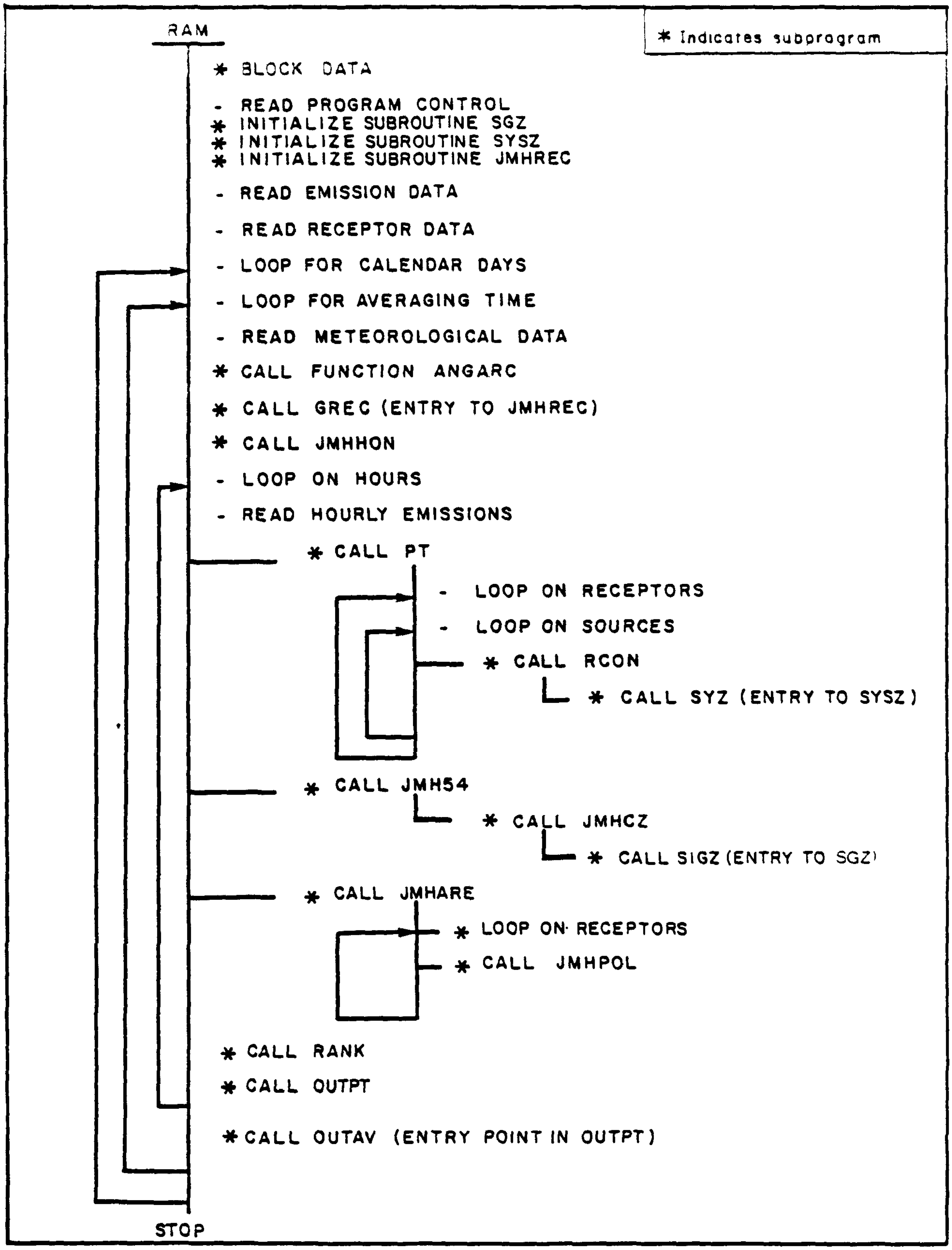

Figure 8. Structure of RAM.

are converted to internal units. An internal unit is a length such that any area source side length used in a given run can be expressed as an integer multiple of an internal unit. The internal unit is generally equal to the length of the side of the smallest area in the emission inventory. The user must determine the internal unit length and specify it in user units. Both point and area sources are ranked according to expected impact at ground level. The 25 point sources and the 10 area sources with the greatest expected ground-level impact are listed. Also, the total emissions from various physical heights for both point and area sources are listed. This helps the user in determining area source heights and the number to be used.

BRIEF DESCRIPTION OF SUBROUTINES

The subroutine and function descriptions that follow are called by RAM to perform specific tasks.

ANGARC - This function determines the appropriate arctan of the east resultant wind component over the north resultant wind component with the resulting angle between 0° and 360°.

JMHREC - This subroutine and entry point GREC called by RAM determine receptor locations downwind of significant sources based upon the resultant meteorological conditions for the averaging period, usually 3 or 24 hours. Plume rise and effective height of emission are calculated. The distance of the maximum concentration is determined as a function of the stability and the effective height of emission in order to locate the position of a receptor. Two receptors are generated for each significant point source, one at the expected distance of maximum concentration and one at twice this distance. One receptor is generated for each significant area source at the expected distance of maximum concentration.

JMHHON - This subroutine called by RAM generates additional receptors within a specified area in order to give adequate coverage of that area with the minimum number of receptors. Receptors are placed equidistant from nearby receptors, resulting in a honeycomb array. The distance between receptors is an input to the main program. Proposed honeycomb receptors located closer than half this distance to any other receptor are not included.

PT - This subroutine calculates concentrations from point sources. Subroutines RCON and SYZ (ENTRY point in SYSZ) are called to complete the computations.

RCON - This subroutine called by PT calculates X/Q, the relative concentrations from point sources. This subroutine calls SYZ.

SYZ - This subroutine called by RCON calculates the standard deviation of the concentration in the y- and z- directions. It employs the Briggs urban dispersion parameters for urban conditions, and the Pasquill-Gifford parameters for rural conditions.

JMH54 - This subroutine called by RAM generates tables of Xu/q_A (relative concentration normalized for wind speed) from area sources that extend from a receptor to various upwind distances. A table is produced for each area source height. One to three heights can be used. This subroutine calls subroutine JMHCZ.

JMHCZ - This subroutine called by JMH54 calculates concentrations from infinite crosswind line sources at a distance x upwind from a receptor. To obtain the vertical dispersion parameter value σ_z, subroutine SIGZ is called.

SIGZ - This subroutine called by JMHCZ determines the value of the vertical dispersion parameter σ_z for a given upwind distance of a receptor to the source. The parameter values for urban areas are those put into equation form by Briggs. The parameter values for rural areas are from Pasquill-Gifford.

JMHARE - This subroutine performs the integration along the line upwind from the receptor to obtain the effect of all area sources along the line. This is accomplished by finding the nearest and farthest distance of each source along the path and calling subroutine JMHPOL for each distance.

JMHPOL - This subroutine called by JMHARE interpolates for a given distance from the values in the tables generated by subroutine JMH54. This yields the effect of an area source at the given height extending upwind to this distance.

RANK - This subroutine arranges concentrations of various averaging times into tables of the highest five concentrations for each receptor for each averaging time (high-five tables).

OUTPT - This subroutine produces output concentrations in micrograms per cubic meter for each hour for significant sources and for the summaries.

OUTAV - This subroutine called by RAM gives concentrations for the averaging period. Contributions and/or summary information are also generated by OUTAV.

PROCESSOR PROGRAM RAMMET

If option 8 specifies that meteorological data should be expected from a file, a peripheral program RAMMET can be used to generate the file. RAMMET processes meteorological data for one year. The data input consists of hourly meteorological records in the standard card format 144 of the National Climatic Data Center and twice-a-day estimates of mixing height (minimum and maximum). Hourly stability class is determined using the objective method of Turner (1964) based on Pasquill's technique (Pasquill, 1961). Shifts by only one stability class are allowed for adjacent hours. Hourly mixing height is interpolated from the twice-a-day estimates. Hourly meteorological data of wind direction, wind speed, temperature, stability class, and mixing height are written into a file with one record per day for the entire year. Random numbers can be read from a file or generated by the computer used. RANDU is a library subroutine of UNIVAC 1110's MATH-PACK. (For use on other computers, this call must be replaced by a call to a suitable random number generator.) For regulatory applications, the file of random numbers included with RAMMET Test 1 in the UNAMAP (Version 6) U. S. EPA, 1986 should be used.

SECTION 9

INPUT DATA PREPARATION

In this section, the general input data requirements are listed. There are 18 record types in the input stream. Each record type consists of one or more records.

Table 2 describes the input data; in some cases an explanation follows the entry.

TABLE 2. RECORD INPUT SEQUENCE FOR RAM

Record type and variable	Column	Format	Variable description	Units
Record type 1				
LINE1	1-80	20A4	80-character title	---
Record type 2				
LINE2	1-80	20A4	80-character title	---
Record type 3				
LINE3	1-80	20A4	80-character title	---

RECORDS 1 - 3. Each card image has up to 80 alphanumeric characters. The input title appears on all output and can suit the user. Normal use has been to identify the user and run date on card-image 1, the location and date of the emissions data on card-image 2, and the location and dates of both surface and upper air meteorological data on card-image 3.

RAM-RECORD TYPE 4 - 14 variables

Record type and variable	Column	Format	Variable description	Units
Record type 4				
IDATE(1)	---	FF*	2-digit year	---

*FF is free format.

Record type and variable	Column	Format	Variable description	Units
IDATE(2)	---	FF	Starting Julian day	---
IHSTRT	---	FF	Starting hour	---
NPER	---	FF	Number of averaging periods	---
NAVG	---	FF	Number of hours in an averaging period (commonly 24)	---
IPOL	---	FF	Pollutant indicator: 3, sulfur dioxide 4, suspended particulate	---
MUOR	---	FF	Model indicator: 1, urban mode 2, rural mode	---
NSIGP	---	FF	Number of point sources from which concentration contributions are desired (maximum=25)	---
NSIGA	---	FF	Number of area sources from which concentration contributions are desired (maximum=10)	---
NAV5	---	FF	Additional averaging time for high-five table. Usually 2, 4, 6, or 12.	---
CONONE	---	FF	Multiplier to convert user units to kilometers.	---

Example multipliers are: 3.048×10^{-4} for feet to kilometers; 1.609347 for miles to kilometers; 1.0×10^{-3} for meters to kilometers.

UNITS	---	FF	Number of user units per smallest area source side length. Should equal 1 if no area sources. (Internal units)	---

Record type and variable	Column	Format	Variable description	Units
Z	---	FF	Receptor height	m
HAFL	---	FF	Pollutant half-life	sec

An entry of zero in HAFL will cause RAM to skip pollutant loss calculations.

RAM-RECORD TYPE 5 - The values are for 50 different options; 1 is used to employ the option and a zero indicates non-use.

Record type 5				
IOPT(1)	1	I1	No stack downwash	---
IOPT(2)	2	I1	No gradual plume rise	---
IOPT(3)	3	I1	Use buoyancy induced dispersion	---
IOPT(4)	4	I1	Not used	---
IOPT(5)	5	I1	Input point sources	---
IOPT(6)	6	I1	Input area sources	---
IOPT(7)	7	I1	Use emissions from previous run. Data accessed from Unit 9.	---
IOPT(8)	8	I1	Meteorology data in input stream. Otherwise, input from Unit 11.	---
IOPT(9)	9	I1	Read hourly point source emissions (Unit 15)	---
IOPT(10)	10	I1	Read hourly area source emissions (Unit 16)	---
IOPT(11)	11	I1	Specify significant point sources	---

Option 11 will allow the examination of the individual contributions to each receptor from each of the specified sources. Both point and area sources may be specified. (See IOPT(12))

Record type and variable	Column	Format	Variable description	Units
IOPT(12)	12	I1	Specify significant area sources	---
IOPT(13)	13	I1	Not used	---
IOPT(14)	14	I1	Enter receptors by specifying coordinates	---
IOPT(15)	15	I1	RAM generates receptors downwind of significant point sources	---
IOPT(16)	16	I1	RAM generates receptors downwind of significant area sources	---
IOPT(17)	17	I1	RAM generates honeycomb array of receptors to cover specified area	---

RAM generates a honeycomb array of receptors, placed equidistant in staggered rows over a specified area. This insures good area coverage. Candidate receptor positions are checked against other receptors (either input or generated by other options of the program) and if the distance between the proposed receptor is less than one-half the normal distance between honeycomb receptors, then the candidate receptor is not added to the list. The boundaries of the area to be covered by these receptors are specified by the user.

IOPT(18)	18	I1	Input radial distances to generate polar coordinate receptor array. 36 receptors for each distance.	---
IOPT(19)	19	I1	Not used	---

Printed output is controlled by the options that follow. Options 20 through 36 are all options to omit output. In

Record type and variable	Column	Format	Variable description	Units
the program default, most of these options to omit output are used since some of the options can generate large amounts of printed output.				
IOPT(20)	20	I1	Omit point source list	---
IOPT(21)	21	I1	Omit area source list and map	---
IOPT(22)	22	I1	Omit emissions with height table	---
IOPT(23)	23	I1	Omit resultant meteorology data summary for averaging period	---
IOPT(24)	24	I1	Omit all hourly output (point, area, summaries)	---
IOPT(25)	25	I1	Omit hourly point contributions	---
IOPT(26)	26	I1	Omit meteorology data on hourly point contributions	---
IOPT(27)	27	I1	Omit plume height and distance to final rise on hourly point contribution	---
IOPT(28)	28	I1	Omit hourly area contributions	---
IOPT(29)	29	I1	Omit meteorology data on hourly area contributions	---
IOPT(30)	30	I1	Omit hourly summary	---
IOPT(31)	31	I1	Omit meteorological data on hourly summary	---
IOPT(32)	32	I1	Omit all averaging period output	---
IOPT(33)	33	I1	Omit point averaging period contributions	---

Record type and variable	Column	Format	Variable description	Units
IOPT(34)	34	I1	Omit area averaging period contributions	---
IOPT(35)	35	I1	Omit averaging period summary	---
IOPT(36)	36	I1	Omit average concentrations and highest five concentrations table	---
IOPT(37)	37	I1	Not used	---

The remaining options control the flow of the program and the amount of output. This is especially so for Option 40, in which a large file can be generated by employing this option.

Record type and variable	Column	Format	Variable description	Units
IOPT(38)	38	I1	Set default option for regulatory application	---

Option 38 sets a series of options and parameters when the model is to be used for regulatory application.

Record type and variable	Column	Format	Variable description	Units
IOPT(39)	39	I1	Part of segmented run	---
IOPT(40)	40	I1	Write partial concentrations to disk or tape (Unit 10)	---

The user will need to write the software to process this output. Although it is unlikely that Options 39 and 40 will be employed on the same run, it is possible to do so. However, the second and subsequent segments will not skip over previously generated partial concentration files. Therefore, unless Unit 10 accesses a different file on each segment, any previously generated partial concentration files will be overwritten.

Record type and variable	Column	Format	Variable description	Units
IOPT(41)	41	I1	Write hourly concentrations to disk or tape (Unit 12)	---

Record type and variable	Column	Format	Variable description	Units
IOPT(42)	42	I1	Write averaging-period concentration to disk or tape (Unit 13)	---

The output files generated by Options 41 and 42 are useful only when the receptors are set for the run and not varying from one averaging period to another. Therefore, these options can be used with Options 14 and 18, but a program termination will occur in trying to use Option 41 or 42 in combination with any of Options 15, 16, or 17.

Record type and variable	Column	Format	Variable description	Units
IOPT(43)	43	I1	Write averaging-period concentrations in card-image format (80 bytes) to Unit 1.	---
IOPT(44)	44	I1	Not used this version	---
IOPT(45)	45	I1	Not used this version	---
IOPT(46)	46	I1	Not used this version	---
IOPT(47)	47	I1	Not used this version	---
IOPT(48)	48	I1	Not used this version	---
IOPT(49)	49	I1	Not used this version	---
IOPT(50)	50	I1	Not used this version	---

RAM-RECORD TYPE 6 - 2 variables, 1 to 7 values. Selection of the default option (Option 38) causes wind exponents to be set to the default values for the appropriate urban or rural cases. This record is still required to input the anemometer height; all other data on the record will be ignored when Option 38 is set.

Record type and variable	Column	Format	Variable description	Units
Record type 6				
HANE	---	FF	Anemometer height	m
PL(I)	---	FF	Wind speed power law exponents	---

Record type and variable	Column	Format	Variable description	Units

RAM-RECORD TYPE 7 - 9 variables, 8 values (one of these records for each point source). This is used if Option 5 = 1 (the user inputs point sources) and Option 7 = 0 (no emissions are entered from a previous run).

Record type and variable	Column	Format	Variable description	Units
Record type 7				
PNAME(I,NPT)	1-12	3A4	12 character point source identification	---
SOURCE(1,NPT)	13-20	F8.2	East coordinate of point source (user units)	---
SOURCE(2,NPT)	21-28	F8.2	North coordinate of point source (user units)	---
SOURCE(3,NPT)	29-36	F8.2	Sulfur dioxide emission rate	g/sec

Emission rates for pollutants other than sulfur dioxide and particulates may be substituted. If substitutions are made, changes in data statements are necessary in order to have the proper pollutant names on the printed output.

Record type and variable	Column	Format	Variable description	Units
SOURCE(4,NPT)	37-44	F8.2	Particulate emission rate	g/sec
SOURCE(5,NPT)	45-52	F8.2	Physical stack height	m
SOURCE(6,NPT)	53-60	F8.2	Stack gas temperature	K
SOURCE(7,NPT)	61-68	F8.2	Stack inside diameter	m
SOURCE(8,NPT)	69-76	F8.2	Stack gas exit velocity	m/sec

To indicate the end of point source records, the word "ENDP" is placed in record columns 1 to 4.

RAM-RECORD TYPE 8 - 7 variables, 6 values (one of these records is required for each area source). This is used if Option 6 = 1 (the user inputs area sources) and Option 7 = 0 (no emissions input from previous run).

Record type and variable	Column	Format	Variable description	Units
Record type 8				
ANAME(J,NAS)	1-12	3A4	12 character area source identification	---
ASORC(1,NAS)	13-22	F10.2	East coordinate of SW corner of area source (user units)	---
ASORC(2,NAS)	23-32	F10.2	North coordinate of SW corner of area source (user units)	---
ASORC(5,NAS)	33-42	F10.2	Side length of area source (user units)	---

Note that ASORC(5,NAS) - side length, is read out of order to conform with the existing order of IPP emissions data.

ASORC(3,NAS)	43-52	F10.2	Sulfur dioxide emission rate for entire area	g/sec
ASORC(4,NAS)	53-62	F10.2	Particulate emission rate for entire area	g/sec

Particulate Emission Rate for entire area is a total rate for the entire area. It is later transformed into gm/sec^{-1}m^{-2}. As with point sources, emission rates for other pollutants may be substituted for sulfur dioxide and particulates, with appropriate name changes made in the data statements to modify titles on the printouts.

ASORC(6,NAS)	63-72	F10.2	Area source height	m

Although only one pollutant can be considered for a given run of RAM, both of the entered emission rates are listed in the output. One of the emission rates may be left off and will appear as zeros in the output.

Area sources can vary in size, but certain requirements must be met. There must be a definable internal unit such that the side length of all other area sources is an integer multiple of the side length of this internal unit. For example, if an emission inventory consists of area source squares having side lengths of 1, 2.5, 5, and 10 km, the internal unit must be chosen to equal 0.5 km. It is better to conduct emission inventories so that area source squares have side lengths that are multiples of the side lengths of the smallest area source squares. Also, if a grid is constructed of unit squares, squares having side length of one internal unit, the boundaries of all area sources must coincide with lines in that grid; there can be no overlap of one area source over another. Although these statements may seem restrictive, the area source entries to RAM are quite versatile. Concentrations from area sources are calculated by performing computations for each area source encountered in proceeding from a receptor in the upwind direction until the upwind boundary of the area source is encountered. If there are large areas (larger than the unit square) of zero emissions within the rectangle that includes all area sources (area source region), it is desirable to define these as area sources with zero emissions in squares as large as possible. This will result in considerable savings in computer processing time.

If the height of emission is the effective height of the area source at a wind speed of 5 m/sec, and if the physical height of the source is a set fraction of this value, which is the same for all area sources, it will be

Record type and variable	Column	Format	Variable description	Units

possible to consider the variation of effective height of area sources with wind speed in RAM. Otherwise, the fraction will be 1.0 and it will be assumed that the input height of emission is the effective height for all wind speeds.

RAM-RECORD TYPE 9 - 2 variables. This record is required only if Option 11 is used (i.e., the user will specify significant point sources).

Record type and variable	Column	Format	Variable description	Units
Record type 9				
INPT	1-3	I3	Number of user specified significant sources	---

The maximum number of user specified significant point sources is 25 - this number must be non-zero.

Record type and variable	Column	Format	Variable description	Units
MPS(I)	4-78	I3	INPT point source numbers the user wants considered significant (max = 25)	---

There will be as many sources in this list as indicated in INPT.

RAM-RECORD TYPE 10 - 4 variables - 4 values. Information for area sources. This record is required only if Option 6 is employed (user will input area sources).

Record type and variable	Column	Format	Variable description	Units
Record type 10				
FH	---	FF	Fraction of area source height which is physical height	---
XLIM	---	FF	Distance limit on integration for area source (user units)	---

The distance XLIM should be equal to or exceed the greatest possible distance from a receptor (including receptors generated by RAM) to the farthest corner of the

Record type and variable	Column	Format	Variable description	Units

area source region for this run, but cannot exceed 116 kilometers.

NHTS	---	FF	Integer number of heights to be used for area sources (min=1, max=3)	---
HINT	---	FF	Height(s) for area source integrations. Same number as NHTS.	m

RAM-RECORD TYPE 11 - 1 variable - 1 or 2 values. This record is required only if record type 10 is used.

Record type 11				
BPH	---	FF	Breakpoint heights between area source heights	m

These values are to be used as boundaries between the specified area source heights used for calculations. If only one area source height is to be used, only one BPH value is entered; it should be greater than any area source height of the area source data. If NHTS is 2, the single value for BPH should be between the two HINT values. If NHTS is 3 and the three HINT values are, for example, 15, 25, and 35; the two values for BPH might be 20 and 30.

RAM-RECORD TYPE 12 - 2 variables - 1 to 11 values. This record is required only if Option 12 is used (i.e., user specifies significant area sources).

Record type 12				
INAS	1-3	I3	Number of user specified significant area sources (max=10)	---
MAS	4-33	I3	INAS area source numbers the user wants to consider significant	---

Record type and variable	Column	Format	Variable description	Units

RAM-RECORD TYPE 13 - 4 variables. Used if Option 8 = 0 (meteorological data will be input on Unit 11).

Record type 13				
ISFCD	---	FF	Surface Met. Station Identifier	---

ISFCD is a 5-digit identification of the meteorological tape to be used. For tapes generated by the National Climatic Data Center, this will normally be the surface station number.

ISFCYR	---	FF	Year of surface meteorology data	---
IMXD	---	FF	Upper-air Station Identifier	---
IMXYR	---	FF	Year of mixing height data (2 digits)	---

RAM-RECORD TYPE 14 - 3 variables - 7 values. This record is used with Option 18 (input of polar coordinates) if the user chooses to input receptor positions according to a radial distance from a coordinate source.

Record type 14				
RADIL(I)	---	FF	One to five radial distances (user units)	---

RADIL(I) is one to five radial distances (with the remaining distances entered as zeros) centered on any location. Each radial distance generates 36 receptors at each radial distance at azimuths of 10 to 360 degrees.

CENTX	---	FF	East coordinate about which radials are centered (user units)	---

Record type and variable	Column	Format	Variable description	Units
CENTY	---	FF	North coordinate about which radials are centered (user units)	---

RAM-RECORD TYPE 15 - 3 variables. If Option 14 (user specifies receptor coordinates) is used there will be one record for each receptor that the user specifies.

Record type 15				
RNAME(I)	1-8	2A4	8 digit alphanumeric station identification	---
RREC	9-18	F10.3	East coordinate of receptor (user units)	---
SREC	19-28	F10.3	North coordinate of receptor (user units)	---

Both coordinates of receptors should be positive. Receptors may be either inside or outside the area source region. A record with "ENDR" in columns 1 - 4 signals that the receptor list has been completed.

RAM-RECORD TYPE 16 - 5 variables - 5 values. This record is needed only if Option 17 is used to generate additional receptors for area coverage.

Record type 16				
GRDSPU	---	FF	Grid spacing between honeycomb receptors (user units)	---
HRMIN	---	FF	Minimum east coordinate (user units)	---
HRMAX	---	FF	Maximum east coordinate (user units)	---
HSMIN	---	FF	Minimum north coordinate (user units)	---
HSMAX	---	FF	Maximum north coordinate (user units)	---

Record type and variable	Column	Format	Variable description	Units
If HRMIN, HRMAX, HSMIN, HSMAX are entered as zero, the boundaries considered for these receptors will be the same as those of the area source region. However, if no area sources are input and if honeycomb receptors are to be generated, this record must have boundaries included to provide the bounds for receptor generation.				
RAM-RECORD TYPE 17 - 2 variables. This record is needed only if Option 39 is used (i.e., this run is part of a segmented run).				
Record type 17				
IDAY	---	FF	Number of days previously processed	---
LDRUN	---	FF	Last day to be processed in this run	---
RAM-RECORD TYPE 18 - 8 variables - 8 values. Meteorology. Used if Option 8 = 0.				
Record type 18				
JYR	---	FF	Year of meteorology data (2 digits)	---
DAY1	---	FF	Julian day of meteorology data	---
JHR	---	FF	Hour of meteorology data	---
IKST	---	FF	Stability class for this hour	---
QU	---	FF	Wind speed for this hour	m/sec
QTEMP	---	FF	Ambient air temperature for this hour	K
QTHETA	---	FF	Wind direction for this hour (degrees azimuth from which winds blows)	deg
QHL	---	FF	Mixing height for this hour	m

Emissions Data

In the emissions file either point sources, area sources, or both may be included. When both types are included, the user still has the option to select one or both source types. Any rectangular coordinate system is allowed provided that the positive quadrant is used, that is, all coordinate values are positive and a single coordinate system is used for both point and area sources. The scale of the coordinate system is arbitrary. An option is also available in which the user can specify radial coordinates of receptors by specifying up to five radial distances.

To account for variability in emission rates with time in order to simulate emissions most accurately, it is possible to enter new emission rates for each of the sources for each simulated hour using Option 9 and/or Option 10. In order to employ this option, emissions for each source must have been determined and written on two tape or disk files (one for point sources and one for area sources) with one record for each hour that is to be simulated. The emission information from RAM is still required and must be a "normal" emission rate in order that the exit velocity of the source can be scaled up or down in proportion to the hourly emission rate. Also, all permanent information about sources such as coordinates, physical stack height, and diameter are furnished on record type 8.

Meteorological Data and RAMMET

As noted previously, meteorological data for RAM can be furnished in either of two ways: 1) records containing the meteorological data for each simulated hour (one record per hour), or 2) magnetic disk or tape output from program RAMMET.

Meteorological data output from RAMMET may be used as input to RAM. RAMMET requires one year of hourly surface observations and one year plus two days of daily maximum and minimum mixing height data. The hourly surface data normally on magnetic tape in card image format, CARD DECK 144, can be obtained from the National Climatic Center in Asheville, NC.

All required surface data for each hour must be included on the tape; therefore, all data flagged as missing by RAMMET must be accounted for, determined, and included in the data set before proceeding. The data used from the surface observation tape for each hour are: year, month, day, hour, cloud ceiling code, wind direction, wind speed, temperature, and opaque cloud cover.

The mixing height data is expected in card image format for RAMMET, one card per day containing the minimum and maximum mixing height for that day.

When using meteorological data from RAMMET, there are greater restrictions on certain input parameters than there are when meteorological data from cards are used. Using RAMMET data, one averaging time must be used, and it must be evenly divisible into 24. The start hour must be 1. Periods must be sequential in the time series. The starting day may be any day included in the file. The file will be positioned to the correct start day.

One averaging time must be used when using meteorological data with the run stream, but it can be any integer value from 1 to 24. The start hour can be any hour from 1 to 24. Day and hour values must be entered correctly and must be in sequence within each period. Data from period to period needs to be in sequence; for example, calculations for two 2-hour periods can be done first: day 181, hour 24, followed by day 182, hour 1.

SECTION 10

EXECUTION OF THE MODEL AND SAMPLE TEST

RAM produces an error-free compile on Univac EXEC 8, IBM MVS, and DEC VAX/VMS computers with comparable output results.

Job Control Language (JCL) for model execution on a Univac EXEC 8 system would have the following form:

```
@RUN,R/R JOB-ID, etc.
@ASG,A MODELS*LOAD
@XQT MODELS*LOAD.RAM
  (Input records)
@FIN
```

On an IBM system under MVS, the JCL would be as follows,

```
//JOBID    JOB  (PROJ,ACCT,OTHER),TIME=1
//RAM      EXEC PGM=RAM,TIME=(,20)
//STEBLIB  DD   DSN=USERID.MODELS.LOAD,DISP=SHR
//FT06F001 DD   SYSOUT=A
//FTD5F001 DD   *
  (Input records)
//
```

Sample Test

The example given here uses one year of meteorological data processed by RAMMET, and uses the default option for regulatory application in the urban mode. Because the default option is exercised, the following features apply:

- urban dispersion parameters are used,
- final plume rise is used,
- bouyancy-induced dispersion is accounted for,
- urban-profile exponents of .15, .15, .20, .25, .30 and .30 are used,
- stack-tip downwash is calculated,
- calms are processed according to regulatory guidance,
- options 7, 8, 11, 12, 15, 16 and 39 through 43 are set to zero, and
- output options 23 through 35 are set to 1.

The input stream is given on the following page. Four averaging periods are requested with a high-five concentration table for each. It should be noted that the default option overrides user input in most cases, for example, NAV5 is given as 6 in the run stream, but since the default option does not allow a fifth averaging time, the request is overridden.

Hardcopy output produced by RAM follows the run stream. Notations are made where appropriate to illustrate the application.

```
@RUN,D/R 12EDK/80,[ACCT. NUMBER]/BDU,EDB/XIMRT,45
SYM,U PRINTS,,FDO4PR
@ASG,A CINDAY2.
@USE 11,CINDAY2.
@ASG,A EOB*UNAMAP.
@XQT EOB*UNAMAP.RAMABS
SAMPLE TEST USING 1964 CINCINNATI-DAYTON DATA.  D. BRUCE TURNER
EMISSIONS: TEST CITY, 1973
SFC MET DATA: TEST CITY 1973;          UPPER AIR: TEST CITY 1973
64,001,01,366,24,3,1,5,10,6,1.609344,2.,0.,14400.
1004111100113111009000000000000000017111111114567890
10.,0.,0.,0.,0.,0.,0.
PLANT 1      579.50   4406.75 232.365 13.335   82.9     513.1    3.5      13.7
PLANT 2      575.25   4405.25 150.465 57.005   76.2     464.3    3.2      12.5
PLANT 3      571.25   4407.00  19.005  3.255   25.9     477.6    1.0      15.8
PLANT 4      571.75   4402.25  81.060 28.350   40.8     499.8    2.8      17.6
PLANT 5      579.50   4403.25  26.145  5.145   18.3     533.2    0.6      14.7
PLANT 6      567.14   4400.89   2.56   0.      26.5     505.     1.04     3.81
PLANT 7      564.70   4407.50  36.43   0.      48.8     464.     3.05     18.6
PLANT 8      577.45   4401.35  33.64   0.      26.5     428.     1.68     5.02
PLANT 9      576.75   4400.70  38.8    0.       6.      654.      .79     24.89
PLANT 10     580.10   4412.00 299.5    0.      93.      405.     4.88     12.59
PLANT 11     583.0    4400.90  16.74   0.      18.1     506.     1.37     4.23
PLANT 12     574.0    4398.00 226.2    0.      93.6     483.     4.88     12.59
ENDP
AONE         570.      4400.      4.         1.25      0.0        10.
ATWO         574.      4400.      2.         3.05      0.0        10.
ATHREE       576.      4400.      2.         6.25      0.0        12.
AFOUR        578.      4400.      2.         8.85      0.0        15.
AFIVE        578.      4402.      2.         3.15      0.0        10.
ASIX         574.      4402.      4.         0.00      0.0        0.
ASEVEN       570.      4404.      4.         4.25      0.0        15.
AEIGHT       574.      4406.      2.         2.60      0.0        10.
ANINE        578.      4406.      2.         3.10      0.0        12.
ATEN         580.      4406.      2.         2.76      0.0        20.
AELEVEN      582.      4406.      2.          .83      0.0        20.
ATWELVE      580.      4404.      2.         1.66      0.0        20.
ATHIRTEEN    582.      4404.      2.         1.90      0.0        20.
AFOURTEEN    580.      4402.      2.          .51      0.0        20.
AFIFTEEN     582.      4402.      2.         1.48      0.0        20.
ENDA
.75, 25., 3, 11.,15.,20.
13., 17.
93814,64,93815,64
RECEP 1    566.00   4405.0
RECEP 2    564.00   4401.5
3          572.     4400.866
4          574.     4400.866
5          576.     4400.866
6          578.     4400.866
7          580.     4400.866
8          571.     4402.598
9          573.     4402.598
10         575.     4402.598
11         577.     4402.598
12         579.     4402.598
13         572.     4404.330
14         574.     4404.330
15         576.     4404.330
16         578.     4404.330
17         580.     4404.330
18         571.     4406.062
19         573.     4406.062
20         575.     4406.062
21         577.     4406.062
22         579.     4406.062
23         572.     4407.794
24         574.     4407.794
25         576.     4407.794
26         578.     4407.794
27         580.     4407.794
ENDR
@FIN
@@
@@
@@
```

```
                                    OUTPUT FROM URBAN RAM (VERSION 85364)
                                    AN AIR QUALITY DISPERSION MODEL IN
                                    SECTION 1. GUIDELINE MODELS
                                    IN UNAMAP (VERSION 6) DEC 86
                                    SOURCE: UNAMAP FILE ON EPA'S UNIVAC 1110, RTP. NC.

SAMPLE TEST USING 1964 CINCINNATI-DAYTON DATA.  D. BRUCE TURNER
EMISSIONS: TEST CITY, 1973
SFC MET DATA: TEST CITY 1973;          UPPER AIR: TEST CITY 1973

                              GENERAL INPUT INFORMATION

 THIS IS THE URBAN VERSION(81352) OF RAM FOR THE POLLUTANT SO2  FOR 366  24-HOUR PERIODS.
 CONCENTRATION ESTIMATES BEGIN ON HOUR- 1, JULIAN DAY-  1, YEAR-1964.
 UNITS - THERE ARE      2.0000000 USER UNITS(INPUT UNITS) PER SMALLEST AREA SOURCE SQUARE SIDE LENGTH(INTERNAL UNIT)
 CONONE - THERE ARE     1.6093440 KILOMETERS PER USER UNIT
 CONTWO - IT IS CALCULATED THAT THERE ARE     3.2186880 KILOMETERS PER SMALLEST AREA SOURCE SQUARE SIDE LENGTH(INTERNAL UNIT)
 RECEPTOR HEIGHT IS       .0000000 METERS

 A HALF-LIFE OF  14400.00 (SECONDS) HAS BEEN ASSUMED  BY THE USER.
 HIGH-FIVE SUMMARY CONCENTRATION TABLES WILL BE OUTPUT FOR   4 AVERAGING PERIODS.
 AVG TIMES OF 1,3,8, AND 24 HOURS ARE AUTOMATICALLY DISPLAYED.

 OPTION       OPTION LIST                   OPTION SPECIFICATION : 0= IGNORE OPTION
                                                                   1= USE OPTION
                       TECHNICAL OPTIONS
     1        NO STACK DOWNWASH                                      0
     2        NO GRADUAL PLUME RISE.                                 1
     3        USE BOUYANCY INDUCED DISPERSION                        1
     4        NOT USED THIS VERSION                                  4

                       INPUT OPTIONS
     5        WILL YOU INPUT POINT SOURCES?                          1
     6        WILL YOU INPUT AREA SOURCES?                           1
     7        WILL YOU USE EMISSIONS FROM PREVIOUS RUN? (UNIT 9)     0
     8        MET.DATA ON CARDS? (FROM UNIT 11 OTHERWISE)            0
     9        READ HOURLY PT. SOURCE' EMISSIONS (UNIT 15).           0
    10        READ HOURLY AREA SOURCE EMISSIONS (UNIT 16).           0
    11        SPECIFY   SIGNIF PT. SOURCES.                          0
    12        SPECIFY SIGNIF. AREA SOURCES.                          0
    13        NOT USED THIS VERSION                                  3

                       RECEPTOR OPTIONS
    14        WILL YOU ENTER RECEPTORS BY SPECIFYING COORDINATES?    1
    15        DO YOU WANT RAM TO GENERATE RECEPTORS DOWNWIND
               OF SIGNIF. PT. SOURCES? (WILL DO SO BY AVG-PERIOD)    0
    16        DO YOU WANT RAM TO GENERATE RECEPTORS DOWNWIND
              OF SIGNIF. AREA SOURCES?(WILL DO SO BY AVG-PERIOD)     0
    17        DO YOU WANT RAM TO GENERATE A HONEYCOMB ARRAY OF
              RECEPTORS TO COVER A SPECIFIC AREA?                    0
    18        WILL YOU INPUT RADIAL DISTANCES(UP TO 5) TO GENERATE
              A POLAR COORDINATE RECEPTOR ARRAY
              (36 RECEPTORS FOR EACH DISTANCE)                       0
    19        NOT USED THIS  VERSION                                 9

                       PRINTED OUTPUT OPTIONS
    20        DELETE POINT SOURCE LIST                               0
```

```
21      DELETE AREA SOURCE LIST AND MAP                              0
22      DELETE EMISSIONS WITH HEIGHT TABLE                           0
23      DELETE RESULANT MET. DATA SUMMARY FOR AVERAGING PERIOD1
24      DELETE ALL HOURLY OUTPUT (PT.,AREA,& SUMMARIES)              1
25      DELETE HOURLY POINT CONTRIBUTIONS                            1
26      DELETE MET. DATA ON HR. PT. CONTRIB.                         1
27      DELETE PLUME HT. AND DIST. TO FINAL RISE ON
          HR. PT. CONTRIB.                                           1
28      DELETE HOURLY AREA CONTRIBUTIONS                             1
29      DELETE MET. DATA ON HR. AREA CONTRIB.                        1
30      DELETE HOURLY SUMMARY.                                       1
31      DELETE MET. 'DATA ON HOURLY SUMMARY.                         1
32      DELETE ALL AVG-PERIOD OUTPUT.                                1
33      DELETE POINT AVG-PERIOD CONTRIBUTIONS.                       1
34      DELETE AREA AVG-PERIOD CONTRIBUTIONS.                        1
35      DELETE AVG-PERIOD SUMMARY.                                   1
36      DELETE AVERAGE CONCENTRATIONS & HI-FIVE TABLE.               0
37      NOT USED THIS VERSION.                                       7
                 DEFAULT OPTION.
38      SET DEFAULT OPTION.                                          1

                 OTHER CONTROL AND OUTPUT OPTIONS:
39      RUN IS PART OF A SEGMENTED RUN.                              0
40      WRITE PARTIAL CONC.TO DISK OR TAPE (UNIT 10).                0
41      WRITE HOURLY CONC.TO DISK OR TAPE (UNIT 12).                 0
42      WRITE AVG-PERIOD CONC.TO DISK OR TAPE (UNIT 13).             0
43      PUNCH AVERAGING-PERIOD CONC. ON CARDS (UNIT 1).              0
44      NOT USED THIS VERSION.                                       4
45      NOT USED THIS VERSION.                                       5
46      NOT USED THIS VERSION.                                       6
47      NOT USED THIS VERSION.                                       7
48      NOT USED THIS VERSION.                                       8
49      NOT USED THIS VERSION.                                       9
50      NOT USED THIS VERSION.                                       0
```

POINT SOURCE INFORMATION

SOURCE	EAST COORD (USER UNITS)	NORTH COORD (USER UNITS)	SO2(G/SEC) EMISSIONS	PART(G/SEC) EMISSIONS	STACK HT(M)	STACK TEMP(K)	STACK DIAM(M)	STACK VEL(M/SEC)	POTEN. IMPACT (MICRO G/M**3)	EFF HT(M)	BUOY FLUX F M**4/S**3
1 PLANT 1	579.500	4406.750	232.365	13.335	82.90	513.10	3.50	13.70	155.805	370.460	176.487
2 PLANT 2	575.250	4405.250	150.465	57.005	76.20	464.30	3.20	12.50	144.901	299.488	115.773
3 PLANT 3	571.250	4407.000	19.005	3.255	25.90	477.60	1.00	15.80	199.064	80.256	14.971
4 PLANT 4	571.750	4402.250	81.060	28.350	40.80	499.80	2.80	17.60	82.104	291.015	139.965
5 PLANT 5	579.500	4403.250	26.145	5.145	18.30	533.20	.60	14.70	818.139	45.144	5.844
6 PLANT 6	567.140	4400.890	2.560	.000	26.50	505.00	1.04	3.81	72.298	47.606	4.241
7 PLANT 7	564.700	4407.500	36.430	.000	48.80	464.00	3.05	18.60	31.988	316.174	156.325
8 PLANT 8	577.450	4401.350	33.640	.000	26.50	428.00	1.68	5.02	461.534	69.507	10.956
9 PLANT 9	576.750	4400.700	38.800	.000	6.00	654.00	.79	24.89	448.911	76.111	21.021
10 PLANT 10	580.100	4412.000	299.500	.000	93.00	405.00	4.88	12.59	171.832	405.998	203.266
11 PLANT 11	583.000	4400.900	16.740	.000	18.10	506.00	1.37	4.23	389.308	52.685	8.193
12 PLANT 12	574.000	4398.000	226.200	.000	93.60	483.00	4.88	12.59	97.496	480.294	289.141

SIGNIFICANT SO2 POINT SOURCES

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     RANK          CHI-MAX     SOURCE NO.
               (MICROGRAMS/M**3)
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1	818.14	5
2	461.53	8
3	448.91	9
4	389.31	11
5	199.06	3
6	171.83	10
7	155.81	1
8	144.90	2
9	97.50	12
10	82.10	4
11	72.30	6
12	31.99	7

AREA SOURCE INFORMATION

SOURCE	EAST COORD (USER UNITS)	NORTH COORD (USER UNITS)	SO2 EMISSIONS (GRAMS/M**2/SEC)	PART EMISSIONS (GRAMS/M**2/SEC)	SIDE LENGTH (USER UNITS)	EFFECTIVE HEIGHT (METERS)	SIGNIFICANCE (G/M/SEC)
1 AONE	570.000	4400.000	3.0164-008	.0000	4.000	10.000	1.9418-004
2 ATWO	574.000	4400.000	2.9440-007	.0000	2.000	10.000	9.4759-004
3 ATHREE	576.000	4400.000	6.0328-007	.0000	2.000	12.000	1.9418-003
4 AFOUR	578.000	4400.000	8.5425-007	.0000	2.000	15.000	2.7496-003
5 AFIVE	578.000	4402.000	3.0406-007	.0000	2.000	10.000	9.7866-004
6 ASIX	574.000	4402.000	.0000	.0000	4.000	.000	.0000
7 ASEVEN	570.000	4404.000	1.0256-007	.0000	4.000	15.000	6.6021-004
8 AEIGHT	574.000	4406.000	2.5097-007	.0000	2.000	10.000	8.0778-004
9 ANINE	578.000	4406.000	2.9923-007	.0000	2.000	12.000	9.6313-004
10 ATEN	580.000	4406.000	2.6641-007	.0000	2.000	20.000	8.5749-004
11 AELEVEN	582.000	4406.000	8.0116-008	.0000	2.000	20.000	2.5787-004
12 ATWELVE	580.000	4404.000	1.6023-007	.0000	2.000	20.000	5.1574-004
13 ATHIRTEEN	582.000	4404.000	1.8340-007	.0000	2.000	20.000	5.9030-004
14 AFOURTEEN	580.000	4402.000	4.9228-008	.0000	2.000	20.000	1.5845-004
15 AFIFTEEN	582.000	4402.000	1.4286-007	.0000	2.000	20.000	4.5981-004

AREA SOURCE MAP ARRAY (IA)

4	7	7	8	0	9	10	11
3	7	7	6	6	0	12	13
2	1	1	6	6	5	14	15
1	1	1	2	3	4	0	0
	1	2	3	4	5	6	7

THE ORIGIN IN INTERNAL UNITS IS (284.00, 2199.00)
THE SIZE OF THE AREA SOURCE ARRAY IS (7, 4)
RMIN= 285.00 RMAX= 292.00 SMIN= 2200.00 SMAX= 2204.00 (IN INTERNAL UNITS)

TOTAL SO2 EMISSION AND CUMULATIVE FRACTION ACCORDING TO HEIGHT

HEIGHT(M)	TOTAL POINT EMISSIONS(G/S)	CUMULATIVE FRACTION	TOTAL AREA FMISSIONS(G/S)	CUMULATIVE FRACTION
0 - 5	.00	.000	.00	.000
6 - 10	38.80	.033	10.05	.241
11 - 15	.00	.033	22.45	.780

16 - 20	42.88	.070	9.14	1.000
21 - 25	.00	.070	.00	1.000
26 - 30	55.20	.118	.00	1.000
31 - 35	.00	.118	.00	1.000
36 - 40	.00	.118	.00	1.000
41 - 45	81.06	.187	.00	1.000
46 - 50	36.43	.219	.00	1.000
51 - 55	.00	.219	.00	1.000
56 - 60	.00	.219	.00	1.000
61 - 65	.00	.219	.00	1.000
66 - 70	.00	.219	.00	1.000
71 - 75	.00	.219	.00	1.000
76 - 80	150.47	.348	.00	1.000
81 - 85	232.36	.548	.00	1.000
86 - 90	.00	.548	.00	1.000
91 - 95	525.70	1.000	.00	1.000
96 -100	.00	1.000	.00	1.000
TOTAL	.00		.00	

ADDITIONAL INFORMATION ON SOURCES.
POINT SOURCE INFORMATION

EMISSION INFORMATION FOR 12 (NPT) POINT SOURCES HAS BEEN INPUT
0 SIGNIFICANT POINT SOURCES (NSIGP) ARE TO BE USED FOR THIS RUN

AREA SOURCE INFORMATION

EMISSION INFORMATION FOR 15 (NAS) AREA SOURCES HAVE BEEN DETERMINED BY RAM
0 SIGNIFICANT AREA SOURCES (NSIGA) ARE TO BE USED FOR THIS RUN
NUMBER OF AREA HEIGHT CLASSES (NHTS)= 3
REPRESENTATIVE AREA SOURCE HEIGHTS FOR EACH HEIGHT CLASS (HINT) IN METERS = 11.00 15.00 20.00
BREAK POINT HEIGHT BETWEEN THE AREA HEIGHT CLASSES (BPH) IN METERS = 13.00 17.00
FRACTION OF AREA SOURCE HEIGHT WHICH IS PHYSICAL HEIGHT (FH) = .750
LIMIT OF DISTANCE FOR AREA SOURCE INTEGRATION TABLES (XLIM) IN USER UNITS = 25.000
BOUNDARIES OF THE AREA SOURCE GRID IN USER UNITS:
RMIN= 570.000 RMAX= 584.000 SMIN= 4400.000 SMAX= 4408.000
SIZE(IRSIZE X ISSIZE) OF AREA SOURCE MAP ARRAY(IA) IN INTERNAL UNITS = 7 EAST-WEST 'BY 4 NORTH-SOUTH

SURFACE MET DATA FROM STATION(ISFCD) 93814, YEAR(ISFCYR) 1964
MIXING HEIGHT DATA FROM STATION(IMXD) 93815, YEAR(IMXYR) 1964

RECEPTOR INFORMATION

RECEPTOR	IDENTIFICATION	EAST COORD (USER UNITS)	NORTH COORD
1 I	RECEP 1	566.000	4405.000
2 I	RECEP 2	564.000	4401.500
3 I	3	572.000	4400.866
4 I	4	574.000	4400.866
5 I	5	576.000	4400.866
6 I	6	578.000	4400.866
7 I	7	580.000	4400.866
8 I	8	571.000	4402.598
9 I	9	573.000	4402.598

10 I	10	575.000	4402.598
11 I	11	577.000	4402.598
12 I	12	579.000	4402.598
13 I	13	572.000	4404.330
14 I	14	574.000	4404.330
15 I	15	576.000	4404.330
16 I	16	578.000	4404.330
17 I	17	580.000	4404.330
18 I	18	571.000	4406.062
19 I	19	573.000	4406.062
20 I	20	575.000	4406.062
21 I	21	577.000	4406.062
22 I	22	579.000	4406.062
23 I	23	572.000	4407.794
24 I	24	574.000	4407.794
25 I	25	576.000	4407.794
26 I	26	578.000	4407.794
27 I	27	580.000	4407.794

SAMPLE TEST USING 1964 CINCINNATI-DAYTON DATA. D. BRUCE TURNER
EMISSIONS: TEST CITY, 1973
SFC MET DATA: TEST CITY 1973;   UPPER AIR: TEST CITY 1973

CALMS FOR PERIOD: 714

RECEPTORS

RECEPTOR			IDENTIFICATION	EAST COORD (USER UNITS)	NORTH COORD (USER UNITS)	DAY	AVG CONC FOR PERIOD 1.HR 1. TO DAY366.HR24. (MICROGRAMS/M**3)
1	I	0	RECEP 1	566.00	4405.00		2.79
2	I	0	RECEP 2	564.00	4401.50		2.23
3	I	0	3	572.00	4400.87		6.99
4	I	0	4	574.00	4400.87		9.86
5	I	0	5	576.00	4400.87		19.52
6	I	0	6	578.00	4400.87		17.77
7	I	0	7	580.00	4400.87		8.21
8	I	0	8	571.00	4402.60		7.90
9	I	0	9	573.00	4402.60		9.06
10	I	0	10	575.00	4402.60		10.55
11	I	0	11	577.00	4402.60		16.46
12	I	0	12	579.00	4402.60		15.38
13	I	0	13	572.00	4404.33		9.14
14	I	0	14	574.00	4404.33		10.01
15	I	0	15	576.00	4404.33		11.99
16	I	0	16	578.00	4404.33		13.37
17	I	0	17	580.00	4404.33		16.48
18	I	0	18	571.00	4406.06		7.46
19	I	0	19	573.00	4406.06		9.57
20	I	0	20	575.00	4406.06		11.77
21	I	0	21	577.00	4406.06		11.76
22	I	0	22	579.00	4406.06		13.87
23	I	0	23	572.00	4407.79		8.34
24	I	0	24	574.00	4407.79		9.09
25	I	0	25	576.00	4407.79		12.57
26	I	0	26	578.00	4407.79		11.29
27	I	0	27	580.00	4407.79		* 21.17

FIVE HIGHEST 1-HOUR SO2 CONCENTRATIONS((ENDING ON JULIAN DAY, HOUR)
(MICROGRAMS/M**3)

RECEPTOR		1		2		3		4		5	
1(566.00,4405.00)		100.14	(179, 4)	98.80	(247,22)	96.11	(186,24)	95.71	(254,20)	94.95	(163,24)
2(564.00,4401.50)		122.26	(138,21)	122.20	(187, 4)	119.62	(164, 4)	101.19	(306, 3)	101.18	(306, 6)
3(572.00,4400.87)		235.41	(35, 1)	204.90	(237, 6)	195.26	(300, 6)	192.58	(34,19)	190.33	(354, 1)
4(574.00,4400.87)		256.45	(78,20)	251.78	(214, 4)	247.02	(169, 2)	234.39	(257,20)	232.83	(192,22)
5(576.00,4400.87)	*	850.35	(46, 2) *	842.20	(177,24)	814.30	(296,23)	814.27	(223,21)	810.23	(253,22)
6(578.00,4400.87)		544.43	(14, 1)	540.13	(191, 4)	468.30	(14, 2)	466.61	(10,19)	446.52	(335,21)
7(580.00,4400.87)		265.72	(291, 3)	249.00	(75, 6)	215.84	(297, 2)	207.32	(200,20)	192.70	(218, 6)
8(571.00,4402.60)		185.21	(163,24)	184.93	(186,24)	182.44	(247,22)	182.35	(179, 4)	176.37	(254,20)
9(573.00,4402.60)		278.76	(300, 6)	252.90	(35, 1)	225.15	(293, 4)	203.96	(159,22)	203.96	(244, 1)
10(575.00,4402.60)		217.13	(341,23)	207.08	(45,20)	204.31	(147, 1)	203.74	(181, 3)	203.74	(246,22)
11(577.00,4402.60)		340.83	(209, 6)	340.80	(242, 1)	327.57	(183,24)	311.81	(246,23)	311.36	(260,24)
12(579.00,4402.60)		559.53	(35, 1)	559.12	(300, 6)	449.94	(269, 6)	396.90	(34,19)	390.39	(271,21)
13(572.00,4404.33)		339.07	(164, 4)	302.47	(206,24)	290.65	(138,21)	290.18	(187, 4)	275.05	(319, 5)
14(574.00,4404.33)		237.85	(206, 5)	196.64	(153,23)	192.26	(177, 1)	189.29	(34,20)	184.77	(58,24)
15(576.00,4404.33)		254.94	(206, 5)	224.64	(58,24)	199.26	(245, 3)	197.08	(153,23)	179.39	(185, 4)
16(578.00,4404.33)		299.77	(46, 3)	262.03	(209, 1)	254.26	(269, 6)	241.97	(11, 4)	234.18	(329, 4)
17(580.00,4404.33)		404.52	(187,24)	393.52	(259,22)	390.45	(230,24)	384.75	(299, 3)	291.99	(287,23)
18(571.00,4406.06)		223.36	(290, 4)	196.18	(223,21)	193.14	(290, 3)	190.85	(218, 4)	190.32	(263,24)
19(573.00,4406.06)		259.07	(47,22)	238.70	(208,22)	213.72	(191,22)	207.32	(111,23)	194.16	(153,24)
20(575.00,4406.06)		267.97	(345,12)	246.23	(231,24)	232.25	(157, 4)	220.59	(206, 4)	213.11	(24, 6)
21(577.00,4406.06)		310.08	(206,24)	295.92	(178, 3)	295.74	(178, 6)	249.53	(164, 4)	248.20	(188, 2)
22(579.00,4406.06)		229.33	(297, 1)	199.47	(330,12)	193.14	(219, 6)	183.37	(293, 4)	178.98	(296,21)
23(572.00,4407.79)		213.94	(187, 3)	209.33	(106, 6)	200.93	(300, 3)	178.27	(269, 7)	175.43	(209, 1)
24(574.00,4407.79)		293.46	(200,23)	257.91	(307,22)	246.55	(30,19)	233.21	(207,24)	222.89	(223,21)
25(576.00,4407.79)		280.75	(264, 1)	275.70	(184, 3)	263.19	(257,21)	261.57	(154, 3)	260.40	(220, 3)
26(578.00,4407.79)		292.61	(209, 1)	291.10	(11, 4)	272.88	(286, 1)	271.80	(208, 4)	251.34	(232,23)
27(580.00,4407.79)		264.71	(230,24)	264.29	(187,24)	253.06	(259,22)	251.38	(292, 8)	250.58	(299, 3)

FIVE HIGHEST 3-HOUR SO2 CONCENTRATIONS((ENDING ON JULIAN DAY, HOUR)
(MICROGRAMS/M**3)
C-FLAG IDENTIFIES CONCENTRATIONS AFFECTED BY CALM HOURS

RECEPTOR		1		2		3		4		5	
1(566.00,4405.00)		54.32	(163,24)	46.00	(213,24)	45.95	(169, 3)	43.95	(284,24)	41.05	(153,24)
2(564.00,4401.50)		77.26	(164, 6)	53.77	(153,24)	53.45	(58,24)	52.29	(250, 6)	51.58	(306, 3)
3(572.00,4400.87)		98.15	(34,21)	94.18	(122, 3)	91.43	(312,24)	91.17	(354, 3)	83.88	(29, 6)
4(574.00,4400.87)		170.56	(78,21)	135.10	(169, 3)	124.05	(214, 6)	109.73	(214, 3)	108.61	(257,21)
5(576.00,4400.87)	*	426.77	(344,21) *	374.25	(243, 6)	358.46	(46, 3)	351.71	(345, 6)	349.64	(214, 6)
6(578.00,4400.87)		365.75	(14, 3)	277.54	(310,21)	251.49	(104,24)	203.15	(279,21)	201.63	(89, 3)
7(580.00,4400.87)		110.90	(141, 3)	106.48	(297, 3)	103.40	(293, 3)	97.34	(14, 3)	93.86	(75, 6)
8(571.00,4402.60)		134.37	(164, 3)	120.49	(242,24)	113.82	(18,21)	109.05	(163,24)	105.05	(181,24)
9(573.00,4402.60)		112.85	(293, 6)	95.23	(58,24)	93.24C	(309, 3)	92.92C	(300, 6)	84.30C	(35, 3)
10(575.00,4402.60)		103.49	(241, 3)	99.59	(14, 3)	98.64	(233, 3)	96.94	(354, 3)	94.58	(265, 3)
11(577.00,4402.60)		199.01	(197, 6)	189.42C	(298,21)	185.59	(347,21)	179.91	(54, 3)	158.84	(60, 3)
12(579.00,4402.60)		196.33	(34,24)	191.41	(304, 3)	186.51C	(35, 3)	186.37C	(300, 6)	181.52	(91,24)
13(572.00,4404.33)		171.85	(164, 6)	150.39	(188, 3)	120.24	(246, 6)	117.94	(178, 6)	115.65C	(298,21)
14(574.00,4404.33)		109.79	(116, 6)	105.77	(11, 6)	99.47	(58,24)	88.13	(304,24)	87.86	(354, 3)
15(576.00,4404.33)		114.46	(58,24)	92.49	(50, 6)	85.85C	(206, 6)	85.33	(160, 6)	82.31C	(205, 3)
16(578.00,4404.33)		125.20	(312, 6)	121.83	(198, 6)	114.47	(290, 3)	111.90	(65,24)	110.47	(34,24)
17(580.00,4404.33)		232.18	(299, 3)	203.16	(156, 6)	197.77	(155,24)	197.73	(65,24)	189.85C	(280,24)
18(571.00,4406.06)		117.63	(288, 6)	105.99	(58,24)	104.25	(312,24)	101.56	(303,24)	93.05	(290, 6)
19(573.00,4406.06)		142.52	(164, 3)	122.23	(153,24)	111.84	(47,24)	101.37	(228,24)	99.96	(242,24)
20(575.00,4406.06)		127.74	(19,15)	120.34	(307, 9)	120.28	(104, 3)	117.76	(159,24)	116.62	(332,24)
21(577.00,4406.06)		153.83	(188, 3)	129.89	(178, 6)	126.35	(164, 6)	112.68C	(260,21)	104.13C	(206,24)
22(579.00,4406.06)		137.20	(153, 6)	135.62	(148,24)	131.38	(13, 3)	131.04	(94,21)	129.55	(330,12)
23(572.00,4407.79)		103.87C	(106, 6)	102.79C	(201,24)	89.19	(344,21)	72.58	(11, 6)	71.31C	(187, 3)
24(574.00,4407.79)		153.00	(30,21)	114.49	(48, 6)	112.42C	(200,24)	112.36	(49, 6)	109.66	(174,24)
25(576.00,4407.79)		154.54	(241, 3)	145.82	(160, 6)	143.79	(197,24)	140.79	(198, 6)	139.18	(137, 3)
26(578.00,4407.79)		144.29	(227,24)	131.11C	(29, 3)	121.42	(48, 3)	102.33C	(209, 3)	99.20	(289,21)
27(580.00,4407.79)		194.91	(299, 3)	191.71	(156, 6)	187.85	(338, 3)	171.47	(196,24)	169.05	(105, 6)

FIVE HIGHEST 8-HOUR SO2 CONCENTRATIONS((ENDING ON JULIAN DAY, HOUR)
(MICROGRAMS/M**3)
C-FLAG IDENTIFIES CONCENTRATIONS AFFECTED BY CALM HOURS

RECEPTOR	1	2	3	4	5
1(566.00,4405.00)	35.84 (11, 8)	32.54 (169, 8)	30.82 (46, 8)	28.99 (214, 8)	28.58C (304,24)
2(564.00,4401.50)	46.96C (306, 8)	46.42 (164, 8)	35.21C (250, 8)	32.25C (58,24)	30.53 (246, 8)
3(572.00,4400.87)	68.85 (34,24)	60.92 (297, 8)	58.18 (291, 8)	55.42C (249, 8)	48.98C (312,24)
4(574.00,4400.87)	95.44C (78,24)	88.73 (214, 8)	83.07C (247, 8)	81.07C (329, 8)	77.65 (169, 8)
5(576.00,4400.87) *	265.05C (306, 8) *	217.53 (344,24)	200.36C (260, 8)	199.43C (285,24)	190.36C (243, 8)
6(578.00,4400.87)	205.04C (14, 8)	160.47C (191, 8)	139.93 (310,24)	137.89C (33, 8)	136.81C (279,24)
7(580.00,4400.87)	76.74C (14, 8)	72.40C (293, 8)	68.62 (297, 8)	64.39 (291, 8)	62.05C (191, 8)
8(571.00,4402.60)	91.04C (285,24)	82.26C (181,24)	78.58C (251, 8)	67.65 (11, 8)	63.14 (163,24)
9(573.00,4402.60)	64.69C (58,24)	61.75 (33,24)	58.82C (300, 8)	58.34C (254,24)	55.67C (274, 8)
10(575.00,4402.60)	71.55 (354, 8)	61.59C (66, 8)	59.90C (261,24)	59.44C (311, 8)	58.41C (48,24)
11(577.00,4402.60)	172.25C (320, 8)	153.99C (66, 8)	129.28 (265, 8)	128.93C (298,24)	117.87 (347,24)
12(579.00,4402.60)	166.76C (304, 8)	155.27C (289, 8)	144.29 (34,24)	118.27 (33,24)	109.72 (271,24)
13(572.00,4404.33)	101.85C (178, 8)	89.28C (66, 8)	78.77C (320, 8)	77.41C (188, 8)	70.34C (306, 8)
14(574.00,4404.33)	68.18 (116, 8)	64.40C (206, 8)	62.06C (300, 8)	60.34C (304,24)	59.55 (11, 8)
15(576.00,4404.33)	68.18 (284, 8)	57.90 (45, 8)	54.88C (184, 8)	52.33 (50,16)	51.88C (206, 8)
16(578.00,4404.33)	79.12C (198, 8)	76.14 (54, 8)	74.15C (266,24)	71.03C (208, 8)	68.77C (127, 8)
17(580.00,4404.33)	152.51 (299, 8)	147.91C (220, 8)	139.71C (231, 8)	138.71C (266, 8)	138.44 (105, 8)
18(571.00,4406.06)	80.88C (288, 8)	72.70 (290, 8)	66.28C (58,24)	51.87C (312,24)	51.47C (78,24)
19(573.00,4406.06)	79.88C (285,24)	74.73C (264, 8)	60.12 (153,24)	60.03C (208,24)	58.94 (164, 8)
20(575.00,4406.06)	91.56 (104, 8)	86.83C (320, 8)	81.90 (275,24)	81.25 (19,16)	75.63C (360,16)
21(577.00,4406.06)	116.15C (178, 8)	78.06C (188, 8)	61.69C (319, 8)	58.25C (260,24)	58.01 (285, 8)
22(579.00,4406.06)	88.43 (12,24)	84.17 (149, 8)	77.57 (153, 8)	77.54 (13, 8)	76.41C (288, 8)
23(572.00,4407.79)	56.19C (106, 8)	55.63C (187, 8)	54.90C (260, 8)	53.65C (248, 8)	52.36C (243, 8)
24(574.00,4407.79)	89.44C (30,24)	66.78 (306,24)	63.48 (307, 8)	60.53C (200,24)	59.41C (174,24)
25(576.00,4407.79)	96.61C (66, 8)	90.43C (266,24)	89.98C (127, 8)	89.00 (137, 8)	87.44C (264, 8)
26(578.00,4407.79)	76.74C (227, 8)	72.12C (29, 8)	65.22C (209, 8)	59.78 (117,24)	57.91 (227,24)
27(580.00,4407.79)	143.31 (299, 8)	125.94 (105, 8)	125.21C (301, 8)	124.26C (220, 8)	122.90 (156, 8)

FIVE HIGHEST 24-HOUR SO2 CONCENTRATIONS((ENDING ON JULIAN DAY, HOUR)
(MICROGRAMS/M**3)
C-FLAG IDENTIFIES CONCENTRATIONS AFFECTED BY CALM HOURS

RECEPTOR	1	2	3	4	5
1(566.00,4405.00)	15.40C (180,24)	15.35C (169,24)	14.97 (11,24)	14.69C (319,24)	13.52C (285,24)
2(564.00,4401.50)	17.48C (285,24)	16.65C (206,24)	15.49 (305,24)	15.49 (164,24)	14.73 (228,24)
3(572.00,4400.87)	36.69 (34,24)	35.98C (297,24)	30.98 (340,24)	30.87C (249,24)	28.53C (307,24)
4(574.00,4400.87)	40.82 (214,24)	39.01C (329,24)	34.56C (78,24)	33.36C (247,24)	32.75C (206,24)
5(576.00,4400.87) *	108.50C (285,24) *	94.57 (228,24)	85.71C (306,24)	84.27C (344,24)	83.84C (260,24)
6(578.00,4400.87)	80.43C (310,24)	74.82C (341,24)	74.79C (191,24)	70.98C (53,24)	59.30C (14,24)
7(580.00,4400.87)	32.71C (297,24)	31.86C (291,24)	31.62C (293,24)	30.65 (326,24)	28.77C (341,24)
8(571.00,4402.60)	47.17C (181,24)	45.66C (285,24)	39.52C (251,24)	37.56C (124,24)	36.46C (180,24)
9(573.00,4402.60)	39.14 (34,24)	32.16C (35,24)	29.94C (58,24)	27.15C (33,24)	26.93C (48,24)
10(575.00,4402.60)	31.96C (48,24)	30.22C (264,24)	29.62C (313,24)	29.53C (237,24)	29.32 (345,24)
11(577.00,4402.60)	63.27C (66,24)	62.15C (237,24)	59.93C (320,24)	56.93C (265,24)	56.77C (298,24)
12(579.00,4402.60)	89.80 (34,24)	67.68C (304,24)	66.59C (313,24)	53.72C (297,24)	53.50C (289,24)
13(572.00,4404.33)	38.19C (178,24)	36.55C (66,24)	32.48C (298,24)	31.73C (142,24)	31.62 (305,24)
14(574.00,4404.33)	47.00 (34,24)	44.46 (272,24)	39.47C (274,24)	38.34 (116,24)	34.44C (300,24)
15(576.00,4404.33)	41.64 (50,24)	37.77C (45,24)	34.77 (330,24)	34.22C (208,24)	29.64C (310,24)
16(578.00,4404.33)	40.18C (266,24)	38.40C (35,24)	36.20 (34,24)	35.86C (287,24)	35.00C (198,24)
17(580.00,4404.33)	79.67C (299,24)	73.97C (220,24)	63.92 (327,24)	60.57C (301,24)	60.21C (287,24)
18(571.00,4406.06)	32.33C (288,24)	30.98 (290,24)	30.14C (312,24)	27.62C (206,24)	27.32C (58,24)
19(573.00,4406.06)	35.53C (264,24)	34.65C (285,24)	30.84C (181,24)	29.99C (319,24)	27.46C (247,24)
20(575.00,4406.06)	49.34 (19,24)	44.09 (43,24)	43.87C (307,24)	42.45 (332,24)	41.80C (125,24)
21(577.00,4406.06)	41.83C (178,24)	35.03 (305,24)	35.03C (206,24)	33.21C (142,24)	30.51C (188,24)
22(579.00,4406.06)	57.40 (256,24)	51.15 (153,24)	46.69 (149,24)	45.88 (115,24)	45.14C (273,24)
23(572.00,4407.79)	30.08 (345,24)	26.08C (247,24)	26.06 (354,24)	24.84C (48,24)	24.03C (300,24)
24(574.00,4407.79)	49.33C (307,24)	38.79 (345,24)	37.47C (30,24)	34.93C (306,24)	31.41 (262,24)
25(576.00,4407.79)	45.46C (266,24)	44.45 (315,24)	43.31 (197,24)	42.72C (184,24)	42.69C (237,24)
26(578.00,4407.79)	47.36C (227,24)	37.70C (48,24)	35.02 (8,24)	35.02 (354,24)	34.67 (262,24)
27(580.00,4407.79)	89.69C (299,24)	79.41 (327,24)	78.90 (5,24)	71.06 (302,24)	70.29C (220,24)

THIS RUN HAS TERMINATED NORMALLY.

SECTION 11

ERROR MESSAGES AND REMEDIAL ACTION

RAM can generate up to 22 error messages, some of which cause program termination. Table 3 lists each message along with error description and suggested corrective action.

TABLE 3. ERROR MESSAGES AND CORRECTIVE ACTION

MESSAGE:	NSIGP (THE NUMBER OF SIGNIFICANT POINT SOURCES) WAS FOUND TO EXCEED THE LIMIT (25). USER TRIED TO INPUT x SOURCES. ******** EXECUTION TERMINATED ********
DESCRIPTION:	The maximum number of significant point sources allowed by the program is 25.
ACTION:	Modify the value input in record type 9 to be 25.
MESSAGE:	NSIGA (THE NUMBER OF SIGNIFICANT AREA SOURCES) WAS FOUND TO EXCEED THE LIMIT (10). USER TRIED TO INPUT x SOURCES. ****EXECUTION TERMINATED ****
DESCRIPTION:	The maximum number of significant area sources allowed by the program is 10.
ACTION:	Modify the input value to be 10.
MESSAGE:	USER TRIED TO INPUT MORE THAN x POINT SOURCES. THIS GOES BEYOND THE CURRENT PROGRAM DIMENSIONS.
DESCRIPTION:	The maximum number of point sources is 250.
ACTION:	Reduce the number of point sources to comply with the maximum of 250.

MESSAGE:	USER TRIED TO INPUT MORE THAN x AREA SOURCES. THIS GOES BEYOND THE CURRENT PROGRAM DIMENSIONS.
DESCRIPTION:	The maximum number of area sources is 100.
ACTION:	Reduce the number of area sources to comply with the maximum of 100.

MESSAGE:	DIMENSIONS TOO SMALL TO HOLD ARRAY x BY y.
DESCRIPTION:	The internal dimensions of the area source array are (25,25) for internal units.
ACTION:	Recompile with dimensions larger than (25,25).

MESSAGE:	AREA SOURCES, UNITS OR SIDE LENGTHS SPECIFIED INCORRECTLY ERROR ON EAST MAXIMUM BOUNDARY.
DESCRIPTION:	The area source east boundary extends beyond the east boundary of the modeling region.
ACTION:	Reduce the area source size, increase the size of the modeling region, or recompile the program with larger dimensions.

MESSAGE:	AREA SOURCES, UNITS OR SIDE LENGTHS SPECIFIED INCORRECTLY ERROR ON NORTH MAXIMUM BOUNDARY.
DESCRIPTION:	The area source north boundary extends beyond the north boundary of the modeling region.
ACTION:	Reduce the area source size, increase the size of the modeling region, or recompile the program with larger dimensions.

MESSAGE:	SOURCE, x, IS ALREADY LOCATED AT POSITION (,x,). CHECK SOURCE x.
DESCRIPTION:	Two sources are collocated.

ACTION: Verify the input stream and separate or combine the collocated sources.

MESSAGE: AREA ARRAY IS TOO WIDE FOR PAGE SIZE, THEREFORE WILL NOT BE PRINTED.

DESCRIPTION: The area source array cannot be printed due to its size.

ACTION: If a printout is needed, reduce the size of the area source region.

MESSAGE: ***ERROR---USER TRIED TO SPECIFY, x, SIGNIFICANT SOURCES BUT IS ONLY ALLOWING, y, TOTAL SIGNIFICANT SOURCES IN THIS RUN. RUN TERMINATED-CHECK INPUT DATA.

DESCRIPTION: The number of significant sources exceeds the total significant sources specified.

ACTION: Verify consistency of significant sources in the input stream.

MESSAGE: (MPS) THE INPUT SIGNIFICANT SOURCE NUMBER WAS FOUND TO EQUAL ZERO - USER CHECK INPUT DATA.

DESCRIPTION: The number of significant sources exceeds the total significant sources specified.

ACTION: Verify consistency of significant sources in the input stream.

MESSAGE: THE INPUT LIMIT OF MAXIMUM DISTANCE FOR AREA INTEGRATION, x, CONVERTS TO y KM WHICH EXCEEDS STORAGE LIMITATIONS. UP TO 116 KM DISTANCES ARE ALLOWED.

DESCRIPTION: The maximum distance for area source integration was exceeded.

ACTION: Modify the limit such that the distance does not exceed 116 km.

MESSAGE:	ERROR IN SPECIFYING SIGNIFICANT POINT SOURCES.
DESCRIPTION:	The significant point sources were not input properly.
ACTION:	Verify the input stream and correct as needed.

MESSAGE:	DISAGREEMENT OF IDENTIFIERS- SURFACE DATA FROM CARD: STATION = x, YEAR = x. FROM MET FILE: STATION = y, YEAR = y. MIXING HEIGHT DATA FROM CARD: STATION = x, YEAR = x. FROM MET FILE: STATION = y, YEAR = y.
DESCRIPTION:	Header information in the meteorological file is not in agreement with that specified in the input stream.
ACTION:	Modify the input stream or replace the meteorological data set to effect a match.

MESSAGE:	****USER EITHER TRIED TO INPUT MORE THAN 180 RECEPTORS OR ENDR WAS NOT PLACED AFTER THE LAST RECEPTOR CARD. ********EXECUTION TERMINATED*******
DESCRIPTION:	The maximum number of user-specified receptors is 180, and a record with ENDR in columns 1-4 is required to signify the end of receptor input.
ACTION:	Modify the input as needed.

MESSAGE:	NO RECEPTORS HAVE BEEN CHOSEN.
DESCRIPTION:	Either user-input or program-generated receptors are required. Neither type was specified.
ACTION:	Correct the input stream to specify receptors.

MESSAGE:	DAYS DO NOT MATCH, IDAY = x, IDAYS = Y.
DESCRIPTION:	If the run is part of a segmented run, the starting day must match the day in the prior run.
ACTION:	Modify the input stream to effect a match.

MESSAGE:	RUN TERMINATED. CAN NOT WRITE FILES (OPTIONS 41 OR 42) WHEN HAVING RAM GENERATE RECEPTORS FOR EACH AVERAGING PERIOD, (OPTIONS 15,16,17).
DESCRIPTION:	Options 41 or 42 are not compatible with options 15, 16, 17.
ACTION:	Modify the input stream to ensure compatibility.

MESSAGE:	DATE ON MET TAPE, x, DOES NOT MATCH INTERNAL DATE, y.
DESCRIPTION:	The Julian date calculated by RAM does not match the date in the input meteorological tape.
ACTION:	Verify the proper data sequence in the input meteorology.

MESSAGE:	HOUR, x, IS NOT PERMITTED. HOURS MUST BE DEFINED BETWEEN 1 AND 24.
DESCRIPTION:	The hour specified is other than 1-24.
ACTION:	Modify the input to conform to the hour stipulation required by RAM.

MESSAGE:	DATE BEING PROCESSED IS = x. DATE OF HOURLY POINT EMISSION RECORD IS y. ***PLEASE CHECK EMISSION RECORDS.
DESCRIPTION:	In the point emission record in process, the date does not match the internal date calculated by RAM.
ACTION:	Verify data sequence in the hourly area source emission file.

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APPENDIX A

FORTRAN SOURCE CODE FOR RAM

```
C                    RAMMET (VERSION 84136)
C                    A MET PREPROCESSOR FOR RAM IN
C                    SECTION 1. GUIDELINE MODELS
C                    IN UNAMAP (VERSION 6) JULY 86
C                    SOURCE:  UNAMAP FILE ON EPA'S UNIVAC 1110, RTP, NC
C***RAMMET-PREPROCESSOR- WRITTEN BY JOAN HRENKO NOVAK
C*** BASED ON METHODS SUGGESTED BY TURNER , ZIMMERMAN, AND IRWIN.
C***RAMMET ASSUMES THERE IS NO MISSING DATA ON THE MET. TAPE.
C***IF MISSING DATA IS DETECTED, THE LOCATION OF THE MISSING DATA IS
C***PRINTED. MISSING DATA MUST BE FILLED IN BEFORE PROCEEDING .
      COMMON SEED,IRN,IRNP
      DIMENSION LSTAB(12,7), IDFAC(12,2), ANGL(3), ICEIL(3), IDG(3), IDI
     1G(11)
      DIMENSION KST(24), SPEED(24), TEMP(24), AFV(24), FVR(24), HLH(2,24
     1)
      DIMENSION IRAND(8784),IRND(24,366)
      EQUIVALENCE (IRAND,IRND)
      DATA IDIG /'0','1','2','3','4','5','6','7','8','9','-'/
      DATA IREC /1/ ,IMO /1/ ,ANGL /60.,35.,15./ ,CONST /57.29578/
      DATA IDFAC /0,31,59,90,120,151,181,212,243,273,304,334,0,31,60,91,
     1121,152,182,213,244,274,305,335/
      DATA LSTAB /7,7,7,6,6,6,5,5,5,5,4,4,6,6,6,5,5,5,4,4,4,4,4,4,4,4,4,
     14,4,4,4,4,4,4,4,4,3,3,3,4,4,4,4,4,4,4,4,2,2,2,3,3,3,3,3,3,4,4,4,
     21,2,2,2,2,2,2,3,3,3,3,4,1,1,1,1,1,2,2,2,2,3,3,3/
C***   UNIT 8 = SURFACE DATA
C***   UNIT 9 = OUTPUT FILE
C***   UNIT 5 = UPPER AIR DATA IN CARD FORMAT
C***   UNIT 12 = RANDOM NUMBERS
      CALL WSTCLK
      WRITE (6,5432)
 5432 FORMAT ('1',21X,'RAMMET (VERSION 84136)'/
     1 22X,'A MET PREPROCESSOR FOR RAM IN'/
     2 22X,'SECTION 1. GUIDELINE MODELS '/
     3 22X,'IN UNAMAP (VERSION 6) JULY 86'/
     4 22X,'SOURCE:  UNAMAP FILE ON EPA''S UNIVAC 1110, RTP, NC.')
      IN=5
      IO=6
      IFLAG=0
      READ (5,395) IRN,IRNP,ISK
  395 FORMAT (3I2)
C         OPTIONAL FEATURES:
C
C           IRN - CONTROL FOR RANDOM NUMBERS.
C            0  READ PREVIOUSLY PREPARED RANDOM NUMBERS FROM FILE 12.
C            1  GENERATE A SET OF RANDOM NUMBERS USING THE UNIVAC LIBRARY
C                 SUBROUTINE RANDU.
C            2  GENERATE A SET OF RANDOM NUMBERS USING THE IMSL LIBRARY
C                 SUBROUTINE GGUBS.
C            3  GENERATE A SET OF RANDOM NUMBERS USING A USER PROVIDED
C                 ROUTINE ACCESSED BY USER WRITTEN CODE AT STATEMENT 170
C                 IN SUBROUTINE RNDM.
C
C           IRNP - CONTROL FOR RANDOM NUMBER LISTING AND ANALYSIS.
C            0  PROVIDE AND PRINT ANALYSIS.
C            1  DON'T.
C
C           ISK - CONTROL FOR USING OPAQUE OR TOTAL SKY COVER.
C                 OPAQUE IS PREFERRED.
C            0  USE OPAQUE (COL79).
C            1  USE TOTAL (COL 56).
      WRITE (6,397) IRN,IRNP,ISK
  397 FORMAT ('0IRN = ',I2,', CONTROL FOR RANDOM NUMBERS.'/
     1 ' 0 - READ FROM FILE 12.'/ ' 1 - GENERATE USING UNIVAC RANDU.'/
     2 ' 2 - GENERATE USING IMSL GGUBS.'/ ' 3 - GENERATE USING USER''S R
     3OUTINE.'/'0IRNP = ',I2,', CONTROL FOR RANDOM NUMBER LISTING AND AN
     4ALYSIS.'/' 0 - PROVIDE AND PRINT ANALYSIS.'/' 1 - DON''T.'/
     5 '0ISK = ',I2,', CONTROL FOR SKY COVER.'/
     6 ' 0 - USE OPAQUE (COL 79).'/' 1 - USE TOTAL (COL 56).'//)
C***READ CARD TO INITIALIZE MET TAPE ID,YEAR,LATITUDE,LONGITUDE,
C*** TIME ZONE ,NO. OF DAYS IN YEAR, INITIAL RANDOM NUMBER.
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C***RAND(24) IS THE INITIAL RANDOM NO. USED TO GENERATE THE SEQUENCE OF RME00700
C***NUMBERS FOR THE RANDOMIZED FLOW VECTOR. IF THE SAME NO. IS USED IN  RME00710
C***DIFFERENT EXECUTIONS OF THE PREPROCESSOR, THE SAME SET OF RANDOM NOSRME00720
C***WILL BE GENERATED. ANY ODD NUMBER GREATER THAN 3 DIGITS CAN BE USED RME00730
C***AS THE SEED. THIS SEED IS MULTIPLIED BY 10,000 INTERNALLY.          RME00740
C***ZONE IS GMT-LST.                                                    RME00750
      READ (IN,400) IDC,IYRC,ALAT,ALONG,ZONE,NDAYS,SEED                 RME00760
      WRITE (IO,410) IDC,IYRC,ALAT,ALONG,ZONE,NDAYS,SEED                RME00770
C                                                                       RME00780
C           IDC     STATION IDENTIFICATION FOR SURFACE OBSERVATION TAPE RME00790
C           IYRC    YEAR OF METEOROLOGICAL DATA                         RME00800
C           ALAT    LATITUDE OF SITE                                    RME00810
C           ALONG   LONGITUDE OF SITE                                   RME00820
C           ZONE    TIME ZONE OF SITE                                   RME00830
C           NDAYS   NUMBER OF DAYS TO BE PROCESSED                      RME00840
C           SEED    NUMBER USED AS SEED FOR RANDOM NUMBER GENERATION    RME00850
C                                                                       RME00860
      CALL RNDM(IRAND)                                                  RME00870
      DUM=ALAT/CONST                                                    RME00880
      SINLAT=SIN(DUM)                                                   RME00890
      COSLAT=COS(DUM)                                                   RME00900
      DUM=ALONG/15.-ZONE                                                RME00910
      TEMPZ=15.*ZONE-ALONG                                              RME00920
C***RESET SUBSCRIPT IF LEAP YEAR                                        RME00930
      LYS=1                                                             RME00940
      IF (NDAYS.EQ.366) LYS=2                                           RME00950
C***READ MET DATA                                                       RME00960
C***THIS READ ASSUMES AN INPUT TAPE WITH HOURLY DATA FROM THE           RME00970
C***NATIONAL CLIMATIC CENTER, ASHVILLE, NC. IN THEIR STANDARD           RME00980
C***HOURLY CARD FORMAT.                                                 RME00990
C***SKIP 00 HOUR OF MET DATA.                                           RME01000
      READ (8,420) ID,IYEAR,IMONTH,IDAY,IHOUR,ICEIL,IDIR,ISPEED,ITEMP,ITRME01010
     1OAMT,ICOVER                                                       RME01020
      LWD=IDIR                                                          RME01030
C***BEGIN PROCESSING WITH HOUR 01                                       RME01040
      READ (8,420) ID,IYEAR,IMONTH,IDAY,IHOUR,ICEIL,IDIR,ISPEED,ITEMP,ITRME01050
     1OAMT,ICOVER                                                       RME01060
C***MIXING HEIGHT VALUES ARE DETERMINED TWICE A DAY FROM RADIOSONDE DATARME01070
C***USING THE PROCEDURES OF HOLZWORTH.                                  RME01080
C***READ PRIOR DAYS MIXING HEIGHT VALUES                                RME01090
      READ (IN,430) XMNM1,XAFM1                                         RME01100
C***PRESENT DAY                                                         RME01110
      READ (IN,440) IDM,IYM,XMN,XAF                                     RME01120
C***WRITE IDENTIFYING INFORMATION ON OUTPUT FILE                        RME01130
      WRITE (9) ID,IYEAR,IDM,IYM                                        RME01140
      WRITE (IO,450) IYEAR,ID,IYM,IDM                                   RME01150
C*** READ NEXT DAY'S MIXING HEIGHT VALUES                               RME01160
      READ (IN,430) XMNP1,XAFP1                                         RME01170
C***START DAY LOOP.                                                     RME01180
      DO 380 IDY=1,NDAYS                                                RME01190
C***CALCULATE THE DAY NO AND THE TIME OF SUNRISE AND SUNSET             RME01200
      DAY1=IDAY+IDFAC(IMONTH,LYS)                                       RME01210
C***CONSTANT 0.0172028=360./365.242*57.29578                            RME01220
C***DETERMINE THE ANGULAR(RADIANS) FRACTION OF A YEAR FOR THIS DATE.    RME01230
      DAYNO=(DAY1-1.0)*0.0172028                                        RME01240
      TDAYNO=2.*DAYNO                                                   RME01250
      SIND=SIN(DAYNO)                                                   RME01260
      COSD=COS(DAYNO)                                                   RME01270
      SINTD=SIN(TDAYNO)                                                 RME01280
      COSTD=COS(TDAYNO)                                                 RME01290
C***ACCOUNT FOR ELLIPTICITY OF EARTH'S ORBIT.                           RME01300
      SIGMA=279.9348+(DAYNO*CONST)+1.914827*SIND-0.079525*COSD+0.019938*RME01310
     1SINTD-0.00162*COSTD                                               RME01320
C***CONSTANT 0.39785=SIN(.4091720193=23.44383/57.29578)                 RME01330
C***FIND THE SINE OF THE SOLAR DECLINATION.                             RME01340
      DSIN=0.39785*SIN(SIGMA/CONST)                                     RME01350
      DCOS=SQRT(1.0-DSIN*DSIN)                                          RME01360
C***DETERMINE TIME(HRS) OF MERIDIAN PASSAGE                             RME01370
      AMM=12.0+0.12357*SIND-0.004289*COSD+0.153809*SINTD+0.060783*COSTD RME01380
      HCOS=(-SINLAT*DSIN)/(COSLAT*DCOS)                                 RME01390
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C***DETERMINE SOLAR HOUR ANGLE OF SUNRISE-SUNSET.
      H2=(ATAN2(SQRT(1.-HCOS*HCOS),HCOS)/15.0)*CONST
C***TIME OF SUNRISE(TSR) AND TIME OF SUNSET(TSS) ARE EXPRESSED IN
C***LOCAL STANDARD TIME SINCE THE ZONE CORRECTION HAS ALREADY BEEN MADE.
C***OTHERWISE THEY WOULD BE IN GREENWICH MEAN TIME.
      TSR=AMM-H2+DUM
      TSS=AMM+H2+DUM
C***START HOUR LOOP
      DO 370 KHR=1,24
      KHRC=KHR
C***INITIALIZE STABILITY BEFORE IT IS CALCULATED
      KST(KHR)=0
      IF (KHR.EQ.24) GO TO 70
C***CHECK DATA FOR CORRECTNESS & CONTINUITY
C***CHECK STATION NUMBER.
      IF (ID.EQ.IDC) GO TO 10
      WRITE (IO,460) IREC,ID,IDC
      WRITE (IO,510)
      CALL WAUDIT
      STOP
C***CHECK YEAR.
10    IF (IYEAR.EQ.IYRC) GO TO 20
      WRITE (IO,470) IYEAR,IYRC,IREC
      WRITE (IO,510)
      CALL WAUDIT
      STOP
C***CHECK MONTH
20    IF (IMONTH.EQ.IMO) GO TO 40
      IF (IMONTH.EQ.(IMO+1)) GO TO 30
      WRITE (IO,480) IMONTH,IMO,IREC
C***
      WRITE (IO,510)
      CALL WAUDIT
      STOP
30    IMO=IMONTH
C***CHECK DAY
40    IF (IFIX(DAY1).EQ.IDY) GO TO 50
      WRITE (IO,490) DAY1,IDY,IREC
      WRITE (IO,510)
      CALL WAUDIT
      STOP
C***CHECK HOUR
50    IF (IHOUR.EQ.KHRC) GO TO 80
      WRITE (IO,500) IHOUR,KHR,IREC
      WRITE (IO,510)
      GO TO 370
60    WRITE (IO,520) KHR,IREC,IHOUR
      CALL WAUDIT
      STOP
70    IF (IHOUR.NE.0) GO TO 60
      KHRC=IHOUR
C***UPDATE MIXING HEIGHTS- STARTING NEW DAY.
      XMNM1=XMN
      XAFM1=XAF
      XMN=XMNP1
      XAF=XAFP1
C***READ NEXT DAYS MIXING HEIGHTS.
      READ (IN,430,END=80) XMNP1,XAFP1
80    ICDAMT=ICOVER
      IF (ISK.EQ.1) ICDAMT=ITOAMT
      JK=0
90    JK=JK+1
      IF (ICDAMT.NE.IDIG(JK)) GO TO 90
      ISKY=JK-1
      IF (ICEIL(1).NE.IDIG(11)) GO TO 110
      IDG(1)=9
      IDG(2)=9
      IDG(3)=8
      GO TO 150
110   DO 140 JI=1,3
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      DO 120 JK=1,10
      IF (ICEIL(JI).EQ.IDIG(JK)) GO TO 130
120   CONTINUE
130   IDG(JI)=JK-1
140   CONTINUE
150   IROOF=IDG(1)*100+IDG(2)*10+IDG(3)
C***IROOF IS CEILING HEIGHT IN HUNDREDS OF FEET.
C***CONVERT TEMP FROM FAHRENHEIT TO KELVIN
      TEMP(KHR)=0.5556*(ITEMP-32.)+273.15
C***CONVERT WIND SPEED FROM KNOTS TO METERS/SEC
      S=ISPEED*0.51444
C***WIND SPEED IS SET TO 1 METER/SEC
      IF (S.LT.1.0) S=1.0
      SPEED(KHR)=S
C***CHECK FOR CALMS
      IF (IDIR.EQ.0) GO TO 160
C***WIND DIRECTION IS ASSUMED TO BE THE SAME AS FOR THE LAST HOUR
C***IF THE WIND DIRECTION IS REPORTED AS "CALM".
      LWD=IDIR
      GO TO 170
160   IDIR=LWD
170   XDIR=IDIR*10.
C***CALCULATE FLOW VECTOR AND RANDOM FLOW VECTOR
      IF (XDIR.GT.180.) GO TO 180
      FV=XDIR+180.
      GO TO 190
180   FV=XDIR-180.
190   AFV(KHR)=FV
      XRN=IRND(KHR,IDY)
      FVR(KHR)=FV+XRN-4.
      IF (FVR(KHR).GT.360.) FVR(KHR)=FVR(KHR)-360.
C***DETERMINE RADIATION INDEX.
      IF (ISKY.EQ.10.AND.IROOF.LT.70) GO TO 200
      IF (IHOUR.GT.TSR.AND.IHOUR.LT.TSS) GO TO 210
      IRADX=2
      IF (ISKY.LE.4) IRADX=1
      GO TO 280
200   IRADX=3
      GO TO 280
C***DETERMINE THE ANGLE OF ELEVATION
C***DETERMINE SOLAR HOUR ANGLE(RADIANS)
210   HI=(15.*(KHRC-AMM)+TEMPZ)/CONST
      ALFSN=SINLAT*DSIN+DCOS*COSLAT*COS(HI)
C***DETERMINE SOLAR ELEVATION ANGLE(DEG).
      ALF=ATAN2(ALFSN,SQRT(1.-ALFSN*ALFSN))*CONST
      DO 220 I=1,3
220   IF (ALF.GT.ANGL(I)) GO TO 230
      I=4
230   ICN=5-I
      IF (ISKY.GT.5) GO TO 240
      IRADX=ICN+3
      GO TO 280
240   IRADX=ICN-1
      IF (IROOF.LT.70) GO TO 250
      IF (IROOF.LT.160) GO TO 260
      IF (ISKY.EQ.10) GO TO 270
      IRADX=ICN
      GO TO 270
250   IRADX=ICN-2
      GO TO 270
260   IF (ISKY.EQ.10) IRADX=IRADX-1
270   IF (IRADX.LT.1) IRADX=1
      IRADX=IRADX+3
280   IND=ISPEED
      IF (ISPEED.GT.12) IND=12
      IF (ISPEED.LE.1) IND=1
C***DETERMINE STABILITY.
      KST(KHR)=LSTAB(IND,IRADX)
C***DO NOT ALLOW STABILITY TO VARY RAPIDLY
      IF (IDY.EQ.1.AND.KHR.EQ.1) LST=KST(KHR)
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```
      IF ((KST(KHR)-LST).GT.1) KST(KHR)=LST+1
      IF ((LST-KST(KHR)).GT.1) KST(KHR)=LST-1
      LST=KST(KHR)
      IF (KST(KHR).LT.1) WRITE (IO,540) KST(KHR),IND,IRADX,IREC
C***CALCULATE MIXING HEIGHT
      IHR=KHRC
      XHR=IHR
      IF (IHR.GT.14.AND.XHR.LE.TSS) GO TO 300
      IND=2
      IF (XHR.LE.TSS) GO TO 310
      IF (KST(KHR).EQ.4) GO TO 290
      HLH(2,KHR)=XAF+(XMNP1-XAF)*((XHR-TSS)/(24.-TSS))
      IND=1
290   HLH(IND,KHR)=XAF+(XAFP1-XAF)*((XHR-TSS)/(38.-TSS))
      IF (IND.EQ.2) HLH(1,KHR)=HLH(2,KHR)
      GO TO 360
300   HLH(1,KHR)=XAF
      HLH(2,KHR)=XAF
      GO TO 360
310   IF (XHR.GT.TSR) GO TO 330
      KSTSP=KST(KHR)
      IF (KST(KHR).EQ.4) GO TO 320
      HLH(2,KHR)=XMN
      IND=1
320   HLH(IND,KHR)=XAFM1+(XAF-XAFM1)*((24.-TSS+XHR)/(24.-TSS+14.))
      IF (IND.EQ.2) HLH(1,KHR)=HLH(2,KHR)
      GO TO 360
330   IF (KSTSP.EQ.4) GO TO 350
      HLH(2,KHR)=XMN+(XAF-XMN)*((XHR-TSR)/(14.-TSR))
      HLH(1,KHR)=XAF*(XHR-TSR)/(14.-TSR)
      GO TO 360
340   IFLAG=1
      IHOUR=0
      GO TO 370
350   HLH(1,KHR)=XAFM1+(XAF-XAFM1)*((24.-TSS+XHR)/(24.-TSS+14.))
      HLH(2,KHR)=HLH(1,KHR)
C***READ NEXT HOUR'S MET DATA
360   IF (IFLAG.EQ.1) GO TO 390
C***STORE CORRECT MONTH AND DAY FOR DAILY PRINTOUT, SINCE 24TH HOUR LABE
      IF(KHR.NE.23) GO TO 365
      LMON=IMONTH
      LDAY=IDAY
365   READ (8,420,END=340) ID,IYEAR,IMONTH,IDAY,IHOUR,ICEIL,IDIR,ISPEED,
     1ITEMP,ITOAMT,ICOVER
      IREC=IREC+1
C***END OF HOUR LOOP.
370   CONTINUE
C***WRITE DAYS CALCULATION ON TO FILE
C***EACH ARRAY CONTAINS THE COMPLETE INFORMATION FOR ONE DAY ORDERED
C***SEQUENTIALLY FROM HOUR 01 THRU 24
      WRITE (9) IYEAR,LMON,DAY1,KST,SPEED,TEMP,AFV,FVR,HLH
      WRITE (IO,550) IYEAR,LMON,LDAY,DAY1,TSR,TSS
      WRITE (IO,560) KST
      WRITE (IO,570) SPEED,TEMP,AFV,FVR,((HLH(I,J),J=1,24),I=1,2)
C***END OF DAY LOOP.
380   CONTINUE
390   WRITE (9) IYEAR,LMON,DAY1,KST,SPEED,TEMP,AFV,FVR,HLH
      WRITE (IO,550) IYEAR,LMON,LDAY,DAY1,TSR,TSS
      WRITE (IO,560) KST
      WRITE (IO,570) SPEED,TEMP,AFV,FVR,((HLH(I,J),J=1,24),I=1,2)
      WRITE (IO,580)
      CALL WAUDIT
      STOP
C
400   FORMAT (I5,I2,1X,2F10.1,F2.0,I4,F10.0)
410   FORMAT('0','     RAMMET - VERSION 84136'/1X,
     *' STATION NUMBER=',I5,5X,'YEAR OF DATA=',I2/1X,
     *'LATITUDE=',F10.1,'   LONGITUDE=',F10.1,'   ZONE=',F4.0/1X,
     *'NUMBER OF DAYS IN YEAR=',I3,'   RANDOM SEED=',F10.0)
420   FORMAT (I5,4I2,3A1,22X,2I2,4X,I3,6X,A1,22X,A1)
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430   FORMAT (12X,F5.0,13X,F5.0)                                         RME03440
440   FORMAT (I5,I2,5X,F5.0,13X,F5.0)                                    RME03450
450   FORMAT (1X,'19',I2,' SURFACE DATA AT STATION ',I5,10X,'19',I2,' MIRME03460
     1XING HEIGHT DATA AT STATION ',I5)                                  RME03470
460   FORMAT (' ID DOES NOT MATCH IN RECORD   ',I4,'  ID ON TAPE IS ',I5RME03480
     *,' ID REQUESTED IS ',I5)                                           RME03490
470   FORMAT (' YEAR IS',I3,' INSTEAD OF ',I2,' IREC=',I4)               RME03500
480   FORMAT (' MONTH ',I2,' DOES NOT AGREE WITH LOOP ',I2,' IREC=',I4)  RME03510
490   FORMAT (' DAY ',F4.0,' DOES NOT AGREE WITH LOOP ',I2,' IREC=',I4)  RME03520
500   FORMAT (' HOUR ',I2,' DOES NOT AGREE WITH LOOP ',I2,' IREC=',I4)   RME03530
510   FORMAT (' *****DATA IS MISSING. PLEASE CORRECT INPUT FILE*****')   RME03540
520   FORMAT (' ERROR: MISSING HOUR LOOP VALUE= ',I3,' WHILE VALUE ','ONRME03550
     1 RECORD ',I7,' IS = ',I3)                                          RME03560
530   FORMAT (' THE CHARACTER ',A1,' IS NOT ALLOWABLE.',' CLOUD COVER DERME03570
     1FAULTS TO 10.')                                                    RME03580
540   FORMAT (' STABILITY=',4I4)                                         RME03590
550   FORMAT (' IYEAR=',I2,' IMONTH=',I2,' DAY=',I2,' JULIAN DAY=',      RME03600
     *F5.0,' SUNRISE=',F7.3,'  SUNSET=',F7.3)                            RME03610
560   FORMAT (' KST= ',24(I1,4X))                                        RME03620
570   FORMAT (' SPEED=   ',24(F4.1,1X)/' TEMP=',24(F4.0,1X)/' AFV= ',24(FRME03630
     14.0,1X)/' FVR=',24(F4.0,1X)/' HLH1=',12(F5.0,1X)/6X,12(F5.0,1X)/' RME03640
     2HLH2=',12(F5.0,1X)/6X,12(F5.0,1X))                                 RME03650
580   FORMAT (' ALL RECORDS HAVE BEEN PROCESSED')                        RME03660
C                                                                        RME03670
      END                                                                RME03680
C
      SUBROUTINE RNDM(IRAND)                                             RME03690
      COMMON SEED,IRN,IRNP                                               RME03700
      DIMENSION RAND(8784),IRAND(8784),IDUM(24)                          RME03710
      DIMENSION KS(10),K2(10),K3(10),K4(10),K5(10),K6(10),KG(10)         RME03720
      DOUBLE PRECISION DSEED                                             RME03730
      DATA DLH,TLH,QLH,FLH,SLH/0.,0.,0.,0.,0./                           RME03740
      IF (IRN.GT.0) GO TO 120                                            RME03750
      DO 8 JA = 1,366                                                    RME03760
      READ (12,1020) J,IDUM                                              RME03770
 1020 FORMAT (I8,3X,24I1)                                                RME03780
C          CHECK TO SEE IF J CORRECT.                                    RME03790
      IF(J.EQ.JA) GO TO 4                                                RME03800
      WRITE (6,1030) J,JA                                                RME03810
 1030 FORMAT('0INPUT RECORD:',I4,' DOESN''T MATCH EXPECTED RECORD:',I4)  RME03820
    4 IE = JA * 24                                                       RME03830
      IB = IE - 24                                                       RME03840
      DO 6 I = 1,24                                                      RME03850
      IS = IB + I                                                        RME03860
    6 IRAND(IS) = IDUM(I)                                                RME03870
    8 CONTINUE                                                           RME03880
      GO TO 150                                                          RME03890
  120 IF(IRN.GT.1) GO TO 160                                             RME03900
      WRITE (6,1050) SEED                                                RME03910
 1050 FORMAT ('0SEED USED FOR THIS RUN =',F10.0//)                       RME03920
C          USE RANDU FROM UNIVAC LIBRARY.                                RME03930
      RAND(1) = SEED                                                     RME03940
      CALL RANDU (RAND,8784)                                             RME03950
      GO TO 190                                                          RME03960
  160 IF(IRN.GT.2) GO TO 170                                             RME03970
      WRITE (6,1050) SEED                                                RME03980
C          USE GGUBS FROM IMSL LIBRARY.                                  RME03990
      DSEED = SEED                                                       RME04000
      CALL GGUBS(DSEED,8784,RAND)                                        RME04010
      GO TO 190                                                          RME04020
C          USER SHOULD REMOVE THIS STOP AND PLACE CODE THAT WILL USE     RME04030
C            HIS/HER OWN ROUTINE TO GENERATE 8784 RANDOM NUMBERS AND PLACE RME04040
C            THEM IN THE ARRAY RAND.                                     RME04050
  170 WRITE (6,2200)                                                     RME04060
 2200 FORMAT ('0NORMALLY EXECUTION WILL CONTINUE USING THE USER''S ',    RME04070
     1 'RANDOM NUMBER ROUTINE.  CURRENTLY THERE IS A STOP CODE AT THAT 'RME04080
     2 , 'POINT!!!')                                                     RME04090
      CALL WAUDIT
      STOP                                                               RME04100
  190 DO 100 I = 1,8784                                                  RME04110
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  100 IRAND(I) = RAND(I) * 10.
  150 IF (IRNP.EQ.1) RETURN
      L = 1
      IS = 1
  200 IL = 120 * L
      M = L * 5
      IF (IL.GT.8784) GO TO 300
      WRITE (6,1100) M,(IRAND(I), I = IS,IL)
      IS = IL + 1
      L = L + 1
      GO TO 200
  300 M = ((8784 - IS + 1)/24) + (L - 1) * 5
      WRITE (6,1100) M,(IRAND(I), I = IS,8784)
 1100 FORMAT (I4,5(1X,24I1))
      L = IRAND(1) + 1
      DO 90 I = 1,8784
      N = IRAND(I)
C         L IS DIGIT FOR LAST HOUR.
C         N IS DIGIT FOR THIS HOUR.
      NA = N
      IF (NA.EQ.0) NA = 10
      KS(NA) = KS(NA) + 1
      IF (N.NE.L) GO TO 60
C         N = L, THEREFORE HAVE A DOUBLE THIS HOUR.
      K2(NA) = K2(NA) + 1
      IF (DLH.EQ.0.) GO TO 50
C         THEREFORE HAVE A TRIPLE THIS HOUR.
      K3(NA) = K3(NA) + 1
      IF(TLH.EQ.0.) GO TO 40
C         THEREFORE HAVE A QUAD THIS HOUR.
      K4(NA) = K4(NA) + 1
      IF (QLH.EQ.0.) GO TO 30
C         THEREFORE HAVE FIVE-IN-A-ROW THIS HOUR.
      K5(NA) = K5(NA) + 1
      IF (FLH.EQ.0.) GO TO 20
C         THEREFORE HAVE SIX-IN-A-ROW THIS HOUR.
      K6(NA) = K6(NA) + 1
      IF (SLH.EQ.0.) GO TO 10
C         THEREFORE HAVE SEVEN-OR-MORE-IN-A-ROW THIS HOUR.
      KG(NA) = KG(NA) + 1
   10 SLH = 1.
   20 FLH = 1.
   30 QLH = 1.
   40 TLH = 1.
   50 DLH = 1.
      GO TO 70
   60 DLH = 0.
      TLH = 0.
      QLH = 0.
      FLH = 0.
      SLH = 0.
   70 L = N
   90 CONTINUE
      WRITE (6,1200) (J,J = 1,9)
 1200 FORMAT ('ODIGIT          0',9I5,7X,'SUM')
      DO 95 J = 1,10
   95 ISUM = ISUM + KS(J)
      WRITE (6,1300) KS(10),(KS(J), J = 1,9),ISUM
 1300 FORMAT ('OSINGLE    ',10I5,I10)
      CHISQ = 0.
      DO 400 J = 1,10
      S = KS(J)
      SA = S - 878.4
  400 CHISQ = CHISQ + SA * SA/878.4
      WRITE (6,1400) CHISQ
 1400 FORMAT ('OCHI SQUARE =',F10.2)
      ISUM = 0
      DO 450 J = 1,10
  450 ISUM = ISUM + K2(J)
      WRITE (6,1500) K2(10),(K2(J), J = 1,9),ISUM
```

```
1500 FORMAT ('ODOUBLE   ',10I5,I10)
     CHISQ = 0.
     DO 500 J = 1,10
     S = K2(J)
     SA = S - 87.83
 500 CHISQ = CHISQ + SA * SA/87.83
     WRITE (6,1400) CHISQ
     ISUM = 0
     DO 550 J = 1,10
 550 ISUM = ISUM + K3(J)
     WRITE (6,1600) K3(10),(K3(J), J = 1,9),ISUM
1600 FORMAT ('OTRIPLE   ',10I5,I10)
     CHISQ = 0.
     DO 600 J = 1,10
     S = K3(J)
     SA = S - 8.782
 600 CHISQ = CHISQ + SA * SA/8.782
     WRITE (6,1400) CHISQ
     ISUM = 0
     DO 650 J = 1,10
 650 ISUM = ISUM + K4(J)
     WRITE (6,1700) K4(10),(K4(J), J = 1,9),ISUM
1700 FORMAT ('04 IN ROW ',10I5,I10)
     CHISQ = 0.
     DO 700 J = 1,10
     S = K4(J)
     SA = S - 0.8781
 700 CHISQ = CHISQ + SA * SA/0.8781
     WRITE (6,1400) CHISQ
     ISUM = 0
     DO 800 J = 1,10
 800 ISUM = ISUM + K5(J)
     WRITE (6,1800) K5(10),(K5(J), J = 1,9),ISUM
1800 FORMAT ('05 IN ROW ',10I5,I10)
     ISUM = 0
     DO 900 J = 1,10
 900 ISUM = ISUM + K6(J)
     WRITE (6,1900) K6(10),(K6(J), J = 1,9),ISUM
1900 FORMAT ('06 IN ROW ',10I5,I10)
     ISUM = 0
     DO 950 J = 1,10
 950 ISUM = ISUM + KG(J)
     WRITE (6,2000) KG(10),(KG(J), J = 1,9),ISUM
2000 FORMAT ('07 IN ROW ',10I5,I10)
     WRITE (6,2100)
2100 FORMAT ('0 WITH 9 DEGREES OF FREEDOM, THE PROBABILITY'/,
    1'  THAT A VALUE OF CHISQ WILL EXCEED:'/,
    2'  23.59 IS 0.005'/,'  21.67 IS 0.01'/,
    3'  19.02 IS 0.025'/,'  16.92 IS 0.05'/,
    4'  14.68 IS 0.10')
     RETURN
     END
```

```
C                   RAM  (VERSION 85364)
C                   AN AIR QUALITY DISPERSION MODEL IN
C                   SECTION 1. GUIDELINE MODELS
C                   IN UNAMAP (VERSION 6) JUL 86
C                   SOURCE: UNAMAP FILE ON EPA'S UNIVAC 1110, RTP. NC.
C
C         THIS MAIN PROGRAM IS REFERRED TO AS A IN COMMMON STATEMENTS
C
C
C->->->-> OUTLINE OF PROGRAM SECTIONS
C
C        SECTION A - GENERAL REMARKS
C        SECTION B - DATA INPUT LISTS.
C        SECTION C - INPUT FILE DESCRIPTIONS
C        SECTION D - OUTPUT PUNCHED CARD DESCRIPTION
C        SECTION E - OUTPUT FILE DESCRIPTIONS
C        SECTION F - TEMPORARY FILE DESCRIPTION
C        SECTION G - COMMON, DIMENSION, AND DATA STATEMENTS  .
C        SECTION H - FLOW DIAGRAM.
C        SECTION I - RUN SET-UP AND READ FIRST 6 INPUT CARDS.
C        SECTION J - INPUT AND PROCESS EMISSION INFORMATION.
C        SECTION K - EXECUTE FOR INPUT OF SIGNIFICANT SOURCE NUMBERS.
C        SECTION L - CHECK MET. DATA IF FROM FILE OF ONE YEARS'S DATA.
C        SECTION M - GENERATE POLAR COORDINATE RECEPTORS.
C        SECTION N - READ AND PROCESS RECEPTOR INFORMATION.
C        SECTION O - POSITION FILES AS REQUIRED.
C        SECTION P - START LOOPS FOR DAY AND AVERAGING TIME; READ
C                       MET. DATA.
C        SECTION Q - CALCULATE AND WRITE MET. SUMMARY INFORMATION.
C        SECTION R - DETERMINE ADDITIONAL RECEPTORS FOR THIS AVG-PER
C                    (OPTIONAL)
C        SECTION S - INITIALIZE FOR HOURLY LOOP.
C        SECTION T - BEGIN HOURLY LOOP.
C        SECTION U - CALCULATE AND STORE FOR HIGH-FIVE TABLE.
C        SECTION V - END HOURLY, AVERAGING TIME, AND DAILY LOOPS.
C        SECTION W - WRITE AVERAGE CONC. AND HIGH-FIVE TABLES.
C        SECTION X - CLOSE OUT FILES.
C        SECTION Y - FORMAT STATEMENTS.
C
C->->->-> SECTION A -  GENERAL REMARKS.
C
C*********************************************************************
C       NOTE: THE CARD INPUT FOR RAM (85364) DIFFERS FROM
C              PREVIOUS VERSIONS.
C             THIS VERSION OF  RAM IS COMPILED WITH THE UNIVAC
C             ASCII FORTRAN COMPILER. THIS VERSION OF THE MODEL
C             DIFFERS SLIGHTLY FROM EARLIER VERSIONS IN THE AREAS
C             OF FORMAT STATEMENTS AND CONDITION STATEMENTS.
C*********************************************************************
C
C       RAM  PROGRAM ABSTRACT.
C    RAM IS AN EFFICIENT GAUSSIAN-PLUME MULTIPLE-SOURCE
C    AIR QUALITY ALGORITHM. RAM IS DESCRIBED IN: NOVAK,J.H., AND
C    TURNER,D.B., 1976: AIR POLLUTION CONTROL ASSOC. J., VOL. 26, NO. 6,
C    PAGES 570-575(JUNE 1976). RAM'S PRINCIPAL USE IS TO DETERMINE
C    SHORT TERM (ONE-HOUR TO ONE-DAY) CONCENTRATIONS FROM POINT AND
C    AREA SOURCES IN URBAN AREAS.
C
C             EXECUTION OF  RAM  IS LIMITED TO A MAXIMUM OF 250 POINT
C        SOURCES,100 AREA SOURCES ,AND 180 RECEPTORS.  SIMULATION
C        IS DONE HOUR-BY-HOUR AND HOURLY METEOROLOGICAL DATA
C        ARE REQUIRED AS INPUT.  LENGTH OF SIMULATED TIME CAN
C        VARY FROM 1 HOUR TO 1 YEAR.
C
C       RAM  AUTHORS:
C        D. BRUCE TURNER* AND JOAN HRENKO NOVAK*
C        METEOROLOGY AND ASSESSMENT DISISION, ESRL
C        ENVIRONMENTAL PROTECTION AGENCY
C
C        * ON ASSIGNMENT FROM NATIONAL OCEANIC AND ATMOSPHERIC ADMIN.,
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C          DEPARTMENT OF COMMERCE.
C
C***     MODIFIED FOR DEFAULT OPTION BY:
C          JEROME B. MERSCH
C          SOURCE RECEPTOR ANALYSIS BRANCH
C          MONITORING AND DATA ANALYSIS DIVISION
C          ENVIRONMENTAL PROTECTION AGENCY
C
C
C        RAM  SUPPORTED BY:
C          ENVIRONMENTAL OPERATIONS BRANCH
C          MAIL DROP 80, EPA
C          RESRCH TRI PK, NC 27711
C
C          PHONE: (919) 541-4564,  FTS 629-4564.
C
C        BACKGROUND--
C          1. THE ORIGINAL RAM BY JOAN HRENKO NOVAK AND D.BRUCE TURNER
C             WAS MADE AVAILABLE IN FOUR VERSIONS:
C                 RAM   SHORT TERM URBAN
C                 RAMR  SHORT TERM RURAL
C                 RAMF  LONG TERM  URBAN
C                 RAMFR LONG TERM RURAL
C             ON UNAMAP(VERSION 3) IN MARCH 1978.
C
C          2. USING THE POINT SOURCE PORTIONS OF RAMR AS A BASIS,
C               THOMAS E. PIERCE AND D.BRUCE TURNER DEVELOPED THE MODEL
C               MPTER.THIS MODEL CONTAINS MANY OPTIONS SO THAT IT IS
C               QUITE VERSATILE PRIMARILY DUE TO ITS MANY USER SELECTED
C               OPTIONS.
C
C          3. IN BEGINNING THE TASK OF REVISING RAM FOR GUIDELINE
C              MODEL CONSISTENCY, IT WAS FELT THAT ADDITIONAL OPTIONS
C              COULD BE EMPLOYED, SIMILAR TO MPTER, IN ORDER TO MAKE
C              THE MODEL MORE VERSATILE. THE APPROACH USED HERE WAS
C              TO BEGIN WITH MPTER, REMOVE ITS OPTIONAL TERRAIN
C              FEATURES AND ADD BACK IN THE AREA SOURCE COMPUTATIONS
C              AND RECEPTOR LOCATION FEATURES.
C
C        CURRENT MODEL - USERS WILL FIND THAT THERE ARE NO LONGER FOUR
C          VERSIONS OF RAM BUT ONLY ONE. USE OF URBAN OR RURAL
C          DISPERSION PARAMETERS ARE CONTROLLED BY THE INPUT
C          VALUE FOR THE VARIABLE MUOR ( "1" FOR URBAN,"2" FOR
C          RURAL). THE LENGTH OF THE MODEL RUN IS DETERMINED BY
C          THE NUMBER OF AVERAGING PERIODS, NPER, TO BE RUN AND
C          THE LENGTH OF THE AVERAGING PERIOD,NAVG. FOR LONG-
C          TERM RUNS (SUCH AS USING A YEAR'S DATA), THE OPTION TO
C          CALCULATE AND PRINT THE HI-FIVE TABLE IS NORMALLY EMPLOYED
C          SO THAT THE HIGHEST AND SECOND HIGHEST CONCENTRATION FOR
C          EACH AVERAGING-TIME CAN BE EASILY DETERMINED.
C
C          THIS VERSION OF RAM WAS ASSEMBLED BY CURTIS A. SMITH
C          (JUN -AUG 1980)AND ALFREIDA D. RANKINS (AUG 1980 -PRESENT)
C          UNDER THE GUIDANCE OF D. BRUCE TURNER.
C
C        NOTE TO USERS:
C          ALTHOUGH THE ORIGINAL VERSION OF RAM CONTAINED
C          SUBROUTINES TO LOCATE RECEPTORS DOWNWIND FROM SIGNIFICANT
C          SOURCES FOR EACH AVERAGING PERIOD, THIS OPTION WAS DELETED
C          FROM THE LONG-TERM VERSION (THE VERY SITUATION WHERE IT
C          WOULD HAVE BEEN MOST USEFUL). THIS ACTION WAS TAKEN
C          BECAUSE IT WAS FELT IT WOULD CREATE CONFUSION FOR THE
C          USER TO GENERATE RECEPTORS WITH GIVEN RECEPTOR NUMBERS
C          WHOSE LOCATIONS SHIFT WITH EACH NEW AVERAGING PERIOD.
C
C          DETERMINATION OF MAXIMUM CONCENTRATIONS FROM
C          MULTIPLE SOURCES IS A DIFFICUT AND TIME CONSUMING TASK.
C          WITH THIS VERSION OF RAM THE FOLLOWING PROCEDURES CAN BE
C          APPLIED TO ASSIST LOCATING MAXIMUM CONCENTRATIONS THAT
C          CAN BE COMPARED WITH AIR QUALITY STANDARDS:
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C
C        1.     EXECUTE FOR A LONG PERIOD OF RECORD (FOR EXAMPLE,A YEAR)
C               FOR EXISTING MONITOR LOCATIONS AND EMPLOYING THE OPTION
C               TO GENERATE RECEPTORS DOWNWIND OF SIGNIFICANT SOURCES
C               (DIFFERENT RECEPTOR LOCATIONS ARE GENERATED FOR EACH
C               AVERAGING PERIOD). YOU MAY WANT TO ADD SPECIFIED OR
C               GENERATED RECEPTORS TO GET REASONABLE AREA COVERAGE.
C               (MOST OUTPUT WOULD BE SUPPRESSED BY USE OF OPTIONS
C               TO AVOID EXCESS PRINTED OUTPUT.) THE HI-FIVE TABLE
C               WOULD BE NEEDED HOWEVER.
C
C        2.     USING THE HI -FIVE TABLE SELECT DATES AND TIMES
C              (AND NOTE RECEPTOR NUMBERS) PRODUCING HIGH
C              VALUES ( HIGHEST, SECOND HIGHEST, AND POSSIBLY ,
C              THIRD HIGHEST).
C
C        3.     MAKE SHORT-TERM RUNS FOR THE ABOVE IDENTIFIED PERIODS
C              USING THE SAME RECEPTORS, RECEPTOR OPTIONS AND AVERAGING
C              PERIOD AS IN THE INITIAL RUN. BE SURE TO GET PRINTOUT
C              FOR THE AVERAGING PERIOD. THIS ALLOWS DETERMINATION OF THE
C              COORDINATES OF EACH RECEPTOR IDENTIFIED IN STEP 2 ABOVE.
C
C        4.    MAKE A LONG TERM RUN USING INPUT RECEPTORS ONLY (SO GIVEN
C              SOURCE NUMBER WILL BE AT SAME LOCATION THROUGHOUT RUN).
C              ALL RECEPTORS IDENTIFIED AS PRODUCING HIGH CONCENTRATIONS
C              IN STEPS 2 AND 3 SHOULD BE USED.  THIS RUN IS PROBABLY
C              FOR A ONE-YEAR PERIOD AND THE ONLY OUTPUT NEEDED IS THE
C              HIGH-FIVE TABLE FOR DETERMINATION OF ANNUAL CONCENTRATIONS
C              AND HIGHEST AND SECOND HIGHEST CONCENTRATIONS FOR EACH
C              AVERAGING TIME.(THESE WILL BE AVAILABLE FOR EACH RECEPTOR)
C
C        ALTHOUGH THIS METHOD WILL STILL BE RELATIVELY EXPENSIVE
C        (ESPECIALLY IF MANY RECEPTORS ARE USED), IT PROVIDES A
C         SYSTEMATIC METHODOLOGY FOR LOOKING FOR MAXIMUM CONCENTRATIONS.
C
C
C      ************************************************************
C      *                                                          *
C      *              DEFAULT OPTION DESCRIPTION                  *
C      *                                                          *
C      *        SELECTION OF THE DEFAULT OPTION CAUSES THE        *
C      *    FOLLOWING FEATURES TO BE SET:                         *
C      *                                                          *
C      *             - FINAL PLUME RISE IS USED; GRADUAL          *
C      *               (TRANSITIONAL) RISE IS NOT PERMITTED.      *
C      *             - MOMENTUM PLUME RISE IS ALWAYS ACCOUNTED    *
C      *               FOR.                                       *
C      *             - BUOYANCY INDUCED DISPERSION IS USED        *
C      *             - THE POWER LAW WIND PROFILE EXPONENTS       *
C      *               HAVE BEEN PRESET TO .15, .15, .20, .25     *
C      *               .30 AND .30 FOR THE URBAN OPTION FOR       *
C      *               STABILITY A THROUGH F RESPECTIVELY;        *
C      *               MUOR HAS BEEN PRESET TO 1 , URBAN          *
C      *               OPTION.                                    *
C      *             - STACK TIP DOWNWASH WILL ALWAYS BE          *
C      *               CALCULATED WHEN APPROPRIATE. BRIGGS        *
C      *               STACK TIP DOWNWASH IS USED.                *
C      *             - EXPONENTIAL DECAY (HALF-LIFE) IS           *
C      *               SET TO 4 HOURS FOR URBAN SO2 APPLICATIONS, *
C      *               OTHER SITUATIONS USE NO DECAY. THIS IS     *
C      *               CONSISTENT WITH REGULATORY GUIDANCE.       *
C      *             - CONCENTRATIONS FOR CALM HOURS ARE SET TO 0.*
C      *             - FOR MULTI-HOUR AVERAGING PERIODS THE       *
C      *               THE CONCENTRATIONS RESULTING FROM THE      *
C      *               CONSIDERATION OF CALM WIND CONDITIONS      *
C      *               ARE TREATED AS DESCRIBED IN SECTION U      *
C      *               OF THIS PROGRAM.                           *
C      *             - IN ORDER TO FACILITATE THE HANDLING OF     *
C      *               CALM WIND CONDITIONS, THE START HOUR       *
C      *               AND THE AVERAGING PERIOD HAVE BEEN         *
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C     *                   PRESET. THIS WILL AVOID CONFLICT           *
C     *                   WITH THE CALMS PROCESSING PROCEDURE.       *
C     *                 - IF ONSITE OR OTHER THAN RAMMET METE-       *
C     *                   OROLOGICAL DATA ARE TO BE USED IT MUST     *
C     *                   CORRESPOND TO THE FORMAT OF THE RAMMET     *
C     *                   FILE AND BE READ INTO THE PROGRAM ON       *
C     *                   DEVICE (11).                               *
C     *                 - OUTPUT OPTIONS 23 THROUGH 35 ARE SET TO 1  *
C     *                   AND OPTIONS 7,8,11,12,15,16 AND 39         *
C     *                   THROUGH 43 ARE SET TO 0.                   *
C     *                                                              *
C     ****************************************************************
C
C
C   THREE SYSTEMS OF LENGTH AND COORDINATES ARE USED IN RAM:
C
C    THE FIRST SYSTEM, USER UNITS, IS SELECTED BY THE USER AND
C     NORMALLY USE THE COORDINATE SYSTEM OF THE EMISSION INVENTORY.
C     ALL LOCATIONS INPUT BY THE USER( SUCH AS SOURCES AND RECEPTORS)
C     ARE IN THIS SYSTEM. ALSO AS A CONVENIENCE TO THE USER ALL
C     LOCATIONS ON OUTPUT ARE ALSO IN THIS SYSTEM.
C
C    THE SECOND SYSTEM, INTERNAL UNITS, IS USED INTERNALLY IN RAM
C     FOR COORDINATE LOCATIONS AND DISTANCES. ONE INTERNAL UNIT IS THE
C     SIDE LENGTH OF THE SMALLEST AREA SOURCE SQUARE. THIS LENGTH MUST
C     BE IDENTIFIED AND SPECIFIED BY THE USER. THE PURPOSE OF USING
C     INTERNAL UNITS IS TO HAVE A CORRESPONDENCE BETWEEN LOCATION(GRID
C     COORDINATES) AND PARTICULAR AREA SOURCE POSITIONS. THIS IS
C     ACCOMPLISHED THROUGH THE USE OF THE AREA SOURCE MAP ARRAY (IA
C     ARRAY). THIS ALLOWS DETERMINATION AS TO WITHIN WHICH AREA SOURCE
C     ANY COORDINATE POINT RESIDES.
C
C    THE THIRD SYSTEM, X, Y, IS AN UPWIND, CROSSWIND COORDINATE SYSTEM
C     WITH REFERENCE TO EACH RECEPTOR. THE X-AXIS IS DIRECTED UPWIND
C     (SAME AS WIND DIRECTION FOR THE PERIOD). IN ORDER TO DETERMINE
C     DISPERSION PARAMETER VALUES AND EVALUATE EQUATIONS FOR
C     CONCENTRATIONS, DISTANCES IN THIS SYSTEM MUST BE IN KILOMETERS.
C
C->->->-> SECTION B -  DATA INPUT LISTS.
C
C      CARD VARIABLES AND FORMAT.
C             THE REQUIRED AND OPTIONAL CARD TYPES USED AS INPUT TO
C         RAM  ARE DESCRIBED BELOW:
C
C      CARDS 1 - 3  ALPHANUMERIC DATA FOR TITLES. FORMAT(20A4)
C
C             (THESE THREE CARDS ARE REQUIRED)
C        LINE1 - 80 ALPHANUMERIC CHARACTERS.
C        LINE2 - 80 ALPHANUMERIC CHARACTERS.
C        LINE3 - 80 ALPHANUMERIC CHARACTERS.
C
C      CARD 4  CONTROL AND CONSTANTS.  FORMAT(FREE)
C
C           (THIS CARD IS REQUIRED)
C        IDATE(1) -  2-DIGIT YEAR FOR THIS RUN.
C        IDATE(2) -  STARTING JULIAN DAY FOR THIS RUN.
C        IHSTRT   -  STARTING HOUR FOR THIS RUN.
C        NPER     -  NUMBER OF AVERAGING PERIODS TO BE RUN.
C        NAVG     -  NUMBER OF HOURS IN AN AVERAGING PERIOD.
C        IPOL     -  POLLUTANT INDICATOR; IS 3 FOR SO2, 4 FOR SUSPENDED
C                      PARTICULATE.
C        MUOR     -  MODEL INDICATOR;  IS 1 FOR URBAN, 2 FOR RURAL.
C        NSIGP    -  NUMBER OF POINT SOURCES FROM WHICH CONC. CONTRIB.
C                      ARE DESIRED (MAX = 25).
C        NSIGA    -  NUMBER OF AREA SOURCES FROM WHICH CONC. CONTRIB.
C                      ARE DESIRED (MAX=10).
C        NAV5     -  ADDITIONAL AVERAGING TIME FOR HIGH-FIVE TABLE;
C                      MOST LIKELY EQUAL TO 2, 4, 6, OR 12.
C        CONONE   -  MULTIPLIER TO CONVERT USER UNITS TO KILOMETERS.
C                         EXAMPLE MULTIPLIERS:
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C                    FEET TO KM     3.048E-04                            RAM02810
C                    MILES TO KM    1.609344                             RAM02820
C                    METERS TO KM   1.0E-03                              RAM02830
C    UNITS     -  NUMBER OF USER UNITS PER SMALLEST AREA SOURCE SIDE RAM02840
C                  LENGTH. (IF NOT USING AREA SOURCES, UNITS            RAM02850
C                        SHOULD EQUAL 1.)                               RAM02860
C    Z         -  RECEPTOR HEIGHT (METERS)                              RAM02870
C    HAFL      -  POLLUTANT HALF-LIFE, SECONDS. AN ENTRY OF ZERO WILLRAM02880
C                  CAUSE SKIPPING OF POLLUTANT LOSS CALCULATIONS.      RAM02890
C                                                                       RAM02900
C    *****************************************************              RAM02910
C    *    RAM  IS CAPABLE OF GENERATING A                   *           RAM02920
C    *  LARGE QUANTITY OF PRINTED INFORMATION UNLESS SOME *             RAM02930
C    *  OF THESE OPTIONS TO DELETE OUTPUT ARE USED          *           RAM02940
C    *  LIBERALLY.                                          *           RAM02950
C    *****************************************************              RAM02960
C                                                                       RAM02970
C                                                                       RAM02980
C  CARD 5.  OPTIONS.  FORMAT(50I1)                                      RAM02990
C                                                                       RAM03000
C        (THIS CARD IS REQUIRED)                                        RAM03010
C    1 = EMPLOY OPTION (OR YES);   0 = DON'T USE OPTION (OR NO).        RAM03020
C                                                                       RAM03030
C   TECHNICAL OPTIONS:                                                  RAM03040
C    IOPT(1)   -  NO STACK DOWNWASH.                                    RAM03050
C    IOPT(2)   -  NO GRADUAL PLUME RISE.                                RAM03060
C    IOPT(3)   -  USE BUOYANCY INDUCED DISPERSION.                      RAM03070
C    IOPT(4)   -  NOT USED THIS VERSION.                                RAM03080
C                                                                       RAM03090
C   INPUT OPTIONS:                                                      RAM03100
C    IOPT(5)   -  WILL YOU INPUT POINT SOURCES?                         RAM03110
C    IOPT(6)   -  WILL YOU INPUT AREA SOURCES?                          RAM03120
C    IOPT(7)   -  WILL YOU USE EMISSIONS FROM PREVIOUS RUN? (UNIT 9) RAM03130
C    IOPT(8)   -  MET. DATA ON CARDS? (FROM UNIT 11 OTHERWISE)          RAM03140
C    IOPT(9)   -  READ HOURLY PT. SOURCE EMISSIONS. (UNIT 15)           RAM03150
C    IOPT(10)  -  READ HOURLY AREA SOURCE EMISSIONS. (UNIT 16)          RAM03160
C    IOPT(11)  -  SPECIFY SIGNIF. PT. SOURCES.                          RAM03170
C    IOPT(12)  -  SPECIFY SIGNIF. AREA SOURCES.                         RAM03180
C    IOPT(13)  -  NOT USED THIS VERSION.                                RAM03190
C                                                                       RAM03200
C   RECEPTOR OPTIONS                                                    RAM03210
C    IOPT(14)  -  WILL YOU ENTER RECEPTORS BY SPECIFYING COORDINATES?RAM03220
C    IOPT(15)  -  DO YOU WANT RAM TO GENERATE RECEPTORS DOWNWIND OF   RAM03230
C                   SIGNIF. PT. SOURCES? (WILL DO SO BY AVG-PERIOD)   RAM03240
C    IOPT(16)  -  DO YOU WANT RAM TO GENERATE RECEPTORS DOWNWIND OF   RAM03250
C                   SIGNIF. AREA SOURCES? (WILL DO SO BY AVG-PERIOD) RAM03260
C    IOPT(17)  -  DO YOU WANT RAM TO GENERATE A HONEYCOMB ARRAY OF    RAM03270
C                   RECEPTORS TO COVER A SPECIFIC AREA?               RAM03280
C    IOPT(18)  -  WILL YOU INPUT RADIAL DISTANCES (UP TO 5) TO        RAM03290
C                   GENERATE A POLAR COORDINATE RECEPTOR ARRAY        RAM03300
C                   (36 RECEPTORS FOR EACH DISTANCE)                  RAM03310
C    IOPT(19)  -  NOT USED THIS VERSION                                RAM03320
C                                                                       RAM03330
C   PRINTED OUTPUT OPTIONS                                              RAM03340
C    IOPT(20)  -  DELETE POINT SOURCE LIST                              RAM03350
C    IOPT(21)  -  DELETE AREA SOURCE LIST AND MAP                       RAM03360
C    IOPT(22)  -  DELETE EMISSIONS WITH HEIGHT TABLE                    RAM03370
C    IOPT(23)  -  DELETE RESULTANT MET. DATA SUMMARY FOR                RAM03380
C                   AVERAGING PERIOD.                                 RAM03390
C    IOPT(24)  -  DELETE ALL HOURLY OUTPUT (PT., AREA, & SUMMARIES)    RAM03400
C    IOPT(25)  -  DELETE HOURLY POINT CONTRIBUTIONS                     RAM03410
C    IOPT(26)  -  DELETE MET. DATA ON HR. PT. CONTRIB.                  RAM03420
C    IOPT(27)  -  DELETE PLUME HT. AND DIST. TO FINAL RISE ON           RAM03430
C                   HR. PT. CONTRIB.                                  RAM03440
C    IOPT(28)  -  DELETE HOURLY AREA CONTRIBUTIONS                      RAM03450
C    IOPT(29)  -  DELETE MET. DATA ON HR. AREA CONTRIB.                 RAM03460
C    IOPT(30)  -  DELETE HOURLY SUMMARY.                                RAM03470
C    IOPT(31)  -  DELETE MET. DATA ON HOURLY SUMMARY.                   RAM03480
C    IOPT(32)  -  DELETE ALL AVG-PERIOD OUTPUT                          RAM03490
C    IOPT(33)  -  DELETE POINT AVG-PERIOD CONTRIBUTIONS.                RAM03500
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C          IOPT(34) -  DELETE AREA AVG-PERIOD CONTRIBUTIONS.
C          IOPT(35) -  DELETE AVG-PERIOD SUMMARY.
C          IOPT(36) -  DELETE AVERAGE CONCENTRATIONS & HI-FIVE TABLE.
C          IOPT(37) -  NOT USED THIS VERSION.
C
C        DEFAULT OPTION
C          IOPT(38) - SET DEFAULT OPTION
C
C        OTHER CONTROL AND OUTPUT OPTIONS:
C          IOPT(39) -  RUN IS PART OF A SEGMENTED RUN.
C * * * * * SEE CAUTION BELOW * * * * *
C          IOPT(40) -  WRITE PARTIAL CONC. TO DISK OR TAPE.(UNIT 10)
C * * * * * SEE NOTE BELOW * * * * *
C          IOPT(41) -  WRITE HOURLY CONC. TO DISK OR TAPE.(UNIT 12)
C * * * * * SEE NOTE BELOW * * * * *
C          IOPT(42) -  WRITE AVG-PERIOD CONC. TO DISK OR TAPE.(UNIT 13)
C          IOPT(43) -  PUNCH AVG-PERIOD CONCENTRATIONS ON CARDS.(UNIT 1)
C          IOPT(44) -  NOT USED THIS VERSION.
C          IOPT(45) -  NOT USED THIS VERSION.
C          IOPT(46) -  NOT USED THIS VERSION.
C          IOPT(47) -  NOT USED THIS VERSION.
C          IOPT(48) -  NOT USED THIS VERSION.
C          IOPT(49) -  NOT USED THIS VERSION.
C          IOPT(50) -  NOT USED THIS VERSION.
C
C* * * * * CAUTION ON USING OPTION 40. * * * * *
C
C             A TREMENDOUS FILE OF MANY RECORDS CAN
C             CAN BE GENERATED BY EMPLOYING OPTION 40.
C             THE USER WILL NEED TO WRITE THE SOFTWARE
C             TO PROCESS THIS FILE ALSO. BE SURE YOU
C             PLAN AHEAD BEFORE USING THIS OPTION.
C             ALTHOUGH THE AUTHORS FEEL IT IS  UNLIKELY
C             TO EMPLOY OPTIONS 39 AND 40 ON THE SAME RUN,
C             IT IS POSSIBLE TO DO SO. HOWEVER, NOTE THAT
C             THE SECOND AND SUBSEQUENT SEGMENTS WILL NOT
C             SKIP OVER PREVIOUSLY GENERATED PARTIAL CONC.
C             FILES. THEREFORE UNLESS THE EXECUTIVE CONTROL
C             LANGAGE HAS BEEN CHANGED SO THAT UNIT 10
C             ACCESSES A DIFFERENT FILE ON EACH SEGMENT,
C             ANY PREVIOUSLY GENERATED PARTIAL CONCENTRATION
C             FILES WILL BE DESTROYED BY WRITING OVER THESE
C             FILES.
C
C
C* * ** * NOTE ON OUTPUT FILES* * * * *
C
C             THE AUTHORS FEEL THAT THE OUTPUT FILES
C             GENERATED BY OPTIONS 41 AND 42 ARE USEFUL
C             ONLY WHEN THE RECEPTORS ARE SET FOR THE RUN
C             AND NOT VARYING FROM ONE AVG-PER TO ANOTHER.
C             THEREFORE THESE OPTIONS CAN BE USED WITH OPTIONS
C             14 AND 18, BUT A PROGRAM TERMINATION WILL
C             OCCUR IF TRYING TO USE OPTIONS 41 OR 42 IN
C             COMBINATION WITH ANY OF OPTIONS 15, 16, OR 17.
C
C
C        CARD 6.  WIND.  FORMAT(FREE)
C             (THIS CARD IS REQUIRED)
C
C          HANE       -  ANEMOMETER HEIGHT (METERS)
C          PL(I),I=1,6 -  WIND SPEED POWER LAW PROFILE EXPONENTS FOR EACH
C                         STABILITY.
C
C         *****DEFAULT OPTION NOTE*****
C
C              SELECTION OF THE DEFAULT OPTION CAUSES PL
C           TO BE SET TO THE VALUES DESCRIBED ABOVE UNDER
C           DEFAULT OPTION DESCRIPTION. UNDER THIS OPTION,
C           CARD 6 IS STILL REQUIRED  TO INPUT HANE.
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C        ALL OTHER DATA ON THE CARD WILL BE IGNORED.
C
C
C     CARD TYPE 7.  POINT SOURCE CARD.  FORMAT(3A4,8F8.2)
C
C          (USED IF OPTION 5 = 1 AND OPTION 7 = 0)
C      (UP TO 250 POINT SOURCE CARDS ARE ALLOWED.)
C
C       PNAME(I,NPT)I=1,3 -  12 CHARACTER POINT SOURCE IDENTIFICATION.
C       SOURCE(1,NPT)   -  EAST COORDINATE OF POINT SOURCE (USER UNITS)
C       SOURCE(2,NPT)   -  NORTH COORDINATE OF POINT SOURCE (USER UNITS)
C       SOURCE(3,NPT)   -  SULFUR DIOXIDE EMISSION RATE (G/SEC).
C       SOURCE(4,NPT)   -  PARTICULATE EMISSION RATE (G/SEC).
C       SOURCE(5,NPT)   -  PHYSICAL STACK HEIGHT (METERS).
C       SOURCE(6,NPT)   -  STACK GAS TEMPERATURE (KELVIN).
C       SOURCE(7,NPT)   -  STACK INSIDE DIAMETER (METERS).
C       SOURCE(8,NPT)   -  STACK GAS EXIT VELOCITY (M/SEC).
C
C        CARD WITH 'ENDP' IN COLS 1-4 IS USED TO SIGNIFY THE
C         END OF THE POINT SOURCES.
C
C     CARD TYPE 8.  AREA SOURCE CARD.  FORMAT(3A4,6F10.2)
C
C           (USED IF OPTION 6 = 1 AND OPTION 7 =0)
C      (ONE CARD FOR EACH AREA SOURCE, UP TO
C         100 AREA SOURCE CARDS ALLOWED.)
C
C       ANAME(J,NAS),J=1,3 - 12 CHAR. AREA SOURCE INDENT.
C       ASORC(1,NAS) - EAST COORD. OF SW CORNER OF AREA SOURCE
C                        (USER UNITS).
C       ASORC(2,NAS) - NORTH COORD. OF SW CORNER OF AREA SOURCE
C                        (USER UNITS).
C       ASORC(5,NAS) - SIDE LENGTH OF AREA SOURCE (USER UNITS).
C       ASORC(3,NAS) - SULFUR DIOXIDE EMISSION RATE FOR ENTIRE
C                        AREA (G/SEC).
C       ASORC(4,NAS) - PARTICULATE EMISSION RATE FOR ENTIRE
C                        AREA (G/SEC).
C       ASORC(6,NAS) - AREA SOURCE HEIGHT (METERS).
C
C      (NOTE THAT ASORC(5,NAS) - SIDE LENGTH IS READ OUT OF ORDER
C        TO CONFORM WITH THE EXISTING ORDER OF IPP EMISSIONS DATA.)
C
C        CARD WITH 'ENDA' IN COLS 1 -4 IS USED
C           TO SIGNIFY THE END OF THE AREA SOURCES.
C
C     CARD TYPE 9.  SPECIFIED SIGNIFICANT PT. SOURCES.  FORMAT(26I3)
C
C      (USED IF OPTION 11 = 1; NSIGP MUST BE NON-ZERO.)
C       INPT               -  NUMBER OF USER SPECIFIED SIGNIFICANT SOURCES.
C       MPS(I),I=1,NPT -  POINT SOURCE NUMBERS USER WANTS CONSIDERED
C                            SIGNIFICANT.
C
C     CARD TYPE 10. INFO. ASSOCIATED WITH AREA SOURCES. FORMAT(FREE)
C      (THIS CARD IS REQUIRED ONLY IF IOPT(6)=1)
C
C       FH          - FRACTION OF AREA SOURCE HEIGHT WHICH IS PHYSICAL
C                       HEIGHT.
C       XLIM        - DISTANCE LIMIT ON INTEGRATION FOR AREA SOURCE (USER
C                       UNITS). XLIM CANNOT EXCEED 116 KM.
C       NHTS        - INTEGER NUMBER OF HEIGHTS TO BE USED FOR AREA
C                       SOURCES (MIN=1,MAX=3).
C       HINT        - HEIGHT(S) (METERS) FOR AREA SOURCE INTEGRATIONS.
C                       THIS IS AN ARRAY OF FROM ONE TO THREE ELEMENTS.
C
C     CARD TYPE 11. BREAKPOINT HEIGHTS. FORMAT(FREE)
C
C      (THIS CARD IS REQUIRED ONLY WHEN CARD TYPE 10 IS USED.)
C
C        BPH  -BREAKPOINT HEIGHTS (METERS) BETWEEN AREA SOURCE HEIGHTS.
C                 THESE VALUES DEFINE THE BOUNDS OF HEIGHTS CLASSES.
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C              BPH IS AN ARRAY OF TWO ELEMENTS. ONE VALUE WILL BE READ
C              IF NHTS ON PREVIOUS CARD IS 1 OR 2. TWO VALUES READ FOR
C              NHTS=3. IF NHTS IS 1, THE VALUE OF BPH MUST BE LARGER
C              THAN ANY AREA HEIGHT IN THE DATA SET FOR THE RUN.
C
C       CARD TYPE 12. SPECIFY SIGNIF. AREA SOURCES. FORMAT(26I3)
C
C        (USED IF IOPT(12)=1; NSIGA MUST BE NON-ZERO.)
C
C         INAS      - NUMBER OF USER SPECIFIED SIGNIFICANT AREA SOURCES
C                     (MAX=10).
C         MAS       - AREA SOURCE NUMBERS USER WANTS TO CONSIDER SIGNIF.
C
C       CARD TYPE 13. MET. DATA IDENTIFIERS.  FORMAT(FREE)
C
C        (USED IF OPTION 8 = 0)
C
C         ISFCD     -  SFC MET STATION IDENTIFIER      (5 DIGITS)
C         ISFCYR    -  YEAR OF SFC MET DATA            (2 DIGITS)
C         IMXD      -  UPPER-AIR STATION IDENTIFIER    (5 DIGITS)
C         IMXYR     -  YEAR OF MIXING HEIGHT DATA      (2 DIGITS)
C
C       CARD TYPE 14.  POLAR COORDINATE RECEPTORS.  FORMAT(FREE)
C
C        (USED IF OPTION 18 = 1)
C
C         RADIL(I),I= 1,5 -  ONE TO FIVE RADIAL DISTANCES (REST OF FIVE
C                             ARE ZEROS) EACH OF WHICH GENERATES 36
C                             RECEPTORS AROUND POINT CENTX, CENTY ON
C                             AZIMUTHS 10 TO 360 DEGREES. (USER UNITS)
C         CENTX     -  EAST COORDINATE ABOUT WHICH RADIALS ARE CENTERED.
C                         (USER UNITS)
C         CENTY     -  NORTH COORDINATE ABOUT WHICH RADIALS ARE CENTERED.
C                             (USER UNITS)
C
C       CARD TYPE 15.  RECEPTOR.  FORMAT(2A4,2F10.3,F10.0)
C
C        (USED IF OPTION 14 = 1)
C        (REMEMBER, 180 IS TOTAL NUMBER OF RECEPTORS ALLOWED IN RAM)
C
C         RNAME(I),I=1,2 -  8 DIGIT ALPHANUMERIC STATION IDENTIFICATION.
C         RREC       -  EAST COORDINATE OF RECEPTOR (USER UNITS)
C         SREC       -  NORTH COORDINATE OF RECEPTOR (USER UNITS)
C
C          CARD WITH 'ENDR' IN COLS 1-4 IS USED TO SIGNIFY THE END OF
C           THE RECEPTOR CARDS. (NEEDED ONLY IF IOPT(14)=1.)
C
C       CARD TYPE 16. HONEYCOMB BOUNDARIES. FORMAT(FREE)
C            (USED IF OPTION 17 = 1)
C
C        (HONEYCOMB RECEPTORS WILL ONLY BE GENERATED FOR THE AREA
C         DEFINED BY THESE BOUNDS)
C
C         NOTE, IF BOUNDARY VARIABLES ARE INPUT AS ZERO, BOUNDARIES
C         WILL BE THE SAME AS THE AREA SOURCE REGION. HOWEVER, IF
C         NO AREA SOURCES ARE INPUT AND IF HONEYCOMB RECEPTORS ARE
C         TO BE GENERATED, THIS CARD MUST HAVE BOUNDARIES INCLUDED
C         TO PROVIDE THE BOUNDS FOR RECEPTOR GENERATION.
C
C         GRIDSPACE - GRID SPACING (DISTANCE BETWEEN) FOR HONEYCOMB
C                     RECEPTORS (USER UNITS).
C         HRMIN      - MINIMUM EAST COORDINATE (USER UNITS).
C         HRMAX      - MAXIMUM EAST COORDINATE (USER UNITS).
C         HSMIN      - MINIMUM NORTH COORDINATE (USER UNITS).
C         HSMAX      - MAXIMUM NORTH COORDINATE (USER UNITS).
C
C
C       CARD TYPE 17.  SEGMENTED RUN. FORMAT(FREE)
C        (USED IF OPTION 39=1)
C
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C         IDAY      -  NUMBER OF DAYS PREVIOUSLY PROCESSED.
C         LDRUN     -  LAST DAY TO BE PROCESSED IN THIS RUN.
C
C      CARD TYPE 18.  METEOROLOGY.  FORMAT(FREE)
C
C          (USED IF OPTION 5 = 1)
C       (ONE CARD FOR EACH HOUR OF THE SIMULATION.)
C         JYR       -  YEAR OF MET DATA. (2 DIGITS)
C         DAY1      -  JULIAN DAY OF MET DATA.
C         JHR       -  HOUR OF MET DATA.
C         IKST      -  STABILITY CLASS FOR THIS HOUR.
C         QU        -  WIND SPEED FOR THIS HOUR (M/SEC).
C         QTEMP     -  AMBIENT AIR TEMPERATURE FOR THIS HOUR (KELVIN).
C         QTHETA    -  WIND DIRECTION FOR THIS HOUR (DEGREES AZIMUTH FROM
C                       WHICH THE WIND BLOWS).
C         QHL       -  MIXING HEIGHT FOR THIS HOUR (METERS).
C
C->->->-> SECTION C -  INPUT  FILE DESCRIPTIONS.
C
C     INPUT FILE (UNIT 11) METEOROLOGICAL DATA (USED IF IOPT(8)=0)
C
C      RECORD 1
C
C         ID           SFC STATION IDENTIFIER, 5 DIGITS
C         IYEAR        YEAR OF SURFACE DATA, 2 DIGITS
C         IDM          MIX HT STATION IDENTIFIER, 5 DIGITS
C         IYR          YEAR OF MIX HT DATA, 2 DIGITS
C
C      RECORD TYPE 2 (ONE FOR EACH DAY OF YEAR)
C
C         JYR          YEAR
C         IMO          MONTH
C         DAY1         JULIAN DAY
C         IKST(24)     STABILITY CLASS
C         QU(24)       WIND SPEED, METERS PER SECOND
C         QTEMP(24)    AMBIENT AIR TEMPERATURE, KELVIN
C         DUMR(24)     FLOW VECTOR TO 10 DEG, DEGREES AZIMUTH
C         QTHETA(24)   RANDOMIZED FLOW VECTOR, DEGREES AZIMUTH
C         HLH(2,24)    MIXING HEIGHT, METERS
C
C    INPUT FILE(UNIT 15)  POINT SOURCE HOURLY EMISSION DATA
C          (USED IF IOPT(9)=1)
C
C     RECORD TYPE 1 (ONE FOR EACH HOUR OF SIMULATION)
C
C         IDATA        DATE-TIME INDICATOR CONSISTING OF YEAR,
C                       JULIAN DAY,AND HOUR: YYDDDHH.
C         SOURCE(IPOL,I),I=1,NPT  EMISSION RATE FOR THE POLLUTANT IPOL
C                                   FOR EACH SOURCE, GRAMS PER SECOND.
C
C    INPUT FILE(UNIT 16) AREA SOURCE HOURLY EMISSION DATA
C          (USED IF IOPT(10) = 1)
C
C     RECORD TYPE 1 (ONE FOR EACH HOUR OF SIMULATION)
C
C         IDATA         DATE-TIME INDICATOR CONSISTING OF YEAR,
C                        JULIAN DAY, AND HOURS YYDDDHH.
C
C         ASORC(IPOL,I),I=1,NAS  EMISSION RATE FOR THE POLLUTANT IPOL
C                           FOR EACH SOURCE, GRAMS PER SECOND FOR EACH AREA
C
C->->->-> SECTION D - OUTPUT PUNCHED CARD DESCRIPTION
C
C     OUTPUT PUNCHED CARDS (UNIT 1) AVERAGE CONCENTRATIONS
C                         (PUNCHED IF IOPT(43)=1)
C
C      CARD TYPE 1 (ONE FOR EACH RECEPTOR FOR EACH AVERAGING TIME)
C
C         CC:1-4       WORD'CNTL' PUNCHED
C         CC:5         BLANK
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C          CC:6-15      RREC  EAST COORDINATE OF RECEPTOR, USER UNITS       RAM06310
C          CC:16-25     SREC  NORTH COORDINATE OF RECEPTOR, USER UNITS      RAM06320
C          CC:26-35     GWU   CONCENTRATION FOR AVERAGING TIME, MICROG/M**3RAM06330
C          CC:36-45     ACHI(K) CONC. FROM  AREAS,MICROG/M**3               RAM06340
C          CC:46-55     PCHI(K) CONC. FROM POINTS,MICROG/M**3               RAM06350
C          CC:56-60     K     RECEPTOR NUMBER                               RAM06360
C          CC:61-65     IDATE(1)     YEAR                                   RAM06370
C          CC:66-70     IDATE(2)     JULIAN DAY                             RAM06380
C          CC:71-75     NE     ENDING HOUR FOR AVG-PER.                     RAM06390
C          CC:76-80     NAVG    NUMBER OF HOURS IN AVG-PER.                 RAM06400
C                                                                           RAM06410
C->->->->-> SECTION E - OUTPUT FILE DESCRIPTIONS                            RAM06420
C                                                                           RAM06430
C      OUTPUT FILE (UNIT 10) PARTIAL CONCENTRATIONS (USED IF IOPT(40)=1)    RAM06440
C                                                                           RAM06450
C       RECORD TYPE 1                                                       RAM06460
C                                                                           RAM06470
C         NPER          NUMBER OF PERIODS                                   RAM06480
C         NAVG          NUMBER OF HOURS IN AVERAGING PERIOD.                RAM06490
C         LINE1(14)     80 ALPHANUMERIC CHARACTERS FOR TITLE.               RAM06500
C         LINE2(14)     80 ALPHANUMERIC CHARACTERS FOR TITLE.               RAM06510
C         LINE3(14)     80 ALPHANUMERIC CHARACTERS FOR TITLE.               RAM06520
C                                                                           RAM06530
C       RECORD TYPE 2 (FROM  RAM ) (ONE FOR EACH AVERAGING PERIOD)          RAM06540
C                                                                           RAM06550
C         NRECEP        NUMBER OF RECEPTORS                                 RAM06560
C         NPT           NUMBER OF POINT SOURCES                             RAM06570
C         NAS            NUMBER OF AREA SOURCES                             RAM06580
C         RREC(I),I=1,NRECEP  EAST COORDINATE OF RECEPTOR, USER UNITS       RAM06590
C         SREC(I),I=1,NRECEP  NORTH COORDINATE OF RECEPTOR, USER UNITS      RAM06600
C                                                                           RAM06610
C           FOR EACH SIMULATION HOUR, NRECEP RECORDS OF TYPE 3              RAM06620
C           ARE GENERATED FOLLOWED BY NRECEP RECORDS OF TYPE 4.             RAM06630
C                                                                           RAM06640
C       RECORD TYPE 3 (ONE FOR EACH RECEPTOR FOR EACH SIMULATED HOUR,       RAM06650
C                        FROM PT )                                          RAM06660
C                                                                           RAM06670
C         IDATE         YEAR AND JULIAN DAY                                 RAM06680
C         LH            HOUR                                                RAM06690
C         K             RECEPTOR NUMBER                                     RAM06700
C         PARTC(J),J=1,NPT  CONCENTRATION AT RECEPTOR K FROM POINT          RAM06710
C                            SOURCE J, G/M**3.                              RAM06720
C                                                                           RAM06730
C       RECORD TYPE 4 (ONE FOR EACH RECEPTOR FOR                            RAM06740
C                      EACH SIMULATED HOUR ,FROM JMHARE)                    RAM06750
C                                                                           RAM06760
C         IDATE         YEAR AND JULIAN DAY                                 RAM06770
C         LH            HOUR                                                RAM06780
C         KREC          RECEPTOR NUMBER                                     RAM06790
C         PARTC(J),J=1,NAS  CONCENTRATION AT RECEPTOR KREC FROM AREA        RAM06800
C                           SOURCE J, G/M**3                                RAM06810
C                                                                           RAM06820
C      OUTPUT FILE (UNIT 12) HOURLY CONCENTRATIONS (USED IF IOPT(41)=1)     RAM06830
C                                                                           RAM06840
C       RECORD 1                                                            RAM06850
C                                                                           RAM06860
C         NPER          NUMBER OF PERIODS                                   RAM06870
C         NAVG          NUMBER OF HOURS IN AVERAGING PERIOD.                RAM06880
C         LINE1(14)     80 ALPHANUMERIC CHARACTERS FOR TITLE.               RAM06890
C         LINE2(14)     80 ALPHANUMERIC CHARACTERS FOR TITLE.               RAM06900
C         LINE3(14)     80 ALPHANUMERIC CHARACTERS FOR TITLE.               RAM06910
C                                                                           RAM06920
C       RECORD 2                                                            RAM06930
C                                                                           RAM06940
C         NRECEP        NUMBER OF RECEPTORS.                                RAM06950
C         RREC(I),I=1,NRECEP  EAST COORDINATE OF RECEPTOR, USER UNITS       RAM06960
C         SREC(I),I=1,NRECEP  NORTH COORDINATE OF RECEPTOR, USER UNITS      RAM06970
C                                                                           RAM06980
C       RECORD TYPE 3 (ONE FOR EACH SIMULATED HOUR)                         RAM06990
C                                                                           RAM07000
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C         IDATE(2)     JULIAN DAY                                             RAM07010
C         LH           HOUR                                                   RAM07020
C         PHCHI(I),I=1,NRECEP  HOURLY CONCENTRATION FOR EACH RECEPTOR,        RAM07030
C                              G/M**3.                                        RAM07040
C                                                                             RAM07050
C      OUTPUT FILE (UNIT 13) AVERAGING-PERIOD CONCENTRATIONS (USED IF         RAM07060
C                            IOPT(42)=1)                                      RAM07070
C                                                                             RAM07080
C       RECORD 1                                                              RAM07090
C                                                                             RAM07100
C         NPER         NUMBER OF PERIODS                                      RAM07110
C         NAVG         NUMBER OF HOURS IN AVERAGING PERIOD.                   RAM07120
C         LINE1(14)    80 ALPHANUMERIC CHARACTERS FOR TITLE.                  RAM07130
C         LINE2(14)    80 ALPHANUMERIC CHARACTERS FOR TITLE.                  RAM07140
C         LINE3(14)    80 ALPHANUMERIC CHARACTERS FOR TITLE.                  RAM07150
C                                                                             RAM07160
C       RECORD 2                                                              RAM07170
C                                                                             RAM07180
C         NRECEP       NUMBER OF RECEPTORS.                                   RAM07190
C         RREC(I),I=1,NRECEP  EAST COORDINATE OF RECEPTOR, USER UNITS         RAM07200
C         SREC(I),I=1,NRECEP  NORTH COORDINATE OF RECEPTOR, USER UNITS        RAM07210
C                                                                             RAM07220
C       RECORD TYPE 3 (ONE FOR EACH SIMULATED AVERAGING PERIOD)               RAM07230
C                                                                             RAM07240
C         IDATE(2)     JULIAN DAY                                             RAM07250
C         NE           ENDING HOUR OF PERIOD                                  RAM07260
C         PCHI(K),K=1,NRECEP  AVERAGING PERIOD CONCENTRATION FOR EACH         RAM07270
C                              RECEPTOR, G/M**3.                              RAM07280
C                                                                             RAM07290
C->->->-> SECTION F - TEMPORARY FILE DESCRIPTIONS                             RAM07300
C                                                                             RAM07310
C      TEMPORARY FILE (UNIT 9) EMISSION DATA                                  RAM07320
C                 (ALWAYS WRITTEN; READ IF IOPT (7)= 1)                       RAM07330
C                                                                             RAM07340
C       RECORD 1                                                              RAM07350
C                                                                             RAM07360
C         NPT          NUMBER OF POINT SOURCES                                RAM07370
C         NAS          NUMBER OF AREA  SOURCES                                RAM07380
C                                                                             RAM07390
C       RECORD 2                                                              RAM07400
C                                                                             RAM07410
C         IMPS(I), I=1,25        NUMBER OF POINT SOURCE SIGNIF.               RAM07420
C         SOURCE(I,J),           POINT SOURCE INFO.                           RAM07430
C          I=1,9                                                              RAM07440
C          J=1,NPT                                                            RAM07450
C                                                                             RAM07460
C       RECORD 3                                                              RAM07470
C                                                                             RAM07480
C         IMAS(I),I=1,10           ORDER OF AREA SOURCE SIGNIF.               RAM07490
C         RMIN                     WEST BOUNDARY OF AREA SOURCES              RAM07500
C         RMAX                     EAST BOUNDARY OF AREA SOURCES              RAM07510
C         SMIN                     SOUTH BOUNDARY OF AREA SOURCES             RAM07520
C         SMAX                     NORTH BOUNDARY OF AREA SOURCES             RAM07530
C         IRSIZE                   FIRST DIMENSION OF IA ARRAY                RAM07540
C         ISSIZE                   SECOND DIMENSION OF IA ARRAY               RAM07550
C         ASORC(I,J)               AREA SOURCE INFO.                          RAM07560
C          I=1,6                                                              RAM07570
C          J=1,NAS                                                            RAM07580
C         IA(I,J)                 AREA SOURCE MAP ARRAY.                      RAM07590
C              I=1,IRSIZE                                                     RAM07600
C              J=1,ISSIZE                                                     RAM07610
C                                                                             RAM07620
C      TEMPORARY FILE (UNIT 14) VALUES FOR HIGH-FIVE TABLES (USED IF          RAM07630
C                               IOPT(39)=1)                                   RAM07640
C                                                                             RAM07650
C       ONLY RECORD                                                           RAM07660
C                                                                             RAM07670
C         IDAY(ON WRITE)      NUMBER OF DAYS PROCESSED                        RAM07680
C         IDAYS(ON READ       NUMBER OF DAYS PREVIOUSLY PROCESSED             RAM07690
C         SUM(180)            CUMULATION OF LONG-TERM CONCENTRATION,(G/M**3RAM07700
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C        NHR                NUMBER OF HOURS PROCESSED
C        DAY1A              JULIAN DAY OF START OF LENGTH OF RECORD.
C        HR1                START HOUR OF LENGTH OF RECORD
C        HMAXA(3,5,180,5)   HIGHEST FIVE CONCENTRATIONS (G/M**3), AND
C                            ASSOCIATED DAY AND HOUR, FOR EACH RECEPTOR,
C                            FOR FIVE DIFFERENT AVERAGING TIMES.
C
C->->->-> SECTION G -  COMMON, DIMENSION, AND DATA STATEMENTS.
C
      COMMON /AB/ DELM,DELN
      COMMON /AMOST/ DELH,FH,HINT(3),H,HL,IO,IOPT(50),KST,MUOR,NHTS,RC,R
     1CZ,SY,SZ,TEMP,TLOS,UPL,X,Y,Z
      COMMON /AE/ HC1(10),PXUCOR(6,9),PXUEXR(6,9),PXCOR(6,9),PXEXR(6,9),
     1PXUCOF(6,9),PXUEXP(6,9),PXCOF(6,9),PXEXP(6,9),AXCOR(6,9),AXEXR(6,9
     2),AXCOF(6,9),AXEXP(6,9)
      COMMON /AEFM/ ITYPE(180),ICODE(180),UNITS,RREU(180),SREU(180)
      COMMON /AEFGKM/ NRECEP,RREC(180),SREC(180),IDATE(2),LH,NPT
      COMMON /AEG/ SOURCE(9,250)
      COMMON /AEGIKM/ IPOL,CONTWO,SINT,COST,U,HANE,PL(6)
      COMMON /AEK/ ASORC(6,100)
      COMMON /AEM/ NSIGP,MPS(25),NSIGA,MAS(10)
      COMMON /AF/ GRIDSP,HRMIN,HRMAX,HSMIN,HSMAX
      COMMON /AGK/ PARTC(250)
      COMMON /AGM/ PSAV(250),HSAV(250),DH(250),DSAV(250),UPH(250),HPR(25
     10),FP(250),PCHI(180),PHCHI(180),PSIGS(180,26),PHSIGS(180,26),IPSIG
     2S(250),GRANDT(180)
      COMMON /AIL/ CIN(3,200),XLIM
      COMMON /AIM/ HARE(3)
      COMMON /AK/ BPH(2),RMIN,SMIN,RMAX,SMAX,NAS,IRSIZE,ISSIZE,IA(25,25)
     1,IWD,IASIGS(100),NBP
      COMMON /AKL/ IH,NS,KREC
      COMMON /AKM/ BPHM(2),ACHI(180),AHCHI(180),ASIGS(180,11),AHSIGS(180
     1,11)
      COMMON /AM/ LINE1(20),LINE2(20),LINE3(20),IPOLU,QTHETA(24),QU(24),
     1QHL(24),QTEMP(24),IKST(24),NAVG,NB,RNAME(2,180)
      COMMON /AN/ HMAXA(5,180,5),NDAY(5,180,5),IHR(5,180,5),CONC(180,5),
     1JDAY
C
      DIMENSION MODEL(2,2), DEG(3)
      DIMENSION PNAME(3,250), ANAME(3,100), IFREQ(7), DUMR(24), HLH(2,24
     1), IMPS(25), TITLE(2), TABLE(4,21), RADIL(5)
      DIMENSION IDUMR(24)
      DIMENSION SUM(180), NTIME(5), ATIME(5), IPOLT(2), DNAME(36)
      DIMENSION STAR(2,180), SIGNIF(250), IMAS(10)
C
       DIMENSION PLL(6,2),CF(5)
C
      EQUIVALENCE (PNAME(1,1),RNAME(1,1),ANAME(1,1))
      EQUIVALENCE (UPH(1),SIGNIF(1))
      EQUIVALENCE (DH(1),TABLE(1,1))
C
      DATA IN /5/ ,IO /6/
      DATA DEG /90.,180.,270./
      DATA IFREQ /7*0/ ,BLNK /' '/ ,BNK4 /'    '/ ,IRIN /'I'/ ,IRPC /'C'
     1/
      DATA TITLE /'SO2 ','PART'/ ,IRSIZE,ISSIZE /1,1/
      DATA IRDIM /25/ ,ISDIM /25/
      DATA MODEL /'URBA','N','RURA','L'/
      DATA IPOLT /'SO2 ','PART'/
      DATA RMIN /99999./ ,SMIN /99999./
      DATA ENDP /'ENDP'/ ,ENDA /'ENDA'/ ,ENDR /'ENDR'/
      DATA MAXP /250/ ,MAXA /100/ ,STR /'*'/ ,STAR /360*' '/
C        MAXP EQUALS SECOND DIMENSION OF THE ARRAY NAMED: SOURCE.
C        MAXA EQUAL SECOND DIMENSION OF THE ARRAY NAMED : ASORC.
      DATA DNAME /' 10',' 20',' 30',' 40',' 50',' 60',' 70',' 80',
     1' 90','100','110','120','130','140','150','160','170','
     2180','190','200','210','220','230','240','250','260','270
     3','280','290','300','310','320','330','340','350','360','/
     4
      DATA NTIME /1,3,8,24,0/ ,ATIME /1.,3.,8.,24.,0./
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      DATA ITMIN1 /9999/,IDIV8 /0/, IDIV24 /0/, ICALM /0/
      DATA C/'C'/,ICFL3/0/,ICFL8/0/,ICFL24/0/,CF/5*' '/
C
C
C      DEFAULT POWER LAW EXPONENTS.
C
      DATA PLL/.15,.15,.20,.25,.30,.30,.07,.07,.10,.15,.35,.55/
C
C->->->->SECTION H - FLOW DIAGRAM
C
C       RELATION OF SUBROUTINES IN  RAM
C
C                    RAM
C                     !
C                     ! * BLOCK DATA
C                     !
C                     ! * READ DATA FROM CARDS
C                     ! * INITIALIZE SGZ
C                     ! * INITIALIZE SYSZ
C                     ! * INITIALIZE JMHREC
C                     !
C                     ! * READ EMISSION DATA FROM
C                     !        CARDS OR DISK
C                     !
C                     ! * READ RECEPTOR DATA
C                     !
C                     !
C             --------! - LOOP FOR CALENDAR DAYS
C             !       !
C             !  -----! - LOOP FOR AVERAGING TIME
C             !  !    !
C             !  !    ! * READ MET DATA
C             !  !    ! * ANGARC
C             !  !    !
C             !  !    ! * GREC (ENTRY TO JMHREC)
C             !  !    !
C             !  !    ! * JMHHON
C             !  !    !
C             !  !  --! - LOOP ON HOURS
C             !  !  ! !
C             !  !  ! ! - (READ HOURLY EMISSIONS)
C             !  !  ! !
C             !  !  ! ! * * * * * PT
C             !  !  ! !            !
C             !  !  ! !       ------- - LOOP ON RECEPTORS
C             !  !  ! !       !    !
C             !  !  ! !       !  --- - LOOP ON SOURCES
C             !  !  ! !       !  ! !
C             !  !  ! !       !  ! ! * * RCON
C             !  !  ! !       !  ! !      !
C             !  !  ! !       !  ! !      ** SYZ(ENTRY TO SYSZ)
C             !  !  ! !       !  ! !
C             !  !  ! !       !  --*
C             !  !  ! !       -----*
C             !  !  ! !
C             !  !  ! ! * * * * * JMH54
C             !  !  ! !            !
C             !  !  ! !            !  * * JMHCZ
C             !  !  ! !                     !
C             !  !  ! !                     !  * * SIGZ(ENTRY TO SGZ)
C             !  !  ! !
C             !  !  ! !
C             !  !  ! !
C             !  !  ! ! * * * * * JMHARE
C             !  !  ! !            !
C             !  !  ! !       -----!LOOP ON RECEPTORS
C             !  !  ! !       !    !
C             !  !  ! !       !    ! * * JMHPOL
C             !  !  ! !            !
C             !  !  ! !       !    !
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```
C              !  !  !  !          -----*
C              !  !  !  ! * RANK
C              !  !  !  !
C              !  !  !  ! * OUTPT
C              !  !  !  !
C              !  !  --*
C              !  !     !
C              !  !     ! * OUTAV  (ENTRY POINT IN OUTPT)
C              !  !     !
C              !  -----*
C              !        !
C              --------*
C                       !
C                     STOP
C
C->->->->SECTION I - RUN SET-UP AND READ FIRST 6 INPUT CARDS.
C
      CALL WSTCLK
C
C        INITIALIZATIONS............
C        THE FOLLOWING 18 STATEMENTS MAY BE DELETED FOR USE ON
C        COMPUTERS THAT ZERO CORE LOCATIONS USED BY A PROBLEM
C        PRIOR TO EXECUTION.
      NP=0
      NHR=0
      NP3=0
      NP8=0
      NP24=0
      NPX=0
      RMAX=0.
      SMAX=0.
      DO 10 I=1,21
      TABLE(1,I)=0.
10    TABLE(2,I)=0.
      DO 40 I=1,180
      SUM(I)=0.
      DO 30 J=1,5
      CONC(I,J)=0.
      DO 20 K=1,5
20    HMAXA(J,I,K)=0.
30    CONTINUE
40    CONTINUE
C        UNIT 11 - DISK INPUT OF MET DATA--USED WHEN IOPT(8)=0.
C        UNIT 10 - DISK OUTPUT OF PARTIAL CONCENTRATIONS
C         AT EACH RECEPTOR--USED WHEN IOPT(40) = 1.
C        UNIT 12 TAPE/DISK OUTPUT OF HRLY CONCENTRATIONS-IF IOPT(41)=1.
C        UNIT 13 TAPE/DISK OUTPUT OF CONCENTRATIONS FOR AVERAGING PERIOD
C           USED IF IOPT(42) = 1.
C        UNIT 14 TAPE/DISK STORAGE FOR SUMMARY INFO, USED IF IOPT(39)=1.
C        UNIT 15 - TAPE/DISK INPUT OF HOURLY POINT SOURCE EMISSIONS
C         -- USED IF IOPT(9) = 1.
C        UNIT 16 - TAPE/DISK INPUT OF HOURLY AREA SOURCE EMISSIONS--
C         -- USED IF IOPT (10)=1.
C
C        READ CARDS 1-3  (SEE DESCRIPTION, SECTION B).
C
      READ (IN,1790) LINE1,LINE2,LINE3
C
C        READ CARD TYPE 4  (SEE DESCRIPTION, SECTION B).
C
      READ (IN,*) IDATE(1),IDATE(2),IHSTRT,NPER,NAVG,IPOL,MUOR,NSIGP,NSI
     1GA,NAV5,CONONE,UNITS,Z,HAFL
C        THE  FORMAT REFERRED TO BY AN * IS UNIVACS FREE FIELD INPUT.
C        VARIABLES MUST BE SEPARATED BY COMMAS.
C        THIS IS SIMILAR TO IBM'S LIST DIRECTED IO.
      WRITE (IO,2100) (MODEL(K,MUOR),K=1,2)
      WRITE (IO,2110) LINE1,LINE2,LINE3
      IPOLU=IPOLT(1)
      IF (IPOL.EQ.4) IPOLU=IPOLT(2)
      IF (NSIGP.LE.25) GO TO 50
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C          WRITE ERROR STATEMENT                                                RAM09790
      WRITE (IO,1860) NSIGP                                                     RAM09800
      CALL WAUDIT
      STOP                                                                      RAM09810
50    IF (NSIGA.LE.10) GO TO 60                                                 RAM09820
C          WRITE ERROR STATEMENT                                                RAM09830
      WRITE (IO,1870) NSIGA                                                     RAM09840
      CALL WAUDIT
      STOP                                                                      RAM09850
60    IP=IPOL-2                                                                 RAM09860
      CONTWO=CONONE*UNITS                                                       RAM09870
C                                                                               RAM09880
C        READ CARD TYPE 5  (SEE DESCRIPTION, SECTION B).                        RAM09890
C                                                                               RAM09900
      READ (IN,1800) (IOPT(I),I=1,50)                                           RAM09910
C                                                                               RAM09920
      IF(IOPT(38).NE.1) GO TO 55                                                RAM09930
C                                                                               RAM09940
C        DEFAULT SELECTION RESULTS IN THE FOLLOWING: USE STACK DOWNWASH         RAM09950
C        (1); USE FINAL PLUME RISE (2); USE BUOYANCY-INDUCED DISPERSION         RAM09960
C        (3); WRITE HIGH-5 TABLES (36) BUT DELETE ALL OTHER OUTPUT (23,         RAM09970
C        24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, AND 35).                   RAM09980
C                                                                               RAM09990
C        EMISSIONS FROM PREVIOUS RUN ARE NOT ALLOWED.                           RAM10000
C        MET DATA ON CARDS ARE NOT ALLOWED.                                     RAM10010
C        SPECIFICATION OF SIGNIFICANT POINT AND AREA                            RAM10020
C        SOURCES IS NOT ALLOWED.                                                RAM10030
C                                                                               RAM10040
         IOPT(1)=0                                                              RAM10050
         IOPT(2)=1                                                              RAM10060
         IOPT(3)=1                                                              RAM10070
         IOPT(7)=0                                                              RAM10080
         IOPT(8)=0                                                              RAM10090
         IOPT(11)=0                                                             RAM10100
         IOPT(12)=0                                                             RAM10110
         IOPT(15)=0                                                             RAM10120
         IOPT(16)=0                                                             RAM10130
         IOPT(23)=1                                                             RAM10140
         IOPT(24)=1                                                             RAM10150
         IOPT(25)=1                                                             RAM10160
         IOPT(26)=1                                                             RAM10170
         IOPT(27)=1                                                             RAM10180
         IOPT(28)=1                                                             RAM10190
         IOPT(29)=1                                                             RAM10200
         IOPT(30)=1                                                             RAM10210
         IOPT(31)=1                                                             RAM10220
         IOPT(32)=1                                                             RAM10230
         IOPT(33)=1                                                             RAM10240
         IOPT(34)=1                                                             RAM10250
         IOPT(35)=1                                                             RAM10260
         IOPT(36)=0                                                             RAM10270
         IOPT(39)=0                                                             RAM10280
         IOPT(40)=0                                                             RAM10290
         IOPT(41)=0                                                             RAM10300
         IOPT(42)=0                                                             RAM10310
         IOPT(43)=0                                                             RAM10320
C                                                                               RAM10330
C        SET HALF-LIFE FOR DEFAULT OPTION                                       RAM10340
C                                                                               RAM10350
         IF(IPOL.EQ.3)HAFL=14400.                                               RAM10360
         IF(IPOL.NE.3)HAFL=0.                                                   RAM10370
C                                                                               RAM10380
C                                                                               RAM10390
C         SET POWER LAW WIND PROFILE EXPONENTS;                                 RAM10400
C         SET START HOUR, AND AVERAGING PERIOD ;                                RAM10410
C         SET THE NUMBER OF SIGNIFICANT POINT AND                               RAM10420
C         AREA SOURCES.                                                         RAM10430
C                                                                               RAM10440
         MUOR=1                                                                 RAM10450
         IHSTRT=1                                                               RAM10460
```

```
          NAVG=24
          NSIGP=0
          NSIGA=0
55      CONTINUE
C
C
C
C
C
C
C            WRITE GENERAL INPUT INFORMATION
        WRITE (IO,2120) (MODEL(K,MUOR),K=1,2),TITLE(IP),NPER,NAVG,IHSTRT,I
       1DATE(2),IDATE(1),UNITS,CONONE,CONTWO,Z
        DAY1A=IDATE(2)
        HR1=IHSTRT
        IF (HAFL.GT.0.0) GO TO 70
        TLOS=0.
        WRITE (IO,2130)
        GO TO 80
70      WRITE (IO,2140) HAFL
        TLOS=693./HAFL
C            IF HI-5 TABLE,IOPT(36),SEE IF FIFTH AVG-TIME NECESSARY.
80      IF (IOPT(36).EQ.1) GO TO 90
        NAVT=5
C
C           FOR DEFAULT OPTION
C           ADDITIONAL AVERAGING PERIOD SET TO ZERO.
        IF(IOPT(38).EQ.1) NAV5=0
C
        IF (NAV5.EQ.1.OR.NAV5.EQ.3.OR.NAV5.EQ.8.OR.NAV5.EQ.24.OR.NAV5.EQ.0
       1) NAVT=4
        NTIME(5)=NAV5
        ATIME(5)=NAV5
        WRITE (IO,2150) NAVT
        IF (NAVT.EQ.5) WRITE (IO,2160) NAV5
C            IF NO SIGNIF. SOURCES TO BE CONSIDERED,ELIMINATE CONTRIB OUTPUT
90      IF (NSIGP.GT.0) GO TO 100
        IOPT(25)=1
        IOPT(33)=1
100     IF (NSIGA.GT.0) GO TO 110
        IOPT(28)=1
        IOPT(34)=1
110     WRITE (IO,2170) (I,IOPT(I),I=1,4)
        WRITE (IO,2180) (I,IOPT(I),I=5,13)
        WRITE (IO,2190) (I,IOPT(I),I=14,19)
        WRITE (IO,2200) (I,IOPT(I),I=20,31)
        WRITE (IO,2210) (I,IOPT(I),I=32,38)
        WRITE (IO,2220) (I,IOPT(I),I=39,50)
        ASSIGN 230 TO KTRL
        MIX=2
        IF (MUOR.EQ.1) GO TO 120
        ASSIGN 240 TO KTRL
        MIX=1
C            EXECUTE ASSIGN STATEMENTS FOR URBAN-RURAL SELECTIONS IN
C              SUBROUTINES.
120     CALL SGZ
        CALL SYSZ
        CALL JMHREC
C
C
C          READ CARD TYPE 6 (SEE DESCRIPTION, SECTION B).
C
C        SWITCH TO SELECT DEFAULT POWER LAW EXPONENTS,
C        TERRAIN ADJUSTMENT FACTORS.
C
        IF(IOPT(38).NE.0)READ(IN,*)HANE
        IF(IOPT(38).EQ.0)READ(IN,*)HANE,PL
        IF(IOPT(38).EQ.0) GO TO 105
        DO 104 I1=1,6
        PL(I1)=PLL(I1,MUOR)
```

```
104    CONTINUE
105    CONTINUE
C
C         MUCH OF THE FOLLOWING PROGRAM SECTION IS BASED UPON
C         RAMQ IN THE PREV. RAM.  THIS SECTION IS RESPONSIBLE
C         FOR MAKING THE NECESSARY DATA CONVERSIONS ON THE RAW
C         EMISSIONS DATA IN ORDER TO ESTABLISH A STANDARD
C         DATA BANK WHICH WILL BE ACCEPTABLE. A CONVERSION FACTOR
C         FROM USER UNITS TO KILOMETERS IS APPLIED WHEN NECESSARY.
C
C->->->->SECTION J - INPUT AND PROCESS EMISSION INFORMATION.
C
C              IF NOT  READING EMISSIONS FROM PREVIOUS RUN, SKIP
C
       IF (IOPT(7).EQ.0) GO TO 140
       READ (9) NPT,NAS
C
C        IF NOT USING POINT SOURCES, SKIP
       IF (NPT.EQ.0) GO TO 130
C              READ RECORD OF POINT SOURCE INFORMATION
       READ (9) (IMPS(I),I=1,25),((SOURCE(I,J),I=1,9),J=1,NPT)
C
C         IF NOT USING AREA SOURCES, SKIP
130    IF (NAS.EQ.0) GO TO 630
C              READ RECORD OF AREA SOURCE INFORMATION
       READ (9) (IMAS(I),I=1,10),RMIN,RMAX,SMIN,SMAX,IRSIZE,ISSIZE,((ASOR
      1C(I,J),I=1,6),J=1,NAS),((IA(I,J),I=1,IRSIZE),J=1,ISSIZE)
       GO TO 630
C
C         ARE THERE POINT SOURCES? IF NOT, SKIP TO AREA SECTION.
140    IF (IOPT(5).EQ.0) GO TO 310
C
       IF (IOPT(20).EQ.1) GO TO 150
C            WRITE HEADING FOR POINT SOURCE INFO.
       WRITE (IO,2240)
150    NPT=0
C
C         BEGIN LOOP TO READ THE POINT SOURCE INFORMATION
160    NPT=NPT+1
       IF (NPT.LE.MAXP) GO TO 170
       READ (IN,1810) DUM
       IF (DUM.EQ.ENDP) GO TO 270
C        WRITE ERROR STATEMENT
       WRITE (IO,1880) MAXP
       CALL WAUDIT
       STOP
C
C         READ CARD TYPE 7  (SEE DESCRIPTION, SECTION B).
C
170    READ (IN,1820) (PNAME(I,NPT),I=1,3),(SOURCE(I,NPT),I=1,8)
C         CARD WITH     'ENDP'   IN COL 1-4 IS USED TO SIGNIFY END OF
C         POINT SOURCES.
       IF (PNAME(1,NPT).EQ.ENDP) GO TO 270
C         CALCULATE BUOYANCY FACTOR
       D=SOURCE(7,NPT)
C           FOLLOWING VARIABLE IS BRIGGS' F WITHOUT TEMPERATURE FACTOR.
       SOURCE(9,NPT)=2.45153*SOURCE(8,NPT)*D*D
C         2.45153 IS GRAVITY OVER FOUR.
       TS=SOURCE(6,NPT)
       IF (TS.GT.293.) GO TO 180
       HF=SOURCE(5,NPT)
       GO TO 200
180    F=SOURCE(9,NPT)*(TS-293.)/TS
       IF (F.GE.55.) GO TO 190
C         ONLY BUOYANCY PLUME RISE IS CONSIDERED HERE.
       HF=SOURCE(5,NPT)+21.425*F**0.75/3.
       GO TO 200
190    HF=SOURCE(5,NPT)+38.71*F**0.6/3.
C         HSAV, DSAV, AND PSAV ARE USED FOR TEMPORARY STORAGE
200    HSAV(NPT)=HF
```

```
C         DETERMINE HEIGHT INDEX.
      DO 210 IH=2,9
      IF (HF.LT.(HC1(IH)-.01)) GO TO 220
210   CONTINUE
      IH=10
220   IS=IH-1
      GO TO KTRL, (230,240)
230   A=PXUCOF(2,IS)
      B=PXUEXP(2,IS)
      GO TO 250
240   A=PXUCOR(2,IS)
      B=PXUEXR(2,IS)
250   DSAV(NPT)=(A*HF**B)*SOURCE(IPOL,NPT)/3.
C         AN ESTIMATE OF THE POTENTIAL IMPACT OF EACH SOURCE IS
C           DETERMINED AND STORED IN DSAV. MAX CONCENTRATION IS
C           DETERMINED BY CHI(MAX)=(A*H**B)*Q/U WHERE
C           A IS THE COEFFICENT AND B IS THE EXPONENT, OF
C           MAXIMUM CHI*U/Q VALUES PREDETERMINED FOR B STABILITY
C           AND A SPECIFIC EFFECTIVE HEIGHT RANGE. PLUME RISE
C           IS CALCULATED FOR B STABILITY AND 3 M/SEC WIND SPEED.
C
      IPSIGS(NPT)=0
      IF (IOPT(20).EQ.1) GO TO 260
C         LIST POINT SOURCE INFORMATION.
      WRITE (IO,2250) NPT,(PNAME(J,NPT),J=1,3),(SOURCE(K,NPT),K=1,8),DSA
     1V(NPT),HSAV(NPT),F
C         SOURCE COORDINATES ARE TRANSFORMED INTO INTERNAL UNITS.
260   SOURCE(1,NPT)=SOURCE(1,NPT)/UNITS
      SOURCE(2,NPT)=SOURCE(2,NPT)/UNITS
C
C         GO BACK AND READ DATA FOR ANOTHER POINT SOURCE.
      GO TO 160
C
270   NPT=NPT-1
C
C
C         RANK  25  HIGHEST POINT SOURCES.
      NLIM=25
      IF (NPT.LT.25) NLIM=NPT
      DO 290 I=1,NLIM
      SIGMAX=-1.0
      DO 280 J=1,NPT
      IF (DSAV(J).LE.SIGMAX) GO TO 280
      SIGMAX=DSAV(J)
      LMAX=J
280   CONTINUE
C         IMPS IS THE SOURCE NUMBER IN ORDER OF SIGNIFICANCE.
      IMPS(I)=LMAX
C         PSAV IS THE CALC. CONC. IN ORDER OF SIGNIFICANCE.
      PSAV(I)=SIGMAX
290   DSAV(LMAX)=-1.0
C         OUTPUT TABLE OF RANKED SOURCES.
      WRITE (IO,2260) TITLE(IP)
      DO 300 I=1,NLIM
      WRITE (IO,2270) I,PSAV(I),IMPS(I)
300   CONTINUE
C       IF NOT EXPECTING AREA SOURCES, SKIP.
310   IF (IOPT(6).EQ.0) GO TO 550
      NAS=0
      IF (IOPT(21).EQ.1) GO TO 320
      WRITE (IO,2280)
C         BEGIN LOOP TO READ AREA SOURCES
320   NAS=NAS+1
      IF (NAS.LE.MAXA) GO TO 330
      READ (IN,1810) DUM
      IF (DUM.EQ.ENDA) GO TO 390
C         WRITE ERROR STATEMENT
      WRITE (IO,1890) MAXA
      CALL WAUDIT
      STOP
```

```
C
C         READ CARD TYPE 8  (SEE DESCRIPTION, SECTION B)
C
330    READ (IN,1830) (ANAME(J,NAS),J=1,3),ASORC(1,NAS),ASORC(2,NAS),ASOR
      1C(5,NAS),ASORC(3,NAS),ASORC(4,NAS),ASORC(6,NAS)
       IF (ANAME(1,NAS).EQ.ENDA) GO TO 390
       IF (IOPT(22).EQ.1) GO TO 370
C         STORE AREA EMISSIONS ACCORDING TO HEIGHT CLASS
       DO 340 I=1,20
       HC=I*5.
       IF (ASORC(6,NAS).LE.HC) GO TO 350
340    CONTINUE
       GO TO 360
C          ADD EMISSION RATE INTO TABLE AND TOTAL.
350    TABLE(3,I)=TABLE(3,I)+ASORC(IPOL,NAS)
360    TABLE(3,21)=TABLE(3,21)+ASORC(IPOL,NAS)
C          CALCULATE SIDE LENGTH IN INTERNAL UNITS
370    WA=ASORC(5,NAS)/UNITS
C        CONVERTS SIDE LENGTH IN INTERNAL UNITS TO METERS AND ADJUST
C        EMISSION RATE
       SF=WA*1000.*CONTWO
C        DETERMINE EMISSION RATE IN G/SEC-M**2.
       ASORC(3,NAS)=ASORC(3,NAS)/(SF*SF)
       ASORC(4,NAS)=ASORC(4,NAS)/(SF*SF)
C        FOR AREA SOURCES, SIGNIFICANCE IS DETERMINED BY SELECTING A
C        SPECIFIED NUMBER OF AREA SOURCES (N < OR = 10) WHICH HAVE
C        THE HIGHEST EMISSION RATE TIMES THE SIDE LENGTH OF THE AREA
C        SOURCE.
       SIGNIF(NAS)=SF*ASORC(IPOL,NAS)
       IF (IOPT(21).EQ.1) GO TO 380
       WRITE (IO,2290) NAS,(ANAME(J,NAS),J=1,3),(ASORC(K,NAS),K=1,6),SIGN
      1IF(NAS)
C        CO-ORDINATES ARE TRANSLATED TO INTERNAL UNITS.
380    ASORC(1,NAS)=ASORC(1,NAS)/UNITS
       ASORC(2,NAS)=ASORC(2,NAS)/UNITS
       ASORC(5,NAS)=WA
C        READJUST AREA SOURCE REGION BOUNDARIES AS REQUIRED
C           (INTERNAL UNITS).
       RC=ASORC(1,NAS)
       SC=ASORC(2,NAS)
       IF (RC.LT.RMIN) RMIN=RC
       IF (SC.LT.SMIN) SMIN=SC
C         RC,SC, AND WA IN INTERNAL UNITS.
       A=RC+WA
       B=SC+WA
       IF (A.GT.RMAX) RMAX=A
       IF (B.GT.SMAX) SMAX=B
C           GO BACK AND READ DATA FOR ANOTHER AREA SOURCE.
       GO TO 320
C
390    NAS=NAS-1
C
C           DETERMINE SIZE OF AREA ARRAY
       A=RMAX-RMIN+.0005
       IRSIZE=A
       IF (A-FLOAT(IRSIZE).GT.0.001) GO TO 410
       B=SMAX-SMIN+.0005
       ISSIZE=B
       IF (B-FLOAT(ISSIZE).GT.0.001) GO TO 420
C         CHECK SIZE OF AREA SOURCE REGION WITH DIMENSIONS OF IA ARRAY.
       IF (IRSIZE.GT.IRDIM) GO TO 400
       IF (ISSIZE.LE.ISDIM) GO TO 430
C          WRITE ERROR STATEMENT
400    WRITE (IO,1900) IRSIZE,ISSIZE
       CALL WAUDIT
       STOP
C          WRITE ERROR STATEMENT
410    WRITE (IO,1910)
       CALL WAUDIT
       STOP
```

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C        WRITE ERROR STATEMENT                                          RAM13230
420   WRITE (IO,1920)                                                   RAM13240
      CALL WAUDIT
      STOP                                                              RAM13250
C       ZERO IA ARRAY(AREA SOURCE MAP ARRAY)                            RAM13260
430   DO 440 I=1,IRSIZE                                                 RAM13270
      DO 440 J=1,ISSIZE                                                 RAM13280
440   IA(I,J)=0                                                         RAM13290
C       LOOP THROUGH ALL AREA SOURCES AND STORE SOURCE NO'S IN IA.      RAM13300
C        THERE CAN BE NO OVERLAPPING OF AREA SOURCES. LOCATIONS ARE     RAM13310
C        DEFINED BY THE INTERNAL GRID SYSTEM.                           RAM13320
      A=RMIN-1.                                                         RAM13330
      B=SMIN-1.                                                         RAM13340
      DO 460 NS=1,NAS                                                   RAM13350
      IR=ASORC(1,NS)-A+.0005                                            RAM13360
      IS=ASORC(2,NS)-B+.0005                                            RAM13370
      IWA=ASORC(5,NS)+.0005-1.                                          RAM13380
      IQ=IS+IWA                                                         RAM13390
      ID=IR+IWA                                                         RAM13400
      DO 450 I=IR,ID                                                    RAM13410
      DO 450 J=IS,IQ                                                    RAM13420
C       CHECK TO SEE IF IA ALREADY HAS A SOURCE IN THE I,J TH POSITION  RAM13430
      IF (IA(I,J).EQ.0) GO TO 450                                       RAM13440
C        WRITE ERROR STATEMENT                                          RAM13450
      WRITE (IO,1930) IA(I,J),I,J,NS                                    RAM13460
      CALL WAUDIT
      STOP                                                              RAM13470
C       STORE SOURCE NO. IN APPROPRIATE POSITION                        RAM13480
450   IA(I,J)=NS                                                        RAM13490
460   CONTINUE                                                          RAM13500
C       PRINT OUT AREA SOURCE MAP ARRAY(IA) IF NOT TOO LARGE TO FIT     RAM13510
C        ACROSS PAGE.                                                   RAM13520
      IF (IRSIZE.GT.41) GO TO 480                                       RAM13530
      WRITE (IO,2300)                                                   RAM13540
      ID=ISSIZE+1                                                       RAM13550
      DO 470 IQ=1,ISSIZE                                                RAM13560
      J=ID-IQ                                                           RAM13570
470   WRITE (IO,2310) J,(IA(I,J),I=1,IRSIZE)                            RAM13580
      WRITE (IO,2320) (I,I=1,IRSIZE)                                    RAM13590
      GO TO 490                                                         RAM13600
C        WRITE EXPLANATORY STATEMENT                                    RAM13610
480   WRITE (IO,1940)                                                   RAM13620
C       PRINT OUT ORIGIN CO-ORDINATES AND BOUNDARIES IN INTERNAL UNITS  RAM13630
490   WRITE (IO,2330) A,B,IRSIZE,ISSIZE                                 RAM13640
      WRITE (IO,2340) RMIN,RMAX,SMIN,SMAX                               RAM13650
C                                                                       RAM13660
C        RANK HIGHEST 10 AREA SOURCES                                   RAM13670
      NLIM=10                                                           RAM13680
      IF (NAS.LT.10) NLIM=NAS                                           RAM13690
      DO 510 I=1,NLIM                                                   RAM13700
      SIGMAX=-1.0                                                       RAM13710
      DO 500 J=1,NAS                                                    RAM13720
      IF (SIGNIF(J).LE.SIGMAX) GO TO 500                                RAM13730
      SIGMAX=SIGNIF(J)                                                  RAM13740
      LMAX=J                                                            RAM13750
500   CONTINUE                                                          RAM13760
      IMAS(I)=LMAX                                                      RAM13770
      HPR(I)=SIGMAX                                                     RAM13780
510   SIGNIF(LMAX)=-1.0                                                 RAM13790
      IF (NSIGA.EQ.0) GO TO 530                                         RAM13800
      WRITE (IO,2350) TITLE(IP)                                         RAM13810
      DO 520 I=1,NLIM                                                   RAM13820
      WRITE (IO,2360) I,HPR(I),IMAS(I)                                  RAM13830
520   CONTINUE                                                          RAM13840
530   DO 540 I=1,NAS                                                    RAM13850
      ASORC(5,I)=ASORC(5,I)*0.5                                         RAM13860
540   IASIGS(I)=0                                                       RAM13870
550   IF (IOPT(22).EQ.1) GO TO 610                                      RAM13880
C                                                                       RAM13890
C            EMISSIONS WITH HEIGHT TABLE.                               RAM13900
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C                                                                       RAM13910
      DO 590 I=1,NPT                                                    RAM13920
      DO 560 J=1,20                                                     RAM13930
      HC=J*5.                                                           RAM13940
      IF (SOURCE(5,I).LE.HC) GO TO 570                                  RAM13950
560   CONTINUE                                                          RAM13960
C        POINT SOURCES WITH PHYSICAL HEIGHTS GT 100 METERS ARE LISTED   RAM13970
C        SEPARATELY.                                                    RAM13980
      WRITE (IO,2370) I,SOURCE(5,I),SOURCE(IPOL,I)                      RAM13990
      GO TO 580                                                         RAM14000
C        ADD EMISSION RATE INTO TABLE AND TOTAL.                        RAM14010
570   TABLE(1,J)=TABLE(1,J)+SOURCE(IPOL,I)                              RAM14020
580   TABLE(1,21)=TABLE(1,21)+SOURCE(IPOL,I)                            RAM14030
590   CONTINUE                                                          RAM14040
C           OUTPUT SOURCE-STRENGTH-HEIGHT TABLE                         RAM14050
C             THIS TABLE DISPLAYS THE TOTAL EMISSIONS FOR BOTH POINT AND RAM14060
C             AREA SOURCES AND THE CUMULATIVE FREQUENCY ACCORDING TO    RAM14070
C             HEIGHT CLASS. REQUIRED INPUT TO RAM, SUCH AS HEIGHT CLASS RAM14080
C             BOUNDARIES FOR AREA SOURCES AND REPRESENTATIVE HEIGHTS FOR RAM14090
C             EACH HEIGHT CLASS, CAN BE DETERMINED FROM THESE TABLES.   RAM14100
      WRITE (IO,2380) TITLE(IP)                                         RAM14110
C          HEIGHT CLASS EMISSIONS ARE IN 1 AND 3.                       RAM14120
C           DETERMINE CUMULATIVE PERCENT IN 2 AND 4.                    RAM14130
      IF (TABLE(1,21).EQ.0.0) TABLE(1,21)=1.0                           RAM14140
      IF (TABLE(3,21).EQ.0.0) TABLE(3,21)=1.0                           RAM14150
      ID=0                                                              RAM14160
      IQ=5                                                              RAM14170
      TABLE(2,1)=TABLE(1,1)/TABLE(1,21)                                 RAM14180
      TABLE(4,1)=TABLE(3,1)/TABLE(3,21)                                 RAM14190
      WRITE (IO,2390) ID,IQ,(TABLE(J,1),J=1,4)                          RAM14200
      DO 600 I=2,20                                                     RAM14210
      IQ=I*5                                                            RAM14220
      ID=IQ-4                                                           RAM14230
      TABLE(2,I)=TABLE(1,I)/TABLE(1,21)+TABLE(2,I-1)                    RAM14240
      TABLE(4,I)=TABLE(3,I)/TABLE(3,21)+TABLE(4,I-1)                    RAM14250
      WRITE (IO,2390) ID,IQ,(TABLE(J,I),J=1,4)                          RAM14260
600   CONTINUE                                                          RAM14270
      IF (NSIGP.EQ.0) TABLE(1,21)=0.0                                   RAM14280
      IF (NSIGA.EQ.0) TABLE(3,21)=0.0                                   RAM14290
      WRITE (IO,2400) TABLE(1,21),TABLE(3,21)                           RAM14300
C         WRITE FIRST EMISSION RECORD                                   RAM14310
610   WRITE (9) NPT,NAS                                                 RAM14320
      IF (NPT.EQ.0) GO TO 620                                           RAM14330
C                                                                       RAM14340
C                                                                       RAM14350
C             WRITE RECORD OF POINT SOURCE INFORMATION                  RAM14360
      WRITE (9) (IMPS(I),I=1,25),((SOURCE(I,J),I=1,9),J=1,NPT)          RAM14370
620   IF (NAS.EQ.0) GO TO 630                                           RAM14380
C            WRITE RECORD OF AREA SOURCE INFORMATION                    RAM14390
      WRITE (9) (IMAS(I),I=1,10),RMIN,RMAX,SMIN,SMAX,IRSIZE,ISSIZE,((ASORAM14400
     1RC(I,J),I=1,6),J=1,NAS),((IA(I,J),I=1,IRSIZE),J=1,ISSIZE)         RAM14410
C                                                                       RAM14420
C->->->->SECTION K - EXECUTE FOR INPUT OF SIGNIFICANT SOURCE NUMBERS.   RAM14430
C                                                                       RAM14440
630   WRITE (IO,2410) NPT,NSIGP                                         RAM14450
      IF (NSIGP.EQ.0) GO TO 700                                         RAM14460
      IF (NSIGP.GT.NPT) NSIGP=NPT                                       RAM14470
      IF (NSIGA.GT.NAS) NSIGA=NAS                                       RAM14480
      IF (IOPT(11).EQ.0) GO TO 660                                      RAM14490
C                                                                       RAM14500
C        READ CARD TYPE 9 (SEE DESCRIPTION, SECTION B).                 RAM14510
C                                                                       RAM14520
      READ (IN,1840) INPT,(MPS(I),I=1,INPT)                             RAM14530
      WRITE (IO,2420) INPT,(MPS(I),I=1,INPT)                            RAM14540
      IF (INPT.LE.NSIGP) GO TO 640                                      RAM14550
C          WRITE ERROR STATEMENT                                        RAM14560
      WRITE (IO,1950) INPT,NSIGP                                        RAM14570
      CALL WAUDIT
      STOP                                                              RAM14580
640   IF (INPT.EQ.0) GO TO 660                                          RAM14590
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C          IF LAST SPECIFIED SOURCE NUMBER IS ZERO WRITE WARNING STATEMENTRAM14600
       IF (MPS(INPT).EQ.0) WRITE (IO,1960)                              RAM14610
       J=INPT+1                                                         RAM14620
       K=1                                                              RAM14630
C         ADD SIGNIFICANT PT. SOURCES DETERMINED FROM RANKED SOURCE LIST RAM14640
C         IF NSIGP GREATER THAN INPT.                                   RAM14650
       IF (J.GT.NSIGP) GO TO 680                                        RAM14660
       DO 650 I=J,NSIGP                                                 RAM14670
       MPS(I)=IMPS(K)                                                   RAM14680
650    K=K+1                                                            RAM14690
       GO TO 680                                                        RAM14700
660    DO 670 I=1,NSIGP                                                 RAM14710
670    MPS(I)=IMPS(I)                                                   RAM14720
680    WRITE (IO,2430) (MPS(I),I=1,NSIGP)                               RAM14730
C         FILL IN SIGNIFICANT POINT SOURCE ARRAY                        RAM14740
       DO 690 I=1,NSIGP                                                 RAM14750
       J=MPS(I)                                                         RAM14760
690    IPSIGS(J)=I                                                      RAM14770
700    IF (IOPT(9).EQ.0) GO TO 720                                      RAM14780
C         SAVE AVERAGE EMISSION RATE                                    RAM14790
       DO 710 I=1,NPT                                                   RAM14800
710    PSAV(I)=SOURCE(IPOL,I)                                           RAM14810
C                                                                       RAM14820
C         IOPT(6) CONTROL OPTION, AREA SOURCE INPUT? 0=NO, 1=YES.       RAM14830
C            IF NO AREA SOURCES, SKIP                                   RAM14840
720    IF (IOPT(6).EQ.0) GO TO 800                                      RAM14850
       WRITE (IO,2440) NAS,NSIGA                                        RAM14860
C                                                                       RAM14870
C           READ CARD TYPE 10                                           RAM14880
C                                                                       RAM14890
       READ (IN,*) FH,XLIM,NHTS,(HINT(I),I=1,NHTS)                      RAM14900
       NBP=NHTS-1                                                       RAM14910
       WRITE (IO,2450) NHTS,(HINT(I),I=1,NHTS)                          RAM14920
       IF (NBP.LE.0) NBP=1                                              RAM14930
C                                                                       RAM14940
C             READ CARD TYPE 11.                                        RAM14950
C                                                                       RAM14960
       READ (IN,*) (BPH(I),I=1,NBP)                                     RAM14970
       WRITE (IO,2460) (BPH(I),I=1,NBP)                                 RAM14980
C         CONVERT TO USER UNITS FOR PRINT OUT. XLIM IS CONVERTED TO KM. RAM14990
       C1=RMIN*UNITS                                                    RAM15000
       C2=RMAX*UNITS                                                    RAM15010
       C3=SMIN*UNITS                                                    RAM15020
       C4=SMAX*UNITS                                                    RAM15030
       C5=XLIM                                                          RAM15040
       XLIM=XLIM*CONONE                                                 RAM15050
       WRITE (IO,2470) FH,C5,C1,C2,C3,C4,IRSIZE,ISSIZE                  RAM15060
       IF (XLIM.LT.116.) GO TO 730                                      RAM15070
C           WRITE ERROR STATEMENT                                       RAM15080
       WRITE (IO,1970) XLIM                                             RAM15090
       CALL WAUDIT
       STOP                                                             RAM15100
730    IF (NSIGA.EQ.0) GO TO 810                                        RAM15110
C         IF NOT SPECIFYING SIGNIF. AREA SOURCES, SKIP                  RAM15120
       IF (IOPT(12).EQ.0) GO TO 760                                     RAM15130
C                                                                       RAM15140
C         READ THE NUMBER OF SIGNIFICANT AREA SOURCES THAT USER         RAM15150
C         WANTS TO SPECIFY AND THE NUMBER DESIGNATIONS OF THOSE SOURCES RAM15160
C         ON CARD TYPE 12.                                              RAM15170
C                                                                       RAM15180
       READ (IN,1840) INAS,(MAS(I),I=1,INAS)                            RAM15190
       WRITE (IO,2480) INAS,(MAS(I),I=1,INAS)                           RAM15200
       IF (INAS.LE.NSIGA) GO TO 740                                     RAM15210
C           WRITE ERROR STATEMENT                                       RAM15220
       WRITE (IO,1950) INAS,NSIGA                                       RAM15230
       CALL WAUDIT
       STOP                                                             RAM15240
740    IF (INAS.EQ.0) GO TO 760                                         RAM15250
C          IF LAST SPECIFIED SOURCE NUMBER IS ZERO WRITE WARNING STATEMENTRAM15260
       IF (MAS(INAS).EQ.0) WRITE (IO,1980)                              RAM15270
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      J=INAS+1                                                          RAM15280
      K=1                                                               RAM15290
C         ADD SIGNIFICANT AREA SOURCES DETERMINED FROM RANKED SOURCE    RAM15300
C                LIST IF NSIGA GREATER THAN INAS.                       RAM15310
      IF (J.GT.NSIGA) GO TO 780                                         RAM15320
      DO 750 I=J,NSIGA                                                  RAM15330
      MAS(I)=IMAS(K)                                                    RAM15340
750   K=K+1                                                             RAM15350
      GO TO 780                                                         RAM15360
C       TRANSFER SIGNIFICANT SOURCES DETERMINED FROM SIGNIFICANT SOURCE RAM15370
C         LIST IF INAS EQUAL ZERO.                                      RAM15380
760   DO 770 I=1,NSIGA                                                  RAM15390
770   MAS(I)=IMAS(I)                                                    RAM15400
780   WRITE (IO,2490) (MAS(I),I=1,NSIGA)                                RAM15410
C                                                                       RAM15420
C         FILL IN SIGNIFICANT AREA SOURCE MARKER ARRAY                  RAM15430
      DO 790 I=1,NSIGA                                                  RAM15440
      J=MAS(I)                                                          RAM15450
790   IASIGS(J)=I                                                       RAM15460
800   CONTINUE                                                          RAM15470
C                                                                       RAM15480
C->->->->SECTION L - CHECK MET DATA IF FROM FILE OF ONE YEAR'S DATA.     RAM15490
C                                                                       RAM15500
810   IF (IOPT(8).EQ.1) GO TO 840                                       RAM15510
C                                                                       RAM15520
C        READ CARD TYPE 13 (SEE DESCRIPTION, SECTION B).                RAM15530
C                                                                       RAM15540
      READ (IN,*) ISFCD,ISFCYR,IMXD,IMXYR                               RAM15550
C        READ ID RECORD FROM PREPROCESSED MET DISK OR TAPE FILE.        RAM15560
      READ (11) ID,IYEAR,IDM,IYM                                        RAM15570
      IF (ISFCD.EQ.ID.AND.ISFCYR.EQ.IYEAR) GO TO 820                    RAM15580
C        WRITE ERROR STATEMENT                                          RAM15590
      WRITE (IO,1990) ISFCD,ISFCYR,ID,IYEAR,IMXD,IMXYR,IDM,IYM          RAM15600
      CALL WAUDIT
      STOP                                                              RAM15610
820   IF (IMXD.EQ.IDM.AND.IMXYR.EQ.IYM) GO TO 830                       RAM15620
C        WRITE ERROR STATEMENT                                          RAM15630
      WRITE (IO,1990) ISFCD,ISFCYR,ID,IYEAR,IMXD,IMXYR,IDM,IYM          RAM15640
      CALL WAUDIT
      STOP                                                              RAM15650
830   WRITE (IO,2500) ISFCD,ISFCYR,IMXD,IMXYR                           RAM15660
C                                                                       RAM15670
C->->->->SECTION M - GENERATE POLAR COORDINATE RECEPTORS.                RAM15680
C                                                                       RAM15690
840   NRECEP=0                                                          RAM15700
      WRITE (IO,2510)                                                   RAM15710
      DO 850 I=1,180                                                    RAM15720
      DO 850 J=1,2                                                      RAM15730
850   RNAME(J,I)=BNK4                                                   RAM15740
      IF (IOPT(18).NE.1) GO TO 890                                      RAM15750
C                                                                       RAM15760
C        READ CARD TYPE 14 (SEE DESCRIPTION, SECTION B).                RAM15770
C                                                                       RAM15780
      READ (IN,*) RADIL,CENTX,CENTY                                     RAM15790
      JA=0                                                              RAM15800
      DO 860 J=1,5                                                      RAM15810
      IF (RADIL(J).EQ.0) GO TO 860                                      RAM15820
      JA=JA+1                                                           RAM15830
860   CONTINUE                                                          RAM15840
      WRITE (IO,2520) CENTX,CENTY,RADIL                                 RAM15850
      DO 880 I=1,36                                                     RAM15860
C           CALCULATE THE ANGLE IN RADIANS                              RAM15870
      A=FLOAT(I)*0.1745329                                              RAM15880
C        0.1745329 IS 2*PI/36                                           RAM15890
      SINT=SIN(A)                                                       RAM15900
      COST=COS(A)                                                       RAM15910
      DO 870 J=1,JA                                                     RAM15920
      NRECEP=I+36*(J-1)                                                 RAM15930
      RREU(NRECEP)=(RADIL(J)*SINT)+CENTX                                RAM15940
C           CALCULATE THE EAST-COORDINATE                               RAM15950
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      SREU(NRECEP)=(RADIL(J)*COST)+CENTY                                RAM15960
C          CALCULATE THE NORTH-COORDINATE                               RAM15970
      ITYPE(NRECEP)=IRPC                                                RAM15980
      RNAME(1,NRECEP)=DNAME(I)                                          RAM15990
C          ALPHANUMERIC INFORMATION WHICH INDICATES DEGREES AZIMUTH     RAM16000
      ENCODE (4,2530,RNAME(2,NRECEP)) RADIL(J)                          RAM16010
C          ENCODE THE FLOATING POINT VARIABLE OF RADIAL DISTANCE        RAM16020
C          TO ALPHANUMERIC REPRESENTATION SO INFO CAN BE PRINTED        RAM16030
870   CONTINUE                                                          RAM16040
880   CONTINUE                                                          RAM16050
      NRECEP=36*JA                                                      RAM16060
C                                                                       RAM16070
C->->->->SECTION N - READ AND PROCESS RECEPTOR INFORMATION.             RAM16080
C                                                                       RAM16090
C          NOW READ CARD TYPE 15 IF NECESSARY. MUST HAVE A CARD WITH    RAM16100
C          'ENDR'IN COLS 1-4 TO INDICATE END OF RECEPTOR CARDS.         RAM16110
C          NO MORE THAN 180 RECEPTORS CAN BE INPUT TO MPTER.            RAM16120
C                                                                       RAM16130
890   IF (IOPT(14).EQ.0) GO TO 940                                      RAM16140
C        START LOOP TO ENTER RECEPTORS.                                 RAM16150
      NRECEP=NRECEP+1                                                   RAM16160
      IF (NRECEP.LE.180) GO TO 910                                      RAM16170
      READ (IN,1810,END=900) DUM                                        RAM16180
      IF (DUM.EQ.ENDR) GO TO 930                                        RAM16190
C        WRITE ERROR STATEMENT                                          RAM16200
900   WRITE (IO,2000)                                                   RAM16210
      CALL WAUDIT
      STOP                                                              RAM16220
C                                                                       RAM16230
C        READ CARD TYPE 15 (SEE DESCRIPTION, SECTION B).                RAM16240
C                                                                       RAM16250
910   READ (IN,1850) (RNAME(J,NRECEP),J=1,2),RREU(NRECEP),SREU(NRECEP)  RAM16260
C        PLACE 'ENDR' IN COLS 1 TO 4 ON CARD FOLLOWING LAST RECEPTOR    RAM16270
C        TO END READING TYPE 15 CARDS.                                  RAM16280
      ITYPE(NRECEP)=IRIN                                                RAM16290
      IF (RNAME(1,NRECEP).EQ.ENDR) GO TO 920                            RAM16300
      GO TO 890                                                         RAM16310
920   RNAME(1,NRECEP)=BNK4                                              RAM16320
930   NRECEP=NRECEP-1                                                   RAM16330
      IF (NRECEP.GT.0) GO TO 940                                        RAM16340
C         WRITE ERROR STATEMENT                                         RAM16350
      WRITE (IO,2010) NRECEP                                            RAM16360
      CALL WAUDIT
      STOP                                                              RAM16370
940   IF (NRECEP.EQ.0) GO TO 960                                        RAM16380
C        PRINT OUT TABLE OF RECEPTORS.    (IN USER UNITS)               RAM16390
      WRITE (IO,2540)                                                   RAM16400
      DO 950 K=1,NRECEP                                                 RAM16410
      WRITE (IO,2550) K,ITYPE(K),(RNAME(J,K),J=1,2),RREU(K),SREU(K)     RAM16420
      RREC(K)=RREU(K)/UNITS                                             RAM16430
      SREC(K)=SREU(K)/UNITS                                             RAM16440
950   ICODE(K)=0                                                        RAM16450
960   NPREC=NRECEP                                                      RAM16460
      IF (IOPT(17).EQ.0) GO TO 990                                      RAM16470
C                                                                       RAM16480
C        READ CARD TYPE 16                                              RAM16490
C                                                                       RAM16500
      READ (IN,*) GRDSPU,HRMNU,HRMXU,HSMNU,HSMXU                        RAM16510
      IF (HRMXU.EQ.0.0) GO TO 970                                       RAM16520
C      IF USER DOESN'T SPECIFY BOUNDARIES FOR HONEYCOMB SOURCES         RAM16530
C      USE AREA SOURCE BOUNDARIES.                                      RAM16540
C      CONVERT INPUT GRID BOUNDARIES(USER UNITS) TO INTERNAL UNITS      RAM16550
      HRMIN=HRMNU/UNITS                                                 RAM16560
      HRMAX=HRMXU/UNITS                                                 RAM16570
      HSMIN=HSMNU/UNITS                                                 RAM16580
      HSMAX=HSMXU/UNITS                                                 RAM16590
      GO TO 980                                                         RAM16600
C      RMIN,RMAX,SMIN,SMAX ARE IN INTERNAL UNITS                        RAM16610
970   HRMIN=RMIN                                                        RAM16620
      HRMAX=RMAX                                                        RAM16630
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      HSMIN=SMIN
      HSMAX=SMAX
C        CONVERT GRIDSP FROM USER UNITS TO INTERNAL UNITS.
980   GRIDSP=GRDSPU/UNITS
C
C->->->->SECTION 0 - POSITION FILES AS REQUIRED.
C
990   IF (IOPT(39).EQ.0) GO TO 1000
C
C        READ CARD TYPE 17 (SEE DESCRIPTION, SECTION B).
C
      READ (IN,*) IDAY,LDRUN
      WRITE (IO,2560) IDAY,LDRUN
      IF (IDAY.EQ.0) GO TO 1000
C        READ INFO FOR HIGH-FIVE TABLE FROM LAST SEGMENT.
      READ (14) IDAYS,SUM,NHR,DAY1A,HR1,HMAXA,NDAY,IHR
      REWIND 14
      IF (IDAY.EQ.IDAYS) GO TO 1000
C         WRITE ERROR STATEMENT
      WRITE (IO,2020) IDAY,IDAYS
      CALL WAUDIT
      STOP
1000  NP=IDAY*(24/NAVG)
C        IF OPTION 40 = 1, WRITE INITIAL INFO TO UNIT 10(PART. CONC.)
      IF (IOPT(40).EQ.1) WRITE (10) NPER,NAVG,LINE1,LINE2,LINE3
      IF (IOPT(41).EQ.0) GO TO 1040
      IF (IOPT(15).EQ.0.AND.IOPT(16).EQ.0.AND.IOPT(17).EQ.0) GO TO 1010
C           WRITE TERMINATION OF RUN STATEMENT
C            (WRONG COMBINATION OF OPTIONS).
      WRITE (IO,2030)
      CALL WAUDIT
      STOP
1010  IF (IDAY.LE.0) GO TO 1030
C        SKIP PREVIOUSLY GENERATED HOURLY RECORDS.
      ISKIP=IDAY*24+2
      DO 1020 I=1,ISKIP
1020  READ (12)
      GO TO 1040
C        WRITE LEAD TWO RECORDS ON HOURLY FILE.
1030  WRITE (12) NPER,NAVG,LINE1,LINE2,LINE3
      WRITE (12) NRECEP,(RREU(I),I=1,NRECEP),(SREU(I),I=1,NRECEP)
1040  IF (IOPT(42).EQ.0) GO TO 1080
      IF (IOPT(15).EQ.0.AND.IOPT(16).EQ.0.AND.IOPT(17).EQ.0) GO TO 1050
C           WRITE TERMINATION OF RUN STATEMENT
C            (WRONG COMBINATION OF OPTIONS).
      WRITE (IO,2030)
      CALL WAUDIT
      STOP
1050  IF (IDAY.LE.0) GO TO 1070
C        SKIP PREVIOUSLY GENERATED AVERAGING-PERIOD FILE.
      ISKIP=NP+2
      DO 1060 I=1,ISKIP
1060  READ (13)
      GO TO 1080
C        WRITE LEAD TWO RECORDS ON AVERAGING PERIOD FILE.
1070  WRITE (13) NPER,NAVG,LINE1,LINE2,LINE3
      WRITE (13) NRECEP,(RREU(I),I=1,NRECEP),(SREU(I),I=1,NRECEP)
      GO TO 1120
1080  IF (IOPT(9).EQ.0) GO TO 1100
      IF (IDAY.EQ.0) GO TO 1100
C         SKIP PREVIOUSLY USED HOURLY PT. EMISSIONS.
      ISKIP=IDAY*24
      DO 1090 I=1,ISKIP
1090  READ (15)
1100  IF (IOPT(10).EQ.0) GO TO 1120
      IF (IDAY.EQ.0) GO TO 1120
C         SKIP PREVIOUSLY USED HOURLY AREA EMISSIONS.
      ISKIP=IDAY*24
      DO 1110 I=1,ISKIP
1110  READ (16)
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1120  IDAY=IDATE(2)-1
      IF (IDAY.LE.0.OR.IOPT(8).EQ.1) GO TO 1140
C        SKIP PREVIOUSLY USED HOURLY MET.  RECORDS.
      DO 1130 I=1,IDAY
1130  READ (11)
1140  CONTINUE
C
C->->->->SECTION P - START LOOPS FOR DAY AND AVG TIME; READ MET DATA.
C
1150  IDAY=IDAY+1
      D=IDAY
      NHRS=0
      IF (IOPT(8).EQ.1) GO TO 1190
C        IF OPTION 8 EQUALS ZERO, INPUT MET DATA OFF DISK (UNIT 11)
      READ (11) JYR,ID,DAY1,IKST,QU,QTEMP,DUMR,QTHETA,HLH
      DO 1151 JM1=1,24
      IDUMR(JM1)=DUMR(JM1)+0.5
 1151 CONTINUE
      IF (JYR.NE.IDATE(1)) GO TO 1160
      IF (DAY1.EQ.D) GO TO 1170
C        DATE ON MET TAPE DOES NOT MATCH INTERNAL DATE
C         WRITE ERROR STATEMENT
1160  WRITE (IO,2040) JYR,IDATE(2),IDATE(1),IDAY
      CALL WAUDIT
      STOP
C        MODIFY WIND VECTOR BY 180 DEGREES. SINCE FLOW VECTORS WERE
C        OUTPUT FROM RAMMET. THIS CONVERTS BACK TO WIND DIRECTIONS.
1170  IDATE(2)=DAY1
      DO 1180 IQ=1,24
      IF (IKST(IQ).EQ.7) IKST(IQ)=6
      QTHETA(IQ)=QTHETA(IQ)+180.
      IF (QTHETA(IQ).GT.360.) QTHETA(IQ)=QTHETA(IQ)-360.
1180  QHL(IQ)=HLH(MIX,IQ)
1190  NB=IHSTRT
      NE=NB+NAVG-1
      IF (NB.GT.0) GO TO 1200
C     WRITE ERROR STATEMENT
      WRITE (IO,2050) IHSTRT
      CALL WAUDIT
      STOP
C        START LOOP FOR AVERAGING PERIOD.
1200  U=0.0
      TEMP=0.0
      DELN=0.0
      DELM=0.0
      DO 1210 I=1,7
1210  IFREQ(I)=0.0
      NRECEP=NPREC
      DO 1240 I=NB,NE
      JHR=I
      DAY2=IDATE(2)
      IF (IOPT(8).EQ.0) GO TO 1220
C
C        READ CARD TYPE 18 IF IOPT(8) =1. (HOURLY MET DATA)
C         (SEE DESCRIPTION, SECTION B).
C
      READ (IN,*) JYR,DAY1,JHR,IKST(JHR),QU(JHR),QTEMP(JHR),QTHETA(JHR),
     1QHL(JHR)
      IF (I.NE.NB) GO TO 1220
C        REDEFINE START HOURS AND DATES AT FIRST HOUR OF EACH
C          AVERAGING PERIOD IF READING HOURLY MET DATA.
C          THE PURPOSE OF THIS IS TO BE ABLE TO CALCULATE
C          FOR SEVERAL AVG-PERIODS THAT ARE NOT CONTINUOUS
C          IN TIME.
      IDATE(1)=JYR
      IHSTRT=JHR
      ISTDAY=DAY1
      IDATE(2)=ISTDAY
      DAY2=IDATE(2)
1220  IF (IKST(JHR).EQ.7) IKST(JHR)=6
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      IF (IOPT(15).EQ.0.AND.IOPT(16).EQ.0.AND.IOPT(23).EQ.1) GO TO 1240 RAM17990
C                                                                       RAM18000
C->->->->SECTION Q - CALCULATE AND  WRITE  MET. SUMMARY INFO.            RAM18010
C                                                                       RAM18020
      IF (IOPT(23).EQ.1) GO TO 1230                                     RAM18030
      IF (I.EQ.NB) WRITE (IO,2570) NAVG,IHSTRT,IDATE                    RAM18040
      WRITE (IO,2580) JHR,QTHETA(JHR),QU(JHR),QHL(JHR),QTEMP(JHR),IKST(JRAM18050
     1HR)                                                               RAM18060
1230  TRAD=QTHETA(JHR)*0.01745329                                       RAM18070
      SINT=SIN(TRAD)                                                    RAM18080
      COST=COS(TRAD)                                                    RAM18090
C        CALCULATE WIND COMPONENTS                                      RAM18100
      URES=QU(JHR)                                                      RAM18110
      A=URES*SINT                                                       RAM18120
      B=URES*COST                                                       RAM18130
      DELM=DELM+A                                                       RAM18140
      DELN=DELN+B                                                       RAM18150
      TEMP=TEMP+QTEMP(JHR)                                              RAM18160
      U=U+URES                                                          RAM18170
      KST=IKST(JHR)                                                     RAM18180
      IFREQ(KST)=IFREQ(KST)+1                                           RAM18190
C        END LOOP TO READ ALL MET DATA FOR AVERAGING PERIOD.            RAM18200
1240  CONTINUE                                                          RAM18210
      IF (IOPT(15).EQ.0.AND.IOPT(16).EQ.0.AND.IOPT(23).EQ.1) GO TO 1310 RAM18220
C        CALCULATE RESULTANT  WIND DIRECTION THETA                      RAM18230
      DELN=DELN/NAVG                                                    RAM18240
      DELM=DELM/NAVG                                                    RAM18250
      THETA=ANGARC(DELM,DELN)                                           RAM18260
C        CALCULATE AVERAGE AND RESULTANT SPEED AND PERSISTENCE.         RAM18270
      U=U/NAVG                                                          RAM18280
      TEMP=TEMP/NAVG                                                    RAM18290
      URES=SQRT(DELN*DELN+DELM*DELM)                                    RAM18300
      A=URES/U                                                          RAM18310
C        DETERMINE MODAL AND AVERAGE STABILITY                          RAM18320
      LSMAX=0                                                           RAM18330
      DO 1250 I=1,7                                                     RAM18340
      LST=IFREQ(I)                                                      RAM18350
      IF (LST.LE.LSMAX) GO TO 1250                                      RAM18360
      LSMAX=LST                                                         RAM18370
      LSTAB=I                                                           RAM18380
1250  CONTINUE                                                          RAM18390
      ID=LSTAB+1                                                        RAM18400
      KST=LSTAB                                                         RAM18410
      DO 1260 I=ID,7                                                    RAM18420
      IF (LSMAX.EQ.IFREQ(I)) GO TO 1270                                 RAM18430
1260  CONTINUE                                                          RAM18440
      GO TO 1290                                                        RAM18450
C        IF TIE FOR MAX MODAL STABILITY, CALCULATE AVERAGE STABILITY    RAM18460
1270  IQ=0                                                              RAM18470
      DO 1280 J=1,7                                                     RAM18480
1280  IQ=IQ+IFREQ(J)*J                                                  RAM18490
      KST=FLOAT(IQ)/FLOAT(NAVG)+0.5                                     RAM18500
C        PRINT RESULTANT MET DATA SUMMARY FOR AVERAGING PERIOD.         RAM18510
1290  IF (IOPT(23).EQ.1) GO TO 1300                                     RAM18520
      WRITE (IO,2590) THETA,URES,U,TEMP,A,KST                           RAM18530
C                                                                       RAM18540
C->->->->SECTION R - DETERMINE ADDITIONAL RECEPTORS FOR THIS AVG-PERIOD RAM18550
C          (OPTIONAL).                                                  RAM18560
C                                                                       RAM18570
C         DETERMINE RECEPTORS ACCORDING TO SIGNIFICANT SOURCES          RAM18580
C         IOPT(15)  CONTROL OPTION, SIGNIFICANT POINT RECEPTORS?        RAM18590
C         IOPT(16)  CONTROL OPTION, SIGNIFICANT AREA RECEPTORS?         RAM18600
1300  IF ((IOPT(15)+IOPT(16)).EQ.0) GO TO 1310                          RAM18610
      TRAD=THETA*0.01745329                                             RAM18620
      SINT=SIN(TRAD)                                                    RAM18630
      COST=COS(TRAD)                                                    RAM18640
      CALL GREC                                                         RAM18650
C        FILL IN RECEPTORS WITH HONEYCOMB ARRAY                         RAM18660
C      IOPT(17) CONTROL OPTION, FILL IN HONEYCOMB RECEPTORS? 0=NO, 1=YESRAM18670
1310  IF (IOPT(17).EQ.0) GO TO 1320                                     RAM18680
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      WRITE (IO,2600) HRMNU,HRMXU,HSMNU,HSMXU,GRDSPU                    RAM18690
      CALL JMHHON                                                       RAM18700
 1320 IF (NRECEP.NE.0) GO TO 1330                                       RAM18710
C         WRITE ERROR STATEMENT                                         RAM18720
      WRITE (IO,2060)                                                   RAM18730
      CALL WAUDIT
      STOP                                                              RAM18740
C         INITIALIZE CONCENTRATION SUMS                                 RAM18750
C      IF SIGNIFICANT OR HONEYCOMB RECEPTORS,WRITE CAUTIONING STATEMENT.RAM18760
 1330 IF ((IOPT(15)+IOPT(16)+IOPT(17)).GT.0) WRITE (IO,2610)            RAM18770
C        REDEFINE NB AND NE IN CASE NON-CONSECUTIVE DAYS ARE BEING RUN  RAM18780
      IF (IOPT(8).EQ.0) GO TO 1340                                      RAM18790
      NB=IHSTRT                                                         RAM18800
      NE=IHSTRT+NAVG-1                                                  RAM18810
C                                                                       RAM18820
C->->->->SECTION S - INITIALIZE FOR HOURLY LOOP.                         RAM18830
C                                                                       RAM18840
C        INITIALIZE SUMS FOR CONC AND PARTIAL CONC FOR AVG PERIOD.      RAM18850
 1340 DO 1370 K=1,NRECEP                                                RAM18860
      ACHI(K)=0.                                                        RAM18870
      PCHI(K)=0.0                                                       RAM18880
      DO 1350 I=1,11                                                    RAM18890
 1350 ASIGS(K,I)=0.                                                     RAM18900
      DO 1360 I=1,26                                                    RAM18910
 1360 PSIGS(K,I)=0.0                                                    RAM18920
 1370 CONTINUE                                                          RAM18930
C        IF SAVING PARTIAL CONCENTRATIONS, WRITE  SECOND RECORD .       RAM18940
      IF (IOPT(40).EQ.0) GO TO 1380                                     RAM18950
      WRITE (10) NRECEP,NPT,NAS,(RREU(I),I=1,NRECEP),(SREU(I),I=1,NRECEPRAM18960
     1)                                                                 RAM18970
C                                                                       RAM18980
C->->->->SECTION T - BEGIN HOURLY LOOP.                                  RAM18990
C                                                                       RAM19000
 1380 DO 1580 ID=NB,NE                                                  RAM19010
      LH=ID                                                             RAM19020
      IF (LH.LE.24) GO TO 1390                                          RAM19030
      LH=MOD(ID,24)                                                     RAM19040
      IF (LH.EQ.1) IDATE(2)=DAY1                                        RAM19050
C        INITIALIZE SUMS FOR CONC AND PARTIAL CONC FOR HOURLY PERIODS.  RAM19060
 1390 DO 1420 K=1,NRECEP                                                RAM19070
      AHCHI(K)=0.                                                       RAM19080
      PHCHI(K)=0.0                                                      RAM19090
      DO 1400 I=1,11                                                    RAM19100
 1400 AHSIGS(K,I)=0.                                                    RAM19110
      DO 1410 I=1,26                                                    RAM19120
 1410 PHSIGS(K,I)=0.0                                                   RAM19130
 1420 CONTINUE                                                          RAM19140
C        SET MET CONDITIONS FOR THIS HOUR                               RAM19150
      THETA=QTHETA(LH)                                                  RAM19160
C       DETERMINE WIND DIRECTION CONTROL, IWD, 90 DEG. QUADRANT OF WIND RAM19170
C                                                                       RAM19180
      DO 1430 I=1,3                                                     RAM19190
      IF (THETA.LE.DEG(I)) GO TO 1440                                   RAM19200
 1430 CONTINUE                                                          RAM19210
      I=4                                                               RAM19220
 1440 IWD=I                                                             RAM19230
      U=QU(LH)                                                          RAM19240
      HL=QHL(LH)                                                        RAM19250
      TEMP=QTEMP(LH)                                                    RAM19260
      KST=IKST(LH)                                                      RAM19270
      TRAD=THETA*0.01745329                                             RAM19280
      SINT=SIN(TRAD)                                                    RAM19290
      COST=COS(TRAD)                                                    RAM19300
C        IF OPTION 9 IS 1, READ HOURLY EMISSIONS.                       RAM19310
      IF (IOPT(9).EQ.0) GO TO 1450                                      RAM19320
C          WRITE ERROR STATEMENT                                        RAM19330
      IDCK=IDATE(1)*100000+IDATE(2)*100+LH                              RAM19340
      READ (15) IDATA,(SOURCE(IPOL,I),I=1,NPT)                          RAM19350
C        CHECK DATE                                                     RAM19360
      IF (IDCK.EQ.IDATA) GO TO 1450                                     RAM19370
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C          WRITE ERROR STATEMENT
      WRITE (IO,2070) IDCK,IDATA
      CALL WAUDIT
      STOP
C        CALCULATE POINT SOURCE CONTRIBUTIONS
1450  CALL PT
C        CHECK FOR AREA SOURCES
      IF (IOPT(6).NE.1) GO TO 1490
C        IOPT(10) CONTROL OPTION, HOURLY EMISSION INPUT? 0=NO, 1=YES
      IF (IOPT(10).EQ.0) GO TO 1480
      IDCK=IDATE(1)*100000+IDATE(2)*100+LH
C        READ HOURLY AREA SOURCE EMISSION RECORD
      READ (16) IDATA,(ASORC(IPOL,I),I=1,NAS)
C        CHECK DATE
      IF (IDCK.EQ.IDATA) GO TO 1460
C        WRITE ERROR STATEMENT
      WRITE (IO,2080) IDCK,IDATA
      CALL WAUDIT
      STOP
C        CONVERT HOURLY AREA EMISSIONS FROM G/SEC TO G/SQ. M/SEC
1460  DO 1470 I=1,NAS
C        CONVERT SIDE LENGTH TO METERS.
C        NOTE: SIDE LENGTH HAD BEEN MULTIPLIED BY .5 ABOVE FOR TIME
C        CONSIDERATIONS
      SF=ASORC(5,I)*2000*CONTWO
1470  ASORC(IPOL,I)=ASORC(IPOL,I)/(SF*SF)
C        SET UP INTEGRATION TABLES FOR AREA SOURCE CALCULATIONS
1480  CALL JMH54
C        CALCULATE AREA SOURCE CONTRIBUTIONS
      CALL JMHARE
C          DETERMINE TOTAL CONCENTRATION.
1490  DO 1500 K=1,NRECEP
1500  GRANDT(K)=AHCHI(K)+PHCHI(K)
      IF (IOPT(41).EQ.0) GO TO 1510
C        WRITE HOURLY CONCENTRATIONS TO TAPE
C          THIS WILL GENERATE NPER*NAVG RECORDS.
      WRITE (12) IDATE(2),LH,(GRANDT(I),I=1,NRECEP)
C
C->->->->SECTION U - CALCULATE AND STORE FOR HIGH-FIVE TABLE.
C
1510  NHR=NHR+1
C         IF OPTION 36 IS 1, DELETE COMPUTATIONS FOR AVG CONC.
C           FOR LENGTH OF RECORD AND HIGH-FIVE TABLE.
      IF (IOPT(36).EQ.1) GO TO 1570
C        CUMULATE CONCENTRATIONS FOR AVG TIMES AND LENGTH OF RECORD.
C
C          FOR DEFAULT OPTION DETERMINE CALM HOURS.
C          FOR CALM HOURS, CONCENTRATIONS AT EACH RECEPTOR ARE
C            SET EQUAL TO ZERO.
C          --- A CALM HOUR IS AN HOUR WITH A WIND SPEED
C              OF 1.00 M/S AND A WIND DIRECTION THE SAME
C                AS THE PREVIOUS HOUR.
      IF(IOPT(38).EQ.1.AND.QU(LH).LT.1.009.AND.ITMIN1.EQ.
     *IDUMR(LH))THEN
      ICALM=ICALM+1
      DO 955 K=1,NRECEP
      GRANDT(K)=0.0
 955  CONTINUE
      GO TO 971
      END IF
      DO 1530 K=1,NRECEP
      DO 1520 L=1,NAVT
1520  CONC(K,L)=CONC(K,L)+GRANDT(K)
1530  SUM(K)=SUM(K)+GRANDT(K)
C          STORE DATE FOR WHICH CONCS. HAVE BEEN CALCULATED.
  971 JDAY=IDATE(2)
C         SUBROUTINE RANK IS CALLED WHENEVER A COUNTER
C         INDICATES THAT ENOUGH END TO END HOURLY CONCENTRATIONS
C         HAVE BEEN STORED OFF TO COMPLETE AN AVG TIME.
C         NP3, NP8, NP24, NPX ARE USED AS COUNTERS FOR EACH
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C         AVG TIME AND ARE ZEROED AFTER EACH CALL TO RANK.
C
C         FOR THE DEFAULT OPTION CALCULATE AVERAGE
C         CONCENTRATION FOR APPROPRIATE AVERAGING PERIOD.
C         SET UP CALM FLAG FOR ENTRY INTO SUBROUTINE RANK.
C
      IF(IOPT(38).EQ.0) GOTO 979
      CALL RANK(1)
      NP3=NP3+1
      IF(QU(LH).LT.1.009.AND.IDUMR(LH).EQ.ITMIN1)ICFL3=1
      IF(NP3.NE.3) GO TO 974
C        FOR 3 HOUR AVERAGING PERIOD DIVIDE SUM BY 3.0.
      DO 972 LQ=1,NRECEP
972   CONC(LQ,2)=CONC(LQ,2)/3.0
      LL2=2
      IF(ICFL3.EQ.1)LL2=22
      CALL RANK(LL2)
      NP3=0
      ICFL3=0
974   NP8=NP8+1
      IDIV8=IDIV8+1
      IF(QU(LH).LT.1.009.AND.IDUMR(LH).EQ.ITMIN1)THEN
      IDIV8=IDIV8-1
      ICFL8=1
      END IF
      IF(NP8.NE.8)GO TO 976
      IF(IDIV8.LT.6)IDIV8=6
      DIV8=IDIV8
C        FOR 8 HOUR AVERAGING PERIOD DIVIDE THE SUM OF THE HOURLY
C        CONCENTRATIONS BY THE NUMBER OF NON-CALM HOURS OR 6.0
C        WHICHEVER IS GREATER.
      DO 975 LQ=1,NRECEP
975   CONC(LQ,3)=CONC(LQ,3)/DIV8
      LL3=3
      IF(ICFL8.EQ.1)LL3=33
      CALL RANK(LL3)
      NP8=0
      IDIV8=0
      ICFL8=0
976   NP24=NP24+1
      IDIV24=IDIV24+1
      IF(QU(LH).LT.1.009.AND.IDUMR(LH).EQ.ITMIN1)THEN
      IDIV24=IDIV24-1
      ICFL24=1
      END IF
      IF(NP24.NE.24)GO TO 1011
      IF(IDIV24.LT.18)IDIV24=18
      DIV24=IDIV24
C        FOR 24 HOUR AVERAGING PERIOD DIVIDE THE SUM OF THE HOURLY
C        CONCENTRATIONS BY THE NUMBER OF NON-CALM HOURS OR 18,
C        WHICHEVER IS GREATER.
      DO 977 LQ=1,NRECEP
977   CONC(LQ,4)=CONC(LQ,4)/DIV24
      LL4=4
      IF(ICFL24.EQ.1)LL4=44
      CALL RANK(LL4)
      NP24=0
      IDIV24=0
      ICFL24=0
1011  ITMIN1=IDUMR(LH)
      GO TO 1570
C
C        WHEN DEFAULT OPTION IS NOT USED, DETERMINE ENTRY INTO
C        SUBROUTINE RANK FOR APPROPRIATE AVERAGING PERIOD.
C        RANKING BASED ON HIGH AVERAGING PERIOD SUM.
C
979   CALL RANK (1)
      NP3=NP3+1
      IF (NP3.NE.3) GO TO 1540
      CALL RANK (2)
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      NP3=0
1540  NP8=NP8+1
      IF (NP8.NE.8) GO TO 1550
      CALL RANK (3)
      NP8=0
1550  NP24=NP24+1
      IF (NP24.NE.24) GO TO 1560
      CALL RANK (4)
      NP24=0
1560  IF (NAVT.EQ.4) GO TO 1570
      NPX=NPX+1
      IF (NPX.NE.NAV5) GO TO 1570
      CALL RANK (5)
      NPX=0
C
C->->->->SECTION V - END HOURLY, AVERAGING TIME, AND DAILY LOOPS.
C
1570  IF (IOPT(24).EQ.1) GO TO 1580
C         IF IOPT(24) = 1,SKIP HOURLY OUTPUT.
      CALL OUTPT
1580  CONTINUE
C
C        END OF HOURLY LOOP
C
      IF (NE.GT.24) IDATE(2)=ISTDAY
C         DETERMINE AVG.-PER.CONCENTRATIONS.
      DO 1590 K=1,NRECEP
      ACHI(K)=ACHI(K)/NAVG
      PCHI(K)=PCHI(K)/NAVG
1590  GRANDT(K)=ACHI(K)+PCHI(K)
      IF (IOPT(42).EQ.0) GO TO 1600
C         WRITE PERIODIC CONC. TO DISK/TAPE- FOR LONG-TERM
C         APPLICATION. THIS STATEMENT WILL GENERATE 'NPER' RECORDS
      WRITE (13) IDATE(2),NE,(GRANDT(K),K=1,NRECEP)
1600  IF (IOPT(43).EQ.0) GO TO 1620
C         PUNCH AVG.-PER. CONC. CARDS (ONE FOR EACH RECEPTOR).
      DO 1610 K=1,NRECEP
      GWU=GRANDT(K)*1.0E+06
      A=ACHI(K)*1.0E+06
      B=PCHI(K)*1.0E+06
      WRITE (1,2090) RREU(K),SREU(K),GWU,A,B,K,IDATE,NE,NAVG
1610  CONTINUE
C        OUTPUT AVG.-PER. RESULTS
1620  IF (IOPT(32).EQ.1) GO TO 1630
      CALL OUTAV
1630  NP=NP+1
      NHRS=NHRS+NAVG
C        NEXT STATEMENT IS BRANCH FOR END OF RUN.
      IF (NP.GE.NPER) GO TO 1660
      IF (NHRS.LT.24) GO TO 1640
      IF (IOPT(39).EQ.0) GO TO 1150
C        NEXT STATEMENT CHECKS FOR END OF SEGMENTED RUN.
      IF (IDAY.GE.LDRUN) GO TO 1650
      GO TO 1150
C
C           END OF LOOP FOR CALENDAR DAYS
C
1640  NB=NB+NAVG
      NE=NE+NAVG
      IF (NB.LE.24) GO TO 1200
      NB=MOD(NB,24)
      NE=NB+NAVG-1
      GO TO 1200
C
C        END OF LOOP FOR AVERAGING PERIOD.
C
C        IF SEGMENTED RUN, TEMPORARILY STORE
C         HIGH-FIVE INFO ON UNIT 14 FILE.
1650  WRITE (14) IDAY,SUM,NHR,DAY1A,HR1,HMAXA,NDAY,IHR
      WRITE (IO,2620) IDAY
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      GO TO 1750
1660  IF (IOPT(36).EQ.1) GO TO 1750
C
C->->->->SECTION W - WRITE AVERAGE CONC. AND HIGH-FIVE TABLES.
C
C        IF OPTION 36 = 0, WRITE AVERAGE CONCENTRATION.
C         FOR LENGTH OF RECORD AND HIGH-FIVE TABLE.
      DO 1670 J=1,NRECEP
      STAR(1,J)=BLNK
      STAR(2,J)=BLNK
1670  CONTINUE
      WRITE (IO,2630) LINE1,LINE2,LINE3
      HR2=NE
C        FOR DEFAULT OPTION CALCULATE AND REPORT THE
C        NUMBER OF CALMS FOR AVERAGING PERIOD.
      IF(IOPT(38).EQ.1)THEN
      NHR=NHR-ICALM
      WRITE(6,1761)ICALM
      END IF
C          INITIALIZE PERIODIC CONC TO BEGIN RANKING FOR PERIODIC MAX
      SUM(1)=SUM(1)/NHR
      HF=SUM(1)
      ID=1
C          FIND HIGHEST AVERAGE CONC. AMONG RECEPTORS.
      DO 1680 K=2,NRECEP
      SUM(K)=SUM(K)/NHR
      IF (SUM(K).LE.HF) GO TO 1680
      ID=K
      HF=SUM(K)
1680  CONTINUE
      STAR(1,ID)=STR
C          WRITE AVERAGE CONC.(HIGHEST HAS ASTERISK).
      WRITE (IO,2640) DAY1A,HR1,DAY2,HR2
      DO 1690 K=1,NRECEP
1690  WRITE (IO,2650) K,ITYPE(K),ICODE(K),(RNAME(J,K),J=1,2),RREU(K),SRE
     1U(K),STAR(1,K),SUM(K)
      STAR(1,ID)=BLNK
C         LOOP TO WRITE HIGH-FIVE TABLE FOR 4 OR 5 AVG TIMES.
      DO 1740 L=1,NAVT
C         ASTERISKS DEPICT RECEPTORS WITH HIGHEST AND
C          SECOND HIGHEST CONCENTRATIONS.
      ID=1
      IQ=1
      A=HMAXA(1,1,L)
      B=HMAXA(2,1,L)
      DO 1710 K=2,NRECEP
      IF (HMAXA(1,K,L).LE.A) GO TO 1700
      A=HMAXA(1,K,L)
      ID=K
1700  IF (HMAXA(2,K,L).LE.B) GO TO 1710
      B=HMAXA(2,K,L)
      IQ=K
1710  CONTINUE
      STAR(1,ID)=STR
      STAR(2,IQ)=STR
C          WRITE HIGH-FIVE TABLE FOR AN AVERAGING TIME.
      IF((IOPT(38).EQ.1.AND.L.EQ.1).OR.(IOPT(38).NE.1))THEN
      WRITE (IO,2660) NTIME(L),TITLE(IP),(I,I=1,5)
      END IF
      IF(IOPT(38).EQ.1.AND.L.NE.1)THEN
      WRITE (IO,2661) NTIME(L),TITLE(IP),(I,I=1,5)
      END IF
      DUM=ATIME(L)
      DO 1730 K=1,NRECEP
C         SET CALM FLAG FOR PRINTING.
C         RESET HOUR VARIABLE FOR CALM HOURS.
      IF(IOPT(38).EQ.1)THEN
      DO 1712 J=1,5
      CF(J)=BLNK
      IF(IHR(J,K,L).GT.24)THEN
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      IHR(J,K,L)=IHR(J,K,L)-100                                         RAM22160
      CF(J)=C                                                           RAM22170
      END IF                                                            RAM22180
 1712 CONTINUE                                                          RAM22190
      END IF                                                            RAM22200
      IF(IOPT(38).EQ.1)GO TO 1711                                       RAM22210
C         CALCULATE AVERAGE CONCENTRATIONS WHEN                         RAM22220
C         DEFAULT OPTION IS NOT ON.                                     RAM22230
      DO 1720 J=1,5                                                     RAM22240
 1720 HMAXA(J,K,L)=HMAXA(J,K,L)/DUM                                     RAM22250
 1711 WRITE (IO,2670) K,RREU(K),SREU(K),(STAR(J,K),HMAXA(J,K,L),CF(J),  RAM22260
     1NDAY(J,K,L),IHR(J,K,L),J=1,2),(HMAXA(J,K,L),CF(J),NDAY(J,K,L),    RAM22270
     2IHR(J,K,L),J=3,5)                                                 RAM22280
 1730 CONTINUE                                                          RAM22290
C         INITIALIZE ASTERISK STORAGE TO BLANKS.                        RAM22300
      STAR(1,ID)=BLNK                                                   RAM22310
      STAR(2,IQ)=BLNK                                                   RAM22320
 1740 CONTINUE                                                          RAM22330
C                                                                       RAM22340
C->->->->SECTION X - CLOSE OUT FILES.                                   RAM22350
C                                                                       RAM22360
 1750 IF (IOPT(40).EQ.0) GO TO 1760                                     RAM22370
      END FILE 10                                                       RAM22380
      END FILE 10                                                       RAM22390
 1760 IF (IOPT(41).EQ.0) GO TO 1770                                     RAM22400
      END FILE 12                                                       RAM22410
      END FILE 12                                                       RAM22420
 1770 IF (IOPT(42).EQ.0) GO TO 1780                                     RAM22430
      END FILE 13                                                       RAM22440
      END FILE 13                                                       RAM22450
 1780 WRITE (IO,2680)                                                   RAM22460
      CALL WAUDIT
      STOP                                                              RAM22470
C                                                                       RAM22480
C->->->->SECTION Y - FORMAT STATEMENTS.                                 RAM22490
C                                                                       RAM22500
C         INPUT FORMATS                                                 RAM22510
C                                                                       RAM22520
 1761 FORMAT(5X,T98,'# CALMS FOR PERIOD: ',I4)                          RAM22530
 1790 FORMAT (20A4/20A4/20A4)                                           RAM22540
 1800 FORMAT (50I1)                                                     RAM22550
 1810 FORMAT (A4)                                                       RAM22560
 1820 FORMAT (3A4,8F8.2)                                                RAM22570
 1830 FORMAT (3A4,6F10.2)                                               RAM22580
 1840 FORMAT (26I3)                                                     RAM22590
 1850 FORMAT (2A4,2F10.3)                                               RAM22600
C                                                                       RAM22610
C         ERROR AND WARNING STATEMENT FORMATS                           RAM22620
C                                                                       RAM22630
 1860 FORMAT (1X,' NSIGP (THE NO. OF SIGNF POINT SOURCES) WAS FOUND',' TRAM22640
     1O EXCEED THE LIMIT (25).  USER TRIED TO INPUT ',I3,' SOURCES'/'   RAM22650
     2******** EXECUTION TERMINATED  ********')                         RAM22660
 1870 FORMAT (1X,'NSIGA(THE NO. OF SIGNIF. AREA SOURCES) WAS FOUND TO ',RAM22670
     1'EXCEED THE LIMIT (10). USER TRIED TO INPUT ',I3,' SOURCES.'/'    RAM22680
     2****EXECUTION TERMINATED   *****')                                RAM22690
 1880 FORMAT (' USER TRIED TO INPUT MORE THAN ',I4,' POINT SOURCES. THISRAM22700
     1 GOES BEYOND THE CURRENT PROGRAM DIMENSIONS.')                    RAM22710
 1890 FORMAT (' USER TRIED TO INPUT MORE THAN ',I4,' AREA SOURCES. THIS RAM22720
     1GOES BEYOND THE CURRENT PROGRAM DIMENSIONS.')                     RAM22730
 1900 FORMAT (' DIMENSIONS TOO SMALL TO HOLD ARRAY ',I3,' BY ',I3)      RAM22740
 1910 FORMAT (' AREA SOURCES, UNITS OR SIDE LENGTH SPECIFIED INCORRECTLYRAM22750
     1; ERROR ON EAST MAX BOUNDARY.')                                   RAM22760
 1920 FORMAT (' AREA SOURCES, UNITS OR SIDE LENGTH SPECIFIED INCORRECTLYRAM22770
     1; ERROR ON NORTH MAX BOUNDARY.')                                  RAM22780
 1930 FORMAT (' SOURCE ',I3,' IS ALREADY LOCATED AT POSITION (',I3,',',IRAM22790
     13,')   CHECK SOURCE ',I3)                                         RAM22800
 1940 FORMAT (' AREA ARRAY IS TOO WIDE FOR PAGE SIZE, THEREFORE WILL NOTRAM22810
     1 BE PRINTED')                                                     RAM22820
 1950 FORMAT (1H1,'***ERROR---USER TRIED TO SPECIFY ',I4,' SIGNIFICANT SRAM22830
     1OURCES, BUT IS ONLY ALLOWING ',I3,' TOTAL SIGNIFICANT SOURCES IN TRAM22840
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     2HIS RUN.',/2X,'    RUN TERMINATED-CHECK INPUT DATA!    ')
1960  FORMAT (' (MPS) THE INPUT SIGNIFICANT SOURCE NUMBER ','WAS FOUND T
     1O EQUAL ZERO - USER CHECK INPUT DATA.')
1970  FORMAT (' THE INPUT LIMIT OF MAX DISTANCE FOR AREA INTEGRATION ','
     1 CONVERTS TO ',F10.3,' KM WHICH EXCEEDS STORAGE ','LIMITATIONS. UP
     2  TO 116 KM DISTANCES ARE ALLOWED.')
1980  FORMAT (47H   ERROR IN SPECIFYING SIGNIF. POINT SOURCES    )
1990  FORMAT ('0DISAGREEMENT OF IDENTIFIERS- ',/' SURFACE DATA FROM CARD
     1: STATION = ',I5,' YEAR = ',I2,/'                FROM MET FILE: STAT
     2ION = ',I5,' YEAR = ',I2,/' MIX HT  DATA FROM CARD: STATION = ',I5
     3,' YEAR =',I2,/'               FROM MET FILE: STATION = ',I5,' YEAR
     4 = ',I2)
2000  FORMAT (1X,'****USER EITHER TRIED TO INPUT MORE THAN 180 ','RECEPT
     1ORS OR ENDR WAS NOT PLACED AFTER THE LAST RECEPTOR ','CARD   *'/'*
     2*******EXECUTION TERMINATED*******')
2010  FORMAT (1X,'NO RECEPTORS HAVE BEEN CHOSEN')
2020  FORMAT (1H0,'    DAYS DO NOT MATCH, IDAY = ',I4,',  IDAYS = ',I4)
2030  FORMAT ('0 RUN TERMINATED . CAN  NOT WRITE FILES (OPTIONS 41, ','0
     1R 42)'/1X,'WHEN HAVING RAM GENERATE RECEPTORS FOR EACH AVG-PER','(
     2OPTIONS 15,16,OR 17).')
2040  FORMAT (' DATE ON MET. TAPE, ',I2,I3,' ,DOES NOT MATCH INTERNAL DA
     1TE, ',I2,I3)
2050  FORMAT (' HOUR ',I3,' IS NOT PERMITTED. HOURS MUST BE DEFINED BETW
     1EEN 1 AND 24')
2060  FORMAT (1X,'NO RECEPTORS HAVE BEEN CHOSEN')
2070  FORMAT (' DATE BEING PROCESSED IS = ',I8/1X,'DATE OF HOURLY POINT
     1EMISSION RECORD IS =',I8/1X,'***PLEASE CHECK EMISSION RECORDS    ')
2080  FORMAT (' DATE BEING PROCESSED IS= ',I8/1X,'DATE OF HOURLY AREA EM
     1ISSION RECORD IS =',I8/1X,'***PLEASE CHECK EMISSION RECORDS***')
C
C     PUNCH CARD FORMAT(FOR OUTPUT, OPTION 43)
C
2090  FORMAT ('CNTL',1X,5F10.3,5I5)
C
C         OUTPUT FORMATS
C
2100  FORMAT (1H1,T40,' OUTPUT FROM ',A4,A1,' RAM (VERSION 85364) ',/1X,
     1T40,' AN AIR QUALITY DISPERSION MODEL IN ',/,1X,T40,' SECTION 1. G
     2UIDELINE MODELS   ',/,1X,T40, ' IN UNAMAP (VERSION 6) DEC 86 ',/,1X
     3,T40,' SOURCE: UNAMAP FILE ON EPA''S UNIVAC 1110, RTP, NC.')
2110  FORMAT (/1X,20A4/1X,20A4/1X,20A4)
2120  FORMAT ('0',T30,'GENERAL INPUT INFORMATION'//2X,'THIS IS THE ',A4,
     1A1,' VERSION(81352) OF RAM FOR THE POLLUTANT ',A4,' FOR ',I3,1X,I3
     2,'-HOUR PERIODS.'/2X,'CONCENTRATION ESTIMATES BEGIN ON HOUR-',I2,'
     3, JULIAN DAY-',I3,',  YEAR-19',I2,'.'/1X,' UNITS - THERE ARE ',F14.
     47,' USER UNITS(INPUT UNITS) PER SMALLEST AREA SOURCE SQUARE SIDE L
     5ENGTH(INTERNAL UNIT)'/2X,'CONONE - THERE ARE',F14.7,' KILOMETERS P
     6ER USER UNIT'/2X,'CONTWO - IT IS CALCULATED THAT THERE ARE',F14.7,
     7' KILOMETERS PER SMALLEST AREA SOURCE SQUARE SIDE LENGTH(INTERNAL 
     8UNIT)'/2X,'RECEPTOR HEIGHT IS ',F14.7,' METERS')
2130  FORMAT (1H0,'THIS RUN WILL NOT CONSIDER ANY POLLUTANT LOSS.')
2140  FORMAT (1H0,' A HALF-LIFE OF ',F10.2,' (SECONDS) HAS BEEN ASSUMED 
     1 BY THE USER.')
2150  FORMAT (1X,' HIGH-FIVE SUMMARY CONCENTRATION TABLES ','WILL BE OUT
     1PUT FOR ',I3,' AVERAGING PERIODS.'/'  AVG TIMES ','OF 1,3,8, AND 2
     24 HOURS ARE AUTOMATICALLY DISPLAYED.')
2160  FORMAT (1X,'THE FIFTH AVERAGING PERIOD FOR THE HIGH ','-FIVE TABLE
     1S IS ',I3,'HOURS ')
2170  FORMAT (1H0,T3,'OPTION  ',T16,'OPTION LIST',T46,'OPTION SPECIFICAT
     1ION : 0= IGNORE OPTION'/1X,T68,' 1= USE OPTION'/T25,'TECHNICAL OPT
     2IONS'/1X,T7,I2,T16,'NO STACK DOWNWASH',T70,I1/1X,T7,I2,T16,'NO GRA
     3DUAL PLUME RISE.',T70,I1/1X,T7,I2,T16,'USE BOUYANCY INDUCED DISPER
     4SION',T70,I1/1X,T7,I2,T16,'NOT USED THIS VERSION',T70,I1)
2180  FORMAT (1H0,T25,'INPUT OPTIONS'/1X,T7,I2,T16,'WILL YOU ','INPUT PO
     1INT SOURCES?',T70,I1/1X,T7,I2,T16,'WILL YOU INPUT AREA SOURCES?',T
     270,I1/1X,T7,I2,T16,'WILL YOU USE EMISSIONS FROM PREVIOUS RUN? (UNI
     3T 9)',T70,I1/1X,T7,I2,T16,'MET.DATA ON CARDS? (FROM UNIT',' 11 OTH
     4ERWISE)',T70,I1/1X,T7,I2,T16,'READ HOURLY PT. SOURCE'' EMISSIONS (
     5UNIT 15).',T70,I1/1X,T7,I2,T16,'READ HOURLY ','AREA SOURCE EMISSIO
     6NS (UNIT 16).',T70,I1/1X,T7,I2,T16,'SPECIFY   SIGNIF PT. SOURCES.'
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     7,T70,I1/1X,T7,I2,T16,'SPECIFY SIGNIF. AREA ','SOURCES.',T70,I1/1X,RAM23550
     8T7,I2,T16,'NOT USED THIS VERSION',T70,I1)                         RAM23560
2190  FORMAT (1H0,T25,'RECEPTOR OPTIONS'/1X,T7,I2,T16,'WILL YOU ENTER ',RAM23570
     1'RECEPTORS BY SPECIFYING COORDINATES?',T70,I1/1X,T7,I2,T16,'DO',' RAM23580
     2YOU WANT RAM TO GENERATE RECEPTORS DOWNWIND '/1X,T7,T16,' OF ','SIRAM23590
     3GNIF. PT. SOURCES? (WILL DO SO BY AVG-PERIOD)',T70,I1,/1X,T7,I2,T1RAM23600
     46,'DO YOU WANT RAM TO GENERATE RECEPTORS DOWNWIND '/1X,T7,T16,'OF RAM23610
     5SIGNIF. AREA SOURCES?(WILL DO SO BY AVG-PERIOD)',T70,I1,/1X,T7,I2,RAM23620
     6T16,'DO YOU WANT RAM TO GENERATE A HONEYCOMB ARRAY OF',/1X,T7,T16,RAM23630
     7'RECEPTORS TO COVER A SPECIFIC AREA?',T70,I1/1X,T7,I2,T16,'WILL YORAM23640
     8U INPUT RADIAL DISTANCES(UP TO 5) TO GENERATE ',/1X,T7,T16,'A POLARAM23650
     9R COORDINATE RECEPTOR ARRAY'/1X,T7,T16,'(36 RECEP','TORS FOR EACH RAM23660
     ADISTANCE)',T70,I1/1X,T7,I2,T16,'NOT USED THIS ',' VERSION',T70,I1)RAM23670
2200  FORMAT (1H0,T25,'PRINTED OUTPUT OPTIONS'/1X,T7,I2,T16,'DELETE POI'RAM23680
     1,'NT SOURCE LIST',T70,I1/1X,T7,I2,T16,'DELETE AREA SOURCE LIST A',RAM23690
     2'ND MAP',T70,I1/1X,T7,I2,T16,'DELETE EMISSIONS WITH HEIGHT TABLE',RAM23700
     3T70,I1/1X,T7,I2,T16,'DELETE RESULANT MET. DATA SUMMARY FOR AVE','RRAM23710
     4AGING PERIOD.',T70,I1/1X,T7,I2,T16,'DELETE ALL HOURLY OUTPUT ','(PRAM23720
     5T.,AREA,& SUMMARIES)',T70,I1/1X,T7,I2,T16,'DELETE HOURLY POI','NT RAM23730
     6CONTRIBUTIONS',T70,I1/1X,T7,I2,T16,'DELETE MET. DATA ON HR. ','PT.RAM23740
     7 CONTRIB.',T70,I1/1X,T7,I2,T16,'DELETE PLUME HT. AND DIST. ','TO FRAM23750
     8INAL RISE ON'/1X,T7,T16,'  HR. PT. CONTRIB.',T70,I1/1X,T7,I2,T16,'RAM23760
     9DELETE HOURLY AREA CONTRIBUTIONS',T70,I1/1X,T7,I2,T16,'DELETE MET.RAM23770
     A DATA ON HR. AREA CONTRIB.',T70,I1/1X,T7,I2,T16,'DELETE HOURLY SUMRAM23780
     BMARY.',T70,I1/1X,T7,I2,T16,'DELETE MET. ''DATA ON HOURLY SUMMARY.'RAM23790
     C,T70,I1)                                                          RAM23800
2210  FORMAT (1X,T7,I2,T16,'DELETE ALL AVG-PERIOD OUTPUT.',T70,I1/1X,T7,RAM23810
     1I2,T16,'DELETE POINT AVG-PERIOD CONTRIBUTIONS.',T70,I1/1X,T7,I2,T1RAM23820
     26,'DELETE AREA AVG-PERIOD CONTRIBUTIONS.',T70,I1/1X,T7,I2,T16,'DELRAM23830
     3ETE AVG-PERIOD SUMMARY.',T70,I1/1X,T7,I2,T16,'DELETE AVE','RAGE CORAM23840
     4NCENTRATIONS & HI-FIVE TABLE.',T70,I1/1X,T7,I2,T16,'NOT',' USED THRAM23850
     5IS VERSION.',T70,I1/1X,T25,'DEFAULT OPTION.'/                     RAM23860
     61X,T7,I2,T16,'SET DEFAULT OPTION.',T70,I1)                        RAM23870
2220  FORMAT (1H0,T25,'OTHER CONTROL AND OUTPUT OPTIONS:'/1X,T7,I2,T16,'RAM23880
     1RUN IS PART OF A SEGMENTED RUN.',T70,I1/1X,T7,I2,T16,'WRITE PAR','RAM23890
     2TIAL CONC.TO DISK OR TAPE (UNIT 10).',T70,I1/1X,T7,I2,T16,'WRIT','RAM23900
     3E',' HOURLY CONC.TO DISK OR TAPE (UNIT 12).',T70,I1/1X,T7,I2,T16,'RAM23910
     4WRITE AVG-PERIOD CONC.TO DISK OR TAPE (UNIT 13).',T70,I1/1X,T7,I2,RAM23920
     5T16,'PUNCH AVERAGING-PERIOD CONC. ON CARDS (UNIT 1).',T70,I1/1X,T7RAM23930
     6,I2,T16,'NOT USED THIS VERSION.',T70,I1/1X,T7,I2,T16,'NOT USED',' RAM23940
     7THIS VERSION.',T70,I1/1X,T7,I2,T16,'NOT USED THIS VERSION.',T70,I1RAM23950
     8/1X,T7,I2,T16,'NOT USED THIS VERSION.',T70,I1/1X,T7,I2,T16,'NOT USRAM23960
     9ED THIS VERSION.',T70,I1/1X,T7,I2,T16,'NOT USED THIS ','VERSION.' RAM23970
     A,T70,I1/1X,T7,I2,T16,'NOT USED THIS VERSION.',T70,I1)             RAM23980
2230  FORMAT (1H0,2X,'ANEMOMETER HEIGHT= ',F10.2/3X,'WIND PROFILE WITH 'RAM23990
     1,'HEIGHT EXPONENTS CORRESPONDING TO STABILITY ARE AS FOLLOWS:'/8X,RAM24000
     2'FOR STABILITY A: ',F4.2,3X,', B: ',F4.2,3X,', C: ',F4.2,3X,' D: 'RAM24010
     3,F4.2,3X,' E: ',F4.2,3X,' F: ',F4.2)                             RAM24020
2240  FORMAT ('0',T40,'POINT SOURCE INFORMATION'//1X,T5,'SOURCE',T23,'EARAM24030
     1ST',T32,'NORTH',T40,'SO2(G/SEC)  PART(G/SEC)  STACK  STACK   STACKRAM24040
     2   STACK',3X,'POTEN. IMPACT',2X,'EFF',3X,' BUOY FLUX'/1X,T23,'COORRAM24050
     3D',T32,'COORD',' EMISSIONS  EMISSIONS   HT(M) TEMP(K) DIAM(M)'RAM24060
     4,'VEL(M/SEC)(MICRO G/M**3) HT(M)',3X,'F'/1X,T17,'         (USER URAM24070
     5NITS)',T116,' M**4/S**3')                                         RAM24080
2250  FORMAT (1X,I3,1X,3A4,1X,2F9.3,2F12.3,4F8.2,6PF13.3,0PF9.3,F9.3)   RAM24090
2260  FORMAT ('0',T3,'SIGNIFICANT ',A4,' POINT SOURCES'//1X,T8,'RANK',T2RAM24100
     12,'CHI-MAX',T33,'SOURCE NO.'/1X,T17,'(MICROGRAMS/M**3)'/1X)       RAM24110
2270  FORMAT (1X,T9,I3,T18,6PF12.2,T35,I3)                              RAM24120
2280  FORMAT ('0',T20,'AREA SOURCE INFORMATION'//1X,T2,'SOURCE',T20,' EARAM24130
     1ST',T28,'NORTH',T37,'SO2',T50,'PART',T61,'SIDE',T72,'EFFECTIVE SIGRAM24140
     2NIFICANCE'/1X,T20,'COORD',T28,'COORD',T37,'EMISSIONS',T50,'EMISSIORAM24150
     3NS',T61,'LENGTH',T72,'HEIGHT',T81,'(G/M/SEC)'/1X,T21,'(USER UNITS)RAM24160
     4',T39,'(GRAMS/M**2/SEC) ',T58,'(USER UNITS) (METERS)'/1X)         RAM24170
2290  FORMAT (1X,T2,I3,1X,3A4,2F9.3,1X,2(1X,1PE11.4),2X,0PF6.3,5X,F6.3,2RAM24180
     1X,1PE11.4)                                                        RAM24190
2300  FORMAT ('0',5X,'AREA SOURCE MAP ARRAY (IA)'/1X)                   RAM24200
2310  FORMAT (1X,I3,2X,41I3/1X)                                         RAM24210
2320  FORMAT (/6X,41I3/1X)                                              RAM24220
2330  FORMAT ('0THE ORIGIN IN INTERNAL UNITS IS (',F10.2,',',F10.2,')'/1RAM24230
     1X,'THE SIZE OF THE AREA SOURCE ARRAY IS (',I5,',',I5,')')         RAM24240
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2340  FORMAT (' RMIN=',F8.2,' RMAX=',F8.2,' SMIN=',F8.2,' SMAX=',F8.2,'  RAM24250
     1 (IN INTERNAL UNITS)')                                            RAM24260
2350  FORMAT ('0'1X,T3,'SIGNIFICANT ',A4,' AREA SOURCES'//1X,T8,'RANK   RAM24270
     1',T20,'Q*LENGTH',T33,'SOURCE NO.'/1X,T19,'(G/M/SEC)'/1X)           RAM24280
2360  FORMAT (1X,T9,I3,T18,1PE12.4,T35,I3)                              RAM24290
2370  FORMAT (1X,'HEIGHT ABOVE 100M FOR POINT SOURCE',I4,3X,' HEIGHT=',FRAM24300
     16.2,' (METERS)',' EMISSIONS=',F10.2,' (G/SEC)')                   RAM24310
2380  FORMAT ('0',4X,'TOTAL ',A4,' EMISSION AND CUMULATIVE FRACTION ACCORAM24320
     1RDING TO HEIGHT'//1X,T12,'TOTAL POINT   CUMULATIVE       TOTAL AREARAM24330
     2  CUMULATIVE'/1X,'HEIGHT(M) EMISSIONS(G/S)  FRACTION     EMISSIRAM24340
     3ONS(G/S)  FRACTION'/1X)                                           RAM24350
2390  FORMAT (1X,T2,I2,' -',I3,T11,F8.2,T26,F7.3,T41,F8.2,T56,F7.3)      RAM24360
2400  FORMAT ('0',T2,'TOTAL',2X,F10.2,T39,F10.2)                        RAM24370
2410  FORMAT (1H0,21X,'ADDITIONAL INFORMATION ON SOURCES.'/1X,T21,'POINTRAM24380
     1 SOURCE INFORMATION'/'0',2X,'EMISSION INFORMATION FOR ',I4,' (NPT)RAM24390
     2 POINT SOUR','CES HAS BEEN INPUT',2X,I2,' SIGNIFICANT POINT SOURCERAM24400
     3S (NSIGP) ','ARE TO BE USED FOR THIS RUN'/3X)                      RAM24410
2420  FORMAT (1H0,' USER SPECIFIED ',I3,' (NPT) SIGNIFICANT POINT ','SORAM24420
     1URCES AS LISTED BY POINT SOURCE NUMBER:'/2X,25I5)                 RAM24430
2430  FORMAT (1X,'THE ORDER OF SIGNIFICANCE (IMPS) FOR 25',' OR LESS POIRAM24440
     1NT SOURCES USED IN THIS RUN AS LISTED BY POINT ','SOURCE NUMBER:'/RAM24450
     22X,25I5)                                                          RAM24460
2440  FORMAT (1H0,T21,'AREA SOURCE INFORMATION'//2X,'EMISSION INFORMATIORAM24470
     1N FOR ',I4,' (NAS) AREA SOURCES HAVE BEEN DETERMINED BY RAM'/2X,I2RAM24480
     2,' SIGNIFICANT AREA SOURCES (NSIGA) ARE TO BE USED FOR THIS RUN') RAM24490
2450  FORMAT (2X,'NUMBER OF AREA HEIGHT CLASSES (NHTS)=',I2/2X,'REPRESENRAM24500
     1TATIVE AREA SOURCE HEIGHTS FOR EACH HEIGHT CLASS (HINT) IN METERS RAM24510
     2=',3F10.2)                                                        RAM24520
2460  FORMAT (2X,'BREAK POINT HEIGHT BETWEEN THE AREA HEIGHT CLASSES (BPRAM24530
     1H) IN METERS =',2F10.2)                                           RAM24540
2470  FORMAT (2X,' FRACTION OF AREA SOURCE HEIGHT WHICH IS PHYSICAL HEIGRAM24550
     1HT (FH) =',F10.3/2X,'LIMIT OF DISTANCE FOR AREA SOURCE INTEGRATIONRAM24560
     2 TABLES (XLIM) IN USER UNITS =',F10.3/2X,'BOUNDARIES OF THE AREA 'RAM24570
     3,'SOURCE GRID IN USER UNITS:'/1X,T6,'RMIN=',F10.3,5X,'RMAX=',F10.3RAM24580
     4,5X,'SMIN=',F10.3,5X,'SMAX=',F10.3/2X,'SIZE(IRSIZE X ISSIZE) OF ','RAM24590
     5 AREA SOURCE MAP ARRAY(IA) IN INTERNAL UNITS =',I3,' EAST-WEST ''RAM24600
     6BY ',I3,' NORTH-SOUTH')                                           RAM24610
2480  FORMAT (1H0,' USER SPECIFIED ',I3,' (NAS) SIGNIFICANT  AREA ','SORAM24620
     1URCES AS LISTED BY  AREA SOURCE NUMBER:'/2X,25I5)                 RAM24630
2490  FORMAT (1X,T21,'THE ORDER OF SIGNIFICANCE (IMAS) FOR 10 OR LESS ',RAM24640
     1' AREA SOURCE IS LISTED BY  AREA SOURCE NUMBER:'/2X,10I5)         RAM24650
2500  FORMAT (1H0,'SURFACE MET DATA FROM STATION(ISFCD) ',I6,', YEAR(ISFRAM24660
     1CYR) 19',I2/2X,'MIXING HEIGHT DATA FROM STATION(IMXD) ',I6,', YEARRAM24670
     2(IMXYR) 19',I2)                                                   RAM24680
2510  FORMAT (1H0,T21,'RECEPTOR INFORMATION')                           RAM24690
2520  FORMAT (1H0,' MPTER INTERNALLY GENERATES 36 RECEPTORS ','ON A CIRCRAM24700
     1LE CORRESPONDING TO EACH NON-ZERO ','RADIAL DISTANCE FROM A CENTERRAM24710
     2 POINT '/1X,T10,'COORDINATES ARE (USER UNITS): (',F8.3,',',F8.3,')'RAM24720
     3/1X,T10,'RADIAL DISTANCE(S) USER SPECIFIED (USER UNITS):',5(F11.3RAM24730
     4,' '))                                                            RAM24740
2530  FORMAT (F4.1)                                                     RAM24750
2540  FORMAT ('0',' RECEPTOR    IDENTIFICATION  EAST      NORTH         RAM24760
     1'/1X,T30,'COORD',T39,'COORD'/1X,T31,'(USER UNITS)')               RAM24770
2550  FORMAT (1X,T3,I3,1X,A1,8X,2A4,F13.3,F10.3)                        RAM24780
2560  FORMAT (//1X,' THE NUMBER OF   DAYS  PREVIOUSLY COMPLETED EQUAL ',RAM24790
     1I3,' AND THE LAST    DAY  TO BE COMPLETED IN THIS RUN IS ',I3)    RAM24800
2570  FORMAT ('1INPUT MET DATA FOR ',I3,'-HR PERIOD STARTING AT HOUR: ',RAM24810
     1I3,', YEAR',I3,', JULIAN DAY',I4/1X,T2,'HOUR   THETA    SPEED   MIRAM24820
     2XING  TEMP      STABILITY'/1X,T9,'(DEG)     (M/S)  HEIGHT(M) (DEG-KRAM24830
     3) CLASS'/1X)                                                      RAM24840
2580  FORMAT (1X,T3,I2,4F9.2,6X,I1)                                     RAM24850
2590  FORMAT ('0','RESULTANT MET CONDITIONS'//2X,'WIND DIRECTION=',F7.2,RAM24860
     1T36,'RESULTANT WIND SPEED=',F7.2/2X,'AVERAGE WIND SPEED=',F7.2,T36RAM24870
     2,'AVERAGE TEMP=',F7.2/2X,'WIND PERSISTENCE=',F6.3,T36,'MODAL STABIRAM24880
     3LITY=',I2)                                                        RAM24890
2600  FORMAT ('0',T20,'GENERATED HONEYCOMB RECEPTORS'/1X,/1X,'THE AREA TRAM24900
     1O BE COVERED BY HONEYCOMB RECEPTORS IS BOUNDED BY:'/1X,' RMIN=',F1RAM24910
     20.3,' RMAX=',F10.3,' SMIN=',F10.3,' SMAX=',F10.3//1X,'DISTANCE BETRAM24920
     3WEEN HONEYCOMB RECEPTORS(GRIDSP) IN USER UNITS=',F7.3//1X,'RECEPTORAM24930
     4R      EAST       NORTH')                                         RAM24940
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2610  FORMAT ('     PLEASE NOTE: THE RECEPTOR NUMBERS AND LOCATIONS GENERRAM24950
     1ATED FOR THIS AVERAGING TIME PERIOD ARE DIFFERENT FROM THOSE GENERRAM24960
     2ATED FOR'/18X,' THE PRECEEDING AVERAGING PERIOD.     ')            RAM24970
2620  FORMAT (1H0,' THIS SEGMENT OF A SEGMENTED RUN HAS COMPLETED',I5,' RAM24980
     1(IDAY) DAYS.')                                                     RAM24990
2630  FORMAT ('1',20A4/1X,20A4/1X,20A4)                                  RAM25000
2640  FORMAT ('0',T9,'       RECEPTORS'//1X,'RECEPTOR    IDENTIFICATION  RAM25010
     1EAST       NORTH                                         ',T99,'AVGRAM25020
     2 CONC FOR PERIOD'/1X,T30,'COORD',T39,'COORD                        RAM25030
     3             ',T94,'DAY',F4.0,'HR',F3.0,' TO DAY',F4.0,'HR',F3.0/1XRAM25040
     4,T31,'(USER UNITS)                                      ',T100,'RAM25050
     5(MICROGRAMS/M**3)'/1X)                                             RAM25060
2650  FORMAT (1X,T3,I3,1X,A1,I3,5X,2A4,5X,F8.2,2X,F8.2,T110,A1,6PF7.2)  RAM25070
2660  FORMAT (1H1,T29,'FIVE HIGHEST ',I2,'-HOUR ',A4,' CONCENTRATIONS((ERAM25080
     1NDING ON JULIAN DAY, HOUR)'/1X,T55,'(MICROGRAMS/M**3)'//2X,'RECEPTRAM25090
     2OR ',T38,4(I1,20X),I1,/1X)                                         RAM25100
2661  FORMAT (1H1,T29,'FIVE HIGHEST ',I2,'-HOUR ',A4,' CONCENTRATIONS((ERAM25110
     1NDING ON JULIAN DAY, HOUR)'/1X,T55,'(MICROGRAMS/M**3)'/            RAM25120
     21X,T36,'C-FLAG IDENTIFIES CONCENTRATIONS AFFECTED BY CALM HOURS'//RAM25130
     32X,'RECEPTOR ',T38,4(I1,20X),I1,/1X)                               RAM25140
2670  FORMAT (1H ,2X,I3,' (',F7.2,',',F7.2,')',2(1X,A1,6PF9.2,A1,1X,'(',IRAM25150
     13,',',I2,')'),3(2X,6PF9.2,A1,1X,'(',I3,',',I2,')'))                RAM25160
2680  FORMAT ('0 THIS RUN HAS TERMINATED NORMALLY.')                     RAM25170
C                                                                        RAM25180
      END                                                                RAM25190
C
      BLOCK DATA                                                         RAM25210
C                      BLOCK DATA         (VERSION 80336), PART OF RAM.  RAM25220
C                 BLOCK DATA FOR RAM                                     RAM25230
C     COEFFICIENTS GENERATED WITH RURAL SIGMAS USING PGSYSZ &PGSZ        RAM25240
C     DIST OF MAX. CONC. FROM PT SOURCE = PXCOR(KST,IH)*H**PXEXR(KST,IH) RAM25250
C     RELATIVE CONC. NORMALIZED FOR WIND SPEED FROM PT SOURCE, CHI*U/Q, = RAM25260
C          PXUCOR(KST,IH)*H**PXUEXR(KST,IH)                              RAM25270
C     DISTANCE OF MAX. CONC. FROM DOWNWIND EDGE OF AREA SOURCE =         RAM25280
C          AXCOR(KST,IH)*H**AXEXR(KST,IH)                                RAM25290
C        IH=1 FOR H LESS THAN 20 METERS.                                 RAM25300
C        IH=2 FOR H FROM 20 TO 30 METERS.                                RAM25310
C        IH=3 FOR H FROM 30 TO 50 METERS.                                RAM25320
C        IH=4 FOR H FROM 50 TO 70 METERS.                                RAM25330
C        IH=5 FOR H FROM 70 TO 100 METERS.                               RAM25340
C        IH=6 FOR H FROM 100 TO 200 METERS.                              RAM25350
C        IH=7 FOR H FROM 200 TO 300 METERS.                              RAM25360
C        IH=8 FOR H FROM 300 TO 500 METERS.                              RAM25370
C        IH=9 FOR H GREATER THAN 500 METERS.                             RAM25380
C                                                                        RAM25390
      COMMON /AE/ HC1(10),PXUCOR(6,9),PXUEXR(6,9),PXCOR(6,9),PXEXR(6,9),RAM25400
     1PXUCOF(6,9),PXUEXP(6,9),PXCOF(6,9),PXEXP(6,9),AXCOR(6,9),AXEXR(6,9RAM25410
     2),AXCOF(6,9),AXEXP(6,9)                                            RAM25420
C                                                                        RAM25430
      DATA HC1 /10.,20.,30.,50.,70.,100.,200.,300.,500.,1000./           RAM25440
      DATA PXCOR /.38964E-02,.54607E-02,.75278E-02,.11563E-01,.12743E-01RAM25450
     1,.21051E-01,.59088E-02,.50774E-02,.74442E-02,.87095E-02,.10152E-01RAM25460
     2,.10867E-01,.59366E-02,.67049E-02,.76095E-02,.14437E-01,.79376E-02RAM25470
     3,.10552E-01,.10739E-01,.67199E-02,.75237E-02,.22618E-02,.38170E-02RAM25480
     4,.13053E-02,.14425E-01,.10509E-01,.75283E-02,.22489E-02,.24006E-02RAM25490
     5,.79956E-03,.37139E-01,.10418E-01,.75363E-02,.17287E-02,.15400E-02RAM25500
     6,.14422E-03,.51107E-01,.10468E-01,.75324E-02,.12670E-02,.13842E-03RAM25510
     7,.43952E-09,.50921E-01,.10472E-01,.75225E-02,.84890E-03,.10930E-06RAM25520
     8,.13979E-02,.50996E-01,.10401E-01,.74961E-02,.19441E-03,.10859E-04RAM25530
     9,.20000E+04/                                                       RAM25540
      DATA PXEXR /.10995E+01,.10757E+01,.10965E+01,.11383E+01,.12469E+01RAM25550
     1,.12577E+01,.96054E+00,.11000E+01,.11002E+01,.12329E+01,.13228E+01RAM25560
     2,.14784E+01,.95916E+00,.10182E+01,.10937E+01,.10843E+01,.13951E+01RAM25570
     3,.14870E+01,.80763E+00,.10176E+01,.10966E+01,.15582E+01,.15823E+01RAM25580
     4,.20212E+01,.73818E+00,.91238E+00,.10965E+01,.15595E+01,.16914E+01RAM25590
     5,.21366E+01,.53282E+00,.91427E+00,.10963E+01,.16166E+01,.17878E+01RAM25600
     6,.25085E+01,.47257E+00,.91337E+00,.10964E+01,.16753E+01,.22426E+01RAM25610
     7,.49057E+01,.47321E+00,.91331E+00,.10966E+01,.17455E+01,.34951E+01RAM25620
     8,.22807E+01,.47297E+00,.91440E+00,.10971E+01,.19827E+01,.27551E+01RAM25630
     9,.00000E+00/                                                       RAM25640
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      DATA PXUCOR /.10401E+00,.12133E+00,.14273E+00,.15351E+00,.18855E+0RAM25650
     10,.18668E+00,.77533E-01,.11728E+00,.14120E+00,.18239E+00,.20458E+0RAM25660
     20,.34326E+00,.67228E-01,.10013E+00,.13963E+00,.19162E+00,.38998E+0RAM25670
     30,.76271E+00,.40484E-01,.75308E-01,.13784E+00,.54357E+00,.72550E+0RAM25680
     40,.22936E+01,.28539E-01,.66936E-01,.13615E+00,.52790E+00,.12908E+0RAM25690
     51,.56943E+01,.14792E-01,.65799E-01,.13315E+00,.74832E+00,.28818E+0RAM25700
     61,.40940E+03,.12403E-01,.64321E-01,.12927E+00,.10826E+01,.77020E+0RAM25710
     72,.23011E+05,.12340E-01,.62874E-01,.12546E+00,.15580E+01,.68810E+0RAM25720
     83,.46522E+06,.12245E-01,.60615E-01,.11952E+00,.22517E+01,.42842E+0RAM25730
     93,.00000E+00/                                                     RAM25740
      DATA PXUEXR /-.19460E+01,-.19774E+01,-.20086E+01,-.20742E+01,-.218RAM25750
     122E+01,-.22176E+01,-.18479E+01,-.19661E+01,-.20050E+01,-.21317E+01RAM25760
     2,-.22094E+01,-.24209E+01,-.18060E+01,-.19196E+01,-.20017E+01,-.214RAM25770
     362E+01,-.23991E+01,-.26556E+01,-.16763E+01,-.18468E+01,-.19984E+01RAM25780
     4,-.24128E+01,-.25578E+01,-.29371E+01,-.15940E+01,-.18191E+01,-.199RAM25790
     555E+01,-.24059E-01,-.26934E+01,-.31511E+01,-.14513E+01,-.18153E+01RAM25800
     6,-.19907E+01,-.24817E+01,-.28678E+01,-.40795E+01,-.14181E+01,-.181RAM25810
     711E+01,-.19851E+01,-.25514E+01,-.34879E+01,-.48399E+01,-.14172E+01RAM25820
     8,-.18071E+01,-.19799E+01,-.26152E+01,-.38719E+01,-.53670E+01,-.141RAM25830
     960E+01,-.18012E+01,-.19721E+01,-.26744E+01,-.37956E+01,-.17020E+02RAM25840
     A/                                                                 RAM25850
      DATA AXCOR /.68365E-02,.79134E-02,.11062E-01,.14818E-01,.17234E-01RAM25860
     1,.19793E-01,.92054E-02,.94211E-02,.11254E-01,.13875E-01,.91114E-02RAM25870
     2,.65416E-02,.12311E-01,.11151E-01,.11079E-01,.53876E-02,.48999E-02RAM25880
     3,.17087E-02,.19297E-01,.13824E-01,.11267E-01,.42195E-02,.17526E-02RAM25890
     4,.13715E-03,.32619E-01,.13833E-01,.11119E-01,.30122E-02,.11144E-02RAM25900
     5,.73510E-06,.53524E-01,.13821E-01,.11115E-01,.22334E-02,.20868E-04RAM25910
     6,.28987E-05,.55881E-01,.13920E-01,.11152E-01,.11204E-02,.21361E-05RAM25920
     7,.20000E+04,.55160E-01,.13838E-01,.11153E-01,.61078E-03,.10114E-03RAM25930
     8,.20000E+04,.55799E-01,.13881E-01,.11140E-01,.61554E-03,.20000E+04RAM25940
     9,.20000E+04/                                                      RAM25950
      DATA AXEXR /.10103E+01,.10748E+01,.10960E+01,.12112E+01,.13211E+01RAM25960
     1,.14994E+01,.91095E+00,.10166E+01,.10903E+01,.12332E+01,.15339E+01RAM25970
     2,.18689E+01,.82547E+00,.96699E+00,.10949E+01,.15113E+01,.17163E+01RAM25980
     3,.22636E+01,.71059E+00,.91206E+00,.10906E+01,.15738E+01,.19791E+01RAM25990
     4,.29084E+01,.58703E+00,.91191E+00,.10937E+01,.16531E+01,.20856E+01RAM26000
     5,.41392E+01,.47949E+00,.91210E+00,.10938E+01,.17181E+01,.29494E+01RAM26010
     6,.38412E+01,.47136E+00,.91075E+00,.10932E+01,.18483E+01,.33796E+01RAM26020
     7,.00000E+00,.47363E+00,.91178E+00,.10932E+01,.19546E+01,.27033E+01RAM26030
     8,.00000E+00,.47178E+00,.91129E+00,.10933E+01,.19534E+01,.00000E+00RAM26040
     9,.00000E+00/                                                      RAM26050
C                                                                       RAM26060
C    COEFFICIENTS GENERATED WITH URBAN SIGMAS USING BRSYSZ & BRSZ       RAM26070
C    DIST OF MAX. CONC. FROM PT SOURCE = PXCOF(KST,IH)*H**PXEXP(KST,IH) RAM26080
C    RELATIVE CONC. NORMALIZED FOR WIND SPEED FROM PT SOURCE, CHI*U/Q, = RAM26090
C         PXUCOF(KST,IH)*H**PXUEXP(KST,IH)                              RAM26100
C    DISTANCE OF MAX. CONC. FROM DOWNWIND EDGE OF AREA SOURCE =         RAM26110
C         AXCOF(KST,IH)*H**AXEXP(KST,IH)                                RAM26120
C       IH=1 FOR H LESS THAN 20 METERS.                                 RAM26130
C       IH=2 FOR H FROM 20 TO 30 METERS.                                RAM26140
C       IH=3 FOR H FROM 30 TO 50 METERS.                                RAM26150
C       IH=4 FOR H FROM 50 TO 70 METERS.                                RAM26160
C       IH=5 FOR H FROM 70 TO 100 METERS.                               RAM26170
C       IH=6 FOR H FROM 100 TO 200 METERS.                              RAM26180
C       IH=7 FOR H FROM 200 TO 300 METERS.                              RAM26190
C       IH=8 FOR H FROM 300 TO 500 METERS.                              RAM26200
C       IH=9 FOR H GREATER THAN 500 METERS.                             RAM26210
C                                                                       RAM26220
      DATA PXCOF /.29000E-02,.29000E-02,.33389E-02,.49374E-02,.76841E-02RAM26230
     1,.76841E-02,.31586E-02,.31586E-02,.34293E-02,.50285E-02,.65931E-02RAM26240
     2,.65931E-02,.31977E-02,.31977E-02,.36114E-02,.45861E-02,.51435E-02RAM26250
     3,.51435E-02,.34513E-02,.34513E-02,.34298E-02,.43860E-02,.33140E-02RAM26260
     4,.33140E-02,.36196E-02,.36196E-02,.33575E-02,.39506E-02,.19672E-02RAM26270
     5,.19672E-02,.41677E-02,.41677E-02,.32748E-02,.32439E-02,.63291E-03RAM26280
     6,.63291E-03,.50465E-02,.50465E-02,.31556E-02,.21446E-02,.19145E-03RAM26290
     7,.19145E-03,.60289E-02,.60289E-02,.30537E-02,.12214E-02,.12483E-03RAM26300
     8,.12483E-03,.77521E-02,.77521E-02,.29817E-02,.39130E-03,.11337E-03RAM26310
     9,.11337E-03/                                                      RAM26320
      DATA PXEXP /.10000E+01,.10000E+01,.10205E+01,.10141E+01,.10829E+01RAM26330
     1,.10829E+01,.97149E+00,.97149E+00,.10116E+01,.10080E+01,.11340E+01RAM26340
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     2,.11340E+01,.96787E+00,.96787E+00,.99634E+00,.10350E+01,.12070E+01
     3,.12070E+01,.94836E+00,.94836E+00,.10095E+01,.10465E+01,.13194E+01
     4,.13194E+01,.93716E+00,.93716E+00,.10145E+01,.10711E+01,.14421E+01
     5,.14421E+01,.90654E+00,.90654E+00,.10200E+01,.11139E+01,.16884E+01
     6,.16884E+01,.87043E+00,.87043E+00,.10270E+01,.11920E+01,.19141E+01
     7,.19141E+01,.83924E+00,.83924E+00,.10327E+01,.12907E+01,.19890E+01
     8,.19890E+01,.79879E+00,.79879E+00,.10365E+01,.14738E+01,.20045E+01
     9,.20045E+01/
      DATA PXUCOF /.16808E+00,.16808E+00,.20927E+00,.20378E+00,.18861E+0
     10,.18861E+00,.15945E+00,.15945E+00,.20527E+00,.20229E+00,.21253E+0
     20,.21253E+00,.14777E+00,.14777E+00,.19871E+00,.20011E+00,.24888E+0
     30,.24888E+00,.13262E+00,.13262E+00,.18908E+00,.19685E+00,.30041E+0
     40,.30041E+00,.11745E+00,.11745E+00,.17767E+00,.19301E+00,.34521E+0
     50,.34521E+00,.91943E-01,.91943E-01,.15327E+00,.18499E+00,.34368E+0
     60,.34368E+00,.65533E-01,.65533E-01,.11984E+00,.17445E+00,.23640E+0
     70,.23640E+00,.47345E-01,.47345E-01,.89821E-01,.16720E+00,.15537E+0
     80,.15537E+00,.29993E-01,.29993E-01,.56100E-01,.16747E+00,.11009E+0
     90,.11009E+00/
      DATA PXUEXP /-.19722E+01,-.19722E+01,-.19896E+01,-.19965E+01,-.206
     149E+01,-.20649E+01,-.19546E+01,-.19546E+01,-.19831E+01,-.19940E+01
     2,-.21047E+01,-.21047E+01,-.19322E+01,-.19322E+01,-.19736E+01,-.199
     308E+01,-.21512E+01,-.21512E+01,-.19045E+01,-.19045E+01,-.19609E+01
     4,-.19867E+01,-.21993E+01,-.21993E+01,-.18759E+01,-.18759E+01,-.194
     562E+01,-.19820E+01,-.22320E+01,-.22320E+01,-.18228E+01,-.18228E+01
     6,-.19142E+01,-.19728E+01,-.22310E+01,-.22310E+01,-.17589E+01,-.175
     789E+01,-.18677E+01,-.19617E+01,-.21604E+01,-.21604E+01,-.17019E+01
     8,-.17019E+01,-.18172E+01,-.19543E+01,-.20868E+01,-.20868E+01,-.162
     984E+01,-.16284E+01,-.17414E+01,-.19545E+01,-.20314E+01,-.20314E+01
     A/
      DATA AXCOF /.44505E-02,.44505E-02,.50000E-02,.68776E-02,.10026E-01
     1,.10026E-01,.45289E-02,.45289E-02,.50000E-02,.68258E-02,.76276E-02
     2,.76276E-02,.47786E-02,.47786E-02,.50000E-02,.63099E-02,.51380E-02
     3,.51380E-02,.52938E-02,.52938E-02,.50000E-02,.59067E-02,.29303E-02
     4,.29303E-02,.57593E-02,.57593E-02,.50000E-02,.52626E-02,.16889E-02
     5,.16889E-02,.68765E-02,.68765E-02,.50000E-02,.39429E-02,.74769E-03
     6,.74769E-03,.82988E-02,.82988E-02,.50000E-02,.22800E-02,.39161E-03
     7,.39161E-03,.99556E-02,.99556E-02,.50000E-02,.10882E-02,.29900E-03
     8,.29900E-03,.12206E-01,.12206E-01,.50000E-02,.28165E-03,.25538E-03
     9,.25538E-03/
      DATA AXEXP /.96437E+00,.96437E+00,.10000E+01,.10199E+01,.11356E+01
     1,.11356E+01,.95855E+00,.95855E+00,.10000E+01,.10224E+01,.12269E+01
     2,.12269E+01,.94276E+00,.94276E+00,.10000E+01,.10455E+01,.13430E+01
     3,.13430E+01,.91659E+00,.91659E+00,.10000E+01,.10624E+01,.14866E+01
     4,.14866E+01,.89676E+00,.89676E+00,.10000E+01,.10896E+01,.16163E+01
     5,.16163E+01,.85826E+00,.85826E+00,.10000E+01,.11523E+01,.17932E+01
     6,.17932E+01,.82277E+00,.82277E+00,.10000E+01,.12557E+01,.19153E+01
     7,.19153E+01,.79086E+00,.79086E+00,.10000E+01,.13853E+01,.19626E+01
     8,.19626E+01,.75807E+00,.75807E+00,.10000E+01,.16028E+01,.19880E+01
     9,.19880E+01/
C
      END
C
      FUNCTION ANGARC(DELM,DELN)
C                     FUNCTION ANGARC     (VERSION 80336), PART OF RAM.
C          THIS SUBROUTINE IS REFERRED TO AS B IN THE COMMON STATEMENTS
C        DETERMINES APPROPRIATE ANGLE OF TAN(ANG) = DELM/DELN
C        WHICH IS REQUIRED FOR CALCULATION OF RESULTANT WIND DIRECTION.
C        DELM IS THE AVERAGE WIND COMPONENT IN THE EAST DIRECTION.
C        DELN IS THE AVERAGE WIND COMPONENT IN THE NORTH DIRECTION.
C        USES LIBRARY FUNCTION ATAN
C
      IF (DELN) 10,40,80
   10 IF (DELM) 20,30,20
   20 ANGARC=57.29578*ATAN(DELM/DELN)+180.
      RETURN
   30 ANGARC=180.
      RETURN
   40 IF (DELM) 50,60,70
   50 ANGARC=270.
      RETURN
```

```
60    ANGARC=0.
C     ANGARC=0. INDICATES INDETERMINATE ANGLE
      RETURN
70    ANGARC=090.
      RETURN
80    IF (DELM) 90,100,110
90    ANGARC=57.29578*ATAN(DELM/DELN)+360.
      RETURN
100   ANGARC=360.
      RETURN
110   ANGARC=57.29578*ATAN(DELM/DELN)
      RETURN
C
      END
C
      SUBROUTINE SYSZ
C                      SUBROUTINE SYSZ   (VERSION 80336), PART OF RAM.
C        THIS SUBROUTINE REFERRED TO AS C IN THE COMMON STATEMENTS
C
      COMMON /AMOST/ DELH,FH,HINT(3),H,HL,IO,IOPT(50),KST,MUOR,NHTS,RC,R
     1CZ,SY,SZ,TEMP,TLOS,UPL,X,Y,Z
      DIMENSION XA(7), XB(2), XD(5), XE(8), XF(9), AA(8), BA(8), AB(3),
     1BB(3), AD(6), BD(6), AE(9), BE(9), AF(10), BF(10)
      DATA XA /.5,.4,.3,.25,.2,.15,.1/
      DATA XB /.4,.2/
      DATA XD /30.,10.,3.,1.,.3/
      DATA XE /40.,20.,10.,4.,2.,1.,.3,.1/
      DATA XF /60.,30.,15.,7.,3.,2.,1.,.7,.2/
      DATA AA /453.85,346.75,258.89,217.41,179.52,170.22,158.08,122.8/
      DATA BA /2.1166,1.7283,1.4094,1.2644,1.1262,1.0932,1.0542,.9447/
      DATA AB /109.30,98.483,90.673/
      DATA BB /1.0971,0.98332,0.93198/
      DATA AD /44.053,36.650,33.504,32.093,32.093,34.459/
      DATA BD /0.51179,0.56589,0.60486,0.64403,0.81066,0.86974/
      DATA AE /47.618,35.420,26.970,24.703,22.534,21.628,21.628,23.331,2
     14.26/
      DATA BE /0.29592,0.37615,0.46713,0.50527,0.57154,0.63077,0.75660,0
     1.81956,0.8366/
      DATA AF /34.219,27.074,22.651,17.836,16.187,14.823,13.953,13.953,1
     14.457,15.209/
      DATA BF /0.21716,0.27436,0.32681,0.41507,0.46490,0.54503,0.63227,0
     1.68465,0.78407,0.81558/
C
      ASSIGN 10 TO K
      IF (MUOR.EQ.2) ASSIGN 70 TO K
      RETURN
C
      ENTRY SYZ
      GO TO K, (10,70)
C           MCELROY-POOLER URBAN DISPERSION PARAMETERS FROM ST. LOUIS
C             EXPERIMENT AS PUT IN EQUATION FORM BY BRIGGS.
C               XK IS DISTANCE IN KM.
C               KST IS PASQUILL STABILITY CLASS.
C               SY AND SZ ARE IN METERS.
C         CONVERT X TO METERS
10    XM=1000.*X
      GO TO (20,20,30,40,50,50), KST
20    SY=0.32*XM/SQRT(1.+0.0004*XM)
      SZ=0.24*XM*SQRT(1.+0.001*XM)
      GO TO 60
30    SY=0.22*XM/SQRT(1.+0.0004*XM)
      SZ=0.2*XM
      GO TO 60
40    SY=0.16*XM/SQRT(1.+0.0004*XM)
      SZ=0.14*XM/SQRT(1.+0.0003*XM)
      GO TO 60
50    SY=0.11*XM/SQRT(1.+0.0004*XM)
      SZ=0.08*XM/SQRT(1.+0.0015*XM)
60    IF (SZ.GT.5000.) SZ=5000.
      RETURN
```

```
C
C        PASQUILL-GIFFORD PARAMETERS VALID FOR RURAL CONDITIONS.
C      VERTICAL DISPERSION PARAMETER VALUE, SZ DETERMINED BY
C       SZ = A * X ** B WHERE A AND B ARE FUNCTIONS OF BOTH STABILITY
C       AND RANGE OF X.
C      HORIZONTAL DISPERSION PARAMETER VALUE, SY DETERMINED BY
C       LOGARITHMIC INTERPOLATION OF PLUME HALF-ANGLE ACCORDING TO
C       DISTANCE AND CALCULATION OF 1/2.15 TIMES HALF-ARC LENGTH.
70    GO TO (80,110,140,150,180,210), KST
C          STABILITY A
80    TH=(24.167-2.5334*ALOG(X))/57.2958
      IF (X.GT.3.11) GO TO 240
      DO 90 ID=1,7
      IF (X.GE.XA(ID)) GO TO 100
90    CONTINUE
      ID=8
100   SZ=AA(ID)*X**BA(ID)
      GO TO 260
C        STABILITY B
110   TH=(18.333-1.8096*ALOG(X))/57.2958
      IF (X.GT.35.) GO TO 240
      DO 120 ID=1,2
      IF (X.GE.XB(ID)) GO TO 130
120   CONTINUE
      ID=3
130   SZ=AB(ID)*X**BB(ID)
      GO TO 250
C        STABILITY C
140   TH=(12.5-1.0857*ALOG(X))/57.2958
      SZ=61.141*X**0.91465
      GO TO 250
C        STABILITY D
150   TH=(8.3333-0.72382*ALOG(X))/57.2958
      DO 160 ID=1,5
      IF (X.GE.XD(ID)) GO TO 170
160   CONTINUE
      ID=6
170   SZ=AD(ID)*X**BD(ID)
      GO TO 250
C        STABILITY E
180   TH=(6.25-0.54287*ALOG(X))/57.2958
      DO 190 ID=1,8
      IF (X.GE.XE(ID)) GO TO 200
190   CONTINUE
      ID=9
200   SZ=AE(ID)*X**BE(ID)
      GO TO 250
C        STABILITY F
210   TH=(4.1667-0.36191*ALOG(X))/57.2958
      DO 220 ID=1,9
      IF (X.GE.XF(ID)) GO TO 230
220   CONTINUE
      ID=10
230   SZ=AF(ID)*X**BF(ID)
      GO TO 250
240   SZ=5000.
      GO TO 260
250   IF (SZ.GT.5000.) SZ=5000.
260   SY=465.116*X*SIN(TH)/COS(TH)
C        465.116 = 1000. (M/KM) / 2.15
      RETURN
C
      END
C
      SUBROUTINE SGZ
C                     SUBROUTINE SGZ     (VERSION 81352), PART OF RAM.
C        THIS SUBROUTINE IS REFERRED TO AS D IN THE COMMON STATEMENTS
C
      COMMON /AMOST/ DELH,FH,HINT(3),H,HL,IO,IOPT(50),KST,MUOR,NHTS,RC,R
     1CZ,SY,SZ,TEMP,TLOS,UPL,X,Y,Z
```

```
      DIMENSION XA(7), XB(2), XD(5), XE(8), XF(9), AA(8), BA(8), AB(3),
     1BB(3), AD(6), BD(6), AE(9), BE(9), AF(10), BF(10)
      DATA XA /.5,.4,.3,.25,.2,.15,.1/
      DATA XB /.4,.2/
      DATA XD /30.,10.,3.,1.,.3/
      DATA XE /40.,20.,10.,4.,2.,1.,.3,.1/
      DATA XF /60.,30.,15.,7.,3.,2.,1.,.7,.2/
      DATA AA /453.85,346.75,258.89,217.41,179.52,170.22,158.08,122.8/
      DATA BA /2.1166,1.7283,1.4094,1.2644,1.1262,1.0932,1.0542,.9447/
      DATA AB /109.30,98.483,90.673/
      DATA BB /1.0971,0.98332,0.93198/
      DATA AD /44.053,36.650,33.504,32.093,32.093,34.459/
      DATA BD /0.51179,0.56589,0.60486,0.64403,0.81066,0.86974/
      DATA AE /47.618,35.420,26.970,24.703,22.534,21.628,21.628,23.331,2
     14.26/
      DATA BE /0.29592,0.37615,0.46713,0.50527,0.57154,0.63077,0.75660,0
     1.81956,0.8366/
      DATA AF /34.219,27.074,22.651,17.836,16.187,14.823,13.953,13.953,1
     14.457,15.209/
      DATA BF /0.21716,0.27436,0.32681,0.41507,0.46490,0.54503,0.63227,0
     1.68465,0.78407,0.81558/
C
      ASSIGN 10 TO K
      IF (MUOR.EQ.2) ASSIGN 70 TO K
      RETURN
C
      ENTRY SIGZ
      GO TO K, (10,70)
C       MCELROY-POOLER URBAN SIGMA Z.
C         XM IS DISTANCE IN KM.
C         KST IS PASQUILL STABILITY CLASS.
C         SZ IS IN METERS.
C              CONVERT X TO METERS
10    XM=1000.*X
      GO TO (20,20,30,40,50,50), KST
20    SZ=0.24*XM*SQRT(1.+0.001*XM)
      GO TO 60
30    SZ=0.2*XM
      GO TO 60
40    SZ=0.14*XM/SQRT(1.+0.0003*XM)
      GO TO 60
50    SZ=0.08*XM/SQRT(1.+0.0015*XM)
60    IF (SZ.GT.5000.) SZ=5000.
      RETURN
C          PASQUILL-GIFFORD PARAMETER VALID FOR RURAL CONDITIONS.
C        VERTICAL DISPERSION PARAMETER VALUE, SZ DETERMINED BY
C          SZ = A * X ** B WHERE A AND B ARE FUNCTIONS OF BOTH STABILITY
C      AND RANGE OF X.
70    GO TO (80,110,140,150,180,210), KST
C         STABILITY A (10)
80    IF (X.GT.3.11) GO TO 240
      DO 90 ID=1,7
      IF (X.GE.XA(ID)) GO TO 100
90    CONTINUE
      ID=8
100   SZ=AA(ID)*X**BA(ID)
      GO TO 260
C         STABILITY B (20)
110   IF (X.GT.35.) GO TO 240
      DO 120 ID=1,2
      IF (X.GE.XB(ID)) GO TO 130
120   CONTINUE
      ID=3
130   SZ=AB(ID)*X**BB(ID)
      GO TO 250
C         STABILITY C (30)
140   SZ=61.141*X**0.91465
      GO TO 250
C         STABILITY D (40)
150   DO 160 ID=1,5
```

```
      IF (X.GE.XD(ID)) GO TO 170
160   CONTINUE
      ID=6
170   SZ=AD(ID)*X**BD(ID)
      GO TO 250
C        STABILITY E (50)
180   DO 190 ID=1,8
      IF (X.GE.XE(ID)) GO TO 200
190   CONTINUE
      ID=9
200   SZ=AE(ID)*X**BE(ID)
      GO TO 250
C        STABILITY F (60)
210   DO 220 ID=1,9
      IF (X.GE.XF(ID)) GO TO 230
220   CONTINUE
      ID=10
230   SZ=AF(ID)*X**BF(ID)
      GO TO 250
240   SZ=5000.
      RETURN
250   IF (SZ.GT.5000.) SZ=5000.
260   RETURN
C
      END
C
      SUBROUTINE JMHREC
C                        SUBROUTINE JMHREC (VERSION 80336), PART OF RAM.
C         THIS SUBROUTINE IS REFERRED TO AS E IN THE COMMON STATEMENTS
C        THE PURPOSE OF THIS SUBROUTINE IS TO DETERMINE RECEPTORS FROM
C          SIGNIFICANT SOURCES.
C
      COMMON /AMOST/ DELH,FH,HINT(3),H,HL,IO,IOPT(50),KST,MUOR,NHTS,RC,R
     1CZ,SY,SZ,TEMP,TLOS,UPL,X,Y,Z
      COMMON /AE/ HC1(10),PXUCOR(6,9),PXUEXR(6,9),PXCOR(6,9),PXEXR(6,9),
     1PXUCOF(6,9),PXUEXP(6,9),PXCOF(6,9),PXEXP(6,9),AXCOR(6,9),AXEXR(6,9
     2),AXCOF(6,9),AXEXP(6,9)
      COMMON /AEFM/ ITYPE(180),ICODE(180),UNITS,RREU(180),SREU(180)
      COMMON /AEFGKM/ NRECEP,RREC(180),SREC(180),IDATE(2),LH,NPT
      COMMON /AEG/ SOURCE(9,250)
      COMMON /AEGIKM/ IPOL,CONTWO,SINT,COST,U,HANE,PL(6)
      COMMON /AEK/ ASORC(6,100)
      COMMON /AEM/ NSIGP,MPS(25),NSIGA,MAS(10)
      DATA ICHAR /'P'/ ,JCHAR /'A'/
C
      ASSIGN 120 TO KNTRL
      ASSIGN 190 TO KNTRM
      IF (MUOR.EQ.1) GO TO 10
      ASSIGN 110 TO KNTRL
      ASSIGN 180 TO KNTRM
10    RETURN
C
      ENTRY GREC
      IF (NSIGP.EQ.0) GO TO 150
      IF (IOPT(15).EQ.0) GO TO 150
      WRITE (IO,270)
C
C       LOOP ON SIGNIFICANT POINT SOURCES
C
      DO 140 IP=1,NSIGP
      X=0.0
      I=MPS(IP)
C       EAST AND NORTH COORDINATES OF THE SOURCE (INTERNAL UNITS)
      RS=SOURCE(1,I)
      SS=SOURCE(2,I)
      Q=SOURCE(IPOL,I)
C       MODIFY WIND SPEED BY POWER LAW PROFILE IN ORDER TO TAKE INTO
C       ACCOUNT THE INCREASE IN WIND SPEED WITH HEIGHT.
      UPL=U*(SOURCE(5,I)/HANE)**PL(KST)
C       CALCULATE BUOYANCY PLUME RISE
```

```
      TS=SOURCE(6,I)
      IF (TS.GT.TEMP) GO TO 20
      HF=SOURCE(5,I)
      GO TO 80
20    F=SOURCE(9,I)*(TS-TEMP)/TS
      GO TO (30,30,30,30,50,60), KST
30    IF (F.GE.55.) GO TO 40
      HF=SOURCE(5,I)+21.425*F**0.75/UPL
      GO TO 80
40    HF=SOURCE(5,I)+38.71*F**0.6/UPL
      GO TO 80
50    DTHDZ=0.02
      GO TO 70
60    DTHDZ=0.035
70    S=9.80616*DTHDZ/TEMP
      HF=SOURCE(5,I)+2.6*(F/(UPL*S))**0.333333
C       DETERMINE PROPER HEIGHT CLASS
80    DO 90 IH=2,10
      IF (HF.LT.(HC1(IH)-.01)) GO TO 100
90    CONTINUE
      IH=10
100   IS=IH-1
      GO TO KNTRL, (110,120)
110   A=PXUCOR(KST,IS)
      B=PXUEXR(KST,IS)
      C=PXCOR(KST,IS)
      D=PXEXR(KST,IS)
      GO TO 130
120   A=PXUCOF(KST,IS)
      B=PXUEXP(KST,IS)
      C=PXCOF(KST,IS)
      D=PXEXP(KST,IS)
C       CALCULATE RELATIVE CONC. NORMALIZED FOR WIND SPEED
130   CONM=A*HF**B*Q/UPL
C       CALCULATE DISTANCE TO MAX. CONC. FROM POINT SOURCE.
C         X IN KM.
      X=C*HF**D
C       DO NOT ALLOW  RECEPTORS BEYOND 1000 KM.
      IF (X.GT.1000.) GO TO 140
      NRECEP=NRECEP+2
      IF (NRECEP.GT.180) GO TO 260
C
C       TWO RECEPTORS ARE GENERATED FOR EACH SIGNIFICANT POINT SOURCE.
C         RECEPTORS ARE LOCATED AT A DISTANCE OF X AND AT 2X. X
C         IS THE LOCATION WHERE THE HIGHEST CONCENTRATION FROM THE IP-TH
C         POINT SOURCE IS EXPECTED. A RECEPTOR IS LOCATED AT A DIST
C         OF 2X TO ALLOW FOR THE INTERSECTION OF PLUMES FROM SEVERAL
C          POINT SOURCES. THE CHARACTERS "A" FOR AREA SOURCE AND "P"
C          FOR POINT SOURCES SIGNIFY WHICH TYPE OF SOURCE CAUSED THE
C          GENERATION OF A SPECIFIC RECEPTOR.
      K=NRECEP-1
      ITYPE(K)=ICHAR
      ICODE(K)=I
C        CALCULATE EAST AND NORTH COORDINATES(INTERNAL UNITS) OF THE
C          RECEPTOR. SINT AND COST REFER TO THE SINE AND COSINE OF THE
C          RESULTANT WIND DIRECTION.
      RREC(K)=RS-X*SINT/CONTWO
      SREC(K)=SS-X*COST/CONTWO
C         CONVERT TO USER UNITS FOR PRINT OUT.
      RREU(K)=RREC(K)*UNITS
      SREU(K)=SREC(K)*UNITS
      WRITE (IO,280) K,ICHAR,I,RREU(K),SREU(K),CONM,X,HF,UPL
      X=2.0*X
      ITYPE(NRECEP)=ICHAR
      ICODE(NRECEP)=I
      RREC(NRECEP)=RS-X*SINT/CONTWO
      SREC(NRECEP)=SS-X*COST/CONTWO
C       CONVERT TO USER UNITS FOR PRINT OUT.
      RREU(NRECEP)=RREC(NRECEP)*UNITS
      SREU(NRECEP)=SREC(NRECEP)*UNITS
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      WRITE (IO,290) NRECEP,ICHAR,I,RREU(NRECEP),SREU(NRECEP),X,HF,UPL
140   CONTINUE
C
C        LOOP ON SIGNIFICANT AREA SOURCES
C      ONE RECEPTOR IS LOCATED ON THE DOWNWIND AZIMUTH FROM THE CENTER
C       OF EACH SIGNIFICANT AREA SOURCE AT A DISTANCE WHERE MAXIMUM
C       CONCENTRATION  IS EXPECTED.
C
150   IF (NSIGA.EQ.0) GO TO 250
      IF (IOPT(16).EQ.0) GO TO 250
      WRITE (IO,300)
      DO 240 IP=1,NSIGA
      I=MAS(IP)
      WA=ASORC(5,I)
C        LOCATE SOURCE CENTER
      RS=ASORC(1,I)+WA
      SS=ASORC(2,I)+WA
      H=ASORC(6,I)
C        DETERMINE HEIGHT CLASS
C        IS = 1 FOR H LESS THAN 20 METERS.
C        IS = 2 FOR H FROM 20 TO 30 METERS.
C        IS = 3 FOR H FROM 30 TO 50 METERS.
      DO 160 IH=2,3
      IF (H.LT.HC1(IH)-0.01) GO TO 170
160   CONTINUE
      IH=4
170   IS=IH-1
C        CALCULATE DISTANCE(KM) TO MAXIMUM CONCENTRATION.
      GO TO KNTRM, (180,190)
180   C=AXCOR(KST,IS)
      D=AXEXR(KST,IS)
      GO TO 200
190   C=AXCOF(KST,IS)
      D=AXEXP(KST,IS)
200   X=C*H**D
C       X IN KM.
      IF (COST.EQ.0.) GO TO 210
      A=ABS(WA/COST)
      IF (SINT.EQ.0.) GO TO 220
      B=ABS(WA/SINT)
      AB=AMIN1(A,B)
      GO TO 230
210   AB=ABS(WA/SINT)
      GO TO 230
220   AB=A
230   X=X+AB*CONTWO
      NRECEP=NRECEP+1
C        NO MORE THAN 180 RECEPTORS ARE ALLOWED.
      IF (NRECEP.GT.180) GO TO 260
C        DETERMINE RECEPTOR COORDINATES(INTERNAL UNITS)
      RREC(NRECEP)=RS-X*SINT/CONTWO
      SREC(NRECEP)=SS-X*COST/CONTWO
      RREU(NRECEP)=RREC(NRECEP)*UNITS
      SREU(NRECEP)=SREC(NRECEP)*UNITS
      WRITE (IO,280) NRECEP,JCHAR,I,RREU(NRECEP),SREU(NRECEP)
      ITYPE(NRECEP)=JCHAR
      ICODE(NRECEP)=I
240   CONTINUE
250   RETURN
260   WRITE (IO,310)
      NRECEP=180
      RETURN
C
270   FORMAT (1H0,T9,'SIGNIFICANT POINT RECEPTORS'//1X,'RECEPTOR #
     1 EAST      NORTH     PREDICTED MAX CONC.  MAX. DIST  EFF. HT    U(PH
     2Y HT)'/1X,T38,'(MICROGRAMS/M**3)',T59,'(KM)',T70,'(M)',T80,'(M/SEC
     3)'/1X)
280   FORMAT (1X,T2,I3,1X,A1,I3,4X,F9.3,3X,F9.3,4X,6PF12.2,5X,0P3F10.3)
290   FORMAT (1X,T2,I3,1X,A1,I3,4X,F9.3,3X,F9.3,21X,3F10.3)
300   FORMAT (1H0,T9,'SIGNIFICANT AREA SOURCE RECEPTORS'//1X,'RECEPTOR #
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     1 EAST      NORTH     '//1X)
310   FORMAT (' THE MAXIMUM NO. OF RECEPTORS HAS BEEN GENERATED'//1X,' N
     1O OTHERS WILL BE ACCEPTED')
C
      END
C
      SUBROUTINE JMHHON
C                    SUBROUTINE JMHHON (VERSION 80336), PART OF RAM.
C         THIS SUBROUTINE IS REFERRED TO AS F IN THE COMMON STATEMENTS
C       THIS ROUTINE GENERATES RECEPTORS IN A HONEYCOMB ARRANGEMENT.
C
      COMMON /AMOST/ DELH,FH,HINT(3),H,HL,IO,IOPT(50),KST,MUOR,NHTS,RC,R
     1CZ,SY,SZ,TEMP,TLOS,UPL,X,Y,Z
      COMMON /AEFM/ ITYPE(180),ICODE(180),UNITS,RREU(180),SREU(180)
      COMMON /AEFGKM/ NRECEP,RREC(180),SREC(180),IDATE(2),LH,NPT
      COMMON /AF/ GRIDSP,HRMIN,HRMAX,HSMIN,HSMAX
      DIMENSION HCOMBR(250), HCOMBS(250)
C        THE CHARACTER 'H' IDENTIFIES A RECEPTOR WHICH WAS GENERATED BY
C        THIS ROUTINE.
      DATA ICHAR /'H'/
      DATA IO /6/
C
C        INITIALIZE SPACING PARAMETER FOR RECEPTOR GENERATION.
C        THE HORIZONTAL LOCATIONS OF ODD AND EVEN ROWS ARE STAGGERED.
C        THE FIRST HORIZONTAL RECEPTOR (EVEN ROW) IS AT A DISTANCE
C        OF .5 GRIDSP FROM THE MINIMUM HORIZONTAL  DISTANCE IN CONTRAST
C         TO A DISTANCE OF GRIDSP FOR ODD ROWS.
      XINC=GRIDSP*0.5
      YINC=GRIDSP*0.866
      YCD=HSMIN+YINC/2.
      DUM=HRMAX-HRMIN
      NCOLS1=DUM/GRIDSP
      NCOLS2=(DUM+XINC)/GRIDSP
      NROWS=(HSMAX-HSMIN)/(2.*YINC)+1.
      NBEES=0
      DO 50 J=1,NROWS
C         THE STARTING LOCATION FOR THE GENERATION OF POSSIBLE HONEYCOMB
C        RECEPTORS IS THE SOUTH WEST CORNER OF THE DEFINED HONEYCOMB GRID
C         AREA.
      XCD1=HRMIN
      XCD2=HRMIN-XINC
C
C         GENERATION OF ODD ROWS.
C
C         THE FIRST POINT(ODD ROW) IS LOCATED AT THE DISTANCE OF GRIDSP
C         EAST FROM THE SOUTH WEST CORNER.
C
      DO 10 I=1,NCOLS1
      XCD1=XCD1+GRIDSP
      IF (XCD1.GT.HRMAX) GO TO 20
      NBEES=NBEES+1
C         NO MORE THAN 250 CANDIDATE RECEPTORS ARE ALLOWED.
      IF (NBEES.GT.250) GO TO 110
      HCOMBR(NBEES)=XCD1
      HCOMBS(NBEES)=YCD
10    CONTINUE
C      ROWS ARE LOCATED AT A PERPENDICULAR DISTANCE OF .866 TIMES GRIDSP
C         ABOVE THE PRECEEDING ROW.
20    YCD=YCD+YINC
      IF (YCD.GT.HSMAX) GO TO 60
C
C        GENERATION OF EVEN ROWS
C
      DO 30 I=1,NCOLS2
      XCD2=XCD2+GRIDSP
      IF (XCD2.GT.HRMAX) GO TO 40
      NBEES=NBEES+1
      IF (NBEES.GT.250) GO TO 110
      HCOMBR(NBEES)=XCD2
      HCOMBS(NBEES)=YCD
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30      CONTINUE
40      YCD=YCD+YINC
        IF (YCD.GT.HSMAX) GO TO 60
50      CONTINUE
C
C          ELIMINATE POSSIBLE HONEYCOMB RECEPTORS THAT ARE CLOSE TO OTHER
C          RECEPTORS.
C
60      NULIM=NRECEP
        DLIM=XINC*XINC
        DO 90 N=1,NBEES
        RH=HCOMBR(N)
        SH=HCOMBS(N)
C          IF NO PREVIOUS RECEPTORS, THERE WILL BE NO COMPARISONS
        IF (NRECEP.LE.0) GO TO 80
        DO 70 M=1,NULIM
        R=RREC(M)
        S=SREC(M)
        DUM1=ABS(R-RH)
        IF (DUM1.GT.XINC) GO TO 70
        DUM2=ABS(S-SH)
        IF (DUM2.GT.XINC) GO TO 70
        DISQ=DUM1*DUM1+DUM2*DUM2
C          IF THE DISTANCE BETWEEN A CURRENT RECEPTOR AND A POSSIBLE
C        HONEYCOMB RECEPTOR IS LESS THAN HALF THE GRIDSPACING,
C          THE POSSIBLE HONEYCOMB RECEPTOR IS DISCARDED.
        IF (DISQ.LT.DLIM) GO TO 90
70      CONTINUE
80      NRECEP=NRECEP+1
C          THE TOTAL NUMBER OF RECEPTORS CAN NOT EXCEED 180.
        IF (NRECEP.GT.180) GO TO 100
C          ADD NEW RECEPTOR COORDINATES (INTERNAL UNITS)
        RREC(NRECEP)=RH
        SREC(NRECEP)=SH
        ITYPE(NRECEP)=ICHAR
        ICODE(NRECEP)=0
C           CONVERT TO USER UNITS FOR PRINTOUT.
        RREU(NRECEP)=RREC(NRECEP)*UNITS
        SREU(NRECEP)=SREC(NRECEP)*UNITS
        WRITE (IO,120) NRECEP,ICHAR,RREU(NRECEP),SREU(NRECEP)
90      CONTINUE
        RETURN
100     WRITE (IO,130)
        NRECEP=180
        RETURN
110     WRITE (IO,140)
        CALL WAUDIT
        STOP
C
120     FORMAT (1X,T3,I3,1X,A1,6X,F9.3,3X,F9.3)
130     FORMAT (' THE MAXIMUM NO. OF RECEPTORS HAS BEEN GENERATED'/1X,' NO
       1 OTHERS WILL BE ACCEPTED.')
140     FORMAT (' TOO  MANY POSSIBLE HONEYCOMB RECEPTOR LOCATIONS HAVE ','
       1BEEN GENERATED. PLEASE REDEFINE BOUNDARIES OR GRID SPACING.')
C
        END
C
        SUBROUTINE PT
C                         SUBROUTINE PT      (VERSION 80336), PART OF RAM.
C            THIS SUBROUTINE IS REFERRED TO AS G IN THE COMMON STATEMENTS
C         THE PURPOSE OF THIS ROUTINE IS TO CALCULATE CONCENTRATIONS FROM
C         POINT SOURCES.
C
C->->->->SECTION PT.A - COMMON AND DIMENSION.
C
        COMMON /AMOST/ DELH,FH,HINT(3),H,HL,IO,IOPT(50),KST,MUOR,NHTS,RC,R
       1CZ,SY,SZ,TEMP,TLOS,UPL,X,Y,Z
        COMMON /AEFGKM/ NRECEP,RREC(180),SREC(180),IDATE(2),LH,NPT
        COMMON /AEG/ SOURCE(9,250)
        COMMON /AEGIKM/ IPOL,CONTWO,SINT,COST,U,HANE,PL(6)
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      COMMON /AGK/ PARTC(250)                                           RAM32640
      COMMON /AGM/ PSAV(250),HSAV(250),DH(250),DSAV(250),UPH(250),HPR(25RAM32650
     10),FP(250),PCHI(180),PHCHI(180),PSIGS(180,26),PHSIGS(180,26),IPSIGRAM32660
     2S(250),GRANDT(180)                                                RAM32670
C                                                                       RAM32680
C->->->->SECTION  PT.B - INITIALIZE AND START RECEPTOR LOOP.            RAM32690
C                                                                       RAM32700
C         ZERO EFFECTIVE STACK HEIGHT FOR EACH SOURCE                   RAM32710
C                                                                       RAM32720
C            NPT - THE NUMBER OF POINT SOURCES                          RAM32730
      DO 10 J=1,NPT                                                     RAM32740
C         HSAV WILL BE USED TO STORE THE SOURCE PLUME HEIGHTS.          RAM32750
10    HSAV(J)=0.0                                                       RAM32760
C         LOOP ON RECEPTORS                                             RAM32770
C            NRECEP - THE NUMBER OF RECEPTORS                           RAM32780
      DO 160 K=1,NRECEP                                                 RAM32790
C                                                                       RAM32800
C->->->->SECTION  PT.C - START SOURCES LOOP, CALCULATE                  RAM32810
C                        UPWIND AND CROSSWIND DISTANCES.                RAM32820
C                                                                       RAM32830
      DO 150 J=1,NPT                                                    RAM32840
      PARTC(J)=0.0                                                      RAM32850
C            RQ - EAST COORDINATE OF THE SOURCE                         RAM32860
      RQ=SOURCE(1,J)                                                    RAM32870
C            SQ - NORTH COORDINATE OF THE SOURCE                        RAM32880
      SQ=SOURCE(2,J)                                                    RAM32890
C         DETERMINE UPWIND DISTANCE                                     RAM32900
C         XDUM,YDUM IN INTERNAL UNITS. X,Y IN KM.                       RAM32910
C            RREC - EAST COORDINATE OF THE RECEPTOR                     RAM32920
      XDUM=RQ-RREC(K)                                                   RAM32930
C            SREC - NORTH COORDINATE OF THE RECEPTOR                    RAM32940
      YDUM=SQ-SREC(K)                                                   RAM32950
C         SINT AND COST ARE THE SIN AND COS OF THE WIND DIRECTION       RAM32960
C         CONTWO - MULTIPLIER CONSTANT TO CONVERT USER UNITS TO KM      RAM32970
      X=(YDUM*COST+XDUM*SINT)*CONTWO                                    RAM32980
C           X IS THE UPWIND DISTANCE  OF THE SOURCE FROM THE RECEPTOR.  RAM32990
C         IF X IS NEGATIVE, INDICATING THAT THE SOURCE IS DOWNWIND OF   RAM33000
C         THE RECEPTOR, THE CALCULATION IS TERMINATED ASSUMING NO       RAM33010
C         CONTRIBUTION FROM THAT SOURCE.                                RAM33020
      IF (X.LE.0.0) GO TO 150                                           RAM33030
C                                                                       RAM33040
C         DETERMINE CROSSWIND DISTANCE                                  RAM33050
C                                                                       RAM33060
      Y=(YDUM*SINT-XDUM*COST)*CONTWO                                    RAM33070
      H=HSAV(J)                                                         RAM33080
C         SKIP PLUME RISE CALCULATION IF EFFECTIVE HT. HAS ALREADY BEEN RAM33090
C               CALCULATED FOR THIS SOURCE                              RAM33100
      IF (H.EQ.0.0) GO TO 20                                            RAM33110
      DELH=DH(J)                                                        RAM33120
C                                                                       RAM33130
C->->->->SECTION  PT.D - EXTRAPOLATE WIND SPEED TO STACK TOP            RAM33140
C                        CALCULATE PLUME RISE.                          RAM33150
C                                                                       RAM33160
      GO TO 100                                                         RAM33170
C           MODIFY WIND SPEED BY POWER LAW PROFILE IN ORDER TO TAKE INTO RAM33180
C         ACCOUNT THE INCREASE OF WIND SPEED WITH HEIGHT.               RAM33190
C         ASSUME WIND MEASUREMENTS ARE REPRESENTATIVE FOR HEIGHT = HANE. RAM33200
C           THT IS THE PHYSICAL STACK HEIGHT                            RAM33210
20    THT=SOURCE(5,J)                                                   RAM33220
C         POINT SOURCE HEIGHT NOT ALLOWED TO BE LESS THAN 1 METER.      RAM33230
      IF (THT.LT.1.) THT=1.                                             RAM33240
C            U - WIND SPEED AT HEIGHT 'HANE'                            RAM33250
C            PL - POWER FOR THE WIND PROFILE                            RAM33260
C            UPL - WIND AT THE PHYSICAL STACK HEIGHT                    RAM33270
      UPL=U*(THT/HANE)**PL(KST)                                         RAM33280
C         WIND SPEED NOT ALLOWED TO BE LESS THAN 1 METER/SEC.           RAM33290
      IF (UPL.LT.1.) UPL=1.                                             RAM33300
C         STORE THE STACK TOP WIND FOR THE JTH SOURCE FOR THIS HOUR     RAM33310
      UPH(J)=UPL                                                        RAM33320
      VS=SOURCE(8,J)                                                    RAM33330
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      BUOY=SOURCE(9,J)                                                  RAM33340
      TS=SOURCE(6,J)                                                    RAM33350
C        TEMP- THE AMBIENT AIR TEMPERATURE FOR THIS HOUR                RAM33360
      DELT=TS-TEMP                                                      RAM33370
      F=BUOY*DELT/TS                                                    RAM33380
C         IOPT(9) HOURLY EMISSION INPUT FROM TAPE/DISK?  0=NO, 1=YES.   RAM33390
      IF (IOPT(9).EQ.0) GO TO 30                                        RAM33400
C        MODIFY EXIT VELOCITY AND BUOYANCY BY RATIO OF HOURLY EMISSIONS RAM33410
C        TO AVERAGE EMISSIONS                                           RAM33420
      SCALE=SOURCE(IPOL,J)/PSAV(J)                                      RAM33430
      VS=VS*SCALE                                                       RAM33440
      F=F*SCALE                                                         RAM33450
30    D=SOURCE(7,J)                                                     RAM33460
C        CALCULATE  H PRIME WHICH TAKES INTO ACCOUNT STACK DOWNWASH     RAM33470
C        BRIGGS(1973) PAGE 4                                            RAM33480
      HPRM=THT                                                          RAM33490
C        IF IOPT(1)=1, THEN NO STACK DOWNWASH COMPUTATION               RAM33500
      IF (IOPT(1).EQ.1) GO TO 40                                        RAM33510
      DUM=VS/UPL                                                        RAM33520
      IF (DUM.LT.1.5) HPRM=THT+2.*D*(DUM-1.5)                           RAM33530
C        'HPRM' IS BRIGGS' H-PRIME                                      RAM33540
      IF (HPRM.LT.0.) HPRM=0.                                           RAM33550
40    CONTINUE                                                          RAM33560
C                                                                       RAM33570
C        CALCULATE PLUME RISE AND ADD H PRIME TO OBTAIN EFFECTIVE       RAM33580
C        STACK HEIGHT.                                                  RAM33590
C                                                                       RAM33600
C        PLUME RISE CALCULATION                                         RAM33610
      IF (KST.GT.4) GO TO 60                                            RAM33620
C        PLUME RISE FOR UNSTABLE CONDITIONS                             RAM33630
      IF (TS.LT.TEMP) GO TO 70                                          RAM33640
      IF (F.GE.55.) GO TO 50                                            RAM33650
C        DETERMINE DELTA-T FOR BUOYANCY-MOMENTUM CROSSOVER(F<55)        RAM33660
C        FOUND BY EQUATING BRIGGS(1969) EQ 5.2, P.59 WITH COMBINATION OFRAM33670
C        BRIGGS(1971) EQUATIONS 6 AND 7, PAGE 1031 FOR F<55.            RAM33680
      DTMB=0.0297*TS*VS**0.33333/D**0.66667                             RAM33690
      IF (DELT.LT.DTMB) GO TO 70                                        RAM33700
C        DISTANCE OF FINAL BUOYANT RISE(0.049 IS 14*3.5/1000)           RAM33710
C        BRIGGS(1971) EQN. 7,F<55, AND DIST TO FINAL RISE IS 3.5 XSTAR  RAM33720
C        DISTF IN KILOMETERS                                            RAM33730
      DISTF=0.049*F**0.625                                              RAM33740
C        COMBINATION OF BRIGGS(1971) EQNS. 6 AND 7, PAGE 1031 FOR F<55. RAM33750
      DELH=21.425*F**0.75/UPL                                           RAM33760
      GO TO 90                                                          RAM33770
C        DETERMINE DELTA-T FOR BUOYANCY-MOMENTUM CROSSOVER(F>55)        RAM33780
C        FOUND BY EQUATING BRIGGS(1969) EQ 5.2, P.59 WITH COMBINATION OFRAM33790
C         BRIGGS(1971) EQUATIONS 6 AND 7, PAGE 1031 FOR F>55.           RAM33800
50    DTMB=0.00575*TS*VS**0.66667/D**0.33333                            RAM33810
      IF (DELT.LT.DTMB) GO TO 70                                        RAM33820
C        DISTANCE OF FINAL BUOYANT RISE (0.119 IS 34*3.5/1000)          RAM33830
C        BRIGGS(1971) EQN. 7, F>55, AND DIST TO FINAL RISE IS 3.5 XSTAR.RAM33840
C        DISTF IN KILOMETERS                                            RAM33850
      DISTF=0.119*F**0.4                                                RAM33860
C        COMBINATION OF BRIGGS(1971) EQNS. 6 AND 7, PAGE 1031 FOR F>55. RAM33870
      DELH=38.71*F**0.6/UPL                                             RAM33880
      GO TO 90                                                          RAM33890
C        PLUME RISE FOR STABLE CONDITIONS.                              RAM33900
60    DTHDZ=0.02                                                        RAM33910
      IF (KST.GT.5) DTHDZ=0.035                                         RAM33920
      S=9.80616*DTHDZ/TEMP                                              RAM33930
      IF (TS.LT.TEMP) GO TO 80                                          RAM33940
C        DETERMINE DELTA-T FOR BUOYANCY-MOMENTUM CROSSOVER(STABLE)      RAM33950
C        FOUND BY EQUATING BRIGGS(1975) EQ 59, P. 96 FOR STABLE BUOYANCYRAM33960
C        RISE WITH BRIGGS(1969) EQ 4.28, P. 59 FOR STABLE MOMENTUM RISE.RAM33970
      DTMB=0.019582*TEMP*VS*SQRT(S)                                     RAM33980
      IF (DELT.LT.DTMB) GO TO 80                                        RAM33990
C        STABLE BUOYANT RISE FOR WIND CONDITIONS.(WIND NOT ALLOWED LOW  RAM34000
C        ENOUGH TO REQUIRE STABLE RISE IN CALM CONDITIONS.)             RAM34010
C        BRIGGS(1975) EQ 59, PAGE 96.                                   RAM34020
      DELH=2.6*(F/(UPL*S))**0.333333                                    RAM34030
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C          COMBINATION OF BRIGGS(1975) EQ 48 AND EQ 59. NOTE DISTF IN KM.
      DISTF=0.0020715*UPL/SQRT(S)
      GO TO 90
C          UNSTABLE-NEUTRAL MOMENTUM RISE
C          BRIGGS(1969) EQN. 5.2, PAGE 59 NOTE: MOST ACCURATE WHEN VS/U>4;
C          TENDS TO OVERESTIMATE RISE WHEN VS/U<4 (SEE BRIGGS(1975) P. 78,
C           FIGURE 4.)
70    DELH=3.*VS*D/UPL
      DISTF=0.
      GO TO 90
C          STABLE MOMENTUM RISE
80    DHA=3.*VS*D/UPL
C          BRIGGS(1969) EQUATION 4.28, PAGE 59
      DELH=1.5*(VS*VS*D*D*TEMP/(4.*TS*UPL))**0.333333/S**0.166667
      IF (DHA.LT.DELH) DELH=DHA
      DISTF=0.
C          STORE OFF PLUME HEIGHT(ETC.) FOR THIS SOURCE FOR USE WITH
C          OTHER RECEPTORS.
90    H=HPRM+DELH
      HSAV(J)=H
      DH(J)=DELH
      DSAV(J)=DISTF
      UPH(J)=UPL
      HPR(J)=HPRM
      FP(J)=F
C          IF SOURCE-RECEPTOR DISTANCE IS GREATER OR EQUAL TO DISTANCE TO
C          FINAL RISE, SKIP PLUME RISE CALCULATION AND USE FINAL RISE.
100   IF (X.GE.DSAV(J)) GO TO 110
      IF (IOPT(3).EQ.0.AND.IOPT(2).EQ.1) GO TO 110
C          CALCULATE GRADUAL PLUME RISE IF (1) THE USER SPECIFIES SO,
C          OR (2) USER EMPLOYS CALCULATION OF INITIAL DISPERSION.....
C          IN THIS CASE, USE OF FINAL EFFECTIVE HEIGHT IN THE CALCULATION
C          OF DISPERSION COEFFICENTS COULD LEAD TO MISLEADING VALUES SINCE
C             SIGMA-Y,-Z =  DELTA-H/3.5
      DELH=160.*FP(J)**0.333333*X**0.666667/UPH(J)
C          PLUME RISE FOR DISTANCE X(160 IS 1.6*1000**.67 BECAUSE X IN KM)
      IF (DELH.GT.DH(J)) DELH=DH(J)
      IF (IOPT(2).EQ.1) GO TO 110
C          IF SPECIFYING CALCULATION OF INITIAL DISPERSION BUT ARE NOT
C          SPECIFYING CALCULATION OF GRADUAL PLUME RISE, THEN DO NOT
C          ADD THE NEW GRADUAL DELTA-H TO THE EFFECTIVE HEIGHT. OTHERWISE,
C          CHECK THE GRADUAL RISE PLUME HEIGHT WITH FINAL EFFECTIVE HEIGHT
C          AND SET THE PLUME HEIGHT TO THE SMALLER OF THE TWO VALUES.
      H=HPR(J)+DELH
C          ADD PLUME RISE TO STACK HEIGHT FOR TOTAL EFFECTIVE STACK HT.
C          END PLUME RISE CALCULATION
110   UPL=UPH(J)
C
C->->->->SECTION  PT.E - CALCULATE THE CONTRIBUTION OF
C                        ONE SOURCE TO ONE RECEPTOR.
C
      IF (KST.GT.4) GO TO 120
      IF (H.LT.HL) GO TO 120
      PROD=0.
      GO TO 130
C             RCON CALCULATES
C           THE RELATIVE CONCENTRATION , CHI/Q (SEC/M**3)
120   CALL RCON
C          CALCULATE TRAVEL TIME IN KM-SEC/M TO INCLUDE DECAY RATE OF
C          POLLUTANT.
      TT=X/UPL
C          TLOS IN METERS/KM-SEC, SO TT*TLOS IS DIMENSIONLESS
C          INCLUDE THE POLLUTANT LOSS
      PROD=RC*SOURCE(IPOL,J)/EXP(TT*TLOS)
C          IF HAFL IS ZERO, TLOS WILL START AS ZERO AND
C          RESULT IN NO COMPUTATIION OF POLLUTANT LOSS.
C          INCREMENT CONCENTRATION AT K-TH RECEPTOR(G/M**3)
C             PCHI - SUM FOR THE AVERAGING TIME AT RECEPTOR K
130   PCHI(K)=PCHI(K)+PROD
C             PHCHI - CONCENTRATION FOR THIS HOUR AT RECEPTOR K
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      PHCHI(K)=PHCHI(K)+PROD                                            RAM34740
      KSIG=IPSIGS(J)                                                    RAM34750
      IF (KSIG.EQ.0) GO TO 140                                          RAM34760
C        STORE CONCENTRATIONS FROM SIGNIFICANT SOURCES.(G/M**3)         RAM34770
      PSIGS(K,KSIG)=PSIGS(K,KSIG)+PROD                                  RAM34780
      PHSIGS(K,KSIG)=PHSIGS(K,KSIG)+PROD                                RAM34790
      PSIGS(K,26)=PSIGS(K,26)+PROD                                      RAM34800
      PHSIGS(K,26)=PHSIGS(K,26)+PROD                                    RAM34810
140   PARTC(J)=PROD                                                     RAM34820
C                                                                       RAM34830
C->->->->SECTION  PT.F - END SOURCE AND RECEPTOR LOOPS.                 RAM34840
C                                                                       RAM34850
150   CONTINUE                                                          RAM34860
C        END OF LOOP FOR SOURCES                                        RAM34870
C        WRITE PARTIAL CONCENTRATIONS ON DISK(G/M**3)  IF IOPT(40) = 1. RAM34880
      IF (IOPT(40).EQ.0) GO TO 160                                      RAM34890
C        USER PLEASE NOTE: PARTIAL CONC. IN G/M**3, NOT MICROGRAM/M**3  RAM34900
      WRITE (10) IDATE,LH,K,(PARTC(J),J=1,NPT)                          RAM34910
160   CONTINUE                                                          RAM34920
C        END OF LOOP FOR RECEPTORS                                      RAM34930
      RETURN                                                            RAM34940
C                                                                       RAM34950
C***   SECTIONS OF SUBROUTINE PTR.                                      RAM34960
C          SECTION  PT.A -  COMMON AND DIMENSION.                       RAM34970
C          SECTION  PT.B -  INITIALIZE AND START RECEPTOR LOOP.         RAM34980
C          SECTION  PT.C -  START SOURCES LOOP; CALCULATE UPWIND AND    RAM34990
C                             CROSSWIND DISTANCES.                      RAM35000
C          SECTION  PT.D -  EXTRAPOLATE WIND SPEED TO STACK TOP;        RAM35010
C                             CALCULATE PLUME RISE.                     RAM35020
C          SECTION  PT.E -  CALCULATE CONTRIBUTION FROM A SOURCE TO ONE RAM35030
C                             RECEPTOR.                                 RAM35040
C          SECTION  PT.F -  END SOURCE AND RECEPTOR LOOPS.              RAM35050
C                                                                       RAM35060
      END                                                               RAM35070
C
      SUBROUTINE RCON                                                   RAM35090
C                        SUBROUTINE RCON    (VERSION 80336), PART OF RAM. RAM35100
C          THIS SUBROUTINE IS REFERRED TO AS H IN THE COMMON STATEMENTS RAM35110
C                                                                       RAM35120
C->->->->SECTION RCON.A - COMMON.                                       RAM35130
      COMMON /AMOST/ DELH,FH,HINT(3),H,HL,IO,IOPT(50),KST,MUOR,NHTS,RC,RRAM35140
     1CZ,SY,SZ,TEMP,TLOS,UPL,X,Y,Z                                      RAM35150
      DATA IO /6/                                                       RAM35160
C                                                                       RAM35170
C->->->->SECTION RCON.B - EXPLANATIONS AND COMPUTATIONS                 RAM35180
C                           COMMON TO ALL CONDITIONS.                   RAM35190
C                                                                       RAM35200
C  RCON DETERMINES RELATIVE CONCENTRATIONS, CHI/Q, FROM POINT SOURCES.  RAM35210
C         IT CALLS UPON  SYZ  TO OBTAIN STANDARD DEVIATIONS.            RAM35220
C        THE INPUT VARIABLES ARE....                                    RAM35230
C          UPL  WIND SPEED (M/SEC)                                      RAM35240
C          Z    RECEPTOR HEIGHT (M)                                     RAM35250
C          H    EFFECTIVE STACK HEIGHT (M)                              RAM35260
C          HL   MIXING HEIGHT- TOP OF NEUTRAL OR UNSTABLE LAYER(M).     RAM35270
C          X    DISTANCE RECEPTOR IS DOWNWIND OF SOURCE (KM)            RAM35280
C          Y    DISTANCE RECEPTOR IS CROSSWIND FROM SOURCE (KM)         RAM35290
C          KST  STABILITY CLASS                                         RAM35300
C          DELH PLUME RISE(METERS)                                      RAM35310
C        THE OUTPUT VARIABLES ARE....                                   RAM35320
C          SY HORIZONTAL DISPERSION PARAMETER                           RAM35330
C          SZ VERTICAL DISPERSION PARAMETER                             RAM35340
C          RC   RELATIVE CONCENTRATION (SEC/M**3) ,CHI/Q                RAM35350
C        IO IS OUTPUT UNIT FOR WARNING OUTPUT.                          RAM35360
C        THE FOLLOWING EQUATION IS SOLVED --                            RAM35370
C        RC = (1/(2*PI*UPL*SIGMA Y*SIGMA Z))* (EXP(-0.5*(Y/SIGMA Y)**2))RAM35380
C           (EXP(-0.5*((Z-H)/SIGMA Z)**2) + EXP(-0.5*((Z+H)/SIGMA Z)**2)RAM35390
C             PLUS THE SUM OF THE FOLLOWING 4 TERMS K TIMES (N=1,K) --  RAM35400
C                  FOR NEUTRAL OR UNSTABLE CASES:                       RAM35410
C              TERM 1- EXP(-0.5*((Z-H-2NL)/SIGMA Z)**2)                 RAM35420
C              TERM 2- EXP(-0.5*((Z+H-2NL)/SIGMA Z)**2)                 RAM35430
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C               TERM 3- EXP(-0.5*((Z-H+2NL)/SIGMA Z)**2)                RAM35440
C               TERM 4- EXP(-0.5*((Z+H+2NL)/SIGMA Z)**2)                RAM35450
C NOTE THAT MIXING HEIGHT- THE TOP OF THE NEUTRAL OR UNSTABLE LAYER-    RAM35460
C HAS A VALUE ONLY FOR STABILITIES 1-4, THAT IS, MIXING HEIGHT,         RAM35470
C THE HEIGHT OF THE NEUTRAL OR UNSTABLE LAYER, DOES NOT EXIST FOR STABLERAM35480
C LAYERS AT THE GROUND SURFACE- STABILITY 5 OR 6.                       RAM35490
C         THE ABOVE EQUATION IS SIMILAR TO EQUATION (5.8) P 36 IN       RAM35500
C          WORKBOOK OF ATMOSPHERIC DISPERSION ESTIMATES WITH THE ADDITIONRAM35510
C          OF THE EXPONENTIAL INVOLVING Y.                              RAM35520
C         IF STABLE, SKIP CONSIDERATION OF MIXING HEIGHT.               RAM35530
      IF (KST.GE.5) GO TO 30                                            RAM35540
C         IF THE SOURCE IS ABOVE THE LID, SET RC = 0., AND RETURN.      RAM35550
      IF (H.GT.HL) GO TO 10                                             RAM35560
      IF (Z-HL) 30,30,20                                                RAM35570
10    IF (Z.LT.HL) GO TO 20                                             RAM35580
      WRITE (IO,260)                                                    RAM35590
20    RC=0.                                                             RAM35600
      RETURN                                                            RAM35610
C         IF X IS LESS THAN 1 METER, SET RC=0. AND RETURN.  THIS AVOIDS RAM35620
C          PROBLEMS OF INCORRECT VALUES NEAR THE SOURCE.                RAM35630
30    IF (X.LT.0.001) GO TO 20                                          RAM35640
C         CALL SYZ  TO OBTAIN VALUES FOR SY AND SZ                      RAM35650
      CALL SYZ                                                          RAM35660
C          SY = SIGMA Y, THE STANDARD DEVIATION OF CONCENTRATION IN THE RAM35670
C           Y-DIRECTION (M)                                             RAM35680
C          SZ = SIGMA Z, THE STANDARD DEVIATION OF CONCENTRATION IN THE RAM35690
C           Z-DIRECTION (M)                                             RAM35700
C        IF IOPT(3)=1, CONSIDER BUOYANCY INDUCED DISPERSION OF PLUME DUE RAM35710
C          TO TURBULENCE DURING BUOYANT RISE.                           RAM35720
      IF (IOPT(3).EQ.0) GO TO 40                                        RAM35730
      DUM=DELH/3.5                                                      RAM35740
      DUM=DUM*DUM                                                       RAM35750
      SY=SQRT(SY*SY+DUM)                                                RAM35760
      SZ=SQRT(SZ*SZ+DUM)                                                RAM35770
40    C1=1.                                                             RAM35780
      IF (Y.EQ.0.0) GO TO 50                                            RAM35790
      YD=1000.*Y                                                        RAM35800
C         YD IS CROSSWIND DISTANCE IN METERS.                           RAM35810
      DUM=YD/SY                                                         RAM35820
      DUM=0.5*DUM*DUM                                                   RAM35830
      IF (DUM.GE.50.) GO TO 20                                          RAM35840
      C1=EXP(DUM)                                                       RAM35850
50    IF (KST.GT.4) GO TO 60                                            RAM35860
      IF (HL.LT.5000.) GO TO 110                                        RAM35870
C         IF STABLE CONDITION OR UNLIMITED MIXING HEIGHT,               RAM35880
C          USE EQUATION 3.2 IF Z = 0, OR EQ 3.1 FOR NON-ZERO Z.         RAM35890
C          (EQUATION NUMBERS REFER TO WORKBOOK OF ATMOSPHERIC DISPERSION RAM35900
C          ESTIMATES.)                                                  RAM35910
60    C2=2.*SZ*SZ                                                       RAM35920
      IF (Z) 20,70,80                                                   RAM35930
C        NOTE: AN ERRONEOUS NEGATIVE Z WILL RESULT IN ZERO CONCENTRATIONSRAM35940
C                                                                       RAM35950
C->->->->SECTION RCON.C - STABLE OR UNLIMITED MIXING, Z IS ZERO.        RAM35960
C                                                                       RAM35970
70    C3=H*H/C2                                                         RAM35980
      IF (C3.GE.50.) GO TO 20                                           RAM35990
      A2=1./EXP(C3)                                                     RAM36000
C         WADE EQUATION 3.2.                                            RAM36010
      RC=A2/(3.14159*UPL*SY*SZ*C1)                                      RAM36020
      RETURN                                                            RAM36030
C                                                                       RAM36040
C->->->->SECTION RCON.D - STABLE OR UNLIMITED MIXING, Z IS NON-ZERO.    RAM36050
C                                                                       RAM36060
80    A2=0.                                                             RAM36070
      A3=0.                                                             RAM36080
      CA=Z-H                                                            RAM36090
      CB=Z+H                                                            RAM36100
      C3=CA*CA/C2                                                       RAM36110
      C4=CB*CB/C2                                                       RAM36120
      IF (C3.GE.50.) GO TO 90                                           RAM36130
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      A2=1./EXP(C3)
90    IF (C4.GE.50.) GO TO 100
      A3=1./EXP(C4)
C        WADE EQUATION 3.1.
100   RC=(A2+A3)/(6.28318*UPL*SY*SZ*C1)
      RETURN
C
C->->->->SECTION RCON.E - UNSTABLE, ASSURED OF UNIFORM MIXING.
C
C        IF SIGMA-Z IS GREATER THAN 1.6 TIMES THE MIXING HEIGHT,
C          THE DISTRIBUTION BELOW THE MIXING HEIGHT IS UNIFORM WITH
C          HEIGHT REGARDLESS OF SOURCE HEIGHT OR RECEPTOR HEIGHT BECAUSE
C          OF REPEATED EDDY REFLECTIONS FROM THE GROUND AND THE MIXING HT
110   IF (SZ/HL.LE.1.6) GO TO 120
C        WADE EQUATION 3.5.
      RC=1./(2.5066*UPL*SY*HL*C1)
      RETURN
C        INITIAL VALUE OF AN SET = 0.
C          AN - THE NUMBER OF TIMES THE SUMMATION TERM IS EVALUATED
C                AND ADDED IN.
120   AN=0.
      IF (Z) 20,210,130
C
C->->->->SECTION RCON.F - UNSTABLE, CALCULATE MULTIPLE EDDY
C                          REFLECTIONS, Z IS NON-ZERO.
C
C       THE FOLLOWING STATEMENTS  CALCULATE RC, THE RELATIVE CONC.,
C         USING THE EQUATION DISCUSSED ABOVE.  SEVERAL INTERMEDIATE
C         VARIABLES ARE USED TO AVOID REPEATING CALCULATIONS.
C         CHECKS ARE MADE TO BE SURE THAT THE ARGUMENT OF THE
C         EXPONENTIAL FUNCTION IS NEVER GREATER THAN 50 (OR LESS THAN
C         -50).
C        CALCULATE MULTIPLE EDDY REFLECTIONS FOR RECEPTOR HEIGHT Z.
130   A1=1./(6.28318*UPL*SY*SZ*C1)
      C2=2.*SZ*SZ
      A2=0.
      A3=0.
      CA=Z-H
      CB=Z+H
      C3=CA*CA/C2
      C4=CB*CB/C2
      IF (C3.GE.50.) GO TO 140
      A2=1./EXP(C3)
140   IF (C4.GE.50.) GO TO 150
      A3=1./EXP(C4)
150   SUM=0.
      THL=2.*HL
160   AN=AN+1.
      A4=0.
      A5=0.
      A6=0.
      A7=0.
      C5=AN*THL
      CC=CA-C5
      CD=CB-C5
      CE=CA+C5
      CF=CB+C5
      C6=CC*CC/C2
      C7=CD*CD/C2
      C8=CE*CE/C2
      C9=CF*CF/C2
      IF (C6.GE.50.) GO TO 170
      A4=1./EXP(C6)
170   IF (C7.GE.50.) GO TO 180
      A5=1./EXP(C7)
180   IF (C8.GE.50.) GO TO 190
      A6=1./EXP(C8)
190   IF (C9.GE.50.) GO TO 200
      A7=1./EXP(C9)
200   T=A4+A5+A6+A7
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      SUM=SUM+T
      IF (T.GE.0.01) GO TO 160
      RC=A1*(A2+A3+SUM)
      RETURN
C
C->->->->SECTION RCON.G - UNSTABLE, CALCULATE MULTIPLE EDDY
C                         REFLECTIONS, Z IS ZERO.
C
C        CALCULATE MULTIPLE EDDY REFLECTIONS FOR GROUND LEVEL RECEPTOR
C        HEIGHT.
210   A1=1./(6.28318*UPL*SY*SZ*C1)
      A2=0.
      C2=2.*SZ*SZ
      C3=H*H/C2
      IF (C3.GE.50.) GO TO 220
      A2=2./EXP(C3)
220   SUM=0.
      THL=2.*HL
230   AN=AN+1.
      A4=0.
      A6=0.
      C5=AN*THL
      CC=H-C5
      CE=H+C5
      C6=CC*CC/C2
      C8=CE*CE/C2
      IF (C6.GE.50.) GO TO 240
      A4=2./EXP(C6)
240   IF (C8.GE.50.) GO TO 250
      A6=2./EXP(C8)
250   T=A4+A6
      SUM=SUM+T
      IF (T.GE.0.01) GO TO 230
      RC=A1*(A2+SUM)
      RETURN
C
C->->->->SECTION RCON.H - FORMAT
260   FORMAT (1HO,'BOTH H AND Z ARE ABOVE THE MIXING HEIGHT SO A RELIABL
     1E COMPUTATION CAN NOT BE MADE.')
C
C
C***    SECTIONS OF SUBROUTINE RCON.
C          SECTION RCON.A -  COMMON.
C          SECTION RCON.B -  EXPLANATIONS AND COMPUTATIONS COMMON TO ALL
C                            CONDITIONS.
C          SECTION RCON.C -  STABLE OR UNLIMITED MIXING, Z IS ZERO.
C          SECTION RCON.D -  STABLE OR UNLIMITED MIXING, Z IS NON-ZERO.
C          SECTION RCON.E -  UNSTABLE, ASSURED OF UNIFORM MIXING.
C          SECTION RCON.F -  UNSTABLE, CALCULATE MULTIPLE EDDY
C                            REFLECTIONS; Z IS NON-ZERO.
C          SECTION RCON.G -  UNSTABLE, CALCULATE MULTIPLE EDDY
C                            REFLECTIONS; Z IS ZERO.
C          SECTION RCON.H -  FORMAT.
C
      END
C
      SUBROUTINE JMH54
C                    SUBROUTINE JMH54  (VERSION 80336), PART OF RAM.
C          THIS SUBROUTINE IS REFERRED TO AS I IN THE COMMON STATEMENTS
C       THE PURPOSE OF THIS ROUTINE IS TO CALCULATE TABLES OF
C       CONCENTRATION NORMALIZED FOR WIND SPEED AND EMISSION RATE
C       FROM AREA SOURCES (CHI*U/Q). SUBROUTINE JMHCZU IS CALLED FOR
C       INTEGRATION OF RELATIVE CONCENTRATION.
C         INPUT VARIABLES ARE...
C          HINT- REPRESENTATIVE HEIGHTS FOR AREA SOURCES
C          NHTS- NUMBER OF HEIGHT CLASSES
C          Z- RECEPTOR HEIGHT(M)
C          XLIM- DISTANCE LIMIT ON INTEGRATION OF AREA SOURCES(KM)
C          TLOS- PARTIAL COMPUTATION RELATED TO POLLUTANT LOSS
C
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      COMMON /AMOST/ DELH,FH,HINT(3),H,HL,IO,IOPT(50),KST,MUOR,NHTS,RC,RRAM37540
     1CZ,SY,SZ,TEMP,TLOS,UPL,X,Y,Z                                      RAM37550
      COMMON /AEGIKM/ IPOL,CONTWO,SINT,COST,U,HANE,PL(6)                RAM37560
      COMMON /AIL/ CIN(3,200),XLIM                                      RAM37570
      COMMON /AIM/ HARE(3)                                              RAM37580
C                                                                       RAM37590
C      CONCENTRATION TABLES ARE GENERATED FOR UP TO 3 HEIGHTS.          RAM37600
      DO 190 IH=1,NHTS                                                  RAM37610
      H=HINT(IH)                                                        RAM37620
      HARE(IH)=H                                                        RAM37630
      IF (FH.EQ.1.) GO TO 10                                            RAM37640
      PHT=FH*H                                                          RAM37650
      UPL=U*(PHT/HANE)**PL(KST)                                         RAM37660
      IF (UPL.LT.1.) UPL=1.                                             RAM37670
      H=((H-PHT)*5.)/UPL+PHT                                            RAM37680
      HARE(IH)=H                                                        RAM37690
      GO TO 20                                                          RAM37700
C      MODIFY WIND SPEED BY POWER LAW PROFILE.                          RAM37710
10    IF (H.LT.1.0) H=1.0                                               RAM37720
      UPL=U*(H/HANE)**PL(KST)                                           RAM37730
      IF (UPL.LT.1.0) UPL=1.0                                           RAM37740
C      ZERO CONCENTRATION ARRAY                                         RAM37750
20    DO 30 J=1,200                                                     RAM37760
30    CIN(IH,J)=0.0                                                     RAM37770
      N=0                                                               RAM37780
      NC=10                                                             RAM37790
      CP=0.0                                                            RAM37800
      CI=0.0                                                            RAM37810
      JD=1                                                              RAM37820
C      DISTANCE IN KM.                                                  RAM37830
      X=0.0                                                             RAM37840
      DELX=0.001                                                        RAM37850
      ID=1                                                              RAM37860
40    CL=CP                                                             RAM37870
      X=X+DELX                                                          RAM37880
C      SUBROUTINE JMHCZ  DETERMINES THE RELATIVE CONCENTRATION AT       RAM37890
C      VARYING DOWNWIND DISTANCES.                                      RAM37900
      CALL JMHCZ                                                        RAM37910
C      CALCULATE TRAVEL TIME IN KM-SEC/M.                               RAM37920
      TT=X/UPL                                                          RAM37930
C      ADJUST RELATIVE CONCENTRATION BY POLLUTANT DECAY RATE.           RAM37940
C      TLOS IN METERS/KM-SEC, SO TT*TLOS IS DIMENSIONLESS.              RAM37950
      CP=RCZ/EXP(TT*TLOS)                                               RAM37960
C      INTEGRATED RELATIVE CONCENTRATION IS DIMENSIONLESS.              RAM37970
C      MULTIPLICATION BY 500. CONVERTS TO METERS AND DIVIDES BY 2.      RAM37980
      CI=500.*DELX*(CL+CP)+CI                                           RAM37990
      GO TO (50,90,120,150,180), JD                                     RAM38000
C      NORMALIZED CONCENTRATIONS ARE STORED IN TABLES FOR VARYING       RAM38010
C      DISTANCES AT VARYING TIME INTERVALS.THE FOLLOWING COMMENTS DETAILRAM38020
C      THE TABLE'S CONSTRUCTION.                                        RAM38030
C      DISTANCE<100M; CALCULATE EVERY 1 M,  STORE EVERY 10 M, 0.01KM.   RAM38040
50    IF (X-0.0993) 60,80,80                                            RAM38050
60    N=N+1                                                             RAM38060
      IF (N.LT.NC) GO TO 40                                             RAM38070
      N=0                                                               RAM38080
70    ID=(100.*X)+0.0008                                                RAM38090
C      STORAGE LOCATIONS 1-9 CONTAIN INTEGRATIONS FOR 10-90 M.          RAM38100
      CIN(IH,ID)=CI                                                     RAM38110
      GO TO 40                                                          RAM38120
C      DISTANCE 100-500M: CHANGE DELX TO 10M; STORE EVERY 10 M, 0.01KM. RAM38130
80    JD=2                                                              RAM38140
      DELX=0.01                                                         RAM38150
      GO TO 70                                                          RAM38160
C      STORAGE LOCATIONS 10-49 CONTAIN INTEGRATIONS FOR 100 M TO 490 M. RAM38170
90    IF (X-0.497) 70,100,100                                           RAM38180
C     DISTANCE 500 -3000M; CHANGE DELX TO 100 M; STORE EVERY 100 M, 0.1KMRAM38190
100   JD=3                                                              RAM38200
      DELX=0.1                                                          RAM38210
110   ID=(10.*X)+45.08                                                  RAM38220
C    STORAGE LOCATIONS 50-74 CONTAIN INTEGRATIONS FOR 500 M TO 2900 M.  RAM38230
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      CIN(IH,ID)=CI
      GO TO 40
120   IF (X-2.95) 110,130,130
C      DISTANCE 3000-15,000M. ; CHANGE DELX TO 500 M; STORE EVERY 500 M,
C       0.5KM.
130   JD=4
      DELX=.5
140   ID=(2.*X)+69.08
C          STORAGE LOCATIONS 75-98 CONTAIN INTEGRATIONS FOR 3000 M TO
C            14.5 KM.
      CIN(IH,ID)=CI
      GO TO 40
150   IF (X-14.95) 140,160,160
C          DISTANCE >15,000M.; CHANGE DELX TO 1000M; STORE EVERY 1000 M,
C            1KM.
160   JD=5
      DELX=1.
170   ID=X+84.08
C      STORAGE LOCATIONS 99-200 CONTAIN INTEGRATIONS FOR 15 KM TO A
C      MAXIMUM OF 116 KM.
      CIN(IH,ID)=CI
      GO TO 40
180   IF (X-XLIM) 170,190,190
190   CONTINUE
      RETURN
C
      END
C
      SUBROUTINE JMHCZ
C                       SUBROUTINE JMHCZ  (VERSION 80336), PART OF RAM.
C          THIS SUBROUTINE IS REFERRED TO AS J IN THE COMMON STATEMENTS
      COMMON /AMOST/ DELH,FH,HINT(3),H,HL,IO,IOPT(50),KST,MUOR,NHTS,RC,R
     1CZ,SY,SZ,TEMP,TLOS,UPL,X,Y,Z
      DATA IO /6/
C
C         SUBROUTINE JMHCZ CALCULATES CHI*U/Q, RELATIVE CONCENTRATION
C           NORMALIZED FOR WIND SPEED AND EMISSION RATE, FOR A RECEPTOR
C           DOWNWIND OF A CROSSWIND INFINTE SOURCE (IN UNITS OF: PER METER
C         JMHCZ CALLS SUBROUTINE SGZ
C         THE INPUT VARIABLES ARE....
C           Z     RECEPTOR HEIGHT (M)
C           H     EFFECTIVE STACK HEIGHT (M)
C           HL    MIXING HEIGHT- TOP OF NEUTRAL OR UNSTABLE LAYER(M)
C                   (THROUGH COMMON/METCON/)
C           X     DISTANCE RECEPTOR IS DOWNWIND OF SOURCE (KM)
C           KST   STABILITY CLASS (THROUGH COMMON /METCON/)
C         THE OUTPUT VARIABLES ARE....
C         SZ      VERTICAL DISPERSION PARAMTER.
C         RCZ     RELATIVE CONCENTRATION HAS UNITS OF: PER METER.
C      THE FOLLOWING EQUATION IS SOLVED --
C         RC = (1/2.5066 *SIGMA Z) * ((EXP(-.05*((Z-H)/SIGMA Z)**2)
C              + (EXP(-0.5*((Z+H)/SIGMA Z)**2))
C              PLUS THE SUM OF THE FOLLOWING 4 TERMS K TIMES (N=1,K) --
C                FOR NEUTRAL OR UNSTABLE CASES:
C              TERM 1- EXP(-0.5*((Z-H-2NL)/SIGMA Z)**2)
C              TERM 2- EXP(-0.5*((Z+H-2NL)/SIGMA Z)**2)
C              TERM 3- EXP(-0.5*((Z-H+2NL)/SIGMA Z)**2)
C              TERM 4- EXP(-0.5*((Z+H+2NL)/SIGMA Z)**2)
C         2.5066 IS THE SQUARE ROOT OF 2 * PI
C    NOTE THAT MIXING HEIGHT- THE TOP OF THE NEUTRAL OR UNSTABLE LAYER-
C    HAS A VALUE ONLY FOR STABILITIES 1-4, THAT IS, MIXING HEIGHT
C    DOES NOT EXIST FOR STABLE LAYERS AT THE GROUND SURFACE- STABILITY
C    5 OR 6.
C           THE SUBROUTINE  CALCULATES RC, THE RELATIVE CONCENTRATION,
C           USING THE EQUATION DISCUSSED ABOVE.  SEVERAL INTERMEDIATE
C           VARIABLES ARE USED TO AVOID REPEATING CALCULATIONS.
C           CHECKS ARE MADE TO BE SURE THAT THE ARGUMENT OF THE
C           EXPONENTIAL FUNCTION IS NEVER GREATER THAN 50 (OR LESS THAN
C           -50).  IF 'AN' BECOMES GREATER THAN 45, A LINE OF OUTPUT IS
C           PRINTED INFORMING OF THIS.
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C         IO IS OUTPUT UNIT  FOR OUTPUT
C       IF STABLE, SKIP CONSIDERATION OF MIXING HEIGHT.
      IF (KST.GE.5) GO TO 30
C         IF THE SOURCE IS ABOVE THE LID, SET RC = 0., AND RETURN.
      IF (H.GT.HL) GO TO 10
      IF (Z-HL) 30,30,20
10    IF (Z.LT.HL) GO TO 20
      WRITE (IO,240)
20    RCZ=0.
      RETURN
C         IF X IS LESS THAN 1 METER, SET RC=0. AND RETURN.  THIS AVOIDS
C           PROBLEMS OF INCORRECT VALUES NEAR THE SOURCE.
30    IF (X.LT.0.001) GO TO 20
      CALL SIGZ
C           SZ = SIGMA Z, THE STANDARD DEVIATION OF CONCENTRATION IN THE
C           Z-DIRECTION (M)
      IF (KST.GT.4) GO TO 40
      IF (HL.LT.5000) GO TO 90
C         IF STABLE CONDITION OR UNLIMITED MIXING HEIGHT:
40    C2=2.*SZ*SZ
      IF (Z) 20,50,60
C       FOR Z = ZERO:
50    C3=H*H/C2
      IF (C3.GE.50.) GO TO 20
      RCZ=2./(2.5066*SZ*EXP(C3))
      RETURN
C       FOR NON-ZERO Z:
60    A2=0.
      A3=0.
      CA=Z-H
      CB=Z+H
      C3=CA*CA/C2
      C4=CB*CB/C2
      IF (C3.GE.50.) GO TO 70
      A2=1./EXP(C3)
70    IF (C4.GE.50.) GO TO 80
      A3=1./EXP(C4)
80    RCZ=(A2+A3)/(2.5066*SZ)
      RETURN
C         IF SIGMA-Z IS GREATER THAN 1.6 TIMES THE MIXING HEIGHT,
C           THE DISTRIBUTION BELOW THE MIXING HEIGHT IS UNIFORM WITH
C           HEIGHT REGARDLESS OF SOURCE HEIGHT.
90    IF (SZ/HL.LE.1.6) GO TO 100
      RCZ=1./HL
      RETURN
C         INITIAL VALUE OF AN SET = 0.
C           AN    THE NUMBER OF TIMES THE SUMMATION TERM IS EVALUATED
C            AND ADDED IN.
100   AN=0.
      IF (Z) 20,190,110
C       NOTE: AN ERRONEOUS NEGATIVE Z WILL RESULT IN ZERO CONCENTRATIONS.
C       CALCULATE MULTIPLE EDDY REFLECTIONS FOR ELEVATED RECEPTOR HEIGHT.
110   A1=1./(2.5066*SZ)
      C2=2.*SZ*SZ
      A2=0.
      A3=0.
      CA=Z-H
      CB=Z+H
      C3=CA*CA/C2
      C4=CB*CB/C2
      IF (C3.GE.50.) GO TO 120
      A2=1./EXP(C3)
120   IF (C4.GE.50.) GO TO 130
      A3=1./EXP(C4)
130   SUM=0.
      THL=2.*HL
140   AN=AN+1.
      A4=0.
      A5=0.
      A6=0.
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      A7=0.
      C5=AN*THL
      CC=CA-C5
      CD=CB-C5
      CE=CA+C5
      CF=CB+C5
      C6=CC*CC/C2
      C7=CD*CD/C2
      C8=CE*CE/C2
      C9=CF*CF/C2
      IF (C6.GE.50.) GO TO 150
      A4=1./EXP(C6)
150   IF (C7.GE.50.) GO TO 160
      A5=1./EXP(C7)
160   IF (C8.GE.50.) GO TO 170
      A6=1./EXP(C8)
170   IF (C9.GE.50.) GO TO 180
      A7=1./EXP(C9)
180   T=A4+A5+A6+A7
      SUM=SUM+T
      IF (T.GE.0.01) GO TO 140
      RCZ=A1*(A2+A3+SUM)
      RETURN
C      CALCULATE MULTIPLE EDDY REFLECTIONS FOR GROUND LEVEL RECEPTOR HT.
190   A1=1./(2.5066*SZ)
      A2=0.
      C2=2.*SZ*SZ
      C3=H*H/C2
      IF (C3.GE.50.) GO TO 200
      A2=2./EXP(C3)
200   SUM=0.
      THL=2.*HL
210   AN=AN+1.
      A4=0.
      A6=0.
      C5=AN*THL
      CC=H-C5
      CE=H+C5
      C6=CC*CC/C2
      C8=CE*CE/C2
      IF (C6.GE.50.) GO TO 220
      A4=2./EXP(C6)
220   IF (C8.GE.50.) GO TO 230
      A6=2./EXP(C8)
230   T=A4+A6
      SUM=SUM+T
      IF (T.GE.0.01) GO TO 210
      RCZ=A1*(A2+SUM)
      RETURN
C
240    FORMAT (1HO,'BOTH H AND Z ARE ABOVE THE MIXING HEIGHT SO A RELIABL
     1E COMPUTATION CAN NOT BE MADE.')
C
       END
C
       SUBROUTINE JMHARE
C                    SUBROUTINE JMHARE (VERSION 80336), PART OF RAM.
C          THIS SUBROUTINE IS REFERRED TO AS K IN THE COMMON STATEMENTS
C
C     THE FUNCTION OF THIS SUBROUTINE IS TO CALCULATE THE CONCENTRATIONS
C     AT EACH RECEPTOR DUE TO AREA SOURCES. THE HANNAH TECHNIQUE
C     IS USED TO EXAMINE THE AREA SOURCES ALONG AN UPWIND LINE FROM
C     THE RECEPTOR. SUBROUTINE JMHPOL IS CALLED TO INTERPOLATE CONC.
C          INPUT VARIABLES ARE ...
C          NHTS- THE NUMBER OF AREA SOURCE HEIGHTS.
C          XLIM- DISTANCE LIMIT ON AREA INTEGRATION
C          IDATE - YEAR AND JULIAN DAY(IN COMMON/METDAT/)
C          LH- HOUR
C
       COMMON /AMOST/ DELH,FH,HINT(3),H,HL,IO,IOPT(50),KST,MUOR,NHTS,RC,R
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     1CZ,SY,SZ,TEMP,TLOS,UPL,X,Y,Z
      COMMON /AEFGKM/ NRECEP,RREC(180),SREC(180),IDATE(2),LH,NPT
      COMMON /AEGIKM/ IPOL,CONTWO,SINT,COST,U,HANE,PL(6)
      COMMON /AEK/ ASORC(6,100)
      COMMON /AGK/ PARTC(250)
      COMMON /AK/ BPH(2),RMIN,SMIN,RMAX,SMAX,NAS,IRSIZE,ISSIZE,IA(25,25)
     1,IWD,IASIGS(100),NBP
      COMMON /AKL/ IH,NS,KREC
      COMMON /AKM/ BPHM(2),ACHI(180),AHCHI(180),ASIGS(180,11),AHSIGS(180
     1,11)
      DIMENSION ADELR(4), ADELS(4)
      DATA ADELR /0.001,0.001,-0.001,-0.001/
      DATA ADELS /0.001,-0.001,-0.001,0.001/
C
C       CALCULATE   MODIFIED BREAK-POINT HEIGHTS, IF NECESSARY
      DO 10 I=1,NBP
      H=BPH(I)
      BPHM(I)=H
      IF (FH.EQ.1.) GO TO 10
      PHT=FH*H
      UPL=U*(PHT/HANE)**PL(KST)
      IF (UPL.LT.1.) UPL=1.
      BPHM(I)=((H-PHT)*5.)/UPL+PHT
10    CONTINUE
C       DELR: SMALL EAST-WEST INCREMENT DEPENDENT ON WIND DIRECTION
C         USED TO STEP INTO NEXT UPWIND AREA SOURCE.
      DELR=ADELR(IWD)
C       DELS: SMALL NORTH-SOUTH INCREMENT DEPENDENT ON WIND DIRECTION
C         USED TO STEP INTO NEXT UPWIND AREA SOURCE
      DELS=ADELS(IWD)
C       SUBTRACT  1 SO THAT POINT IN SOUTHWEST CORNER OF AREA SOURCE
C       REGION WILL HAVE IA INDEX OF (1,1).
      RMINI=RMIN-1.
      SMINI=SMIN-1.
C
C       LOOP ON RECEPTORS
C         UNITS FOR GEOMETRIC CALCULATIONS ARE INTERNAL UNITS.
      DO 290 KREC=1,NRECEP
C       ZERO PARTIAL CONCENTRATION ARRAY
      DO 20 I=1,NAS
20    PARTC(I)=0.0
      XL=0.0
      CONCL=0.0
      IHL=0
C       SEARCH FOR UPWIND AREA SOURCES WHICH CONTRIBUTE TO THE K-TH
C         RECEPTOR, BEGINNING AT THE K-TH RECEPTOR LOCATION.
      RRE=RREC(KREC)
      SRE=SREC(KREC)
C       SUBTRACT MINIMUM AND STEP UPWIND INTO AREA SOURCE,
C         THEN INTEGERIZE TO ACCESS SOURCE NUMBER IN IA ARRAY.
      IR=RRE-RMINI+DELR
      IS=SRE-SMINI+DELS
C         IS RECEPTOR WITHIN DEFINED LIMITS?
      IF ((RRE.LE.RMIN).OR.(RRE.GE.RMAX)) GO TO 230
      IF ((SRE.LE.SMIN).OR.(SRE.GE.SMAX)) GO TO 230
C
C    RECEPTOR IS WITHIN AREA SOURCE REGION.
C
C       DETERMINE SOURCE NUMBER,NS, SOURCE CENTER(RC,SC),
C     HALF OF SOURCE SIDE LENGTH,D, SOURCE STRENGTH,QA, AND
C         SOURCE HEIGHT, HA.
30    IF ((IR.LE.0).OR.(IR.GT.IRSIZE)) GO TO 280
      IF ((IS.LE.0).OR.(IS.GT.ISSIZE)) GO TO 280
      NS=IA(IR,IS)
C       DO ONLY GEOMETRIC CALCULATIONS IF NS = 0.
      IF (NS.EQ.0) GO TO 60
      D=ASORC(5,NS)
      RC=ASORC(1,NS)+D
      SC=ASORC(2,NS)+D
      QA=ASORC(IPOL,NS)
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      HA=ASORC(6,NS)                                                    RAM41040
      IF (QA.LE.0.0) GO TO 70                                           RAM41050
C       USE POWER LAW DEPENDENT ON STABILITY CLASS TO MODIFY WIND SPEED RAM41060
C         AT EFFECTIVE HEIGHT OF STACK.                                 RAM41070
C         VARY EFFECTIVE HEIGHT(M) ACCORDING TO WIND SPEED              RAM41080
C         HA- EFFECTIVE AREA SOURCE HEIGHT(M)                           RAM41090
C         FH- FRACTION OF HA WHICH IS PHYSICAL HEIGHT                   RAM41100
C         PHT- PHYSICAL STACK HEIGHT(M)                                 RAM41110
C         (HA-PHT) IS PLUME RISE                                        RAM41120
      PHT=FH*HA                                                         RAM41130
      THT=PHT                                                           RAM41140
      IF (PHT.LT.1.) THT=1.                                             RAM41150
      UPL=U*(THT/HANE)**PL(KST)                                         RAM41160
      IF (UPL.LT.1.) UPL=1.                                             RAM41170
      HA=((HA-PHT)*5.)/UPL+PHT                                          RAM41180
C       DETERMINE HEIGHT CLASS                                          RAM41190
      IH=NHTS                                                           RAM41200
      GO TO (70,50,40), NHTS                                            RAM41210
40    IF (HA.LT.BPHM(2)) IH=2                                           RAM41220
50    IF (HA.LT.BPHM(1)) IH=1                                           RAM41230
      GO TO 70                                                          RAM41240
C       SINCE SOURCE NO. IS ZERO, CALCULATE COORDINATES OF SOURCE CENTERRAM41250
C       AND DEPENDING ON WIND DIRECTION BRANCH TO CODE WHICH DETERMINES RAM41260
C       THE NEXT AREA SOURCE IN THE UPWIND DIRECTION.                   RAM41270
60    D=.5                                                              RAM41280
      RC=FLOAT(IR)+RMINI+D                                              RAM41290
      SC=FLOAT(IS)+SMINI+D                                              RAM41300
C       IWD IS 1 FOR THETA LESS THAN 90 DEG., 2 FOR 90-180  DEG, ETC.   RAM41310
70    GO TO (80,90,110,120), IWD                                        RAM41320
C       IWD=1                                                           RAM41330
C       DETERMINE TWO UPWIND BOUNDARIES(NORTH AND EAST).                RAM41340
80    SB=SC+D                                                           RAM41350
      GO TO 100                                                         RAM41360
C       IWD=2                                                           RAM41370
C       DETERMINE TWO UPWIND BOUNDARIES(SOUTH AND EAST).                RAM41380
90    SB=SC-D                                                           RAM41390
100   RB=RC+D                                                           RAM41400
      GO TO 140                                                         RAM41410
C       IWD=3                                                           RAM41420
C       DETERMINE TWO UPWIND BOUNDARIES(SOUTH AND WEST).                RAM41430
110   SB=SC-D                                                           RAM41440
      GO TO 130                                                         RAM41450
C       IWD=4                                                           RAM41460
C       DETERMINE TWO UPWIND BOUNDARIES(NORTH AND WEST).                RAM41470
120   SB=SC+D                                                           RAM41480
130   RB=RC-D                                                           RAM41490
C       FIND LOCUS OF UPWIND RAY AND CLOSEST BORDER                     RAM41500
140   IF (SINT.EQ.0.) GO TO 160                                         RAM41510
C       IF SIN=0. NORTH OR SOUTH BOUNDARY IS APPROPRIATE.               RAM41520
      XD1=(RB-RRE)/SINT                                                 RAM41530
C       XD1 IS DISTANCE(USER UNITS) TO EAST OR WEST BOUNDARY,           RAM41540
C         WHICHEVER IS UPWIND.                                          RAM41550
      IF (COST.EQ.0.) GO TO 170                                         RAM41560
C       IF COS=0. EAST OR WEST BOUNDARY IS APPROPRIATE.                 RAM41570
      XD2=(SB-SRE)/COST                                                 RAM41580
C       XD2 IS DISTANCE(USER UNITS) TO NORTH  OR SOUTH BOUNDARY,        RAM41590
C         WHICHEVER IS UPWIND.                                          RAM41600
      IF (XD1.LT.XD2) GO TO 170                                         RAM41610
150   RDUM=RRE+XD2*SINT+DELR                                            RAM41620
      SDUM=SB+DELS                                                      RAM41630
C       RDUM,SDUM ARE COORDINATES OF INTERSECTION WITH BOUNDARY PLUS    RAM41640
C         SMALL INCREMENTS TO STEP INSIDE NEXT UPWIND SOURCE.           RAM41650
      DIST=XD2                                                          RAM41660
C       DIST IS DISTANCE TO NEAREST BORDER.                             RAM41670
      GO TO 180                                                         RAM41680
160   XD2=(SB-SRE)/COST                                                 RAM41690
      GO TO 150                                                         RAM41700
170   RDUM=RB+DELR                                                      RAM41710
      SDUM=SRE+XD1*COST+DELS                                            RAM41720
      DIST=XD1                                                          RAM41730
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180   DIST=DIST*CONTWO                                                  RAM41740
C       DIST IS IN KM.                                                  RAM41750
C       IF SOURCE NO. IS ZERO, PASS ON TO NEXT UPWIND AREA SOURCE       RAM41760
      IF (NS.EQ.0) GO TO 210                                            RAM41770
C       IF EMISSION RATE < 10E-10, POLLUTANT CONTRIBUTION WILL BE       RAM41780
C         INSIGNIFICANT, GO ON TO NEXT UPWIND AREA SOURCE.              RAM41790
      IF (QA.LE.10.0E-10) GO TO 210                                     RAM41800
C      (A SUBSTANTIAL SAVINGS IN COMPUTATION TIME IS EFFECTED IF A LARGERAM41810
C          AREA WITH NO EMISSIONS IS DEFINED WITH A ZERO SOURCE STRENGTH RAM41820
C         AS OPPOSED TO LEAVING THE AREA UNDEFINED,THUS DEFAULTING TO THERAM41830
C         MIN.GRID SQ.SIZE WHEN SEARCHING FOR THE NEXT UPWIND SOURCE.)USERAM41840
C       THIS SOURCE TO RECEPTOR DISTANCE AND HEIGHT CLASS TO GET A VALUERAM41850
C         FOR INTEGRATED XU/Q TO THIS DISTANCE BY INTERPOLATING IN TABLE RAM41860
C         OF PRECALCULATED CHI*U/Q VALUES. SUBROUTINE JMHPOL PERFORMS THERAM41870
C         INTERPOLATION.                                                RAM41880
      CALL JMHPOL (DIST,CONA)                                           RAM41890
C       XL(KM) IS THE UPWIND DISTANCE TO THE LAST INTERSECTION WITH A   RAM41900
C        BOUNDARY POINT.                                                RAM41910
      IF (XL.LE.0) GO TO 190                                            RAM41920
      IF (IH.NE.IHL) CALL JMHPOL (XL,CONCL)                             RAM41930
190   DIFF=CONA-CONCL                                                   RAM41940
C         THE CHI*U/Q DIFFERENCE IS MULTIPLIED BY EMISS. RATE AND DIVIDEDRAM41950
C         BY WIND SPEED WHICH HAS BEEN MOD.BY THE POWER LAW TO THE PROPERRAM41960
C         HEIGHT.THIS CALCULATED VALUE,PROD,IS THE CONTRIBUTION OF SOURCERAM41970
C         NS TO THE TOTAL POLLUTANT CONCENTRATION AT THE K-TH RECEPTOR. RAM41980
      PROD=QA*DIFF/UPL                                                  RAM41990
      ACHI(KREC)=ACHI(KREC)+PROD                                        RAM42000
      AHCHI(KREC)=AHCHI(KREC)+PROD                                      RAM42010
      KSIG=IASIGS(NS)                                                   RAM42020
      IF (KSIG.EQ.0) GO TO 200                                          RAM42030
C       IF THE SOURCE IS SIGNIFICANT, STORE PARTIAL CONCENTRATION       RAM42040
      ASIGS(KREC,KSIG)=ASIGS(KREC,KSIG)+PROD                            RAM42050
      AHSIGS(KREC,KSIG)=AHSIGS(KREC,KSIG)+PROD                          RAM42060
      ASIGS(KREC,11)=ASIGS(KREC,11)+PROD                                RAM42070
      AHSIGS(KREC,11)=AHSIGS(KREC,11)+PROD                              RAM42080
200   CONCL=CONA                                                        RAM42090
C       SAVE PARTIAL CONCENTRATION FOR ALL SOURCES                      RAM42100
      PARTC(NS)=PROD                                                    RAM42110
      IHL=IH                                                            RAM42120
      GO TO 220                                                         RAM42130
210   IHL=0                                                             RAM42140
220   XL=DIST                                                           RAM42150
C       IS THIS POINT OUTSIDE SOURCE REGION?                            RAM42160
      IF ((RDUM.LE.RMIN).OR.(RDUM.GE.RMAX)) GO TO 280                   RAM42170
      IF ((SDUM.LE.SMIN).OR.(SDUM.GE.SMAX)) GO TO 280                   RAM42180
C       IR,IS ARE IA INDICES FOR NEXT SOURCE                            RAM42190
      IR=RDUM-RMINI                                                     RAM42200
      IS=SDUM-SMINI                                                     RAM42210
      GO TO 30                                                          RAM42220
C                                                                       RAM42230
C     RECEPTOR IS OUTSIDE AREA SOURCE REGION.                           RAM42240
C                                                                       RAM42250
230   DXMIN=99999.                                                      RAM42260
C       FIND THE INTERSECTION OF THE UPWIND AZIMUTH FROM THE RECEPTOR TORAM42270
C         THE NEAREST BORDER OF THE AREA SOURCE REGION.                 RAM42280
      ICNT=0                                                            RAM42290
      RM=RMIN                                                           RAM42300
C       FIND LOCUS FOR RMIN, THEN RMAX                                  RAM42310
      DO 250 L=1,2                                                      RAM42320
      RMR=RM-RRE                                                        RAM42330
C       IF SINT IS ZERO, THERE IS NO LOCUS WITH THIS BOUNDARY.          RAM42340
      IF (SINT.EQ.0.) GO TO 240                                         RAM42350
C       FIND NORTH COORDINATE OF LOCUS.                                 RAM42360
      S=RMR*COST/SINT+SRE                                               RAM42370
      IF (S.GT.SMAX) GO TO 240                                          RAM42380
      IF (S.LT.SMIN) GO TO 240                                          RAM42390
C       FIND DISTANCE FROM RECEPTOR TO LOCUS.                           RAM42400
      DX=RMR*SINT+(S-SRE)*COST                                          RAM42410
C       IF DISTANCE IS NEGATIVE, THIS IS A DOWNWIND LOCUS, NOT UPWIND.  RAM42420
      IF (DX.LT.0.) GO TO 240                                           RAM42430
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C         IS THIS DISTANCE SHORTER THAN A PREVIOUS LOCUS?                          RAM42440
        IF (DX.GE.DXMIN) GO TO 240                                               RAM42450
        RLOC=RM                                                                  RAM42460
        SLOC=S                                                                   RAM42470
        DXMIN=DX                                                                 RAM42480
C         COUNT THE NUMBER OF LOCI FOUND.                                          RAM42490
        ICNT=ICNT+1                                                              RAM42500
240     RM=RMAX                                                                  RAM42510
250     CONTINUE                                                                 RAM42520
        SM=SMIN                                                                  RAM42530
C         FIND LOCUS FOR SMIN, THEN SMAX.                                          RAM42540
        DO 270 L=3,4                                                             RAM42550
        SMS=SM-SRE                                                               RAM42560
C         IF COSINE IS ZERO, THERE IS NO LOCUS WITH THIS BOUNDARY.                 RAM42570
        IF (COST.EQ.0.) GO TO 260                                                RAM42580
C         FIND EAST COORDINATE OF LOCUS.                                           RAM42590
        R=SMS*SINT/COST+RRE                                                      RAM42600
        IF (R.GT.RMAX) GO TO 260                                                 RAM42610
        IF (R.LT.RMIN) GO TO 260                                                 RAM42620
C         FIND DISTANCE FROM RECEPTOR TO LOCUS.                                    RAM42630
        DX=(R-RRE)*SINT+SMS*COST                                                 RAM42640
C         IF DISTANCE IS NEGATIVE, THIS IS A DOWNWIND LOCUS, NOT UPWIND.           RAM42650
        IF (DX.LT.0.) GO TO 260                                                  RAM42660
C         IS THIS DISTANCE SHORTER THAN A PREVIOUS LOCUS?                          RAM42670
        IF (DX.GE.DXMIN) GO TO 260                                               RAM42680
        RLOC=R                                                                   RAM42690
        SLOC=SM                                                                  RAM42700
        DXMIN=DX                                                                 RAM42710
        ICNT=ICNT+1                                                              RAM42720
260     SM=SMAX                                                                  RAM42730
270     CONTINUE                                                                 RAM42740
C         IF ICNT=0 NO LOCI WERE FOUND, THEREFORE NO AREA SOURCE CONTRIB.          RAM42750
C           AT THIS RECEPTOR.                                                      RAM42760
        IF (ICNT.EQ.0) GO TO 280                                                 RAM42770
        DIST=DXMIN                                                               RAM42780
C         FIND THE DISTANCE TO THE NEAREST SOURCE IN KM                            RAM42790
C         FIND CO-ORDINATES TO LOCATE SOURCE                                       RAM42800
C         DIST IS IN INTERNAL UNITS.                                               RAM42810
        XL=DIST*CONTWO                                                           RAM42820
C         XL IS IN KM.                                                             RAM42830
C         IR AND IS NOW ARE COORDINATES OF A POINT LYING IN THE NEXT               RAM42840
C         UPWIND AREA SOURCE.                                                      RAM42850
        IR=RLOC+DELR-RMINI                                                       RAM42860
        IS=SLOC+DELS-SMINI                                                       RAM42870
        GO TO 30                                                                 RAM42880
C         WRITE PARTIAL CONCENTRATIONS TO DISK                                     RAM42890
280     IF (IOPT(40).EQ.0) GO TO 290                                             RAM42900
        WRITE (10) IDATE,LH,KREC,(PARTC(J),J=1,NAS)                              RAM42910
290     CONTINUE                                                                 RAM42920
        RETURN                                                                   RAM42930
C                                                                                  RAM42940
        END                                                                      RAM42950
C
        SUBROUTINE JMHPOL (X,CON)                                                RAM42970
C                          SUBROUTINE JMHPOL (VERSION 80336), PART OF RAM.         RAM42980
C           THIS SUBROUTINE IS REFERRED TO AS L IN THE COMMON STATEMENTS           RAM42990
C         INTERPOLATE FROM PRECALCULATED AREA TABLES.                              RAM43000
C         THIS SUBROUTINE INTERPOLATES FROM A TABLE OF INTEGRATED VALUES           RAM43010
C       TO DETERMINE THE CONCENTRATION AT A RECEPTOR FROM AN AREA SOURCE           RAM43020
C           AT A GIVEN DISTANCE AND HEIGHT                                         RAM43030
C          INPUT VARIBALES ARE...                                                  RAM43040
C             X - UPWIND DISTANCE IN KM.                                           RAM43050
C             IH - THE HEIGHT INDEX.                                               RAM43060
C             CON  - RELATIVE CON. NORMALIZED FOR WIND SPEED, CHI*U/Q.             RAM43070
C             NS - CURRENT SOURCE NUMBER                                           RAM43080
C             KREC - CURRENT RECEPTOR NUMBER                                       RAM43090
C             XLIM - MAXIMUM DISTANCE FOR INTERPOLATION IN AREA TABLES             RAM43100
C                                                                                  RAM43110
        COMMON /AIL/ CIN(3,200),XLIM                                             RAM43120
        COMMON /AKL/ IH,NS,KREC                                                  RAM43130
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      DATA IO /6/                                                       RAM43140
      IF (X.LT.0.01) GO TO 50                                           RAM43150
      IF (X.GE.0.5) GO TO 10                                            RAM43160
C      FOR DISTANCES < 500M, CON. WAS STORED EVERY 10M.                 RAM43170
C      STORAGE LOCATIONS 1-50 CONTAIN INTEGRATED CON.  FOR 10 TO 500M.  RAM43180
      J=100.*X                                                          RAM43190
      D=J                                                               RAM43200
      XL=D/100.                                                         RAM43210
      XU=XL+0.01                                                        RAM43220
      GO TO 40                                                          RAM43230
10    IF (X.GE.3.) GO TO 20                                             RAM43240
C      FOR DISTANCES  FROM 500 TO 3,000KM CON.  WAS STORED EVERY 100M.  RAM43250
C      STORAGE LOCATIONS 50-75 CONTAIN INTEGRATED CON. FOR 0.5 TO 3. KM.RAM43260
      J=IFIX(10.*X)+45                                                  RAM43270
      D=J-45                                                            RAM43280
      XL=D/10.                                                          RAM43290
      XU=XL+0.1                                                         RAM43300
      GO TO 40                                                          RAM43310
20    IF (X.GE.15.) GO TO 30                                            RAM43320
C      FOR DISTANCES 3 TO 15 KM,  CON.  WAS STORED EVERY 500M.          RAM43330
C      STORAGE LOCATIONS 75-99 CONTAIN INTEGRATED CON.  FOR 3 TO 15 KM. RAM43340
      J=IFIX(2.*X)+69                                                   RAM43350
      D=J-69                                                            RAM43360
      XL=D/2.                                                           RAM43370
      XU=XL+0.5                                                         RAM43380
      GO TO 40                                                          RAM43390
C      FOR DISTANCES > 15,000M CON.  WAS STORED EVERY 1000M.            RAM43400
C      STORAGE LOCATIONS 99-200 CONTAIN INTEGRATED CON. FOR 15 TO 116KM.RAM43410
30    IF (X.GT.XLIM) GO TO 60                                           RAM43420
      J=IFIX(X)+84                                                      RAM43430
      XL=J-84                                                           RAM43440
      XU=XL+1.                                                          RAM43450
40    K=J+1                                                             RAM43460
C     RETRIEVE CONCENTRATIONS FOR INTERPOLATION ACCORDING TO HEIGHT     RAM43470
C        CLASS AND DISTANCE OUT.                                        RAM43480
      C1=CIN(IH,J)                                                      RAM43490
      CON=C1+((X-XL)/(XU-XL))*(CIN(IH,K)-C1)                            RAM43500
      RETURN                                                            RAM43510
C      FOR DISTANCES < 100M, CON.  WAS STORED IN CIN EVERY 10 M.        RAM43520
C      STORAGE LOCATION 1 CONTAINS INTEGRATED CON.  FOR 10 M.           RAM43530
50    CON=100.*X*CIN(IH,1)                                              RAM43540
      RETURN                                                            RAM43550
60    WRITE (IO,70) XLIM,NS,KREC                                        RAM43560
      CALL WAUDIT
      STOP                                                              RAM43570
C                                                                       RAM43580
70    FORMAT (' ***THE INPUT VALUE OF XLIM,',F10.2,', IS SMALLER THAN THRAM43590
     1E CALCULATED DISTANCE FROM AREA SOURCE ',I4,' TO RECEPTOR ',I4,'**RAM43600
     2*'/1X,'PLEASE REDEFINE XLIM')                                     RAM43610
C                                                                       RAM43620
      END                                                               RAM43630
C
      SUBROUTINE OUTPT                                                  RAM43650
C                     SUBROUTINE OUTPT  (VERSION 80336), PART OF RAM.   RAM43660
C          THIS SUBROUTINE IS REFERRED TO AS M IN THE COMMON STATEMENTS RAM43670
C        THIS SUBROUTINE PROVIDES OUTPUT CONCENTRATIONS IN              RAM43680
C        MICROGRAMS PER CUBIC METER FOR EACH HOUR IN TWO WAYS:          RAM43690
C           1) CONTRIBUTIONS FROM SIGNIFICANT SOURCES, AND              RAM43700
C           2) SUMMARIES.                                               RAM43710
C        BEYOND ENTRY POINT OUTAV THE SUBROUTINE PROVIDES               RAM43720
C        CONCENTRATION OUTPUT FOR EACH AVERAGING PERIOD AGAIN           RAM43730
C        IN THE ABOVE MANNER.                                           RAM43740
C                                                                       RAM43750
C->->->->SECTION OUTPT.A - COMMON, DIMENSION, AND DATA.                 RAM43760
C                                                                       RAM43770
      COMMON /AMOST/ DELH,FH,HINT(3),H,HL,IO,IOPT(50),KST,MUOR,NHTS,RC,RRAM43780
     1CZ,SY,SZ,TEMP,TLOS,UPL,X,Y,Z                                      RAM43790
      COMMON /AEFM/ ITYPE(180),ICODE(180),UNITS,RREU(180),SREU(180)     RAM43800
      COMMON /AEFGKM/ NRECEP,RREC(180),SREC(180),IDATE(2),LH,NPT        RAM43810
      COMMON /AEGIKM/ IPOL,CONTWO,SINT,COST,U,HANE,PL(6)                RAM43820
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      COMMON /AEM/ NSIGP,MPS(25),NSIGA,MAS(10)                          RAM43830
      COMMON /AGM/ PSAV(250),HSAV(250),DH(250),DSAV(250),UPH(250),HPR(25RAM43840
     10),FP(250),PCHI(180),PHCHI(180),PSIGS(180,26),PHSIGS(180,26),IPSIGRAM43850
     2S(250),GRANDT(180)                                                RAM43860
      COMMON /AIM/ HARE(3)                                              RAM43870
      COMMON /AKM/ BPHM(2),ACHI(180),AHCHI(180),ASIGS(180,11),AHSIGS(180RAM43880
     1,11)                                                              RAM43890
      COMMON /AM/ LINE1(20),LINE2(20),LINE3(20),IPOLU,QTHETA(24),QU(24),RAM43900
     1QHL(24),QTEMP(24),IKST(24),NAVG,NB,RNAME(2,180)                  RAM43910
      DIMENSION IRANK(180)                                              RAM43920
      DIMENSION GRANDS(180)                                             RAM43930
C                                                                       RAM43940
C->->->->SECTION OUTPT.B - HOURLY CONTRIB. OUTPUT FROM PT. SOURCE        RAM43950
C                                                                       RAM43960
C           SKIP IF THERE ARE NO POINT SOURCES                          RAM43970
      IF (IOPT(5).EQ.0) GO TO 100                                       RAM43980
C                                                                       RAM43990
C->->->->SECTION OUTPT.B(1) DELETE HOURLY PT. SOURCE CONTRIB. OUTPUT?    RAM44000
      IF (IOPT(25).EQ.1) GO TO 100                                      RAM44010
C                                                                       RAM44020
C           PRODUCE POINT SOURCE CONTRIBUTION TITLE                     RAM44030
      WRITE (IO,390) LINE1,LINE2,LINE3                                  RAM44040
      WRITE (IO,410) IPOLU,IDATE,LH                                     RAM44050
C                                                                       RAM44060
C->->->->SECTION OUTPT.B(2) - DELETE MET. DATA FROM HOURLY PT.          RAM44070
C        SOURCE OUTPUT?                                                 RAM44080
C                                                                       RAM44090
      IF (IOPT(26).EQ.1) GO TO 10                                       RAM44100
C                                                                       RAM44110
C           PRODUCE HOURLY MET. DATA                                    RAM44120
      WRITE (IO,530)                                                    RAM44130
      WRITE (IO,540) LH,QTHETA(LH),QU(LH),QHL(LH),QTEMP(LH),IKST(LH)    RAM44140
10    WRITE (IO,520) HANE,PL(KST)                                       RAM44150
C                                                                       RAM44160
C->->->->SECTION OUTPT.B(3) - DELETE FINAL PLUME HT. AND DIST. TO       RAM44170
C        FINAL RISE?                                                    RAM44180
C                                                                       RAM44190
      IF (IOPT(27).EQ.1) GO TO 20                                       RAM44200
C                                                                       RAM44210
C           PRODUCE FINAL PLUME HT. AND DIST. TO FINAL RISE             RAM44220
      WRITE (IO,550) (I,I=1,10)                                         RAM44230
C        HSAV ARE CALCULATED PLUME HEIGHTS FOR THIS HOUR                RAM44240
      WRITE (IO,560) (HSAV(I),I=1,NPT)                                  RAM44250
C        DSAV ARE DISTANCES TO FINAL RISE FOR THIS HOUR.                RAM44260
      WRITE (IO,570) (DSAV(I),I=1,NPT)                                  RAM44270
C                                                                       RAM44280
C->->->->SECTION OUTPT.B(4) - PRINT POINT CONTRIBUTIONS                 RAM44290
C                                                                       RAM44300
20    IF (NSIGP.GT.10) GO TO 40                                         RAM44310
C           PRINT OUT FIRST PAGE AND TOTALS FOR 10 OR < SIGNIF. SOURCES RAM44320
      WRITE (IO,430)                                                    RAM44330
      WRITE (IO,440) (I,I=1,NSIGP)                                      RAM44340
      WRITE (IO,460)                                                    RAM44350
      WRITE (IO,440) (MPS(I),I=1,NSIGP)                                 RAM44360
      WRITE (IO,470)                                                    RAM44370
      DO 30 K=1,NRECEP                                                  RAM44380
      WRITE (IO,480) K,(PHSIGS(K,I),I=1,NSIGP)                          RAM44390
C           PRINT TOTALS                                                RAM44400
      WRITE (IO,490) PHSIGS(K,26),PHCHI(K)                              RAM44410
30    CONTINUE                                                          RAM44420
      GO TO 100                                                         RAM44430
C                                                                       RAM44440
C           PRINT FIRST PAGE FOR MORE THAN 10 SIGNIFICANT SOURCES.      RAM44450
40    WRITE (IO,430)                                                    RAM44460
      WRITE (IO,440) (I,I=1,10)                                         RAM44470
      WRITE (IO,500) (MPS(I),I=1,10)                                    RAM44480
      WRITE (IO,470)                                                    RAM44490
      DO 50 K=1,NRECEP                                                  RAM44500
50    WRITE (IO,480) K,(PHSIGS(K,I),I=1,10)                             RAM44510
      IF (NSIGP.GT.20) GO TO 70                                         RAM44520
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C                                                                       RAM44530
C          PRINT SECOND PAGE AND TOTALS FOR 11 TO 20 SIGNIFICANT SOURCESRAM44540
      WRITE (IO,390) LINE1,LINE2,LINE3                                  RAM44550
      WRITE (IO,410) IPOLU,IDATE,LH                                     RAM44560
      WRITE (IO,430)                                                    RAM44570
      WRITE (IO,440) (I,I=11,NSIGP)                                     RAM44580
      WRITE (IO,460)                                                    RAM44590
      WRITE (IO,440) (MPS(I),I=11,NSIGP)                                RAM44600
      WRITE (IO,470)                                                    RAM44610
      DO 60 K=1,NRECEP                                                  RAM44620
      WRITE (IO,480) K,(PHSIGS(K,I),I=11,NSIGP)                         RAM44630
60    WRITE (IO,490) PHSIGS(K,26),PHCHI(K)                              RAM44640
      GO TO 100                                                         RAM44650
C                                                                       RAM44660
C           WRITE SECOND PAGE FOR MORE THAN 20 SIGNIFICANT SOURCES.     RAM44670
70    WRITE (IO,390) LINE1,LINE2,LINE3                                  RAM44680
      WRITE (IO,410) IPOLU,IDATE,LH                                     RAM44690
      WRITE (IO,430)                                                    RAM44700
      WRITE (IO,440) (I,I=11,20)                                        RAM44710
      WRITE (IO,500) (MPS(I),I=11,20)                                   RAM44720
      WRITE (IO,470)                                                    RAM44730
      DO 80 K=1,NRECEP                                                  RAM44740
80    WRITE (IO,480) K,(PHSIGS(K,I),I=11,20)                            RAM44750
      WRITE (IO,390) LINE1,LINE2,LINE3                                  RAM44760
      WRITE (IO,410) IPOLU,IDATE,LH                                     RAM44770
      WRITE (IO,430)                                                    RAM44780
C                                                                       RAM44790
C           WRITE LAST PAGE AND TOTALS FOR MORE THAN 20 SIGNIF. SOURCES.RAM44800
      WRITE (IO,440) (I,I=21,NSIGP)                                     RAM44810
      WRITE (IO,460)                                                    RAM44820
      WRITE (IO,440) (MPS(I),I=21,NSIGP)                                RAM44830
      WRITE (IO,470)                                                    RAM44840
      DO 90 K=1,NRECEP                                                  RAM44850
      WRITE (IO,480) K,(PHSIGS(K,I),I=21,NSIGP)                         RAM44860
90    WRITE (IO,490) PHSIGS(K,26),PHCHI(K)                              RAM44870
C                                                                       RAM44880
C->->->->SECTION OUTPT.C - HOURLY CONTRIB. FROM AREA SOURCE              RAM44890
C                                                                       RAM44900
C           SKIP IF THERE ARE NO AREA SOURCES                           RAM44910
      IF (IOPT(6).EQ.0) GO TO 130                                       RAM44920
C                                                                       RAM44930
C->->->->SECTION OUTPT.C(1) - DELETE HOURLY AREA CONTRIB.?               RAM44940
C                                                                       RAM44950
100   IF (IOPT(28).EQ.1) GO TO 130                                      RAM44960
C                                                                       RAM44970
C           PRODUCE AREA SOURCE CONTRIB. TITLE                          RAM44980
      WRITE (IO,390) LINE1,LINE2,LINE3                                  RAM44990
      WRITE (IO,420) IPOLU,IDATE,LH                                     RAM45000
C                                                                       RAM45010
C->->->->SECTION OUTPT.C(2) - DELETE HOURLY AREA MET. DATA               RAM45020
C                                                                       RAM45030
      IF (IOPT(29).EQ.1) GO TO 110                                      RAM45040
C                                                                       RAM45050
C           PRODUCE HOURLY AREA SOURCE MET. DATA                        RAM45060
      WRITE (IO,530)                                                    RAM45070
      WRITE (IO,540) LH,QTHETA(LH),QU(LH),QHL(LH),QTEMP(LH),IKST(LH)    RAM45080
C                                                                       RAM45090
C->->->->SECTION OUTPT.C(3) - PRINT AREA CONTRIBUTIONS                   RAM45100
C                                                                       RAM45110
110   WRITE (IO,520) HANE,PL(KST)                                       RAM45120
      WRITE (IO,400) HARE,BPHM                                          RAM45130
      WRITE (IO,430)                                                    RAM45140
      WRITE (IO,440) (I,I=1,NSIGA)                                      RAM45150
      WRITE (IO,450)                                                    RAM45160
      WRITE (IO,440) (MAS(I),I=1,NSIGA)                                 RAM45170
      WRITE (IO,470)                                                    RAM45180
      DO 120 K=1,NRECEP                                                 RAM45190
      WRITE (IO,480) K,(AHSIGS(K,I),I=1,NSIGA)                          RAM45200
120   WRITE (IO,490) AHSIGS(K,11),AHCHI(K)                              RAM45210
C                                                                       RAM45220
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C->->->->SECTION OUTPT.D - HOURLY SUMMARY TABLE
C
C->->->->SECTION OUTPT.D(1) - DELETE HOURLY SUMMARIES?
C
130   IF (IOPT(30).EQ.1) RETURN
C
C            PRODUCE HOURLY SUMMARY TITLE
      WRITE (IO,390) LINE1,LINE2,LINE3
      WRITE (IO,510) IPOLU,IDATE,LH
C
C->->->->SECTION OUTPT.D(2) - DELETE HOURLY MET. DATA?
C
      IF (IOPT(31).EQ.1) GO TO 140
C            PRODUCE HOURLY SUMMARY TABLE MET. DATA
      WRITE (IO,530)
      WRITE (IO,540) LH,QTHETA(LH),QU(LH),QHL(LH),QTEMP(LH),IKST(LH)
140   WRITE (IO,520) HANE,PL(KST)
      IF (IOPT(6).EQ.1) WRITE (IO,400) HARE,BPHM
      WRITE (IO,580)
C
C->->->->SECTION OUTPT.D(3) -  RANK CONCENTRATIONS
C
      DO 150 K=1,NRECEP
150   GRANDS(K)=GRANDT(K)
C
      DO 170 I=1,NRECEP
      CMAX=-1.0
      DO 160 K=1,NRECEP
      IF (GRANDT(K).LE.CMAX) GO TO 160
      CMAX=GRANDT(K)
      LMAX=K
160   CONTINUE
      IRANK(LMAX)=I
      GRANDT(LMAX)=-1.0
170   CONTINUE
C
C->->->->SECTION OUTPT.D(4) - PRINT SUMMARY TABLE
C
      DO 180 K=1,NRECEP
180   WRITE (IO,590) K,ITYPE(K),ICODE(K),(RNAME(J,K),J=1,2),RREU(K),SREU
     1(K),PHSIGS(K,26),PHCHI(K),AHSIGS(K,11),AHCHI(K),GRANDS(K),IRANK(K)
      RETURN
C
C
C->->->->SECTION OUTPT.E - ENTRY POINT FOR AVERAGING TIME
C
C
      ENTRY OUTAV
C             AT THIS ENTRY POINT, CONCENTRATION OUTPUT
C         IN MICROGRAMS PER CUBIC METER ARE PRINTED FOR THE
C         AVERAGING PERIOD. CONTRIBUTIONS AND/OR SUMMARY
C         INFORMATION IS AVAILABLE.
C
C->->->->SECTION OUTPT.E(1) - AVG. CONC. OVER SPEC. TIME PERIOD
C
C            SKIP IF THERE ARE NO POINT SOURCE CONTRIBUTIONS PRINTED OUT
      IF (IOPT(5).EQ.0) GO TO 290
C          CALCULATE AVERAGE POINT CONTRIBUTIONS.
      DO 190 K=1,NRECEP
190   PSIGS(K,26)=PSIGS(K,26)/NAVG
      IF (IOPT(33).EQ.1) GO TO 290
      DO 210 K=1,NRECEP
      DO 200 I=1,NSIGP
200   PSIGS(K,I)=PSIGS(K,I)/NAVG
210   CONTINUE
C
C->->->->SECTION OUTPT.F - AVG. PERIOD PT. CONTRIB.
C            SKIP IF THERE ARE NO POINT SOURCES
C
C
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C->->->->SECTION OUTPT.F(2) - PRINT AVG. PERIOD PT. SOURCE CONTRIB.
      WRITE (IO,390) LINE1,LINE2,LINE3
      WRITE (IO,600) NAVG,IPOLU,IDATE,NB,HANE,PL
      IF (NSIGP.GT.10) GO TO 230
C
C            PRINT OUT FIRST PAGE AND TOTALS FOR 10 OR < SIGNIF. SOURCES
      WRITE (IO,440) (I,I=1,NSIGP)
      WRITE (IO,460)
      WRITE (IO,440) (MPS(I),I=1,NSIGP)
      WRITE (IO,470)
      DO 220 K=1,NRECEP
      WRITE (IO,480) K,(PSIGS(K,I),I=1,NSIGP)
C            PRINT TOTALS
220   WRITE (IO,490) PSIGS(K,26),PCHI(K)
      GO TO 290
C
C            PRINT FIRST PAGE FOR MORE THAN 10 SIGNIF SOURCES
230   WRITE (IO,440) (I,I=1,10)
      WRITE (IO,500) (MPS(I),I=1,10)
      WRITE (IO,470)
      DO 240 K=1,NRECEP
240   WRITE (IO,480) K,(PSIGS(K,I),I=1,10)
      IF (NSIGP.GT.20) GO TO 260
C
C            PRINT SECOND PAGE AND TOTALS FOR 11 TO 20 SIGNIF SOURCES
      WRITE (IO,390) LINE1,LINE2,LINE3
      WRITE (IO,600) NAVG,IPOLU,IDATE,NB,HANE,PL
      WRITE (IO,440) (I,I=11,NSIGP)
      WRITE (IO,460)
      WRITE (IO,440) (MPS(I),I=11,NSIGP)
      WRITE (IO,470)
      DO 250 K=1,NRECEP
      WRITE (IO,480) K,(PSIGS(K,I),I=11,NSIGP)
250   WRITE (IO,490) PSIGS(K,26),PCHI(K)
      GO TO 290
C
C            WRITE SECOND PAGE FOR MORE THAN 20 SIGNIF SOURCES
260   WRITE (IO,390) LINE1,LINE2,LINE3
      WRITE (IO,600) NAVG,IPOLU,IDATE,NB,HANE,PL
      WRITE (IO,440) (I,I=11,20)
      WRITE (IO,500) (MPS(I),I=11,20)
      WRITE (IO,470)
      DO 270 K=1,NRECEP
270   WRITE (IO,480) K,(PSIGS(K,I),I=11,20)
C
C            WRITE LAST PAGE AND TOTALS FOR MORE THAN 20 SIGNIF SOURCES
      WRITE (IO,390) LINE1,LINE2,LINE3
      WRITE (IO,600) NAVG,IPOLU,IDATE,NB,HANE,PL
      WRITE (IO,440) (I,I=21,NSIGP)
      WRITE (IO,460)
      WRITE (IO,440) (MPS(I),I=21,NSIGP)
      WRITE (IO,470)
      DO 280 K=1,NRECEP
      WRITE (IO,480) K,(PSIGS(K,I),I=21,NSIGP)
280   WRITE (IO,490) PSIGS(K,26),PCHI(K)
C
C->->->->SECTION OUTPT.G - AVG.PERIOD AREA CONTRIB.
C
C->->->->SECTION OUTPT.G(1) - DELETE AVG. PERIOD AREA SOURCE CONTRIB?
290   IF (IOPT(6).EQ.0) GO TO 340
C       CALCULATE AVERAGE AREA CONTRIBUTIONS.
      DO 300 K=1,NRECEP
300   ASIGS(K,11)=ASIGS(K,11)/NAVG
      IF (IOPT(34).EQ.1) GO TO 340
      DO 320 K=1,NRECEP
      DO 310 I=1,NSIGA
310   ASIGS(K,I)=ASIGS(K,I)/NAVG
320   CONTINUE
C
C->->->->SECTION OUTPT.G(2) - PRINT AVG. PERIOD AREA SOURCE CONTRIB.
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C
      WRITE (IO,390) LINE1,LINE2,LINE3
      WRITE (IO,610) NAVG,IPOLU,IDATE,NB,HANE,PL
      WRITE (IO,440) (I,I=1,NSIGA)
      WRITE (IO,450)
      WRITE (IO,440) (MAS(I),I=1,NSIGA)
      WRITE (IO,470)
      DO 330 K=1,NRECEP
      WRITE (IO,480) K,(ASIGS(K,I),I=1,NSIGA)
330   WRITE (IO,490) ASIGS(K,11),ACHI(K)
C
C->->->->SECTION OUTPT.H - AVG. PERIOD SUMMARY
C
C->->->->SECTION OUTPT.H(1) - DELETE AVG. PERIOD SUMMARY?
C
340   IF (IOPT(35).EQ.1) RETURN
C
C           PRINT AVG. PERIOD SUMMARY
      WRITE (IO,390) LINE1,LINE2,LINE3
      WRITE (IO,620) NAVG,IPOLU,IDATE,NB,HANE,PL
      WRITE (IO,580)
C            RANK CONCENTRATIONS
      DO 350 K=1,NRECEP
350   GRANDS(K)=GRANDT(K)
      DO 370 I=1,NRECEP
      CMAX=-1.0
      DO 360 K=1,NRECEP
      IF (GRANDT(K).LE.CMAX) GO TO 360
      CMAX=GRANDT(K)
      LMAX=K
360   CONTINUE
      IRANK(LMAX)=I
370   GRANDT(LMAX)=-1.0
      DO 380 K=1,NRECEP
380   WRITE (IO,590) K,ITYPE(K),ICODE(K),(RNAME(J,K),J=1,2),RREU(K),SREU
     1(K),PSIGS(K,26),PCHI(K),ASIGS(K,11),ACHI(K),GRANDS(K),IRANK(K)
C
      RETURN
C
C->->->->SECTION OUTPT.J - FORMATS
C
390   FORMAT ('1',20A4/1X,20A4/1X,20A4)
400   FORMAT (1H0,T40,'AREA HTS:  ',F8.3,',',F8.3,',',F8.3,';    SEPARATI
     1ON HTS:  ',F8.3,',',F8.3)
410   FORMAT ('0',T30,A4,' CONTRIBUTION(MICROGRAMS/M**3) FROM SIGNIFICAN
     1T POINT SOURCES ',5X,I2,'/',I4,' : HOUR ',I2//)
420   FORMAT ('0',T30,A4,' CONTRIBUTION(MICROGRAMS/M**3) FROM SIGNIFICAN
     1T AREA SOURCES ',5X,I2,'/',I4,' :  HOUR',I2//)
430   FORMAT (1H0,T5,'RANK')
440   FORMAT ('+',T12,10(I3,7X))
450   FORMAT ('+',T113,'TOTAL      TOTAL'/1X,T113,'SIGNIF     ALL AREA'/1X
     1,T113,'AREA       SOURCES'/1X,'SOURCE #')
460   FORMAT ('+',T113,'TOTAL      TOTAL'/1X,T113,'SIGNIF     ALL POINT'/1
     1X,T113,'POINT      SOURCES'/1X,'SOURCE #')
470   FORMAT (1X,'RECEP #')
480   FORMAT (1X,I3,2X,6P10F10.3)
490   FORMAT ('+',T109,6P2F10.3)
500   FORMAT (1H0,'SOURCE #',T12,10(I3,7X))
510   FORMAT ('0',T25,A4,' SUMMARY CONCENTRATION TABLE(MICROGRAMS/M**3)
     1'5X,I2,'/',I4,' : HOUR ',I2/1X)
520   FORMAT (1H+,T60,'ANEMOM HT: ',F6.2,'      PL: ',F6.2)
530   FORMAT (1X,T2,'HOUR    THETA    SPEED   MIXING    TEMP    STABILITY'/
     11X,T9,'(DEG)     (M/S)  HEIGHT(M)    (K)      CLASS'/1X)
540   FORMAT (1X,T3,I2,4F9.2,6X,I1)
550   FORMAT (1H0,8X,10I11/)
560   FORMAT (' FINAL HT (M) ',10F11.2)
570   FORMAT (' DIST FIN HT (KM)',10F11.3)
580   FORMAT (1X,'RECEPTOR NO.               EAST       NORTH ',2X,5('TOTAL
     1 FROM    '),' CONCENTRATION'/1X,T46,'SIGN','IF POINT  ALL POINT   S
     2IGNIF AREA    ALL AREA      ALL SOURCES',5X,'RANK'/1X,T48,4('SOURCE
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     3S',6X)/1X)                                                        RAM47330
590   FORMAT (1X,T3,I3,1X,A1,I3,2X,2A4,F11.3,F12.3,6P5F13.4,6X,I3)      RAM47340
600   FORMAT ('0',T22,I2,'-HOUR AVERAGE ',A4,' CONTRIBUTION(MICROGRAMS/MRAM47350
     1**3) FROM SIGNIFICANT POINT SOURCES',5X,I2,'/',I3,'  START HOUR: 'RAM47360
     2,I2//1X,T20,'ANEMOM HT: ',F4.0,3X,'PL:  A-',F4.2,2X,'B- ',F4.2,'C-RAM47370
     3 ',F4.2,2X,'D- ',F4.2,2X,'E- ',F4.2,2X,'F- ',F4.2/1X,T5,'RANK')   RAM47380
610   FORMAT ('0',T22,I2,'-HOUR AVERAGE ',A4,' CONTRIBUTION(MICROGRAMS/MRAM47390
     1**3) FROM SIGNIFICANT AREA SOURCES',5X,I2,'/',I3,'  START HOUR: ',RAM47400
     2I2//1X,T20,'ANEMOM HT: ',F4.0,2X,'PL: A-',F4.2,2X,'B- ',F4.2,2X,'CRAM47410
     3- ',F4.2,2X,'D- ',F4.2,2X,'E- ',F4.2,2X,'F- ',F4.2,/1X,T5,'RANK') RAM47420
620   FORMAT ('0',T25,I2,'-HOUR AVERAGE ',A4,' SUMMARY CONCENTRATION TABRAM47430
     1LE(MICROGRAMS/M**3)',5X,I2,'/',I3,'  START HOUR: ',I2//1X,T20,'ANERAM47440
     2MOM HT: ',F4.0,2X,'PL: A- ',F4.2,2X,'B- ',F4.2,2X,'C- ',F4.2,2X,'DRAM47450
     3- ',F4.2,2X,'E- ',F4.2,2X,'F- ',F4.2/1X)                          RAM47460
C                                                                       RAM47470
      END                                                               RAM47480
C
      SUBROUTINE RANK (L)                                               RAM47500
C                     SUBROUTINE RANK   (VERSION 80336), PART OF RAM.   RAM47510
C         THIS SUBROUTINE IS REFERRED TO AS N IN THE COMMON STATEMENTS  RAM47520
C       CALLED BY  RAM  TO ARRANGE CONCENTRATIONS OF VARIOUS AVG        RAM47530
C       TIMES INTO HIGH-FIVE TABLES...THAT IS, ARRAYS STORING           RAM47540
C       THE HIGHEST FIVE CONCENTRATIONS FOR EACH RECEPTOR FOR           RAM47550
C       EACH AVG TIME.                                                  RAM47560
C       VARIABLES OUTPUT:                                               RAM47570
C            HMAXA(J,K,L)  CONCENTRATIONS ACCORDING TO                  RAM47580
C                    J : RANK OF CONC. (1-5)                            RAM47590
C                    K : RECEPTOR NUMBER                                RAM47600
C                    L : AVG TIME                                       RAM47610
C            NDAY(J,K,L) : ASSOCIATED DAY OF CONC.                      RAM47620
C             IHR(J,K,L) : ENDING HOUR OF CONC.                         RAM47630
      COMMON /AEFGKM/ NRECEP,RREC(180),SREC(180),IDATE(2),LH,NPT        RAM47640
      COMMON /AN/ HMAXA(5,180,5),NDAY(5,180,5),IHR(5,180,5),CONC(180,5),RAM47650
     1JDAY                                                              RAM47660
C                                                                       RAM47670
      IO=6                                                              RAM47680
C       RESET AVERAGING PERIOD FLAG AND SET CALM FLAG, LL.              RAM47690
C       CALMS ACCOUNTED FOR ONLY WHEN DEFAULT OPTION ON.                RAM47700
      LL=0                                                              RAM47710
      IF(L.GT.4)LL=1                                                    RAM47720
      IF(L.EQ.22)L=2                                                    RAM47730
      IF(L.EQ.33)L=3                                                    RAM47740
      IF(L.EQ.44)L=4                                                    RAM47750
      DO 50 K=1,NRECEP                                                  RAM47760
      IF (CONC(K,L).LE.HMAXA(5,K,L)) GO TO 50                           RAM47770
      DO 10 J=1,5                                                       RAM47780
      IF  (CONC(K,L).GT.HMAXA(J,K,L)) GO TO 20                          RAM47790
C          CONCENTRATION IS ONE OF THE TOP FIVE                         RAM47800
10    CONTINUE                                                          RAM47810
      WRITE (IO,70)                                                     RAM47820
      GO TO 50                                                          RAM47830
C          THE FOLLOWING DO-LOOP HAS THE EFFECT OF INSERTING A NEW      RAM47840
C          CONCENTRATION ENTRY INTO ITS PROPER POSITION WHILE SHIFTING  RAM47850
C          DOWN THE 'OLD' LOWER CONCENTRATIONS THUS ESTABLISHING THE    RAM47860
C          'HIGH-FIVE' CONCENTRATION TABLE.                             RAM47870
20    IF (J.EQ.5) GO TO 40                                              RAM47880
      DO 30 IJ=4,J,-1                                                   RAM47890
      IJP1=IJ+1                                                         RAM47900
      HMAXA(IJP1,K,L)=HMAXA(IJ,K,L)                                     RAM47910
      NDAY(IJP1,K,L)=NDAY(IJ,K,L)                                       RAM47920
30    IHR(IJP1,K,L)=IHR(IJ,K,L)                                         RAM47930
C          INSERT LATEST CONC, DAY AND ENDING HR INTO THE               RAM47940
C             PROPER RANK IN THE HIGH-FIVE TABLE                        RAM47950
40    HMAXA(J,K,L)=CONC(K,L)                                            RAM47960
      NDAY(J,K,L)=JDAY                                                  RAM47970
      IHR(J,K,L)=LH                                                     RAM47980
C       ADD 100 TO HOUR TO SET CALM FLAG FOR MAIN.                      RAM47990
      IF(LL.EQ.1.AND.L.NE.1)IHR(J,K,L)=IHR(J,K,L)+100                   RAM48000
50    CONTINUE                                                          RAM48010
      DO 60 K=1,NRECEP                                                  RAM48020
```

```
      CONC(K,L)=0.
60    CONTINUE
      RETURN
C
70    FORMAT (1X,'    ****ERROR IN FINDING THE MAX CONCENTRATION***')
C
      END
```

APPENDIX B

JAPCA REPRINT

An Efficient Gaussian-Plume Multiple-Source Air Quality Algorithm

Joan Hrenko Novak and D. Bruce Turner
U. S. Environmental Protection Agency

The information presented in this paper is directed to air pollution scientists with an interest in applying air quality simulation models. RAM is the three letter designation for this efficient Gaussian-plume multiple-source air quality algorithm. RAM is a method of estimating short-term dispersion using the Gaussian steady-state model. This algorithm can be used for estimating air quality concentrations of relatively stable pollutants for averaging times from an hour to a day in urban areas from point and area sources. The algorithm is applicable for locations with level or gently rolling terrain where a single wind vector for each hour is a good approximation to the flow over the source area considered. Calculations are performed for each hour. Hourly meteorological data required are wind direction, wind speed, stability class, and mixing height. Emission information required of point sources consists of source coordinates, emission rate, physical height, stack gas volume flow and stack gas temperature. Emission information required of area sources consists of south-west corner coordinates, source area, total area emission rate and effective area source height. Computation time is kept to a minimum by the manner in which concentrations from area sources are estimated using a narrow plume hypothesis and using the area source squares as given rather than breaking down all sources to an area of uniform elements. Options are available to the user to allow use of three different types of receptor locations: 1) those whose coordinates are input by the user, 2) those whose coordinates are determined by the model and are downwind of significant point and area sources where maxima are likely to occur, and 3) those whose coordinates are determined by the model to give good area coverage of a specific portion of the region. Computation time is also decreased by keeping the number of receptors to a minimum.

The purpose of formulating RAM is to provide a readily available computer program based on the assumptions of steady-state Gaussian dispersion. RAM can be used for any short-term (one-hour to one-day) determination of urban air quality resulting from pollutants released from point and/or area sources. Urban planners can use RAM to determine the effects of new source locations and of control strategies upon short term air quality. If the input meteorological parameter values can be forecast with sufficient accuracy, control agency officials can use RAM to predict ambient air quality levels, primarily over the 24-hour averaging time, to 1) locate mobile air sampling units, and 2) assist with emission reduction tactics. Especially for control tactics, diurnal and day-to-day emission variations must be considered in the source inventory input to the model. For most of these uses, the optional feature to assist in locating maximum points should be utilized. Computations are organized so that execution of the program is rapid, thus real-time computations are feasible.

Briggs' plume rise equations are used to estimate effective height of point sources. Concentrations from the point sources are determined using distance crosswind and distance upwind from the receptor. Considerable time is saved in calculating concentrations from area sources by using a narrow plume

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simplification which considers sources upwind from a receptor to be representative of those affecting the receptor. Area source sizes are used as given in the inventory rather than creating an internal inventory of uniform elements.

The algorithm is applicable for locations with level or gently rolling terrain where a single wind vector for each hour is a reasonable approximation of the flow over the source area considered. A single mixing height and a single stability class for each hour are assumed representative of the area. The use of the RAM is restricted to relatively stable pollutants.

Options are available to allow the use of three different types of receptor locations: 1) those whose coordinates are input by the user, 2) those whose coordinates are determined by RAM and are downwind of significant point and area sources where maxima are likely to occur, and 3) those whose coordinates are determined by RAM to give good area coverage of a specific portion of the region. Options are also available concerning the detail of output produced.

The Algorithm

Inputs Required

The algorithm always requires emission and meteorological data, and depending on receptor options used, it may also require receptor data. Any convenient east-north rectangular coordinate system may be used since all conversion from user units to meters is performed internally by use of an input conversion factor.

A. *Point source information consists* of the following for each source:
   1. East coordinate of source location, user units
   2. North coordinate of source location, user units
   3. Stack height (above ground), meters
   4. Stack inside top diameter, meters
   5. Stack gas temperature, °K
   6. Stack gas velocity, m sec^{-1}
   7. Pollutant *emission rate, g* sec^{-1}

B. Area source information consists of the following for each source:
   1. East coordinate of the southwest corner of the area source, user units
   2. North coordinate of the southwest corner of the area source, user units
   3. Effective emission height, meters
   4. Side length of area source, user units
   5. Total pollutant emission rate for the area, g sec^{-1}

Area sources must be squares. They can be of various sizes, but their side length must be an integer multiple of a common side length. The term UNIT SQUARE refers to a source with this minimum common side length. The effective emission height of the area sources is assumed to be the effective height that occurs with a 5 m sec^{-1} wind. The effective height of the area sources can be varied with wind speed. Area emission rates are converted internally to g sec^{-1} m^{-2}.

C. Meteorological data, representative of the region being considered, consists of hourly values of the following:
   1. Wind direction, deg clockwise from North
   2. Wind speed, m sec^{-1}
   3. Stability class, dimensionless
   4. Mixing height, meters

   The stability class is that of Pasquill.

D. Receptor information, if required by user specification, consists of the following for each receptor:
   1. East coordinate of the receptor location, user units
   2. North coordinate of the receptor location, user units

Only one receptor height, *z*, above ground is allowed for a given execution of the model. This height can be zero or positive.

Basic Principles

The following assumptions are made: 1) Dispersion from points and area elements result in Gaussian distributions in both the horizontal and vertical directions through the dispersing plume, and therefore steady-state Gaussian plume equations can be used for point sources and the integration of these equations for area sources. 2) Concentration estimates may be made for each hourly period using the mean meteorological conditions appropriate for each hour. 3) The total concentration at a receptor is the sum of the concentrations estimated from all point and area sources, that is, concentrations are additive.

For point sources, the plume rise is calculated from the stack gas temperature, stack diameter, and stack gas velocity using the equations of Briggs.[1-3] The effective emission height is the physical stack height plus the plume rise.

In order to calculate contributions from point sources the upwind distance, x, and the crosswind distance, y, of each source from each receptor are calculated using Eq. A1 and A2

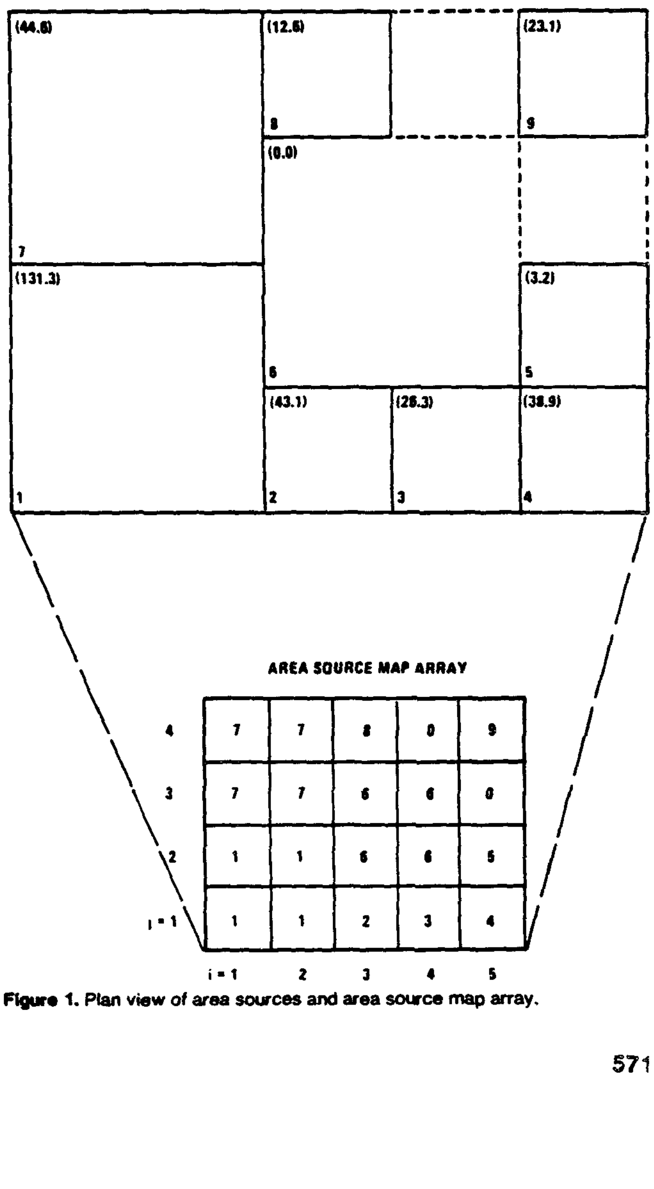

Figure 1. Plan view of area sources and area source map array.

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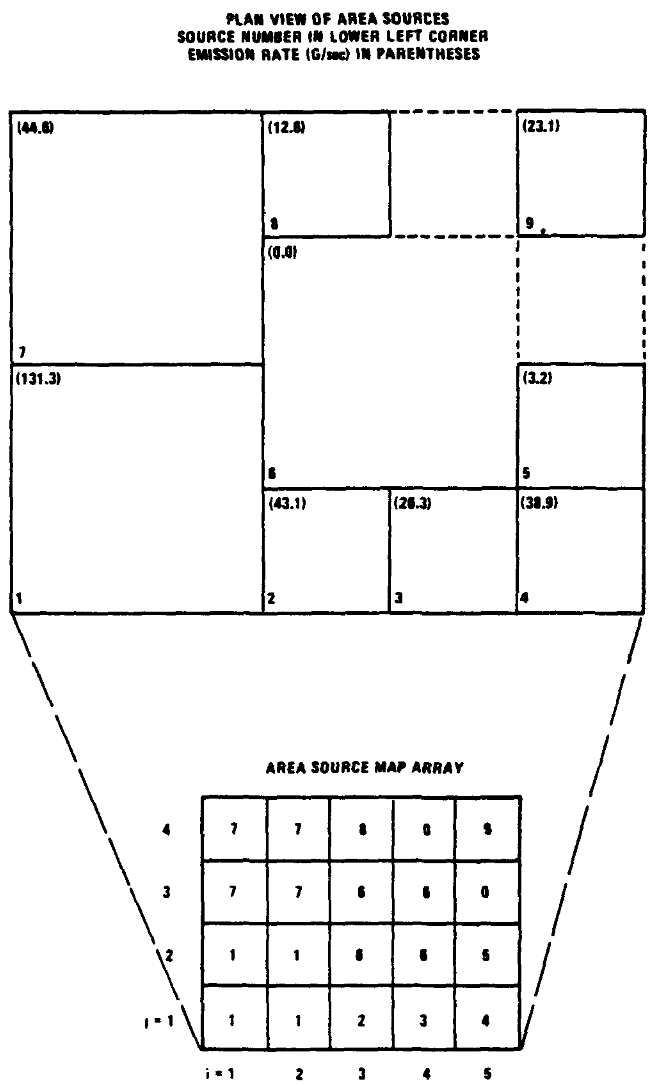

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in the Appendix. The dispersion parameter values, σ_y and σ_z are determined as a function of the upwind distance, x, and stability class (See p 374 of Pasquill[4]). The three equations used to estimate concentrations under various conditions of stability and mixing height (Equations A3, A4, and A5) are discussed in the Appendix. These equations are for a receptor height, z, above ground and simplify considerably when the receptor height is assumed to be at ground level, $z = 0$. (Those simplifications are incorporated into RAM.)

The total concentration at a receptor arising from the two-dimensional area-source distribution is calculated using the narrow plume simplification of Gifford and Hanna.[5] This simplification is assumed because, on an urban scale, the plume from a point source release is normally quite narrow in comparison with the characteristic length scale for appreciable changes of the magnitude of the area-source emission rate itself. Under these circumstances the two-dimensional integral that expresses the total area-source contribution to concentration can be replaced approximately by a one-dimensional integral that only involves knowledge of the distribution of the area-source emissions along the line in the direction of the upwind azimuth from the receptor location, and the meteorologically-dependent function that specifies the crosswind-integrated concentration in the Gaussian plume from a point source. Further evidence for the validity of this approximation for treating area-source concentrations has been provided by some numerical tests of Thayer and Koch.[6]

In the use of this area source technique by Gifford and Hanna,[5] area source emissions were assumed at ground level allowing integration upwind to be accomplished analytically. However, in our application of this technique within RAM, the area sources are considered to have an effective height, thus requiring the integration to be accomplished numerically. The equations used to estimate concentrations from area sources (Eq. A10 through A13) are given in the Appendix. The total concentration from all area sources is determined by performing the integration in the upwind direction until the farthest boundary of the source region is reached.

Concentrations at a receptor for periods longer than 1 hr are determined by averaging the hourly concentrations over the period of interest.

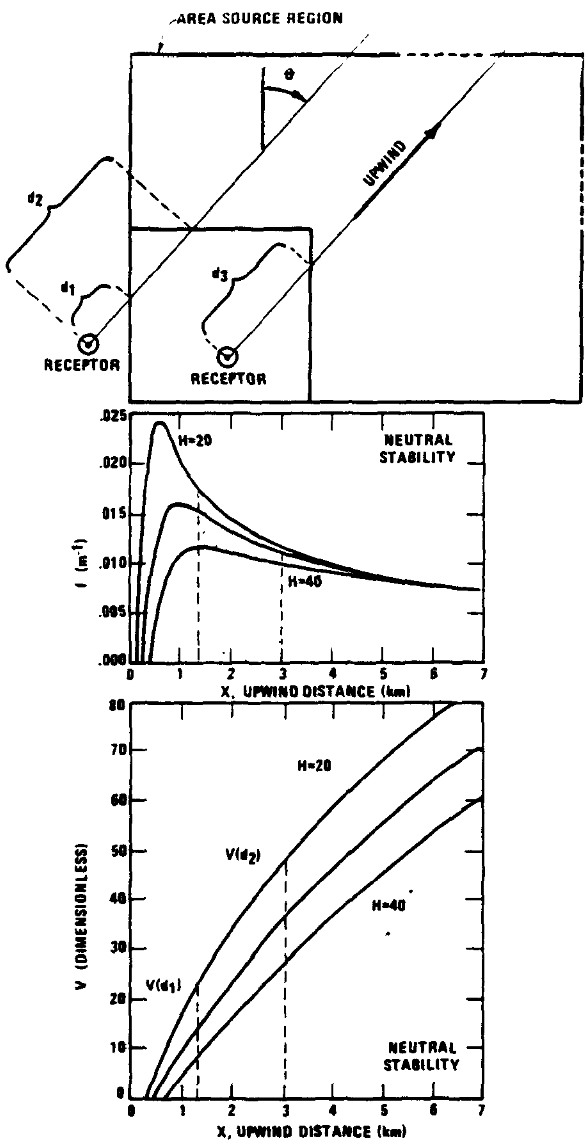

Figure 2. Features of area source estimates.

How Computations Are Made

Initially, a preprocessor program is used to store the emission inventory in a convenient form and perform any necessary conversions. A most important function of the preprocessor is to arrange the area sources in such a way as to minimize computation time for area source concentrations. Each area source number (area sources are numbered sequentially as the sources are input) is stored in a two dimensional array which essentially forms a map of the relative locations of all the area sources. Each element in the array corresponds to an area the size of a unit square (previously defined). Therefore a unit source will have its source number stored into one element of the array, whereas an area source that is 4 units by 4 units will have its source number stored into 16 elements of the array (4 × 4). Obviously area sources must be mutually exclusive; they must not overlap. Array elements corresponding to areas of the source region not covered by area sources will have a zero stored in the array. As will be explained later, it is to the advantage of the user to define areas 2 × 2 units or larger with no emissions as specific source areas with zero emissions (source 6, Figure 1). An example of a simplified source region and the resulting array are shown in Figure 1.

Concentration estimates are made hour-by-hour for up to 24 hr. This algorithm is not designed to determine average concentrations over periods longer than 24 hr. First, concentrations resulting from area sources are calculated. In an effort to reduce the total amount of computer time, tables (arrays) which contain relative concentrations, V, normalized for emission rate and wind speed, are calculated only once for each simulated hour using the appropriate stability and mixing height, and thereby eliminating all repetitive calculations. The function V is calculated from:

$$V(d) = \int_0^d f \, dx \tag{1}$$

and is the non-dimensional concentration resulting from an area source of given effective height extending upwind from a receptor to the distance, d. The function f, whose form depends on stability, and mixing height, is defined in the Appendix (Eq. A11, A12, and A13). The stored tables contain values of this integral obtained by numerical integration for a number of values of d. Both f and V for 3 area source heights are shown in Figure 2. Because $V(d)$ changes rapidly for small values of d, the numerical integration using the trapezoidal rule is done using varying size intervals, as small as 1 meter for x less than 100 meters, and as large as 1 km for x greater than 15 km. The values of V are also stored for varying intervals of d (ranging from 10 m to 1 km), so that linear interpolation between stored values will result in an accurate estimate of V. For each effective area source height, up to a maximum of three, a V table is generated and stored at the beginning of each simulated hour.

The concentrations from the area sources are computed receptor by receptor. If the receptor is outside the source region (the rectangular region containing all the area sources), it is first determined if the upwind ray (the line pointed in the wind direction) intersects the source region. If it does not intersect the source region, no contribution from area sources at this receptor is calculated. If the upwind ray does intersect the source region, the distance, d_1, (See Figure 2) along the ray to the source region is determined using Eq. A6 and A8 in the Appendix. The coordinates of this intersection point and consideration of wind direction provide direct access, through the area source map array, to the source number of the particular area source at this intersection point. Since all other source information is stored in arrays indexed on source number, the area source location (coordinates of SW corner), size, effective height, and emission rate are readily available.

Knowledge of the location and size of the area source permits the calculation of the intersection point of the upwind ray from the receptor with the area source boundary on the other side of the source (See Equations A6 through A9 in Appendix) and subsequently the calculation of distance (d_2) from the receptor to this point (Figure 2). These two distances, d_1 and d_2, are then used to obtain linearly interpolated values of V from the tables, $V(d_2)$ and $V(d_1)$. The concentration from this source (assume this is source number i) is then given by:

$$\chi_{Ai} = (q_{Ai}/u)[V(d_2) - V(d_1)] \quad (2)$$

where χ_{Ai} is the concentration at the receptor from the ith area source, q_{Ai} is the area source emission rate from the ith area source, and u is the mean wind speed. $V(d_1)$ is subtracted since it represents the area source contribution not present. If, however, the emission rate is zero or the source number stored in the area source map array is zero, the source does not contribute to the concentration, but the intersection with the boundary and the distance to this intersection is determined as before.

After estimating the contribution of this area source to the receptor, the coordinates at the boundary furthest from the receptor are used to determine the next adjacent source entered by the upwind ray. The procedures are then repeated for this source and all other sources until the boundary of the area source region is reached by working upwind along the upwind ray.

In the case where the receptor is initially within the area source region, the coordinates of the receptor are used to determine within which area source the receptor lies. If the source number is zero, indicating no source area, the intersection point of the upwind ray and the upwind boundary of a unit square is determined and computation proceeds as above. If the receptor is within a numbered source area, the intersection point of the upwind ray and the upwind area source boundary, see Figure 2, as well as the distance, d_3, to this point are determined. Then by interpolation in the V table corresponding to the appropriate area source height, the contribution to the concentration is computed as follows:

$$\chi_{Ai} = (q_{Ai}/u)V(d_3) \quad (3)$$

The next area source upwind is determined and computations proceed for the other upwind sources as above. The advantage of specifying large areas of no emission, rather than leave them numbered as zero in the area source map array, is that the intersection of the upwind ray and the far boundary can be determined directly rather than stepping across a number of unit squares.

After the influence of area sources upon all receptors is calculated for a simulated hour the contribution from point sources is determined. Concentrations from point sources are also calculated receptor by receptor; and for each receptor, calculations are made source by source. The upwind distance, x, of the point source from the receptor is determined for this hour from the coordinates of the point source, the coordinates of the receptor, and the wind direction (See Eq. A1 in the Appendix). If this distance is negative, the source does not contribute to the receptor and the next source is examined. However, if the upwind distance is positive, the crosswind distance, y, and the ratio y/σ_y are determined next. If y/σ_y is greater than 10, the factor g_1 (See Appendix) is always so small that the contribution from this point source to the receptor is negligible. But with y/σ_y less than 10 an additional test must be made to see if the concentration is significant. If the factor g_1 multiplied by the point source emission rate is less than some specified threshold concentration, no further calculations are made for this source.

In most cases the concentration is above the threshold, and plume rise must be calculated for the source being considered provided that it was not calculated previously for estimates at another receptor for this simulated hour. A table of final plume heights and distance to the final rise is filled in as plume rise calculations are required, thus final plume rise is calculated only once for each source for each hour's simulation. If the upwind distance of the source from the receptor, x, is less than the distance to final plume rise, the gradual rise of the plume from stack top to final rise is considered, and the plume height at this nearer distance is used for estimates for this receptor. After the appropriate plume rise is obtained, the concentration at the receptor from this point source is calculated using the equation appropriate for stability class and mixing height as discussed in the Appendix. Concentrations from other point sources are similarly determined. Similar procedures are repeated then for each of the other receptors.

The total concentration at a receptor is the sum of the concentrations from area sources and from point sources. If any background concentration exists that is caused by sources outside the source region, it must be added to the concentration estimates from RAM.

Options

Three options are available regarding use of receptor locations in RAM. The first option allows coordinates of specific receptors to be entered as input.

Use of the second receptor option allows the user to specify how many significant point and how many significant area sources he wants to consider. The model then calculates the location of the maximum concentration from each significant point source using a plume rise calculation, the resultant wind direction, and the most frequently occurring (modal) stability class during the period modeled (24 hr or less). (It is not desirable to use this option if there are significant shifts of the wind during the period modeled, because the resultant direction will not represent the mean transport.) A receptor is located at the estimated point of maximum from each significant source, and another in the same direction but twice as far away. A receptor at this second distance may also have high concentrations for cases of overlapping plumes from several sources. Using this second receptor option there are two receptors established for each significant point source.

for x less than 100 meters, and as large as 1 km for x greater than 15 km. The values of V are also stored for varying intervals of d (ranging from 10 m to 1 km), so that linear interpolation between stored values will result in an accurate estimate of V. For each effective area source height, up to a maximum of three, a V table is generated and stored at the beginning of each simulated hour.

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$$\chi_{Ai} = (q_{Ai}/u)V(d_3) \qquad (3)$$

The next area source upwind is determined and computations proceed for the other upwind sources as above. The advantage of specifying large areas of no emission, rather than leave them numbered as zero in the area source map array, is that the intersection of the upwind ray and the far boundary can be determined directly rather than stepping across a number of unit squares.

After the influence of area sources upon all receptors is calculated for a simulated hour the contribution from point sources is determined. Concentrations from point sources are also calculated receptor by receptor; and for each receptor, calculations are made source by source. The upwind distance, x, of the point source from the receptor is determined for this hour from the coordinates of the point source, the coordinates of the receptor, and the wind direction (See Eq. A1 in the Appendix). If this distance is negative, the source does not contribute to the receptor and the next source is examined. However, if the upwind distance is positive, the crosswind distance, y, and the ratio y/σ_y are determined next. If y/σ_y is greater than 10, the factor g_1 (See Appendix) is always so small that the contribution from this point source to the receptor is negligible. But with y/σ_y less than 10 an additional test must be made to see if the concentration is significant. If the factor g_1 multiplied by the point source emission rate is less than some specified threshold concentration, no further calculations are made for this source.

In most cases the concentration is above the threshold, and plume rise must be calculated for the source being considered provided that it was not calculated previously for estimates at another receptor for this simulated hour. A table of final plume heights and distance to the final rise is filled in as plume rise calculations are required, thus final plume rise is calculated only once for each source for each hour's simulation. If the upwind distance of the source from the receptor, x, is less than the distance to final plume rise, the gradual rise of the plume from stack top to final rise is considered, and the plume height at this nearer distance is used for estimates for this receptor. After the appropriate plume rise is obtained, the concentration at the receptor from this point source is calculated using the equation appropriate for stability class and mixing height as discussed in the Appendix. Concentrations from other point sources are similarly determined. Similar procedures are repeated then for each of the other receptors.

The total concentration at a receptor is the sum of the concentrations from area sources and from point sources. If any background concentration exists that is caused by sources outside the source region, it must be added to the concentration estimates from RAM.

Options

Three options are available regarding use of receptor locations in RAM. The first option allows coordinates of specific receptors to be entered as input.

Use of the second receptor option allows the user to specify how many significant point and how many significant area sources he wants to consider. The model then calculates the location of the maximum concentration from each significant point source using a plume rise calculation, the resultant wind direction, and the most frequently occurring (modal) stability class during the period modeled (24 hr or less). (It is not desirable to use this option if there are significant shifts of the wind during the period modeled, because the resultant direction will not represent the mean transport.) A receptor is located at the estimated point of maximum from each significant source, and another in the same direction but twice as far away. A receptor at this second distance may also have high concentrations for cases of overlapping plumes from several sources. Using this second receptor option there are two receptors established for each significant point source.

in the Appendix. The dispersion parameter values, σ_y and σ_z are determined as a function of the upwind distance, x, and stability class (See p 374 of Pasquill[4]). The three equations used to estimate concentrations under various conditions of stability and mixing height (Equations A3, A4, and A5) are discussed in the Appendix. These equations are for a receptor height, z, above ground and simplify considerably when the receptor height is assumed to be at ground level, $z = 0$. (Those simplifications are incorporated into RAM.)

The total concentration at a receptor arising from the two-dimensional area-source distribution is calculated using the narrow plume simplification of Gifford and Hanna.[5] This simplification is assumed because, on an urban scale, the plume from a point source release is normally quite narrow in comparison with the characteristic length scale for appreciable changes of the magnitude of the area-source emission rate itself. Under these circumstances the two-dimensional integral that expresses the total area-source contribution to concentration can be replaced approximately by a one-dimensional integral that only involves knowledge of the distribution of the area-source emissions along the line in the direction of the upwind azimuth from the receptor location, and the meteorologically-dependent function that specifies the crosswind-integrated concentration in the Gaussian plume from a point source. Further evidence for the validity of this approximation for treating area-source concentrations has been provided by some numerical tests of Thayer and Koch.[6]

In the use of this area source technique by Gifford and Hanna,[5] area source emissions were assumed at ground level allowing integration upwind to be accomplished analytically. However, in our application of this technique within RAM, the area sources are considered to have an effective height, thus requiring the integration to be accomplished numerically. The equations used to estimate concentrations from area sources (Eq. A10 through A13) are given in the Appendix. The total concentration from all area sources is determined by performing the integration in the upwind direction until the farthest boundary of the source region is reached.

Concentrations at a receptor for periods longer than 1 hr are determined by averaging the hourly concentrations over the period of interest.

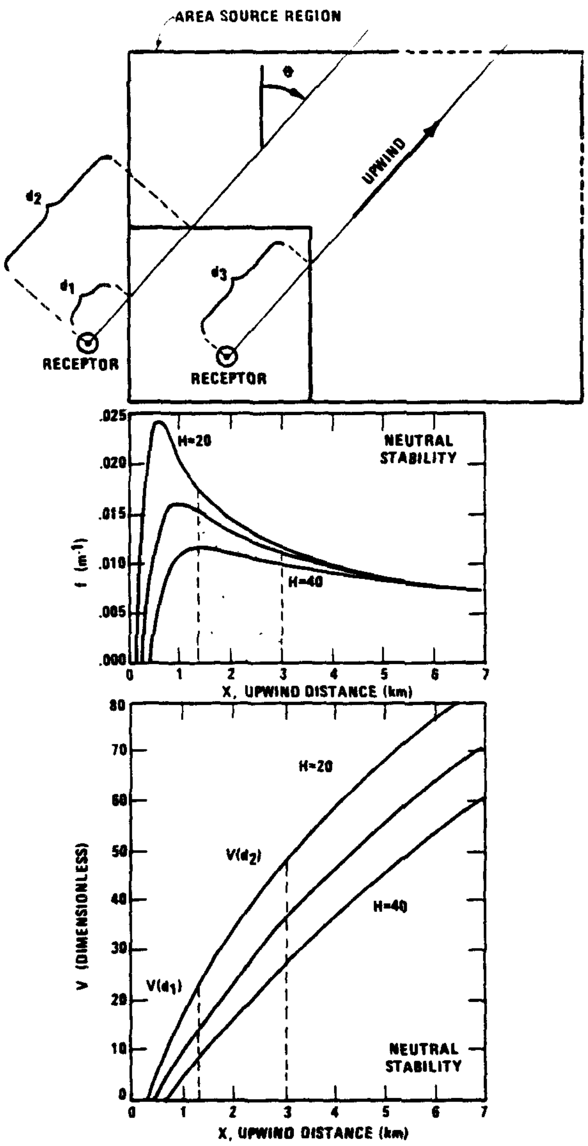

Figure 2. Features of area source estimates.

How Computations Are Made

Initially, a preprocessor program is used to store the emission inventory in a convenient form and perform any necessary conversions. A most important function of the preprocessor is to arrange the area sources in such a way as to minimize computation time for area source concentrations. Each area source number (area sources are numbered sequentially as the sources are input) is stored in a two dimensional array which essentially forms a map of the relative locations of all the area sources. Each element in the array corresponds to an area the size of a unit square (previously defined). Therefore a unit source will have its source number stored into one element of the array, whereas an area source that is 4 units by 4 units will have its source number stored into 16 elements of the array (4 × 4). Obviously area sources must be mutually exclusive; they must not overlap. Array elements corresponding to areas of the source region not covered by area sources will have a zero stored in the array. As will be explained later, it is to the advantage of the user to define areas 2 × 2 units or larger with no emissions as specific source areas with zero emissions (source 6, Figure 1). An example of a simplified source region and the resulting array are shown in Figure 1.

Concentration estimates are made hour-by-hour for up to 24 hr. This algorithm is not designed to determine average concentrations over periods longer than 24 hr. First, concentrations resulting from area sources are calculated. In an effort to reduce the total amount of computer time, tables (arrays) which contain *relative concentrations, V,* normalized for emission rate and wind speed, are calculated only once for each simulated hour using the appropriate stability and mixing height, and thereby eliminating all repetitive calculations. The function V is calculated from:

$$V(d) = \int_0^d f\,dx \qquad (1)$$

and is the non-dimensional concentration resulting from an area source of given effective height extending upwind from a receptor to the distance, d. The function f, whose form depends on stability, and mixing height, is defined in the Appendix (Eq. A11, A12, and A13). The stored tables contain values of this integral obtained by numerical integration for a number of values of d. Both f and V for 3 area source heights are shown in *Figure 2.* Because $V(d)$ changes rapidly for small values of d, the numerical integration using the trapezoidal rule is done using varying size intervals, as small as 1 mete

The second receptor option also determines the location of a single receptor downwind of each significant area source. Since the effective height of area sources are generally lower than point sources, the maximum concentration from the area source is calculated quite near the boundary of the source.

The location of the maximum concentrations from specific point and area sources will, of course, not necessarily be a location where the contribution from all sources will result in a maximum. Since the location of the maxima are highly dependent upon the dispersion parameter values, σ_y and σ_z, any modification of the algorithm that changes the way in which these dispersion parameters are calculated will also require extensive modifications to the subroutines, which determine the maximum distances from point and area sources, if the second receptor option is to be used.

The third receptor option allows for good area coverage of a specified portion of the region. The boundaries of the region to be covered and the spacing between receptors, w, are specified by the user. In order to cover the maximum area with the fewest number of stations, a hexagonal or 'honeycomb' grid is used. Receptor locations are at equal distances from nearby receptors so that if lines are drawn to all nearby receptors, six equilateral triangles will result. Also in order to keep the total number of receptors to a minimum, any potential receptor locations generated by the third option are deleted if they are within one-half w of any other existing receptor.

Several other options available are mainly used to delete special output when not required. These options are not as significant as the receptor options and will not be discussed here.

Summary

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Estimation of concentrations from point sources is straightforward. Briggs' plume rise equations are used. Upwind and crosswind distances of each source from each receptor are determined and concentration is estimated from various Gaussian equations.

Innovative techniques are used in keeping the number of receptors to a minimum and in the treatment of the area emission inventory. Except for the area source map array used for coordinating area source number with location, area source information is stored and used directly for a number of possible source sizes. A narrow plume simplification with consideration of source height of each area is used. The emission rates of the area sources in the source region along the upwind azimuth are considered representative of the area emission rates affecting the receptor from various distances upwind (narrow plume hypothesis). Determination, at the beginning of each simulated hour, of the effect of area sources extending to different distances upwind are stored in tabular form with a different table for each effective area source height (up to 3 heights allowed). Linear interpolation of these tabular values for each source, and receptor by receptor, to obtain concentrations from area sources saves considerable computer time.

The various receptor options in the model allow for versatility in the use of RAM. Coordinates corresponding to fixed locations, such as air quality sampling locations may be used. In attempting to estimate maximum concentrations for particular short-term periods, the option to select locations downwind of particularly significant sources can be used. To insure good area coverage, an option is available to select additional receptors equally spaced from each other. These equally spaced receptors cover a particular defined region and are added only if other receptors have not been located in the vicinity of each proposed receptor location.

A user's guide for RAM is under preparation. One version of this algorithm has been applied to a 3-month urban data base related to sulfur dioxide. In order to assess the validity of the model, comparisons of these estimates with measurements are being accomplished by a group under Dr. Patrick Hamill at Clark College in Atlanta. It is anticipated that the algorithm will soon be made available to users as part of EPA's User's Network for Applied Modeling of Air Pollution (UNAMAP).

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Appendix

Dispersion and Analytic Geometry Equations Used in RAM

Expressions

These expressions are used in the discussions that follow:

$$g_1 = \exp(-0.5y^2/\sigma_y^2)$$

$$g_2 = \exp[-0.5(z-H)^2/\sigma_z^2] + \exp[-0.5(z+H)^2/\sigma_z^2]$$

$$g_3 = \sum_{N=-\infty}^{\infty} \{\exp[-0.5(z-H+2NL)^2/\sigma_z^2] + \exp[-0.5(z+H+2NL)^2/\sigma_z^2]\}$$

(This infinite series converges rapidly and evaluation with N varying from −4 to +4 is usually sufficient.)

where

- H = effective height of emission, meters
- L = mixing height, the top of the unstable layer, meters
- y = crosswind distance, meters
- z = receptor height above ground, meters
- σ_y = standard deviation of plume concentration distribution in the horizontal, meters
- σ_z = standard deviation of plume concentration distribution in the vertical, meters

Point Source Computations

The upwind distance, x, and the crosswind distance, y, of a point source from a receptor are given by:

$$x = (S_p - S_r)\cos\theta + (R_p - R_r)\sin\theta \tag{A1}$$

$$y = (S_p - S_r)\sin\theta - (R_p - R_r)\cos\theta \tag{A2}$$

where R_p, S_p are the coordinates of the point source; R_r, S_r are the coordinates of the receptor, and θ is the wind direction (the direction from which the wind blows). The units of x and y will be the same as those of the coordinate system R, S. Frequently a conversion is required in order to express x, and y in meters or kilometers.

The contribution to the concentration, χ_p, from a single point source to a receptor is given by one of the three following equations where χ_p is in g m,$^{-3}$, Q is point source emission rate in g sec^{-1}, u is wind speed in m sec^{-1}, and σ_y and σ_z are evaluated for the upwind distance x, and the stability class.

For stable conditions or unlimited mixing:

$$\chi_p = Qg_1g_2/(2\pi\sigma_y\sigma_z u) \tag{A3}$$

In unstable or neutral conditions and if σ_z is greater than 1.6 times the mixing height, L, the distribution below the mixing height is uniform with height provided that both the effective height, H, and the receptor height, z, are below the mixing height:

$$\chi_p = Qg_1/[\sigma_y Lu(2\pi)^{1/2}] \tag{A4}$$

(If H or z is above the mixing height, $\chi_p = 0$.)

In all other unstable or neutral conditions, that is, if σ_z is less than 1.6 times the mixing height:

$$\chi_p = Qg_1g_3/(2\pi\sigma_y\sigma_z u) \tag{A5}$$

Area Source Computations

Some analytic geometry relationships are used in estimating concentrations from area sources.

The distance, d_1, along an upwind ray in the direction θ from a receptor R_r, S_r to a north-south boundary given by $R = R_b$ is;

$$d_1 = (R_b - R_r)/\sin\theta \tag{A6}$$

The east coordinate of the locus of the boundary and the upwind ray is, of course, R_b. The north coordinate of this intersection is:

$$S_L = S_r + d_1\cos\theta \tag{A7}$$

The distance, d_2, along an upwind ray in the direction θ from a receptor R_r, S_r to an east-west boundary given by $S = S_b$ is:

$$d_2 = (S_b - S_r)/\cos\theta \tag{A8}$$

The north coordinate of the locus of the boundary and the upwind ray is, S_b. The east coordinate of this intersection is:

$$R_L = R_r + d_2\sin\theta \tag{A9}$$

(Depending upon the units of the coordinate system R, S, the results of these equations may have to be multiplied by a factor to convert to meters).

The contribution of the concentration, χ_A, from a uniform area source directly upwind of a receptor is:

$$\chi_A = (q_A/u)\int_{x_1}^{x_2} f\,dx \tag{A10}$$

where χ_A is in g m^{-3}, q_A is area source emission rate in g sec^{-1} m^{-2}, u is wind speed in m sec^{-1}, x_1 is the distance in meters from the receptor to the locus of the upwind ray (extending from the receptor) and the closest boundary of the area source, x_2 is the distance in meters from the receptor to the locus of the upwind ray (extending from the receptor) and the distant boundary of the area source, and f is given by one of the three equations below. The integral in the preceeding equation is evaluated numerically.

For stable conditions or unlimited mixing:

$$f = g_2/[\sigma_z(2\pi)^{1/2}] \tag{A11}$$

In unstable or neutral conditions and if σ_z is greater than 1.6 times the mixing height, L, the distribution below the mixing height is uniform with height provided that both the effective height, H, and the receptor height, z, are below the mixing height:

$$f = 1/L \tag{A12}$$

(If H or z is above the mixing height, $f = 0$.)

In all other unstable or neutral conditions, that is, if σ_z is less than 1.6 times the mixing height:

$$F = g_3/[\sigma_z(2\pi)^{1/2}] \tag{A13}$$

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