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ADDENDUM TO THE USER'S GUIDE FOR MPTER

by

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ABSTRACT

This addendum applies to the "User's Guide for MPTER -- A Multiple Point Gaussain Dispersion Algorithm with Optional Terrain Adjustment" of Pierce and Turner, 1980. While the cited document describes the features of the MPTER model, its technical basis, and applications, this addendum deals exclusively with algorithm modifications to accommodate new knowledge and technique as well as address recommendations of the "Guideline on Air Quality Models." The Guideline lists MPTER as a preferred model for calculating concentrations due to point sources at averaging times from one hour to one year in rural or urban areas where the terrain is flat or gently rolling and pollutant transport distances are less than 50 kilometers.

MPTER is a Gaussian steady-state model applicable to relatively nonreactive pollutants emitted from one or more point sources which impact receptors in level or rolling terrain. The model contains stability-dependent terrain-adjustment factors to simulate the impact on nearby terrain provided the point of impact is no higher than the elevation of the lowest stack top. Calculations use a meteorological data set with hourly wind direction, wind speed, temperature, stability class, and mixing height. Meteorological conditions are assumed to remain constant throughout each simulation hour; in particular, the input wind vector is assumed to represent flow field throughout the modeling region. Source input parameters include emission rate, stack height, stack exit diameter, temperature of the effluent, and exit velocity.

The original version of the model offered options for stack-tip downwash, gradual plume rise, and buoyancy-induced dispersion. Added to this release (UNAMAP Version 6) are options that allow selection of either rural or urban dispersion parameters and wind-profile exponents. To address model over-prediction when wind speeds are low, an algorithm for the treatment of calms has been added. Also new in this release is a default option to set parameters for regulatory applications as suggested by the Guideline. These are: final plume rise, rather than gradual rise, is used and buoyancy-induced dispersion and momentum plume rise are considered, as are calm conditions.

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TABLES

ACKNOWLEDGEMENTS

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ADDENDUM TO THE USER'S GUIDE FOR MPTER

MPTER (Multiple Point source model with TERrain adjustment) was developed by the Environmental Protection Agency (EPA) in 1979 to estimate air quality concentrations of relatively non-reactive pollutants from multiple sources with adjustments made for slight terrain differences (Pierce and Turner, 1980). The model was first released as part of the User's Network for Applied Modeling of Air Pollution (UNAMAP) Version 4, and re-released with minor modifications in UNAMAP Version 5. This addendum provides a complete description of the MPTER revisions and outlines the modifications required for updating the user's guide and the earlier versions of the FORTRAN source code to result in the code included in UNAMAP (Version 6).

SUMMARY OF MODIFICATIONS

Important features added to the MPTER model are as follows:

- o Urban and rural modes, for wind-profile exponents and dispersion parameters,
- o Treatment of calm conditions according to methods developed by EPA (1984), and a
- o Default option, primarily for regulatory application.

These features were designed to satisfy the requirements outlined in "Guideline on Air Quality Models (Revised)" (EPA, 1986). The default option feature is designed as a convenience for the user to avoid inadvertent errors in setting the appropriate options for regulatory applications. The reader is cautioned to refer to the current regulatory guidance contained in EPA's "Guideline on Air Quality Models" and to confer with the appropriate regional meteorologist when this model is being used to satisfy regulatory requirements. With the addition of the above features, the model is acceptable for regulatory applications and is considered a guideline model by the EPA. The revisions are discussed in greater detail next; user's guide and computer code modifications follow the revisions.

The numerical values in the original test case output remain unchanged.

Urban and Rural Modes

Separate urban and rural default wind-profile exponents were added to MPTER and are presented in Table 1. These exponents are used by the model when the user exercises the default option. 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).

TABLE 1. DEFAULT URBAN AND RURAL WIND-PROFILE EXPONENTS

Mode	Stability class					
	A	B	C	D	E	F
Urban	0.15	0.15	0.20	0.25	0.30	0.30
Rural	0.07	0.07	0.10	0.15	0.35	0.55

An urban dispersion algorithm has been added to the rural scheme in the original MPTER. The urban dispersion parameter values are those recommended by Briggs and included in Figure 7 and Table 8 of Gifford (1976).

The urban or rural setting is indicated by the user via input variable MUOR on card 4.

Treatment of Calm Conditions

When the default option is exercised, calm conditions are handled according to methods developed by the EPA (1984) which are summarized here. A calm hour is indicated by an hour with a wind speed of 1.0 m/sec and a wind direction equal to that of the previous hour. When a calm is detected in the meteorological data, the concentrations at all receptors are set to zero, and the number of hours being averaged is reduced by one, except that the divisor used in calculating the average is never less than 75 per cent of the averaging time. For any simulation, this results in the following:

- 3-hour averages are determined by dividing the sum of the hourly contributions by 3;
- 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, regardless of length, are calculated by dividing the sum of all the hourly contributions by the number of non-calm hours during the period of record. This is the only exception to the 75 per cent rule.

This calms procedure is not available in MPTER outside of the default option. The user can employ this procedure, however, through the use of the CALMPRO postprocessor program (EPA, 1984). CALMPRO is available as part of UNAMAP Version 6.

Default Option

An option has been added to the model to facilitate compliance with regulatory requirements. Exercising the default option (i.e., IOPT (25) = 1) overrides other user-input selections and results in the following:

- o Final plume rise is used (gradual or transitional plume rise is not exercised for plume height, but is used to calculate the magnitude of the buoyancy induced dispersion),
- o Buoyancy induced dispersion is exercised,
- o Terrain adjustment factors are set to zero for all stabilities,
- o Stack tip downwash (Briggs, 1974) is considered,
- o Default urban or rural wind profile exponents are used (See Table 1), and
- o Calms are treated according to methods developed by the EPA (1984) as noted previously.
- o Decay half-life is set to 4.0 hours for SO_2 for the urban option, and infinite half-life (no decay) for all other cases.

Other Features

There are several additional regulatory features that are inherent in the UNAMAP Version 5 and later versions of MPTER. These are summarized below.

(1) Momentum plume rise is always considered.

(2) Terrain adjustments are used for receptors below stack base elevation in the same manner as elevated receptors. The difference, defined as the receptor ground level elevation minus source ground level elevation, is computed and subtracted from the effective plume height. This has the effect of raising the plume at receptors below the source ground level elevation and lowering the plume at receptors above the source ground level elevation.

(3) Mixing height is compared with the final plume height without regard to plume height changes due to terrain.

(4) Exponential decay (half-life) is available if required by the simulation.

USER'S GUIDE MODIFICATIONS

The modifications to the User's Guide for MPTER by T. E. Pierce and D. B. Turner (1980) (EPA-600/8-80-016) are summarized next. All the replacement pages for the User's Guide are provided in Appendix A.

PAGES 1 and 2 -- The Executive summary is modified to reflect changes made to the MPTER source code. The urban dispersion parameter scheme and default option are included in the discussion.

PAGE 6 -- An urban/rural switch is added to the control requirements.

PAGE 7 -- The urban/rural modes and default option are added to the discussion in the first paragraph.

PAGE 9 -- The urban/rural modes and the urban dispersion parameter scheme are added to the discussion in the fourth paragraph.

PAGE 12 -- "P-G" as a modifier for "dispersion parameters" is no longer adequate since the addition of the urban dispersion parameter scheme (Gifford, 1976). "P-G" is deleted from the discussion in the second paragraph.

PAGE 14 -- "P-G" is deleted from the discussion in the second paragraph.

PAGE 17 -- The second paragraph and Table 1 are modified to include mention of the urban wind profile exponents.

PAGE 19 -- The urban dispersion parameter scheme is added to the discussion in the second paragraph.

PAGE 22 -- "P-G" is deleted from the discussion in the last paragraph since it is no longer adequate.

PAGE 26 -- The last paragraph is modified to reflect changes in the MPTER code; the executable program now requires 56 K of core memory. Also, table 2 is deleted.

PAGE 31 -- Section 6.2.1.9 is modified to reflect the code revisions (i.e., urban/rural modes and default option). Section 6.2.1.10 is added to the text and discusses the urban/rural swith, MUOR. It is now an input data requirement.

PAGE 34 -- The discussion in Section 6.2.3 is modified to reflect that there are now five technical options.

PAGE 36 -- Section 6.2.3.1.5 is added to the text and discusses the default option.

PAGE 50 -- Variable MUOR (i.e., urban/rural swith) is added to Table 6.

PAGE 51 -- Variable IOPT (25) (i.e., the default option) is added to Table 7.

PAGE 64 -- Variables NDAY and IHR are added to Table 23.

PAGE 145 -- "Guideline on Air Quality Models (Revised)" 1986 has been added to the list of references.

PAGES 150 through 154 -- The description of the plume rise algorithm is modified to reflect changes in the code.

REFERENCES

Briggs, G. A. 1974. Diffusion Estimation for Small Emissions. In: ERL, ARL USAEC Report ATDL-106. U. S. Atomic Energy Commission, Oak Ridge, TN. 59 pp.

Gifford, F. A. 1976. Turbulent diffusion-typing schemes: a review. Nucl. Saf. 17: 68-86.

Irwin, J. S. 1979. A theoretical variation of the wind profile law exponent as a function of surface roughness and stability. Atmos. Environ. 13: 191- 194.

Pierce, T. E. and Turner, D. B. 1980. User's Guide for MPTER A Multiple Point Gaussian Dispersion Algorithm with Optional Terrain Adjustment. EPA-600/8-80-016, U. S. Environmental Protection Agency, Research Triangle Park, NC 27711. 247 pp.

U. S. Environmental Protection Agency. 1984: Calms Processor (CALMPRO) User's Guide. EPA-901/9-84-001. U. S. Environmental Protection Agency, Region I, Boston, MA 02203.

U. S. Environmental Protection Agency. 1986: Guideline on Air Quality Models (Revised) EPA 450/2-78-027R, U. S. Environmental Protection Agency, Research Triangle Park, NC 27711.

APPENDIX A

REPLACEMENT PAGES FOR USER'S GUIDE

Portions of the original document should be replaced with the pages that follow. Where more than one page replaces a single one, the additions have the same page number plus a letter. With the revised pages inserted, the user's guide is a complete and technically accurate description of the modified MPTER model as released in UNAMAP Version 6.

All revised portions of the user's guide appear in light italic print.

EXECUTIVE SUMMARY

The MPTER computer code (Multiple Point source model with TERrain adjustments) provides a method to estimate air pollutant concentrations from multiple sources in rural *or urban* environments, and can make optional adjustments for slight terrain variations.

The algorithm is based upon Gaussian modeling assumptions and incorporates the Pasquill-Gifford (P-G) dispersion parameter values *for rural settings and the dispersion parameter scheme recommended by Briggs for urban situations, see Figure 7 and Table 8 of Gifford (1976)*. However, several technical options and various parameter values may also be entered as input. MPTER may be considered a research tool for exploratory use of various assumptions and parameter values, as well as a standardized model for more routine impact analyses.

The version of MPTER (85165) released with UNAMAP 6 includes a default option which allows the user to set the model for regulatory applications. When the option is employed, the model satisfies the requirements outlined in the "Guideline on Air Quality Models (Revised)" (EPA, 1986) for most applications. The default option is provided as a convenience for the user, to help avoid inadvertent errors in setting the appropriate options. The user is cautioned to refer to the current regulatory modeling guidance in EPA's "Guideline on Air Quality Models (Revised)" and to confer with the appropriate regional meteorologist.

MPTER can estimate the resulting concentrations at a maximum of 180 receptors from a maximum of 250 point sources. Gaussian assumptions and techniques are used to perform the estimates hourly, considering each hour as a steady state period. Required input information consists of point source and hourly meteorological data. Periods from one hour to one year may be simulated, with all output controlled by the user through the selection of options.

Features of the algorithm include:

- Averaging periods of longer than 1 hour, if selected by user.
- Hourly meteorological data that may be read off punched cards for each hour, or from tape (or disk) containing a year's data (same data as used for RAM or CRSTER).
- An optional terrain adjustment as a function of stability class.
- Inclusion or omission of stack downwash.
- Inclusion of gradual plume rise, or final rise only.
- Inclusion or omission of buoyancy-induced dispersion of pollutant at the source using the method of Pasquill.
- Input of anemometer height.
- Input of wind profile power law exponents as functions of stability.
- Concentration contributions that are available per hour and/or for the selected averaging period at each receptor from up to 25 sources.
- Concentrations available hourly and/or for the selected averaging period at each receptor.
- Optional output of the following information: average concentration over length of record, plus highest five concentrations for each receptor for four averaging times (1-, 3-, 8-, and 24-hour); and an additional averaging time selected by the user.
- Optional output files for further processing of concentrations that are available per hour and for each averaging period.
- *Option for setting default values for regulatory applications.*
- *Choice of urban or rural settings.*

CONTROL DATA

The following control information is needed for a run. Some additional information, to be discussed later, may be required depending upon options selected. Control information needed includes:

- Headings (for output)
- Year
- Starting Julian Day
- Starting Hour
- Number of averaging periods to be run
- Number of hours in each averaging period
- Code for selecting the pollutant for this run (sulfur dioxide or particulate)
- *Mode of simulation (urban or rural)*
- Number of significant sources (used for contribution to concentration from individual sources)
- Additional averaging time for high-five table (explained later)
- Conversion for user units (east and north coordinates)
- Conversion for user height units
- Half-life of pollutant used in this run
- Values to select each option
- Anemometer height
- Wind profile power law exponents (one for each stability)
- Terrain adjustments, if used (one for each stability)

Further discussion of input data is given in Chapter 7.

SECTION 3

RECOMMENDATIONS

USES

As stated in the introduction, MPTER is a multiple point source dispersion model for *urban or rural* situations. Because optional adjustments can be made for slight terrain variations, careful study of model inputs is required to ensure the user's problem is addressed, and to provide proper output for the problem at hand. *The model may also be applied to impact analyses in response to regulatory requirements by selecting the default option which sets certain features, overriding other user-input selections as required.*

Its versatility allows MPTER to function as both a tool for research and for more routine impact analysis. In research, numerous parameter variations can be explored for comparisons with measured air quality data, and various sensitivities can be determined.

A frequent use of the model will be to assess air pollutant impact to compare with National Ambient Air Quality Standards. Since the short-term standards are not to be exceeded more than once a year, extremes of the frequency distribution must be determined. Brute force approaches may be required to estimate these extremes through calculation of a full year's data, as is done by CRSTER. Receptor locations are input by the user, except when the model's option is used for generating a polar coordinate set of receptors centered in a specific location.

Determining appropriate receptor locations where maximum impact might be expected is a difficult user problem. Little guidance is available for selecting optimum receptor positions, but the following three steps may prove helpful: 1) use screening methods to locate distances to maxima; 2) at these distances, use polar coordinate locations about each source of significance, analyzing a year's or more meteorological data, and then 3) make estimates

ASSUMPTIONS

The foundation of MPTER, including much of its computer code, is the point source portion of RAMR.

Gaussian Modeling

The following assumptions are made: 1) continuous plumes are diluted upon release by the wind speed at stack top; 2) dispersion from continuous plumes results in time averaged Gaussian distributions in both the horizontal and vertical directions through the dispersing plume; 3) concentration estimates may be made for each hourly period using the mean meteorological conditions appropriate for each hour; 4) the total concentration at a receptor is the sum of the concentrations estimated at the receptor from each source, i.e., concentrations are additive; and 5) concentrations at a receptor for periods longer than an hour can be determined by averaging the hourly concentrations over the period.

The upwind distance x and the crosswind distance y of the source from the receptor is determined as a function of the mean hourly wind direction. Dispersion parameter values are determined as functions of stability class and upwind distance. Equations to estimate concentration are selected dependent upon stability class, and, for neutral or unstable conditions, upon the relation of dispersion parameter value to mixing height (see Appendix A). The location of the receptor relative to the plume position is a dominant factor in the magnitude of the concentration.

Dispersion Parameter Values

The dispersion parameter values used for a particular run of MPTER depend upon the mode of simulation (either urban or rural). For the rural situations, a roughness of approximately 0.1 meters is assumed and the Pasquill-Gifford (P-G) parameters are employed. The urban dispersion parameter values are those recommended by Briggs and included in Figure 7 and Table 8 of Gifford (1976).

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

Option 2: Stack Downwash

A second optional feature of MPTER is considerations of stack tip downwash using the methods of Briggs. In such an analysis, a height increment is deducted from the physical stack height before determining momentum or buoyancy rise. This option primarily affects computations from stacks having small ratios of exit velocity to wind speed.

Option 3: Gradual Rise

Gradual plume rise has been made an optional feature of MPTER, because although the use of the $x^{2/3}$ dependence for rising plumes will determine average plume height with distances quite well, the plume axis is not horizontal during the rising phase. Therefore, dispersion is taking place perpendicular to the bent-over plume axis rather than vertically. The dispersion parameters represent horizontal and vertical dispersion about a horizontal plume, which may not be appropriate for estimating dispersion of a rising bent-over plume. By making computations with and without the gradual plume rise, at least identification is possible of potentially high concentrations during the gradual plume rise phase. When gradual rise is not employed, computations are made using the final effective plume height.

Option 4: Buoyancy-Induced Dispersion

The final optional feature of MPTER is a method suggested by Pasquill (1976) for determining the buoyancy-induced dispersion in both the horizontal and vertical directions. This feature is offered because emitted plumes undergo a certain amount of growth during the plume rise phase, due to the turbulent motions associated with the conditions of plume release and the turbulent entrainment of ambient air. Such dispersion, however, will generally have little effect upon maximum concentrations unless the stack height is small compared to the plume rise.

be either clockwise or counterclockwise. Although surface wind direction may have little effect upon long-term concentrations (such as annual average) from single plants, and may not greatly alter estimates of extreme concentration values from such a source, use of surface wind direction to determine plume transport direction usually causes large errors in hour-to-hour estimates. This potential error is a very important consideration if attempting to compare air quality measurements with the model estimates. The error is also important in considering interactions of several sources where actual wind directions are significant in determining the location of a plume from a source passing over another source.

Since the *dispersion parameters are based upon* P-G stability classes, the fact should be recognized that a change of only one stability class for input will cause large changes (factors of 5 to 10) in concentration at a receptor. Such changes are especially likely if the receptor is closer to the source than the distance to maximum concentration.

Other potential causes of large inaccuracies in concentration at a given point include wind speed errors, wind speed profile power law exponents that differ from actual variations, and nonrepresentative stability classes. However, if the user is searching for maximum impact and is relocating receptors in order to find such maxima, there will be considerably less sensitivity to wind speed differences and power law exponents, but still significant sensitivity to stability class.

Not included in this model are situations where wind speed varies markedly within the hour, whereby the effective plume height will fluctuate, causing increased vertical dispersion of the plume.

Maxima even at the extreme ends of the frequency distribution will tend to have more accuracy than hour-to-hour comparisons. Longer averaging times, such as annual concentrations, will also have less error than short averaging times. Background concentrations from sources not considered in the emission inventory may become more important for the longer averaging times.

where u_z is the input wind speed for this hour, z_a is the anemometer height, and the exponent p is a function of stability. If u_h is determined to be less than 1 m s^{-1}, it is set equal to 1.

Separate urban and rural default wind profile exponents are considered by MPTER and are shown below. These exponents are used by the model when the user exercises the default option. 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).

TABLE 1. DEFAULT WIND PROFILE POWER LAW EXPONENTS FOR THE URBAN AND RURAL MODES.

Stability	*Urban Exponent*	*Rural 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*

As stated in the previous chapter, directional shear with height is not included, which means that the direction of flow is assumed to be the same at all heights over the region. The taller the effective height of a source, the larger the expected error in 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) can overcome the effect of friction and cause backing (turning counterclockwise with height) instead of veering.

In the program RAMMET, which processes National Weather Service hourly observations, the wind directions (reported to the nearest 10°) are altered by a randomly generated number from 0 to 9 used to add -4° to +5° to the wind vector. An extreme overestimate of concentration

In ranking the point sources by the significance of their expected impact, only the rise due to buoyancy is processed, since it is expected to be the dominant plume rise factor. In the computation of the effect of each point source upon receptors for each simulated hour, however, all three of the above mentioned effects -- stack downwash, momentum plume rise, and buoyant plume rise -- can be considered . These computations are discussed in detail in Appendix B. Of note is that since wind speeds are not allowed to be less than 1 m s^{-1}, the stable buoyancy plume rise for calm conditions is not required and is therefore not included in the program code for MPTER.

DISPERSION PARAMETERS

The rural dispersion parameter values in MPTER are the P-G values (Pasquill, 1961; Gifford, 1960), which appear as graphs in Turner (1970) and in Gifford (Figure 2; 1976). The subroutines used to determine these open-countryside parameter values are the same as in the UNAMAP program PTPLU (Pierce et al.,1982). The urban dispersion parameter values are those recommended by Briggs and included in Figure 7 and Table 8 of Gifford (1976).

Except for stable layers aloft that inhibit vertical dispersion, the atmosphere is treated as a single layer vertically, 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, which is given by the mixing height.

GAUSSIAN PLUME EQUATIONS

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 using Equations (A1) and (A2) in Apppendix A, for each source-receptor pair per simulated hour. Both dispersion parameter values σ_y and σ_z are determined as functions of this upwind distance x and stability class.

One of the three equations is used to estimate concentations under various conditions of stability and mixing height. Equation (A3) in Appendix A is used for stable conditions or for unlimited mixing; eddy reflection at the ground is assumed. For unstable or neutral conditions where vertical dispersion is so great that uniform mixing is assured beneath

$$H_A = H \qquad \text{for } F_T = 1$$
$$H_A = H - \Delta E \qquad \text{for } F_T = 0$$
$$H_A = H - 0.7\ \Delta E \qquad \text{for } F_T = 0.3$$
$$H_A = H - 0.1\ \Delta E \qquad \text{for } F_T = 0.9$$

The manner in which the terrain adjustment is simulated is depicted in Figure 1 for three values of the factor.

Of note to the user is that calculation of terrain adjustment is limited to receptors whose ground-level elevation is less than the elevation of the lowest stack top used in the run.

The terrain adjustment incorporated in MPTER is obviously simplistic. For the estimation of plume behavior in the vicinity of a single hill, the stable-plume fluid modeling studies of Hunt et al (1978) have shown the importance of the Froude number, and of the location of the receptor and the plume relative to hill base and top. None of these parameters is considered here, but rather the relation of the receptor and source ground-level elevations. The reader is therefore cautioned against assigning too great a significance to results obtained using the terrain adjustment option.

Option 2: Stack Downwash

A second optional feature of MPTER is consideration of stack tip downwash using the methods of Briggs. In such an analysis, a height increment is deducted from the physical stack height before determining momentum or buoyancy rise. Use of this option primarily affects computations from stacks having small ratios of exit velocity to wind speed.

Option 3: Gradual Rise

Gradual plume rise determination has been made an optional feature of MPTER, because although the use of the $x^{2/3}$ dependence for rising plumes will determine average plume height with distance quite well, the plume axis is not horizontal during the rising phase. Dispersion is thus taking place perpendicular to the bent-over plume axis rather than vertically. The dispersion parameters represent horizontal and vertical dispersion about a horizontal plume, which may not be appropriate

OUTHR - Subroutine which arranges and then prints tables of concentration. Number of tables that is output depends on the option combination specified.

RANK - Subroutine called by MPTER that ranks concentrations for four or five averaging times so that highest five concentrations are printed for each receptor.

ADDITIONAL COMMENTS

Figure 2 is an abbreviated flow diagram of MPTER showing its major loops and the relationships of the subroutines to each other and the main program.

The main program of MPTER primarily exists for input and bookkeeping; most technical calculations are performed by subroutine PTR. PTR calls subroutine RCP, which in turn obtains dispersion parameter values from subroutine PGYZ, then selects and solves the appropriate Gaussian equation. Subroutine RANK orders the highest five concentrations for each averaging time for each receptor. Subroutine OUTHR essentially provides the printed output.

The executable program for MPTER requires 56 K core on EPA's UNIVAC 1110.

6.2.1.8 Pollutant Half-Life -- HAFL

An exponential loss of the considered pollutant with travel time is included in the model. At a travel time equal to the half-life, 50% of the pollutant will remain. Although this view of chemical or physical depletion processes is overly simplistic, it may be useful under certain circumstances. Note that the half-life is entered in seconds. If the user wants no depletion to be considered, entering zero for the half-life will cause skipping of those portions of the code calculating pollutant loss.

6.2.1.9 Values of Variables Related to Increase of Wind with Height--

The anemometer height in meters for the meteorological data used is entered on CARD TYPE 6. Six values for the wind profile power law exponent, one for each stability class, are also entered on CARD TYPE 6. Table 1 in Section 4 provides appropriate values for the urban and rural modes. For computations submitted in response to regulatory requirements, Option 25 should be used. Current regulatory guidance should be consulted (check with the appropriate regional meteorologist). This will automatically utilize the values listed in Table 1.

If Option 1 is employed to make terrain adjustments, six terrain adjustment factor values (one for each stability class) that are read in on CARD TYPE 6 are used in subsequent computations (see 6.2.3.1.1 below). The values must be real numbers between 0 and 1.

6.2.1.10 Urban/Rural Mode Indicator--

The urban or rural setting is indicated via input variable, MUOR. If MUOR = 1, then the urban dispersion parameter values recommended by Briggs and included in Figure 7 and Table 8 of Gifford (1976) are used; if MUOR = 2, then the P-G dispersion values are exercised. When the regulatory option is chosen (IOPT(25) = 1), MUOR also determines the set of wind profile power law exponents used (either urban or rural).

6.2.2 <u>Input Data</u>

Comments on emission, receptor, and meteorological data are made here.

6.2.2.1 Emission Data -- (See CARD TYPE 7)

The alphanumeric name and eight variables of point source information are the same as used in most dispersion models. Only one of the two emission rates will be used in a given run (see 6.2.1.3 above). If only one pollutant is of interest, the other field may be left blank. If Option 6 to enter hourly emission rates (see 6.2.3.2.2 below) is not used, the emission rates should provide the best estimate of the emission for the length of record being run. If maximum or design emissions are used, concentration estimates may be somewhat larger than actual concentrations. However, Irwin and

Users who want to make a run for a significant length of simulated time are thus advised that when employing the terrain adjustment option, they must first make a run for a short period (one hour -- meteorological data are unimportant) to see if double asterisks appear on the receptor list. Then these receptors should be eliminated before making the long-term run.

6.2.2.3 Meteorological Data -- (See CARD TYPE 14)

Meteorological data files prepared by the CRSTER Preprocessor or by the similar program from the RAM system, RAMMET, are acceptable by MPTER. Proper running of these preprocessor programs results in a one-year period of record with one record for each calendar day. Twenty-four values of each of the following parameters are contained in this record: Pasquill-Gifford Stability Class, wind speed (at anemometer height), ambient air temperature, wind flow vector (wind direction ± 180°), and mixing height. The user should be reminded that if using either of these programs to process meteorological data, a complete set of data must be input to either program. Any "holes" in the data set must be filled by the user. In using this data for input to MPTER one record is read for each simulated day. If making a run for a period of record of less than a year and starting after Day 001 (January 1st), MPTER will skip records to arrive at the proper day based upon the variable IDATE(2) on CARD 4 (see 6.2.1.4 above).

If using meteorological data from the preprocessed file, Option 5 will be zero. Also, the four variables on CARD TYPE 8 are to be read in and will be checked against the data on the input file.

Alternatively, when employing Option 5, meteorological data is read from punched cards (see CARD TYPE 14) with one record for each simulated hour in the run. The wind speed on this card again is for the anemometer height. The wind direction is the direction from which the wind blows.

6.2.3 Options

There are *five* technical options, four input options, 11 print options, and five other options either for control or for output to files. To employ a particular option, a 1 is entered as input to the element of the array IOPT with the same number as the option number. Otherwise, a zero is plume rise using the techniques suggested by Pasquill (see Section 4). It should be pointed out that even if Option 3 is employed, resulting in use of only the final plume height for effective height of emission, the gradual plume rise is determined internally to determine the buoyancy-induced plume size. (It would not be the least bit appropriate to use the final plume rise to determine the initial size close to the stack).

6.2.3.1.5 Option 25: Set Defaults (used for regulatory applications)--

The default option (IOPT(25) = 1) automatically sets several input features, overriding other user-input selections as required. Currently the default option sets features required for regulatory applications. Exercising this option results in the following.

- *Final plume rise is used (gradual or transitional plume rise is not considered), that is, IOPT(3) is set to "1".*
- *Buoyancy-induced dispersion is used (i.e., IOPT(4) is set to "1"). For distances less than the distance to final rise, the gradual plume rise is used to determine the buoyancy-induced dispersion regardless of the setting of IOPT(3).*
- *Terrain adjustment factors are set to "0" for all stabilities.*
- *Stack tip downwash (Briggs, 1974) is considered (i.e., IOPT(2) is set to "0").*
- *Default urban or rural wind profile exponents are used depending on the value of MUOR; appropriate mixing heights are set.*
- *Calms are treated according to methods developed by the EPA (1984) as discussed below.*
- *Decay half-life is set to 4.0 hours for SO_2 for the urban option, and infinite half-life (no decay) for all other cases.*

It is possible to operate in either the urban or rural mode when the default option is selected.

Table 7A contains a list of the subsequent settings for other options and the values for specific variables that will result when the default option is selected.

One result of exercising the default option is that calm conditions are handled according to methods developed by the EP: (1984). A calm hour can be identified in the model as an hour with a wind speed of 1.0 m/sec and a wind direction equal to the previous hour. When a calm is detected in the meteorological data, the concentrations at all receptors are set to zero, and the number of hours being averaged is reduced by one, except that the divisor used in calculating the average is never less than 75 percent of the averaging time. For any simulation, this results in the following:

- 3-hour averages are determined by always dividing the sum of the hourly contibutions by 3;
- 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, regardless of length, are calculated by dividing the sum of all the hourly contributions by the number of non-calm hours during the period of record.

Concentration calculations which are affected by calms are flagged in the printed output with the letter C placed next to the concentration value. Note that this treatment of calm cases is always used when the default option is selected, but cannot be used if the default option is not selected.

This calms procedure is not available in MPTER outside of the default option. The user can employ this procedure, however, through the use of the CALMPRO postprocessor program (EPA, 1984)). CALMPRO is available as part of UNAMAP Version 6.

6.2.3.2 Input Options --

For the four following input options, specific action is taken if the value of 1 is entered.

6.2.3.2.1 Option 5: Met. Data on Cards -- If IOPT(5) = 1, met data are entered on cards with one card for each simulated hour (see 6.2.2.3 above). If Option 5 is 0, meteorological data is entered using records on unit 11. The specification of the records on this input file are given in the next section.

When the default option (IOPT (25)=1) is employed, IOPT (5) is set equal to 0, thus restricting the use of this option. This is done to avoid conflict with the calms processing procedure. If on-site or other than RAMMET data are to be used, they must correspond to the format of the RAMMET file and be read into the model on device (11).

6.2.3.2.2 Option 6: Read Hourly Emissions -- If IOPT(6) = 1, hourly emissions for each point source are read from unit 15 in the main program, then are compared with the emissions input on the point source card for scaling the exit velocity (see 6.2.2.1). Subroutine PTR performs these tasks; Section 7 specifies that records on this input file.

6.2.3.2.3 Option 7: Specify Significant Sources -- The number of significant sources, given as NSIGP on Card 4, is ranked when the emissions data are processed according to expected ground-level impact under B stability, with a wind at stack top of 3 m s^{-1}. This option can be employed if the contribution of a source is sought for a subsequent run that is outside this list or too far down it to be included among the significant sources, NSIGP on Card 4 (see 6.2.1.5 above). When IOPT(7) = 1, an additional input card is read (CARD TYPE 9) that indicates how many sources will be specified (NPT), then gives their source numbers (the array MPS) corresponding to the source numbers in the printed output list. Source numbers are assigned according to the order of the source input. For example, consider an application having 30 sources, where a run is deemed useful that shows contributions from 10 sources (NSIGP on CARD 4 will be set to 10). Specifically, the contributions from sources 7 and 22 are desired. The 12 most significant of the 25 sources, in order, are: 3, 8, 23, 11, 2, 15, 4, 27, 1, 5, 28, and 14. Since 7 and 22 are not among these 12, and further are not in the first 10, Option 7 is set equal to 1, and CARD TYPE 9 contains 2 for NPT and the two numbers 7 and 22 for the two entries to MPS. Sources 7 and 22 will occupy the first two columns in the contribution table. The program will fill the other eight positions of the significant source list (to total 10) with the first eight sources of the list of 25, i.e., 3, 8, 23, 11, 2, 15, 4 and 27.

When the default option (IODT(25)=1) is employed, IOPT (7) is set equal to 0, thus restricting the use of this option. This is done to avoid confusion between estimates of zero concentration and hours with missing data since flags are not used other than in the high-5 tables to identify concentrations calculated for periods of calm winds.

6.2.3.2.4 Option 8: Input Radial Distances and Generate Polar Coordinate Receptors -- For the user's convenience in making computations at an array of receptors that are positioned about a specific source or some other point, Option 8 provides for reading an additional input card (CARD TYPE 10) with from one to five non-zero distances in user units. Additionally, the east and north coordinates (also in user units) of a center position are provided. The program generates the east and north coordinates of each receptor in a polar coordinate array, generating 36 receptors for each non-zero distance (one for each 10 degrees of azimuth). A five-value distance array is read from the card with distances entered for the number of distances desired. Zeros are added to fill the array. For example, to produce a receptor array with two distances, two distances and three zeros are entered. This step will generate 72 receptors (36 for each distance). Putting non-zero values for all five distances will generate 180 receptors, which is the maximum number that MPTER can compute. Thus using Option 8 in this manner will not allow the input of any additional receptor cards with positions specified by the user.

Of note to the user is that if both Option 8 and Option 1 for terrain adjustment are used, elevations of the polar coordinate receptors must be read in using CARD TYPE 11. These can best be obtained by drawing 36 radials from the designated center point on a topographical map, and drawing circles for each distance. Then the elevations can be determined from the map by reading elevations outward from the center, starting with the 10-degree azimuth radial. If all five distances are used so that 180 receptors are generated, a card with ENDREC in Columns 1-6 must be read following CARD TYPE 10 (or the last card of CARD TYPE 11 if used).

TABLE 6. MPTER CARD 4 - CONTROL AND CONSTANTS (1 card)

Variable	Description	Units
IDATE(1)	2 digit year (see 6.2.1.4)	-
IDATE(2)	starting Julian day for this run	-
IHSTRT	starting hour for this run	-
NPER	number of averaging periods to be run (see 6.2.1.2)	-
NAVG	number of hours in an averaging period	-
IPOL	pollutant indicator: (see 6.2.1.3) 3 = SO_2 4 = suspended particulates	-
MUOR	*urban/rural mode indicator: (see 6.2.1.10)* *1 = urban* *2 = rural*	-
NSIGP	number of significant point sources, max = 25. (see 6.2.1.5)	-
NAV5	number of hours in the user specified period for which a high-five concentration table is generated. (see 6.2.1.3)	-
CONONE	multiplier constant, user units to km (see 6.2.1.5)	-
CELM	multiplier constant, user height units to m (see 6.2.1.6)	-
HAFL	pollutant half-life (see 6.2.1.7)	sec

All input variables are free format.

TABLE 7. MPTER CARD 5 - OPTIONS (1 card) - integer values: 0 or 1

Variable	Format	Description
		TECHNICAL OPTIONS (see 6.2.3.1)
IOPT(1)	Free	Use Terrain Adjustments
IOPT(2)	Format	No Stack Downwash
IOPT(3)		No Gradual Plume Rise
IOPT(4)		Include Buoyancy-Induced Dispersion
		INPUT OPTIONS (see 6.2.3.2)
IOPT(5)		Met. Data on Cards
IOPT(6)		Read Hourly Emissions
IOPT(7)		Specify Significant Sources
IOPT(8)		Input Radial Distances and Generate Polar Coordinate Receptors
		PRINTED OUTPUT OPTIONS (see 6.2.3.3)
IOPT(9)		Delete Emissions With Height Table
IOPT(10)		Delete Resultant Met. Data Summary for Averaging Period
IOPT(11)		Delete Hourly Contributions
IOPT(12)		Delete Met. Data on Hourly Contributions
IOPT(13)		Delete Final Plume Height and Distance to Final Rise on Hourly Contributions
IOPT(14)		Delete Hourly Summary
IOPT(15)		Delete Met. Data on Hourly Summary
IOPT(16)		Delete Final Plume Height and Distance to Final Rise on Hourly Summary
IOPT(17)		Delete Averaging-Period Contributions
IOPT(18)		Delete Averaging-Period Summary
IOPT(19)		Delete Average Concentrations and High-Five Table
		OTHER CONTROL AND OUTPUT OPTIONS (see 6.2.3.4)
IOPT(20)		Run is Part of a Segmented Run
IOPT(21)		Write Partial Concentrations to Disk or Tape
IOPT(22)		Write Hourly Concentrations to Disk or Tape
IOPT(23)		Write Averaging-Period Concentrations to Disk or Tape
IOPT(24)		Punch Averaging-Period Concentrations on Cards
IOPT(25)		*Set Default Values (used for regulatory applications)*

TABLE 7A DEFAULT OPTION - SUBSEQUENT SETTINGS

Employment of the default option (IODT (25)=1) will cause the input option switches and specified variables to be set to the following:

IOPT (2) = 0
IOPT (3) = 1
IOPT (4) = 1
IOPT (5) = 0
IOPT (7) = 0
IOPT (10) = 1
IOPT (11) = 1
IOPT (12) = 1
IOPT (13) = 1
IOPT (14) = 1
IOPT (15) = 1
IOPT (16) = 1
IOPT (17) = 1
IOPT (18) = 1
IOPT (19) = 0
IOPT (20) = 0
IOPT (21) = 0
IOPT (22) = 0
IOPT (23) = 0
IOPT (24) = 0

HAFL = 14400. (For IPOL = 3, MUOR = 1)
HAFL = 0. (For IPOL ≠ 3 or MUOR ≠ 1)
IHSTRT = 1
NAVG = 24
NSIGP = 0
NAV5 = 0
PL = .15,.15,.20,.25,.30,.30 for MUOR = 1
= .07,.07,.10,.15,.35,.55 for MUOR = 2
CONTER = .0,.0,.0,.0,.0,.0

TABLE 23. MPTER OPTIONAL TEMPORARY FILE - VALUES FOR HIGH-FIVE TABLES (unit 14) (output if option 20 = 1)

Variable	Dimensions	Description	Units
ONLY RECORD			
IDAY (on write)		Number of days processed	-
IDAYS (on read)		Number of days previously processed	-
SUM	180	Cumulation of long-term concentration	g/m^3
NHR		Number of hours processed	-
DAY1A		Starting Julian day of period of record	-
HR1		Starting hour of period of record	-
HMAXA	5,180,5	Concentrations according to rank, receptor, and averaging period	g/m^3
NDAY	5,180,5	Associated Julian day of concentration	-
IHR	5,180,5	Ending hour of concentration	-

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APPENDIX B

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 (*1974*, p. 4). The h' is found from

$$h' = h + 2\{[v_s/u(h)] - 1.5\}d \quad \text{for} \quad v_s < 1.5u(h), \qquad \text{(B1)}$$

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

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 value 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:

$$F = (gv_s d^2 \Delta T)/(4T_s), \qquad \text{(B2)}$$

where $\Delta T = T_s - T$, T_s is stack gas temperature (Kelvin), and T is ambient air temperature (Kelvin).

Unstable or Neutral: Momentum Rise

Regardless of the atmospheric stability, neutral-unstable momentum rise is calculated. The plume height is calculated from Briggs' (1969, p. 59) Eq. 5.2:

$$H = h' + 3dv_s/u(h). \tag{B3}$$

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.

Unstable or Neutral: Buoyancy Rise

For situations where $T_s \geq T$, plume rise due to buoyancy is calculated. The distance to final rise x_f (in kilometers) is determined 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 dominate entrainment. For F less than 55,

$$x_f = 0.049F^{5/8}. \tag{B4}$$

For F equal to or greater than 55,

$$x_f = 0.119F^{2/5}. \tag{B5}$$

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,

$$H = h' + 21.425F^{3/4}/u(h). \tag{B6}$$

For F equal to or greater than 55,

$$H = h' + 38.71F^{3/5}/u(h). \tag{B7}$$

If the unstable-neutral momentum rise (previously calculated from Eq. B3) is higher than the unstable-neutral buoyancy rise calculated here, momentum rise applies. Since momentum rise takes place near the stack top, 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):

$$s = g(\partial\theta/\partial z)/T. \qquad (B8)$$

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: 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. A plume height is calculated from Briggs' (1969, p. 59) Eq. 4.28:

$$H = h' + 1.5\{(v_s^2 d^2 T)/[4T_s u(h)]\}^{1/3} s^{-1/6}. \qquad (B9)$$

This is compared with the value for unstable-neutral momentum rise (Eq. B3) and the lower of the two values is used as the resulting momentum plume height.

Stable: Buoyancy Rise

For situations where $T_s \geq T$, the plume rise due to buoyancy is calculated. The distance to final rise (in kilometers) is determined by the equivalent of a combination of Briggs' (1975, p. 96) Eqs. 48 and 59:

$$x_f = 0.0020715u(h)s^{-1/2}. \qquad (B10)$$

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

$$H = h' + 2.6\{F/[u(h)s]\}^{1/3}. \qquad (B11)$$

If the stable momentum rise is higher than the stable buoyancy rise calculated here, momentum rise applies and the distance to final rise is set equal to zero.

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 plume height:

$$H = h' + (160F^{1/3}x^{2/3})/u(h). \qquad (B12)$$

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.

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APPENDIX B

LISTING OF FORTRAN SOURCE CODE

The source code of MPTER (Version 85165) follows. The program consists of a main module , five subroutines, and one function. These pages replace Appendix C of the original document.

```
C                   MPTER        (DATED 85165)
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->->->-> SECTION A -  GENERAL REMARKS.
C
C***********************************************************************
C         NOTE: THIS VERSION OF MPTER 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        NOTE: THE CARD INPUT FOR SOURCES DIFFERS SLIGHTLY FROM
C               PREVIOUS VERSIONS. ENDP SHOULD NOW BE INPUT TO
C               INDICATE THE LAST OF THE POINT SOURCES.
C***********************************************************************
C
C***    MPTER PROGRAM ABSTRACT.
C              MPTER IS A MUTIPLE POINT SOURCE CODE WITH AN OPTIONAL
C         DEFAULT MODE AND AN OPTIONAL TERRAIN ADJUSTMENT
C         FEATURE. THE ALGORITHM CODE IS PRIMARILY BASED ON THE POINT
C         SOURCE PORTION OF RAM WHICH IS BASED ON GAUSSIAN MODELING
C         ASSUMPTIONS. THIS VERSION OF MPTER ALLOWS FOR THE SELECTION
C         OF URBAN OR RURAL DISPERSION PARAMETERS AND IS CONTROLLED
C         BY THE INPUT VALUE FOR THE VARIABLE MUOR("1" FOR URBAN,
C         "2" FOR RURAL). THREE OTHER FEATURES OF MPTER ARE: 1) TO
C         TURN OFF STACK DOWNWASH, 2) TO TURN OFF GRADUAL PLUME RISE,
C         AND 3) TO INCLUDE PLUME SIZE DEPENDENT ON PLUME RISE.
C
C              EXECUTION OF MPTER IS LIMITED TO A MAXIMUM OF 250 POINT
C         SOURCES AND 180 RECEPTORS.  SIMULATION IS DONE HOUR-BY-HOUR
C         AND HOURLY METEOROLOGICAL DATA ARE REQUIRED AS INPUT.  LENGTH
C         OF SIMULATED TIME CAN VARY FROM 1 HOUR TO 1 YEAR.
C
C***    MPTER AUTHORS:
C         THOMAS E. PIERCE* AND D. BRUCE TURNER*
C         ENVIRONMENTAL OPERATIONS BRANCH
C         METEOROLOGY AND ASSESSMENT DIVISION, ESRL
C         ENVIRONMENTAL PROTECTION AGENCY
C
C         * ON ASSIGNMENT FROM NATIONAL OCEANIC AND ATMOSPHERIC ADMIN.,
C           DEPARTMENT OF COMMERCE.
C
C***    MODIFIED FOR DEFAULT OPTION AND URBAN OPTION BY:
C         JEROME B. MERSCH
C         SOURCE RECEPTOR ANALYSIS BRANCH
C         MONITORING AND DATA ANALYSIS DIVISION
C         ENVIRONMENTAL PROTECTION AGENCY
C
C***    MPTER 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       ************************************************************
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       *              - BUOYANCY INDUCED DISPERSION IS USED       *
C       *              - DEFAULT VALUES OF .07,.07,.10,.15,.35,    *
C       *                AND .55 FOR THE RURAL AND .15,.15,.20,    *
C       *                .25,.30, AND .30 FOR THE URBAN OPTION     *
```

```
C      *                  HAVE BEEN SET FOR THE POWER LAW WIND          *
C      *                  PROFILE EXPONENTS FOR STABILITY               *
C      *                  A THROUGH F RESPECTIVELY.                     *
C      *                - TERRAIN ADJUSTMENT FACTORS ARE SET TO         *
C      *                  ZERO FOR ALL STABILITIES.                     *
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 S         *
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            *
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 5,7 AND 10 THROUGH 18 ARE      *
C      *                  SET TO 1 AND OPTIONS 20 THROUGH 24 ARE        *
C      *                  SET TO 0.                                     *
C      *                - AVERAGE CONC. AND HI-5 TABLES ARE PRINTED.    *
C      *                                                                *
C      *         THERE ARE IN ADDITION SEVERAL                          *
C      *     FEATURES THAT ARE INHERENT IN THE UNAMAP 5 AND             *
C      *     LATER VERSIONS OF MPTER. THESE ARE:                        *
C      *                                                                *
C      *                - MOMENTUM PLUME RISE IS ALWAYS ACCOUNTED       *
C      *                  FOR.                                          *
C      *                - TERRAIN ADJUSTMENTS ARE USED FOR              *
C      *                  RECEPTORS BELOW STACK BASE ELEVATION IN       *
C      *                  THE SAME MANNER AS ELEVATED RECEPTORS         *
C      *                - MIXING HEIGHT IS COMPARED WITH FINAL          *
C      *                  PLUME HEIGHT WITHOUT REGARD TO PLUME          *
C      *                  HEIGHT CHANGES DUE TO TERRAIN.                *
C      *                                                                *
C      ******************************************************************
C
C***   TWO SYSTEMS OF LENGTH AND COORDINATES ARE USED IN MPTER:
C
C             THE FIRST SYSTEM, USER UNITS, IS SELECTED BY THE USER AND
C        NORMALLY USES 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, X, Y, IS AN UPWIND, CROSSWIND
C        COORDINATE SYSTEM RELATIVE TO EACH RECEPTOR.  THE X-AXIS IS
C        DIRECTED UPWIND (SAME AS WIND DIRECTION FOR THE HOUR).  IN
C        ORDER TO DETERMINE DISPERSION PARAMETER VALUES AND EVALUATE
C        EQUATIONS FOR CONCENTRATION ESTIMATES, DISTANCES IN THIS
C        SYSTEM MUST BE IN KILOMETERS. THIS SYSTEM IS INTERNAL AND IS
C        NOT APPARENT TO THE USER.
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        MPTER ARE DESCRIBED BELOW:
C
```

```
C***   CARDS 1 - 3  ALPHANUMERIC DATA FOR TITLES. FORMAT(20A4)          MPT01410
C                                                                       MPT01420
C        LINE1 - 80 ALPHANUMERIC CHARACTERS.                            MPT01430
C        LINE2 - 80 ALPHANUMERIC CHARACTERS.                            MPT01440
C        LINE3 - 80 ALPHANUMERIC CHARACTERS.                            MPT01450
C                                                                       MPT01460
C***   CARD 4  CONTROL AND CONSTANTS.  FORMAT(FREE)                     MPT01470
C                                                                       MPT01480
C        IDATE(1) -  2-DIGIT YEAR FOR THIS RUN.                         MPT01490
C        IDATE(2) -  STARTING JULIAN DAY FOR THIS RUN.                  MPT01500
C        IHSTRT   -  STARTING HOUR FOR THIS RUN.                        MPT01510
C        NPER     -  NUMBER OF AVERAGING PERIODS TO BE RUN.             MPT01520
C        NAVG     -  NUMBER OF HOURS IN AN AVERAGING PERIOD.            MPT01530
C        IPOL     -  POLLUTANT INDICATOR; IS 3 FOR SO2, 4 FOR SUSPENDED MPT01540
C                     PARTICULATE.                                      MPT01550
C        MUOR     -  MODEL INDICATOR: 1 FOR URBAN, 2 FOR RURAL.         MPT01560
C        NSIGP    -  NUMBER OF SOURCES FROM WHICH CONC. CONTRIBUTIONS   MPT01570
C                     ARE DESIRED (MAX = 25).                           MPT01580
C        NAV5     -  ADDITIONAL AVERAGING TIME FOR HIGH-FIVE TABLE;     MPT01590
C                     MOST LIKELY EQUAL TO 2, 4, 6, OR 12.              MPT01600
C        CONONE   -  MULTIPLIER TO CONVERT USER UNITS TO KILOMETERS.    MPT01610
C                       EXAMPLE MULTIPLIERS:                            MPT01620
C                         FEET TO KM    3.048E-04                       MPT01630
C                         MILES TO KM   1.609344                        MPT01640
C                         METERS TO KM  1.0E-03                         MPT01650
C        CELM     -  MULTIPLIER TO CONVERT USER HEIGHT UNITS TO METERS. MPT01660
C                       EXAMPLE MULTIPLIER:                             MPT01670
C                         FEET TO METERS  0.3048                        MPT01680
C        HAFL     -  POLLUTANT HALF-LIFE, SECONDS. AN ENTRY OF ZERO WILLMPT01690
C                     CAUSE SKIPPING OF POLLUTANT LOSS CALCULATIONS.    MPT01700
C                                                                       MPT01710
C        ******************************************************         MPT01720
C        *      THE USER IS REFERRED TO THE USERS GUIDE FOR   *         MPT01730
C        *  MORE DETAILED INFORMATION ON OPTIONS. ESPECIALLY  *         MPT01740
C        *  IMPORTANT IS AN UNDERSTANDING OF PRINTED OUTPUT   *         MPT01750
C        *  AND USE OF OPTIONS 9 THROUGH 19 TO DELETE UNNEEDED*         MPT01760
C        *  INFORMATION. MPTER IS CAPABLE OF GENERATING A     *         MPT01770
C        *  LARGE QUANTITY OF PRINTED INFORMATION UNLESS SOME *         MPT01780
C        *  OF THESE OPTIONS TO DELETE OUTPUT ARE USED        *         MPT01790
C        *  LIBERALLY.                                        *         MPT01800
C        ******************************************************         MPT01810
C                                                                       MPT01820
C***   CARD 5.  OPTIONS.  FORMAT(FREE)                                  MPT01830
C                                                                       MPT01840
C         1 = EMPLOY OPTION;  0 = DON'T USE OPTION.                     MPT01850
C                                                                       MPT01860
C       TECHNICAL OPTIONS:                                              MPT01870
C         IOPT(1)  -  USE TERRAIN ADJUSTMENTS.                          MPT01880
C         IOPT(2)  -  NO STACK DOWNWASH.                                MPT01890
C         IOPT(3)  -  NO GRADUAL PLUME RISE.                            MPT01900
C         IOPT(4)  -  USE BUOYANCY INDUCED DISPERSION.                  MPT01910
C                                                                       MPT01920
C       INPUT OPTIONS:                                                  MPT01930
C         IOPT(5)  -  MET. DATA IS ON CARDS.                            MPT01940
C         IOPT(6)  -  READ HOURLY EMISSIONS.                            MPT01950
C         IOPT(7)  -  SPECIFY SIGNIFICANT SOURCES.                      MPT01960
C         IOPT(8)  -  INPUT RADIAL DISTANCES AND GENERATE POLAR         MPT01970
C                      COORDINATE RECEPTORS.                            MPT01980
C                                                                       MPT01990
C       PRINTED OUTPUT OPTIONS:                                         MPT02000
C         IOPT(9)  -  DELETE EMISSIONS WITH HEIGHT TABLE.               MPT02010
C         IOPT(10) -  DELETE RESULTANT MET. DATA SUMMARY FOR AVG. PERIOD.MPT02020
C         IOPT(11) -  DELETE HOURLY CONTRIBUTIONS.                      MPT02030
C         IOPT(12) -  DELETE MET. DATA ON HOURLY CONTRIBUTIONS.         MPT02040
C         IOPT(13) -  DELETE FINAL PLUME HEIGHT AND DISTANCE TO FINAL   MPT02050
C                      RISE ON HOURLY CONTRIBUTIONS.                    MPT02060
C         IOPT(14) -  DELETE HOURLY SUMMARY.                            MPT02070
C         IOPT(15) -  DELETE MET. DATA ON HOURLY SUMMARY.               MPT02080
C         IOPT(16) -  DELETE FINAL PLUME HEIGHT AND DISTANCE TO FINAL   MPT02090
C                      RISE ON HOURLY SUMMARY.                          MPT02100
```

```
C        IOPT(17) -  DELETE AVERAGING-PERIOD CONTRIBUTIONS.
C        IOPT(18) -  DELETE AVERAGING-PERIOD SUMMARY.
C        IOPT(19) -  DELETE AVERAGE CONCENTRATIONS AND HIGH-FIVE TABLE.
C
C       OTHER CONTROL AND OUTPUT OPTIONS:
C        IOPT(20) -  RUN IS PART OF A SEGMENTED LONG RUN.
C        IOPT(21) -  WRITE PARTIAL CONCENTRATIONS TO DISK OR TAPE.
C        IOPT(22) -  WRITE HOURLY CONCENTRATIONS TO DISK OR TAPE.
C        IOPT(23) -  WRITE AVERAGING-PERIOD CONCS TO DISK OR TAPE.
C        IOPT(24) -  PUNCH AVERAGING-PERIOD CONCENTRATIONS ON CARDS.
C
C       DEFAULT OPTION
C        IOPT(25) -  SET DEFAULT FEATURES
C
C***    CARD 6.  WIND AND TERRAIN. FORMAT(FREE)
C
C        HANE      -  ANEMOMETER HEIGHT (METERS)
C        PL(I),I=1,6 -  WIND SPEED POWER LAW PROFILE EXPONENTS FOR EACH
C                        STABILITY.
C        CONTER(I),I=1,6 -  TERRAIN ADJUSTMENT FACTORS FOR EACH
C                            STABILITY.
C
C       *****DEFAULT OPTION NOTE*****
C
C             SELECTION OF THE DEFAULT OPTION CAUSES PL AND
C         CONTER 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.
C         ALL OTHER DATA ON THE CARD WILL BE IGNORED.
C
C***    CARD TYPE 7.  POINT SOURCE CARD.  FORMAT(3A4,8F8.2,F4.0)
C
C       (UP TO 250 POINT SOURCE CARDS ARE ALLOWED.)
C        PNAME(I,NPT)I=1,3 -  12 CHARACTER 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        ELP(NPT)        -  SOURCE GROUND-LEVEL ELEVATION (USER HT UNITS)
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.  SPECIFIED SIGNIFICANT SOURCES.  FORMAT(26I3)
C
C       (USED IF OPTION 7 = 1)
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 9. MET. DATA IDENTIFIERS.  FORMAT(FREE)
C
C       (USED IF OPTION 5 = 0)
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 10.  POLAR COORDINATE RECEPTORS.  FORMAT(FREE)
C
C       (USED IF OPTION 8 = 1)
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                             (USER UNITS)
```

```
C          CENTX      -  EAST COORDINATE ABOUT WHICH RADIALS ARE CENTERED.
C          CENTY      -  NORTH COORDINATE ABOUT WHICH RADIALS ARE CENTERED.
C                              (USER UNITS)
C
C***    CARD TYPE 11.  POLAR COORDINATE RECEPTOR ELEVATIONS.
C
C        FORMAT(I2,8X,5F10.0).  (USED IF OPTIONS 1 AND 8 ARE BOTH 1)
C          IDUM       -  AZIMUTH INDICATOR (1 TO 36)
C          ELRDUM(I),I=1,5  -  RECEPTOR ELEVATIONS FOR THIS AZIMUTH FOR
C                                 UP TO FIVE DISTANCES (USER HEIGHT UNITS).
C
C***    CARD TYPE 12.  RECEPTOR.  FORMAT(2A4,2F10.3,2F10.0)
C
C        (UP TO 180 RECEPTORS MAY BE GENERATED INCLUDING POLAR COORDINATE
C          ONES IF OPTION 8 = 1.)
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          ZR         -  RECEPTOR HEIGHT ABOVE LOCAL GROUND-LEVEL (METERS)
C          ELR        -  RECEPTOR GROUND-LEVEL ELEVATION (USER HT UNITS)
C
C           CARD WITH 'ENDR' IN COLS 1-4 IS USED TO SIGNIFY THE END OF
C            THE RECEPTOR CARDS.
C
C***    CARD TYPE 13.  SEGMENTED RUN. FORMAT(FREE)
C
C        (USED IF OPTION 20=1)
C          IDAY       -  NUMBER OF DAYS PREVIOUSLY PROCESSED.
C          LDRUN      -  LAST DAY TO BE PROCESSED IN THIS RUN.
C
C***    CARD TYPE 14.  METEOROLOGY.  FORMAT(FREE)
C
C        (ONE CARD FOR EACH HOUR OF THE SIMULATION.)
C        (USED IF OPTION 5 = 1)
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 -  COMMON, DIMENSION, AND DATA STATEMENTS.
C
C           /EXPOS/  BETWEEN MAIN PROGRAM AND BLOCK DATA
      COMMON /EXPOS/ PXUCOF(6,9),PXUEXP(6,9),HC1(10),BXUCOF(6,9),BXUEXP(
     *6,9)
C           /MPOR/ BETWEEN MAIN, PTR, OUTHR, AND RCP
      COMMON /MPOR/ IOPT(26)
C           /MPO/ BETWEEN MAIN, PTR, AND OUTHR
      COMMON /MPO/ NRECEP,NAVG,NB,LH,NPT,IDATE(2),RREC(180),SREC(180),ZR
     1(180),ELR(180),PHCHI(180),PHSIGS(180,26),HSAV(250),DSAV(250),PCHI(
     2180),PSIGS(180,26),IPOL
C           /MPR/  BETWEEN MAIN, PTR, AND RCP
      COMMON /MPR/ UPL,Z,H,HL,X,Y,KST,DELH,SY,SZ,RC,MUOR
C           /MP/  BETWEEN MAIN PROGRAM AND PTR
      COMMON /MP/ SOURCE(9,250),CONTWO,PSAV(250),IPSIGS(250),U,TEMP,SINT
     1,COST,PL(6),ELP(250),ELHN,HANE,TLOS,CEIM,CTER
C           /MO/  BETWEEN MAIN PROGRAM AND OUTHR
      COMMON /MO/ QTHETA(24),QU(24),IKST(24),QHL(24),QTEMP(24),MPS(25),N
     1SIGP,IO,LINE1(20),LINE2(20),LINE3(20),RNAME(2,180),IRANK(180),STAR
     2(5,180)
C           /MR/  BETWEEN MAIN PROGRAM AND RANK
      COMMON /MR/ HMAXA(5,180,5),NDAY(5,180,5),IHR(5,180,5),CONC(180,5),
     1JDAY,NR
C
      DIMENSION PNAME(3,250), IFREQ(7), DUMR(24), HLH(2,24), IMPS(25), T
     1ITLE(2), TABLE(2,21), CONTER(6), RADIL(5), ANAME(36),PLL(6,2)
```

```
      DIMENSION SUM(180), ELRDUM(5), NTIME(5), ATIME(5), MODEL(2,2)
      DIMENSION CF(5),IDUMR(24)
C
      DATA IFREQ /7*0/ ,BLNK /' '/
      DATA TITLE /'S02 ','PART'/
      DATA MODEL /'URBA','N','RURA','L'/
      DATA ENDP /'ENDP'/ ,ENDR /'ENDR'/
      DATA MAXP /250/ ,STR /'*'/ ,STAR /900*' '/
C        MAXP EQUALS SECOND DIMENSION OF THE ARRAY NAMED: SOURCE.
      DATA ANAME /' 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
C
      DATA NTIME /1,3,8,24,0/ ,ATIME /1.,3.,8.,24.,0./
      DATA ITMIN1 /9999/,IDIV8 /0/, IDIV24 /0/, ICALM /0/
      DATA C/'C'/,ICFL3/0/,ICFL8/0/,ICFL24/0/
C
C      DEFAULT POWER LAW EXPONENTS AND TERRAIN ADJUSTMENT FACTORS.
C
      DATA PLL/.15,.15,.20,.25,.30,.30,.07,.07,.10,.15,.35,.55/
      DATA CONTER/0.,0.,0.,0.,0.,0./
C
      WRITE (6,5432)
 5432 FORMAT ('1',34X,'MPTER  (DATED 85165)'/
     1 29X,'AN AIR QUALITY DISPERSION MODEL IN'/
     1 32X,'SECTION 1. GUIDELINE MODELS.                  '/
     3 32X,'IN UNAMAP (VERSION 6) JUL 86'/
     4 22X,'SOURCE: UNAMAP FILE ON EPA''S UNIVAC 1110, RTP. NC.')
C
C->->->->SECTION D - FLOW DIAGRAM
C
C       RELATION OF SUBROUTINES IN MPTER
C
C                   MPTER
C                     !
C                     ! * READ INPUT DATA
C             --------! - LOOP FOR CALENDAR DAYS
C             !       !
C             !  -----! - LOOP FOR AVERAGING TIME
C             !  !    !
C             !  !    ! * READ MET DATA
C             !  !    ! * ANGARC
C             !  !    !
C             !  !  --! - LOOP ON HOURS
C             !  !  ! !
C             !  !  ! ! * * * * * PTR
C             !  !  ! !            !
C             !  !  ! !       ------ - LOOP ON RECEPTORS
C             !  !  ! !       !    !
C             !  !  ! !       !  --- - LOOP ON SOURCES
C             !  !  ! !       !  ! !
C             !  !  ! !       !  ! ! * * RCP
C             !  !  ! !       !  ! !      !
C             !  !  ! !       !  ! !     **PGYZ
C             !  !  ! !       !  ! !
C             !  !  ! !       !  --*
C             !  !  ! !       -----*
C             !  !  ! !
C             !  !  ! ! * RANK
C             !  !  ! !
C             !  !  ! ! * OUTHR
C             !  !  ! !
C             !  !  --*
C             !  !    !
C             !  !    ! * OUTAVG (ENTRY POINT IN OUTHR)
C             !  !    !
C             !  -----*
C             !       !
```

```
C               --------*
C                       !
C                      EXIT
C
C->->->->SECTION E - RUN SET-UP AND READ FIRST 6 INPUT CARDS.
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.
      NRECEP=0
      NP=0
      NHR=0
      NP3=0
      NP8=0
      NP24=0
      NPX=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        I/O DEVICE INITIALIZATIONS
      IN=5
      IO=6
C        UNIT 11 - DISK INPUT OF MET DATA--USED WHEN IOPT(5)=1.
C        UNIT 10 - DISK OUPUT OF PARTIAL CONCENTRATIONS
C         AT EACH RECEPTOR--USED WHEN IOPT(21) = 1.
C        UNIT 12 TAPE/DISK OUTPUT OF HRLY CONCENTRATIONS-IF IOPT(22)=1.
C        UNIT 13 TAPE/DISK OUTPUT OF CONCENTRATIONS FOR AVERAGING PERIOD
C           USED IF IOPT(23) = 1.
C        UNIT 14 TAPE/DISK STORAGE FOR SUMMARY INFO, USED IF IOPT(20)=1.
C        UNIT 15 - TAPE/DISK INPUT OF HOURLY POINT SOURCE EMISSIONS
C          -- USED IF IOPT(6) = 1.
C
C        READ CARDS 1-3  (SEE DESCRIPTION, SECTION B).
C
      READ (IN,1180) 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,
     1NAV5,CONONE,CELM,HAFL
C        THE ABOVE FORMAT IS UNIVACS FREE FIELD INPUT.
C        VARIABLES MUST BE SEPARATED BY COMMAS.
C        THIS IS SIMILAR TO IBM'S LIST DIRECTED IO.
      WRITE (IO,1395)(MODEL(K,MUOR),K=1,2),LINE1,LINE2,LINE3
      IF (NSIGP.LE.25) GO TO 50
      WRITE (IO,1250) NSIGP
      STOP
50    IP=IPOL-2
      CONTWO=CONONE
C        READ CARD TYPE 5  (SEE DESCRIPTION, SECTION B).
C
      READ (IN,*) (IOPT(I),I=1,25)
C
      IF(IOPT(25).NE.1) GO TO 55
C
C        DEFAULT SELECTION RESULTS IN THE FOLLOWING: USE STACK DOWNWASH
C        (2); USE FINAL PLUME RISE (3); USE BUOYANCY-INDUCED DISPERSION
C        (4); WRITE HIGH-5 TABLES (19) BUT DELETE ALL OTHER OUTPUT (10,
C        11,12, 13, 14, 15, 16, 17, 18, 21, 22, 23, AND 24).
C
         IOPT(2)=0
```

```
      IOPT(3)=1
      IOPT(4)=1
      IOPT(5)=0
      IOPT(7)=0
      IOPT(10)=1
      IOPT(11)=1
      IOPT(12)=1
      IOPT(13)=1
      IOPT(14)=1
      IOPT(15)=1
      IOPT(16)=1
      IOPT(17)=1
      IOPT(18)=1
      IOPT(19)=0
      IOPT(20)=0
      IOPT(21)=0
      IOPT(22)=0
      IOPT(23)=0
      IOPT(24)=0
C
C     SET HALF-LIFE FOR DEFAULT OPTION
C
      IF(IPOL.EQ.3.AND.MUOR.EQ.1)HAFL=14400.
      IF(IPOL.NE.3.OR.MUOR.NE.1)HAFL=0.
C
C       SET START HOUR AND AVERAGING PERIOD;
C       SET THE NUMBER OF SIGNIFICANT POINT AND
C       AREA SOURCES.
C
      IHSTRT=1
      NAVG=24
      NSIGP=0
C
55    CONTINUE
C
C           WRITE GENERAL INPUT INFORMATION
      WRITE (IO,1410) TITLE(IP),NPER,NAVG,IHSTRT,IDATE(2),IDATE(1),CONTW
     1O,NSIGP
      DAY1A=IDATE(2)
      HR1=IHSTRT
      IF (HAFL.GT.0.0) GO TO 60
      TLOS=0.
      WRITE (IO,1420)
      GO TO 70
60    WRITE (IO,1430) HAFL
      TLOS=693./HAFL
70    IF (IOPT(19).EQ.1) GO TO 80
      NAVT=5
C        FOR DEFAULT OPTION
C        ADDITIONAL AVERAGING PERIOD SET TO ZERO.
      IF(IOPT(25).EQ.1) NAV5=0
      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,1440) NAVT
80    IF (IOPT(1).EQ.0) GO TO 90
      WRITE (IO,1450) CELM
      ELHN=99999.
      ELOW=99999.
90    IF (NSIGP.GT.0) GO TO 100
      IOPT(11)=1
      IOPT(17)=1
100   WRITE (IO,1460) (I,IOPT(I),I=1,13)
      WRITE (IO,1470) (I,IOPT(I),I=14,25)
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(25).NE.0)READ(IN,*)HANE
      IF(IOPT(25).EQ.0)READ(IN,*)HANE,PL,CONTER
      IF(IOPT(25).EQ.0) GO TO 105
      DO 104 I1=1,6
      PL(I1)=PLL(I1,MUOR)
104   CONTINUE
105   CONTINUE
C
      IF (IOPT(1).EQ.1) GO TO 110
      WRITE (IO,1480) HANE,PL
      GO TO 140
110   WRITE (IO,1490) HANE,PL,CONTER
      DO 120 I=1,6
      IF (CONTER(I).LT.0..OR.CONTER(I).GT.1.) GO TO 130
120   CONTINUE
      GO TO 140
130   WRITE (IO,1260)
      STOP
C
C        MUCH OF THE FOLLOWING PROGRAM SECTION IS BASED UPON
C        RAMQ IN THE RAM SYSTEM. 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 F - INPUT AND PROCESS EMISSION INFORMATION.
C
140   WRITE (IO,1500)
      NPT=0
C        BEGIN LOOP TO READ THE POINT SOURCE INFORMATION
150   NPT=NPT+1
      IF (NPT.LE.MAXP) GO TO 160
      READ (IN,1200) DUM
      IF (DUM.EQ.ENDP) GO TO 230
      WRITE (IO,1270) MAXP
      STOP
C
C        READ CARD TYPE 7  (SEE DESCRIPTION, SECTION B).
C
160   READ (IN,1210) (PNAME(I,NPT),I=1,3),(SOURCE(I,NPT),I=1,8),ELP(NPT)
C        CARD WITH     'ENDP'    IN COL 1-10 IS USED TO SIGNIFY END OF
C        POINT SOURCES.
      IF (PNAME(1,NPT).EQ.ENDP) GO TO 230
C        ELHN, ELEVATION OF LOWEST STACK TOP IN INVENTORY, IS DETERMINED
C        IN USER HEIGHT UNITS
      IF (IOPT(1).EQ.0) GO TO 170
      TOM=SOURCE(5,NPT)/CELM+ELP(NPT)
      IF (TOM.LT.ELHN) ELHN=TOM
C        LOWPT, ELEVATION OF LOWEST SOURCE GROUND-LEVEL
C         IN INVENTORY, IN USER HEIGHT UNITS.
      IF (ELP(NPT).LT.ELOW) ELOW=ELP(NPT)
C        CALCULATE BUOYANCY FACTOR
170   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
C        (OR AS DUMMIES) FOR THE NEXT 60 STATEMENTS.
```

```
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
      IF(MUOR.EQ.1)GO TO 221
      A=PXUCOF(2,IS)
      B=PXUEXP(2,IS)
      GO TO 222
221   A=BXUCOF(2,IS)
      B=BXUEXP(2,IS)
222   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 COEFFICIENT 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
C        GO BACK AND READ DATA FOR ANOTHER POINT SOURCE.
      IPSIGS(NPT)=0
C        LIST POINT SOURCE INFORMATION.
      WRITE (IO,1510) NPT,(PNAME(J,NPT),J=1,3),(SOURCE(K,NPT),K=1,8),DSA
     1V(NPT),HSAV(NPT),ELP(NPT),F
      GO TO 150
230   NPT=NPT-1
C         CHECK FOR NPT < OR = 0
      IF (NPT.GT.0) GO TO 240
      WRITE (IO,1280) NPT
      STOP
C
C->->->->SECTION G - RANK SIGNIFICANT SOURCES.
C
240   IF (NSIGP.EQ.0) GO TO 280
C        RANK NSIGP HIGHEST POINT SOURCES.
      IF (NPT.LT.NSIGP) NSIGP=NPT
      DO 260 I=1,NSIGP
      SIGMAX=-1.0
      DO 250 J=1,NPT
      IF (DSAV(J).LE.SIGMAX) GO TO 250
      SIGMAX=DSAV(J)
      LMAX=J
250   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
260   DSAV(LMAX)=-1.0
C        OUTPUT TABLE OF RANKED SOURCES.
      WRITE (IO,1520) TITLE(IP)
      DO 270 I=1,NSIGP
      WRITE (IO,1530) I,PSAV(I),IMPS(I)
270   CONTINUE
C
C->->->->SECTION H - EMISSIONS WITH HEIGHT TABLE.
C
280   IF (IOPT(9).EQ.1) GO TO 340
      DO 320 I=1,NPT
      DO 290 J=1,20
      HC=J*5.
      IF (SOURCE(5,I).LE.HC) GO TO 300
290   CONTINUE
C        POINT SOURCES WITH PHYSICAL HEIGHTS GT 100 METERS ARE LISTED
C        SEPARATELY.
      WRITE (IO,1540) I,SOURCE(5,I),SOURCE(IPOL,I)
      GO TO 310
C        ADD EMISSION RATE INTO TABLE AND TOTAL.
```

```
300   TABLE(1,J)=TABLE(1,J)+SOURCE(IPOL,I)
310   TABLE(1,21)=TABLE(1,21)+SOURCE(IPOL,I)
320   CONTINUE
C        OUTPUT SOURCE-STRENGTH-HEIGHT TABLE
C        THIS TABLE DISPLAYS THE TOTAL EMISSIONS FOR POINT
C        SOURCES AND THE CUMULATIVE FREQUENCY ACCORDING TO
C        HEIGHT CLASS
      WRITE (IO,1550) TITLE(IP)
C        HEIGHT CLASS EMISSIONS ARE IN 1
C        DETERMINE CUMULATIVE PERCENT IN 2
      IH1=0
      IH2=5
      IM1=1
      TABLE(2,1)=TABLE(1,1)/TABLE(1,21)
      WRITE (IO,1560) IH1,IH2,(TABLE(J,1),J=1,2)
      DO 330 I=2,20
      IH2=I*5
      IH1=IH2-4
      IM1=I-1
      TABLE(2,I)=TABLE(1,I)/TABLE(1,21)+TABLE(2,IM1)
      WRITE (IO,1560) IH1,IH2,(TABLE(J,I),J=1,2)
330   CONTINUE
      WRITE (IO,1570) TABLE(1,21)
C
C->->->->SECTION I - EXECUTE FOR INPUT OF SIGNIFICANT SOURCE NUMBERS.
C
340   WRITE (IO,1580)
      IF (IOPT(7).EQ.0) GO TO 370
C
C        READ CARD TYPE 8 (SEE DESCRIPTION, SECTION B).
C
      READ (IN,1220) INPT,(MPS(I),I=1,INPT)
      WRITE (IO,1590) INPT,(MPS(I),I=1,INPT)
      IF (INPT.LE.NSIGP) GO TO 350
      WRITE (IO,1290) INPT,NSIGP
      STOP
350   IF (INPT.EQ.0) GO TO 370
      IF (MPS(INPT).EQ.0) WRITE (IO,1300)
      J=INPT+1
      K=1
C        ADD SIGNIFICANT SOURCES DETERMINED FROM RANKED SOURCE LIST
C        IF NSIGP GREATER THAN INPT.
      IF (J.GT.NSIGP) GO TO 390
      DO 360 I=J,NSIGP
      MPS(I)=IMPS(K)
360   K=K+1
      GO TO 390
370   DO 380 I=1,NSIGP
380   MPS(I)=IMPS(I)
390   WRITE (IO,1600) NPT,NSIGP,(MPS(I),I=1,NSIGP)
      IF (IOPT(6).EQ.0) GO TO 410
C        SAVE AVERAGE EMISSION RATE
      DO 400 I=1,NPT
400   PSAV(I)=SOURCE(IPOL,I)
C        FILL IN SIGNIFICANT POINT SOURCE ARRAY
410   DO 420 I=1,NSIGP
      J=MPS(I)
420   IPSIGS(J)=I
C
C->->->->SECTION J - CHECK MET DATA IF FROM FILE OF ONE YEAR'S DATA.
C
      IF (IOPT(5).EQ.1) GO TO 450
C
C        READ CARD TYPE 9 (SEE DESCRIPTION, SECTION B).
C
      READ (IN,*) ISFCD,ISFCYR,IMXD,IMXYR
C        READ ID RECORD FROM PREPROCESSED MET DISK OR TAPE FILE.
      READ (11) ID,IYEAR,IDM,IYM
      IF (ISFCD.EQ.ID.AND.ISFCYR.EQ.IYEAR) GO TO 430
      WRITE (IO,1310) ISFCD,ISFCYR,ID,IYEAR
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      STOP
430   IF (IMXD.EQ.IDM.AND.IMXYR.EQ.IYM) GO TO 440
      WRITE (IO,1320) IMXD,IMXYR,IDM,IYM
      STOP
440   WRITE (IO,1610) ISFCD,ISFCYR,IMXD,IMXYR
C
C->->->->SECTION K - GENERATE POLAR COORDINATE RECEPTORS.
C
450   NRECEP=0
      WRITE (IO,1620)
      IF (IOPT(8).NE.1) GO TO 520
C
C        READ CARD TYPE 10 (SEE DESCRIPTION, SECTION B).
C
      READ (IN,*) RADIL,CENTX,CENTY
      JA=0
      DO 460 J=1,5
      IF (RADIL(J).EQ.0) GO TO 460
      JA=JA+1
460   CONTINUE
      WRITE (IO,1630) CENTX,CENTY,RADIL
      DO 480 I=1,36
C          CALCULATE THE ANGLE IN RADIANS
      RADIK=FLOAT(I)*0.1745329
C        0.1745329 IS 2*PI/36
      SINRAD=SIN(RADIK)
      COSRAD=COS(RADIK)
      DO 470 J=1,JA
      NRECEP=I+36*(J-1)
      RREC(NRECEP)=(RADIL(J)*SINRAD)+CENTX
C          CALCULATE THE EAST-COORDINATE
      SREC(NRECEP)=(RADIL(J)*COSRAD)+CENTY
C          CALCULATE THE NORTH-COORDINATE
      RNAME(1,NRECEP)=ANAME(I)
C          ALPHANUMERIC INFORMATION WHICH INDICATES DEGREES AZIMUTH
      ENCODE (4,1640,RNAME(2,NRECEP)) RADIL(J)
C          ENCODE THE FLOATING POINT VARIABLE OF RADIAL DISTANCE
C          TO ALPHANUMERIC REPRESENTATION SO INFO CAN BE PRINTED
      ZR(NRECEP)=0.
      ELR(NRECEP)=0.
470   CONTINUE
480   CONTINUE
      NRECEP=36*JA
C
C->->->->SECTION L - READ POLAR COORDINATE ELEVATIONS.
C
      IF (IOPT(1).EQ.0) GO TO 520
C
C        READ 36 CARDS, TYPE 11 (SEE DESCRIPTION, SECTION 8).
C
      DO 510 I=1,36
      READ (IN,1230) IDUM,(ELRDUM(J),J=1,JA)
      IF (IDUM.EQ.I) GO TO 490
      WRITE (IO,1330) I,IDUM
      STOP
490   DO 500 J=1,JA
      K=J-1
      L=K*36+I
500   ELR(L)=ELRDUM(J)
510   CONTINUE
C
C->->->->SECTION M - READ AND PROCESS RECEPTOR INFORMATION.
C
C          NOW READ CARD TYPE 12 IF NECESSARY. MUST HAVE A CARD WITH
C          'ENDR'IN COLS 1-4 TO INDICATE END OF RECEPTOR CARDS.
C          NO MORE THAN 180 RECEPTORS CAN BE INPUT TO MPTER.
C        START LOOP TO ENTER RECEPTORS.
520   NRECEP=NRECEP+1
      IF (NRECEP.LE.180) GO TO 540
      READ (IN,1200,END=530) DUM
```

```
      IF (DUM.EQ.ENDR) GO TO 550
530   WRITE (IO,1340)
      STOP
C
C        READ CARD TYPE 12 (SEE DESCRIPTION, SECTION B).
C
540   READ (IN,1240) (RNAME(J,NRECEP),J=1,2),RREC(NRECEP),SREC(NRECEP),Z
     1R(NRECEP),ELR(NRECEP)
C        PLACE 'ENDR' IN COLS 1 TO 4 ON CARD FOLLOWING LAST RECEPTOR
C        TO END READING TYPE 12 CARDS.
      IF (RNAME(1,NRECEP).EQ.ENDR) GO TO 550
      GO TO 520
550   NRECEP=NRECEP-1
      IF (IOPT(1).EQ.0) GO TO 570
C        IF TERRAIN OPTION IS EMPLOYED, DETERMINE IF
C         RECEPTOR ELEVATIONS REQUIRE LABELING WITH ASTERISKS
C         FOR ADDITIONAL REMARKS.
      DO 560 J=1,NRECEP
      IF (ELR(J).GT.ELHN.OR.ELR(J).LT.ELOW) STAR(2,J)=STR
      IF (ELR(J).GT.ELHN) STAR(1,J)=STR
560   CONTINUE
570   IF (NRECEP.GT.0) GO TO 580
      WRITE (IO,1350) NRECEP
      STOP
C        PRINT OUT TABLE OF RECEPTORS. ***
580   WRITE (IO,1650)
      DO 590 K=1,NRECEP
590   WRITE (IO,1660) K,STAR(1,K),STAR(2,K),(RNAME(J,K),J=1,2),RREC(K),S
     1REC(K),ZR(K),ELR(K)
      IF (IOPT(1).EQ.0) GO TO 600
      WRITE (IO,1670)
C
C->->->->SECTION N - POSITION FILES AS REQUIRED.
C
600   IF (IOPT(20).EQ.0) GO TO 610
C
C        READ CARD TYPE 13 (SEE DESCRIPTION, SECTION B).
C
      READ (IN,*) IDAY,LDRUN
      WRITE (IO,1680) IDAY,LDRUN
      IF (IDAY.EQ.0) GO TO 610
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 610
      WRITE (IO,1360) IDAY,IDAYS
      STOP
610   NP=IDAY*(24/NAVG)
C        IF OPTION 21 = 1, WRITE INITIAL INFO TO UNIT 10
      IF (IOPT(21).EQ.1) WRITE (10) NPER,NAVG,LINE1,LINE2,LINE3
      IF (IOPT(22).EQ.0) GO TO 640
      IF (IDAY.LE.0) GO TO 630
C        SKIP PREVIOUSLY GENERATED HOURLY RECORDS.
      ISKIP=IDAY*24+2
      DO 620 I=1,ISKIP
620   READ (12)
      GO TO 640
C        WRITE LEAD TWO RECORDS ON HOURLY FILE.
630   WRITE (12) NPER,NAVG,LINE1,LINE2,LINE3
      WRITE (12) NRECEP,(RREC(I),I=1,NRECEP),(SREC(J),J=1,NRECEP)
640   IF (IOPT(23).EQ.0) GO TO 670
      IF (IDAY.LE.0) GO TO 660
C        SKIP PREVIOUSLY GENERATED AVERAGING-PERIOD FILE.
      ISKIP=NP+2
      DO 650 I=1,ISKIP
650   READ (13)
      GO TO 670
C        WRITE LEAD TWO RECORDS ON AVERAGING PERIOD FILE.
660   WRITE (13) NPER,NAVG,LINE1,LINE2,LINE3
      WRITE (13) NRECEP,(RREC(I),I=1,NRECEP),(SREC(J),J=1,NRECEP)
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```
670    IF (IOPT(6).EQ.0) GO TO 690
       IF (IDAY.LE.0) GO TO 690
       ISKIP=IDAY*24
       DO 680 I=1,ISKIP
680    READ (15)
690    IDAY=IDATE(2)-1
       IF (IDAY.LE.0.OR.IOPT(5).EQ.1) GO TO 710
C         SKIP PREVIOUSLY USED HOURLY EMISSION RECORDS.
       DO 700 I=1,IDAY
700    READ (11)
710    CONTINUE
C
C->->->->SECTION O - START LOOPS FOR DAY AND AVG TIME; READ MET DATA.
C
720    IDAY=IDAY+1
       DAY=IDAY
       NHRS=0
       IF (IOPT(5).EQ.1) GO TO 760
C         IF OPTION 5 EQUALS ZERO, INPUT MET DATA OFF DISK (UNIT 11)
       READ (11) JYR,IMO,DAY1,IKST,QU,QTEMP,DUMR,QTHETA,HLH
       DO 781 JM1=1,24
       IDUMR(JM1)=DUMR(JM1)+0.5
 781   CONTINUE
       IF (JYR.NE.IDATE(1)) GO TO 730
       IF (DAY1.EQ.DAY) GO TO 740
C         DATE ON MET TAPE DOES NOT MATCH INTERNAL DATE
730    WRITE (IO,1370) JYR,IDATE(2),IDATE(1),IDAY
       STOP
C         MODIFY WIND VECTOR BY 180 DEGREES. SINCE FLOW VECTORS WERE
C         OUTPUT FROM RAMMET. THIS CONVERTS BACK TO WIND DIRECTIONS.
740    IDATE(2)=DAY1
       DO 750 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.
C        SELECT URBAN OR RURAL MIXING HEIGHTS AS APPROPRIATE.
       IF(MUOR.EQ.1)IMX=2
       IF(MUOR.EQ.2)IMX=1
750    QHL(IQ)=HLH(IMX,IQ)
760    NB=IHSTRT
       NE=NB+NAVG-1
       IF (NB.GT.0) GO TO 770
       WRITE (IO,1380) IHSTRT
       STOP
C         START LOOP FOR AVERAGING PERIOD.
770    U=0.0
       TEMP=0.0
       DELN=0.0
       DELM=0.0
       DO 780 I=1,7
780    IFREQ(I)=0.0
       DO 800 I=NB,NE
       JHR=I
       DAY2=IDATE(2)
       IF (IOPT(5).EQ.0) GO TO 790
C
C         READ CARD TYPE 14 IF IOPT(5) =1. (HOURLY MET DATA)
C          (SEE DESCRIPTION, SECTION B).
C
       READ (IN,*) JYR,DAY1,JHR,IKST(JHR),QU(JHR),QTEMP(JHR),QTHETA(JH
      1R),QHL(JHR)
       IF (I.NE.NB) GO TO 790
C         REDEFINE START HOURS AND DATES AT FIRST HOUR OF EACH
C          AVERAGING PERIOD IF READING HOURLY MET DATA.
       IDATE(1)=JYR
       IHSTRT=JHR
       ISTDAY=DAY1
       IDATE(2)=ISTDAY
       DAY2=IDATE(2)
790    IF (IKST(JHR).EQ.7) IKST(JHR)=6
```

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      IF (IOPT(10).EQ.1) GO TO 800                                      MPT09810
C                                                                       MPT09820
C->->->->SECTION P - CALCULATE AND STORE FOR HIGH-FIVE TABLE.            MPT09830
C                                                                       MPT09840
      IF (I.EQ.NB) WRITE (IO,1690) IDATE                                MPT09850
      TRAD=QTHETA(JHR)*0.01745329                                       MPT09860
      WRITE (IO,1700) JHR,QTHETA(JHR),QU(JHR),QHL(JHR),QTEMP(JHR),IKST(JMPT09870
     1HR)                                                               MPT09880
      SINT=SIN(TRAD)                                                    MPT09890
      COST=COS(TRAD)                                                    MPT09900
C        CALCULATE WIND COMPONENTS                                      MPT09910
      URES=QU(JHR)                                                      MPT09920
      UR=URES*SINT                                                      MPT09930
      VR=URES*COST                                                      MPT09940
      DELM=DELM+UR                                                      MPT09950
      DELN=DELN+VR                                                      MPT09960
      TEMP=TEMP+QTEMP(JHR)                                              MPT09970
      U=U+URES                                                          MPT09980
      KST=IKST(JHR)                                                     MPT09990
      IFREQ(KST)=IFREQ(KST)+1                                           MPT10000
C        END LOOP TO READ ALL MET DATA FOR AVERAGING PERIOD.            MPT10010
800   CONTINUE                                                          MPT10020
      IF (IOPT(10).EQ.1) GO TO 860                                      MPT10030
C        CALCULATE RESULTANT  WIND DIRECTION THETA                      MPT10040
      DELN=DELN/NAVG                                                    MPT10050
      DELM=DELM/NAVG                                                    MPT10060
      THETA=ANGARC(DELM,DELN)                                           MPT10070
C        CALCULATE AVERAGE AND RESULTANT SPEED AND PERSISTENCE.         MPT10080
      U=U/NAVG                                                          MPT10090
      TEMP=TEMP/NAVG                                                    MPT10100
      URES=SQRT(DELN*DELN+DELM*DELM)                                    MPT10110
      PERSIS=URES/U                                                     MPT10120
C        DETERMINE MODAL AND AVERAGE STABILITY                          MPT10130
      LSMAX=0                                                           MPT10140
      DO 810 I=1,7                                                      MPT10150
      LST=IFREQ(I)                                                      MPT10160
      IF (LST.LE.LSMAX) GO TO 810                                       MPT10170
      LSMAX=LST                                                         MPT10180
      LSTAB=I                                                           MPT10190
810   CONTINUE                                                          MPT10200
      IP1=LSTAB+1                                                       MPT10210
      KST=LSTAB                                                         MPT10220
      DO 820 I=IP1,7                                                    MPT10230
      IF (LSMAX.EQ.IFREQ(I)) GO TO 830                                  MPT10240
820   CONTINUE                                                          MPT10250
      GO TO 850                                                         MPT10260
C        IF TIE FOR MAX MODAL STABILITY CALCULATE AVERAGE STABILITY     MPT10270
830   KSUM=0                                                            MPT10280
      DO 840 J=1,7                                                      MPT10290
840   KSUM=KSUM+IFREQ(J)*J                                              MPT10300
      KST=FLOAT(KSUM)/FLOAT(NAVG)+0.5                                   MPT10310
C        PRINT RESULTANT MET DATA SUMMARY FOR AVERAGING PERIOD.         MPT10320
850   WRITE (IO,1710)                                                   MPT10330
      WRITE (IO,1720) THETA,URES,U,TEMP,PERSIS,KST                      MPT10340
C        REDEFINE NB AND NE IN CASE NON-CONSECUTIVE DAYS ARE BEING RUN  MPT10350
860   IF (IOPT(5).EQ.0) GO TO 870                                       MPT10360
      NB=IHSTRT                                                         MPT10370
      NE=IHSTRT+NAVG-1                                                  MPT10380
C                                                                       MPT10390
C->->->->SECTION Q - INITIALIZE FOR HOURLY LOOP.                         MPT10400
C                                                                       MPT10410
C        INITIALIZE SUMS FOR CONC AND PARTIAL CONC FOR AVG PERIOD.      MPT10420
870   DO 890 K=1,NRECEP                                                 MPT10430
      PCHI(K)=0.0                                                       MPT10440
      DO 880 I=1,26                                                     MPT10450
880   PSIGS(K,I)=0.0                                                    MPT10460
890   CONTINUE                                                          MPT10470
C        IF SAVING PARTIAL CONCENTRATIONS, WRITE INITIAL RECEPTOR INFO. MPT10480
      IF (IOPT(21).EQ.0) GO TO 900                                      MPT10490
      WRITE (10) NRECEP,NPT,(RREC(I),I=1,NRECEP),(SREC(I),I=1,NRECEP)   MPT10500
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C
C->->->->SECTION R - BEGIN HOURLY LOOP.
C
900   DO 1020 ILH=NB,NE
      LH=ILH
      IF (LH.LE.24) GO TO 910
      LH=MOD(ILH,24)
      IF (LH.EQ.1) IDATE(2)=DAY1
C        INITIALIZE SUMS FOR CONC AND PARTIAL CONC FOR HOURLY PERIODS.
910   DO 930 K=1,NRECEP
      PHCHI(K)=0.0
      DO 920 I=1,26
920   PHSIGS(K,I)=0.0
930   CONTINUE
C        SET MET CONDITIONS FOR THIS HOUR
      THETA=QTHETA(LH)
      U=QU(LH)
      HL=QHL(LH)
      TEMP=QTEMP(LH)
      KST=IKST(LH)
      TRAD=THETA*0.01745329
      SINT=SIN(TRAD)
      COST=COS(TRAD)
      CTER=CONTER(KST)
C        IF OPTION 6 IS 1, READ HOURLY EMISSIONS.
      IF (IOPT(6).EQ.0) GO TO 940
      IDCK=IDATE(1)*100000+IDATE(2)*100+LH
      READ (15) IDATP,(SOURCE(IPOL,I),I=1,NPT)
C        CHECK DATE
      IF (IDCK.EQ.IDATP) GO TO 940
      WRITE (IO,1390) IDCK,IDATP
      STOP
C        CALCULATE POINT SOURCE CONTRIBUTIONS
940   CALL PTR
      IF (IOPT(22).EQ.0) GO TO 950
C        WRITE HOURLY CONCENTRATIONS TO TAPE
      WRITE (12) IDATE(2),LH,(PHCHI(I),I=1,NRECEP)
C
C->->->->SECTION S - CALCULATE AND STORE FOR HIGH-FIVE TABLE.
C
950   NHR=NHR+1
C        IF OPTION 19 IS 1, DELETE COMPUTATIONS FOR AVG CONC.
C         FOR LENGTH OF RECORD AND HIGH-FIVE TABLE.
      IF (IOPT(19).EQ.1) GO TO 1010
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(25).EQ.1.AND.QU(LH).LT.1.009.AND.ITMIN1.EQ.
     *IDUMR(LH))THEN
      ICALM=ICALM+1
      DO 955 K=1,NRECEP
      PHCHI(K)=0.0
955   CONTINUE
      GO TO 971
      END IF
      DO 970 K=1,NRECEP
      DO 960 L=1,NAVT
960   CONC(K,L)=CONC(K,L)+PHCHI(K)
970   SUM(K)=SUM(K)+PHCHI(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(25).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 1010
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 980
      CALL RANK (2)
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      NP3=0
980   NP8=NP8+1
      IF (NP8.NE.8) GO TO 990
      CALL RANK (3)
      NP8=0
990   NP24=NP24+1
      IF (NP24.NE.24) GO TO 1000
      CALL RANK (4)
      NP24=0
1000  IF (NAVT.EQ.4) GO TO 1010
      NPX=NPX+1
      IF (NPX.NE.NAV5) GO TO 1010
      CALL RANK (5)
      NPX=0
C
C->->->->SECTION T - END HOURLY, AVERAGING TIME, AND DAILY LOOPS.
C
1010  IF (IOPT(11).EQ.1.AND.IOPT(14).EQ.1) GO TO 1020
C        IF BOTH OPTIONS 11 AND 14 CALL FOR OUTPUT DELETIONS,
C         SKIP HOURLY PRINTOUT.
      CALL OUTHR
1020  CONTINUE
C
C        END OF HOURLY LOOP
C
      IF (NE.GT.24) IDATE(2)=ISTDAY
C        OUTPUT FINAL RESULTS
      CALL OUTAVG
      NP=NP+1
      NHRS=NHRS+NAVG
C        NEXT STATEMENT IS BRANCH FOR END OF RUN.
      IF (NP.GE.NPER) GO TO 1050
      IF (NHRS.LT.24) GO TO 1030
      IF (IOPT(20).EQ.0) GO TO 720
C        NEXT STATEMENT CHECKS FOR END OF SEGMENTED RUN.
      IF (IDAY.GE.LDRUN) GO TO 1040
      GO TO 720
C
C          END OF LOOP FOR CALENDAR DAYS
C
1030  NB=NB+NAVG
      NE=NE+NAVG
      IF (NB.LE.24) GO TO 770
      NB=MOD(NB,24)
      NE=NB+NAVG-1
      GO TO 770
C
C        END OF LOOP FOR AVERAGING PERIOD.
C
C        IF SEGMENTED RUN, TEMPORARILY STORE
C         HIGH-FIVE INFO ON UNIT 14 FILE.
1040  WRITE (14) IDAY,SUM,NHR,DAY1A,HR1,HMAXA,NDAY,IHR
      WRITE (IO,1730) IDAY
      GO TO 1140
1050  IF (IOPT(19).EQ.1) GO TO 1140
C
C->->->->SECTION U - WRITE AVERAGE CONC. AND HIGH-FIVE TABLES.
C
C        IF OPTION 19 = 0, WRITE AVERAGE CONCENTRATION.
C         FOR LENGTH OF RECORD AND HIGH-FIVE TABLE.
      DO 1060 J=1,NRECEP
      STAR(1,J)=BLNK
      STAR(2,J)=BLNK
1060  CONTINUE
      WRITE (IO,1400)(MODEL(K,MUOR),K=1,2), LINE1,LINE2,LINE3
      HR2=NE
C        FOR DEFAULT OPTION CALCULATE AND REPORT THE
C        NUMBER OF CALMS FOR AVERAGING PERIOD.
      IF(IOPT(25).EQ.1)THEN
      NHR=NHR-ICALM
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      WRITE(6,1061)ICALM
      END IF
      SUM(1)=SUM(1)/NHR
      HIMAX=SUM(1)
      KMX=1
C        INITIALIZE PERIODIC CONC TO BEGIN RANKING FOR PERIODIC MAX
      DO 1070 K=2,NRECEP
      SUM(K)=SUM(K)/NHR
      IF (SUM(K).LE.HIMAX) GO TO 1070
      KMX=K
      HIMAX=SUM(K)
1070  CONTINUE
      STAR(1,KMX)=STR
C        FIND HIGHEST AVERAGE CONC. AMONG RECEPTORS.
      WRITE (IO,1740) DAY1A,HR1,DAY2,HR2
      DO 1080 K=1,NRECEP
1080  WRITE (IO,1750) K,(RNAME(J,K),J=1,2),RREC(K),SREC(K),ZR(K),ELR(K),
     1STAR(1,K),SUM(K)
      STAR(1,KMX)=BLNK
C        LOOP TO WRITE HIGH-FIVE TABLE FOR 4 OR 5 AVG TIMES.
      DO 1130 L=1,NAVT
C        ASTERISKS DEPICT RECEPTORS WITH HIGHEST AND
C         SECOND HIGHEST CONCENTRATIONS.
      K1=1
      K2=1
      HI1=HMAXA(1,1,L)
      HI2=HMAXA(2,1,L)
      DO 1100 K=2,NRECEP
      IF (HMAXA(1,K,L).LE.HI1) GO TO 1090
      HI1=HMAXA(1,K,L)
      K1=K
1090  IF (HMAXA(2,K,L).LE.HI2) GO TO 1100
      HI2=HMAXA(2,K,L)
      K2=K
1100  CONTINUE
      STAR(1,K1)=STR
      STAR(2,K2)=STR
      IF((IOPT(25).EQ.1.AND.L.EQ.1).OR.(IOPT(25).NE.1))THEN
      WRITE (IO,1760) NTIME(L),TITLE(IP),(I,I=1,5)
      END IF
      IF(IOPT(25).EQ.1.AND.L.NE.1)THEN
      WRITE (IO,1761) NTIME(L),TITLE(IP),(I,I=1,5)
      END IF
      DUM=ATIME(L)
      DO 1120 K=1,NRECEP
C        SET CALM FLAG FOR PRINTING.
C        RESET HOUR VARIABLE FOR CALM HOURS.
      IF(IOPT(25).EQ.1)THEN
      DO 1112 J=1,5
      CF(J)=BLNK
      IF(IHR(J,K,L).GT.24)THEN
      IHR(J,K,L)=IHR(J,K,L)-100
      CF(J)=C
      END IF
1112  CONTINUE
      END IF
      IF(IOPT(25).EQ.1)GO TO 1111
C        CALCULATE AVERAGE CONCENTRATIONS WHEN
C        DEFAULT OPTION IS NOT ON.
      DO 1110 J=1,5
1110  HMAXA(J,K,L)=HMAXA(J,K,L)/DUM
 1111 WRITE (IO,1770) K,RREC(K),SREC(K),(STAR(J,K),HMAXA(J,K,L),CF(J),
     1NDAY(J,K,L),IHR(J,K,L),J=1,2),(HMAXA(J,K,L),CF(J),NDAY(J,K,L),
     2IHR(J,K,L),J=3,5)
1120  CONTINUE
C        INITIALIZE ASTERISK STORAGE TO BLANKS.
      STAR(1,K1)=BLNK
      STAR(2,K2)=BLNK
1130  CONTINUE
C
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C->->->->SECTION V - CLOSE OUT FILES.
C
1140  IF (IOPT(21).EQ.0) GO TO 1150
      END FILE 10
      END FILE 10
1150  IF (IOPT(22).EQ.0) GO TO 1160
      END FILE 12
      END FILE 12
1160  IF (IOPT(23).EQ.0) GO TO 1170
      END FILE 13
      END FILE 13
1170  STOP
C
C->->->->SECTION X - OUTLINE OF PROGRAM SECTIONS
C
C         SECTION A - GENERAL REMARKS
C         SECTION B - DATA INPUT LISTS.
C         SECTION C - COMMON, DIMENSION, AND DATA STATEMENTS.
C         SECTION D - FLOW DIAGRAM.
C         SECTION E - RUN SET-UP AND READ FIRST 6 INPUT CARDS.
C         SECTION F - INPUT AND PROCESS EMISSION INFORMATION.
C         SECTION G - RANK SIGNIFICANT SOURCES.
C         SECTION H - EMISSIONS WITH HEIGHT TABLE.
C         SECTION I - EXECUTE FOR INPUT OF SIGNIFICANT SOURCE NUMBERS.
C         SECTION J - CHECK MET. DATA IF FROM FILE OF ONE YEARS'S DATA.
C         SECTION K - GENERATE POLAR COORDINATE RECEPTORS.
C         SECTION L - READ POLAR COORDINATE ELEVATIONS.
C         SECTION M - READ AND PROCESS RECEPTOR INFORMATION.
C         SECTION N - POSITION FILES AS REQUIRED.
C         SECTION O - START LOOPS FOR DAY AND AVERAGING TIME; READ
C                        MET. DATA.
C         SECTION P - CALCULATE AND WRITE MET. SUMMARY INFORMATION.
C         SECTION Q - INITIALIZE FOR HOURLY LOOP.
C         SECTION R - BEGIN HOURLY LOOP.
C         SECTION S - CALCULATE AND STORE FOR HIGH-FIVE TABLE.
C         SECTION T - END HOURLY, AVERAGING TIME, AND DAILY LOOPS.
C         SECTION U - WRITE AVERAGE CONC. AND HIGH-FIVE TABLES.
C         SECTION V - CLOSE OUT FILES.
C         SECTION W - FORMAT STATEMENTS.
C         SECTION X - OUTLINE OF PROGRAM SECTIONS.
C         SECTION Y - INPUT AND OUTPUT FILE DESCRIPTIONS.
C         SECTION Z - INDEX AND GLOSSARY.
C
C
C->->->-> SECTION Y -  INPUT AND OUTPUT FILE DESCRIPTIONS.
C
C***      INPUT AND OUTPUT FILE DESCRIPTIONS.
C
C***  INPUT FILE (UNIT 11) METEOROLOGICAL DATA (USED IF IOPT(5)=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) EMISSION DATA (USED IF IOPT(6)=1)
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C
C      RECORD TYPE 1 (ONE FOR EACH HOUR OF SIMULATION)
C
C        IDATP        DATE-TIME INDICATOR CONSISTING OF YEAR, JULIAN DAY,
C                      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***  OUTPUT PUNCHED CARDS (UNIT 1) AVERAGE CONCENTRATIONS (PUNCHED IF
C                                   IOPT(24)=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
C        CC:6-15      RREC  EAST COORDINATE OF RECEPTOR, USER UNITS
C        CC:16-25     SREC  NORTH COORDINATE OF RECEPTOR, USER UNITS
C        CC:26-35     GWU   CONCENTRATION FOR AVERAGING TIME, MICROG/M**3
C        CC:36-55     BLANK
C        CC:56-59     K      RECEPTOR NUMBER
C        CC:60-69     ZR     RECEPTOR HEIGHT ABOVE GROUND, METERS
C        CC:70-79     ELR  RECEPTOR GROUND-LEVEL ELEVATION, USER HT UNITS
C
C***  OUTPUT FILE (UNIT 10) PARTIAL CONCENTRATIONS (USED IF IOPT(21)=1)
C
C     RECORD TYPE 1
C
C        NPER         NUMBER OF PERIODS
C        NAVG         NUMBER OF HOURS IN AVERAGING PERIOD.
C        LINE1(14)    80 ALPHANUMERIC CHARACTERS FOR TITLE.
C        LINE2(14)    80 ALPHANUMERIC CHARACTERS FOR TITLE.
C        LINE3(14)    80 ALPHANUMERIC CHARACTERS FOR TITLE.
C
C     RECORD TYPE 2 (FROM MPTER) (ONE FOR EACH AVERAGING PERIOD)
C
C        NRECEP       NUMBER OF RECEPTORS
C        NPT          NUMBER OF SOURCES
C        RREC(I),I=1,NRECEP  EAST COORDINATE OF RECEPTOR, USER UNITS
C        SREC(I),I=1,NRECEP  NORTH COORDINATE OF RECEPTOR, USER UNITS
C
C      RECORD TYPE 3 (ONE FOR EACH RECEPTOR FOR EACH SIMULATED HOUR,
C                     FROM PTR)
C
C        IDATE        YEAR AND JULIAN DAY
C        LH           HOUR
C        K            RECEPTOR NUMBER
C        PARTC(J),J=1,NPT  CONCENTRATION AT RECEPTOR K FROM SOURCE J,
C                           G/M**3.
C
C***  OUTPUT FILE (UNIT 12) HOURLY CONCENTRATIONS (USED IF IOPT(22)=1)
C
C     RECORD 1
C
C        NPER         NUMBER OF PERIODS
C        NAVG         NUMBER OF HOURS IN AVERAGING PERIOD.
C        LINE1(14)    80 ALPHANUMERIC CHARACTERS FOR TITLE.
C        LINE2(14)    80 ALPHANUMERIC CHARACTERS FOR TITLE.
C        LINE3(14)    80 ALPHANUMERIC CHARACTERS FOR TITLE.
C
C      RECORD 2
C
C        NRECEP       NUMBER OF RECEPTORS.
C        RREC(I),I=1,NRECEP  EAST COORDINATE OF RECEPTOR, USER UNITS
C        SREC(I),I=1,NRECEP  NORTH COORDINATE OF RECEPTOR, USER UNITS
C
C      RECORD TYPE 3 (ONE FOR EACH SIMULATED HOUR)
C
C        IDATE(2)     JULIAN DAY
C        LH           HOUR
C        PHCHI(I),I=1,NRECEP  HOURLY CONCENTRATION FOR EACH RECEPTOR,
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C                               G/M**3.
C
C***  OUTPUT FILE (UNIT 13) AVERAGING-PERIOD CONCENTRATIONS (USED IF
C                               IOPT(23)=1)
C
C       RECORD 1
C
C         NPER         NUMBER OF PERIODS
C         NAVG         NUMBER OF HOURS IN AVERAGING PERIOD.
C         LINE1(14)    80 ALPHANUMERIC CHARACTERS FOR TITLE.
C         LINE2(14)    80 ALPHANUMERIC CHARACTERS FOR TITLE.
C         LINE3(14)    80 ALPHANUMERIC CHARACTERS FOR TITLE.
C
C       RECORD 2
C
C         NRECEP       NUMBER OF RECEPTORS.
C         RREC(I),I=1,NRECEP  EAST COORDINATE OF RECEPTOR, USER UNITS
C         SREC(I),I=1,NRECEP  NORTH COORDINATE OF RECEPTOR, USER UNITS
C
C       RECORD TYPE 3 (ONE FOR EACH SIMULATED AVERAGING PERIOD)
C
C         IDATE(2)     JULIAN DAY
C         NB           ENDING HOUR OF PERIOD
C         PCHI(K),K=1,NRECEP  AVERAGING PERIOD CONCENTRATION FOR EACH
C                               RECEPTOR, G/M**3.
C
C***  TEMPORARY FILE (UNIT 14) VALUES FOR HIGH-FIVE TABLES (USED IF
C                               IOPT(20)=1)
C
C       ONLY RECORD
C
C         NDAY(ON WRITE)      NUMBER OF DAYS PROCESSED
C         IDAYS(ON READ       NUMBER OF DAYS PREVIOUSLY PROCESSED
C         SUM(180)            CUMULATION OF LONG-TERM CONCENTRATION,(G/M**3
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 W - FORMAT STATEMENTS.
C
C         INPUT FORMATS
C
1061  FORMAT(5X,T98,'# CALMS FOR PERIOD: ',I4)
1180  FORMAT (20A4/20A4/20A4)
1200  FORMAT (A4)
1210  FORMAT (3A4,8F8.2,F4.0)
1220  FORMAT (26I3)
1230  FORMAT (I2,8X,5F10.0)
1240  FORMAT (2A4,2F10.3,2F10.0)
C
C         ERROR STATEMENT FORMATS
C
1250  FORMAT (1X,' NSIGP (THE NO. OF SIGNF POINT SOURCES) WAS FOUND',' T
     1O EXCEED THE LIMIT (25).  USER TRIED TO INPUT ',I3,' SOURCES'/'
     2 *********EXECUTION TERMINATED**********')
1260  FORMAT (1H0,'CONTER VALUE IS OUTSIDE OF RANGE: ','ZERO TO ONE. EXE
     1CUTION TERMINATED.')
1270  FORMAT (' USER TRIED TO INPUT MORE THAN ',I4,' POINT SOURCES. THIS
     1 GOES BEYOND THE CURRENT PROGRAM DIMENSIONS.')
1280  FORMAT (1X,'NPT =  ',I3,'I.E., EQUAL OR LESS THAN ZERO'/' RUN TERM
     1INATED----CHECK INPUT DATA')
1290  FORMAT (1H1,'***ERROR---USER TRIED TO SPECIFY ',I4,' SIGNIFICANT S
     1OURCES, BUT IS ONLY ALLOWING ',I3,' TOTAL SIGNIFICANT SOURCES IN T
     2HIS RUN.',/2X,'***RUN TERMINATED-CHECK INPUT DATA!***')
1300  FORMAT (' (MPS) THE INPUT SIGNIFICANT SOURCE NUMBER ','WAS FOUND T
     1O EQUAL ZERO - USER CHECK INPUT DATA.')
1310  FORMAT (' SURFACE DATA IDENTIFIERS READ INTO MODEL (STATION=',I5,'
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     1 ,YEAR=',I2,') DO NOT AGREE WITH THE PREPROCESSOR OUTPUT FILE',/1XMPT15410
     2,' (STATION=',I5,' ,YEAR=',I2)                                   MPT15420
1320  FORMAT (' MIXING HEIGHT IDENTIFIERS READ INTO MODEL (STATION=',I5,MPT15430
     1' ,YEAR=',I2,') DO NOT AGREE WITH THE PREPROCESSOR OUTPUT FILE',/1MPT15440
     2X,' (STATION=',I5,' ,YEAR=',I2)                                  MPT15450
1330  FORMAT (1H0,' WRONG RECEPTOR ELEVATION CARD READ.','READ CARD FOR MPT15460
     1AZIMUTH ',I3,' SHOULD HAVE BEEN ',I3,'.')                        MPT15470
1340  FORMAT (1X,'****USER EITHER TRIED TO INPUT MORE THAN 180 ','RECEPTMPT15480
     1ORS OR ENDREC WAS NOT PLACED AFTER THE LAST RECEPTOR ','CARD****'/MPT15490
     2'********EXECUTION TERMINATED*******')                           MPT15500
1350  FORMAT (1X,'NO RECEPTORS HAVE BEEN CHOSEN')                      MPT15510
1360  FORMAT (1H0,'***DAYS DO NOT MATCH, IDAY = ',I4,', IDAYS = ',I4)  MPT15520
1370  FORMAT (' DATE ON MET. TAPE, ',I2,I3,' ,DOES NOT MATCH INTERNAL DAMPT15530
     1TE, ',I2,I3)                                                     MPT15540
1380  FORMAT (' HOUR ',I3,' IS NOT PERMITTED. HOURS MUST BE DEFINED BETWMPT15550
     1EEN 1 AND 24')                                                   MPT15560
1390  FORMAT (' DATE BEING PROCESSED IS= ',I8/1X,'DATE OF HOURLY POINT EMPT15570
     1MISSION RECORD IS =',I8/1X,'***PLEASE CHECK EMISSION RECORDS***') MPT15580
C                                                                      MPT15590
C       OUTPUT FORMATS                                                 MPT15600
C                                                                      MPT15610
 1395 FORMAT ('0',T35,A4,A1,1X,'MPTER - VERSION 85165'/1X,20A4/1X,20A4/ MPT15620
     *1X,20A4)                                                         MPT15630
 1400 FORMAT ('1',T40,A4,A1,1X,'MPTER - VERSION 85165'/1X,20A4/1X,20A4/ MPT15640
     *1X,20A4)                                                         MPT15650
1410  FORMAT (1H0,T30,'GENERAL INPUT INFORMATION'//2X,'THIS RUN OF MPTERMPT15660
     1-VERSION 85165 IS FOR ','THE POLLUTANT ',A4,' FOR ',I3,1X,I3,'-HOUMPT15670
     2R PERIODS.'/2X,'CONCENTRATION ESTIMATES BEGIN ON HOUR-',I2,', JULIMPT15680
     3AN DAY-',I3,', YEAR-19',I2,'.'/1X,' A FACTOR OF ',F14.7,' HAS BEENMPT15690
     4 SPECIFIED TO ','CONVERT USER LENGTH UNITS TO KILOMETERS.'/1X,I3,'MPT15700
     5 SIGNIFICANT SOURCES ARE TO BE CONSIDERED.')                     MPT15710
1420  FORMAT (1H ,'THIS RUN WILL NOT CONSIDER ANY POLLUTANT LOSS.')    MPT15720
1430  FORMAT (1H ,2X,'A HALF-LIFE OF ',F10.2,' (SECONDS) HAS BEEN ASSUMEMPT15730
     1D BY THE USER.')                                                 MPT15740
1440  FORMAT (1X,' HIGH-FIVE SUMMARY CONCENTRATION TABLES ','WILL BE OUTMPT15750
     1PUT FOR ',I3,' AVERAGING PERIODS.'/' AVG TIMES ','OF 1,3,8, AND 2MPT15760
     24 HOURS ARE AUTOMATICALLY DISPLAYED.')                           MPT15770
1450  FORMAT (1H ,2X,'A FACTOR OF ',F14.7,' HAS BEEN SPECIFIED TO CONVERMPT15780
     1T USER HEIGHT UNITS TO METERS.')                                 MPT15790
1460  FORMAT (1H0,T3,'OPTION ',T16,'OPTION LIST',T46,'OPTION SPECIFICATMPT15800
     1ION : 0= IGNORE OPTION'/1X,T68,' 1= USE OPTION'/T25,'TECHNICAL OPTMPT15810
     2IONS'/1X,T7,I2,T16,'TERRAIN ADJUSTMENTS',T70,I1/1X,T7,I2,T16,'DO NMPT15820
     3OT INCLUDE STACK DOWNWASH CALCULATIONS',T70,I1/1X,T7,I2,T16,'DO NOMPT15830
     4T INCLUDE GRADUAL PLUME RISE CALCULATIONS',T70,I1/1X,T7,I2,T16,'CAMPT15840
     5LCULATE INITIAL PLUME SIZE',T70,I1/1X,T25,'INPUT OPTIONS'/1X,T7,I2MPT15850
     6,T16,'READ MET DATA FROM CARDS',T70,I1/1X,T7,I2,T16,'READ HOURLY EMPT15860
     7MISSIONS',T70,I1/1X,T7,I2,T16,'SPECIFY SIGNIFICANT SOURCES',T70,I1MPT15870
     8/1X,T7,I2,T16,'READ RADIAL DISTANCES TO GENERATE RECEPTORS',T70,I1MPT15880
     9/T25,'PRINTED OUTPUT OPTIONS'/1X,T7,I2,T16,'DELETE EMISSIONS WITH MPT15890
     AHEIGHT TABLE',T70,I1/1X,T7,I2,T16,'DELETE MET DATA SUMMARY FOR AVGMPT15900
     B PERIOD',T70,I1/1X,T7,I2,T16,'DELETE HOURLY CONTRIBUTIONS',T70,I1/MPT15910
     C1X,T7,I2,T16,'DELETE MET DATA ON HOURLY CONTRIBUTIONS',T70,I1/1X,TMPT15920
     D7,I2,T16,'DELETE FINAL PLUME RISE CALC ON HRLY CONTRIBUTIONS',T70,MPT15930
     EI1)                                                              MPT15940
1470  FORMAT (1X,T7,I2,T16,'DELETE HOURLY SUMMARY',T70,I1/1X,T7,I2,T16,'MPT15950
     1DELETE MET DATA ON HRLY SUMMARY',T70,I1/1X,T7,I2,T16,'DELETE FINALMPT15960
     2 PLUME RISE CALC ON HRLY SUMMARY',T70,I1/1X,T7,I2,T16,'DELETE AVG-MPT15970
     3PERIOD CONTRIBUTIONS',T70,I1/1X,T7,I2,T16,'DELETE AVERAGING PERIODMPT15980
     4 SUMMARY',T70,I1/1X,T7,I2,T16,'DELETE AVG CONCENTRATIONS AND HI-5 MPT15990
     5TABLES',T70,I1/T25,'OTHER CONTROL AND OUTPUT OPTIONS'/1X,T7,I2,T16MPT16000
     6,'RUN IS PART OF A SEGMENTED RUN',T70,I1/1X,T7,I2,T16,'WRITE PARTIMPT16010
     7AL CONC TO DISK OR TAPE',T70,I1/1X,T7,I2,T16,'WRITE HOURLY CONC TOMPT16020
     8 DISK OR TAPE',T70,I1/1X,T7,I2,T16,'WRITE AVG-PERIOD CONC TO DISK MPT16030
     9OR TAPE',T70,I1/1X,T7,I2,T16,'PUNCH AVG-PERIOD CONC ONTO CARDS',T7MPT16040
     A0,I1/T25,'DEFAULT OPTION '/1X,T7,I2,T16,                         MPT16050
     B'USE DEFAULT OPTION',T70,I1)                                     MPT16060
1480  FORMAT (1H0,2X,'ANEMOMETER HEIGHT= ',F10.2/3X,'WIND PROFILE WITH 'MPT16070
     1,'HEIGHT EXPONENTS CORRESPONDING TO STABILITY ARE AS FOLLOWS:'/8X,MPT16080
     2'FOR STABILITY A: ',F4.2/12X,'STABILITY B: ',F4.2/12X,'STABILITY CMPT16090
     3: ',F4.2,/12X,'STABILITY D: ',F4.2,/12X,'STABILITY E: ',F4.2/12X,'MPT16100
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      4STABILITY F: ',F4.2)
 1490 FORMAT (1H0,'ANEMOMETER HEIGHT IS:',F10.2/1X,'EXPONENTS FOR POWER-
      1 LAW WIND INCREASE WITH HEIGHT ARE:',F4.2,5(',',F4.2)/' TERRAIN AD
      2JUSTMENTS ARE: ',F5.3,5(',',F5.3)//)
 1500 FORMAT ('1',T40,'POINT SOURCE INFORMATION'//1X,T5,'SOURCE',T23,'EA
      1ST',T31,'NORTH',T39,'SO2(G/SEC)  PART(G/SEC)  STACK  STACK   STACK
      2  STACK',3X,'POTEN. IMPACT',2X,'EFF',3X,'GRD-LVL BUOY FLUX'/1X,T2
      33,'COORD',T31,'COORD','  EMISSIONS   EMISSIONS   HT(M) TEMP(K) D
      4IAM(M)','VEL(M/SEC)(MICRO G/M**3) HT(M)',3X,'ELEV',6X,'F'/1X,T24,'
      5(USER UNITS)',T116,'USER HT M**4/S**3'/1X,T117,'UNITS'/)
 1510 FORMAT (1X,I3,1X,3A4,1X,2F9.2,2F12.2,4F8.2,6PF13.2,0PF9.2,2F9.2)
 1520 FORMAT ('0',T3,'SIGNIFICANT ',A4,' POINT SOURCES'//1X,T8,'RANK',T2
      12,'CHI-MAX',T33,'SOURCE NO.'/1X,T17,'(MICROGRAMS/M**3)'/1X)
 1530 FORMAT (1X,T9,I3,T18,6PF12.2,T35,I3)
 1540 FORMAT (1X,'HEIGHT ABOVE 100M FOR POINT SOURCE',I4,3X,' HEIGHT=',F
      16.2,' (METERS)','   EMISSIONS=',F10.2,' (G/SEC)')
 1550 FORMAT ('0',4X,'TOTAL ',A4,' EMISSION AND CUMULATIVE FRACTION ACCO
      1RDING TO HEIGHT'//1X,T12,'TOTAL POINT   CUMULATIVE '/1X,'HEIGHT(M)
      2 EMISSIONS(G/S)   FRACTION'/1X)
 1560 FORMAT (1X,T2,I2,' -',I3,T11,F8.2,T26,F7.3,T41,F8.2,T56,F7.3)
 1570 FORMAT ('0',T2,'TOTAL',2X,F10.2)
 1580 FORMAT (1H0,21X,'ADDITIONAL INFORMATION ON SOURCES.')
 1590 FORMAT (1H0,'  USER SPECIFIED ',I3,' (NPT) SIGNIFICANT POINT ','SO
      1URCES AS LISTED BY POINT SOURCE NUMBER:'/2X,25I5)
 1600 FORMAT ('0',2X,'EMISSION INFORMATION FOR ',I4,' (NPT) POINT SOUR',
      1'CES HAS BEEN INPUT'/2X,I2,' SIGNIFICANT POINT SOURCES(NSIGP) ','A
      2RE TO BE',' USED FOR THIS RUN'/2X,'THE ORDER OF SIGNIFICANCE(IMPS)
      3 FOR 25 OR LESS POINT SOURCES USED IN THIS RUN AS LISTED BY POINT
      4SOURCE NUMBER:'/2X,25I5)
 1610 FORMAT (2X,'SURFACE MET DATA FROM STATION(ISFCD) ',I6,', YEAR(ISFC
      1YR) 19',I2/2X,'MIXING HEIGHT DATA FROM STATION(IMXD) ',I6,', YEAR(
      2IMXYR) 19',I2)
 1620 FORMAT (1H0,T21,'RECEPTOR INFORMATION')
 1630 FORMAT (1H0,' MPTER INTERNALLY GENERATES 36 RECEPTORS ','ON A CIRC
      1LE CORRESPONDING TO EACH NON-ZERO ','RADIAL DISTANCE FROM A CENTER
      2 POINT '/1X,T10,'COORDINATES ARE (USER UNITS): (',F8.3,',',F8.3,')'
      3/1X,T10,'RADIAL DISTANCE(S) USER SPECIFIED (USER UNITS): ',5(F11.3
      4,' '))
 1640 FORMAT (F4.1)
 1650 FORMAT ('0',' RECEPTOR    IDENTIFICATION   EAST     NORTH     RECEP
      1TOR HT     RECEPTOR GROUND LEVEL'/1X,T30,'COORD',T39,'COORD  ABV L
      2OCAL GRD LVL          ELEVATION'/1X,T31,'(USER UNITS)        (METER
      3S)        (USER HT UNITS)'/1X)
 1660 FORMAT (1X,T3,I3,2A1,8X,2A4,F13.3,F10.3,F10.1,F20.1)
 1670 FORMAT (1H0,T3,'* ONE ASTERISK INDICATES THAT THE ASSOCIATED ','RE
      1CEPTOR(S) HAVE A GROUND LEVEL ELEVATION LOWER ','THAN THE LOWEST S
      2OURCE BASE ELEVATION.'/' CAUTION SHOULD ','BE USED IN INTERPRETING
      3 CONCENTRATIONS FOR THESE RECEPTORS.'/' **  TWO ASTERISKS ','INDIC
      4ATE THAT THE ASSOCIATED RECEPTOR(S) HAVE GROUND LEVEL ','ELEVATION
      5S ABOVE THE LOWEST STACK TOP.'/'     CONSEQUENTLY',' NO CALCULATION
      6S WILL BE PERFORMED WITH THIS RECEPTOR.A ','SERIES OF ASTERISKS WI
      7LL INSTEAD APPEAR IN THE OUTPUT.')
 1680 FORMAT (//1X,' THE NUMBER OF   DAYS  PREVIOUSLY COMPLETED EQUAL ',
      1I3,' AND THE LAST   DAY  TO BE COMPLETED IN THIS RUN IS ',I3)
 1690 FORMAT ('1INPUT MET DATA   ',I2,'/',I4/1X,T2,'HOUR   THETA    SPEED
      1   MIXING    TEMP     STABILITY'/1X,T9,'(DEG)     (M/S)  HEIGHT(M)  (
      2DEG-K)  CLASS'/1X)
 1700 FORMAT (1X,T3,I2,4F9.2,6X,I1)
 1710 FORMAT ('0','RESULTANT MET CONDITIONS'/1X)
 1720 FORMAT (2X,'WIND DIRECTION=',F7.2,T36,'RESULTANT WIND SPEED=',F7.2
      1/2X,'AVERAGE WIND SPEED=',F7.2,T36,'AVERAGE TEMP=',F7.2/2X,'WIND P
      2ERSISTENCE=',F6.3,T36,'MODAL STABILITY=',I2)
 1730 FORMAT (1H0,' THIS SEGMENT OF A SEGMENTED RUN HAS COMPLETED',I5,'
      1(IDAY) DAYS.')
 1740 FORMAT ('0',T9,'        RECEPTORS'//1X,'RECEPTOR     IDENTIFICATION
      1EAST      NORTH      RECEPTOR HT      RECEPTOR GROUND LEVEL',T99,'AVG
      2 CONC FOR PERIOD'/1X,T30,'COORD',T39,'COORD  ABV LOCAL GRD LVL
      3    ELEVATION',T94,'DAY',F4.0,'HR',F3.0,' TO DAY',F4.0,'HR',F3.0/1X
      4,T31,'(USER UNITS)          (METERS)          (USER HT UNITS)',T100,'
      5(MICROGRAMS/M**3)'/1X)
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1750  FORMAT (1X,T3,I3,10X,2A4,5X,F8.2,2X,F8.2,F10.1,F20.1,T110,A1,6PF7.MPT16810
     12)                                                                MPT16820
1760  FORMAT (1H1,T29,'FIVE HIGHEST ',I2,'-HOUR ',A4,' CONCENTRATIONS((EMPT16830
     1NDING ON JULIAN DAY, HOUR)'/1X,T55,'(MICROGRAMS/M**3)'//2X,'RECEPTMPT16840
     2OR ',T38,4(I1,20X),I1,/1X)                                        MPT16850
1761  FORMAT (1H1,T29,'FIVE HIGHEST ',I2,'-HOUR ',A4,' CONCENTRATIONS((EMPT16860
     1NDING ON JULIAN DAY, HOUR)'/1X,T55,'(MICROGRAMS/M**3)'/           MPT16870
     21X,T36,'C-FLAG IDENTIFIES CONCENTRATIONS AFFECTED BY CALM HOURS'//MPT16880
     32X,'RECEPTOR ',T38,4(I1,20X),I1,/1X)                              MPT16890
1770  FORMAT (1H ,2X,I3,'(',F7.2,',',F7.2,')',2(1X,A1,6PF9.2,A1,1X,'(',IMPT16900
     13,',',I2,')'),3(2X,6PF9.2,A1,1X,'(',I3,',',I2,')'))              MPT16910
C                                                                       MPT16920
      END                                                               MPT16930
C
      BLOCK DATA                                                        MPT16950
C                       BLOCK DATA          (VERSION 79365), PART OF MPTER.  MPT16960
      COMMON /EXPOS/ PXUCOF(6,9),PXUEXP(6,9),HC1(10),BXUCOF(6,9),BXUEXP(MPT16970
     *6,9)                                                              MPT16980
C***COEFFICIENTS GENERATED WITH RURAL SIGMAS USING PGYZ                 MPT16990
C***RELATIVE CONC. NORMALIZED FOR WIND SPEED FROM PT SOURCE, CHI*U/Q, = MPT17000
C***     PXUCOF(KST,IH)*H**PXUEXP(KST,IH)                               MPT17010
C***   IH=1 FOR H LESS THAN 20 METERS.                                 MPT17020
C***   IH=2 FOR H FROM 20 TO 30 METERS.                                MPT17030
C***   IH=3 FOR H FROM 30 TO 50 METERS.                                MPT17040
C***   IH=4 FOR H FROM 50 TO 70 METERS.                                MPT17050
C***   IH=5 FOR H FROM 70 TO 100 METERS.                               MPT17060
C***   IH=6 FOR H FROM 100 TO 200 METERS.                              MPT17070
C***   IH=7 FOR H FROM 200 TO 300 METERS.                              MPT17080
C***   IH=8 FOR H FROM 300 TO 500 METERS.                              MPT17090
C***   IH=9 FOR H GREATER THAN 500 METERS.                             MPT17100
      DATA PXUCOF /.10401E+00,.12133E+00,.14273E+00,.15351E+00,.18855E+0MPT17110
     10,.18668E+00,.77533E-01,.11728E+00,.14120E+00,.18239E+00,.20458E+0MPT17120
     20,.34326E+00,.67228E-01,.10013E+00,.13963E+00,.19162E+00,.38998E+0MPT17130
     30,.76271E+00,.40484E-01,.75308E-01,.13784E+00,.54357E+00,.72550E+0MPT17140
     40,.22936E+01,.28539E-01,.66936E-01,.13615E+00,.52790E+00,.12908E+0MPT17150
     51,.56943E+01,.14792E-01,.65799E-01,.13315E+00,.74832E+00,.28818E+0MPT17160
     61,.40940E+03,.12403E-01,.64321E-01,.12927E+00,.10826E+01,.77020E+0MPT17170
     72,.23011E+05,.12340E-01,.62874E-01,.12546E+00,.15580E+01,.68810E+0MPT17180
     83,.46522E+06,.12245E-01,.60615E-01,.11952E+00,.22517E+01,.42842E+0MPT17190
     93,.00000E+00/                                                     MPT17200
      DATA PXUEXP /-.19460E+01,-.19774E+01,-.20086E+01,-.20742E+01,-.218MPT17210
     122E+01,-.22176E+01,-.18479E+01,-.19661E+01,-.20050E+01,-.21317E+01MPT17220
     2,-.22094E+01,-.24209E+01,-.18060E+01,-.19196E+01,-.20017E+01,-.214MPT17230
     362E+01,-.23991E+01,-.26556E+01,-.16763E+01,-.18468E+01,-.19984E+01MPT17240
     4,-.24128E+01,-.25578E+01,-.29371E+01,-.15940E+01,-.18191E+01,-.199MPT17250
     555E+01,-.24059E+01,-.26934E+01,-.31511E+01,-.14513E+01,-.18153E+01MPT17260
     6,-.19907E+01,-.24817E+01,-.28678E+01,-.40795E+01,-.14181E+01,-.181MPT17270
     711E+01,-.19851E+01,-.25514E+01,-.34879E+01,-.48399E+01,-.14172E+01MPT17280
     8,-.18071E+01,-.19799E+01,-.26152E+01,-.38719E+01,-.53670E+01,-.141MPT17290
     960E+01,-.18012E+01,-.19721E+01,-.26744E+01,-.37956E+01,-.17020E+02MPT17300
     A/                                                                 MPT17310
C                                                                       MPT17320
C***COEFFICIENTS GENERATED WITH URBAN SIGMAS USING BRSYSZ & BRSZ        MPT17330
C***  FROM RAM MODEL.                                                   MPT17340
C***RELATIVE CONCENTRATIONS NORMALIZED FOR WIND SPEED FROM POINT        MPT17350
C***  SOURCE, CHI*U/Q, =BXUCOF(KST,IH)*H**BXUEXP(KST,IH)               MPT17360
C***   IH=1 FOR H LESS THAN 20 METERS.                                 MPT17370
C***   IH=2 FOR H FROM 20 TO 30 METERS.                                MPT17380
C***   IH=3 FOR H FROM 30 TO 50 METERS.                                MPT17390
C***   IH=4 FOR H FROM 50 TO 70 METERS.                                MPT17400
C***   IH=5 FOR H FROM 70 TO 100 METERS.                               MPT17410
C***   IH=6 FOR H FROM 100 TO 200 METERS.                              MPT17420
C***   IH=7 FOR H FROM 200 TO 300 METERS.                              MPT17430
C***   IH=8 FOR H FROM 300 TO 500 METERS.                              MPT17440
C***   IH=9 FOR H GREATER THAN 500 METERS.                             MPT17450
C                                                                       MPT17460
      DATA BXUCOF /.16808E+00,.16808E+00,.20927E+00,.20378E+00,.18861E+0MPT17470
     10,.18861E+00,.15945E+00,.15945E+00,.20527E+00,.20229E+00,.21253E+0MPT17480
     20,.21253E+00,.14777E+00,.14777E+00,.19871E+00,.20011E+00,.24888E+0MPT17490
     30,.24888E+00,.13262E+00,.13262E+00,.18908E+00,.19685E+00,.30041E+0MPT17500
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     40,.30041E+00,.11745E+00,.11745E+00,.17767E+00,.19301E+00,.34521E+0MPT17510
     50,.34521E+00,.91943E-01,.91943E-01,.15327E+00,.18499E+00,.34368E+0MPT17520
     60,.34368E+00,.65533E-01,.65533E-01,.11984E+00,.17445E+00,.23640E+0MPT17530
     70,.23640E+00,.47345E-01,.47345E-01,.89821E-01,.16720E+00,.15537E+0MPT17540
     80,.15537E+00,.29993E-01,.29993E-01,.56100E-01,.16747E+00,.11009E+0MPT17550
     90,.11009E+00/                                                     MPT17560
      DATA BXUEXP /-.19722E+01,-.19722E+01,-.19896E+01,-.19965E+01,-.206MPT17570
     149E+01,-.20649E+01,-.19546E+01,-.19546E+01,-.19831E+01,-.19940E+01MPT17580
     2,-.21047E+01,-.21047E+01,-.19322E+01,-.19322E+01,-.19736E+01,-.199MPT17590
     308E+01,-.21512E+01,-.21512E+01,-.19045E+01,-.19045E+01,-.19609E+01MPT17600
     4,-.19867E+01,-.21993E+01,-.21993E+01,-.18759E+01,-.18759E+01,-.194MPT17610
     562E+01,-.19820E+01,-.22320E+01,-.22320E+01,-.18228E+01,-.18228E+01MPT17620
     6,-.19142E+01,-.19728E+01,-.22310E+01,-.22310E+01,-.17589E+01,-.175MPT17630
     789E+01,-.18677E+01,-.19617E+01,-.21604E+01,-.21604E+01,-.17019E+01MPT17640
     8,-.17019E+01,-.18172E+01,-.19543E+01,-.20868E+01,-.20868E+01,-.162MPT17650
     984E+01,-.16284E+01,-.17414E+01,-.19545E+01,-.20314E+01,-.20314E+01MPT17660
     A/                                                                 MPT17670
      DATA HC1 /10.,20.,30.,50.,70.,100.,200.,300.,500.,1000./          MPT17680
C                                                                       MPT17690
      END                                                               MPT17700
C
      FUNCTION ANGARC (DELM,DELN)                                       MPT17720
C                    FUNCTION ANGARC    (VERSION 79365), PART OF MPTER. MPT17730
C        DETERMINES APPROPRIATE ANGLE OF TAN(ANG) = DELM/DELN           MPT17740
C        WHICH IS REQUIRED FOR CALCULATION OF RESULTANT WIND DIRECTION. MPT17750
C        DELM IS THE AVERAGE WIND COMPONENT IN THE EAST DIRECTION.      MPT17760
C        DELN IS THE AVERAGE WIND COMPONENT IN THE NORTH DIRECTION.     MPT17770
C        NO COMMON REQUIREMENT, NO ARRAYS, USES LIBRARY FUNCTION ATAN   MPT17780
      IF (DELN) 10,40,80                                                MPT17790
10    IF (DELM) 20,30,20                                                MPT17800
20    ANGARC=57.29578*ATAN(DELM/DELN)+180.                              MPT17810
      RETURN                                                            MPT17820
30    ANGARC=180.                                                       MPT17830
      RETURN                                                            MPT17840
40    IF (DELM) 50,60,70                                                MPT17850
50    ANGARC=270.                                                       MPT17860
      RETURN                                                            MPT17870
60    ANGARC=0.                                                         MPT17880
C     ANGARC=0. INDICATES INDETERMINATE ANGLE                           MPT17890
      RETURN                                                            MPT17900
70    ANGARC=090.                                                       MPT17910
      RETURN                                                            MPT17920
80    IF (DELM) 90,100,110                                              MPT17930
90    ANGARC=57.29578*ATAN(DELM/DELN)+360.                              MPT17940
      RETURN                                                            MPT17950
100   ANGARC=360.                                                       MPT17960
      RETURN                                                            MPT17970
110   ANGARC=57.29578*ATAN(DELM/DELN)                                   MPT17980
      RETURN                                                            MPT17990
C                                                                       MPT18000
      END                                                               MPT18010
C
      SUBROUTINE PTR                                                    MPT18030
C                    SUBROUTINE PTR     (VERSION 81350), PART OF MPTER. MPT18040
C      THE PURPOSE OF THIS ROUTINE IS TO CALCULATE CONCENTRATIONS FROM  MPT18050
C      POINT SOURCES.                                                   MPT18060
C                                                                       MPT18070
C->->->->SECTION PTR.A - COMMON AND DIMENSION.                          MPT18080
C                                                                       MPT18090
      COMMON /MPOR/ IOPT(25)                                            MPT18100
      COMMON /MPO/ NRECEP,NAVG,NB,LH,NPT,IDATE(2),RREC(180),SREC(180),ZRMPT18110
     1(180),ELR(180),PHCHI(180),PHSIGS(180,26),HSAV(250),DSAV(250),PCHI(MPT18120
     2180),PSIGS(180,26),IPOL                                           MPT18130
      COMMON /MPR/ UPL,Z,H,HL,X,Y,KST,DELH,SY,SZ,RC,MUOR                MPT18140
      COMMON /MP/ SOURCE(9,250),CONTWO,PSAV(250),IPSIGS(250),U,TEMP,SINTMPT18150
     1,COST,PL(6),ELP(250),ELHN,HANE,TLOS,CELM,CTER                     MPT18160
      DIMENSION UPH(250), HPR(250), FP(250), DH(250), PARTC(250)        MPT18170
C                                                                       MPT18180
C->->->->SECTION PTR.B - INITIALIZE AND START RECEPTOR LOOP.            MPT18190
C                                                                       MPT18200
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C         ZERO EFFECTIVE STACK HEIGHT FOR EACH SOURCE
C
C           NPT - THE NUMBER OF POINT SOURCES
      DO 10 J=1,NPT
C        HSAV WILL BE USED TO STORE THE SOURCE PLUME HEIGHTS.
10    HSAV(J)=0.0
C        LOOP ON RECEPTORS
C          NRECEP - THE NUMBER OF RECEPTORS
      DO 180 K=1,NRECEP
C        IF IOPT(1)=1, TERRAIN ADJUSTMENTS ARE MADE.
      IF (IOPT(1).EQ.0) GO TO 20
C          ELR - RECEPTOR GROUND LEVEL ELEVATION
      ER=ELR(K)
C          ELHN - LOWEST SOURCE STACK-TOP ELEVATION?
      IF (ER.LE.ELHN) GO TO 20
      PCHI(K)=99999.E+26
      PHCHI(K)=99999.E+26
      GO TO 180
20    CONTINUE
C          ZR - RECEPOR HEIGHT ABOVE GROUND
      Z=ZR(K)
C
C->->->->SECTION PTR.C - START SOURCES LOOP, CALCULATE
C                        UPWIND AND CROSSWIND DISTANCES.
C
      DO 170 J=1,NPT
      PARTC(J)=0.0
C          RQ - EAST COORDINATE OF THE SOURCE
      RQ=SOURCE(1,J)
C          SQ - NORTH COORDINATE OF THE SOURCE
      SQ=SOURCE(2,J)
C          ELP - SOURCE GROUND LEVEL ELEVATION
      EP=ELP(J)
C        DETERMINE UPWIND DISTANCE
C        XDUM,YDUM IN USER UNITS. X,Y IN KM.
C          RREC - EAST COORDINATE OF THE RECEPTOR
      XDUM=RQ-RREC(K)
C          SREC - NORTH COORDINATE OF THE RECEPTOR
      YDUM=SQ-SREC(K)
C        SINT AND COST ARE THE SIN AND COS OF THE WIND DIRECTION
C        CONTWO - MULTIPLIER CONSTANT TO CONVERT USER UNITS TO KM
      X=(YDUM*COST+XDUM*SINT)*CONTWO
C         X IS THE UPWIND DISTANCE  OF THE SOURCE FROM THE RECEPTOR.
C        IF X IS NEGATIVE, INDICATING THAT THE SOURCE IS DOWNWIND OF
C        THE RECEPTOR, THE CALCULATION IS TERMINATED ASSUMING NO
C        CONTRIBUTION FROM THAT SOURCE.
      IF (X.LE.0.0) GO TO 170
C
C        DETERMINE CROSSWIND DISTANCE
C
      Y=(YDUM*SINT-XDUM*COST)*CONTWO
      H=HSAV(J)
C        SKIP PLUME RISE CALCULATION IF EFFECTIVE HT. HAS ALREADY BEEN
C           CALCULATED FOR THIS SOURCE
      IF (H.EQ.0.0) GO TO 30
      DELH=DH(J)
C
C->->->->SECTION PTR.D - EXTRAPOLATE WIND SPEED TO STACK TOP
C                        CALCULATE PLUME RISE.
C
      GO TO 110
C         MODIFY WIND SPEED BY POWER LAW PROFILE IN ORDER TO TAKE INTO
C        ACCOUNT THE INCREASE OF WIND SPEED WITH HEIGHT.
C        ASSUME WIND MEASUREMENTS ARE REPRESENTATIVE FOR HEIGHT = HANE.
C         THT IS THE PHYSICAL STACK HEIGHT
30    THT=SOURCE(5,J)
C        POINT SOURCE HEIGHT NOT ALLOWED TO BE LESS THAN 1 METER.
      IF (THT.LT.1.) THT=1.
C          U - WIND SPEED AT HEIGHT 'HANE'
C          PL - POWER FOR THE WIND PROFILE
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C          UPL - WIND AT THE PHYSICAL STACK HEIGHT
      UPL=U*(THT/HANE)**PL(KST)
C        WIND SPEED NOT ALLOWED TO BE LESS THAN 1 METER/SEC.
      IF (UPL.LT.1.) UPL=1.
C        STORE THE STACK TOP WIND FOR THE JTH SOURCE FOR THIS HOUR
      UPH(J)=UPL
      VS=SOURCE(8,J)
      BUOY=SOURCE(9,J)
      TS=SOURCE(6,J)
C        TEMP- THE AMBIENT AIR TEMPERATURE FOR THIS HOUR
      DELT=TS-TEMP
      F=BUOY*DELT/TS
C          IOPT(6) HOURLY EMISSION INPUT FROM TAPE/DISK?  0=NO, 1=YES.
      IF (IOPT(6).EQ.0) GO TO 40
C        MODIFY EXIT VELOCITY AND BUOYANCY BY RATIO OF HOURLY EMISSIONS
C        TO AVERAGE EMISSIONS
      SCALE = SOURCE(IPOL,J)/PSAV(J)
      VS = VS*SCALE
      F = F*SCALE
40    D=SOURCE(7,J)
C
C*****PLUME RISE AND STACK TIP DOWNWASH CALCULATIONS
C
C        CALCULATE  H PRIME WHICH TAKES INTO ACCOUNT STACK DOWNWASH
C        BRIGGS(1973) PAGE 4
      HPRM=THT
C        IF IOPT(2)=1, THEN NO STACK DOWNWASH COMPUTATION
      IF (IOPT(2).EQ.1) GO TO 50
      DUM=VS/UPL
      IF (DUM.LT.1.5) HPRM=THT+2.*D*(DUM-1.5)
C        'HPRM' IS BRIGGS' H-PRIME
      IF (HPRM.LT.0.) HPRM=0.
C
C        CALCULATE PLUME RISE
C         MOMENTUM RISE EQUATION
C
50    DELHM=3.*VS*D/UPL
      IF(KST.GT.4)GO TO 70
C
C        PLUME RISE FOR NEUTRAL - UNSTABLE CONDITIONS
C
      IF(TS.LT.TEMP)GO TO 80
      IF(F.GE.55.)GO TO 60
C
C        COMBINATION OF BRIGG'S(1971) EQNS. 6&7, PAGE 1031, FOR F<55.
C
      DELH=21.425*F**0.75/UPL
      IF(DELHM.GT.DELH)GO TO 80
      DISTF=0.049*F**0.625
      GO TO 100
C
C        COMBINATION OF BRIGG'S(1971) EQNS. 6&7, PAGE 1031, FOR F>=55.
C
60    DELH=38.71*F**0.6/UPL
      IF(DELHM.GT.DELH)GO TO 80
      DISTF=0.119*F**0.4
      GO TO 100
C
C        PLUME RISE FOR STABLE CONDITIONS
C
70    DTHDZ=0.02
      IF(KST.GT.5)DTHDZ=0.035
      S=9.80616*DTHDZ/TEMP
C
C        MOMENTUM RISE EQUATION
C        BRIGG'S(1969) EQUATION 4.28, PAGE 59
C
      DHA=1.5*(VS*VS*D*D*TEMP/(4.*TS*UPL))**0.333333/S**0.166667
      IF(DHA.LT.DELHM)DELHM=DHA
      IF(TS.LT.TEMP)GO TO 80
```

```
C
C         STABLE, BUOYANT RISE (WITH WIND)
C
      DELH=2.6*(F/(UPL*S))**0.333333
      IF(DELHM.GT.DELH)GO TO 80
      DISTF=0.0020715*UPL/SQRT(S)
      GO TO 100
80    DELH=DELHM
      DISTF=0.
100   H=HPRM+DELH
105   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.
110   IF (X.GE.DSAV(J)) GO TO 120
      IF (IOPT(4).EQ.0.AND.IOPT(3).EQ.1) GO TO 120
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 COEFFICIENTS 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(3).EQ.1) GO TO 120
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
120   UPL=UPH(J)
C
C->->->->SECTION PTR.E - CALCULATE THE CONTRIBUTION OF
C                         ONE SOURCE TO ONE RECEPTOR.
C
      IF(KST.GT.4)GOTO130
      IF (H.LT.HL) GO TO 130
      PROD=0.
      GO TO 150
C        IF IOPT(1) = 1, TERRAIN ADJUSTMENTS ARE MADE
130   IF (IOPT(1).EQ.0) GO TO 140
      DUM=ER-EP
      H=H+CELM*(CTER*DUM-DUM)
C         RCP RETURNS THE DISPERSION PARAMETERS, SY AND SZ (METERS)
C        AND THE RELATIVE CONCENTRATION VALUES CHI/Q (SEC/M**3)
140   CALL RCP
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 COMPUTATION OF POLLUTANT LOSS.
C        INCREMENT CONCENTRATION AT K-TH RECEPTOR(G/M**3)
C          PCHI - SUM FOR THE AVERAGING TIME AT RECEPTOR K
150   PCHI(K)=PCHI(K)+PROD
C          PHCHI - CONCENTRATION FOR THIS HOUR AT RECEPTOR K
      PHCHI(K)=PHCHI(K)+PROD
      KSIG=IPSIGS(J)
      IF (KSIG.EQ.0) GO TO 160
C        STORE CONCENTRATIONS FROM SIGNIFICANT SOURCES.(G/M**3)
      PSIGS(K,KSIG)=PSIGS(K,KSIG)+PROD
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      PHSIGS(K,KSIG)=PHSIGS(K,KSIG)+PROD
      PSIGS(K,26)=PSIGS(K,26)+PROD
      PHSIGS(K,26)=PHSIGS(K,26)+PROD
160   PARTC(J)=PROD
C
C->->->->SECTION PTR.F - END SOURCE AND RECEPTOR LOOPS.
C
170   CONTINUE
C        END OF LOOP FOR SOURCES
C        WRITE PARTIAL CONCENTRATIONS ON DISK(G/M**3)  IF IOPT(21) = 1.
      IF (IOPT(21).EQ.0) GO TO 180
C        USER PLEASE NOTE: PARTIAL CONC. IN G/M**3, NOT MICROGRAM/M**3
      WRITE (10) IDATE,LH,K,(PARTC(J),J=1,NPT)
180   CONTINUE
C        END OF LOOP FOR RECEPTORS
      RETURN
C
C***    SECTIONS OF SUBROUTINE PTR.
C          SECTION PTR.A -  COMMON AND DIMENSION.
C          SECTION PTR.B -  INITIALIZE AND START RECEPTOR LOOP.
C          SECTION PTR.C -  START SOURCES LOOP; CALCULATE UPWIND AND
C                            CROSSWIND DISTANCES.
C          SECTION PTR.D -  EXTRAPOLATE WIND SPEED TO STACK TOP;
C                            CALCULATE PLUME RISE.
C          SECTION PTR.E -  CALCULATE CONTRIBUTION FROM A SOURCE TO ONE
C                            RECEPTOR.
C          SECTION PTR.F -  END SOURCE AND RECEPTOR LOOPS.
C
      END
C
      SUBROUTINE RCP
C                    SUBROUTINE RCP    (VERSION 79365), PART OF MPTER.
C
C->->->->SECTION RCP.A - COMMON.
      COMMON /MPOR/ IOPT(25)
      COMMON /MPR/ UPL,Z,H,HL,X,Y,KST,DELH,SY,SZ,RC,MUOR
C
C***    MODIFICATIONS:
C        11/27/79 BY K.W.BALDRIDGE, C.S.C., CONVERTED CODE FROM FIELDATA
C                  TO ASCII FORTRAN AND MADE CODE MORE STANDARD
C
C->->->->SECTION RCP.B - EXPLANATIONS AND COMPUTATIONS
C                         COMMON TO ALL CONDITIONS.
C
C   RCP DETERMINES RELATIVE CONCENTRATIONS, CHI/Q, FROM POINT SOURCES.
C          IT CALLS UPON  PGYZ TO OBTAIN STANDARD DEVIATIONS.
C         THE INPUT VARIABLES ARE....
C          UPL  WIND SPEED (M/SEC)
C          Z    RECEPTOR HEIGHT (M)
C          H    EFFECTIVE STACK HEIGHT (M)
C          HL   MIXING HEIGHT- TOP OF NEUTRAL OR UNSTABLE LAYER(M).
C          X    DISTANCE RECEPTOR IS DOWNWIND OF SOURCE (KM)
C          Y    DISTANCE RECEPTOR IS CROSSWIND FROM SOURCE (KM)
C          KST  STABILITY CLASS
C          DELH PLUME RISE(METERS)
C         THE OUTPUT VARIABLES ARE....
C           SY HORIZONTAL DISPERSION PARAMETER
C           SZ VERTICAL DISPERSION PARAMETER
C          RC   RELATIVE CONCENTRATION (SEC/M**3) ,CHI/Q
C         IO IS CONTROL CODE FOR WARNING OUTPUT.
       IO=6
C         THE FOLLOWING EQUATION IS SOLVED --
C         RC = (1/(2*PI*UPL*SIGMA Y*SIGMA Z))* (EXP(-0.5*(Y/SIGMA Y)**2))
C            (EXP(-0.5*((Z-H)/SIGMA Z)**2) + 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)
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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 THE HEIGHT OF THE NEUTRAL OR UNSTABLE LAYER, DOES NOT EXIST FOR STABLE
C LAYERS AT THE GROUND SURFACE- STABILITY 5 OR 6.
C          THE ABOVE EQUATION IS SIMILAR TO EQUATION (5.8) P 36 IN
C           WORKBOOK OF ATMOSPHERIC DISPERSION ESTIMATES WITH THE ADDITION
C           OF THE EXPONENTIAL INVOLVING Y.
C        IF STABLE, SKIP CONSIDERATION OF MIXING HEIGHT.
      IF (KST.GE.5) GO TO 50
C          IF THE SOURCE IS ABOVE THE LID, SET RC = 0., AND RETURN.
      IF (H.GT.HL) GO TO 20
      IF (Z-HL) 50,50,40
20    IF (Z.LT.HL) GO TO 40
      WRITE (IO,470)
40    RC=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.
50    IF (X.LT.0.001) GO TO 40
C         CALL PGYZ TO OBTAIN VALUES FOR SY AND SZ
      CALL PGYZ
C           SY = SIGMA Y, THE STANDARD DEVIATION OF CONCENTRATION IN THE
C           Y-DIRECTION (M)
C           SZ = SIGMA Z, THE STANDARD DEVIATION OF CONCENTRATION IN THE
C           Z-DIRECTION (M)
C        IF IOPT(4)=1, CONSIDER BUOYANCY INDUCED DISPERSION OF PLUME DUE
C           TO TURBULENCE DURING BUOYANT RISE.
      IF (IOPT(4).EQ.0) GO TO 70
      DUM=DELH/3.5
      DUM=DUM*DUM
      SY=SQRT(SY*SY+DUM)
      SZ=SQRT(SZ*SZ+DUM)
70    C1=1.
      IF (Y.EQ.0.0) GO TO 100
      YD=1000.*Y
C         YD IS CROSSWIND DISTANCE IN METERS.
      DUM=YD/SY
      TEMP=0.5*DUM*DUM
      IF (TEMP.GE.50.) GO TO 40
      C1=EXP(TEMP)
100   IF (KST.GT.4) GO TO 120
      IF (HL.LT.5000.) GO TO 200
C          IF STABLE CONDITION OR UNLIMITED MIXING HEIGHT,
C           USE EQUATION 3.2 IF Z = 0, OR EQ 3.1 FOR NON-ZERO Z.
C           (EQUATION NUMBERS REFER TO WORKBOOK OF ATMOSPHERIC DISPERSION
C           ESTIMATES.)
120   C2=2.*SZ*SZ
      IF (Z) 40,130,150
C        NOTE: AN ERRONEOUS NEGATIVE Z WILL RESULT IN ZERO CONCENTRATIONS
C
C->->->->SECTION RCP.C - STABLE OR UNLIMITED MIXING, Z IS ZERO.
C
130   C3=H*H/C2
      IF (C3.GE.50.) GO TO 40
      A2=1./EXP(C3)
C          WADE EQUATION 3.2.
      RC=A2/(3.14159*UPL*SY*SZ*C1)
      RETURN
C
C->->->->SECTION RCP.D - STABLE OR UNLIMITED MIXING, Z IS NON-ZERO.
C
150   A2=0.
      A3=0.
      CA=Z-H
      CB=Z+H
      C3=CA*CA/C2
      C4=CB*CB/C2
      IF (C3.GE.50.) GO TO 170
      A2=1./EXP(C3)
170   IF (C4.GE.50.) GO TO 190
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      A3=1./EXP(C4)
C        WADE EQUATION 3.1.
190   RC=(A2+A3)/(6.28318*UPL*SY*SZ*C1)
      RETURN
C
C->->->->SECTION RCP.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
200   IF (SZ/HL.LE.1.6) GO TO 220
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.
220   AN=0.
      IF (Z) 40,380,230
C
C->->->->SECTION RCP.F - UNSTABLE, CALCULATE MULTIPLE EDDY
C                         REFLECTIONS, Z IS NON-ZERO.
C
C       STATEMENTS 220-260 CALCULATE 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).
C        CALCULATE MULTIPLE EDDY REFLECTIONS FOR RECEPTOR HEIGHT Z.
230   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 250
      A2=1./EXP(C3)
250   IF (C4.GE.50.) GO TO 270
      A3=1./EXP(C4)
270   SUM=0.
      THL=2.*HL
280   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 300
      A4=1./EXP(C6)
300   IF (C7.GE.50.) GO TO 320
      A5=1./EXP(C7)
320   IF (C8.GE.50.) GO TO 340
      A6=1./EXP(C8)
340   IF (C9.GE.50.) GO TO 360
      A7=1./EXP(C9)
360   T=A4+A5+A6+A7
      SUM=SUM+T
      IF (T.GE.0.01) GO TO 280
```

```
      RC=A1*(A2+A3+SUM)                                                 MPT22410
      RETURN                                                            MPT22420
C                                                                       MPT22430
C->->->->SECTION RCP.G - UNSTABLE, CALCULATE MULTIPLE EDDY              MPT22440
C                        REFLECTIONS, Z IS ZERO.                        MPT22450
C                                                                       MPT22460
C        CALCULATE MULTIPLE EDDY REFLECTIONS FOR GROUND LEVEL RECEPTOR  MPT22470
C        HEIGHT.                                                        MPT22480
380   A1=1./(6.28318*UPL*SY*SZ*C1)                                      MPT22490
      A2=0.                                                             MPT22500
      C2=2.*SZ*SZ                                                       MPT22510
      C3=H*H/C2                                                         MPT22520
      IF (C3.GE.50.) GO TO 400                                          MPT22530
      A2=2./EXP(C3)                                                     MPT22540
400   SUM=0.                                                            MPT22550
      THL=2.*HL                                                         MPT22560
410   AN=AN+1.                                                          MPT22570
      A4=0.                                                             MPT22580
      A6=0.                                                             MPT22590
      C5=AN*THL                                                         MPT22600
      CC=H-C5                                                           MPT22610
      CE=H+C5                                                           MPT22620
      C6=CC*CC/C2                                                       MPT22630
      C8=CE*CE/C2                                                       MPT22640
      IF (C6.GE.50.) GO TO 430                                          MPT22650
      A4=2./EXP(C6)                                                     MPT22660
430   IF (C8.GE.50.) GO TO 450                                          MPT22670
      A6=2./EXP(C8)                                                     MPT22680
450   T=A4+A6                                                           MPT22690
      SUM=SUM+T                                                         MPT22700
      IF (T.GE.0.01) GO TO 410                                          MPT22710
      RC=A1*(A2+SUM)                                                    MPT22720
      RETURN                                                            MPT22730
C                                                                       MPT22740
C->->->->SECTION RCP.H - FORMAT                                         MPT22750
C                                                                       MPT22760
C***   SECTIONS OF SUBROUTINE RCP.                                      MPT22770
C         SECTION RCP.A -  COMMON.                                      MPT22780
C         SECTION RCP.B -  EXPLANATIONS AND COMPUTATIONS COMMON TO ALL  MPT22790
C                           CONDITIONS.                                 MPT22800
C         SECTION RCP.C -  STABLE OR UNLIMITED MIXING, Z IS ZERO.       MPT22810
C         SECTION RCP.D -  STABLE OR UNLIMITED MIXING, Z IS NON-ZERO.   MPT22820
C         SECTION RCP.E -  UNSTABLE, ASSURED OF UNIFORM MIXING.         MPT22830
C         SECTION RCP.F -  UNSTABLE, CALCULATE MULTIPLE EDDY            MPT22840
C                           REFLECTIONS; Z IS NON-ZERO.                 MPT22850
C         SECTION RCP.G -  UNSTABLE, CALCULATE MULTIPLE EDDY            MPT22860
C                           REFLECTIONS; Z IS ZERO.                     MPT22870
C         SECTION RCP.H -  FORMAT.                                      MPT22880
C                                                                       MPT22890
470   FORMAT (1HO,'BOTH H AND Z ARE ABOVE THE MIXING HEIGHT SO A RELIABLMPT22900
     1E COMPUTATION CAN NOT BE MADE.')                                  MPT22910
C                                                                       MPT22920
      END                                                               MPT22930
C
      SUBROUTINE PGYZ                                                   MPT22950
C                     SUBROUTINE PGYZ   (VERSION 79365), PART OF MPTER. MPT22960
C        VERTICAL DISPERSION PARAMETER VALUE, SZ DETERMINED BY          MPT22970
C          SZ = A * X ** B WHERE A AND B ARE FUNCTIONS OF BOTH STABILITY MPT22980
C          AND RANGE OF X.                                              MPT22990
C        HORIZONTAL DISPERSION PARAMETER VALUE, SY DETERMINED BY        MPT23000
C          LOGARITHMIC INTERPOLATION OF PLUME HALF-ANGLE ACCORDING TO   MPT23010
C          DISTANCE AND CALCULATION OF 1/2.15 TIMES HALF-ARC LENGTH.    MPT23020
      COMMON /MPR/ UPL,Z,H,HL,X,Y,KST,DELH,SY,SZ,RC,MUOR                MPT23030
      DIMENSION XA(7), XB(2), XD(5), XE(8), XF(9), AA(8), BA(8), AB(3), MPT23040
     1BB(3), AD(6), BD(6), AE(9), BE(9), AF(10), BF(10)                 MPT23050
      DATA XA /.5,.4,.3,.25,.2,.15,.1/                                  MPT23060
      DATA XB /.4,.2/                                                   MPT23070
      DATA XD /30.,10.,3.,1.,.3/                                        MPT23080
      DATA XE /40.,20.,10.,4.,2.,1.,.3,.1/                              MPT23090
      DATA XF /60.,30.,15.,7.,3.,2.,1.,.7,.2/                           MPT23100
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      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
      IF (MUOR.EQ.2)  GO TO 9
C
C           MCELROY-POOLER URBAN DISPERSION PARAMETERS FROM ST. LOUIS
C              EXPERIMENT AS PUT IN EQUATION FORM BY BRIGGS.
C                X IS DISTANCE IN KM.
C                KST IS PASQUILL STABILITY CLASS.
C                SY AND SZ ARE IN METERS.
      GO TO(2,2,3,4,5,5), KST
2     SY=320.*X/SQRT(1.+0.4*X)
      SZ=240.*X*SQRT(1.+X)
      GO TO 6
3     SY=220.*X/SQRT(1.+0.4*X)
      SZ=200.*X
      GO TO 6
4     SY=160.*X/SQRT(1.+0.4*X)
      SZ=140.*X/SQRT(1.+0.3*X)
      GO TO 6
5     SY=110.*X/SQRT(1.+0.4*X)
      SZ=80.*X/SQRT(1.+1.5*X)
6     IF (SZ.GT.5000.) SZ=5000.
      RETURN
C
    9 XY=X
      GO TO (10,40,70,80,110,140), KST
C        STABILITY A
10    TH=(24.167-2.5334*ALOG(XY))/57.2958
      IF (X.GT.3.11) GO TO 170
      DO 20 ID=1,7
      IF (X.GE.XA(ID)) GO TO 30
20    CONTINUE
      ID=8
30    SZ=AA(ID)*X**BA(ID)
      GO TO 190
C        STABILITY B
40    TH=(18.333-1.8096*ALOG(XY))/57.2958
      IF (X.GT.35.) GO TO 170
      DO 50 ID=1,2
      IF (X.GE.XB(ID)) GO TO 60
50    CONTINUE
      ID=3
60    SZ=AB(ID)*X**BB(ID)
      GO TO 180
C        STABILITY C
70    TH=(12.5-1.0857*ALOG(XY))/57.2958
      SZ=61.141*X**0.91465
      GO TO 180
C        STABILITY D
80    TH=(8.3333-0.72382*ALOG(XY))/57.2958
      DO 90 ID=1,5
      IF (X.GE.XD(ID)) GO TO 100
90    CONTINUE
      ID=6
100   SZ=AD(ID)*X**BD(ID)
      GO TO 180
C        STABILITY E
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110     TH=(6.25-0.54287*ALOG(XY))/57.2958
        DO 120 ID=1,8
        IF (X.GE.XE(ID)) GO TO 130
120     CONTINUE
        ID=9
130     SZ=AE(ID)*X**BE(ID)
        GO TO 180
C          STABILITY F
140     TH=(4.1667-0.36191*ALOG(XY))/57.2958
        DO 150 ID=1,9
        IF (X.GE.XF(ID)) GO TO 160
150     CONTINUE
        ID=10
160     SZ=AF(ID)*X**BF(ID)
        GO TO 180
170     SZ=5000.
        GO TO 190
180     IF (SZ.GT.5000.) SZ=5000.
190     SY=465.116*XY*SIN(TH)/COS(TH)
C          465.116 = 1000. (M/KM) / 2.15
        RETURN
C
        END
C
        SUBROUTINE RANK (L)
C                             SUBROUTINE RANK    (VERSION 79365), PART OF MPTER.
C          CALLED BY MPTER TO ARRANGE CONCENTRATIONS OF VARIOUS AVG
C          TIMES INTO HIGH-FIVE TABLES...THAT IS, ARRAYS STORING
C          THE HIGHEST FIVE CONCENTRATIONS FOR EACH RECEPTOR FOR
C          EACH AVG TIME.
C          VARIABLES OUTPUT:
C                 HMAXA(J,K,L)  CONCENTRATIONS ACCORDING TO
C                          J : RANK OF CONC. (1-5)
C                          K : RECEPTOR NUMBER
C                          L : AVG TIME
C                 NDAY(J,K,L) : ASSOCIATED DAY OF CONC.
C                 IHR(J,K,L) : ENDING HOUR OF CONC.
        COMMON/MR/HMAXA(5,180,5),NDAY(5,180,5),IHR(5,180,5),CONC(180,5),
       1          JDAY,NR
        COMMON /MPO/ NRECEP,NAVG,NB,LH,NPT,IDATE(2),RREC(180),SREC(180),ZR
       1(180),ELR(180),PHCHI(180),PHSIGS(180,26),HSAV(250),DSAV(250),PCHI(
       2180),PSIGS(180,26),IPOL
        IO=6
C          RESET AVERAGING PERIOD FLAG AND SET CALM FLAG, LL.
C          CALMS ACCOUNTED FOR ONLY WHEN DEFAULT OPTION ON.
        LL=0
        IF(L.GT.4)LL=1
        IF(L.EQ.22)L=2
        IF(L.EQ.33)L=3
        IF(L.EQ.44)L=4
        DO 50 K=1,NRECEP
        IF (CONC(K,L).LE.HMAXA(5,K,L)) GO TO 50
        DO 10 J=1,5
        IF (CONC(K,L).GT.HMAXA(J,K,L)) GO TO 20
C             CONCENTRATION IS ONE OF THE TOP FIVE
10      CONTINUE
        WRITE (IO,70)
        GO TO 50
C          THE FOLLOWING DO-LOOP HAS THE EFFECT OF INSERTING A NEW
C          CONCENTRATION ENTRY INTO ITS PROPER POSITION WHILE SHIFTING
C          DOWN THE 'OLD' LOWER CONCENTRATIONS THUS ESTABLISHING THE
C          'HIGH-FIVE' CONCENTRATION TABLE.
20      IF (J.EQ.5) GO TO 40
        DO 30 IJ=4,J,-1
        IJP1=IJ+1
        HMAXA(IJP1,K,L)=HMAXA(IJ,K,L)
        NDAY(IJP1,K,L) = NDAY(IJ,K,L)
30      IHR(IJP1,K,L) = IHR(IJ,K,L)
C             INSERT LATEST CONC, DAY AND ENDING HR INTO THE
C             PROPER RANK IN THE HIGH-FIVE TABLE
```

```
40    HMAXA(J,K,L)=CONC(K,L)                                          MPT24510
      NDAY(J,K,L) = JDAY                                              MPT24520
      IHR(J,K,L) = LH                                                 MPT24530
C       ADD 100 TO HOUR TO SET CALM FLAG FOR MAIN.                    MPT24540
      IF(LL.EQ.1.AND.L.NE.1)IHR(J,K,L)=IHR(J,K,L)+100                 MPT24550
50    CONTINUE                                                        MPT24560
      DO 60 K=1,NRECEP                                                MPT24570
      CONC(K,L)=0.                                                    MPT24580
60    CONTINUE                                                        MPT24590
      RETURN                                                          MPT24600
C                                                                     MPT24610
70    FORMAT (1X,'    ****ERROR IN FINDING THE MAX CONCENTRATION***') MPT24620
C                                                                     MPT24630
      END                                                             MPT24640
C
      SUBROUTINE OUTHR                                                MPT24660
C                  SUBROUTINE OUTHR  (VERSION 79365), PART OF MPTER.  MPT24670
C       THIS SUBROUTINE PROVIDES OUTPUT CONCENTRATIONS IN             MPT24680
C       MICROGRAMS PER CUBIC METER FOR EACH HOUR IN TWO WAYS:         MPT24690
C          1) CONTRIBUTIONS FROM SIGNIFICANT SOURCES, AND             MPT24700
C          2) SUMMARIES.                                              MPT24710
C       BEYOND ENTRY POINT OUTAVG THE SUBROUTINE PROVIDES             MPT24720
C       CONCENTRATION OUTPUT FOR EACH AVERAGING PERIOD AGAIN          MPT24730
C       IN THE ABOVE MANNER.                                          MPT24740
C                                                                     MPT24750
C->->->->SECTION OUTHR.A - COMMON, DIMENSION, AND DATA.               MPT24760
C                                                                     MPT24770
      COMMON /MPOR/ IOPT(25)                                          MPT24780
      COMMON /MPO/ NRECEP,NAVG,NB,LH,NPT,IDATE(2),RREC(180),SREC(180),ZRMPT24790
     1(180),ELR(180),PHCHI(180),PHSIGS(180,26),HSAV(250),DSAV(250),PCHI(MPT24800
     2180),PSIGS(180,26),IPOL                                         MPT24810
      COMMON /MO/ QTHETA(24),QU(24),IKST(24),QHL(24),QTEMP(24),MPS(25),NMPT24820
     1SIGP,IO,LINE1(20),LINE2(20),LINE3(20),RNAME(2,180),IRANK(180),STARMPT24830
     2(5,180)                                                         MPT24840
      DIMENSION IPOLT(2)                                              MPT24850
      DATA IPOLT /'SO2 ','PART'/                                      MPT24860
      IPOLU=IPOLT(1)                                                  MPT24870
      IF (IPOL.EQ.4) IPOLU=IPOLT(2)                                   MPT24880
C       OPTION(11): PRINT ONLY THE HOURLY SUMMARIES.                  MPT24890
      IF (IOPT(11).EQ.1) GO TO 100                                    MPT24900
C                                                                     MPT24910
C->->->->SECTION OUTHR.B - WRITE HOURLY CONTRIBUTION TITLE.           MPT24920
C                                                                     MPT24930
      WRITE (IO,350) LINE1,LINE2,LINE3                                MPT24940
      WRITE (IO,360)IPOLU,IDATE,LH                                    MPT24950
C                                                                     MPT24960
C->->->->SECTION OUTHR.C - WRITE HOURLY MET DATA.                     MPT24970
C                                                                     MPT24980
      IF (IOPT(12).EQ.1) GO TO 10                                     MPT24990
      WRITE (IO,450)                                                  MPT25000
      WRITE (IO,460) LH,QTHETA(LH),QU(LH),QHL(LH),QTEMP(LH),IKST(LH)  MPT25010
C                                                                     MPT25020
C->->->->SECTION OUTHR.D - WRITE FINAL PLUME HEIGHT AND DISTANCE      MPT25030
C                          FINAL RISE.                                MPT25040
C                                                                     MPT25050
10    IF (IOPT(13).EQ.1) GO TO 20                                     MPT25060
      WRITE (IO,470) (I,I=1,10)                                       MPT25070
C       HSAV ARE THE CALCULATED PLUME HEIGHTS FOR THIS HOUR           MPT25080
      WRITE (IO,480) (HSAV(I),I=1,NPT)                                MPT25090
      WRITE (IO,490) (DSAV(I),I=1,NPT)                                MPT25100
C                                                                     MPT25110
C->->->->SECTION OUTHR.E - WRITE HRLY SIGNIFICANT SOURCE CONTRIB.     MPT25120
C                                                                     MPT25130
20    IF (NSIGP.GT.10) GO TO 40                                       MPT25140
C       PRINT FIRST PAGE OF OUTPUT AND TOTALS FOR 10 OR LESS SIGNIF SOUMPT25150
      WRITE (IO,370)                                                  MPT25160
      WRITE (IO,380) (I,I=1,NSIGP)                                    MPT25170
      WRITE (IO,390)                                                  MPT25180
      WRITE (IO,380) (MPS(I),I=1,NSIGP)                               MPT25190
      WRITE (IO,400)                                                  MPT25200
```

```
      DO 30 K=1,NRECEP
      WRITE (IO,410) K,STAR(1,K),STAR(2,K),(PHSIGS(K,I),I=1,NSIGP)
C        PRINT TOTALS
      WRITE (IO,420) PHSIGS(K,26),PHCHI(K)
30    CONTINUE
      GO TO 100
C        PRINT FIRST PAGE FOR MORE THAN 10 SIGNIFICANT SOURCES.
40    WRITE (IO,370)
      WRITE (IO,380) (I,I=1,10)
      WRITE (IO,430) (MPS(I),I=1,10)
      WRITE (IO,400)
      DO 50 K=1,NRECEP
50    WRITE (IO,410) K,STAR(1,K),STAR(2,K),(PHSIGS(K,I),I=1,10)
      IF (NSIGP.GT.20) GO TO 70
C        PRINT SECOND PAGE AND TOTALS FOR 11 TO 20 SIGNIFICANT SOURCES
      WRITE (IO,350) LINE1,LINE2,LINE3
      WRITE (IO,360)IPOLU,IDATE,LH
      WRITE (IO,370)
      WRITE (IO,380) (I,I=11,NSIGP)
      WRITE (IO,390)
      WRITE (IO,380) (MPS(I),I=11,NSIGP)
      WRITE (IO,400)
      DO 60 K=1,NRECEP
      WRITE (IO,410) K,STAR(1,K),STAR(2,K),(PHSIGS(K,I),I=11,NSIGP)
60    WRITE (IO,420) PHSIGS(K,26),PHCHI(K)
      GO TO 100
C        WRITE SECOND PAGE FOR MORE THAN 20 SIGNIFICANT SOURCES.
70    WRITE (IO,350) LINE1,LINE2,LINE3
      WRITE (IO,360)IPOLU,IDATE,LH
      WRITE (IO,370)
      WRITE (IO,380) (I,I=11,20)
      WRITE (IO,430) (MPS(I),I=11,20)
      WRITE (IO,400)
      DO 80 K=1,NRECEP
80    WRITE (IO,410) K,STAR(1,K),STAR(2,K),(PHSIGS(K,I),I=11,20)
      WRITE (IO,350) LINE1,LINE2,LINE3
      WRITE (IO,360)IPOLU,IDATE,LH
      WRITE (IO,370)
C        WRITE LAST PAGE AND TOTALS FOR MORE THAN 20 SIGNIF. SOURCES.
      WRITE (IO,380) (I,I=21,NSIGP)
      WRITE (IO,390)
      WRITE (IO,380) (MPS(I),I=21,NSIGP)
      WRITE (IO,400)
      DO 90 K=1,NRECEP
      WRITE (IO,410) K,STAR(1,K),STAR(2,K),(PHSIGS(K,I),I=21,NSIGP)
90    WRITE (IO,420) PHSIGS(K,26),PHCHI(K)
C        OPTION(14): SKIP OUTPUT OF THE HOURLY SUMMARIES.
100   IF (IOPT(14).EQ.1) GO TO 170
C
C->->->->SECTION OUTHR.F - WRITE HOURLY SUMMARY TITLE.
C
      WRITE (IO,350) LINE1,LINE2,LINE3
      WRITE (IO,440)IPOLU,IDATE,LH
C
C->->->->SECTION OUTHR.G - WRITE HOURLY MET DATA.
C
      IF (IOPT(15).EQ.1) GO TO 110
      WRITE (IO,450)
      WRITE (IO,460) LH,QTHETA(LH),QU(LH),QHL(LH),QTEMP(LH),IKST(LH)
C
C->->->->SECTION OUTHR.H - WRITE FINAL PLUME HEIGHT AND
C         DISTANCE TO FINAL RISE.
C
110   IF (IOPT(16).EQ.1) GO TO 120
      WRITE (IO,470) (I,I=1,10)
C         HSAV ARE THE CALCULATED PLUME HEIGHTS FOR THIS HOUR
      WRITE (IO,480) (HSAV(I),I=1,NPT)
      WRITE (IO,490) (DSAV(I),I=1,NPT)
C
C->->->->SECTION OUTHR.I - WRITE HOURLY SUMMARY TABLE.
```

```
C
120   WRITE (IO,500)
C        CALCULATE GRAND TOTALS AND RANK CONCENTRATIONS
      DO 130 K=1,NRECEP
C        HSAV IS USED AS A DUMMY VARIABLE FOR THE REMAINDER OF THIS
C        SUBROUTINE. IT IS ZEROED AGAIN IN PTR BEFORE ITS NORMAL USE.
130   HSAV(K)=PHCHI(K)
C        DETERMINE RANKING ACCORDING TO CONCENTRATION
      DO 150 I=1,NRECEP
      CMAX=-1.0
      DO 140 K=1,NRECEP
      IF (HSAV(K).LE.CMAX) GO TO 140
      CMAX=HSAV(K)
      LMAX=K
140   CONTINUE
      IRANK(LMAX)=I
      HSAV(LMAX)=-1.0
150   CONTINUE
      DO 160 K=1,NRECEP
      WRITE (IO,510) K,STAR(1,K),STAR(2,K),(RNAME(J,K),J=1,2),RREC(K),SR
     1EC(K),ZR(K),ELR(K),PHSIGS(K,26),PHCHI(K),IRANK(K)
160   CONTINUE
170   RETURN
C
C->->->->SECTION OUTHR.J - ENTRY POINT FOR AVERAGING TIME
C
      ENTRY OUTAVG
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        AVERAGE CONCENTRATIONS OVER SPECIFIED TIME PERIOD
      DO 190 K=1,NRECEP
      PCHI(K)=PCHI(K)/NAVG
      HSAV(K)=PCHI(K)
      DO 180 I=1,26
180   PSIGS(K,I)=PSIGS(K,I)/NAVG
190   CONTINUE
C        OPTION(17): SKIP OUTPUT OF THE AVERAGED CONTRIBUTIONS.
      IF (IOPT(17).EQ.1) GO TO 270
C->->->->SECTION OUTHR.K - WRITE AVERAGING-TIME SIGNIFICANT
C                  SOURCE CONTRIBUTIONS.
      WRITE (IO,350) LINE1,LINE2,LINE3
      WRITE (IO,520) NAVG,IPOLU,IDATE,NB
      IF (NSIGP.GT.10) GO TO 210
C        PRINT FIRST PAGE OF OUTPUT AND TOTALS FOR 10 OR LESS SIGNIF SOU
      WRITE (IO,380) (I,I=1,NSIGP)
      WRITE (IO,390)
      WRITE (IO,380) (MPS(I),I=1,NSIGP)
      WRITE (IO,400)
      DO 200 K=1,NRECEP
      WRITE (IO,410) K,STAR(1,K),STAR(2,K),(PSIGS(K,I),I=1,NSIGP)
C        PRINT TOTALS
      WRITE (IO,420) PSIGS(K,26),PCHI(K)
200   CONTINUE
      GO TO 270
C        PRINT FIRST PAGE FOR MORE THAN 10 SIGNIF SOURCES
210   WRITE (IO,380) (I,I=1,10)
      WRITE (IO,430) (MPS(I),I=1,10)
      WRITE (IO,400)
      DO 220 K=1,NRECEP
220   WRITE (IO,410) K,STAR(1,K),STAR(2,K),(PSIGS(K,I),I=1,10)
      IF (NSIGP.GT.20) GO TO 240
C        PRINT SECOND PAGE AND TOTALS FOR 11 TO 20 SIGNIF SOURCES
      WRITE (IO,350) LINE1,LINE2,LINE3
      WRITE (IO,520) NAVG,IPOLU,IDATE,NB
      WRITE (IO,380) (I,I=11,NSIGP)
      WRITE (IO,390)
      WRITE (IO,380) (MPS(I),I=11,NSIGP)
      WRITE (IO,400)
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```
      DO 230 K=1,NRECEP
      WRITE (IO,410) K,STAR(1,K),STAR(2,K),(PSIGS(K,I),I=11,NSIGP)
230   WRITE (IO,420) PSIGS(K,26),PCHI(K)
      GO TO 270
C        WRITE SECOND PAGE FOR MORE THAN 20 SIGNIF SOURCES
240   WRITE (IO,350) LINE1,LINE2,LINE3
      WRITE (IO,520) NAVG,IPOLU,IDATE,NB
      WRITE (IO,380) (I,I=11,20)
      WRITE (IO,430) (MPS(I),I=11,20)
      WRITE (IO,400)
      DO 250 K=1,NRECEP
250   WRITE (IO,410) K,STAR(1,K),STAR(2,K),(PSIGS(K,I),I=11,20)
      WRITE (IO,350) LINE1,LINE2,LINE3
      WRITE (IO,520) NAVG,IPOLU,IDATE,NB
C        WRITE LAST PAGE AND TOTALS FOR MORE THAN 20 SIGNIF SOURCES
      WRITE (IO,380) (I,I=21,NSIGP)
      WRITE (IO,390)
      WRITE (IO,380) (MPS(I),I=21,NSIGP)
      WRITE (IO,400)
      DO 260 K=1,NRECEP
      WRITE (IO,410) K,STAR(1,K),STAR(2,K),(PSIGS(K,I),I=21,NSIGP)
260   WRITE (IO,420) PSIGS(K,26),PCHI(K)
C
C->->->->SECTION OUTHR.L - WRITE AVERAGING-TIME SUMMARY.
C
C        OPTION(18): SKIP OUTPUT OF THE AVERAGED SUMMARIES.
270   IF (IOPT(18).EQ.1) GO TO 310
      WRITE (IO,350) LINE1,LINE2,LINE3
      WRITE (IO,530) NAVG,IPOLU,IDATE,NB
      WRITE (IO,500)
C        CALCULATE GRAND TOTALS AND RANK CONCENTRATIONS
      DO 290 I=1,NRECEP
      CMAX=-1.0
      DO 280 K=1,NRECEP
      IF (HSAV(K).LE.CMAX) GO TO 280
      CMAX=HSAV(K)
      LMAX=K
280   CONTINUE
      IRANK(LMAX)=I
      HSAV(LMAX)=-1.0
290   CONTINUE
      DO 300 K=1,NRECEP
      WRITE (IO,510) K,STAR(1,K),STAR(2,K),(RNAME(J,K),J=1,2),RREC(K),SR
     1EC(K),ZR(K),ELR(K),PSIGS(K,26),PCHI(K),IRANK(K)
300   CONTINUE
310   IF (IOPT(24).EQ.0) GO TO 330
C        PUNCH CONCENTRATIONS FOR CONTOURING(MICROGRAMS/CUBIC METER)
C        RECEPTOR COORDINATES IN USER UNITS.
      DO 320 K=1,NRECEP
      GWU=PCHI(K)*1.0E+06
      WRITE (IO,540) RREC(K),SREC(K),GWU,K,ZR(K),ELR(K)
      WRITE (1,540) RREC(K),SREC(K),GWU,K,ZR(K),ELR(K)
320   CONTINUE
330   IF (IOPT(23).EQ.0) GO TO 340
C        WRITE PERIODIC CONC. TO DISK/TAPE - FOR LONG-TERM APPLICATION
C        FOR EACH RUN, THIS WRITE STATEMENT WILL GENERATE
C        'NPER' RECORDS.
      WRITE (13) IDATE(2),NB,(PCHI(K),K=1,NRECEP)
340   RETURN
C
C->->->->SECTION OUTHR.M - FORMATS.
C
C***    SECTIONS OF SUBROUTINE OUTHR.
C          SECTION OUTHR.A -  COMMON, DIMENSION, AND DATA.
C          SECTION OUTHR.B -  WRITE HOURLY CONTRIBUTION TITLE.
C          SECTION OUTHR.C -  WRITE HOURLY MET. DATA.
C          SECTION OUTHR.D -  WRITE FINAL PLUME HEIGHT AND DISTANCE TO
C                                FINAL RISE.
C          SECTION OUTHR.E -  WRITE HOURLY SIGNIFICANT SOURCE CONTRIB.
C          SECTION OUTHR.F -  WRITE HOURLY SUMMARY TITLE.
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C         SECTION OUTHR.G -  WRITE HOURLY MET. DATA.                          MPT27310
C         SECTION OUTHR.H -  WRITE FINAL PLUME HEIGHT AND DISTANCE TO         MPT27320
C                              FINAL RISE.                                    MPT27330
C         SECTION OUTHR.I -  WRITE HOURLY SUMMARY TABLE.                      MPT27340
C         SECTION OUTHR.J -  ENTRY POINT FOR AVERAGING TIME.                  MPT27350
C         SECTION OUTHR.K -  WRITE AVERAGING-TIME SIGNIFICANT SOURCE          MPT27360
C                              CONTRIBUTIONS.                                 MPT27370
C         SECTION OUTHR.L -  WRITE AVERAGING-TIME SUMMARY.                    MPT27380
C         SECTION OUTHR.M -  FORMATS.                                         MPT27390
C                                                                             MPT27400
350   FORMAT ('1',20A4/1X,20A4/1X,20A4)                                       MPT27410
360   FORMAT('0',T30,A4,' CONTRIBUTION(MICROGRAMS/M**3) FROM SIGNIFICANTMPT27420
     1 POINT SOURCES ',5X,I2,'/',I4,' : HOUR ',I2//)                          MPT27430
370   FORMAT (1H0,T5,'RANK')                                                  MPT27440
380   FORMAT ('+',T12,10(I3,7X))                                              MPT27450
390   FORMAT ('+',T113,'TOTAL      TOTAL'/1X,T113,'SIGNIF     ALL POINT'/1MPT27460
     1X,T113,'POINT       SOURCES'/1X,'SOURCE #')                             MPT27470
400   FORMAT (1X,'RECEP #')                                                   MPT27480
410   FORMAT (1X,I3,2A1,6P10F10.3)                                            MPT27490
420   FORMAT ('+',T109,6P2F10.3)                                              MPT27500
430   FORMAT (1X,'SOURCE #',T12,10(I3,7X))                                    MPT27510
440   FORMAT('0',T25,A4,' SUMMARY CONCENTRATION TABLE(MICROGRAMS/M**3) 'MPT27520
     15X,I2,'/',I4,' : HOUR ',I2/1X)                                          MPT27530
450   FORMAT (1X,T2,'HOUR    THETA    SPEED    MIXING    TEMP    STABILITY'/MPT27540
     11X,T9,'(DEG)    (M/S) HEIGHT(M)    (K)      CLASS'/1X)                  MPT27550
460   FORMAT (1X,T3,I2,4F9.2,6X,I1//)                                         MPT27560
470   FORMAT (13X,10I11)                                                      MPT27570
480   FORMAT (' FINAL HT (M) ',10F11.2)                                       MPT27580
490   FORMAT (' DIST FIN HT (KM)',10F11.3)                                    MPT27590
500   FORMAT ('0',T7,'RECEPTOR',T23,'EAST',T33,'NORTH',T43,'RECEPTOR HT'MPT27600
     1,T61,'RECEPTOR',T78,'TOTAL FROM',T93,'TOTAL FROM',T106,'CONCENTRATMPT27610
     2ION'/' ',T7,'NO. NAME',T22,'COORD',T33,'COORD',T44,'ABV GRD (M)',TMPT27620
     359,'GRD-LVL ELEV',T77,'SIGNIF POINT',T93,'ALL SOURCES',T111,'RANK'MPT27630
     4/' ',T58,'(USER HT UNITS)',T80,'SOURCES'//)                             MPT27640
510   FORMAT (1H ,I8,2A1,2X,2A4,2F10.2,F12.1,F20.1,6P2F15.4,I15)              MPT27650
520   FORMAT ('0',T22,I2,'-HOUR AVERAGE ',A4,' CONTRIBUTION(MICROGRAMS/MMPT27660
     1**3) FROM SIGNIFICANT POINT SOURCES',5X,I2,'/',I3,'  START HOUR: 'MPT27670
     2,I2//1X,T5,'RANK')                                                      MPT27680
530   FORMAT ('0',T25,I2,'-HOUR AVERAGE ',A4,' SUMMARY CONCENTRATION TABMPT27690
     1LE(MICROGRAMS/M**3)',5X,I2,'/',I3,'  START HOUR: ',I2//1X)              MPT27700
540   FORMAT ('CNTL',1X,3F10.3,20X,I4,2F10.1)                                 MPT27710
C                                                                             MPT27720
      END                                                                     MPT27730
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