&EPA   Project Summary

User's Guide to CTDMPLUS: Volume 2. The Screening Mode (CTSCREEN)

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The EPA's Technology Transfer Workgroup has developed CTSCREEN, a screening version of the Complex Terrain Dispersion Model, CTDMPLUS. CTSCREEN uses an array of predetermined meteorological conditions to model the user-supplied source-terrain configuration. CTSCREEN yields estimates of maximum 1-h, 3-h, 24-h, and annual impacts that are conservative with respect to CTDMPLUS estimates (with a full year of on-site data). In comparison with other complex terrain screening models, CTSCREEN provides estimates that most consistently reflect those of CTDMPLUS.

This Project Summary was developed by EPA's Atmospheric Research and Exposure Assessment Laboratory, Research Triangle Park, NC, to announce key findings of the research project that is fully documented in a separate report of the same title (see Project Report ordering information at back).

Introduction

CTDMPLUS is a point-source, steady-state air quality model that is applicable to pollutant sources located in or near complex topography. The model accounts for the three-dimensional nature of plume and terrain interaction and therefore requires detailed topographic and meteorological descriptions of the modeling domain. Although the terrain data may be obtained from topographic maps and digitized for use in CTDMPLUS, the required meteorological data may not be as readily available.

Since meteorological input requirements can limit the application of CTDMPLUS, a methodology was developed to use the advanced techniques of CTDMPLUS in situations where on-site meteorological measurements are limited or unavailable. This approach uses CTDMPLUS in a "screening" mode (CTSCREEN) in which actual source and terrain characteristics are modeled with an extensive array of predetermined meteorological conditions. CTSCREEN obtains the necessary meteorological information from two matrices of meteorological variables: one for stable/neutral conditions and one for unstable/convective conditions.

Model Description

The technical basis of the CTDMPLUS and CTSCREEN models is the same and is described in the *User's Guide to CTDMPLUS: Volume 1* (EPA/600/8-89/41). They are applicable to situations with multiple sources and multiple hills. Both models yield identical 1-h estimates for the same meteorological conditions. The user supplies the terrain, source, and receptor information identically to both. The models differ in the manner in which the meteorological inputs are obtained. For input to CTDMPLUS, meteorological data are collected on site. With CTSCREEN, meteorology is predetermined.

Wind direction is a critical variable for estimating the maximum impacts from a point source in complex terrain. The source-hill geometry and plume height greatly influence the concentration on the terrain surface. Since this geometry

changes with meteorology, CTSCREEN automatically calculates the optimum wind direction (that yields highest impacts) for each combination of meteorological variables. Users are also given the option to specify wind directions.

Since CTSCREEN uses different methodologies for modeling stable/neutral and unstable/convective atmospheric stabilities, the combinations of meteorological variables required for each were developed separately. Values for the meteorological variables were determined from analyses of model sensitivities, typical distributions of meteorological conditions, and the ranges of conditions associated with high concentrations at actual field monitoring sites. The stable/neutral algorithms of CTSCREEN require the following meteorological variables to compute concentrations: wind speed at plume height, standard deviation of the lateral wind speed, standard deviation of the vertical wind speed, vertical potential temperature gradient, and wind direction. Ambient temperature at stack top is set to 293 K. CTSCREEN requires the following meteorological variables to compute concentrations for unstable/convective conditions: wind speed at half plume height, mixing height, friction velocity, Monin-Obukhov length, and potential temperature gradient above the mixing height.

Although CTSCREEN calculates maximum 1-h impacts at all receptor locations, it is also designed to provide conservative estimates of worst-case 3-h and 24-h highest-second-high (HSH) and annual impacts. The results of a comparison study between CTSCREEN and CTDMPLUS were used to select appropriate factors for conversion from 1-h to 3-h HSH, from 1-h to 24-h HSH, and from 1-h to annual estimates of worst case impacts. The comparisons included a wide variety of source and terrain types and source-terrain configurations. A conservative conversion factor of 0.7 is used to convert CTSCREEN 1-h maxima to 3-h HSH estimates, a factor of 0.15 to convert 1-h maxima to 24-h HSH estimates, and a factor of 0.03 to convert 1-h maxima to annual estimates.

Comparison with Other Screening Models

In order to evaluate the usefulness of CTSCREEN as a screening tool, predicted concentrations from CTSCREEN were compared with those from CTDMPLUS and from two established regulatory screening models, COMPLEX-I and VALLEY, for 22 different potential plume impaction scenarios. Predictions from CTSCREEN were always higher than those of CTDMPLUS, and generally lower than those of COMPLEX-I and VALLEY for all averaging periods.

Summary of CTSCREEN Operation

CTSCREEN is used in the same manner as CTDMPLUS, with the exception of the meteorological inputs. All necessary meteorological data are provided with CTSCREEN; users do not need to create any additional meteorological input files. Files containing information on sources, terrain, and receptors are identical to those of CTDMPLUS.

As with CTDMPLUS, CTSCREEN is designed for use on an IBM®-compatible personal computer (PC) system, but with a few simple modifications, it can be run on other computer systems. The model is written in ANSI standard FORTRAN. A math coprocessor chip and a core space of about 480K bytes is required to run the model on a PC system.

2

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