

any of the hills in the modeling domain, require separate treatment.

#### g. Plume Behavior

(1) As in CTDM, the basic plume rise algorithms are based on Briggs' (1975) recommendations.

(2) A central feature of CTDMPLUS for neutral/stable conditions is its use of a critical dividing-streamline height ( $H_c$ ) to separate the flow in the vicinity of a hill into two separate layers. The plume component in the upper layer has sufficient kinetic energy to pass over the top of the hill while streamlines in the lower portion are constrained to flow in a horizontal plane around the hill. Two separate components of CTDMPLUS compute ground-level concentrations resulting from plume material in each of these flows.

(3) The model calculates on an hourly (or appropriate steady averaging period) basis how the plume trajectory (and, in stable/neutral conditions, the shape) is deformed by each hill. Hourly profiles of wind and temperature measurements are used by CTDMPLUS to compute plume rise, plume penetration (a formulation is included to handle penetration into elevated stable layers, based on Briggs (1984)), convective scaling parameters, the value of  $H_c$ , and the Froude number above  $H_c$ .

#### h. Horizontal Winds

CTDMPLUS does not simulate calm meteorological conditions. Both scalar and vector wind speed observations can be read by the model. If vector wind speed is unavailable, it is calculated from the scalar wind speed. The assignment of wind speed (either vector or scalar) at plume height is done by either:

- Interpolating between observations above and below the plume height, or
- Extrapolating (within the surface layer) from the nearest measurement height to the plume height.

#### i. Vertical Wind Speed

Vertical flow is treated for the plume component above the critical dividing streamline height ( $H_c$ ); see "Plume Behavior".

#### j. Horizontal Dispersion

Horizontal dispersion for stable/neutral conditions is related to the turbulence velocity scale for lateral fluctuations,  $\sigma_v$ , for which a minimum value of 0.2 m/s is used. Convective scaling formulations are used to estimate horizontal dispersion for unstable conditions.

#### k. Vertical Dispersion

Direct estimates of vertical dispersion for stable/neutral conditions are based on observed vertical turbulence intensity, *e.g.*,  $\sigma_w$  (standard deviation of the vertical velocity fluctuation). In simulating unstable (convective) conditions, CTDMPLUS relies on a skewed, bi-Gaussian probability density function (pdf) description of the vertical velocities to estimate the vertical distribution of pollutant concentration.

#### l. Chemical Transformation

Chemical transformation is not treated by CTDMPLUS.

#### m. Physical Removal

Physical removal is not treated by CTDMPLUS (complete reflection at the ground/hill surface is assumed).

#### n. Evaluation Studies

Burns, D.J., L.H. Adams and S.G. Perry, 1990. Testing and Evaluation of the CTDMPLUS Dispersion Model: Daytime Convective Conditions. Environmental Protection Agency, Research Triangle Park, NC.

Paumier, J.O., S.G. Perry and D.J. Burns, 1990. An Analysis of CTDMPLUS Model Predictions with the Lovett Power Plant Data Base. Environmental Protection Agency, Research Triangle Park, NC.

Paumier, J.O., S.G. Perry and D.J. Burns, 1992. CTDMPLUS: A Dispersion Model for Sources near Complex Topography. Part II: Performance Characteristics. *Journal of Applied Meteorology*, 31(7): 646–660.

### A.6 Emissions and Dispersion Modeling System (EDMS) 3.1

#### Reference

Benson, Paul E., 1979. CALINE3—A Versatile Dispersion Model for Predicting Air Pollutant Levels Near Highways and Arterial Streets. Interim Report, Report Number FHWA/CA/TL-79/23. Federal Highway Administration, Washington, DC. (NTIS No. PB 80-220841)

Federal Aviation Administration, 1997. Emissions and Dispersion Modeling System (EDMS) Reference Manual. FAA Report No. FAA-AEE-97-01, USAF Report No. AL/EQ-TR-1997-0010, Federal Aviation Administration, Washington, DC 20591. SEE Availability below. (**Note:** this manual includes supplements that are available on the EDMS Internet Web site: <http://www.aee.faa.gov/aee-100/aee-120/edms/banner.htm>)

Petersen, W.B. and E.D. Rumsey, 1987. User's Guide for PAL 2.0—A Gaussian-Plume Algorithm for Point, Area, and Line Sources. EPA Publication No. EPA-600/8-87-009. Office of Research and Development, Research Triangle Park, NC. (NTIS No. PB 87-168 787/AS)

#### Availability

EDMS is available for \$45 (\$55 for users outside of the United States). The order form is available from: <http://www.aee.faa.gov>. Click the EDMS button on the left side of the page, and then click on the "EDMS Order Form" link. The \$45 cost covers the distribution of the EDMS package: A CD ROM containing the executable installation file, the user manual, and the model changes document. This EDMS package does not include the source code, which is available only through special request and FAA approval. Upon installation the user will have on their computer an executable file for the model and supporting data and program files. Official contact at Federal Aviation Administration: Ms. Julie Draper, AEE, 800 Independence Avenue, SW., Washington, DC 20591, Phone: (202) 267-3494.

#### Abstract

EDMS is a combined emissions/dispersion model for assessing pollution at civilian

airports and military air bases. This model, which was jointly developed by the Federal Aviation Administration (FAA) and the United States Air Force (USAF), produces an emission inventory of all airport sources and calculates concentrations produced by these sources at specified receptors. The system stores emission factors for fixed sources such as fuel storage tanks and incinerators and also for mobile sources such as aircraft or automobiles. The EDMS emissions inventory module incorporates methodologies described in AP-42 for calculating aircraft emissions, on-road and off-road vehicle emissions, and stationary source emissions. The dispersion modeling module incorporates PAL2 and CALINE3 (Section A.3) for the various emission source types. Both of these components interact with the database to retrieve and store data. The dispersion module, which processes point, area, and line sources, also incorporates a special meteorological preprocessor for processing up to one year of National Climatic Data Center (NCDC) hourly data.

#### a. Recommendations for Regulatory Use

EDMS is appropriate for the following applications:

- Cumulative effect of changes in aircraft operations, point source and mobile source emissions at airports or air bases;
- Simple terrain;
- Non-reactive pollutants;
- Transport distances less than 50 kilometers; and
- 1-hour to annual averaging times.

#### b. Input Requirements

(1) All data are entered through the EDMS graphical user interface. Typical entry items are annual and hourly source activity, source and receptor coordinates, etc. Some point sources, such as heating plants, require stack height, stack diameter, and effluent temperature inputs.

(2) Wind speed, wind direction, hourly temperature, and Pasquill-Gifford stability category (P-G) are the meteorological inputs. They can be entered manually through the EDMS data entry screens or automatically through the processing of previously loaded NCDC hourly data.

#### c. Output

Printed outputs consist of:

- A summary emission inventory report with pollutant totals by source category and detailed emission inventory reports for each source category; and
- A concentration summary report for up to 8760 hours (one year) of meteorological data that lists the number of sources, receptors, and the five highest concentrations for applicable averaging periods for the respective primary NAAQS.

#### d. Type of Model

For its emissions inventory calculations, EDMS uses algorithms consistent with the EPA Compilation of Air Pollutant Emission Factors, AP-42 (Section 11.0, ref. 96). For its dispersion calculations, EDMS uses the Point Area & Line (PAL2) model and the CALifornia LINE source (CALINE3) model, both of which use Gaussian algorithms.