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Project Summary

CDM-2.0—Climatological Dispersion Model User's Guide

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The Climatological Dispersion Model—Version 2.0 (CDM-2.0) determines long-term (seasonal or annual) quasi-stable pollutant concentrations in rural or urban settings using average emission rates from point and area sources and a joint frequency distribution of wind direction, wind speed, and stability. The Gaussian plume hypothesis forms the basis for the calculations. Contributions from area sources are calculated assuming the narrow plume hypothesis and involve an upwind integration over the area sources. Computations can be made for up to 200 point sources and 2500 area sources at an unlimited number of receptor locations. The number of point and area sources can be easily modified within the code. CDM-2.0 is an enhanced version of CDM and includes the following options: 16 or 36 wind-direction sectors, initial plume dispersion, buoyancy-induced dispersion, stack-tip downwash, and gradual (transitional) plume rise. The user has a choice of seven vertical dispersion parameter schemes. Optional output includes point and area concentration roses and histograms of pollutant concentration by stability class.

This Project Summary was developed by EPA's Atmospheric Sciences Research 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

The Climatological Dispersion Model User's Guide—Version 2.0 is an upgraded version of the CDM that was released in 1973. CDM-2.0 is a long-term (seasonal or annual) algorithm for evaluating the effects of multiple point and area sources in the near-field (within 25 km). The modeling region should consist of relatively flat terrain. The model includes the following computation features in common with CDM:

- handles up to 200 point sources and 2500 area sources,
- considers an unlimited number of receptors,
- optionally uses Holland's equation (1953) for limiting plume rise.

The number of sources can be modified by a global change within the code. Optional output features common to both CDM and CDM-2.0 are point and area concentration roses at user-specified receptors. The user can reduce output volume by only listing concentration results and not echoing the input data.

Results and Discussion

Modeling features added to CDM-2.0 include the following:

- optional initial dispersion, buoyancy-induced dispersion, stack-tip downwash, and gradual plume rise;
- choice of joint frequency function based on 16 or 36 wind direction sectors;
- choice of one of seven vertical dispersion parameter schemes; and
- optional output of concentration versus stability histograms at user-specified receptors.

The seven vertical dispersion parameter schemes are as follows:

- Briggs-rural,
- Briggs-urban,
- Brookhaven National Laboratory,
- Klug,
- St. Louis,
- PGCDM, and
- PGSIG.

PGCDM are the Pasquill-Gifford curves as employed in the version of CDM released in 1973. PGSIG are the Pasquill-Gifford curves as currently employed in the models approved for use for regulatory applications. The plume rise algorithm has been modified to handle rise during stable conditions and to consider momentum-dominated plumes.

Modeling limitations are as follows:

- source emissions and meteorology should be uncorrelated,
- variation in emission rates between adjacent area sources is assumed to be negligible,
- terrain should be flat to gently rolling, and
- chemical reactions or removal mechanisms other than those that can be handled as a simple exponential decay are not considered.

It is assumed that one wind vector and one stability category are representative of the area being modeled at any given time.

Conclusions and Recommendations

CDM-2.0 is an enhanced version of the Climatological Dispersion Model (Version 80247) released in 1973. This new version provides greater flexibility for the user in the characterizations of the dispersion and plume rise. The model can be adapted for estimation of annual or seasonal pollutant concentrations in both urban and rural situations. For rural applications, the area-source algorithm (based on the narrow-plume hypothesis) should be employed with caution. A default option has been incorporated in the model to preselect several of the modeling choices. The default selections are consistent with current regulatory guidance. It is intended that the default selections be revised and updated when and if regulatory guidance changes.

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The complete report, entitled "CDM-2.0—Climatological Dispersion Model User's Guide," (Order No. PB 86-136 546/AS; Cost: $16.95, subject to change) will be available only from:
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