Technology Transfer Network

Support Center for Regulatory Atmospheric Modeling

Preferred/Recommended Models

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These refined dispersion models are listed in Appendix W and are required to be used for State Implementation Plan (SIP) revisions for existing sources and for New Source Review (NSR) and Prevention of Significant Deterioration (PSD) programs. The models in this section include the following:

AERMOD Modeling System - A steady-state plume model that incorporates air dispersion based on planetary boundary layer turbulence structure and scaling concepts, including treatment of both surface and elevated sources, and both simple and complex terrain.

CALPUFF Modeling System - A non-steady-state puff dispersion model that simulates the effects of time- and space-varying meteorological conditions on pollution transport, transformation, and removal. CALPUFF can be applied for long-range transport and for complex terrain.

Other Models - Other dispersion models including BLP, CALINE3, CAL3QHC/CAL3QHCR, CTDMPLUS, and OCD.

AERMOD Modeling System

The American Meteorological Society/Environmental Protection Agency Regulatory Model Improvement Committee (AERMIC) was formed to introduce state-of-the-art modeling concepts into the EPA's air quality models. Through AERMIC, a modeling system, AERMOD, was introduced that incorporated air dispersion based on planetary boundary layer turbulence structure and scaling concepts, including treatment of both surface and elevated sources, and both simple and complex terrain.

There are two input data processors that are regulatory components of the AERMOD modeling system: AERMET, a meteorological data preprocessor that incorporates air dispersion based on planetary boundary layer turbulence structure and scaling concepts, and AERMAP, a terrain data preprocessor that incorporates complex terrain using USGS Digital Elevation Data. Other non-regulatory components of this system include: AERSCREEN, a screening version of AERMOD; AERSURFACE, a surface characteristics preprocessor, and BPIPPRIME, a multi-building dimensions program incorporating the GEP technical procedures for PRIME applications.

Below is the model code and documentation for AERMOD Version 09292. The model code and supporting documents are not static but evolve to accommodate the best available science. Please check this website often for updates to model code and associated documents. As of December 9, 2006, AERMOD is fully promulgated as a replacement to ISC3, in accordance with Appendix W.

AERMOD Implementation Guide
AERMOD Implementation Guide (PDF) - Provides information on the recommended use of AERMOD for particular applications and is an evolving document. (Updated March 19, 2009.)

Model Code
README (txt)
Executable (800k,zip)
Source Code (377k,zip)
Test Cases (17.4MB,zip)

Model Documentation
README (txt)
Model Change Bulletin #1 (txt)
Model Change Bulletin #2 (txt)
Model Change Bulletin #3 (txt)
User's Guide and Addendum (zip)
Model Formulation Document (PDF)
Addendum to the AERMOD Model Formulation Document (PDF) - PVMRM technical description
PVMRM and OLM Sensitivity Analysis (PDF)
Development and Evaluation of the PRIME Plume Rise and Building Downwash Model (PDF) (19k)
Project PRIME: Evaluation of Building Downwash Models Using Field and Wind Tunnel Data (PDF) (32k)
Development and Evaluation of the PRIME Plume Rise and Building Downwash Model (PDF) (588k)

Model Supporting Documents
Model Evaluation Paper
Bulk Richardson Number Evaluation Report
Comparison of Regulatory Design Concentrations: AERMOD vs ISCST3, CTDMPLUS, ISC-PRIME
Evaluation of Bias in AERMOD-PVMRM
AERMOD Deposition Science Document
AERMOD Deposition Parameterizations Document
Draft Peer Review Document - For the AERMOD Deposition Parameterizations Document (above)

Model Evaluation Databases
README - Document that explains the databases below that contain input and output data for the model evaluation
AGA (2.1MB,zip) - Input/output data for AGA: Flat, Rural, Downwash, Independent
Alaska (0.7MB,zip) - Input/output data for Alaska: Flat, Rural Downwash, Developmental
Baldwin (4.6MB,zip) - Input/output data for Bladwin: Flat, Rural, Non-downwash, Independent
Bowline - Input/output data for Bowline: Flat, Rural, Downwash, Developmental/Independent (1.8 mb)
Clifty Creek (3.5MB,zip) - Input/output data for Clifty Creek: Flat, Rural , Non-downwash, Independent
DAEC (1.1MB,zip) - Input/output data for DAEC: Flat, Rural, Downwash, Developmental
EOCR (4.3MB,zip) - Input/output data for EOCR: Flat, Rural, Downwash, Independent
Indianapolis (1.3MB,zip) - Input/output data for Indianapolis: Flat, Urban, Non-downwash, Developmental
Kincaid SF6 (3.1MB,zip) - Input/output data for Kincaid SF6: Flat, Rural, Non-downwash, Developmental
Kincaid SO2 (5.6MB,zip) - Input/output data for Kincaid SO2: Flat, Rural, Non-downwash, Developmental
Lee Wind Tunnel (13.4 MB,zip)- Input/output data for Lee Wind Tunnel: Flat, Rural,

Downwash, Independent
Lovett (9MB,zip) - Input/output data for Lovett: Terrain, Rural, Non-downwash, Developmental
Martin's Creek (11.5MB,zip) - Input/output data for Martin's Creek: Terrain, Rural, Non-downwash, Independent
Millstone (0.6MB,zip) - Input/output data for Millstone: Flat, Rural, Downwash, Developmental
Prairie Grass (0.4MB,zip) - Input/output data for Prairie Grass: Flat, Rural, Non-downwash, Developmental
Tracy (2.4MB,zip) - Input/output data for Tracy: Terrain, Rural, Non-downwash, Independent
Westvaco (10.1MB,zip) - Input/output data for Westvaco: Terrain, Rural, Non-downwash, Independent

CALPUFF Modeling System

CALPUFF is a multi-layer, multi-species non-steady-state puff dispersion model that simulates the effects of time- and space-varying meteorological conditions on pollution transport, transformation and removal. CALPUFF can be applied on scales of tens to hundreds of kilometers. It includes algorithms for subgrid scale effects (such as terrain impingement), as well as, longer range effects (such as pollutant removal due to wet scavanging and dry deposition, chemical transformation, and visibility effects of particulate matter concentrations).

--***Please read the following before accessing the CALPUFF modeling system***--

The files associated with this system, e.g., executables/source code, preprocessors, associated utilities, test cases, selected meteorological data sets and documentation can be found on TRC's website. Support documents related to CALPUFF can be found on this website and are listed below. TRC will provide updates and changes as necessary for the CALPUFF modeling system on their website. Users entering the TRC website will have the opportunity to register their e-mail addresses in order to receive notices of any updates to the system. This registration is voluntary and not necessary to access the system files.

Upon entering the TRC website, you will see the CALPUFF Model listing on the left-hand panel. To access the system code, click on "*DOWNLOAD*", then click on Skip Registration if you do not want to register. Go to TRC EXIT Disclaimer

CALPUFF Regulatory Updates and Consequence Analysis

The current regulatory version of the CALPUFF Modeling System includes:
CALPUFF version 5.8, level 070623
CALMET version 5.8, level 070623
CALPOST version 5.6394, level 070622

For every update of the "EPA-approved" version of the CALPUFF Modeling System, a consequence analysis is performed by EPA using an update protocol that identifies what model changes have been made and their implications based on the analysis results. This analysis compares the base CALPUFF Modeling System (i.e., current regulatory version) with the beta (i.e., proposed updated version).

Summary of Update Process

05-27-09 UPDATE
EPA is releasing the DRAFT document Reassessment of the Interagency Workgroup on Air Quality Modeling (IWAQM) Phase 2 Summary Report: Revisions to Phase 2 Recommendations at this time to provide additional technical information in support of the May 15, 2009 Model Clearinghouse recommendations to U.S. EPA Region 8 regarding

the Otter Tail BART modeling protocol. The purpose of this document is to inform the modeling community of our concerns regarding the CALPUFF modeling system for long range transport (LRT) applications, and to notify the community of our plans for addressing these concerns. The draft revisions to the IWAQM Phase 2 recommendations provided in this document are still undergoing internal testing to assess their viability for meeting the technical objectives of this reassessment. Some sections are still under development and will be incorporated in future updates to the DRAFT document.

06-29-07 UPDATE
Model Change Bulletins MCB-B, MCB-C, MCB-D
Model Update Report

Support Documents
A Comparison of CALPUFF Modeling Results To Two Tracer Field Experiments. (1998) 48 pages

An Analysis of the Calmet/Calpuff Modeling System In A Screening Mode. (1998) 56 pages.

A Comparison of CALPUFF with ISC3. (1998) 50 pages

Application of CALMET/CALPUFF and MESOPUFF II to Compare Regulatory Design Concentrations for a Typical Long-Range Transport Analysis. (2002) 88 pp.

Peer Review of Calmet/Calpuff Modeling System. (1998) 40 pp. Note: Part of Appendix F and all of Appendix G are unavailable in electronic form.

Response to Peer Review Comments of Calmet/Calpuff Modeling System. (1998) 5 pages.

Technical Issues Related to CALPUFF Near-field Applications. (2008) 16 pages

Support Literature
Bennett, M.J, M.E. Yansura, I.G. Hornyik, J.M. Nall, D.G. Caniparoli and C.G. Ashmore, 2002. Evaluation of the CALPUFF Long-range Transport Screening Technique by Comparison to Refined CALPUFF Results for Several Power Plants in Both the Eastern and Western United States. Proceedings of the Air & Waste Management Association's 95th Annual Conference, June 23-27, 2002; Baltimore, MD. Paper #43454.

Levy, JI; Spengler, JD; Hlinka, D; Sullivan, D; Moon, D (2002): Using CALPUFF to evaluate the impacts of power plant emissions in Illinois: mode sensitivity and implications. Atmos. Environ. Vol 36(6):1063-1075.

Zhou, Y; Levy, JI; Hammitt, JK; Evans, JS (2003): Estimating population exposure to power plant emissions using CALPUFF: a case study in Beijing, China. Atmos. Environ. Vol. 37(6):815-826

Other Preferred/Recommended Dispersion Models

BLP
BLp is a Gaussian plume dispersion model designed to handle unique modeling problems associated with aluminum reduction plants, and other industrial sources where plume rise and downwash effects from stationary line sources are important.

Model Code
Code/Executable/Test Cases/Post-processors (213KB,ZIP)

Model Documentation
User's Guide
User's Guide Addendum
Model Change Bulletin

CALINE3
CALINE3 is a steady-state Gaussian dispersion model designed to determine air pollution concentrations at receptor locations downwind of highways located in relatively uncomplicated terrain. CALINE3 is incorporated into the more refined CAL3QHC and CAL3QHCR models.

Model Code
Code/Executable/Test Case (53KB,ZIP)

Model Documentation
User's Guide
Latest Model Change Bulletin

CAL3QHC/CAL3QHCR
CAL3QHC is a CALINE3 based CO model with queuing and hot spot calculations and with a traffic model to calculate delays and queues that occur at signalized intersections; CAL3QHCR is a more refined version based on CAL3QHC that requires local meteorological data. Both models are available below.

Model Code
Executables for CAL3QHC and CAL3QHCR **--** (323KB,ZIP)

Model Documentation
User's Guide --(131KB,ZIP)
Latest Model Change Bulletin

CTDMPLUS
Complex Terrain Dispersion Model Plus Algorithms for Unstable Situations (CTDMPLUS) is a refined point source gaussian air quality model for use in all stability conditions for complex terrain. The model contains, in its entirety, the technology of CTDM for stable and neutral conditions. CTSCREEN is the screening version of CTDMPLUS.

Model Code
Code/Executable/Test Case (842KB,ZIP)

Model Documentation
User's Guide Supplement (12KB,ZIP)
User's Guide, Volume 1
User's Guide, Volume 2
User's Guide for Terrain Preprocessor
User's Guide for Meteorological Preprocessor
Final Report available from NTIS
Latest Model Change Bulletin

OCD
Offshore and Coastal Dispersion Model Version 5 (OCD) is a straight line Gaussian model developed to determine the impact of offshore emissions from point, area or line sources on the air quality of coastal regions. OCD incorporates overwater plume transport and dispersion as well as changes that occur as the plume crosses the shoreline. Hourly meteorological data are needed from both offshore and onshore locations.

Model Code

Code/Executable (8.6MB, ZIP, Windows XP Compatible, 5/16/05)

Model Documentation
User's Guide (408 MB, ZIP)
User's Guide Supplement
Latest Model Change Bulletin