Support Center for Regulatory Atmospheric Modeling (SCRAM)

CONTACT US <https://epa.gov/scram/forms/contact-us-about-air-quality-models>

Air Quality Dispersion Modeling - Preferred and Recommended Models

These refined dispersion models are listed in the Guideline on Air Quality Models - Appendix W (PDF) <https://epa.gov/sites/production/files/2020-09/documents/appw_17.pdf>(54 pp, 761 K, 01-17-2017) 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.

CTDMPLUS - A refined point source gaussian air quality model for use in all stability conditions for complex terrain.

OCD - 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.

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. As of December 9, 2006, AERMOD is fully promulgated as a replacement to ISC3, in accordance with Appendix W (PDF) <https://epa.gov/sites/production/files/2020-09/documents/appw_17.pdf>(54 pp, 761 K, 01-17-2017).

There are two input data processors that are regulatory components of the AERMOD modeling system: AERMET <https://epa.gov/scram/meteorological-processors-and-accessory-programs#aermet>, a meteorological data preprocessor that incorporates air dispersion based on planetary boundary layer turbulence structure and scaling concepts, and AERMAP <https://epa.gov/scram/air-quality-dispersion-modeling-related-model-support-programs#aermap>, a terrain data preprocessor that incorporates complex terrain using USGS Digital Elevation Data. Other non-regulatory components of this system include: AERSCREEN <https://epa.gov/scram/air-quality-dispersion-modeling-screening-models#aerscreen>, a screening version of AERMOD; AERSURFACE <https://epa.gov/scram/air-quality-dispersion-modeling-related-model-support-programs#aersurface>, a surface characteristics preprocessor, and BPIPPRIM <https://epa.gov/scram/air-quality-dispersion-modeling-related-model-support-programs#bpipprm>, a multi-building dimensions program incorporating the GEP technical procedures for PRIME applications.

At this time, AERMOD does not calculate design values for the lead NAAQS (rolling 3-month averages). A post-processing tool, LEADPOST (ZIP) <https://gaftp.epa.gov/air/aqmg/scram/models/preferred/aermod/leadpost.zip>(65 MB, 09-19-2013), is available to calculate design values from monthly AERMOD output. This tool calculates and outputs the rolling cumulative (all sources) 3-month average concentration at each modeled receptor with source group contributions and the maximum cumulative (all sources) rolling 3-month average concentration by receptor.

Below is the model code and documentation for AERMOD Version 22112. 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.

AERMOD Modeling System Code and Documentation
AERMOD Implementation Guide

AERMOD Modeling System Code and Documentation
AERMOD Implementation Guide (PDF) <https://gaftp.epa.gov/air/aqmg/scram/models/preferred/aermod/aermod_implementation_guide.pdf>(38 pp, 434 KB, 06-01-2022, 454-B-22-008) - Provides information on the recommended use of AERMOD for particular applications and is an evolving document.
AERMOD Modeling System Development
Modeling System Development Website and White Papers <https://epa.gov/scram/aermod-modeling-system-development>
Model Code
Executable (v22112) (ZIP) <https://gaftp.epa.gov/air/aqmg/scram/models/preferred/aermod/aermod_exe.zip> (1.5 MB, 04-22-2022) - 64-bit Operating Systems Executable (v22112) (ZIP) <https://gaftp.epa.gov/air/aqmg/scram/models/preferred/aermod/aermod_exe-32.zip>(1.4 MB, 04-22-2022) - 32-bit Operating Systems Source Code (v22112) (ZIP) <https://gaftp.epa.gov/air/aqmg/scram/models/preferred/aermod/aermod_source.zip>(622 KB, 04-22-2022)
Model Documentation

AERMOD Modeling System Code and Documentation

AERMOD Modeling System Transmittal Memorandum (v22112) (PDF) <https://gaftp.epa.gov/air/aqmg/scram/models/preferred/aermod/aermod_22112_transmittal_memo.pdf>(7pp, 355 KB, 06-27-2022)

AERMOD Quick Reference Guide (PDF) <https://gaftp.epa.gov/air/aqmg/scram/models/preferred/aermod/aermod_quick-reference-guide.pdf> (30 pp, 450 KB, 04-22-2022)

User's Guide (PDF) <https://gaftp.epa.gov/air/aqmg/scram/models/preferred/aermod/aermod_userguide.pdf> (316 pp, 2.0 MB, 06-01-2022, 454-B-22-007)

AERMOD System Bugs, Errata, and Related Guidance (PDF) <https://gaftp.epa.gov/air/aqmg/scram/models/preferred/aermod/aermod_system_bugs_and_related_guidance.pdf> (3 pp, 180 KB, 08-09-2022)

Model Change Bulletin #16 - Version Date 22112 (PDF) <https://gaftp.epa.gov/air/aqmg/scram/models/preferred/aermod/aermod_mcb16_v22112.pdf> (5 pp, 168 KB, 04-22-2022)

Model Change Bulletins Archive (ZIP) <https://gaftp.epa.gov/air/aqmg/scram/models/preferred/aermod/aermod_mcbs.zip>(876 KB, 04-22-2022)

Model Formulation Document (PDF) <https://gaftp.epa.gov/air/aqmg/scram/models/preferred/aermod/aermod_mfd.pdf>(174 pp, 2.0 MB, 06-01-2022, 454-B-22-009)

Model Evaluation Document (PDF) <https://gaftp.epa.gov/air/aqmg/scram/models/preferred/aermod/aermod_med.pdf>(59 pp, 2.8 MB, 06-01-2022, 454-B-22-010)

AERMOD System Data Resources

AERMOD Modeling System Data Resources (PDF) <https://gaftp.epa.gov/air/aqmg/scram/models/preferred/aermod/aermod_data_resources.pdf> (4 pp, 172 KB, 10-21-2021)

Test Cases

AERMOD Modeling System Code and Documentation

AERMOD Test Cases (ZIP) <https://gaftp.epa.gov/air/aqmg/scram/models/preferred/aermod/aermod_test_cases_22112.zip>(43.6 MB, 04-22-2022)

Installation Guide (Sample Run)

Read Me (TXT) <https://gaftp.epa.gov/air/aqmg/scram/models/preferred/aermod/readme_install.txt>(1 KB, 08-21-2019) - please read this file first
Sample Run Instructions (PDF) <https://gaftp.epa.gov/air/aqmg/scram/models/preferred/aermod/aermod_sample_run.pdf>(11 pp, 464 KB, 09-16-2019) - detailed installation and execution instructions
Sample Run (ZIP) <https://gaftp.epa.gov/air/aqmg/scram/models/preferred/aermod/samplerun.zip>(1.2 MB, 09-16-2019) - sample test case

AERPLOT Sample Run Instructions (PDF) <https://gaftp.epa.gov/air/aqmg/scram/models/related/aerplot/sample_aerplot_run.pdf>(4 pp, 190 KB, 01-24-2020) - detailed installation and execution instructions
AERPLOT Sample Run (ZIP) <https://gaftp.epa.gov/air/aqmg/scram/models/related/aerplot/sample_aerplot_run.zip>(4.3 MB, 01-24-2020) - sample test for AERPLOT

Model Supporting Documents

AERMOD Modeling System Code and Documentation

Model Evaluation Paper (PDF) <https://gaftp.epa.gov/air/aqmg/scram/models/preferred/aermod/aermod_mep.pdf> (41 pp, 1 MB, 06-01-2003, 454-R-03-003)

Bulk Richardson Number Evaluation Report (PDF) <https://gaftp.epa.gov/air/aqmg/scram/models/preferred/aermod/bulkri_eval.pdf>(34 pp, 329 KB, 09-01-2004)

Comparison of Regulatory Design Concentrations: AERMOD vs ISCST3, CTDMPLUS, ISC-PRIME (PDF) <https://gaftp.epa.gov/air/aqmg/scram/models/preferred/aermod/compar.pdf>(89 pp, 31 KB, 06-01-2003, 454-R-03-002)

Development and Evaluation of the PRIME Plume Rise and Building Downwash Model (PDF) <https://gaftp.epa.gov/air/aqmg/scram/models/other/iscprime/tekpapr1.pdf>(5 pp, 19 KB, 1995)

Project PRIME: Evaluation of Building Downwash Models Using Field and Wind Tunnel Data (PDF) <https://gaftp.epa.gov/air/aqmg/scram/models/other/iscprime/tekpapr2.pdf>(4 pp, 32 KB, 1998)

Development and Evaluation of the PRIME Plume Rise and Building Downwash Model (PDF) <https://gaftp.epa.gov/air/aqmg/scram/models/other/iscprime/primpldn.pdf>(34 pp, 588 KB, 10-05-1999)

Evaluation of Bias in AERMOD-PVMRM (PDF) <https://gaftp.epa.gov/air/aqmg/scram/models/preferred/aermod/pvmrm_bias_eval.pdf>(33 pp, 236 KB, 06-01-2005)

PVMRM and OLM Sensitivity Analysis (PDF) <https://gaftp.epa.gov/air/aqmg/scram/models/preferred/aermod/pvmrm_sens.pdf>(67 pp, 522 KB, 09-01-2004)

Ambient Ratio Method Version 2 (ARM2) for use with AERMOD for 1-hr NO_2 Modeling - Development and Evaluation Report (PDF) <https://gaftp.epa.gov/air/aqmg/scram/models/preferred/aermod/arm2_development_and_evaluation_report-september_20_2013.pdf>(95 pp, 2.2 MB, 09-20-2013)

Guidance on R-LINE Additions to AERMOD for Refined Transportation Project Analyses <https://epa.gov/state-and-local-transportation/project-level-conformity-and-hot-spot-analyses#guidance-19191>

AERMOD Deposition Science Document (PDF) <https://gaftp.epa.gov/air/aqmg/scram/models/preferred/aermod/aer_scid.pdf>(22 pp, 196 KB, 03-19-2004)

AERMOD Deposition Parameterizations Document (ZIP) <https://gaftp.epa.gov/air/aqmg/scram/models/preferred/aermod/driscdep.zip>(338 KB, 10-28-2003)

Draft Peer Review Document (ZIP) <https://gaftp.epa.gov/air/aqmg/scram/models/preferred/aermod/driscpr.zip>(797 KB, 08-27-2001) - For the AERMOD Deposition Parameterizations Document (above)

Technical Support Document (TSD) for AERMOD/BLP Development and Testing <https://gaftp.epa.gov/air/aqmg/scram/models/preferred/aermod/aermod_blp_tsd.pdf> (43 pp, 1.0 MB, 12-01-2016, 454-B-16-009)

AERMOD Modeling System Code and Documentation
Technical support document (TSD) for NO2-related AERMOD modifications <https://gaftp.epa.gov/air/aqmg/scram/models/preferred/aermod/aermod_no2_changes_tsd.pdf> (32 pp, 1.6 MB, 12-01-2015, 454-B-15-004) NO_2/NO_x In-Stack Ratio (ISR) Database <https://epa.gov/scram/nitrogen-dioxidenitrogen-oxide-stack-ratio-isr-database>
Model Evaluation Databases

AERMOD Modeling System Code and Documentation

README (TXT) <https://gaftp.epa.gov/air/aqmg/scram/models/preferred/aermod/eval_databases/evalreadme.txt> (2 KB, 01-22-2004) - Document that explains the databases below that contain input and output data for the model evaluation

AGA (ZIP) <https://gaftp.epa.gov/air/aqmg/scram/models/preferred/aermod/eval_databases/aga.zip>(2 MB, 01-22-2004) - Input/output data for AGA: Flat, Rural, Downwash, Independent

Alaska (ZIP) <https://gaftp.epa.gov/air/aqmg/scram/models/preferred/aermod/eval_databases/alaska.zip>(661 KB, 01-22-2004) - Input/output data for Alaska: Flat, Rural Downwash, Developmental

Baldwin (ZIP) <https://gaftp.epa.gov/air/aqmg/scram/models/preferred/aermod/eval_databases/baldwin.zip> (4.5 MB, 01-22-2004) - Input/output data for Bladwin: Flat, Rural, Non-downwash, Independent

Bowline (ZIP) <https://gaftp.epa.gov/air/aqmg/scram/models/preferred/aermod/eval_databases/bowline.zip>(2 MB, 01-22-2004) - Input/output data for Bowline: Flat, Rural, Downwash, Developmental/Independent

Clifty Creek (ZIP) <https://gaftp.epa.gov/air/aqmg/scram/models/preferred/aermod/eval_databases/clifty.zip> (3.5 MB, 01-22-2004) - Input/output data for Clifty Creek: Flat, Rural , Non-downwash, Independent

DAEC (ZIP) <https://gaftp.epa.gov/air/aqmg/scram/models/preferred/aermod/eval_databases/daec.zip>(1 MB, 01-22-2004) - Input/output data for DAEC: Flat, Rural, Downwash, Developmental

EOCR (ZIP) <https://gaftp.epa.gov/air/aqmg/scram/models/preferred/aermod/eval_databases/eocr.zip>(4 MB, 01-22-2004) - Input/output data for EOCR: Flat, Rural, Downwash, Independent

Indianapolis (ZIP) <https://gaftp.epa.gov/air/aqmg/scram/models/preferred/aermod/eval_databases/indiana.zip>(1 MB, 01-22-2004) - Input/output data for Indianapolis: Flat, Urban, Non-downwash, Developmental

Kincaid SF6 (ZIP) <https://gaftp.epa.gov/air/aqmg/scram/models/preferred/aermod/eval_databases/kinsf6.zip> (3 MB, 01-22-2004) - Input/output data for Kincaid SF6: Flat, Rural, Non-downwash, Developmental

Kincaid SO2 (ZIP) <https://gaftp.epa.gov/air/aqmg/scram/models/preferred/aermod/eval_databases/kinso2.zip> (5 MB, 01-22-2004) - Input/output data for Kincaid SO2: Flat, Rural, Non-downwash, Developmental

Lee Wind Tunnel (ZIP) <https://gaftp.epa.gov/air/aqmg/scram/models/preferred/aermod/eval_databases/lee.zip>(13 MB, 01-22-2004) - Input/output data for Lee Wind Tunnel: Flat, Rural, Downwash, Independent

Lovett (ZIP) <https://gaftp.epa.gov/air/aqmg/scram/models/preferred/aermod/eval_databases/lovett.zip>(9 MB, 01-22-2004) - Input/output data for Lovett: Terrain, Rural, Non-downwash, Developmental

Martin's Creek (ZIP) <https://gaftp.epa.gov/air/aqmg/scram/models/preferred/aermod/eval_databases/martin.zip>(11.5 MB, 01-22-

AERMOD Modeling System Code and Documentation
2004) - Input/output data for Martin's Creek: Terrain, Rural, Non-downwash, Independent Millstone (ZIP) <https://gaftp.epa.gov/air/aqmg/scram/models/preferred/aermod/eval_databases/millston.zip> (660 KB, 01-22-2004) - Input/output data for Millstone: Flat, Rural, Downwash, Developmental Prairie Grass (ZIP) <https://gaftp.epa.gov/air/aqmg/scram/models/preferred/aermod/eval_databases/pgrass.zip> (342 KB, 01-22-2004) - Input/output data for Prairie Grass: Flat, Rural, Non-downwash, Developmental Tracy (ZIP) <https://gaftp.epa.gov/air/aqmg/scram/models/preferred/aermod/eval_databases/tracy.zip>(2.5 MB, 01-22-2004) - Input/output data for Tracy: Terrain, Rural, Non-downwash, Independent Westvaco (ZIP) <https://gaftp.epa.gov/air/aqmg/scram/models/preferred/aermod/eval_databases/westvaco.zip> (10 MB, 01-22-2004) - Input/output data for Westvaco: Terrain, Rural, Non-downwash, Independent Denver-Julesburg (ZIP) <https://gaftp.epa.gov/air/aqmg/scram/models/preferred/aermod/eval_databases/denver-julesburg.zip>(108 MB, 08-18-2020) - Input/output data for Denver-Julesburg: Flat, Rural, Non-downwash, Independent

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 <https://epa.gov/scram/air-quality-dispersion-modeling-screening-models#ctscreen> is the screening version of CTDMPLUS.

CTDMPLUS Model Code and Documentation
Model Code
Code/Executable/Test Case (ZIP) <https://gaftp.epa.gov/air/aqmg/scram/models/preferred/ctdmplus/ctdmplus.zip>(842 KB, 08-19-1993)
Model Documentation

User's Guide Supplement (PDF)
<https://gaftp.epa.gov/air/aqmg/scram/models/preferred/ctdmplus/ctdmsup.pdf>(5 pp, 60 KB, 03-01-1993)
User's Guide, Volume 1 (PDF)
<https://gaftp.epa.gov/air/aqmg/scram/models/preferred/ctdmplus/ctdmplusvol1.pdf>(210 pp, 7 MB, 03-01-1989, 600-8-89-041)
User's Guide, Volume 2 (PDF)
<https://gaftp.epa.gov/air/aqmg/scram/models/preferred/ctdmplus/ctdmplusvol2.pdf>(77 pp, 2 MB, 10-01-1990, 600-8-90-087)
User's Guide for Terrain Preprocessor (PDF)
<https://gaftp.epa.gov/air/aqmg/scram/models/preferred/ctdmplus/ctdmterrprepug.pdf>(180 pp, 6 MB, 03-01-1988, 600-8-88-003)
User's Guide for Meteorological Preprocessor (PDF)
<https://gaftp.epa.gov/air/aqmg/scram/models/preferred/ctdmplus/ctdmmetprepug.pdf>(166 pp, 5 MB, 03-01-1989, 600-8-88-004)
Final Report (PDF)
<https://gaftp.epa.gov/air/aqmg/scram/models/preferred/ctdmplus/ctdmplusfinal_report.pdf>(484 pp, 16 MB, 12-01-1987)

Model Change Bulletin #5 - Version Date 93228 (TXT)
<https://gaftp.epa.gov/air/aqmg/scram/models/preferred/ctdmplus/ctdz5.txt>(5 KB, 08-19-1993)
Model Change Bulletins Archive (ZIP)
<https://gaftp.epa.gov/air/aqmg/scram/models/preferred/ctdmplus/ctdmplus_mcbs.zip>(11 KB, 08-19-1993)

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.

OCD Model Code and Documentation
Model Code

Code/Executable (ZIP) <https://gaftp.epa.gov/air/aqmg/scram/models/preferred/ocd/ocd5.zip>(9 MB, 01-06-2000)
Model Documentation
User's Guide (PDF) <https://gaftp.epa.gov/air/aqmg/scram/models/preferred/ocd/ocdug.pdf>(160pp, 1.7 MB, 11-06-1997) User's Guide (ZIP) <https://gaftp.epa.gov/air/aqmg/scram/models/preferred/ocd/ocd5ug.zip>(Original WP6 files, 369 KB, 11-06-1997) User's Guide Supplement (PDF) <https://gaftp.epa.gov/air/aqmg/scram/models/preferred/ocd//ocdugsup.pdf>(204 pp, 3 MB, 11-01-1989) Model Change Bulletin #3 - Version Date 00006 (TXT) <https://gaftp.epa.gov/air/aqmg/scram/models/preferred/ocd/ocdz3.txt>(6 KB, 01-06-2000) Model Change Bulletins Archive (ZIP) <https://gaftp.epa.gov/air/aqmg/scram/models/preferred/ocd/ocd_mcbs.zip>(4 KB, 01-06-2000)

SCRAM Home <https://epa.gov/scram>

Air Quality Models <https://epa.gov/scram/air-quality-models>

Model Applications and Tools <https://epa.gov/scram/modeling-applications-and-tools>

Modeling Guidance and Support <https://epa.gov/scram/modeling-guidance-and-support>

Meteorological Data and Processors <https://epa.gov/scram/meteorological-data-and-processors>

Conferences and Workshops <https://epa.gov/scram/air-modeling-conferences-and-workshops>

Reports and Journal Articles <https://epa.gov/scram/air-modeling-reports-and-journal-articles>

Related Links <https://epa.gov/scram/air-modeling-resources-selected-agencies-and-organizations>

Contact Us <https://epa.gov/scram/forms/contact-us-about-air-quality-models> to ask a question, provide feedback, or report a problem.

LAST UPDATED ON JULY 19, 2023


UNITED STATES
ENVIRONMENTAL PROTECTION AGENCY

Discover.

Accessibility Statement <https://epa.gov/accessibility/epa-accessibility-statement>

Budget & Performance <https://epa.gov/planandbudget>

Contracting <https://epa.gov/contracts>

EPA www Web Snapshot <https://epa.gov/utilities/wwwepagov-snapshots>

Grants <https://epa.gov/grants>

No FEAR Act Data <https://epa.gov/ocr/whistleblower-protections-epa-and-how-they-relate-non-disclosure-agreements-signed-epa>

Plain Writing <https://epa.gov/web-policies-and-procedures/plain-writing>

Privacy <https://epa.gov/privacy>

Privacy and Security Notice <https://epa.gov/privacy/privacy-and-security-notice>

Connect.

Data.gov <https://www.data.gov/>

Inspector General <https://epa.gov/office-inspector-general/about-epas-office-inspector-general>

Jobs <https://epa.gov/careers>

Newsroom <https://epa.gov/newsroom>

Open Government <https://epa.gov/data>

Regulations.gov <https://www.regulations.gov/>

Subscribe <https://epa.gov/newsroom/email-subscriptions-epa-news-releases>

USA.gov <https://www.usa.gov/>

White House <https://www.whitehouse.gov/>

Ask.

Contact EPA <https://epa.gov/home/forms/contact-epa>

EPA Disclaimers <https://epa.gov/web-policies-and-procedures/epa-disclaimers>

Hotlines <https://epa.gov/aboutepa/epa-hotlines>

FOIA Requests <https://epa.gov/foia>

Frequent Questions <https://epa.gov/home/frequent-questions-specific-epa-programstopics>

Follow.