



UNITED STATE ENVIRONMENTAL PROTECTION AGENCY
RESEARCH TRIANGLE PARK, NC 27111

OFFICE OF
AIR QUALITY PLANNING
AND STANDARDS

MEMORANDUM

SUBJECT: Release of AERMOD & AERMET Version 23132 and MMIF Version 4.1
FROM: Clint Tillerson, Model Development Team Lead
Air Quality Modeling Group
Air Quality Assessment Division, Office of Air Quality Planning and Standards
TO: EPA Regional Modeling Contacts

The United States Environmental Protection Agency (EPA), Office of Air Quality Planning and Standards (OAQPS) is releasing new versions (23132) of the AERMOD dispersion model and the AERMET preprocessor AERMOD, replacing AERMOD version 22112 and AERMET version 22112 as the regulatory versions of AERMOD and AERMET. Released concurrently with AERMOD and AERMET is MMIF 4.1 which replaces MMIF 4.0.

This memorandum provides information on these updated programs, including the nature of the updates and the status of the releases regarding regulatory applications. If there are any questions about this new release of the AERMOD Modeling System or issues found with the updated model components, please send an email to Tillerson.Clint@epa.gov.

Background

In 2005, the American Meteorological Society/Environmental Protection Agency Regulatory Model (AERMOD) was promulgated as the EPA's preferred near-field dispersion model for regulatory applications, replacing the Industrial Source Complex (ISC) model. AERMET is the regulatory meteorological preprocessor for AERMOD and can process National Weather Service (NWS) surface data, NWS upper air data, site-specific data, (i.e., data collected at a nearby representative meteorological station), and pre-processed prognostic meteorological data.

AERMET processes the input meteorological data to calculate boundary layer parameters for input to the AERMOD model.

This release is concurrent with a Notice of Proposed Rulemaking (NPRM) to revise Appendix W to CFR 40 Part 51, *Guideline on Air Quality Models (Guideline)*. The revision to the *Guideline* proposes updates to the regulatory formulation of AERMOD and AERMET and implementation. The proposed updates are included in this release as BETA options and cannot be used for regulatory applications of the modeling system without approval as an alternative model by the appropriate EPA Regional Office and subsequent concurrence by the EPA Model Clearinghouse (MCH). The EPA anticipates the proposed *Guideline* to be finalized in the Spring of 2024.

For more information regarding the regulatory application of the AERMOD Modeling System, please consult the *Guideline*.

AERMOD

AERMOD 23132 replaces the regulatory version 22112. In summary, updates in AERMOD 23132 include numerous small bug fixes related to the BUOYLINE, AREACIRC, RLINE, RLINEXT and SWPOINT source types; updates to error and warning messages; enhancements to the BUOYLINE and URBANOPT debug files; formulation updates and enhancements to the RLINE and RLINEXT source types, addition of new ALPHA options; and the BETA flag requirement to accept meteorological data processed with the COARE algorithm implemented in AERMET 23132. Note that the ALPHA and BETA options in AERMOD 23132 cannot be used in regulatory applications of the AERMOD Modeling System without EPA Region Office approval as an alternative model and concurrence from EPA's MCH. Refer to the AERMOD Model Change Bulletin #17 for a complete list of changes in AERMOD 23132. Some of the more substantial updates and new options of interest include the following:

Proposed Regulatory Updates

- Reformulation of RLINE source type to bring the RLINE source type into better agreement with other AERMOD source types. There were three main aspects of the reformulation: (1) Wind Speed calculation, (2) Harmonization with AERMOD sources, and (3) Dispersion Coefficients (RLINE - BETA option proposed as formulation update).
- Formulation updates to the Generic Reaction Set Method (GRSM) Tier 3 screening option for NO₂ conversion (GRSM - BETA option proposed as formulation update).

- Requirement of the BETA flag in the AERMOD control file if 'COARE' is found in the SFC meteorological input file header. The presence of 'COARE' in the SFC file header indicates the meteorological data were processed with the COARE algorithm in AERMET ('COARE' SFC Header Flag - BETA option).

New ALPHA Options

- A treatment for highly buoyant plumes when they penetrate the top of the mixed layer (HBP).
- Area meander for area source types (AREAMNDR).
- Characterization for aircraft sources as area and/or volume source types that accounts for plume rise from aircraft (ARCFTOPT).

Bug Fixes and Enhancements

- Capability to account for elevated terrain with RLINE and RLINEXT source types.
NOTE: When modeling project level conformity and hot-spot analyses, refer to the Office of Transportation and Air Quality (OTAQ) for current guidance for modeling roadway sources.
- New debug file for urban debug option that reports temperature and vertical potential temperature profiles.
- Ability to use a mixture of 2-digit and 4-digit years across data input files (e.g., SFC meteorology, PFL meteorology, hourly emissions, and hourly background).
- Correction to conversion of 2-digit year to 4-digit year for check on SRFDATA keyword in control file. Year is assumed to be in the 1900s if the year is ≥ 50 and in the 2000s if < 50 .
- Correction to conflicts with source group IDs during event processing with BUOYLINE source type.
- Correction for NaN in the urban debug file.
- Correction for false warning message "Julian Day Out of Range" that was issued when using DAYRANGE keyword.
- Requirement of ALPHA flag when RLINEXT source type is specified.
- Correction when AREACIRC sources are listed in an INCLUDED file. Sources were overwritten when multiple reads of AREACIRC sources caused memory conflicts between array sizing and source ID assignments.

- Correction to ARM_RATIO minimum and maximum values to match the ranges provided in the AERMOD User's Guide, based on whether the DFAULT keyword is specified.
- Warning message added when the SCREEN option is used with RLINE, RLINEXT, BUOYLINE, SWPOINT, AREA, or LINE source types.
- Correction for inconsistent results between BUOYLINE, RLINE, and RLINEXT source types when modeling for FLAT terrain and depending on how FLAT terrain was specified.

AERMET and MMIF

AERMET 23132 replaces the regulatory version 22112. Version 22112 represented a complete overhaul of the AERMET source code structure, though no updates to the formulation of AERMET were introduced. Version 23132 corrects various bugs reported since the code overhaul. In addition, several enhancements were included related to quality assurance (QA) checks on the number of site-specific sub-hourly observations and data reported in the QA output file. Perhaps the most substantial update to AERMET is the addition of the Coupled Ocean Atmosphere Response Experiment (COARE) air-sea flux procedure for processing meteorological data representative of a marine boundary layer needed for modeling offshore sources. The implementation of COARE in AERMET is being proposed as a regulatory update to AERMET in the proposed *Guideline* updates and replaces the stand-alone AERCOARE meteorological processor which has recently been approved as an alternative model for several offshore source permit applications. Note that the use of meteorological data processed with the COARE option in AERMET is a BETA option in AERMOD and requires EPA Regional Office approval and EPA MCH concurrence until this updated formulation of AERMET has been finalized in the *Guideline*. Refer to the AERMET Model Change Bulletin #13 for a complete list of changes in AERMET 23132. Some of the more substantial updates and new options of interest include the following:

Proposed Regulatory Update

- Addition of COARE air-sea flux procedure (BETA flag required in AERMOD).

Bug Fixes and Enhancements

- Additional QA on the number of observations/hour in sub-hourly site-specific data.

- Added NWS elevation to SURFACE EXTRACT and QAOUT file when derived from ISHD data.
- Additional QA checks to ONSITE/PROG heights when OSHEIGHTS is not specified.
- Updated AERMET to allow multi-level data to be out of ascending order.
- Check added on OUTPUT and PROFILE file for format overflows and NaN.
- Modified PBL_PROC and WRITE_SRSS to only get target sounding hours and UPPERAIR sunrise/sunset times when UPPERAIR data being used in Stage 2.
- Correction in subroutine MECH_HT to use unsmoothed mixing height when u^* is missing for the hour.
- Initialized variables to correct issues with Linux compilation.
- Correction to allow primary surface characteristics keywords to be used with AERSURF2 file in subroutine AERSURF.
- Correction for sounding target hours when beginning of window is in previous day of sounding in subroutines PBL_PROC and CHECK_OBS.
- Correction in UPPERAIR location when using ONSITE/PROG mixing heights and no UPPERAIR data.
- Correction to SURFACE winds to only set to calm if not missing.
- Correction to sum ONSITE sub-hourly precipitation variables instead of averaging.

The addition of COARE in AERMET subsequently required updates to the Mesoscale Model Interface Program (MMIF) to extract additional meteorological parameters from prognostic model output for input to AERMET and modify the AERMET control files generated by MMIF. MMIF 4.1 replaces MMIF 4.0.