OFFICE OF AIR QUALITY PLANNING AND STANDARDS

RESEARCH TRIANGLE PARK, NC 27711

November 20, 2024

<u>**MEMORANDUM**</u>

SUBJECT: Release of the regulatory AERMOD Modeling System (AERMOD, AERMET, and AERMAP), AERSURFACE, and AERPLOT (Version 24142), and MMIF (Version 4.1.1)

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 a new version (24142) of the AERMOD Modeling System, including the AERMOD dispersion model, AERMET meteorological preprocessor, and the AERMAP terrain preprocessor. This release replaces AERMOD and AERMET version 23132 and AERMAP version 18081 as the regulatory versions of AERMOD, AERMET, and AERMAP. Released concurrently are non-regulatory components including the AERSURFACE land cover preprocessor, version 24142 replacing version 20060, AERPLOT version 24142 replacing version 16216, and the Mesoscale Model Interface Program (MMIF) version 4.1.1 replacing version 4.1.

This memorandum provides information on these updated programs, including the nature of the updates and the status of the releases regarding regulatory applications. Updated programs can be downloaded from the EPA's Support Center for Regulatory Atmospheric Modeling (SCRAM) website, links provided below. If there are any questions about this new release of the AERMOD Modeling System and related programs or if issues are encountered, please send an email to Tillerson.Clint@epa.gov. A live webinar for the public is scheduled for December 10, 2024 at 3:00 PM EST. Refer to the SCRAM website linked above for information on how to join the webinar.

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 generated with a model such as the Weather Research and Forecasting (WRF) Model. AERMET processes the meteorological data to calculate boundary layer parameters that are input into the AERMOD dispersion model. AERMAP is the terrain preprocessor for AERMOD and can process elevation data provided by the U.S. Geological Survey (USGS) from the 3D Elevation Program (3DEP) as GeoTIFF files; however, data compression must be removed for AERMAP to read the file. Instructions for removing the data compression and an alternate source for the data are available at: https://gaftp.epa.gov/Air/aqmg/SCRAM/models/related/aermap/Access_and_Conversion_of_Elevatio n_Data_for_AERMAP.pdf.

With respect to the non-regulatory programs released concurrently with AERMOD, AERMET, and AERMAP programs, AERSURFACE processes land cover data from the National Land Cover Database (NLCD) provided by the USGS and distributed by the Multi-Resolution Land Characteristics (MRLC) Consortium as GeoTIFF files to calculate surface characteristics (albedo, Bowen ratio, and surface roughness) which are required inputs to AERMET. More information about obtaining land cover data from the MRLC is available at: https://gaftp.epa.gov/Air/aqmg/SCRAM/models/related/aersurface/NLCD_Sources_for_AERSURFACE_ v24142.pdf.

MMIF converts prognostic meteorological model output fields generated by WRF to a format that can be read directly by AERMET. AERPLOT processes AERMOD output and generates a Keyhole Markup Language (KML) file of receptor concentrations, concentration contours, and emission source locations that can be viewed directly in Google Earth or imported into Geographic Information System (GIS) programs such as ArcGIS.

These programs are being released concurrent with a Notice of Final Rulemaking (NFRM) that revises Appendix W to CFR 40 Part 51, *Guideline on Air Quality Models* (*Guideline*). More information regarding this final rule can be found at: https://www.epa.gov/scram/2024-appendix-w-final-rule. The revision to the *Guideline* updates the regulatory formulation of AERMOD and AERMET in the form of additional model options. These updates to AERMET and AERMOD are included in this release as new regulatory options and can be used for regulatory applications of the modeling system without approval as an alternative model. Updates to AERMAP are limited to bug fixes and enhancements as summarized below and do not include any formulation changes associated with the revisions to the *Guideline*. Updates to each of the programs included in this release are summarized below.

For more information regarding the regulatory version of the AERMOD Modeling System and its application, please consult the *Guideline* and the EPA's Support Center for Regulatory Atmospheric Modeling (SCRAM) at: https://www.epa.gov/scram/air-quality-dispersion-modeling-preferred-and-recommended-models#aermod.

AERMOD

https://www.epa.gov/scram/air-quality-dispersion-modeling-preferred-and-recommended-models#aermod

AERMOD 24142 replaces the regulatory version 23132. The primary updates in AERMOD 24142 include the removal of the BETA flag requirement for the use of the Coupled-Ocean Atmosphere Response Experiment (COARE) option implemented in AERMET for preprocessing marine-based meteorological data; the RLINE mobile source type based on the Research-LINE model developed by EPA's Office and Research and Development (ORD); and the Generic Reaction Set Method (GRSM) Tier 3 NO_X-to-NO_2 conversion screening option. Although these options are now part of the regulatory version of the AERMOD Modeling System, the appropriate reviewing authority should be consulted prior to use in a regulatory application.

The COARE algorithm extends the use of AERMET and AERMOD to overwater applications in limited environments. Per the *Guideline*, the Offshore Coastal Dispersion (OCD) Model is still the preferred model for offshore sources, but in some cases, it might be appropriate to use the COARE option in AERMET along with the AERMOD dispersion model in the place of OCD when the plume is not affected by platform downwash or shoreline fumigation. Thus, the use of the COARE option in AERMET should be discussed with the reviewing authority to determine whether it's use is appropriate under the *Guideline*.

GRSM has been added as a Tier 3 screening option for the conversion of NO_X-to-NO_2, to compliment the prior existing PVMRM and OLM screening options. The reviewing authority should be consulted for agreement on which of the three options is most appropriate for a specific NO_2 modeling application, as well as agreement on appropriate in-stack NO_2/NO_X ratios, hourly ozone data, hourly NO_X data, and background NO_2 model inputs.

The RLINE source type, added to better characterize mobile emissions sources, should be used in accordance with guidance provided by the EPA's Office of Transportation and Air Quality (OTAQ). OTAQ guidance for project-level conformity and hot-spot analyses can be found at: https://www.epa.gov/state-and-local-transportation/project-level-conformity-and-hot-spot-analyses.

In addition, this updated version of AERMOD includes a short list of bug fixes and enhancements related in part to the use of the EMISUNIT keyword with the BUOYLINE source type; 2-digit year when crossing centuries; new and updated error and warning messages; and a correction to eliminate "NaN" (Not a Number) in numerical output fields for non-point sources ground-level releases when using the GRSM screening option. Refer to AERMOD Model Change Bulletin #18 for a complete list of changes in AERMOD 24142.

AERMET

https://www.epa.gov/scram/meteorological-processors-and-accessory-programs#aermet

AERMET 24142 replaces the regulatory version 23132. Version 24142 corrects minor bugs reported since the release of version 23132 related in part to new and updated error and warning messages;

COARE option and input requirements; and missing data. While no code updates were required related to the finalization of the *Guideline*, the COARE algorithm implemented in AERMET version 23132 as a BETA option is now a regulatory option in AERMET version 24142 and does not require approval as an alternative model. However, as previously stated, OCD is still the preferred model for offshore sources. In limited environments, it might be appropriate to use the COARE option in AERMET along with the AERMOD dispersion model in the place of OCD. The use of the COARE option in AERMET and the AERMOD dispersion model should be discussed with the reviewing authority. An enhancement was also added to AERMET to require the surface level station pressure at the site of the upper air station using the LOCATION keyword on the UPPERAIR pathway. Prior to this enhancement, AERMET would skip the upper air sounding if the surface level station pressure for the sounding hour was missing. With this enhancement, AERMET will now substitute the missing surface level station pressure with the user supplied station pressure and preserve the sounding. Refer to AERMET Model Change Bulletin #14 for a complete list of changes in AERMET 24142.

AERMAP

https://www.epa.gov/scram/air-quality-dispersion-modeling-related-model-support-programs#aermap

AERMAP 24142 replaces the regulatory version 18081. No code updates were required related to the revisions to the *Guideline*. Updates include minor bug fixes that correct inconsistences and errors associated with different receptor types when extracting or providing flagpole heights and elevations and inconsistences in input requirements by AERMAP and AERMOD when using the EVALCART keyword. More substantial updates include enhancements that add checks for filename conflicts; the addition of source elevation extraction for the LINE, BUOYLINE, and RLINE source types; and the capability to extract elevations for sources only without the requirement to include receptors in the AERMAP control input file. Previous versions of AERMAP could extract elevations for receptors only, but if extracting elevations for sources, AERMAP required the inclusion of at least one receptor. Refer to AERMAP Model Change Bulletin #5 for a complete list of changes in AERMAP 24142.

AERSURFACE

https://www.epa.gov/scram/air-quality-dispersion-modeling-related-model-support-programs#aersurface

AERSURFACE 24142 replaces version 20060. AERSURFACE is not a regulatory component of the AERMOD Modeling System but has been updated to correct several bugs and includes the addition of several enhancements. A more significant bug that was addressed is the tolerance level AERSURFACE uses to check the horizontal resolution of the land cover, percent impervious, and percent canopy files. In the past, files provided by the MRLC had a horizontal resolution of exactly 30 m x 30 m. The horizontal resolution of the data products downloaded from the MRLC website can now vary by small differences, in which case, AERSURFACE version 20060 would generate a fatal run error and abort processing.

Primary enhancements to AERSURFACE 24142 include 1) the replacement of hardcoded keywords that combine the data type and the representative year (e.g., NLCD2016, MPRV2016, and CNPY2016) with

separate entries for data type and year and 2) the replacement of the airport (AP) and non-airport (NONAP) keywords with more descriptive keywords LOWZ0 and HIGHZ0, respectively. These enhancements 1) enable the use of data for more recent years when released by the MRLC without having to update the AERSURFACE source code include additional keywords and 2) clarify that the method that AERSURFACE uses to calculate surface roughness for the "Developed" classes of land cover for an individual wind sector can extend beyond airport environments. With these updates, AERSURFACE 24142 has retained the use of the old keywords for backward compatibility. Refer to the AERSURFACE Model Change Bulletin #4 for a complete list of updates in AERSURFACE 24142.

Also, note that just prior to the release of AERSURFACE version 24142, USGS announced the release of new land cover data products including the annual NLCD that includes land cover and percent impervious data from 1985 – 2023 and percent tree canopy data from 2011 – 2021. These new annual datasets are based on the 16 Anderson Level II land cover classes that previous versions have been based beginning with the initial release of the 2021 NLCD. Refer to https://gaftp.epa.gov/Air/aqmg/SCRAM/models/related/aermap/Access_and_Conversion_of_Elevation_Data_for_AERMAP.pdf for information on the spatial coverage, as well as accessing and processing these newer datasets.

MMIF

https://www.epa.gov/scram/air-quality-dispersion-modeling-related-model-support-programs#mmif

MMIF 4.1.1 replaces version 4.1. MMIF is not a regulatory component of the AERMOD Modeling System but has been updated to include the surface level station pressure on the UPPERAIR pathway now required by AERMET version 24142 when prognostic meteorological data are extracted and formatted for input to AERMET.

AERPLOT

https://www.epa.gov/scram/air-quality-dispersion-modeling-related-model-support-programs#aerplot

AERPLOT 24142 replaces version 16216. AERPLOT is not a regulatory component of the AERMOD Modeling system but has been updated with the capability to plot the location of the LINE, RLINE, RLINEXT, and BUOYLINE source types read from an AERMOD input control file.