UNITED STATE ENVIRONMENTAL PROTECTION AGENCY
RESEARCH TRIANGLE PARK, NC 27111

OFFICE OF
AIR QUALITY PLANNING
AND STANDARDS

MEMORANDUM

SUBJECT: Release of Draft AERMET, Version 21DRF

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Originally promulgated in 2005, the American Meteorological Society/Environmental Protection Agency Regulatory Model (AERMOD) is the United States Environmental Protection Agency's (EPA) preferred near-field dispersion model for regulatory applications. As part of the AERMOD modeling system, AERMET is the regulatory meteorological pre-processor for AERMOD. AERMET is routinely updated to include bug fixes and non-scientific formulation enhancements to the program. Such updates are normally released to the public and ready for immediate use for regulatory applications. However, EPA's, Office of Air Quality Planning and Standards (OAQPS) is releasing a draft version (21DRF) of the AERMET preprocessor for informal public review, testing and comment. Unlike previous releases of AERMET, this release is draft and subject to an informal public review due to a complete overhaul of the AERMET code and EPA wishes for feedback and testing from the user community. After the informal comment period, EPA intends to incorporate the public feedback and release an updated version of AERMET for regulatory applications that will replace AERMET 21112. This memorandum provides information on this draft release, including the nature of the updates, the status of the draft release regarding regulatory applications, and details on providing public comments.

Background and Status of AERMET

As noted above, AERMOD was promulgated as the EPA's preferred near-field dispersion model for regulatory applications in 2005, replacing the Industrial Source Complex (ISC) model. AERMOD was designed to accept more robust meteorological data, including multi-level profiles of wind, temperature, and turbulence to simulate the atmospheric boundary layer more accurately. 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 a at local representative meteorological station, and beginning with the 2017 revision of the *Guideline on Air Quality Models* (40CFR Appendix W), pre-processed prognostic meteorological data. AERMET processes the input meteorological data to calculate boundary layer parameters for input to the AERMOD model.

Purpose of the draft release

AERMET is based on a set of Fortran programs and was developed from the pre-processors used for the Industrial Source Complex (ISC) model, such as the Meteorological Processor for Regulatory Models (MPRM). Those programs were developed in the 1980's when computing power was less than it is today. AERMET used a series of interim files to process the data between the three stages (Stage 1, data ingestion and QA, Stage 2, merger of the upper-air and surface data, and Stage 3, boundary layer calculations). Because of the use of these interim files and the coding practices in the current version of AERMET, some of AERMET capabilities are limited and code updates such as including new variables or data sources is an arduous process.

In 2018, EPA decided to "overhaul" the AERMET code. This overhaul included rewriting the AERMET code using updated Fortran coding practices as much as possible, remove the dependency of intermediate files in processing, and allow for the capability to run all stages of AERMET in one AERMET run instead of three different AERMET runs, i.e., one for each stage. Please note the overhaul does not include any scientific formulation changes; it only contains code changes related to the updated coding practices and bug fixes discovered since the release of version 21112 earlier this year (see AERMET MCB 11). The draft release of AERMET discussed in this memorandum is the culmination of the overhaul.

Updates Included in AERMET 21DRF

Section 1.4 of the AERMET 21DRF user's guide explains many of the differences between AERMET 21DRF and the latest regulatory version of AERMET 21112, including differences in control file setup and other differences users may see when comparing output from AERMET 21DRF and 21112. The user is referred to Section 1.4 of the draft user's guide for more details but some of the differences are highlighted below:

- AERMET has been recoded into modules and uses internal arrays instead of temporary files to store data. For a description of the modules and subroutines in AERMET see Appendix E of the draft AERMET user's guide.
- AERMET now is composed of two stages instead of three stages. The first stage is unchanged, data ingestion and QA of NWS upper air data, NWS surface data, site-specific, or prognostic data. The merge stage, stage 2, has been eliminated. The old stage 3, the boundary layer calculations, is now stage 2. Throughout the rest of this memorandum, stage 2 refers to the boundary layer calculations stage
- AERMET 21DRF can now run both stage 1 and stage 2 in a single AERMET run. Previously, users had to run each stage in a separate AERMET run. Users now have the choice to run each stage separately as before, or in a single run.
- A new pathway, PROG for prognostic meteorological data, has been created. This pathway is analogous to the ONSITE pathway and allows AERMET to recognize the data is prognostic in nature. This pathway also allows for the special processing of overwater prognostic data (more below).
- When inputting the processing dates via the XDATES keyword, the user must now input the years as 4-digit years.
- AERMET retains the original case of input and output filenames from the control file. This makes the code more portable across operating systems
- The EXTRACT and QAOUT files have different formats than previous versions of AERMET. The ONSITE and PROG QAOUT file now has a consistent format regardless of the input data. Previously, the ONSITE QAOUT file followed the format of the raw input data file.

- A new upper air data source, the Integrated Global Radiosonde Archive (IGRA) has been added in addition to the 6201 and FSL formats
- The 3280 format for SURFACE data has been dropped due to age of the format.
- AERMET now allows for the specification of year specific surface characteristics via the FREQ_SECT, FREQ_SECT2, AERSURF, and AERSURF2 keywords. This allows for a multi-year AERMET run for stage 2 in one AERMET run instead of separate annual AERMET runs when surface characteristics change on an annual basis.
- For seasonal surface characteristics only, AERMET uses the primary and secondary station coordinates to determine the hemisphere of the respective station. This is used to allocate the seasonal characteristics to the appropriate months based on the hemisphere. For example, for winter characteristics, if the station is in the northern hemisphere, the winter characteristics are assigned to January, February, and December. If the station is in the southern hemisphere, then the winter characteristics are assigned to June-August.
- The no persistence keyword, NOPERS, used for cloud cover and temperature substitution for hours 23 and 24 in METPREP are now obsolete. These keywords were present because previous versions of AERMET processed each day separately within the program and previous versions could not read ahead to the next day to allow for hours 23 and 24 interpolation. Based on the recoding of AERMET, AERMET can now read the next day's observations so hours 23 and 24 can be interpolated in the same manner as other hours in the day.
- For applications involving site-specific or prognostic mixing heights, AERMET 21DRF smooths the mixing height based on the previous hour's mixing height in similar fashion as when AERMET calculates mechanical mixing heights. Previous versions of AERMET did not smooth the mechanical mixing heights read from the site-specific or prognostic data.
- As part of the overhaul of AERMET, the variables that are type real in FORTRAN are now double precision in AERMET. Previous versions of AERMET treated these variables as real.

New PROG pathway and overwater applications

As part of the 2017 update to the *Guideline*, prognostic meteorological data is now allowed for use in regulatory applications. Currently, prognostic data is processed in AERMET via the ONSITE pathway. As noted above, AERMET 21DRF has a new PROG pathway to process prognostic data output from the Mesoscale Model Interface (MMIF). MMIF creates AERMET ready inputs from prognostic data. A draft version of MMIF, version 4.0, is being released in conjunction with this draft version of AERMET and processes the prognostic data and outputs new variables[1] that can be used for overwater applications involving AERMOD. The original variables output by MMIF (winds, insolation, mixing heights, etc) are still output by MMIF. These new variables are output from MMIF for either overland or overwater applications. When processing an overland site, these new variables are not used from the input data and are calculated by AERMET in the same manner as when using NWS data or site-specific data. For overwater applications, these variables are used and passed through AERMET for input to AERMOD. The reasoning for this new approach is that EPA feels that calculations of variables such as Monin-Obukhov length, w*, and potential temperature lapse rate are more representative of overwater conditions, more so than what would be calculated from AERMET, which is more appropriate for land-based applications. This new feature is not compatible with AERMET version 21112 or earlier. More information about the overwater variables can be found in Section 3.5.1 of the draft AERMET user's guide.

Use of this Draft Version of AERMET and Draft MMIF 4.0

At this time, this draft version of AERMET and Draft MMIF 4.0 are for testing purposes only and should not be used for regulatory applications. Regulatory applications should still use AERMET 21112 as the meteorological pre-processor to AERMOD and MMIF 3.4.2 for processing WRF output for regulatory applications. Note that MMIF 4.0 is compatible with AERMET version 21112 and earlier but as noted above, the new overwater feature is not compatible with AERMET version 21112 and earlier versions as these versions of AERMET cannot read the new variables. The user can specify whether to output the new variables via the

[1] Sensible heat flux, latent heat flux, hourly varying surface roughness, Monin-Obukhov length, cloud cover, surface friction velocity (u*), convective velocity scale (w*) and potential temperature lapse rate.

MMIF input file. The user should refer to the MMIF 4.0 user's guide. But to reiterate, MMIF 4.0 does not replace MMIF 3.4.2 for regulatory applications.

Providing comments

EPA would appreciate written informal comments no later than February 7, 2022. These would include comments on AERMET 21DRF or MMIF v4.0. The following types of comments are specifically requested, although others are welcome as well:

- Bug reports on AERMET or MMIF v4.0
- Discrepancies of concern between AERMET 21112 and AERMET 21DRF outputs
- Comments on the draft user guide including needed clarifications and typographical errors
- Possible additional options for AERMET or MMIF
- General feedback on the ease of use of the new AERMET including the combined stage 1 and 2 capability and multi-year surface characteristics.

While feedback is certainly welcome and encouraged beyond that date, the feedback received within the timeframe denoted by February 7,2021 will be considered in EPA's release of an updated version of AERMET later in 2022. That version of AERMET will then become the latest regulatory version of AERMET and will replace AERMET version 21112. MMIF 4.0 will also be updated based on comments and that version of MMIF will be the version of MMIF to be used for regulatory applications. Please send questions and provide feedback on AERMET to James Thurman through email at thurman.james@epa.gov. Please send questions and provide feedback on MMIF to Chris Misenis at misenis.chris@epa.gov.