AERMOD

NEW ALGORITHMS, ENHANCEMENTS, APPLICATIONS

AERMOD: New Algorithms , Enhancements, Applications

- This presentation provides feedback and questions regarding the new algorithms and enhancements from APM members, and provides some recommendations for further enhancements for EPA's consideration.
- Additional comments on some topics will be prepared during the comment period.
- Our presentation also provides observations, comments, and recommendations on various aspects of application of the AERMOD system in Appendix W.

AERMOD: New Algorithms , Enhancements, Applications

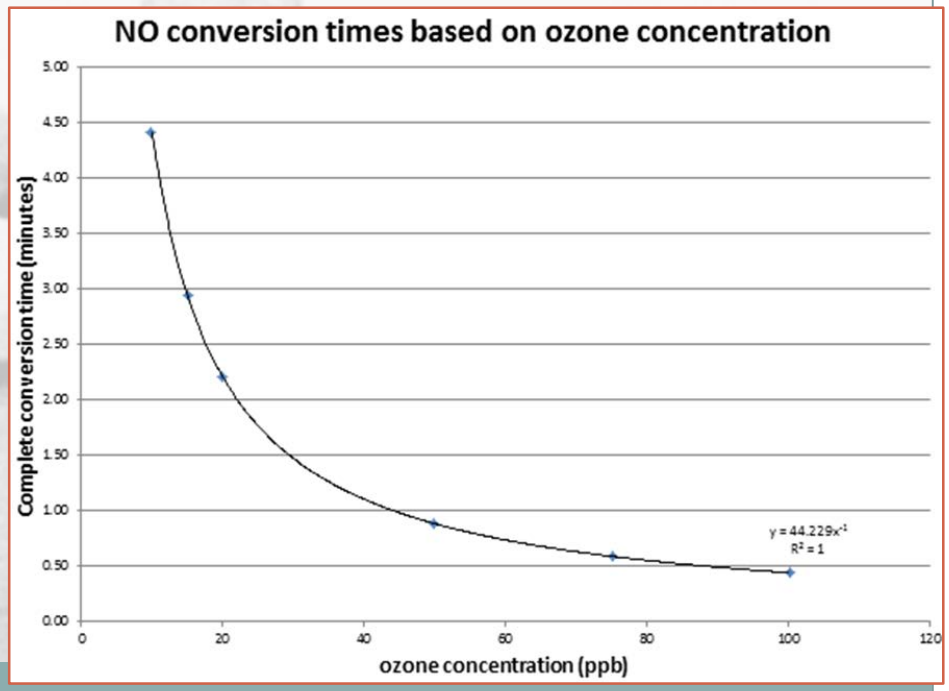
- AERMOD Version 15181 incorporates some new algorithms including PVMRM2; LOWWIND3; BLP source types.
- Also included in 15181 are BETA options (ADJ_U* in AERMET for use in AERMOD; LOWWIND1 and 2; ARM2) from previous versions.
- These are welcome and appropriate new and existing enhancements to AERMOD.
- APM members appreciate EPA's ongoing efforts to consider and incorporate changes that improve the AERMOD system.

Proposed Incorporation of NO_2 Modeling Options

- Installation of ARM2 is more realistic.
- Default minimum ratio of 0.5 is likely too conservative for many applications; language on alternatives (4.2.2.d.) is welcome.
- Improvements to PVMRM address previously-submitted comments; PVMRM2 test runs should be distributed with AERMOD.
- ARM2 is indicated as a Beta option. Elevation to Default status is encouraged.

Proposed Incorporation of NO_2 Modeling Options

- EPA states that negative emission rates cannot be used in AERMOD for NO_2 modeling.
- Guidance on how to model for increment and for net air quality benefit analyses involving NO_2 is needed.
  - The graph shown here was provided to Bob Paine (AECOM) by Chris Owen (EPA OAQPS) during discussions on this topic. Further work is needed on partial NO conversion in the first minute or so after release. This can be important in some situations to address unrealistically high fenceline NO_2 concentrations, and should be readily adaptable in AERMOD.



Proposed Incorporation of LOWWIND3

- Clarification is needed on whether LOWWIND3 is considered an enhancement/improvement over LOWWIND1 and LOWWIND2, or simply an additional method available for consideration.
- All LOWWIND options (including ADJ_U*) are indicated as a Beta option. Elevation to Default status is encouraged.

Proposed Incorporation of BLP

- This is a welcome step to facilitate modeling of buoyant line sources in one model and in combination with other traditional sources.
- The proposed revisions should currently be treated as a Beta version due to limited user testing, known bugs (incompatible with “background” keyword), and incomplete features (“SO BLPGROUP”).
- User input and comments should be accepted beyond the rulemaking comment period.
- Test runs using the BUOYLINE source should be distributed with AERMOD.

Proposed Incorporation of BLP

- What is the basis for AERMOD/BLP treating the following differently than AERMOD? Is one theory better than the other?
  - Building wakes effects in AERMOD/BLP treated using initial dispersion coefficient versus PRIME algorithms in AERMOD.
  - Dispersion coefficients in BLP are based on Pasquill-Gifford versus boundary-layer parameterization in AERMOD.
  - Momentum plume rise entrainment coefficient calculation is different in BLP (but correct) versus incorrect coefficient used in AERMOD.
  - Terrain correction factor method in BLP is different than AERMOD.
  - Plume rise calculation in building wake uses different equations.
  - Boundary layer profiling is not used in BLP

Proposed Incorporation of BLP

- The report summarizing the comparison of the revised version of AERMOD with BLP shows many unexplained differences, some of which are quite large.
  - Is this AERMOD version of BLP equivalent to the original BLP?
  - Does it treat hours with calms or low wind speeds in a manner consistent with BLP?
  - Were the 1st high testing results where AERMOD-BLP gave much higher results than BLP considered?
  - Have the causes of these differences been examined?
  - Is further testing being planned?

Mobile Sources

- Does the revised AERMOD replace CAL3QHC and CAL3QHCR?
  - The revised version of AERMOD does not include queuing algorithms.
  - Even though MOVES accounts for the effect of queuing on emissions, how should the length of queue links be determined for use in AERMOD?
  - Will the consideration of hundreds of adjacent low level release area and volume sources be reasonable given the problems of AERMOD in low wind situations?
  - How will AERMOD account for cut sections of roadway? (assuming overpasses will be considered by having elevated area and volume sources)

Secondary $PM_{2.5}$ Application

- Reduced Form Model for Secondary $PM_{2.5}$ Could be Adapted for AERMOD
  - Secondary $PM_{2.5}$ should NOT be a constant concentration added to background – should vary with distance.
  - Post-processor could take SO_2 or NOx concentration at each receptor and apply a %/hour transformation rate (function of day/night/season) with travel time data.
  - Transformation rate could be look-up table or more refined (function of humidity, temperature, etc.).
  - Could/should be incorporated into AERMOD directly.

Background Concentrations

- Modeled Nearby Sources
  - Focus should be on actual emissions not allowable.
  - Modeling and Monitoring Technical Assistance Documents for Data Requirements Rule provides useful guidance.
- Regional Background
  - Use of near-peak statistic for regional background continues to provide results that are biased too high.
  - With current procedure, could try to eliminate modeled source impacts using multiple monitors – taking lowest value among all monitors each hour to construct background time sequence.
  - Reliance on wind direction to screen source impacts fails with low, variable winds.

Background Concentrations

- The following aspects need to be considered when combining monitor-based background to the modeled concentrations:
- Monitoring data includes hours not suitable for calculating background concentrations because:
  - Most monitors are sited in close proximity to industrial sources.
  - Even monitors labeled as regional/rural have been shown to be impacted by industrial sources.
  - The hours when the monitor is impacted by exceptional events (e.g., Canadian forest fires) need to be ignored from background calculations.

Background Concentrations

- Temporal and spatial mismatch:
  - Excluding monitoring sites based on a 90° degree sector downwind from a source is not appropriate because frequently there are significant contributions outside of the 90° downwind sector.
  - Temporal mismatch between observed and modeled values in AERMOD makes seasonal pairing difficult to justify.
  - The likelihood that the modeled design concentration will occur at the same time as the monitored design concentration is significantly smaller and more conservative.
  - The use of lower percentiles than the design value (e.g., the 50th percentile) needs to be considered as a viable option to account for a “true” background in refined modeling.

Building Downwash

- Still need improvements in building downwash:
  - Long and narrow buildings
  - Low wind speeds
- Downwash for stacks at or above GEP height is questionable and needs further review.
- We encourage EPA to seek feedback from external stakeholders and allow input on a proposed approach before issuing final guidance on basic model formulation changes.

Building Downwash

- Theoretical issues:
  - Assumed constant building downwash factor up the height of the wake.
  - Higher enhanced building downwash factor during stable conditions.
  - Building downwash factors that do not vary with surface roughness.
  - Streamlines that do not vary with structure type (e.g., lattice, streamlined).

Building Downwash

- Guidance is needed for use of wind-tunnel or computation fluid dynamics applications for dealing with very complex building cases, porous structures, and streamlined structures.
  - This issue can be addressed with an Equivalent Building Dimension approach for AERMOD.
- PRIME implementation in AERMOD has no meander consideration.
  - In low winds, unexpectedly high downwash concentrations can be predicted, due in part to no meander being modeled.
- PRIME model does not consider situations with excess heat release around buildings, plume liftoff can occur and downwash is not observed.

Prognostic Meteorological Data in AERMOD

- Encouraging and welcome option for cases where airport representativeness is uncertain.
  - The use of MMIF should be encouraged and should become a Default option.
- Additional testing is recommended for field studies with comprehensive meteorological profiles from tall tower and SODAR data.
- Comparison of MMIF data to station measurements should focus on low winds, since these can lead to design concentration predictions.
- EPA should advise users on applications in which MMIF data has limitations: e.g., terrain scales less than MMIF grid sizes, heterogeneous surfaces.

Prognostic Meteorological Data in AERMOD

- The option to work with the appropriate reviewing authority to use prognostic meteorological data in situations where in situ measurements are not representative and/or cost prohibitive is welcomed.
- Reference provided for MMIF (reference 103) specifies the User's Manual for Version 3.1. With Version 3.2 recently released and additional versions likely to be released in the future, we recommend a more general citation be provided similar to citation for AERSURFACE in the References section.

Prognostic Meteorological Data in AERMOD

- There is a possible disconnect in guidance regarding definition of land use based surface parameters from MMIF and AERSURFACE.
  - MMIF uses land use for entire representative grid cell – could be 4 km to 36 km across for many prognostic data sets.
  - AERSURFACE uses 1 km radius from observation location for surface roughness and 10 km x 10 km square for albedo and Bowen ratio.
  - It is understandable that there is a limitation on the grid cell size in prognostic models and concern for data mismatch if AERSURFACE data is used with prognostic model data.
  - However, the impacts of this assumption are worthy of study.

Prognostic Meteorological Data in AERMOD

- At what point will the Beta tag be removed from MMIF?
- Can a program that is Beta be a recommended program in the Guideline?
- Citation to reference for MMIF in paragraph 8.4.2 should be “103” not “93”.

Prognostic Meteorological Data in AERMOD

- MMIF provides output suitable for overwater dispersion modeling (e.g., air-sea temperature difference for overwater stability).
- This can be used as input to an AERMOD adaptation of the Offshore & Coastal Dispersion (OCD) model: AERCOARE.
  - AERCOARE was approved in 2011 by Region 10 under App. W. Section 3.2.2.e for Shell air permit applications.
  - BOEM has approved use of AERCOARE.
- This implementation of an “old” model into AERMOD would be similar to BLP inclusion.

AERMOD Comments: Summary

- Proposals are encouraging and reflect considerable hard work by EPA.
  - The community anxiously awaits the elevation to Default status of several important updates (e.g. ARM2, LOWWINDs, MMIF).
  - **BLP**: Welcome addition; much work to be done.
  - **Mobile Sources:** Clarify status of AERMOD with respect to CAL3QHC/CAL3QHCR.
  - **Background**: Current procedures still very conservative.
  - **Downwash**: Work needed on long buildings, low wind speeds, recognition of EBD, treatment of excess heat release.
  - **MMIF**: Use should be encouraged. Clearinghouse for WRF datasets? Include AERCOARE in AERMOD?