

CALPUFF Near-Field Applications

Roger W. Brode
U.S. EPA/OAQPS
Air Quality Modeling Group
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Outline

- Review of regulatory status – clarification memo
- Some examples of complex wind situations
- Discussion of technical issues and concerns related to CALPUFF near-field applications
- Summary and conclusions

CALPUFF Near-field Clarification Memorandum

- **Summary of Key Points:**
 - **The EPA-preferred model for near-field regulatory applications (less than 50 kilometers) for simple and complex terrain is AERMOD.** The AERMOD model should be used for all near-field regulatory applications, unless an adequate determination is made that AERMOD is not appropriate for that application or is clearly less appropriate than an alternative model. *[See paragraph 4.2.2(b) of Appendix W – “For a wide range of regulatory applications in all types of terrain, the recommended model is AERMOD.”]*
 - **CALPUFF is not the EPA-preferred model for near-field applications, but may be considered as an alternative model on a case-by-case basis for near-field applications involving “complex winds,” subject to approval by the reviewing authority.** The approval of CALPUFF for near-field regulatory applications should be based on case-specific justification, including necessary documentation and an adequate determination that AERMOD is not appropriate or clearly less appropriate than CALPUFF. Generalized approval of CALPUFF for near-field applications based on reference to other cases where CALPUFF has been approved for near-field use is not acceptable, unless such cases are similar enough to the application under review to be applicable, and are adequately documented to support that determination. *[See paragraph 7.2.8(a) of Appendix W – “the CALPUFF modeling system (described in Appendix A) may be applied on a case-by-case basis for air quality estimates in such complex non-steady-state meteorological conditions.”]*

CALPUFF Near-field Clarification Memorandum

- From Preamble to April 2003 FR Notice promulgating CALPUFF:
 - *“We will require approval to be obtained prior to accepting CALPUFF for complex wind situations, as this will ensure that a protocol is agreed to between the parties involved, and that all are willing to accept the results as binding. As experience is gained in using CALPUFF for complex wind situations, acceptance will become clear and those cases that are problematic will be better identified.” (pp. 18441-2)*

CALPUFF Near-field Clarification Memorandum

- From Section 7.2.8 of Appendix W:
 - *“The setup and application of the model should be determined in consultation with the appropriate reviewing authority (paragraph 3.0(b)) consistent with limitations of paragraph 3.2.2(e).”*
 - *Reference to paragraph 3.2.2(e) places CALPUFF in the status of an alternative model.*

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- Paragraph 3.2.2(e) of Appendix W:
 - “e. Finally, for condition (3) in paragraph (b) of this subsection [preferred model is less appropriate for the specific application, or there is no preferred model], an alternative refined model may be used provided that:
 - i. The model has received a scientific peer review;
 - ii. The model can be demonstrated to be applicable to the problem on a theoretical basis;
 - iii. The data bases which are necessary to perform the analysis are available and adequate;
 - iv. Appropriate performance evaluations of the model have shown that the model is not biased toward underestimates; and
 - v. A protocol on methods and procedures to be followed has been established.”

CALPUFF Near-field Clarification Memorandum

- **Summary of main steps:**
 - 1) *a determination that treatment of complex winds is critical to estimating design concentrations;*
 - 2) *a determination that the preferred model is not appropriate or less appropriate than CALPUFF; and*
 - 3) *a demonstration that the five criteria listed in paragraph 3.2.2(e) for use of an alternative model are adequately addressed.*
- **Each of these steps involves case-specific considerations**

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- Importance of consistency, spelled out in paragraph 1(b) of the Guideline:

“The model that most accurately estimates concentrations in the area of interest is always sought. However, it is clear from the needs expressed by the States and EPA Regional Offices, by many industries and trade associations, and also by the deliberations of Congress, that **consistency in the selection and application of models and data bases should also be sought, even in case-by-case analyses**. Consistency ensures that air quality control agencies and the general public have a common basis for estimating pollutant concentrations, assessing control strategies and specifying emission limits. Such consistency is not, however, promoted at the expense of model and data base accuracy. The *Guideline* provides a consistent basis for selection of the most accurate models and data bases for use in air quality assessments.”

Examples of Complex Winds

- Examples of complex winds are described in paragraph 7.2.8(a) of Appendix W:
 - “a. *Inhomogeneous Local Winds*. In many parts of the United States, the ground is neither flat nor is the ground cover (or land use) uniform. These geographical variations can generate local winds and circulations, and modify the prevailing ambient winds and circulations. Geographic effects are most apparent when the ambient winds are light or calm. In general these geographically induced wind circulation effects are named after the source location of the winds, e.g., lake and sea breezes, and mountain and valley winds. In very rugged hilly or mountainous terrain, along coastlines, or near large land use variations, the characterization of the winds is a balance of various forces, such that the assumptions of steady-state straight-line transport both in time and space are inappropriate.”

Examples of Complex Winds

- Valley flows
 - Down-slope/down-valley flows under light wind stable conditions
 - Cross-valley circulations due to differential heating under convective conditions
 - Valley channeling, may be driven by different conditions
 - Stagnation conditions
 - Significant horizontal and vertical discontinuities in wind, temperature, etc.
 - Grid resolution and availability of representative met data may be significant issues

Examples of Complex Winds

- Coastal influences
 - Land/sea-breeze (lake-breeze) circulations driven by differential heating between land and water
 - Thermal internal boundary layer (TIBL) near coast during daytime onshore flow
 - Grid resolution and representative met data may be significant issues
 - TIBL effects most important for elevated releases near the coast, and may be addressed through subgrid-scale modules

Complex Winds - Issues

- General issues
 - Complex wind influences will vary significantly based on source characteristics and location
 - Plume recirculation may occur under various conditions, such as cross-valley and coastal circulations and stagnation
 - Availability of representative meteorological inputs to “inform” the system
 - Ability of modeling system to effectively utilize site-specific information
 - Model performance/uncertainty for spatiotemporal pairing of model results is not well documented or understood

Complex Winds - Issues

- More specific issues
 - Near-field, localized plume terrain interactions may be grossly misrepresented due to grid resolution limitations
 - Ability of modeling system to effectively utilize site-specific information appears to be significantly lacking – important information may be effectively destroyed or grossly misrepresented

Questions?