UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
RESEARCH TRIANGLE PARK, NC 27711

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OFFICE OF
AIR QUALITY PLANNING
AND STANDARDS

**MEMORANDUM**

**SUBJECT:** Clarification of Regulatory Status of CALPUFF for Near-field Applications

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**TO:** Regional Air Division Directors

## Introduction and Purpose

The purpose of this memorandum is to clarify the regulatory status of the CALPUFF modeling system for applications involving near-field dispersion, with transport distances of less then 50 kilometers. The content of this memorandum is not intended to nullify, supplant, or otherwise modify any of the current guidance in EPA's *Guideline on Air Quality Models* ("*Guideline*"), published as Appendix W to 40 CFR Part 51, but merely to clarify the guidance in order to foster more consistent and technically sound application of the guidance in this area.

We are providing this clarification to address serious concerns about the use of the CALPUFF model for near-field applications arising from growing evidence that important aspects of the guidance presented in the *Guideline* are not being fully complied with in some cases. Our focus is primarily on *regulatory applications* of the CALPUFF modeling system that explicitly fall under the purview of the *Guideline*. The *Guideline* addresses the regulatory application of air quality models for assessing criteria pollutant impacts under the Clean Air Act. Paragraph 1(a) of the *Guideline* clearly states its scope as follows:

> "The *Guideline* recommends air quality modeling techniques that should be applied to State Implementation Plan (SIP) revisions for existing sources and to new source reviews (NSR), including prevention of significant deterioration (PSD). Applicable only to criteria air pollutants, it is intended for use by EPA Regional Offices in judging the adequacy of modeling analyses performed by EPA, State and local agencies and by industry."

However, given that the *Guideline* is often cited in relation to other non-regulatory modeling applications, such as air toxics modeling under State regulations, the clarifications presented in this memorandum also have relevance to these non-regulatory applications of the CALPUFF modeling system.

Our concerns regarding near-field applications of CALPUFF have been compounded by issues brought to light through last year's assessment of the "VISTAS" version of CALPUFF[1] leading to the approval of version 5.8, which highlighted unexpected sensitivities and technical issues related to CALMET options. The magnitude of these sensitivities has also raised concerns regarding CALPUFF model performance. To address concerns regarding model performance, we have initiated an effort to reassess CALPUFF model performance, and results of this reassessment will be provided as they become available.[2] We also wish to emphasize that CALPUFF's status for near-field applications relative to other *Guideline* models has changed significantly with the promulgation of the AERMOD model, replacing ISCST3, since AERMOD is applicable across a wider range of applications than ISCST3.

**Summary of Key Points**

The key points we wish to emphasize related to CALPUFF near-field modeling are summarized as follows:

1. 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."]*

2. CALPUFF is <u>not</u> 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."]*

These key points are discussed in more detail below.

**Discussion of Guidance**

The CALPUFF modeling system, consisting of the CALPUFF non-steady-state Lagrangian puff model, and the CALMET diagnostic wind field and meteorological processor, was promulgated by the U.S. EPA in a Federal Register notice published on April 15, 2003, as the preferred model for long range transport (LRT) dispersion modeling, i.e., beyond 50 kilometers, of criteria pollutants and their impacts on Federal Class I areas. In keeping with the general scope of the *Guideline* stated above, the regulatory status of the CALPUFF modeling system pertains to LRT applications to support regulatory permitting of criteria pollutant emission sources under the NSR and PSD programs of the Clean Air Act. Other LRT applications of CALPUFF to support visibility and other air quality related value (AQRV) impact assessments for Class I areas are considered non-regulatory applications of the model.

While the CALPUFF modeling system was promulgated as the preferred model for LRT regulatory permitting applications (beyond 50 kilometers), the *Guideline* also addresses the application of the CALPUFF modeling system for near-field impacts (i.e., less than 50 kilometer transport distance) in cases involving "complex winds" due to locally inhomogeneous conditions. Section 7.2.8 of the *Guideline* states that "[I]n the special cases described [inhomogeneous local winds], the CALPUFF modeling system (described in Appendix A [of the *Guideline*]) may be applied on a case-by-case basis for air quality estimates in such complex non-steady-state meteorological conditions." Section 7.2.8 further stipulates that "[T]he 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)." Paragraph 3.2.2(e) provides the specific requirements that should be addressed for the use of an alternative model for applications satisfying condition (3) in paragraph (b), which refers to cases where "the preferred model is less appropriate for the specific application, or there is no preferred model." The reference to section 3.2.2(e) places CALPUFF in the status of an alternative model for near-field applications. Section 7.2.8 also states that "the purpose of choosing a modeling system like CALPUFF is to fully treat the time and space variations of meteorology effects on transport and dispersion."

Examples of complex winds are described in paragraph 7.2.8(a):

> "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."

At the time CALPUFF was promulgated, the EPA-preferred model for near-field, simple terrain applications, was the ISCST3 model. The EPA-preferred model for complex terrain applications at that time was CTDMPLUS, while several screening-level models for complex terrain applications were also listed in the *Guideline*, including the COMPLEX1 model, which was incorporated into the ISCST3 model. EPA announced the promulgation of the AERMOD dispersion modeling system, consisting of the AERMOD dispersion model, AERMET meteorological processor, and AERMAP terrain processor, in the Federal Register on November 9, 2005. Following a 1-year grandfathering period from the effective date of that announcement, AERMOD fully replaced ISCST3 as the preferred model for near-field application on December 6, 2006. Unlike ISCST3, the AERMOD model is considered a refined model for all types of terrain, which has implication regarding the justification of CALPUFF for near-field applications. More specifically, since AERMOD is considered to be appropriate for a wider range of applications involving complex terrain than ISCST3, it will be more difficult to justify the use of CALPUFF for some near-field applications on the basis that it is more appropriate than the preferred model. As a result, CALPUFF near-field applications that might have been justifiable based on the inappropriateness of ISCST3 for the application, might not be justifiable in the current context with AERMOD as the preferred near-field model.

Beyond the explicit text of Appendix W, the Preamble to the 2003 promulgation of the CALPUFF modeling system provides the following summary of the regulatory action related to the use of CALPUFF for complex winds for near-field applications:

> "(B) Complex Winds
>
> (1) On a case-by-case basis, the CALPUFF modeling system may be applied for air quality estimates involving complex meteorological conditions, where the assumptions of steady-state straight-line transport both in time and space are inappropriate.
> (2) In such situations, where the otherwise preferred dispersion model is found to be less appropriate, use of the CALPUFF modeling system will be in accordance with the procedures and requirements outlined in paragraph 3.2.2(e) of the Guideline." (p. 18444)

The 2003 Preamble further amplifies the case-by-case nature of the use of CALPUFF for near-field, complex wind applications as follows:

> "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)

While 'we' in the previous paragraph clearly refers to EPA as author of the Preamble, whether this refers to the Regional Office in its role as reviewing authority or OAQPS is less clear. However, the stated goal of learning from experience and identifying cases that are problematic can only effectively be achieved through utilizing the Model Clearinghouse process involving OAQPS. A failure to comply with the expectation expressed in the 2003 Preamble has undermined the goal of learning from experience and contributed to the current situation regarding CALPUFF near-field applications that necessitates this clarification.

The specific requirements applicable to use of CALPUFF as an alternative model for near-field applications are presented in paragraph 3.2.2(e) as follows:

"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."

Once a determination regarding the appropriateness of CALPUFF for a near-field application is made, the adequacy of available databases to support the CALPUFF analysis and the adequacy of appropriate performance evaluations to show that the model is not biased toward underprediction (items iii and iv in paragraph 3.2.2(e) above) should be addressed based on the specifics of the application. Given that the purpose for "choosing a modeling system like CALPUFF is to fully treat the time and space variations of meteorology effects on transport and dispersion," the burden of proof to show through appropriate performance evaluations that the model is not biased toward underprediction is higher in these cases, given the importance of modeled vs. monitored results paired in space to the justification, than would be applied for more typical regulatory model performance evaluations where temporal and spatial pairing of impacts is not as critical.

**Conclusion**

This memorandum provides clarification regarding the regulatory status of the CALPUFF modeling system for applications involving near-field dispersion, based on the guidance presented in EPA's *Guideline on Air Quality Models*. The requirements for justifying use of CALPUFF for near-field regulatory applications consist of three main components; 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 components involves case-specific considerations. A number of technical issues and concerns have arisen in relation to each of these components. These issues are documented in more detail in a separate report[3] that is intended to serve as an additional resource for those considering the use of CALPUFF for near-field applications.

In conclusion, we would like to reiterate and stress the following points:

1. 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 a determination is made that AERMOD is not appropriate, or is clearly less appropriate than an alternative model, for that application.
2. CALPUFF is <u>not</u> 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 documentation and justification that AERMOD is not appropriate. Generalized approval based on reference to other cases is not acceptable, unless such cases are similar enough to the application under review to be applicable, and adequate documentation is available to support that determination.
3. Given the complex nature of three-dimensional meteorological modeling in order to simulate non-steady-state inhomogeneous wind fields, care and caution should be exercised in determining whether the necessary data bases are available to adequately characterize the important features of the non-steady-state meteorology for the specific application, and whether appropriate and applicable performance evaluations of the model are available to justify its use.

We also conclude by stressing the importance of vetting CALPUFF near-field applications through the Model Clearinghouse process to ensure that adequate justifications and other documentation requirements are met, in order to foster the consistency that provides an essential foundation for and necessary element of the *Guideline*, as spelled out in paragraph 1(d):

> "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." [emphasis added]

**References**

1. EPA, 2008. Assessment of the "VISTAS" Version of the CALPUFF Modeling System
2. EPA, 2008. Reassessment of CALPUFF Model Performance (draft report)
3. EPA, 2008. Technical Issues Related to Use of CALPUFF for Near-field Applications

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