RESPONSE TO PEER REVIEW COMMENTS OF CALMET/CALPUFF MODELING SYSTEM

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Introduction

During July and August of 1998 a peer review was conducted of the CALMET/CALPUFF modeling system (Allwine *et al.*, 1998). The comments received from the peer review of the modeling system can be summarized into several general areas:

1) the technical descriptions of the model formulations were considered sufficient to understand the science foundation of the modeling system, and the formulations were considered to be state-of-practice and a significant advance over those within MESOPUFF II;

2) the extent of the performance evaluations were considered superior to that of many other models, and probably sufficient to recommend use of the modeling system as proposed;

3) the CALMET and CALPUFF graphical user interfaces (GUIs) were considered helpful and easy to use, but the user instructions of the model options and implications of alternative choices were unclear, and

4) several suggestions were provided on future enhancements, and some reservations were expressed in use of mesoscale meteorological modeling results and United States Geological Service (USGS) geophysical data.

The following discussion provides a brief summary of the main points of the peer review comments, and describes how the Environmental Protection Agency (EPA) intends to address the comments received.

Model Formulations

Comment Summary. The peer reviewers did not believe any aspect of the model formulations or descriptions of model formulations needed to be changed prior to release. They believed the descriptions were sufficiently complete with liberal references, such that the science foundation of the modeling system was understandable and well documented. They believed that the CALMET/CALPUFF modeling system provides a state-of-the-practice puff dispersion model. The modeling system contains very significant advances over MESOPUFF II, in that it explicitly treats virtually all of the important physical processes affecting transport, diffusion, deposition, and transformation. Important areas of improvement are: a) the wind field representation provided by CALMET and the explicit integration of mesoscale model outputs; b) the explicit treatment of terrain effects, both in the wind-field model and the dispersion model, c) a comprehensive treatment of near-field effects, including building effects; and d) the more general treatment of diffusion using boundary-layer parameterizations. They encouraged EPA to retain an independent firm or consultant to perform in-depth test and checks of the model to detect errors in coding.

Response. The EPA intents to formally submit the CALMET/CALPUFF modeling system as a refined modeling technique for inclusion in Appendix W of 40 CFR Part 51 (*Guideline On Air Quality Models*). When this occurs the EPA will likely receive comments from the public regarding the efficacy of routinely using the modeling system as proposed. The suggestion of

having an independent firm capable of providing tests of the modeling system is worthwhile, but the EPA believes it would be prudent to review the suggestion in light of comments and recommendations received from the public when the modeling system is formally proposed for use.

Performance Evaluations

Comment Summary. The reviewers believed that the extent of the evaluation of the CALMET/CALPUFF modeling system was sufficient to recommend use of the system as proposed (a refined modeling system for routine use for characterization of long-range transport impacts, and a refined modeling system for case-by-case use for characterization of short-range transport impacts). This judgement was based in part on a recognition that the modeling system incorporates basic concepts that are well understood, and numerous algorithms, each of which has been reasonably well characterized. It is the composite that has seen modest but meaningful performance evaluation. Further, the mesoscale and diagnostic wind field modeling approaches used in CALMET have undergone a history of more than 20 years of testing and evaluation in the meteorological and wind power communities. They did encourage EPA to seek independent assessment of the performance of the modeling system against other, less comprehensive, but well characterized models. They recognized that much of this has been accomplished and summarized in the Phase II report currently being drafted by the Interagency Workgroup on Air Quality Modeling (IWAQM).

Response. The EPA believes that the CALMET/CALPUFF modeling system will likely be involved in various evaluation studies over the next few years, especially as various groups become familiar with its capabilities, and test various extensions to its model formulations. The EPA maintains a web site for the distribution of modeling guidance, and will accept summaries of their findings for posting on the EPA web site.

User Documentation and Instructions

Comment Summary. The peer reviewers found the CALMET and CALPUFF GUIs to be helpful. They offered some possible corrections to the CALMET and CALPUFF GUIs. It was their belief that user friendliness concerns do not outweigh general release of the CALMET/CALPUFF modeling system at this time. They believed that the release of the modeling system will have two significant benefits to the user community. One, it will provide informed users with a more powerful, flexible, and realistic simulation tool. And two, it may help increase the level of expertise within the user community. The reviewers considered the user instructions of the options and implications and tradeoffs between options to be unclear. They recommended an independent review be performed of the user instructions, once they have been revised in accordance with the review comments.

Response. The EPA discussed the reviewer's suggestions and concerns with Earth Tech Inc., who developed the modeling system and was charged with finalizing the user's guides, code

and test cases for public release. To the extent that resources were available, Earth Tech agreed to address the reviewer's concerns. It is EPA's and Earth Tech's opinion that several clear example problems (including application of the modeling system to both short-range and long-range model situations) would greatly assist understanding by the users. It remains to be seen whether development of these examples will resolve all of the concerns expressed, but EPA believes that the new examples will go a long way toward helping a user through the process. In addition, Earth Tech intends to provide example test cases of the various processors that organize the input data for use by CALMET (which includes processing the geophysical data, the upper-air observations, and the hourly surface weather data). The EPA decided not to include the descriptions of the various example problems within the user's guides, as they may require further enhancements in the future, and EPA wanted to finalize the user's guides. The EPA intends to reevaluate the adequacy of the user instructions once the modeling system has been formally proposed for routine use and comments have been received from the public.

Reservations on Use and Future Enhancements

Comment Summary. The reviewers expressed concern against cart-blanche acceptance of 1) the output from sophisticated mesoscale meteorological models, and 2) the USGS elevation data and land use data. In the first case, the reviewers felt that although the output from mesoscale meteorological models would be valuable, a review of such data was needed on a case-by-case basis prior to its use. Likewise, the reviewers were aware of instances where the USGS elevation data and land use data were not in accord, as evidenced by noticeable inappropriate alignment between the terrain elevations of river boundaries and the land use characterizations.

Response. The EPA believes that both of the cautions expressed are reasonable, given the lack of experience that exist in the routine use of these data sources for air pollution model applications. With more experience and (as the reviewers suggest) a collection of model protocols that the public can review where the modeling system has been successfully applied, these concerns will likely diminish in time. The EPA envisions that most long-range modeling assessments will involve development of a modeling protocol. Protocols that appear to be instructive can be made available. The EPA has cautioned users to review all input data for appropriateness, especially given that this will be the first puff modeling system offered for routine use, and the regulatory modeling community has little experience with such models.

Comment Summary. The reviewers offered several studies that they felt would prove useful in the future. They suggested that sensitivity studies might provide insight to users in the tradeoffs between model options. They suggested that a future enhancement to CALMET and CALPUFF might allow use of nested grids to provide higher resolution to facilitate better treatment of local terrain effects. They offered the idea that the use of ensemble simulations (currently being investigated in climate and weather forecasting) might provide a means for characterizing uncertainties in simulated pollution impacts, due to stochastic effects that can be characterized by ensemble meteorological simulations. They strongly emphasized the need for some graphical visualization system to aid the review of the output from CALMET and

CALPUFF. They were aware of one such system, called CalDESK, and hoped that other systems would be forthcoming. They encouraged EPA to support training programs in the CALMET/CALPUFF modeling system to aid a user community that is largely experienced in steady-state plume modeling.

Response. In reviewing these suggestions for future enhancements and activities, EPA is encouraged that the reviewers share EPA's outlook that the CALMET/CALPUFF modeling system represents a valuable and significant advance over commonly used plume modeling systems, that likely will see increased use and application (in lieu of plume modeling) in future years as experience is gained. The suggested studies, training and possible enhancements can be pursued in future years as resources allow. The EPA currently views its primary mission to complete the effort started, which is focused on routine use for long-range transport applications, and case-by-case use for short-range applications. In this regard, EPA shares the reviewers views that good user instructions and training are needed. The user instructions will be revised, and likely will be updated as future comments are received. The training will evolve as more experience is gained and EPA has a better appreciation of where to focus the training.

References

Allwine, K.J., W.F. Dabberdt, and L.L. Simmons. 1998. Peer Review of the CALMET/CALPUFF Modeling System. EPA Contract No. 68-D-98-092, Work Assignment No. 1-03 report.