EVALUATING PERFORMANCE OF METEOROLOGICAL MODELS IN REGULATORY APPLICATION STUDIES

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A model evaluation protocol has been developed to offer guidance on quantitative and qualitative procedures for evaluating the performance of meteorological models used for dispersion modeling applications. There is currently little comprehensive regulatory guidance on the techniques and approaches for evaluating meteorological model performance and how to systematically evaluate model options such as horizontal grid size, vertical layer structure and other model parameters.

Dispersion modeling studies often involve the creation of three-dimensional meteorological fields for time periods of one year or more. For example, regulatory guidance in the United States requires that dispersion modeling with the CALMET-CALPUFF modeling system be conducted for a minimum of one year. The meteorological fields created for these applications involve large amounts of data that, due to their sheer volume, is difficult to summarize and evaluate thoroughly. Often the meteorological fields generated to support dispersion modeling are not subject to any routine regulatory evaluation, although they are certainly a critical component of any dispersion modeling study. Recent reviews of dispersion modeling studies have identified previously undetected serious flaws in the meteorological fields used in the dispersion modeling.

A software package implementing a set of quantitative and qualitative procedures for systematically evaluating meteorological model performance is described. The model performance of a prognostic model (MM5) and a diagnostic model (CALMET) are illustrated with annual datasets. The methodology is simple and can be used to generate a standardized set of model performance statistics and graphical displays that can be inter-compared across studies. The methodology is applied to winds, temperatures, mixing heights and other meteorological variables with specific emphasis on parameters important to dispersion modeling applications. Recommendations are provided for the break down of performance as a function of time of day, season, and location in order to illustrate the model performance in predicting flows such as the sea-land breeze circulation and terrain-forced flows.

The model evaluation protocol describes statistical and graphical measures for evaluating the operational performance of the meteorological model as well as a set of techniques for conducting a diagnostic evaluation. The operation evaluation is designed to test the utility of the model as a whole to simulate the reference system, without regard to why the model performs well or not. The diagnostic evaluation tests specific components of the system in order to determine if the model produces the correct results for the right reasons. The proposed approach is recommended as a standard evaluation tool for regulatory meteorological modeling studies.