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Standard Guide for Statistical Evaluation of Atmospheric Dispersion Model Performance[1]

This standard is issued under the fixed designation D 6589; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ϵ) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This guide provides techniques that are useful for the comparison of modeled air concentrations with observed field data. Such comparisons provide a means for assessing a model's performance, for example, bias and precision or uncertainty, relative to other candidate models. Methodologies for such comparisons are yet evolving; hence, modifications will occur in the statistical tests and procedures and data analysis as work progresses in this area. Until the interested parties agree upon standard testing protocols, differences in approach will occur. This guide describes a framework, or philosophical context, within which one determines whether a model's performance is significantly different from other candidate models. It is suggested that the first step should be to determine which model's estimates are closest on average to the observations, and the second step would then test whether the differences seen in the performance of the other models are significantly different from the model chosen in the first step. An example procedure is provided in Appendix X1 to illustrate an existing approach for a particular evaluation goal. This example is not intended to inhibit alternative approaches or techniques that will produce equivalent or superior results. As discussed in Section 6, statistical evaluation of model performance is viewed as part of a larger process that collectively is referred to as model evaluation.

1.2 This guide has been designed with flexibility to allow expansion to address various characterizations of atmospheric dispersion, which might involve dose or concentration fluctuations, to allow development of application-specific evaluation schemes, and to allow use of various statistical comparison metrics. No assumptions are made regarding the manner in which the models characterize the dispersion.

1.3 The focus of this guide is on end results, that is, the accuracy of model predictions and the discernment of whether differences seen between models are significant, rather than operational details such as the ease of model implementation or the time required for model calculations to be performed.

1.4 This guide offers an organized collection of information or a series of options and does not recommend a specific course of action. This guide cannot replace education or experience and should be used in conjunction with professional judgment. Not all aspects of this guide may be applicable in all circumstances. This guide is not intended to represent or replace the standard of care by which the adequacy of a given professional service must be judged, nor should it be applied without consideration of a project's many unique aspects. The word "Standard" in the title of this guide means only that the document has been approved through the ASTM consensus process.

1.5 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and to determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:*

D 1356 Terminology Relating to Sampling and Analysis of Atmospheres[2]

3. Terminology

3.1 *Definitions*—For definitions of terms used in this guide, refer to Terminology D 1356.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *atmospheric dispersion model*, *n*—an idealization of atmospheric physics and processes to calculate the magnitude and location of pollutant concentrations based on fate, transport, and dispersion in the atmosphere. This may take the form of an equation, algorithm, or series of equations/algorithms used to calculate average or time-varying concentration. The model may involve numerical methods for solution.

3.2.2 *dispersion, absolute*, *n*—the characterization of the spreading of material released into the atmosphere based on a coordinate system fixed in space.

3.2.3 *dispersion, relative*, *n*—the characterization of the spreading of material released into the atmosphere based on a

[1] This guide is under the jurisdiction of ASTM Committee D22 on Sampling and Analysis of Atmospheres and is the direct responsibility of Subcommittee D22.11 on Meteorology.

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[2] *Annual Book of ASTM Standards*, Vol 11.03.

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