PM MODEL PERFORMANCE METRICS, GOALS, AND CRITERIA

James W. Boylan*
Georgia Department of Natural Resources, Air Protection Branch, Atlanta, GA
e-mail: **james_boylan@dnr.state.ga.us**
Voice (404) 362-4851 Fax (404) 363-7100

1. INTRODUCTION

In order to use an air quality modeling system with confidence, model performance must be evaluated against observations. While ozone modeling and evaluation is fairly developed, particulate matter (PM) modeling is still an evolving science. EPA has issued minimal guidance on PM and visibility model performance evaluation metrics, goals, and criteria. This paper addresses these issues by examining various bias and error metrics and proposes PM model performance goals (the level of accuracy that is considered to be close to the best a model can be expected to achieve) and criteria (the level of accuracy that is considered to be acceptable for regulatory applications) that vary as a function of concentration based upon an analysis of numerous PM and visibility modeling studies (e.g., SAMI, WRAP, VISTAS, etc.) performed throughout the country.

2.0 PROPOSED PM PERFORMANCE GOALS AND CRITERIA

It has been suggested that different performance goals and criteria should be developed for: (1) different components of PM, (2) different seasons, (3) different parts of the country, (4) urban vs. rural sites, and (5) clean vs. polluted days. However, performance goals and criteria that vary as a function of concentration can address all these concern with a single set of goals and criteria (Table 1). In this paper, it has been proposed that a model performance goal has been met when both the mean fractional error (MFE) and the mean fractional bias (MFB) are less than or equal to +50% and ±30%, respectively. Additionally, the model performance criteria has been met when both the MFE ≤ +75% and MFB ≤ ±60%. Less abundant species (< 2.5 μg/m^3) will have less stringent performance goals and criteria.

Table 1: Model Performance Goals and Criteria.

MFB Goal	$MFB \le \pm 170 e^{\frac{-0.5(\overline{C_o}+\overline{C_m})}{0.5 mg/m^3}} + 30$
MFE Goal	$MFE \le 150 e^{\frac{-0.5(\overline{C_o}+\overline{C_m})}{0.75 mg/m^3}} + 50$
MFB Criteria	$MFB \le \pm 140 e^{\frac{-0.5(\overline{C_o}+\overline{C_m})}{0.5 mg/m^3}} + 60$
MFE Criteria	$MFE \le 125 e^{\frac{-0.5(\overline{C_o}+\overline{C_m})}{0.75 mg/m^3}} + 75$

Where $\overline{C_o}$ is the mean observed concentration and $\overline{C_m}$ is the mean modeled concentration for each component of PM.

The equations in Table 1 are continuous functions with the features of: (1) asymptotically approaching the proposed goals and criteria when the mean of the observed and modeled concentrations are greater than approximately 2.5 μg/m^3 and (2) approaching +200% MFE and ±200% MFB when the mean of the observed and modeled concentrations are extremely small. These proposed goals and criteria are not necessarily a pass/fail test, but can be used to help identify the level of diagnostic evaluation that must be performed to insure the modeling is reliable for regulatory purposes. Finally, this same concept can be applied to evaluate the ability of the atmospheric modeling system to predict speciated components of light extinction by applying the appropriate light scattering efficiency, absorption coefficient, and/or relative humidity multiplier.

* *Corresponding author address:* James W. Boylan, Georgia Department of Natural Resources, 4244 International Parkway, Suite 120, Atlanta, GA 30354