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Project Summary

The Role of Grid-Based, Reactive Air Quality Modeling in Policy Analysis: Perspectives and Implications, as Drawn from a Case Study

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A primary objective of this study is to improve the understanding of the role of performance quality in determining a model's acceptability and usefulness to the policy maker, and thus to aid in developing soundly-based expectations of the modeling process. The vehicle for pursuing this objective is examining the historical evolution of the Urban Airshed Model (UAM) – a grid-based photochemical model, whose basic formulation is similar to the Regional Acid Deposition Model (RADM) – and its application to policy analysis in the South Coast Air Basin of California. A derivative objective is to draw implications from the findings to aid in appraising the merits of future pursuits, notably the mounting of comprehensive field programs to support the evaluation of regional acid deposition models.

In the technical report, we: (1) describe the UAM, (2) examine its predictive capability thrugh scrutiny of historical performance statistics, (3) assess its degree of acceptance in the scientific and regulatory communities, based on information and viewpoints solicited through questionnaires and interviews, (4) examine the influence on the policy-making community of the UAM studies and, (5) based on these "findings," attempt to develop a perspective on the expectations of current regional acid deposition models.

This Project Summary was developed by EPA's Atmospheric Research and Exposure Assessment Laboratory, Research Triangle Park, NC, to announce key findings of the research project that is fully documented in a separate report of the same title (see Project Report ordering information at back).

Introduction

During the 1980s the National Acid Precipitation Assessment Program supported the development of the Regional Acid Deposition Model (RADM). The technical community urged that sound performance evaluation be a part of the overall development process and, consequently, that a comprehensive data collection program be supported financially. They also expressed concerns that policy makers may hold overly optimistic expectations of performance of the RADM at its current stage of development and of time-to-availability of the model for unrestricted use.

One means of developing a realistic portrayal of the model evaluation and acceptance process is to examine the experiences of the past. In 1970, Systems Applications Inc. began development of the Urban Airshed Model (UAM), a grid-based photochemical

model of ozone formation on an urban scale. A recent version of that original model is now in widespread use. The history of the UAM's continuing development, sporadic evaluation, and frequent application is of particular relevance since the UAM is a complex, grid-based "chemical" model similar in basic formulation to the RADM.

A primary objective of this study is to gain an improved understanding of the importance of quality of performance in determining a model's acceptability and usefulness to the policy maker. We hoped to learn some lessons from the UAM experience and present them for others to consider in planning and executing RADM-related activities. The vehicle for pursuing this objective is to examine the historical evolution of the UAM and its application to policy analysis in the South Coast Air Basin of California over a period of years. A derivative objective is to draw implications from the findings that may be of value in appraising the merits of future pursuits, notably the mounting of expensive field programs to support the evaluation of regional acid deposition models. The technical report offers insight gained from the study of one model's use that is intended to aid the policy maker in developing soundly-based expectations of the modeling process.

Procedure

In this study we surveyed both the performance evaluation history of the UAM and the degree of acceptance achieved by the model in the policy-making and scientific communities. We first examined and interpreted performance statistics for the model over the history of its development. We then interviewed three categories of interested and informed parties: (1) members of the contemporaneous scientific community whose pursuits led them to become familiar with the UAM and its development history, (2) industry representatives, and (3) regulatory agency staff and policy makers who have had to assess the merits of using the results of the UAM. The broad questions to be answered by these interviews were:

- Was the model acceptable?
- Did its degree of acceptability change over time?
- How was model acceptability related to model performance?

Based on the findings of these efforts, we developed a "subjective history" of the perception of model performance and of model acceptance.

Results and Discussion

Analysis of time trends in performance statistics for the UAM suggest that (1) the tendency toward underprediction of ozone concentrations decreased with time over fifteen years of testing, but the range in estimates of bias at a particular time were high and remained relatively unchanged with time, and (2) the average error in prediction decreased with time, but even in recent times displayed a significant range in variation.

Analysis of interviews of thirty individuals who have been associated with UAM-use in policy analysis in the South Coast Air Basin suggests that (1) performance of the UAM was "good enough for estimates to be considered" in the policy context, but not "good enough to provide a high degree of confidence in the model," (2) increased acceptance of the UAM *was not* related to improved performance with time (or to perceived performance), (3) interviewees' increased acceptance of the model *was* related to improved understanding of the model's capabilities and limitations, (4) interviewees are prepared to accept model use in assessing the *relative* effects of alternative control scenarios, but not in quantitative evaluation of specific measures, and (5) interviewees favor increased emphasis on acquisition of better input data and more comprehensive data bases for supporting model evaluation.

Conclusions

Modeling is most appropriately conceived as a continuing process of model development, collection of data, testing, diagnostic analysis, modification and improvement of the model, and repetition of the cycle. Performance evaluation is an essential, though not the only, element in establishing confidence in a models' value. Sensitivity analyses are considered as important as performance evaluations for assessing the accuracy and reliability of a model.

Acceptance of a model by regulatory and industrial communities appears to be linked as much or more to understanding the model as it is to the results of performance evaluations. Key ingredients in gaining familiarity with a model and establishing an understanding of the model's strengths and limitations are:

- dialogues with modelers, in lay terms, about the model – its formulation, limitations, and attributes.
- discussions of results of performance evaluations, including at the stage of diagnostic assessment, when possible problems and "cures" were conte plated.
- discussions of sensitivity analys when model behavior could be s jectively compared with expectatic based on individual knowledge and degree of conformity with the expectations could be examined.

For complex atmospheric modeli systems, experience suggests that process of acceptance requires seve cycles of development and testing a that the overall time required to achie model acceptance, based on quality performance, may be fifteen to twe years. While this admittedly subjecti time estimate may not be welcom knowledge gained during the process development, data acquisition, and di nostic analysis is generally of cons erable value.

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The complete report, entitled "The Role of Grid-Based, Reactive Air Quality Modeling in Policy Analysis: Perspectives and Implications, as Drawn from a Case Study," (Order No. PB 90-187 204/AS; Cost: $23.00, subject to change) will be available only from:
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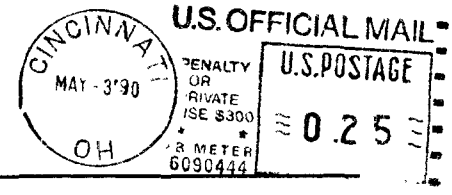

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