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BUILDING A SCIENTIFIC FOUNDATION FOR SOUND ENVIRONMENTAL DECISIONS

CLEAN **AIR** RESEARCH PROGRAM

AIR QUALITY MODELS USED TO REDUCE POLLUTION AND IMPROVE AIR QUALITY

Issue:

The U.S. Environmental Protection Agency (EPA) sets and enforces national air quality standards to protect public health. Pollutants are generated by many sources from factories and power plants to motor vehicles and wildfires. These pollutants can travel thousands of miles across state and international borders.

Pollutants mixed from various sources in the atmosphere may interact with one another, especially in sunlight, causing the formation of new chemicals. Air pollution can even be exacerbated by the interaction of man-made chemicals with naturally occurring organic emissions from trees, crops, and other vegetation.

To assist states in implementing air pollution standards, scientific tools are needed such as atmospheric computer models that can be used to determine how best to reduce or mitigate pollution and improve air quality. Such state-of-the-art modeling is critical to understanding the impacts of pollutants in today's complex atmosphere.

Air quality models are needed to help risk assessors determine if the actions they take today will result in reduced pollution tomorrow. They are used to protect people from air pollution by forecasting what may happen to the quality of the air under different potential emissions-control strategies and varying weather conditions.

Scientific Objective:

The Clean Air Research Program in EPA's Office of Research and Development is advancing air quality models that can simulate the transport and fate (or outcome) of pollutants in the atmosphere. Research is conducted to develop, evaluate, and improve models for use by EPA and states in implementing the air quality standards for ozone and fine particulate matter.

The major focus of model development is to improve EPA's Community Multistage Air Quality (CMAQ) modeling system for use by EPA as well as its research and regulatory partners. CMAQ combines current knowledge in atmospheric science and air quality modeling with multi-processor computing techniques in an open-source framework to deliver fast, technically sound estimates of air pollutants.

This multistage and multipollutant chemistry-transport model (CTM) permits the assessment not only of a target pollutant but also its interactions with other environmental contaminants. It also enables EPA and its partners to test how well emissions-control strategies reduce air pollutants.

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CLEAN AIR RESEARCH PROGRAM

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CMAQ workgroups are focused in several areas of research to improve the chemical and physical process representations in the model and to develop refined versions of the model on a regular basis for particular applications. Some of the research focus areas are:

- Atmospheric chemistry and aerosols
- Two-way, meteorology-chemical transport modeling
- Weather research and forecast model
- Multipollutant modeling
- Air quality and climate change interactions
- Modeling resolution to depict local community levels

Application and Impact:

Air quality models are being used by EPA to help formulate national emissions control programs, while states use air quality models to examine the impacts of local emissions control policies on air pollution. In addition, models are being used to examine the longer-range potential impacts of global climate change and rising levels of Asian industrialization on air quality in the United States.

The CMAQ model, made publicly available through the Community Modeling and Analysis System Center, is used by over 500 groups nationally and internationally to study air pollution issues from both research and air quality management perspectives.

The model has been used effectively by EPA regulators to assess the impacts of potential new nationwide or regional emissions-control rules to improve air quality.

The National Weather Service is using the CMAQ model to produce operational daily forecasts for ozone air quality over the continental United States. The model is also used by states to assess implementation actions to attain the air quality standards set by EPA and to assess the interstate transport of air pollution.

The CMAQ model has been used by scientists to better probe, understand, and simulate chemical and physical interactions in the atmosphere. The complex emissions and chemical interactions of air pollutants from man-made and natural sources have been studied with the model to provide a better understanding on reducible and irreducible pollution levels.

The CMAQ modeling system is also being used to understand the separate and combined impacts of source emissions and weather/climate impacts on air quality over the United States.

REFERENCES

Byun, D., and K.L. Schere, 2006: Review of the Governing Equations, Computational Algorithms, and Other Components of the Models-3 Community Multiscale Air Quality (CMAQ) Modeling System. Applied Mechanics Reviews 59:51-77.

Binkowski, F.S. and S.J. Roselle, 2003: Models-3 Community Multiscale Air Quality (CMAQ) model aerosol component. 1. Model description. Journal of Geophysical Research, 108: 4183, doi:10.1029/2001JD001409.

CMAQ model Web site: www.cmaq-model.org.

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