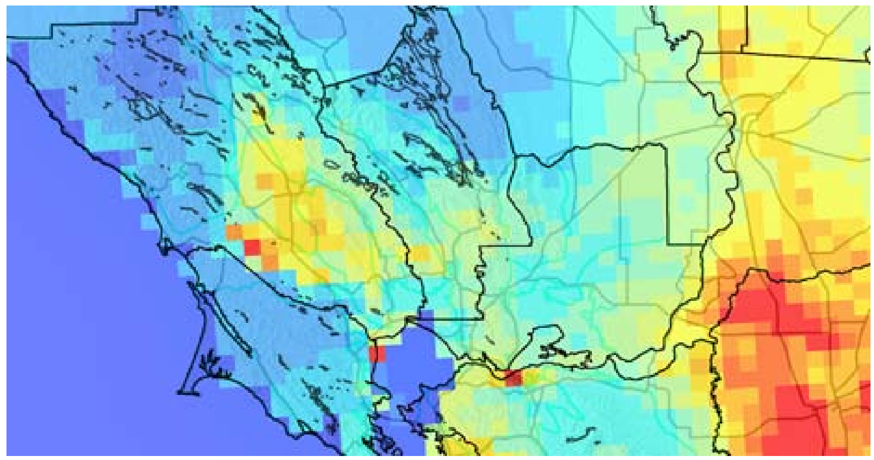
EPA'S Community Multi-scale Air Quality Model offers tools for controlling air pollution; studying climate change



What is CMAQ?

For more than a decade, the U.S. EPA's Community Multi-scale Air Quality (CMAQ) Model has been a powerful computational tool used by EPA and states for air quality management. The National Weather Service uses the model to produce daily U.S. forecasts for ozone air quality.

CMAQ is also used by states to assess implementation actions needed to attain National Ambient Air Quality Standards. The system simultaneously models multiple air pollutants, including ozone, particulate matter, and a variety of air toxics to help regulators determine the best air quality management scenarios for their communities, states, and countries.

CMAQ brings together three kinds of models:

- Meteorological models to represent atmospheric and weather activities;
- Emission models to represent man-made and naturally-occurring contributions to the atmosphere; and
- An air chemistry-transport model to predict the atmospheric fate of air pollutants under varying conditions.

CMAQ 5.0

In October 2011, EPA will publically release the newest version of the model — CMAQ v5.0. The new version represents a leap forward in air chemistry modeling. In the past, CMAQ's meteorological models have run in sequence, taking hourly meteorology data, including wind speed and direction, temperature, and solar radiation, and feeding them into an air chemistry model to calculate air quality.

The new CMAQ 5.0 model uses up-to-the minute data in its meteorology and chemical transport models. Instead of running models in sequence as it did previously, the meteorology and air chemistry-transport models in CMAQ 5.0 are coupled and synchronized to interact in feedback loops on the fly, thus providing more accurate forecasts that reflect interactions between pollution and weather.

CMAQ 5.0 also includes numerous updates to its representation of physical and chemical atmospheric processes that provide a more realistic portrayal of atmospheric chemistry over a broader range of conditions. CMAQ 5.0's new modeling framework will allow scientists to simulate air quality at smaller, finer-resolution settings, such as individual towns and cities, and also expand the model's spatial scale to include the entire northern hemisphere.

This new capability will allow scientists to study the intercontinental movement of air pollution and how it may affect air quality and climate change. Earlier versions of the model were typically applied at regional to continental levels.

The ability to apply CMAQ 5.0 to the hemispheric scale will allow scientists to better understand the ways that air pollution moves around the globe, and provide much-needed information for decision makers. As air quality regulations become stricter, "background pollution" from elsewhere in the world must be accounted for more accurately for policymakers to fully understand what portion of air pollution problems can be managed with local and national policies, and what portion need international solutions.

A Little History

Using data about land usage, meteorology, and emissions, CMAQ was designed to provide detailed information about the concentrations of air pollutants in a given area under almost any imaginable emissions or climate scenario.

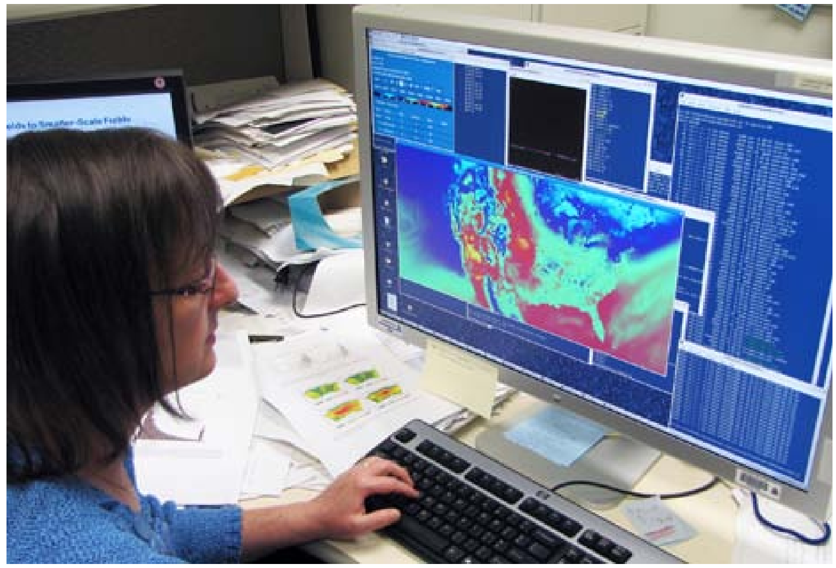
Since 1998, when the first version was released, users have used CMAQ to evaluate potential air quality policy management decisions. The model can show the probable impacts of different air quality policies, giving policymakers a clear picture of how best to implement pollution controls.

CMAQ represents a cross-disciplinary effort, incorporating atmospherics, physics, chemistry, engineering, numerical and computer sciences as part of the ongoing effort to accurately model air quality.

Modularity

Since its inception, CMAQ has been designed as a modular system able to incorporate data from related models that have alternate mathematical processes. This capability has allowed for inclusion of new science in the model to address increasingly complex air pollution issues.

Several modules have been developed and made available for CMAQ, including the Sparse Matrix Operator Kernel Emissions (SMOKE) system, which simulates the growth and behavior of a variety of air pollutants as they are emitted from their sources. Other available modules help couple CMAQ to a variety of meteorological models and provide visualizations for the model's output.



Community Based

CMAQ stands out from other air. quality models because it has systematically incorporated input from a large, world-wide user community throughout its ongoing development and evaluation.

To support the CMAQ user community, EPA and the University of North Carolina at Chapel Hill host the Community Modeling and Analysis System (CMAS) center, which distributes CMAQ software, hosts user email exchanges, and provides new user training on the CMAQ modeling system.

This growing community, which includes thousands of users in more than 50 countries, has helped assess and improve the model's functionality. Their input has assisted EPA scientists in prioritizing modeling research to improve CMAQ's capabilities.

CMAS also hosts an annual CMAQ users' conference at UNC-Chapel Hill, which draws about 250 participants each year. The conference provides a venue for sharing best practices and new ideas for air quality modeling science.

CMAQ on the Web

EPA's CMAQ resource page:
www.epa.gov/amad/CMAQ

CMAS at UNC-Chapel Hill:
www.cmascenter.org

Technical Contact

Jon Pleim
EPA National Exposure Research Laboratory
919-541-1336 or
pleim.jon@epa.gov