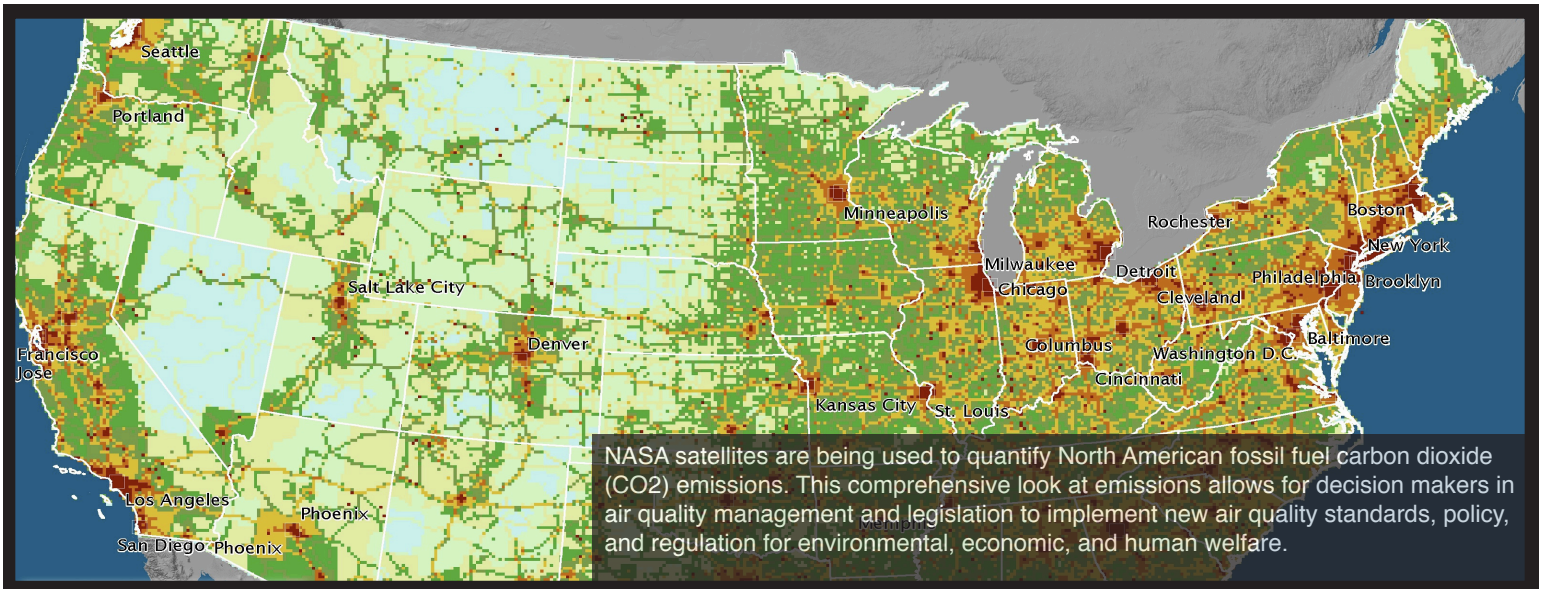
National Aeronautics and Space Administration

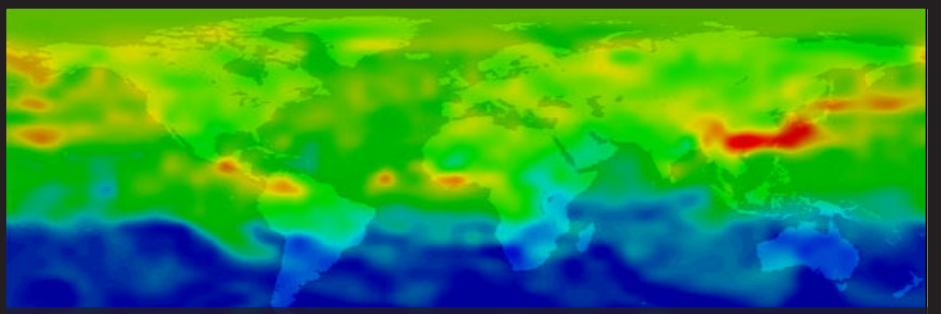
Monitoring Air Quality Effects from Industrial and Natural Sources

Applying NASA Satellites to Enhance Air Quality Modeling Capabilities



NASA satellites are being used to quantify North American fossil fuel carbon dioxide (CO_2) emissions. This comprehensive look at emissions allows for decision makers in air quality management and legislation to implement new air quality standards, policy, and regulation for environmental, economic, and human welfare.

NASA assists the EPA to monitor air quality associated with anthropogenic emissions.



NASA's Terra spacecraft has assembled the most complete view ever of the world's air pollution travelling through the atmosphere

Project Goals

Combine CMAQ model with NASA OMI NO_2 data to monitor air quality improvements associated with large power plant emissions reductions

Use meteorological variables to estimate lightning flash rates and generate a lightning NO_x emission inventory for use with the CMAQ model and test using OMI NO_2 data

Improve the accuracy of soil NO_x emissions measurements using OMI NO_2 data

Project Outcomes

Improved air quality forecasts

Improved emission source attribution

Improved air quality monitoring leading to improved public health protection

Assist EPA and states to make improved decisions concerning air quality planning and legislation

Help EPA determine if emission reduction strategies need to be changed

Monitoring Air Quality Effects of Industrial and Natural Emissions

Applying NASA Satellites to Enhance Air Quality Modeling

Summary

This project assesses the potential uses of NASA remote sensing data (MODIS, OMI, GOES, CALIPSO, and others) and advanced analysis tools in the Environmental Protection Agency's (EPA) Community Multiscale Air Quality (CMAQ) Model, an integrated decision support system. The CMAQ model is used for operational air quality forecasts by the National Oceanic and Atmospheric Administration (NOAA), for national air quality assessments by EPA and for air quality planning by state agencies. In all applications of CMAQ, accurate emissions inventories are necessary for making reliable air quality estimates

In 2003 the EPA began design and implementation of a model to produce daily air quality forecasts. CMAQ has been integral in estimating the air quality impacts of large changes in power plant nitrogen oxide (NOx) emissions. EPA is additionally required to demonstrate the resulting improvement in air quality through monitoring activities, to accomplish this, NASA's Aura satellite is being used in conjunction with CMAQ to monitor air quality improvements. NASA is currently developing ways to input data on naturally occurring emissions of NOx (from soil and lightning) into CMAQ. Factoring in naturally occurring emissions will give partner organizations a more thorough view and enable improved decision-making.

Project Details

Substantial NOx emissions reductions have been taking place at Eastern and Central U.S. electrical generating plants since 2003. Satellite data provide a more comprehensive assessment of the results of the emission reductions than surface monitoring alone. The EPA has begun an advanced monitoring initiative project using satellite NO2 data. NASA contributes to the EPA effort by employing a methodology for use of a combination of the CMAQ model and the Ozone Monitoring Instrument (OMI) data in examining the air quality impacts of the emissions reductions. By inputting data from OMI into the CMAQ model, the actual magnitude of air quality improvement can be determined.

The Global Modeling Initiative (GMI) will be used to incorporate accurate lightning emissions into the existing emissions data. Other models required for the lightning NOx emissions estimates will come from existing cloud-resolving model output. Testing the results of the models will be conducted using observations of lightning flash rates from the National Lightning Detection Network and other NASA measuring tools. The longer-term evaluation of the lightning emissions will be conducted using the OMI NO2 data. OMI NO2 data from regions of cropland will reflect soil emissions and will be included in CMAQ in order for the model to be a comprehensive look at both industrial and natural emissions.

The ability to apply satellite observations to air quality issues stems from decades of investments by NASA and the atmospheric research community. The work by Allen, D.J., et al. described in "Evaluation of Lightning Flash Parameterizations for use in a Global CTM" (2002) specifically laid the foundation for this project.

NASA APPLIED SCIENCES PROGRAM & AIR QUALITY

The NASA Applied Sciences Program supports innovative approaches to integrate Earth science research results (e.g., satellite observations and models) in decision-making tools that organizations use to benefit the nation and society.

The air quality applications program supports activities to apply Earth science research results to air quality management, policy, and decision making.

The air quality program focuses its activities according to four themes: air quality planning, forecasting, emissions inventories, and compliance.

For more information about this project
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Lawrence Friedl at
202-358-1599
http://science.hq.nasa.gov/earth-sun/applications/index.html

Key Web sites

NASA Aura Satellite:
http://aura.gsfc.nasa.gov

MODIS Instrument:
http://modis.gsfc.nasa.gov/

Global Modeling Intitiative:
http://gmi.gsfc.nasa.gov/gmi.html

NLDN and OTD/LIS Data
http://thunder.nsstc.nasa.gov

Community Multiscale Air Quality Model
http://www.epa.gov/AMD/CMAQ