Emission Modeling for the National Air Quality Forecasting Capability (NAQFC)

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Goals:

1) Advance the science of emission modeling;

2) Apply the state-of-the-art emission science to generate high quality emission data to support the Nation's air quality forecasting operation.

Approaches:

ARL has developed and continues improving an emission modeling system that utilizes the most updated information of emission sources and their trends, provided by a number of government agencies and the research community, including the US Environmental Protection Agency (EPA), National Oceanic and Atmospheric Administration (NOAA), US Geological Survey (USGS) and US Department of Energy. The flow chart below demonstrates how these sources are integrated into the ARL emission modeling system.

Fig.1 Flow chart of the ARL emission modeling system. In the real world, there are over ten thousands of noticeable emission sources. These sources are incorporated into the NAQFC system through emission inventories and dynamic emission modeling.

Accomplishments

1. ARL has developed the emission modeling system to support the NAQFC and their air quality guidance;

Accomplishments (Continued)

2. ARL provided emission data and model codes to expand the NOAA NAM-CMAQ NAQFC into three operational domains: Continental U.S., Hawaii and Alaska (Fig 2);

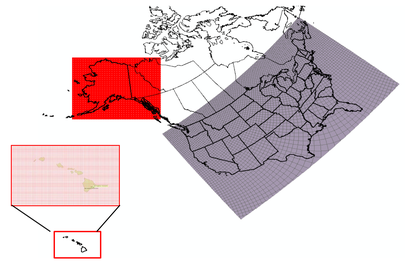

Fig.2 Expanded NAQFC forecasting domains: Continental United States , Hawaii and Alaska.

3. Updated chemical mechanisms: Currently, the NAQFC systems are driven by emission data that are compatible with the CB4 mechanism and two versions of the CB05 chemical mechanisms used in different forecast domains.

4. Improved emission inventories: ARL is taking lead in identifying the weakness of and improving the emission inventory of anthropogenic fugitive dust emissions, together with the US EPA Office of Research and Development (ORD) and Office of Air Quality Planning and Standard (OAQPS);

5. Incorporating new emission sources into the NAQFC developmental or operational forecasting. These new sources include A) Windblown dust emissions; ; B) Dynamic fire emissions C) Marine Isoprene emissions; D) Volcanic emissions.

A) Windblown Dust Emission: ARL developed the physics-based natural dust emission model FENGSA to account for the missing natural dust emissions (Fig. 3);

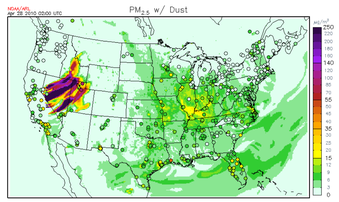

Fig.3 Windblown dust model FENGSA improved PM prediction.

B) Dynamic Fire Emission: Replaced the EPA historic fire emissions by NOAA Hazard Mapping System (HMS) based fire detection and Blue-Sky emission algorithm;

C) Marine Isoprene Emission: ARL is developing a marine isoprene emission algorithm, based on published experimental results in literature and NOAA satellite products, to account for marine emissions.

D) Volcanic SO_2 Emission: ARL has built and tested an emission tool to use the near real-time ground measurements provided by the Hawaii volcanos (Fig. 4)

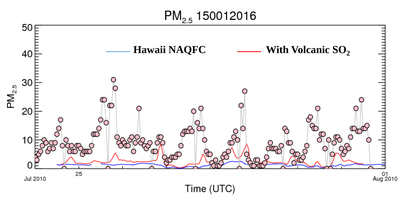

Fig.4 Improvement of aerosol forecast performance by adding near real-time volcanic emissions.

Indicators of Success

1. Successful Operation: ARL has provided quality emission data to support the National Weather Service's air quality forecasting operations over three US domains;
2. Transfer of Knowledge: Several interagency collaborations have resulted from ARL's improvements to the emission inventories and modeling approaches; The Emissions models and tools developed by ARL emission scientists are being increasingly used by the research and regulatory communities;
3. Scientific publications: ARL emission related works have been published in peer-reviewed journals including *Nature, Environmental Science & Technology, JGR-Atmosphere, Atmospheric Chemistry and Physics, Atmospheric Environment, Environment International, and Environmental Health Perspective*.

Collaborators/Partners

Office of Research and Development, US EPA;
Office of Air Quality Planning and Standards, US EPA;
US Department of Energy;
US Geological Survey;

Future Direction

➢ Better use of the near real-time data, including both ground and satellite monitoring, to better represent the real world emissions for air quality forecasting;
➢ Development of an "**emission forecasting system**" to replace the inventory-based modeling approach:

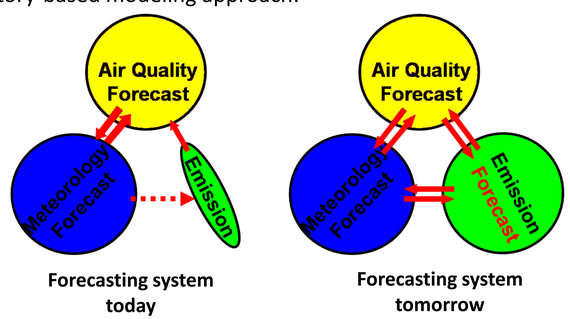

Fig.5 Make better use of near real-time data to build an emission forecasting model that is able to tell emissions of tomorrow.