

## **FRAQ Motivation and Science Questions:**

**The study of air quality in the Northern Front Range Metropolitan Area (NFRMA) is of high interest both in terms of scientific importance and societal relevance.**

- The Denver metro area, one of the top ten mega-urban regions in the U.S., is also one of the nation's fastest-growing urban regions; its current population of 2.6 million people is expected to increase by nearly 50% by 2030.
- The large number of local resources available for studying air quality/atmospheric chemistry provides an unprecedented opportunity for conducting research in a highly efficient and detailed manner.

**Despite efforts to limit emissions, the NFRMA is still experiencing air quality (AQ) problems and is exceeding AQ standards for ozone on a regular basis in summer.**

- The Regional Air Quality Council (RAQC) and the Colorado Department of Public Health and Environment (CDPHE) have aggressively pursued controls to limit ozone precursor emissions since 2003.
- Still, on average, there are about 30 exceedances per year of the current 0.075 ppm National Ambient Air Quality Standard from the 17 NFRMA ozone sites.

What are the factors controlling NFRMA surface ozone and are current emission controls sufficient to reduce ozone levels below standards?

**Flow patterns are highly complex due to the unique meteorological situation, driven in particular by mountain-valley circulation effects, as well as the high elevation and complex terrain, and significantly influence air quality in NFRMA.**

- Concentrations of ozone and particulates are strongly influenced by local air recirculation patterns and also by long range transport of pollution from remote sources (e.g. intercontinental or upwind regions within North-America such as California, active oil shale exploration areas in Western CO, Wyoming and Utah, and the Four Corners).
- The outflow from the NFRMA is the major contributor to air quality and visibility degeneration in downwind areas such as Eastern Colorado and the neighboring states to the E and NE.

What are the relative contributions of local mountain-valley recirculation patterns and long-range transport to buildup of photochemical oxidants and particulates during smog episodes in the NFRMA in the summer?

**The complex meteorology and the mix of diverse pollution sources in the NFRMA present challenges with respect to characterizing, modeling and forecasting the transport and photochemical processes contributing to local air quality.**

- Diverse sources in NFRMA include urban emissions of NO<sub>x</sub> and NMHC (transportation and power generation), strong point sources such as large power plants and industrial complexes and airports, and area sources such as agricultural emissions as well as emissions from oil and gas exploration and natural (biogenic) emissions.
- In the last decade, wildfires (both local and remote) have been playing an increasingly important role as a source of both particulate and gas-phase pollutants for the NFRMA.

What are the relative contributions of the diverse local sources of pollution to air quality degradation and photochemical oxidant formation in the NFRMA?

To what degree does pollution from both NFRMA sources and long-range transport contribute to photochemical smog / ozone pollution, visibility degradation, and nitrate deposition in Rocky Mountain National Park and other Wilderness Regions to the West of NFRMA?

**NFRMA has seen a strong increase in the development of oil and gas exploration but little is known about the implications on near-by populated areas.**

- Oil and gas exploration has also undergone dynamic changes in other regions in the country and results from this project would contribute to assessing how these developments affect air quality.

What is the impact of ozone precursor emissions from oil and gas exploration on the photochemical regime and the ozone production efficiency?

**The three field missions that are planned to happen during the same time period provide an outstanding opportunity to study and characterize local AQ at a level of detail not possible previously.**

- NASA's DISCOVER-AQ project will be using Denver as a base for the 2014 deployment phase if the FRAQ request for the C-130 is successful, which will bring three fully instrumented aircraft to the area at the same time.
- Aircraft data will be complemented with instrumented ground sites and the highly specialized meteorological dynamics instrumentation to be deployed in the region through the FRONT-PORCH project.

**Society strongly benefits from a more advanced and accurate warning system and a future cleaner environment.**

- Analysis of the comprehensive set of observations combined with meteorological and chemical modeling will provide the information needed to understand the driving forces of high pollution events in NFRMA.
- The results of this project will lead to a much improved forecasting of pollution events and a more certain foundation on which to base mitigation strategies to reduce air pollution.