Utah Division of Air Quality:
Final Research Goals & Priorities FY2020

PM2.5 CHEMISTRY AND PRECURSOR GASES

To better inform air pollution control strategies in northern Utah, it is necessary to understand the complex chemical and physical processes that contribute to secondary PM2.5 formation. Secondary PM2.5 accounts for over 70% of total PM2.5 during wintertime exceedances of the federal standard. Secondary PM2.5 is produced from complex atmospheric chemistry that involves several different gaseous compounds. UDAQ would like to better quantify the contribution and sources of compounds contributing to wintertime air pollution along the Wasatch Front and Cache Valley. Additional information on PM2.5 precursor gases emissions from diesel vehicles is also needed. Compounds and sources of interest include but are not limited to:

- Ammonia
- HCl and halogens
- Volatile organic compounds (VOCs)
- Oxidized nitrogen compounds
- Atmospheric radicals and radical sources
- Diesel emissions, catalytic technologies and cold-starting engines

PM2.5 SOURCE CONTRIBUTIONS

Organic mass is an important component of wintertime ambient PM2.5. Its sources in PM2.5 are, however, unclear. While residential wood combustion may be a significant contributor to the organic mass, its source contribution is not fully quantified. The contribution of aged wood smoke to the organic mass and PM2.5 is uncertain. The contributions of other sources of organic material to PM2.5 are also unclear. More spatially-resolved measurements are also needed.

- Residential wood combustion
- Organic mass

EMISSIONS SOURCES AND THEIR IMPACT ON OZONE FORMATION

Ground level ozone mitigation efforts require an improved understanding of emissions source contribution to high ozone concentrations. The Uinta Basin is prone to high ozone levels in the wintertime (oil and gas development), while the Wasatch Front is subject to higher ozone concentrations in the summer (transport and urban development). UDAQ seeks to identify how various activities influence ozone formation mechanisms in both summer and winter conditions.

- Uinta Basin
    - Variability in the composition of Volatile Organic Compounds (VOCs) (e.g. carbonyls, BTEX)
    - Other sources of ozone precursor emissions, particularly in the oil and gas sector (e.g. abandoned wells, pipelines, blowdowns/liquids unloading, produced water, fugitive emissions)
- Wasatch Front
    - Background ozone
    - Anthropogenic impacts (e.g. mobile sources) and heat fluxes

AIR EXCHANGE PROCESSES AND POLLUTANTS TRANSPORT

Air mass exchanges are important meteorological processes affecting the transport of air pollutants. Air exchanges across the Great Salt Lake, different Utah valleys and canyons as well as between the

polluted boundary layer and free troposphere affect the transport and mixing of key precursors to PM2.5 during winter. Regional meteorological processes also lead to long-range transport and stratospheric intrusion of ozone. A more detailed characterization of these processes and their impact on air pollutants chemistry and levels is needed.

- Lake-land interaction
- Canyon flows
- Interbasin exchange
- Oxidants exchange between cold air pool and free troposphere
- Long-range transport and stratospheric intrusion of ozone

AIR QUALITY MODELING AND EMISSIONS INVENTORY IMPROVEMENTS

Air quality modeling remains the best available method for determining State compliance with federal air pollution standards. Modeling enables UDAQ to demonstrate and quantify the effectiveness of future emissions control strategies. Therefore, serious efforts should be taken to enhance model performance. Improving estimates of emissions and reconciling differences between inventory estimates and measurements is needed for improving model performance. Better characterization of the complex meteorological features associated with cold air pool episodes and improved representation of the chemical mechanisms as well as physical processes relevant to wintertime photochemistry are also needed.

- Numerical representation of complex chemical and physical processes
- Volatile organic compounds (VOCs) composition profiles
- High-resolution data for the spatio-temporal allocation of emissions
- Emission factors used for deriving annual emissions estimates
- Identifying missing emissions sources
- Resolving top-down vs. bottom-up inventory discrepancies
- Ammonia bidirectional flux parameterization
- Surface land use characterization and topography
- Urban canopy models and anthropogenic heat fluxes
- Albedo and snow cover representation

URBAN AIR POLLUTANTS AND THEIR EFFECT ON HUMAN HEALTH

Utah is experiencing a rapidly increasing urbanization, population growth and economic development, which can lead to increased anthropogenic air pollutants emissions and associated health risks. The impact of this urban growth on the health of local communities, particularly sensitive and socio-economically disadvantaged populations, is unclear and needs assessment.

- Continual population growth
- Urban development, policy and economic impacts
- Human health exposure assessment models
- Indoor-outdoor sampling
- Personal exposure monitoring

INTERSECTION OF AIR QUALITY AND HUMAN BEHAVIOR

Human behavior can significantly impact air pollution, and increasing urban growth makes this impact even more pronounced. The daily choices a population makes such as whether to utilize public transportation, to observe wood burning bans, or to limit idling may have a perceivable impact on Utah's air quality. While various air quality rules and regulations can be developed, the true compliance and adoption rates may not reach their ideal levels. An improved understanding of the direct impacts of human behavior on air quality is needed.

- Human behavior and policy impacts

- Impacts of public outreach and communication
- Influencing behavioral change
- Intersection between regulators, scientists, and public health professionals

INSTRUMENTATION AND METHODS

Air quality monitoring for determining compliance with federal air pollution standards is conducted at fixed ground-based air monitoring stations. While data collected at these stations is highly valuable, the data is limited to specific locations and time periods. New air monitoring technologies with increased spatial and temporal resolution, such as low-cost and remote sensing technologies, have emerged recently. However, while these methods provide more spatial and temporal coverage than traditional ground-based stationary air monitors, they have various limitations. UDAQ is interested in evaluating the sensors' limitations and performance under environmental conditions and air pollutants concentrations specific to Utah. Additionally, UDAQ would like to understand the potential role these technologies may take in disseminating air quality information to the public. Finally, UDAQ is interested in evaluating the applicability of these sensors for regulatory measurements.

- Citizen science
- Low-cost sensors
- Remote sensing technologies

EXCEPTIONAL EVENTS AND THEIR IMPACT ON AIR QUALITY

Exceptional events are unusual or naturally occurring events that can affect air quality but are not reasonably preventable or controllable using strategies implemented to attain federal air quality standards. While these events are becoming more frequent, their impact on ambient air quality and contribution to background levels, particularly ozone levels, are unclear and need further assessment. Demonstrating the occurrence of these events is also important for regulatory purposes.

- Wildfires
- Dust events