Utah's Environment 2013: Planning and Analysis: Uintah Basin Ozone Study

Teams of scientists continued their work in the Uintah Basin this year to identify the sources and conditions that create ozone during winter inversions. The Division of Air Quality (DAQ) and its partners collected additional data this winter to improve their understanding of the atmospheric chemistry that leads to the formation of wintertime ozone in the Basin.

Winter ozone concentrations increase in the Basin when snow cover creates strong temperature inversions. Multi-year ozone studies aim to identify the emissions and photochemical processes that elevate these ozone levels. DAQ will use this data to support development of effective strategies for reducing ozone concentrations to meet the health-based National Ambient Air Quality Standards (NAAQS) in the Uintah Basin.

2013 Uintah Basin Ozone Study

Key Findings

The 2013 Uintah Basin Ozone Study (UBOS) experienced far different wintertime conditions than the 2012 study, when minimal snow cover kept the 8-hour average ozone levels below federal air quality standard of 63 parts per billion (ppb). Persistent snow cover in 2013 led to inversions, which in turn resulted in ozone concentrations well above the NAAQS.

Maximum 8-hour average ozone concentrations at the Ouray air monitoring station during the 2013 study period reached 142 ppb, 89 percent higher than the federal air quality standards. Ozone values exceeded the NAAQs for 22 days in Vernal and 29 days in Roosevelt. Individual episodes of elevated ozone ranged from 3 to nearly 15 days in length.

Air Quality

- Elevated ozone coincided with elevated levels of VOCs and NOx, the primary chemical precursors of ozone.
- Ozone concentrations within the Basin are not influenced to any significant extent by the transport of ozone

or its precursors from outside of the Basin or the Bonanza Power Plant.

Meteorology

- Elevated winter ozone only occurs with snow cover that leads to temperature inversions.
- Reflection of sunlight from the snow surface significantly increases the rate of ozone formation.
- Complex patterns of light winds appear to contribute to intra-basin mixing of ozone and ozone precursors.

Chemistry

- Nitrous acid (HONO) and formaldehyde were found to be the biggest contributors to the creation of the chemically reactive radicals that drive ozone formation.
- Oxidized aromatic VOCs (including toluene and xylene) are another significant source of these radicals.

Uncertainties

- Based on 2012 data, VOC reductions appear to reduce ozone but the overall effectiveness is unknown. The effectiveness of NOx reductions is less certain and under some conditions may increase ozone levels. It is unclear whether NOx controls become effective when ozone levels are particularly high.
- Unreactive nitrates that recycle into reactive NOx through chemical reactions in snow and on particles in the atmosphere may impact the effectiveness of NOx controls.

Control Strategies

- Episodic or seasonal controls may be a useful component of a management strategy for the Basin since elevated ozone levels only occur during winter inversion periods.
- Reductions in emissions of highly reactive VOCs such as aromatics will be beneficial. Ozone response to NOx reductions is more complex and requires further study.
- Reducing formaldehyde would be an effective way to reduce ozone, but it is not yet clear which sources of formaldehyde are most important.
- Uncertainty in HONO concentrations makes it difficult to predict how responsive ozone will be to reductions in both VOC and NOx emissions.

Study Partners

The Uintah Basin Ozone Study is a collaborative effort between county, State, and federal entities, industry organizations, and higher education. Researchers for the UBOS 2013 include:

- Utah State University (USU)
- National Oceanic and Atmospheric Administration (NOAA)
- University of Colorado, Boulder (CU)
- University of Wyoming (U of WY)
- University of Washington (UW)
- Utah Department of Environmental Quality (DEQ)

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- The Uintah Impact Mitigation Special Service District (UIMSSD)
- Western Energy Alliance
- Bureau of Land Management (BLM)
- National Oceanic and Atmospheric Administration (NOAA)
- Environmental Protection Agency (EPA)
- Utah Department of Environmental Quality (DEQ)
- Utah Science Technology and Research Initiative (USTAR)
- Utah School and Institutional Trust Lands Administration (SITLA)

Next Steps

The 2014 Basin Study will focus on understanding the nitric acid (HONO) chemistry in the atmosphere and how it might affect the responsiveness of ozone concentrations to VOC and NOx reduction strategies.

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