Title:

Organic compound concentrations and composition in ambient air across the Uinta Basin

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Abstract:

The Uintah Basin is a rural area in Northeast Utah where the oil and gas industry is prominent. During multi-day temperature inversions that occur during some winters, locally-emitted air pollutants, particularly from the oil and gas industry, react in the atmosphere to produce ozone. While it is well known that oxides of nitrogen and organic compounds are the main precursors to ozone formation, the magnitude and composition of organics emitted from many oil and gas-related sources are highly uncertain. Better understanding of organic compound emissions will allow regulators and industry to make better decisions to reduce ozone-forming pollution to protect the health of residents and workers in the Uintah Basin.

During the winters of 2019 and 2020, we deployed remote measurement stations (14 in 2019, 17 in 2020) that collected air samples in 6 L silonite-coated canisters (for non-methane hydrocarbons and light alcohols) and on 2,4-dinitrophenylhydrazine-coated sorbent cartridges (for carbonyls). We analyzed the canister and cartridge samples in our laboratory via gas and liquid chromatography, respectively, to determine concentrations of a suite of 70 organic compounds, all of which are known to be involved in the formation of wintertime ozone in the Uintah Basin. We positioned these stations in different configurations around the Basin to characterize certain facility types and to characterize organic compound concentrations across the entire region.

Concentrations of the compounds were about ten times higher during multiday temperature inversion episodes compared to periods without inversion, and the highest concentrations were in the low-elevation center of the Basin, where inversions start earlier and last longer. We found that concentrations of carbonyls and alkenes (especially ethylene and propylene) are higher in the western Uinta Basin, where oil production is dominant. The most likely sources of these highly reactive compounds (i.e., compounds that are very active in ozone production) are natural gas-fueled pump jack engines. The next step in this project is to compare our measurement results against organic compound concentrations simulated by a photochemical model using the official Utah Air Agencies Oil and Gas Emissions Inventory.