Emissions from Oil and Gas Operations and Their Role in Ozone Production in the Uintah Basin, Utah

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Frequent exceedance of the ozone (O_3) U.S. National Ambient Air Quality Standard has been reported in the Uintah Basin in northeast Utah, U.S. during the winter time. Using data acquired during two consecutive years from the Uintah Basin Winter Ozone Study (UBWOS 2012 and UBWOS 2013), we investigate the relationship between oil and gas emissions and O_3 production and accumulation events. During the winter of 2012, relatively warm, windy, and sunny conditions with no snow cover provided a base case scenario during which no O_3 exceedances were observed. In contrast, during the 2013 colder winter with sustained snow cover, multiple events with significant O_3 accumulation were observed.

We present continuous vertical profile measurements of O_3, methane (CH_4) and nitrogen oxides (NO_x) between 2 m and 160 m (4 heights) from a tethered balloon platform at the Horsepool site to describe the O_3 formation characteristics. Ozone mole fractions built up to ~160 ppbv in 2013 within the lowest 200-300 m of the atmosphere, much in contrast to 2012, when levels up to ~60 ppbv were observed. The accumulation behavior of oil and gas emissions and ozone in 2013 differs, indicating different controlling processes. Methane, used here as a primary indicator for oil and gas emissions, built up under cold pool conditions over multiple days, reaching steady levels of ~7-10 ppm after 4-5 days. Ozone increased at a similar rate, however, with larger diurnal amplitudes. Furthermore, the ozone buildup continued for several more days after methane reached steady state levels, indicating continued ozone production under these elevated ozone precursor conditions.

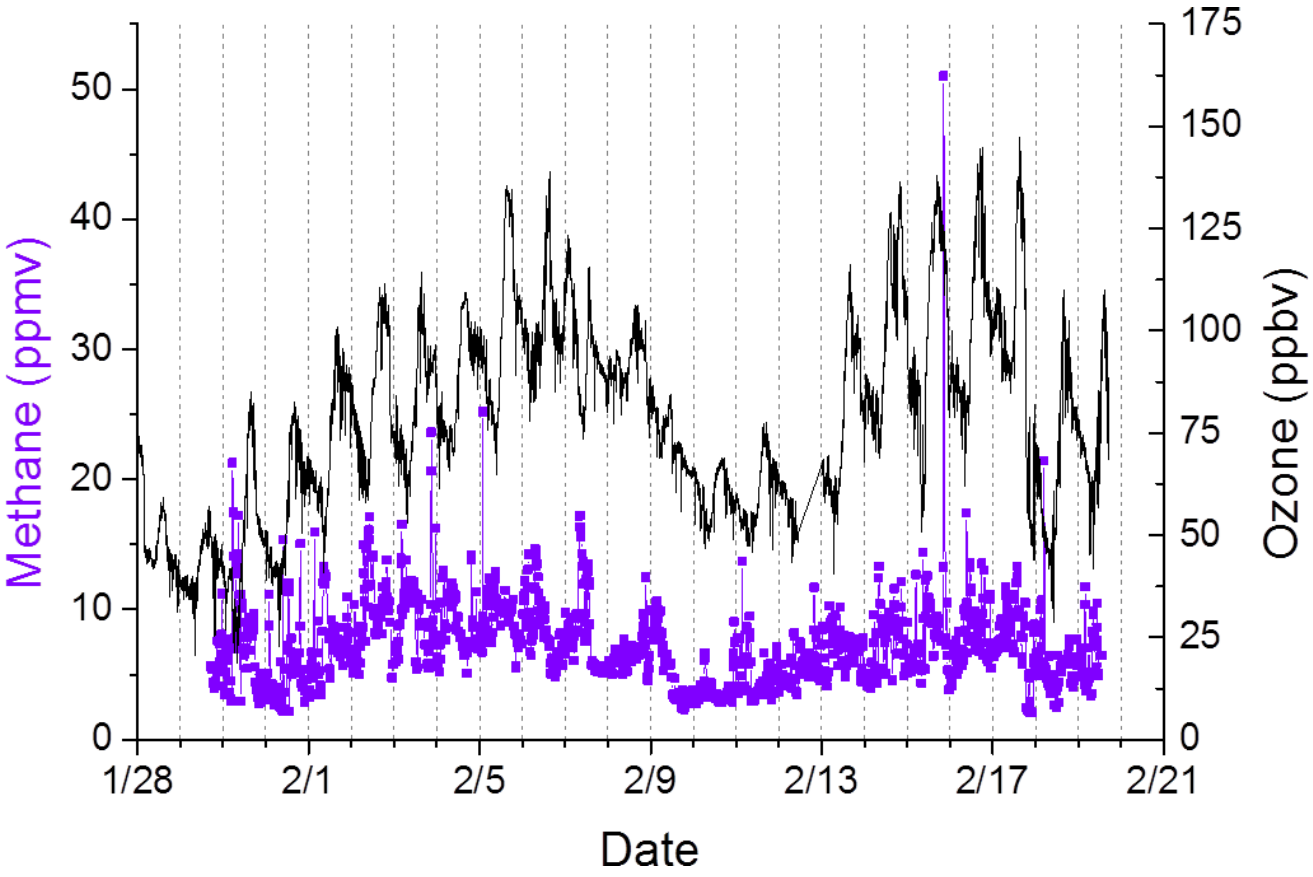

Figure 1. Surface methane (purple square) and ozone (black line) during UBWOS 2013.