3.070 High wintertime ozone in the Uinta Basin: Insights from aircraft, tethersonde and surface measurements.

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Abstract:

Extreme high ozone mixing ratios, far exceeding U.S. National Air Quality Standards, were observed in the Uinta Basin in January-February 2013. Extensive surface and tethered balloon profile measurements of ozone and meteorological variables as well as aircraft measurements of O_3, CH_4, CO_2, NO_2 and a suite of non-methane hydrocarbons (NMHCs) link emissions from oil and natural gas extraction and production activity with strong ozone formation. Under conditions highly favorable for wintertime ozone production including snow-covered ground, prolonged temperature inversions, and air confining topography, hourly average ozone mixing ratios built up from regional background levels of 40-50 ppbv to >160 ppbv during several multiday episodes. High ozone mixing ratios were found across the entire Basin and extended from the surface to the top of the inversion layer at ~200 m above ground level. This layer was at a nearly uniform height across the Basin even though there are significant terrain variations. Very high mixing ratios of CH_4 were also seen throughout the Basin within the inversion layer. High levels of NMHCs that were highly correlated with CH_4 showed that abundant O_3 precursors were available throughout the Basin leading to Basin-wide production. Ozone levels were well correlated with CH_4 implying that the associated NMHCs were key precursors in ozone formation. The highest CH_4 and NMHC levels were found near the main natural gas field in the central to eastern portion of the Basin. Surface wind data showed a consistent diurnal pattern driven by heating on the rim of the Basin that moved air from the vicinity of the gas field to the edges of the Basin during the day with air draining back into the Basin at night. This transport pattern was likely responsible for dispersing ozone and its precursors throughout the Basin.