Ozone Vertical Profiles and Buildup During the 2013 Uintah Basin Winter Ozone Study

J. Evans[1], D. Helming[1], C.R. Stephens[1], P. Boylan[1], J. Park[1], B. Johnson[2], S.J. Oltmans[3] and R. Schnell[2]

[1]Institute of Arctic and Alpine Research (INSTAAR), University of Colorado, Boulder, CO 80309; 501-256-1452, E-mail: jason.evans@colorado.edu
[2]NOAA Earth System Research Laboratory, Boulder, CO 80305
[3]Cooperative Institute for Research in Environmental Sciences, University of Colorado, Boulder, CO 80309

During the 2012 and 2013 Uintah Basin Winter Ozone Studies, methane, non-methane hydrocarbons (NMHC), nitrogen oxides (NO_x), and ozone were measured continuously at ~60 m height intervals from the surface to ~180 m above ground from a tethered balloon within an oil and gas development area at the Horsepool site, approximately 40 km south of Vernal, UT. A second, smaller balloon was raised and lowered four to six times a day to periodically measure meteorological variables and ozone from the surface to 500 m above ground. 2012 was one of the mildest winters in the region, with no snow cover on the ground. Under these conditions ozone remained below 60 ppbv for the duration of the campaign. The winter of 2013 was significantly colder and saw 20-40 cm snow cover. Under these conditions several high ozone episodes occurred. These events were accompanied by increases in concentrations of methane, NMHC, and NO_x. The meteorological profile data show a preponderance of positive potential temperature profiles with up to a 20 kelvin temperature increase in the lowest 500 m of the atmosphere, indicative of sustained highly stable atmospheric conditions. During these inversion events significant buildup of ozone was observed over periods lasting 5-7 days, with elevated ozone first forming near the surface and then gradually increasing to ~200-300 m in height. Maximum ozone levels were >160 ppbv, well in exceedance of the 75 ppbv ozone National Ambient Air Quality Standard.

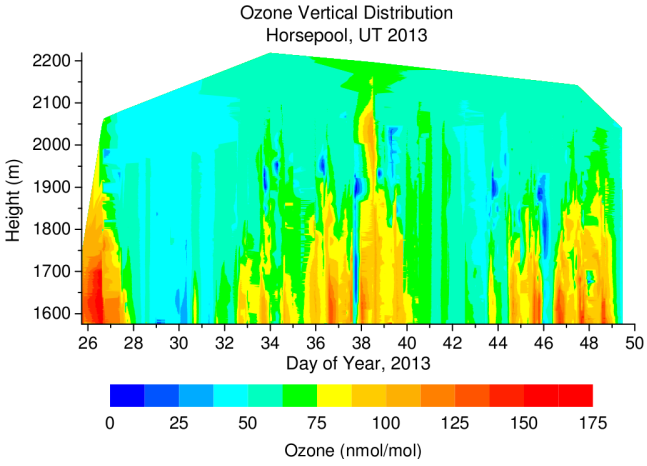

Figure 1. Ozone vertical distribution measured by electrochemical ozone sonde from a tethered balloon during the 2013 Uintah Basin Winter Study.

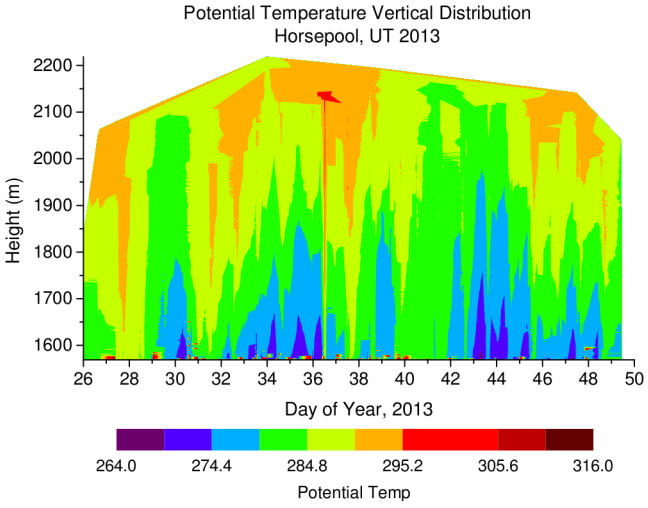

Figure 2. Potential temperature profiles measured from the concurrent radiosonde soundings.