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Air-snow exchange of nitrogen oxides and ozone at a polluted mid-latitude site

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Vertical gradients of O_3, NO, NO_2 and NO_ywere measured within and above the snowpack between January 17 to February 14, 2014 as part of the Uintah Basin Winter Ozone Study. During the first half of the campaign, the snowpack was relatively aged and contained high levels of inorganic ions and dissolved and particulate organics. A snowfall on Jan 31 added 5 cm of fresh snow with lower solute concentrations to the top of the snowpack. Vertical gradients ($\Delta C = C_{(25cm)} - C_{(125cm)}$) in the measured gas phase species were used to investigate the role of the snowpack as a source or sink. Small positive gradients were seen for NO, peaking in the middle of the day, which much larger negative gradients were seen for O_3 and NO_y. Comparing the fresh to the aged snowpacks, there was a noticeable decrease in the gradient for O_3, but not for NO_y over the fresh snow, implying a chemical control of O_3 deposition to the snow. The ratio of the gradient of NO_x to the gradient of NO_y was used to determine a snowpack NO_y recycling ratio (emission/deposition) of approximately 4 %, consistent with independent estimates of low nitrate photolysis rates inferred from nitrogen isotopes by Zatko et al., (2016).

Reference

Zatko et al., The magnitude of the snow-sourced reactive nitrogen flux to the boundary layer in the Uintah Basin, Utah, USA, *Atmos. Chem. Phys.*, 16, 13837-13851, 2016.