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An overview of snow photochemistry: evidence, mechanisms and impacts

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Abstract. It has been shown that sunlit snow and ice plays an important role in processing atmospheric species. Photochemical production of a variety of chemicals has recently been reported to occur in snow/ice and the release of these photochemically generated species may significantly impact the chemistry of the overlying atmosphere. Nitrogen oxide and oxidant precursor fluxes have been measured in a number of snow covered environments, where in some cases the emissions significantly impact the overlying boundary layer. For example, photochemical ozone production (such as that occurring in polluted mid-latitudes) of 3–4 ppbv/day has been observed at South Pole, due to high OH and NO levels present in a relatively shallow boundary layer. Field and laboratory experiments have determined that the origin of the observed NO_x flux is the photochemistry of nitrate within the snowpack, however some details of the mechanism have not yet been elucidated. A variety of low molecular weight organic compounds have been shown to be emitted from sunlit snowpacks, the source of which has been proposed to be either direct or indirect photo-oxidation of natural organic materials present in the snow. Although myriad studies have observed active processing of species within irradiated snowpacks, the fundamental chemistry occurring remains poorly understood. Here we consider the nature of snow at a fundamental, physical level; photochemical processes within snow and the caveats needed for comparison to atmospheric photochemistry; our current understanding of nitrogen, oxidant, halogen and organic photochemistry within snow; the current limitations faced by the field and implications for the future.

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