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Atmosphere-Snowpack NO_x Exchange: Measurements at Summit, Greenland and Process-Scale Modeling

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Snowpack over glacial ice is a reservoir for reactive nitrogen gases. During the sunlit season, NO_x is generated in the interstitial air of snowpack through photolysis of nitrate (NO_3-) in snow. Gradients in NO_x mixing ratios between snowpack interstitial air and the overlying atmosphere regulate transfer of NO_x to/from snowpack and affect the atmospheric O_3 budget, oxidation capacity and, consequently, climate. To better understand the dynamics in cryosphere-atmosphere exchange of NO_x we have collected 2 years of meteorological and chemical data at Summit, Greenland. Profiles of NO, NO_2 and O_3 mixing ratios were measured in interstitial air at several depths in the snowpack and at 2 levels above the snow surface. NO_x emissions are episodic, with large NO_x events occurring in early spring during high wind speed events (10-20 mph) that elevate NO_x levels to $\sim$500 pptv to depths of 2.5 meters into the snowpack. The poster will present measurements of NO, NO_2, O_3, wind, and irradiance for a high NO_x event in the snowpack during the 2008-2010 period. Analysis of these observations will be based upon the application of a 1-D process-scale model of the atmosphere-snowpack exchange of NO_x, which includes representations of the snowpack chemistry of reactive nitrogen, peroxides, and small hydrocarbon species. A more highly parameterized version of the process-scale model is currently being developed for inclusion in a global-scale model to assess the implications of climate change on cryosphere-atmosphere NO_x and Ox exchange. We will present a first comparison of the predicated NO_x and O_3 profiles and fluxes from the process-scale/parameterized models, respectively, to observed measurements.