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Atmospheric nitrogen oxides (NO and NO2) at Dome C: first observations & implications for reactive nitrogen cycling above the East Antarctic Ice Sheet

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The nitrogen oxides NO and NO2 (NOx) play a key role in determining the oxidizing capacity of the boundary layer in high latitudes. Previous Arctic and Antarctic field campaigns have demonstrated that the polar snow pack can release significant amounts of NOx and that one of the major driving mechanisms is UV-photolysis of snow nitrate (NO3-). Unusually high levels of NO observed at South Pole and on an airborne campaign suggested that the East Antarctic Ice Sheet (EAIS) can be perceived as a gigantic chemical reactor, processing many chemical trace species at the surface and thereby modifying their concentration eventually preserved in ice cores. However, the database for a quantitative understanding of reactive nitrogen recycling across Antarctica is still weak.

First measurements of atmospheric NOx mixing ratios at Dome C (DC), East Antarctica (75.1°S 123.3°E, 3233 m) during austral summer 2009/2010 yield new insights: NOx mixing ratios were large, ranging between 3 pptv and >1000 pptv, but unlike at South Pole showed a strong diurnal variability. Concentration maxima in ambient air at 0.01, 1.0 and 4.0m above the snow occurred in the evening hours. They coincided with the strongest concentration gradients between the snow surface and 4.0 m, highlighting the importance of the interplay between snow pack source strength and the evolution of the boundary layer diffusivity profile. Conversely, near-surface firn air levels of NOx varied in phase with solar radiation, consistent with a photolytic source in the near-surface snow.

Steady-state analysis shows strong increases in the Leighton ratio around solar noon, confirming the importance of oxidants other than ozone, i.e. hydroxyl radicals. Comparison of observations with a potential NO2 flux based on a radiation transfer model (TUV-snow) allows to improve the parameterization of NOx emissions in a quantitative model of reactive nitrogen recycling above Antarctica.

Please list some keywords

NOx snow emissions, nitrate photolysis, Antarctica, oxidation capacity

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