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Characteristics of the Atmospheric Surface Layer at Summit, Greenland

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Motivated by a strong desire to quantify the impact of snow photochemistry upon the composition of surface snow and the overlying atmosphere an integrated program of field research at Summit, Greenland took place during the summers of 2000 and 2001. A full suite of oxidized nitrogen compounds, organics and oxygenated organics were obtained in both air and snow, while fluxes above the snow surface were calculated to quantify impacts of air and snow exchange on atmospheric and snow composition. Vertical gradients of chemical species measured very near the surface combined with direct measurements of diffusion coefficients from eddy correlation instruments enabled fluxes to be determined. The turbulence measurements obtained during these field campaigns are the focus of this presentation.

One of the challenges of calculating turbulent fluxes at Summit, where weak winds in both stable and unstable conditions are common, is to meet requirements of stationarity as defined by Monin-Obukhov similarity theory. Not only do the dampening effects of strong stability need to be considered at Summit but problems of nonstationarity also occur during the transition from one stability regime to the other as a result of the diurnal cycle in summer. Tests of stationarity applied to all available runs show that 40% of the data are classified as nonstationary. A classification procedure that accounts for the intermittent nature of turbulence at Summit shows that during nonstationary runs 50% of the total flux is realized in 21% of the sampling time in stable conditions. If wind speeds are ≤ 1 m s^{-1} there is a 90% or greater chance that a run will be classified as nonstationary. Fluxes of momentum and heat between 1 and 2 m above the surface appear to be constant with height but contain errors as large as $\pm$18%. Stability functions of momentum and heat can be approximated with linear

fits in stable conditions, but with smaller coefficients than standard formulations. In unstable conditions the choice of stability function is not as important. There is good agreement between all data (including nonstationary runs) and stationary runs when simple thresholds are applied to the turbulence data. This is important if nonstationarity cannot be accounted for in an experiment.