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High Resolution Snow Stratigraphy: Field Studies and numerical Simulation of Snow Temperatures at Summit, Greenland

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The climatology section of the Institute for Atmospheric and Climate Science (IAC-ETHZ), is carrying out a research program on glacier climate at the Summit Environmental Observatory on the Greenland Ice Sheet. The activities are focused on the energy and mass balance of the ice sheet. The present work is a part of this project dealing with the physical properties of shallow snow layers and their interaction with the components of the energy balance.

The influence of snow microstructure on thermal properties of snow was hardly investigated so far, as the tools necessary to measure microstructural geometry at millimeter-resolution were not available. During the field season in Summer 2003, detailed information on physical properties of the snow cover was collected. We present a new set of snow microstructure data, measured with the high resolution penetrometer (SnowMicroPen, SMP). SMP is a motor-driven, constant speed micropenetrometer which generates high resolution data, sampling approximately 250 measurements of hardness (penetration resistance) per mm.

The data was used to describe the snow cover and to compute snow temperatures at shallow depth. The temperatures are calculated with the Swiss snowcover model SNOWPACK. The spatial resolution of the snow microstructure and density, and the subsequent parametrization of the thermal conductivities, influenced the temperature and temperature gradients strongly. The observed formation of sub-surface hoar can only be explained with a highly resolved stratigraphy. The measurements and simula-

tions show that highly resolved stratigraphic input data are necessary to simulate the physically and relevant metamorphic processes in this high-arctic snow cover.