



Impact of seasonality on snow permeability and microstructure at Summit, Greenland

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The snow-atmosphere interface is a region of complex physical and chemical exchange that is very sensitive to weather and climate. In this paper we present the first year-round, co-registered measurements of permeability, grain scale characteristics, and density of the near-surface snow at Summit, Greenland. It has traditionally been assumed that the surface snow characteristics remain similar throughout the year. Our measurements show that there are clear and large seasonal variations in the permeability of the top 30 cm of snow. A high permeability profile dominates the near-surface during the summer months, but it becomes displaced downwards by new winter accumulation to which forms a much lower surface permeability profile in the top 30 cm during the winter. Grain sizes follow a similar pattern, with summer near-surface grain sizes being larger than the fine-grained near-surface wind pack of the winter. Density shows less variability and no clear seasonal pattern. The seasonal timing agrees with our previous surface roughness measurements showing rougher surfaces occurring in winter. Polarimetric observations of the Summit region from satellite imagery from WindSat show clear seasonal patterns with the same timing as variations in the measured properties. The impact of the variations for ventilation and air-snow transfer is discussed. The seasonal changes in surface roughness and in grain size may provide a measurement benchmark against which longer-term climate-related changes could be assessed.