Geophysical Research Abstracts, Vol. 7, 08282, 2005
SRef-ID: 1607-7962/gra/EGU05-A-08282

Spatial and temporal variation of the momentum roughness lengths in the ablation zone of the Greenland ice sheet.

C.J.P.P. Smeets and M.R. van den Broeke

Institute for Marine and Atmospheric research Utrecht (IMAU), Utrecht, The Netherlands (c.j.p.p.smeets@phys.uu.nl)

Data from three Automatic Weather Stations (AWS) and one turbulence mast during the period August 2003 to August 2004 are presented. The stations are located along the Kangerlussuaq-transect (K-transect) on the western part of the Greenland ice sheet near 67° N. Their altitudes are 484, 1014 and 1500 m for the locations referred to as S5, S6 and S9, respectively with S9 being close to the equilibrium line. The AWS's perform measurements of radiation (all components seperately), temperature, humidity, wind speed, and wind direction at 2 and 6 m height. Surface height changes in time were measured with a sonic height ranger and one stake. At S6 also a turbulence mast was set up consisting of a sonic anemometer, a thermocouple, and a fast hygrometer. Despite the harsh conditions during winter the data coverage of the sonic and thermocouple measuments was high throughout the year ($\sim$91%). Due to the relatively high energy comsumption of the hygrometer it was often shut down during cold conditions but during the melt season (May to August) it operated well covering 85% of the time.

Turbulence measurements in the ablation zone of the Greenland ice sheet are very scarce and we use these to assess the quality of profile derived momentum roughness lengths (z_o) and bulk fluxes. It was found that z_o derived from the two level profile measurements are in fair agreement with those from the sonic when using strict selection criteria. All three stations have pronounced temporal and spatial variations of z_o. In the ablation zone (S5, S6) we find high values at the end of the melt season and low values in winter. Near the equilibrium line at S9 this is vice versa with smaller variations. The range of values found for z_o are 20 – 0.4 mm, 3 – 0.1 mm, and 0.3 – 0.05 mm for S5, S6, and S9, respectively. The temporal variations perfectly match those of

the sonic height rangers at all stations. In the ablation zone the start of the melt season shows an increase of z_o due to large differential melt. At the end of the melt season the values start decreasing to their winter minima which is related to snow filling up depressions and/or covering them with snow bridges. Near the equilibrium line at S9 the winter periode shows a maximum are probably related to the unusual high winds at this site leading to the combined effects of sastrughi and wind driven snow. In the melt season the snow melts while the differential melt is very small leaving a smooth surface at S9.

At S6 the comparison between directly measured turbulence fluxes and those calculated with the bulk method using a temporal variation of z_o and the surface renewal model of Andreas (1987) to calculate scalar roughness lengths shows a fair agreement throughout the year. At present we study the scalar roughness lengths calculated from the turbulence measurements.