

Preliminary analysis of interannual variation in snow physical parameters retrieved from MODIS over northwest Greenland

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Snow and ice in the Arctic have drastically changed in recent decades. The Greenland ice sheet mass loss has rapidly increased from the late 1990s. Possible causes are qualitative change of snow surface conditions including snow grain size and impurities, and the resulting change of snow albedo. An increase in snow grain size reduces the near-infrared albedo and that in light absorbing impurities reduces the visible albedo. The latter effect is larger for large snow grains. Therefore, light absorbing impurities enhance the absorption of solar radiation and speed up grain growth, causing further albedo reduction in a positive feedback. To detect the qualitative change of snow conditions which affect the albedo, we retrieved snow grain size and mass concentration of impurities from Terra/MODIS and preliminary analyzed the interannual variations over the Greenland ice sheet.

The target parameters were snow grain sizes in different snow layers (surface, top and bottom layer) and mass concentrations of light absorbing impurities optically equivalent to soot, which were retrieved from MODIS single scene data over northwest region of Greenland from late July to early August in each year from 2001 to 2011. The snow grain sizes were larger in the coastal region and smaller in the inland area. The wet snow areas where the surface grain size is large were widely varied from year to year, implying that the seasonal variations in snow grain size are greatly different during each year. The surface snow grain size was the smallest, and the top and bottom layer grain sizes are comparable. This result indicates that the snow grain size was almost vertically homogeneous except for the surface. The retrieved grain sizes were roughly within the range of the preliminary validation measurement in August 2011. On the other hand, the soot concentrations were generally under the lower detection limit (0.001ppmw) in the early period, which was consistent with previous ground measurements. However, they exceeded the limit and around 0.01 ppmw in the last several years, which were overestimated compared with the validation measurement in August 2011. This might be possibly caused by a change in the sensitivity of MODIS sensor.

Keywords: snow grain size, light absorbing snow impurities, MODIS, Greenland, interannual variation