グリーンランド・カナック氷河における分光アルベド測定

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Spectral albedos measured on Qaanaaq Glacier in Greenland

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Snow and ice in the Arctic are presently undergoing drastic changes. The mass balance loss from the Greenland Ice Sheet increased significantly after the mid-1990s. One of the possible reasons of snow/ice surface melting is due to the increases of snow impurities and snow grain size. To clarify this we carried out the spectral albedo measurements on ablation area in Qaanaaq Glacier in northwestern Greenland (Fig.1) in July 2011. The almost glacier surfaces in the ablation area were covered with cryoconite on ice grain layer with the size of 1 to 2 centimeters and the several-centimeter depth above bare ice. Cryoconite holes, red snow and rivulets were also found in some parts of the surfaces. Spectral albedo measurements were performed with the method by Aoki et al. (2000) using a spectrometer FieldSpecrPro (ASD Inc., USA) for a spectral range from 0.35 to 2.5 μm. Figures 2a and 2b depict the spectral albedos and their standard deviations measured for red snow and cryoconite surface, respectively. There is remarkable difference in the spectral variations mainly for the ultraviolet to visible regions (0.35-0.75 μm) between them, where the spectral variation is upward-sloping curve for the red snow and relatively flat for the cryoconite. These spectral features suggest a possibility to discriminate red snow areas from cryoconite surfaces by satellite remote sensing. The spectral albedos in the spectral domain from 1.0 to 1.4 μm in Fig 2 are higher than that for usual bare ice although it is not shown here. This is due to light scattering by ice grains above bare ice. Since the spectral albedo in this spectral region is theoretically not so sensitive to snow impurities, we may retrieve the ice grain size by satellite remote sensing. The relative high albedo in the near-infreared spectral domain is important for the melting process of glacier surface as well as those in the visible region affected by glacier microbes.

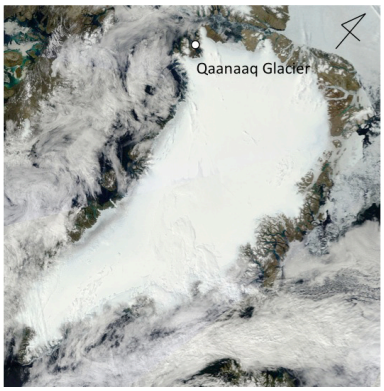

Fig.1 Location map of Qaanaaq Glacier (77° 30’ N, 69° 14’ W) in Greenland.

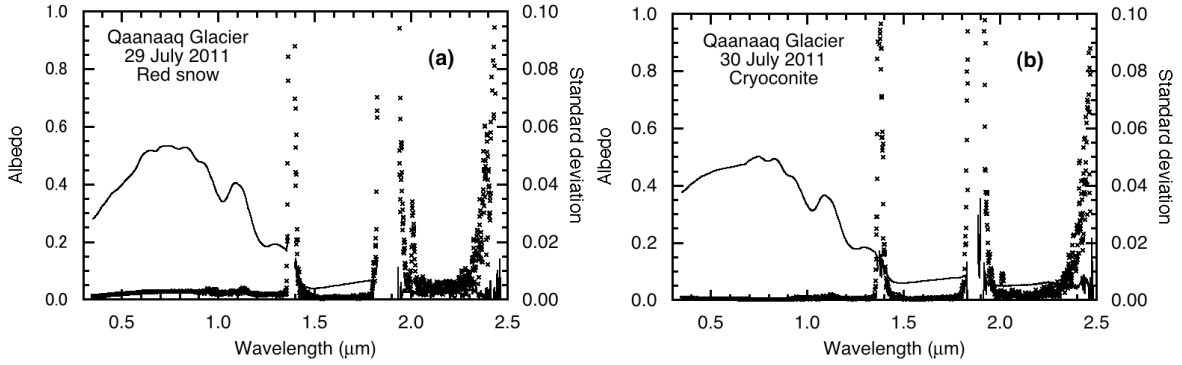

Fig.2 Spectral albedos (curves) and standard deviations (crosses) of (a) red snow measured on 29 July 2011 at altitude of 565 m a. s. l. and (b) cryoconite surface measured on 30 June 2011 at altitude of 665 m a. s. l on ablation area in Qaanaaq Glacier.

References

Aoki, Te., Ta. Aoki, M. Fukabori, A. Hachikubo, Y. Tachibana and F. Nishio, Effects of snow physical parameters on spectral albedo and bidirectional reflectance of snow surface. J. Geophys. Res., 105, 10219-10236, 2000.