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RETRIEVALS OF SNOW ALBEDO AND ICE SURFACE TEMPERATURE IN THE NORTH-WEST GREENLAND USING MODIS DATA

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Much works in the Greenland ice sheet (GrIS) have reported recent Arctic warming. The GrIS has been experiencing extensive melt. Such an event results in increasing ice surface temperature (IST) as well as decreasing snow surface albedo. It makes a large contribution to the ice-albedo feedback in the total melt energy. Thus, the monitoring of broadband snow surface albedo (BALB) and the IST in the north-west GrIS by using NASA's optical sensor MODIS data are important.

We developed algorithms to retrieve BALB and IST based on the radiative transfer model of atmosphere-snow system. It was developed for an Earth observing satellite for climate study named "GCOM-C", which will be launched in Japanese fiscal year 2016. We employed the MODIS morning-path and afternoon-path images, respectively, to show temporal and spatial variation in more detail. We built monthly composite MODIS images by collecting clear day (cloud-free) pixels, and then estimated BALB and IST from 2003 to 2013. In this research, we define the morning-path data (M-) as data taken at 0700 - 0900(LT) and the afternoon-path data (A-) as data taken at 1400 - 1600(LT).

Figure 1 shows M-BALB and A-BALB images in July, 2003 and 2012, respectively. The edge of the ice sheet was confirmed to be low albedo. This implies that there are a dark region and a surrounding blue ice area. These low-albedo areas were gradually expanded toward the inland during the ten years for both M-BALB and A-BALB. However, there are no significant reduction in the BALB at SIGMA-A site (N78°03'06"/W67°37'42"; 1490 m a.s.l.)¹ where an automate weather station (AWS) was installed in 2012. For the IST (Fig. 2), the edge of the ice sheet was measured to be almost melting point, and these areas were gradually expanding toward the inland. There is a significant positive trend in the M-IST during 2003 - 2012. The A-IST was widely confirmed to be almost melting point. This means there is a potential of melting the ice sheet and increasing snow grain size over a wide area, resulting in the accelerate albedo more rather now. In contrast, the IST in 2013 was drastically changed to be lower temperature compared to the recent trend. This is because it tends to be cloudy in the Arctic Sea as well as the relatively low air temperature was kept in 2013 summer.

¹ Aoki, T., S. Matoba, J. Uetake, N. Takeuchi and H. Motoyama, 2014: Field activities of "Snow Impurities and Glacial Microbe effects on abrupt warming in the Arctic" (SIGMA) Project in Greenland in 2011-2013. *Bull. Glaciol. Res.*, 32, 3-20, doi:10.5331/bgr.32.3.

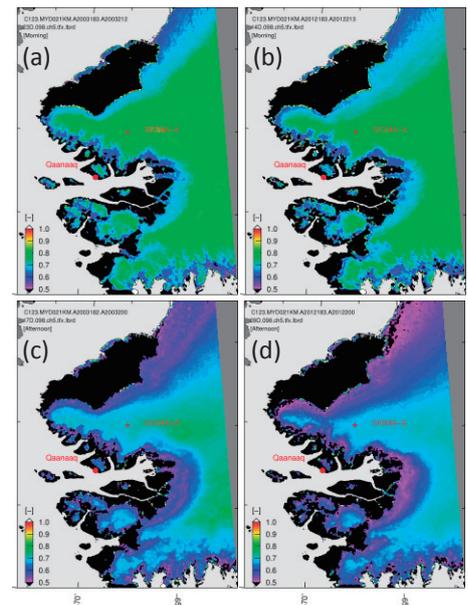


Fig.1 (a-b) M-BALB images and (c-d) A-BALB images. The BALB in July, 2002 (a)(c) and July, 2012 (b)(d), respectively.

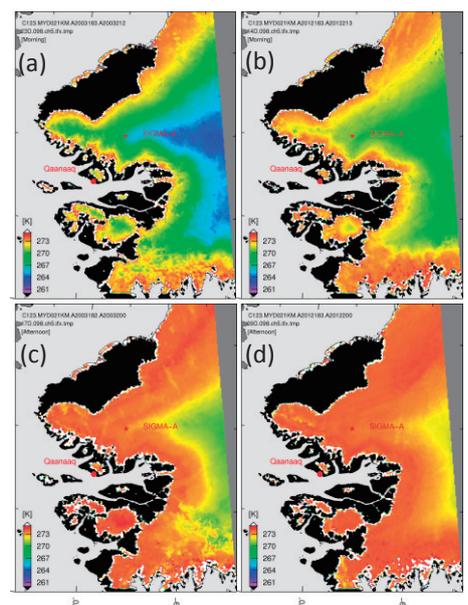


Fig.2 (a-b) M-IST images and (c-d) A-IST images. The IST in July, 2002 (a)(c) and July, 2012 (b)(d), respectively.