

Seasonal variations of Greenland ice sheet surface reflectance and brightness temperature derived from Terra/MODIS and GCOM-W/AMSR-2

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Dark ice area expansion on the Greenland ice sheet is one of the factors to cause albedo reduction and mass loss of the ice sheet in recent years. Dark ice appears on ablation area in summer and accelerates melting of the ice sheet due to its intense light absorption. Dark ice is due to impurities in the surface ice such as mineral particles, glacial microbes, organic matter and their aggregate called cryoconite granules. Cryoconite granules are formed by microbial activities and are darker than abiotic mineral particles. Since the microbes can be active only on melting ice surface, duration of surface melting on the ice sheet possibly affect the microbial activities and thus formation of cryoconite granules. Therefore, spatio-temporal variation in surface melting is important to understand the darkening process. We report seasonal variations in surface reflectance and brightness temperature derived from Terra/MODIS and GCOM-W/AMSR-2 satellite images in order to understand relationship between darkening and surface melting processes of the ice surface from April to August in 2013, 2014, 2015 and 2016. Reflectance (660 nm) and brightness temperature (18 GHz Horizontal polarization) were investigated at the nearest neighbor pixel of the Automatic Weather Station (67.07N, 48.83W) installed by PROMICE. The brightness temperature showed similar timing of the onset of surface melting in 2013 and 2015. In these years, the melting onset occurred in early June. On the other hand, the melting onset occurred in mid May in 2014 and 2016. The surface reflectance started to decrease down to around 0.4 in mid July 2013 and early July 2015. In contrast, it rapidly decreased down to around 0.4 in the end of June 2014 and early June 2016. These results suggested that earlier onset and prolonged period of the surface melting causes the earlier appearance of the dark ice surface.

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