複数衛星によるグリーンランド氷床裸氷域および暗色域の長期解析
Long term analysis of the Bare Ice and Dark Ice on the Greenland Ice Sheet using multi satellites

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Bare ice and dark ice expansions are albedo reduction factors on the ablation area of the Greenland Ice Sheet in recent years. The annual variations of the bare ice and dark ice has been revealed from the analysis using MODIS satellite images. However its behavior before the 2000 has not been investigated. In this study, we are investigating the annual variation in the bare ice and dark ice areas during melting season (June to August) from 1979 using a long-term continuous satellite data set derived from AVHRR and MODIS. The bare ice and dark ice extent derived from AVHRR (1979 to 1999, except 1980) and MODIS (2000 to 2017) showed positive trend in the whole region of the GrIS. Bare ice extent was gradually expanded from 1979, however dark ice extent was rapidly expanded after 2007. In order to investigate the difference of features in these annual variation, we compared them with melt duration published in Mote (2014). Melt days in each pixels were counted during April to September. The correlations between bare ice/dark ice extent and melt extent in any period were investigated. Bare ice extent and dark ice extent showed the best correlation with melt extent of over 54 days ($r = 0.86$, $p < 0.01$) and 67 days ($r = 0.81$, $p < 0.01$), respectively. It is showed that the dark ice exposure is caused by longer melt duration. Tedstone et al. (2017) showed the earlier snow cover disappearance could cause the microbial activation and dark ice exposure from comparison between MODIS satellite image analysis and MAR model simulation. Our result supports this hypothesis from remote sensing observations.

Mote, T.L., MEaSUREs Greenland Surface Melt Daily 25km EASE-Grid 2.0, Version 1., Boulder, Colorado USA, NASA National Snow and Ice Data Center Distributed Active Archive Center, 2014.

Tedstone, A.J. et al., Dark ice dynamics of the south-west Greenland Ice Sheet, The Cryosphere, 11, 2491-2506, 2017.

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