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グリーンランド氷床上における 2000-2014 年の衛星抽出積雪粒径変動
Satellite-derived snow grain size variation during 2000-2014 on Greenland ice sheet

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Satellite-derived albedo of Greenland ice sheet (GrIS) in summer season reveals a remarkable decreasing trend since 2009. Snow surface albedo depends on snow grain size (SGS) and concentrations of light absorbing snow impurities (LASIs). In accumulation area of GrIS, the surface albedo strongly controlled by the SGS variation because the concentrations of LASIs are generally not high to reduce the albedo significantly. When air temperature increases, the SGS also increases by accelerating snow metamorphism and thus the albedo decreases. Hence, it is important to monitor the annual and seasonal changes of SGS distribution over GrIS. We have developed an algorithm to retrieve SGS for Second Generation Global Imager (SGLI) algorithms for Global Change Observation Mission - Climate (GCOM-C). The algorithm is based on a look-up table method for bidirectional reflectance distribution function at the top of the atmosphere as functions of SGS, LASI concentration and solar and satellite geometries. We employed a two-snow-layer model, which consists of the topmost layer (depth of 5 mm fixed) and the subsurface layer, for the retrievals of SGSs in those two snow layers (Rs1 and Rs2), respectively. We validated the Rs1 derived from Terra/Aqua Moderate Resolution Imaging Spectroradiometer (MODIS) data with the in-situ measurements synchronized with the satellite overpasses at Summit (73 ^{0} N, 38 ^{0} W, 3,216 m a.s.l.) in 2011 and at SIGMA-A (78 ^{0} N, 67 ^{0} W, 1,490 m a.s.l.) in 2012. The results showed the excellent agreement for a wide range of SGS.

Using this algorithm, Rs1 and Rs2 over Greenland ice sheet were retrieved with Terra/MODIS data from 2000 to 2015 and the monthly averages were calculated for different elevation areas. The results showed that Rs1 and Rs2 for all of the GrIS except the areas higher than 3,000 m have an increasing trend from June to August during the observed period, which are 28 μm and 174 μm per decade in case the area of an elevation higher than 1,000 m in June. These values become small for the higher elevation areas from June to August and are close to zero or negative for all areas in April and September, indicating the warming influence to SGS is remarkable over the lower elevation areas than 3,000 m in summer season.

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