MODIS データから抽出されたグリーンランド氷床上の積雪粒径

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Snow grain size derived from MODIS data over Greenland ice sheet

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Snow surface albedo depends on snow grain size (SGS) and concentrations of light absorbing snow impurities. In accumulation area of Greenland ice sheet (GrIS), the surface albedo strongly controlled by the SGS variation because the impurity concentrations are generally low. GrIS is presently undergoing drastic changes. When the air temperature increases due to global warming, the SGS also increases by accelerating the snow metamorphism and thus the albedo decreases. Hence, it is important to monitor the annual and seasonal change of SGS distribution over GrIS. We developed an algorithm to retrieve SGS based on Second Generation Global Imager (SGLI) algorithms (Stamnes et al., 2006; Aoki et al., 2006; Hori et al., 2006) 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, snow impurity concentration and solar and satellite geometries. We employed 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. The validation experiment of SGS synchronized with satellite overpasses was performed at SIGMA-A site (78°03’N, 67°38’W, 1,490 m a.s.l.) on GrIS during the period from June 26 to July 15, 2012. Figure 1 presents a scatter plot of ground-based remote sensing values of the topmost SGS and the satellite-derived SGS (R_{s1}) performed at SIGMA-A site. The ground-based SGS values were determied from spectral albedo data measured with a spectrometer, and the satellite sensor emplyed is Moderate Resolution Imaging Spectroradiometer (MODIS). The MODIS-derived R_{s1} agrees well with the ground-based mesurements. Figure 2 dipicts the monthly averaged distribution of MODIS-derived R_{s1} over GrIS from April to September in 2000 and 2012. The R_{s1} values in June and July, 2012 are larger in wide areas than those in 2000. The monthly averages of SGSs from 2000 to 2013 over GrIS revealed the following facts. (1) The areas of large grain size changed year by year. (2) There is no constant increasing trend, but the larger values were observed in recent years (2009-2012) and especially for 2012 the remarkable increase in whole GrIS. (3) Larger snow grain size is distributed in coastal regions in June (mainly in southern part), July and August.

References

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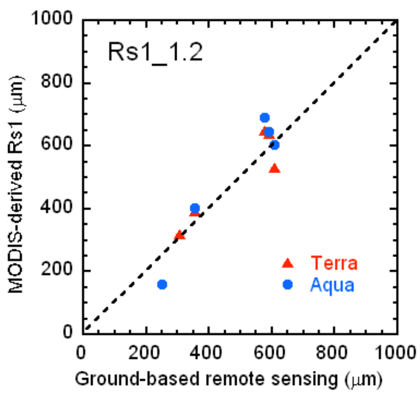

Fig. 1 Scatter plot between ground-based remote sensing values of the topmost SGS and satellite-derived SGS (R_{s1}) performed at SIGMA-A site on GrIS in 2012. Red and blue dots indicate Terra and Aqua satellites.

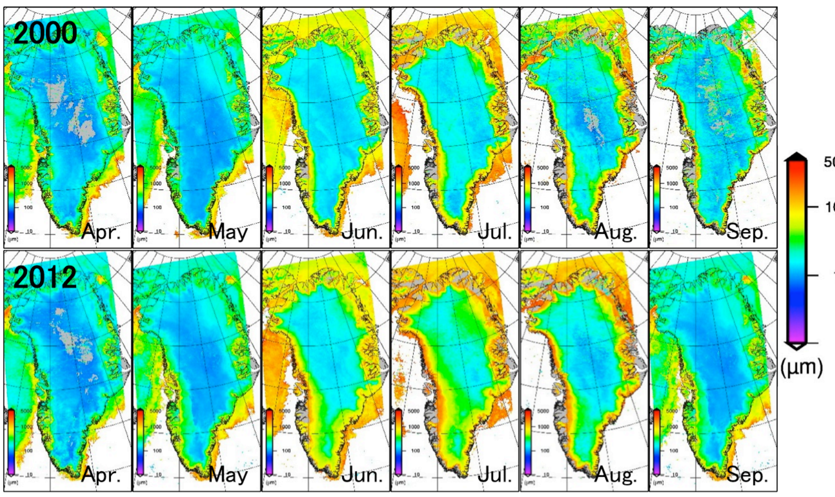

Fig. 2 Monthly averaged distribution of R_{s1} derived from MODIS data over GrIS from April to September in 2000 and 2012.