Surface energy balance at SIGMA-A site on the northwest Greenland ice sheet

*Satoshi Hirose[1], Teruo Aoki[1,2], Masashi Niwano[2], Sumito Matoba[3], Tomonori Tanikawa[2], Satoru Yamaguchi[4], Tetsuhide Yamasaki[5]

1. Okayama University, 2. Meteorological Research Institute, 3. Institute of Low Temperature Science, 4. National Research Institute for Earth Science and Disaster Prevention, 5. Avangnaq

The Greenland ice sheet (GrIS) has been losing snow and ice mass at an accelerating rate since the late 1990s (Shepherd et al., 2012). This is due to both enhanced surface melting during the summer and increased ice discharge into the ocean (van den Broeke et al., 2009). In this study, we investigated the surface energy balance (SEB) (positive downward) by using the data obtained with an automated weather station (AWS) which was installed in the SIGMA project (Aoki et al., 2014) to clarify the contributing factors to surface melting. The AWS is located at the SIGMA-A site (78˚03’ N, 67˚38’ W, 1,490 m a.s.l.) on the northwest GrIS and the study period is from 30 June 2012 to 31 August 2013.
The analysis result shows that the snow surface was essentially heated by the net shortwave radiation and sensible heat flux, and cooled by the net longwave radiation and latent heat flux. Surface melting occurred commonly at positive air temperature in summer season. Especially, the GrIS experienced the record surface melt in July 2012 (Nghiem et al., 2012). The monthly averaged air temperature in July 2012 was -0.2℃, which is 3.9℃ higher than that in 2013. The snow height change in July was - 27 cm and + 16 cm in 2012 and 2013, respectively. Comparing the monthly averaged SEB in July between 2012 and 2013, the net shortwave radiation shows the largest difference. The value in 2012 is 18 W m^{-2} larger than that in 2013. In addition, the monthly averaged near-infrared albedo in June 2012 was 15 % lower than that in June 2013, whereas there was relatively small difference in visible albedo. For this reason, snow grain size would increase due to air temperature rise in July 2012. We thus concluded that the positive feedback effect by the snow grain growth –near-infrared albedo reduction played an important role in the observed surface melting in July 2012.

References

Aoki et al., 2014: *BGR*, doi:105331/bgr.32.3.
Nghiem et al., 2012: *GRL*, doi: 10.1029/2012GL053611.
Shepherd et al., 2012: *Science*, doi: 10.1126/science.1228102.
van den Broeke et al., 2009: *Science*, doi: 10.1126/science.1178176.

