

Satellite remote sensing of snow cover dynamics in Svalbard, Norwegian Arctic

Takeshi Motohka^{1*}, Masaki Uchida², Ayaka Kishimoto (W. Mo)³, Kentaro Hayashi³,
Hiroyuki Muraoka⁴, Hibiki Noda⁴, Takayuki Nakatsubo⁵, Kenlo Nishida Nasahara¹

¹Tsukuba Univ., ²NIPR, ³NIAES, ⁴Gifu Univ., ⁵Hiroshima Univ.

The onset and offset of snow cover are one of the key factors that influence the phenology and the cycle of materials (water, carbon, nitrogen, etc.) and energy in the Arctic terrestrial ecosystem. Therefore, monitoring of snow cover dynamics is important to understand the present and the future change in the ecosystem. In the study, we investigated the interannual changes of snow cover onset and offset in Svalbard islands of the Norwegian Arctic, with satellite remote sensing which offers a periodic and large-scale monitoring.

At first, time-series NDVI (Normalized Difference Vegetation Index) images from year 2000 to 2009 was made from Terra MODIS ground surface reflectance data (MOD09Q1 product by NASA, 250-m resolution, 8-days composite image, collection 5). Next, for each pixel, the first day that exceeds NDVI=0 from the new year was judged the snow cover offset (snowmelt), while the first day that falls below NDVI=0 from August was judged the snow cover onset. The threshold (NDVI=0) was determined based on the spectral reflectance data observed at Ny-Alesund in the Spitsbergen island. The area of glacier and sea were removed for the analysis. The results of this method were evaluated by comparing to satellite images acquired from ALOS AVNIR-2 (10-m resolution) and LANDSAT (30-m resolution).

As a result, we revealed the spatial distribution at the snow cover onset and offset over Svalbard islands from 2000 to 2009. The averaged snow cover offset (snowmelt) around Ny-Alesund was earlier in 2006 and later in 2009 than the 10-years average. The averaged snow cover onset was earlier in 2001, 2005, and 2008 and later in 2004, 2006, and 2009. The interannual variation of offset and onset were up to about 25-days and 15-days, respectively. The non-snowy season calculated from the onset and offset of snow cover was varied up to about 30-days from year to year. From the results, we could not find a significant interannual trend of the onset and offset of snow cover. In this region, the impact of snowmelt timing on vegetation phenology was reported, and therefore the variation of the offset of snow cover shown in our results could influences the carbon cycle of the arctic terrestrial ecosystem.