Forest resources change observation using spaceborne LiDAR in Siberian

*Masato Hayashi[1], Kazuhito Ichii[2,1], habura borjigin[1], Nobuko Saigusa[1], Yoshito Sawada[1], Yoshiki Yamagata[1]

1.National Institute for Environmental Studies, 2.Japan Agency for Marine-Earth Science and Technology

High-latitude area in the northern hemisphere, including Siberia, is the region most affected by climate change. A monitoring technology for vegetation change is very important for such region. Satellite remote sensing can provide the most practical mean for the large-scale and continuous observation, and spaceborne LiDAR is particularly expected. This sensor transmits a laser pulse to measure vertical structure near the Earth's surface. ICESat/GLAS was the only spaceborne LiDAR so far, which was operated by NASA from 2003 to 2009. However, there are some future plans of spaceborne LiDAR, such as ICESat-2, GEDI, and MOLI, and they are expected to be used for forest monitoring. This study aims to clarify the potential of spaceborne LiDAR to quantitatively observe forest resources change in Siberia. We collected GLAS data acquired in 40°N-90°N and 60°E-170°W. Then, we excluded some GLAS data as follows: 1) the data in cloud covered area or non-forested area, 2) the data with large noise (SNR of GLAS waveform < 10), and 3) the data in steep sloped area (surface slope > 5°). As a result, we obtained about 3,000,000 points GLAS data suitable for the analysis. Next, we estimated canopy height and aboveground biomass from each of GLAS waveform data. We adopted RH100 (height from signal start to ground peak) for canopy height and an existing model (Neigh et al., 2013) for aboveground biomass. As a result, the average values were 7.4m of canopy height, and 23.0 Mg ha^{-1} of aboveground biomass in the whole study area. Next, we calculated the average of canopy height and aboveground biomass for every 5° longitude and latitude mesh, to understand the spatial distribution of forest resources. The spatial distributions of canopy height and aboveground biomass showed similar pattern, which was high in the south and low in the north in general. And, we separated the estimates data into the two period according to the GLAS observation (2003-2005 and 2005-2007), to understand the yearly change. As a result, canopy height showed a slightly decreasing trend, and aboveground biomass showed alomost no change, however, an increasing trend was seen in the western region (see figure). For the future, we will investigate the cause of this trend. This study showed that spaceborne LiDAR is suitable for monitoring the forest resources change accurately.

Keywords: Forest biomass, Spaceborne LiDAR, ICESat/GLAS, Siberia