Function of Polarimetric SAR of ALOS/PALSAR and its applications to Environmental studies in Mongolia

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JAXA (Japan Aerospace Exploration Agency) launched the earth observation satellite ALOS””Daichi””, which is equipped with three independent sensors in January 2006. One of the sensors is ””PALSAR”” which is a full polarimetric SAR, which is the world first full polarimetric SAR system operated regularly on a space craft for a long term. PALSAR operates in L-band (1.27GHz) and is capable to observe the ground surface condition accurately compared to other SAR operating at higher frequency band, namely C-band or X-band. Therefore, we have a hope that ALSO/PALSAR will be used for various environmental observations.

The ALOS data products are now available in public domain, after sensor calibration. We jointed polarimetric calibration validation missions for ALOS/PALSAR and have deployed corner reflectors. We selected Ulaan Baatar as one of the calibration sites, because we think ALOS data will be quite usefully used for environment studies in Mongolia. Mongolia has various different ground and environmental conditions. I south, Gobi dessert shows bear soil, and in the middle, we have flat grassland, and in north, it is a typical boreal forest area.

The first data acquisition for polarimetric calibration was conducted on 25 May, 2006. We sat corner reflectors in a flat area inside the Chingis Khaan International airport, which is located west of Ulaan Baatar city (N47.836,E106.770). We selected this site, because the topography is flat. The site is selected along the run way of the airport. The ground surface was covered by grass, having about 30cm height. At the same time, we conducted Ground Penetrating Radar (GPR) measurement around the test site, in order to measure the ground moisture condition.

The second ALOS/PALSAR data acquisition was carried out on 25 August 2006. In this time, we settled the corner reflectors in grass field close to the international air port. The height of the grass was less than 30cm, and was sparse in this test site. The flight path of this data acquisition is almost the same as that in May 2006.

We could determine the location of the corner reflectors from the polarimetric SAR images. Then we picked up the polarimetric scattering coefficients from the SAR images in order to confirm the polarimetric characteristics of the SAR images. The polarimetric SAR images we have obtained from JAXA were already calibrated using the polarimetric compensation matrix, and the coefficients shown in the flowing sections are the original data we received from JAXA.

PALSAR data scenes were acquired in May and August. It covers quite wide area of Mongolia including boreal forest, grassland and dessert. May is early spring, and grass is still very young, although there is no snow except high mountains. August is the end of summer, and the height of grass is most high in this season. The conditions of trees in the two seasons are almost the same. PALSAR Pauli decomposed images in north part of Mongolia showed that most of the area shown in these images is shallow smooth mountains. We can find small villages in the middle. Changes on the ground use are small in general. However, in the polarimetric image, we can find clear change in agricultural area. Agriculture in Mongolia is not very popular, but here we can find that the agricultural activities can be clearly detected by PLASAR images.

Terrain slope was estimated by using the polarization orientation angle shift. The ground surface of the observed area is general smooth slope, having very sparse grass, therefore it is almost bare soil. We believe this condition is quite ideal for many theoretical studies of application of polarimetric SAR