Japan Geoscience Union Meeting 2014
(28 April - 02 May 2014 at Pacifico YOKOHAMA, Kanagawa, Japan)

U04-10 Room:211 Time:April 29 11:30-11:45

Applicability of airborne remote sensing to terrestrial ecosystem sciences

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Although the airborne remote sensing generally cannot be conducted repeatedly for a region during a multi-year long time period like satellite (space borne) remote sensing, the airborne remote sensing has many advantages in the observation of terrestrial ecosystem. One of them is, of course, the spatial resolution of the airborne remote sensing can be much higher than that of the satellite because the airborne platform flies at much lower altitude than satellite. Although WorldView-2 and GeoEye-1 provide high resolution images of land surfaces, it is practically hard to identify the individual tree in a forest, while the image of airborne remote sensing allows us to observe the tree crown structure and the forest floor condition. In 2000, an airborne remote sensing was conducted from spring to summer over forests around Yakutsk, eastern Siberia, and forest images were recorded by the onboard video camera from heights of 100 to 150m above the land surface. We examined the presences of green leaves in the crown of forest and the snow cover on the floor, and the spectral reflectance of the forest was investigated in relation to those conditions. The result suggested the reflectance from the forest floor significantly influenced the satellite-derived vegetation index (e.g. NDVI) in case of sparse boreal forests. The airborne remote sensing at a further lower height, several tens meters, enables us to indentify the individual leaf and insect, and subsequently, to study the biodiversity on individual basis. Recently, the remote sensing technique by airborne hyperspectral camera and LiDAR has explored a feasibility to identify species and retrieve the chemical trait and structure of vegetation. This methodology made a breakthrough for investigating the ecosystem function and biodiversity. Another advantage of airborne remote sensing is the capacity to select the observation geometry such as the incident angle of solar illumination and the view angle of the sensor. This capacity leads a robust development of radiative transfer model of vegetation based on the bidirectional reflectance distribution function (BRDF).

Keywords: forest ecosystem, LiDAR, ecosystem function, biodiversity