# Identification of canopy greenness and floor greenness in Siberiantaiga by aircraft observation

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A popular method to evaluate the vegetation greenness by remote sensing is to calculate the vegetation index according to the difference in spectral reflectance between visible (VIS) and near-infrared (NIR) bands. The vegetation index is used for the estimation of the global Leaf Area Index (LAI). Concerning the vegetation index for forest, we should take care that the satellite remote sensing measures the total greenness of the forest canopy and the forest floor. This issue may be serious especially for sparse forests like Siberian taiga. It has been pointed out that the LAI derived from the satellite remote sensing in the boreal forest indicates higher values than the LAI of the forest canopy derived by in situ observation. It is considered that the satellite-sensed measurement includes both canopy and floor greenness. Such satellite-derived LAI prevents an appropriate application to vegetation numerical models as forcing and validation values. This paper tried to separate the greenness of the forest canopy and floor based on the airborne spectral reflectance data which were observed around Yakutsk in Siberia from spring to summer in 2000.

The airborne observation was carried out 8 times from April (snow-covered season) to June (fully-foliated season) in 2000. The target region (about 100km wide) was covered by deciduous larch forests (60%), deciduous birch forests (about 10%), and evergreen pine forests (about 7%). 5,515 samples of the spectral reflectance of the land surface observed by airborne spectrometer at 100m or 150m heights were obtained. The land surface images were simultaneously recorded by a video camera. Base on the video images, land surface conditions were classified into 4 cases: (1) no-green canopy and snow floor (276 samples), (2) green canopy and snow floor (37 samples), (3) no-green canopy and no-snow floor (326 samples), and (4) green canopy and no-snow floor (301 samples).

For the 4 cases, the mean spectral reflectance from 350 - 1200nm was calculated. The case (1), that is, completely no green condition, exhibits the spectral feature of snow. In the case of (2), a large reflectance gap between VIS and NIR bands was seen that is a signal from the canopy greenness. However, the reflectance was totally high due to the reflection from the snow on the floor. In the case of (3), there was no green on the forest canopy, while the green vegetation on the floor exposed. Consequently, the spectral reflectance had a large gap between VIS and NIR bands. The magnitude of the gap is similar to that of (2), but the reflectance was totally lower than (2). In the case of (4), a very large reflectance gap, about double of the gap of (2) and (3), was found between VIS and NIR bands due to green canopy and green floor.

Normalized Difference Vegetation Index (NDVI) was calculated for the 4 cases. Mean NDVIs for the cases (1), (2), (3), and (4) were -0.03, 0.17, 0.43, and 0.76, respectively. The negative NDVI for (1) is owing to the reflectance from the snow on the floor. As for the case (2), the NDVI was rather small for the large reflectance gap. This is because the large background reflectance from the snow floor made the NDVI small. By contrast, the NDVI of (3), which had no greenness on forest canopy, is considerably large, because there is no snow which makes NDVI small like (2). The case of (4) indicated the largest NDVI due to the green canopy and green floor. Thus, it was revealed that NDVI considerably depends on the forest canopy greenness and forest floor greenness, and moreover, the snow cover. We should carefully interpret the NDVI by the satellite remote sensing in the boreal forest region.