Retrieving leaf area index and fraction of absorbed photosynthetically active radiation using GCOM-C/SGLI data

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The Japan Aerospace Exploration Agency (JAXA) will launch the Global Change Observation Mission - Climate (GCOM-C) satellite. We developed the algorithms for retrieving the Leaf Area Index (LAI) and the fraction of Absorbed Photosynthetically Active Radiation (fAPAR), which will be produced and distributed as one of the GCOM-C standard land products by JAXA. In this document, we introduce the methods for retrieving them.

LAI and fAPAR were estimated based on the look-up tables showing the relationships between Normalized Difference Vegetation Index (NDVI) data and the LAI or fAPAR. They were retrieved by comparing the values of multi-angle NDVIs derived from satellite and from the look-up tables for each sun and satellite geometries. The multidirectional observation capability is one of the feature of the Second generation GLobal Imager (SGLI) onboard the GCOM-C satellite. The look-up tables were produced for each solar and view zenith angles and relative azimuth angle. The relationships among LAI, fAPAR and multi-angle NDVIs were estimated for 6 kinds of land cover types. They were adjusted to fit with the collected in-situ reference data. The data from several databases such as VALERI and BIGFOOT were used as in-situ reference data.

The relationships among LAI, fAPAR and NDVIs were simulated using a radiative transfer simulator, the Forest Light Environmental Simulator (FLiES) [1]. It simulates radiative transfers in the forests and grasslands based on the Monte Carlo method. The inputs of the FLiES were the reflectance and the transmittance of canopy leaves and understory vegetation, the reflectance of stems and soils, the leaf area density (LAD) of tree canopies, the non-photosynthetic bark area density (BAD) of trees, and the forest landscape data. The forest landscape data were the total number of trees, the geometric shapes of the trees, and the positions, radius and the heights of the trees.

The accuracy of the retrieved LAI and fAPAR will be assessed using the in-situ observation data which will be collected at several sites on global after the launch of the GCOM-C satellite. In this research, the MODIS reflectance data were used for the satellite data for producing the look-up tables, because the GCOM-C satellite has not been launched yet. The look-up tables will be revised to fit with the SGLI data after the launch of the GCOM-C satellite.

[1] H. Kobayashi *et al.*, A coupled 1-D atmosphere and 3-D canopy radiative transfer model for canopy reflectance, light environment, and photosynthesis simulation in a heterogeneous landscape, *Remote Sensing of Environment*, **112** (2008), 173-185.

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