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Mapping of Leaf Area Index over Japan using Terra/MODIS data

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It is required to estimate carbon budget accurately, since carbon dioxide concentration in the atmosphere would accelerate global warming. Terrestrial vegetation fixes carbon from the atmospheric carbon dioxide by photosynthesis and biological models utilize leaf amount as one of important parameters. Therefore, it is important to estimate distribution of leaf amount of ecosystems accurately in a large area. Satellite image data provide land surface information and are used mapping of various land surface information including leaf area index (LAI). A simple LAI mapping method was developed based on Beer-Lambert law and applied for 32-day MODIS images over Japan obtained in 2002 and a LAI map was produced.

Eight-day MODIS composites produced by NASA was used and rearranged for 32-day mosaics except August using the minimum value within each 32 day interval. The normalized difference vegetation index (NDVI) was computed using the 32-day mosaics, and noises were reduced using the principal component analysis and its inversion.

The following equation was derived using Monsi & Saeki's equation based on Beer-Lambert's law for LAI.

$LAI=-\ln(1-PARr/PAR0-(a+b*NDVI))/k$ (1)

where PAR: photosynthetcally active radiation, PARr/ PAR0: reflectance of visible wavelength, k: extinct coefficient. The constants a and b are determined based on field measurements or literature. It is difficult to determine k accurately, but 0.4 for needle-leaf, 0.48 for needle-broad-leaf mixed, 0.56 for broad-needle-leaf mixed, 0.64 for broad-leaf for bamboo shrub were assigned by the literature. Distribution of each category was determined using a MODIS based forest type map and LAI was mapped using reflectance factor of visible channels, NDVI and equation (1)

Average LAI was 6.7 a rather large value and LAI range was small. Seasonal changes of LAI were different area by area on the monthly LAI maps.

Keywords: LAI, Beer-Lambert's law, MODIS, Japanese archipelago, seasonal change