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The effect of land cover heterogeneity of MODIS pixel on canopy LAI estimation

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The boreal zone land cover has a very significant influence on the northern hemisphere albedo and is an important component of the northern hemisphere carbon budget. Both albedo and the leaf area index (LAI) are one of the most important biophysical vegetation parameters and belong to the Essential Climate Variables (ECV) . In addition, in winter time the boreal forest albedo is a complicated combination of snow and canopy radiative properties, so that the albedo is a function of the canopy LAI.

One possibility to estimate LAI using optical satellite data is by determination of spectral vegetation indices (SVIs), such as the reduced simple ratio (RSR). It uses the visible near infrared and short wave infrared channels. In large areas moderate resolution instruments, like MODIS, are suitable for LAI mapping. Yet, the heterogeneity of land cover in many boreal areas, for example in Finland, causes a challenge for LAI estimation. This effect was studied using several Landsat and MODIS images and the high resolution CORINE land cover map covering the same area in various parts of Finland. The atmospheric correction of the Landsat images was adjusted so that each MODIS pixel reflectance matched the average of the Landsat pixel reflectances within the MODIS pixel. The LAI values for Landsat and MODIS images were then determined using the RSR index. The LAI average of forested Landsat pixels was compared to the corresponding MODIS pixel LAI as a function of open water area fraction in the MODIS pixel. A regression function was determined to derive a method to correct the MODIS based LAI values with the open water area fraction. It turned out that the existence of open water in the MODIS pixels reduces the determined canopy LAI value on the average 30%. Also other land cover classes affect the LAI value, but the effect of water is largest, because the reflectance of water deviates so much from that of the canopy.
The canopy LAI map of whole Finland was then calculated using two MODIS images. The water corrected and uncorrected LAI values were compared to each other.