ESTIMATING BIOPHYSICAL VARIABLES AT 250 M WITH RECONSTRUCTED EOS/MODIS TIME SERIES TO MONITOR FRAGMENTED LANDSCAPES

Rémi LECERF [a], Laurence HUBERT-MOY [a], Frédéric BARET [b], Bassam ABDEL LATIF [c], Thomas CORPETTI [a], Hervé NICOLAS [d]

[a] COSTEL CNRS UMR 6554 LETG – IFR CAREN
Université Rennes 2
Place du recteur H. Le Moal – CS 24307 – F-35043 Rennes Cedex

[b] INRA EMMAH, UMR1114
Domaine Saint Paul - Site Agroparc – F-84914 Avignon Cedex 9

[c] GET / ENST Bretagne / dpt ITI
CNRS UMR 2872 TAMCIC / TIME
Technopôle Brest-Iroise - CS 83818 - F-29238 Brest Cedex 3, France

[d] INRA SAS
Agrocampus - 65, rue de St-Brieuc – F-35042 Rennes Cedex

Contacting author: remi.lecerf@univ-rennes2.fr

The objective of this study is to identify changes in the vegetation cover in estimating crop fraction cover in the Brittany region over the 2000-2007 period. In this intensive farming region, located in the western part of France, more than 60 % of the area is dedicated to the production of corn, winter wheat and meadows. The landscape is fragmented and characterized by small fields surrounded by wooded hedges.

Biophysical variables derived from satellite observations are now widely used to monitor changes in canopy vegetation over large areas at global and regional scales. Biophysical products derived from current coarse and medium sensors allow estimating changes in landscapes made of large patches. In fragmented landscapes, the 1 km spatial resolution is not suited to identify changes in vegetation cover due to mixing effects. Higher spatial resolution is thus required.

For this purpose reflectance products derived from EOS/MODIS sensors are available at 250 m spatial resolution for the red and near infrared bands. Unfortunately, fAPAR and LAI MODIS-NASA products are only available at 1 km spatial resolution. In this paper, we present an original method to estimate biophysical variables at 250 m resolution from EOS/MODIS sensor. More precisely, we intended to retrieve fAPAR, LAI and fCOVER using the combined PROSPECT-SAIL model.

EOS/MODIS Level 1B images have been atmospherically corrected using the 6S model and aerosol characteristics derived from MODIS images. Clouds have been screened out using the MODIS cloudmask and a box and whisker on the blue and middle infrared bands (Band 3 and Band 6). The box and whisker method consists in filtering reflectance values lower or greater than 1.5 interquartile from the median. The blue band has been used to filter clouds, whereas the middle infrared band has been selected to filter cloud shadows. Only images with at least 25 % of cloudless observations and a sensor zenith angle lower than 35 ° over the whole region have been processed. Missing observations have been then replaced in using Kohonen self organizing maps and randomly selecting temporal signatures without missing observations

[1]. Time series have been then linearly interpolated to obtain observations each 15 days. The reflectance time series obtained have not been corrected from BRDF effects, so a robust function has been used to smooth remaining variations [2].

Bands 1 and 2 have been used to estimate biophysical variables based on the combined PROSPECT-SAIL radiative transfer model. Inversion of the model is achieved using a neural network within a methodology similar to that used with SPOT/VEGETATION for CYCLOPES products [3]. Top of canopy reflectance for near nadir viewing angle are firstly simulated using a priori defined distributions of soil reflectance, canopy characteristics and sun position. The resulting learning data base is used to train neural networks. Once neural networks are calibrated, they are applied on each image of the time series to obtain fAPAR, fCOVER and LAI time courses. Results have been then compared with CYCLOPES LAI and fCOVER and EOS/MODIS LAI at 1 km resolution.

The correlation between CYCLOPES LAI at 1 km and EOS/MODIS LAI at 250 m determinated from the previous processing stage is greater than 0.9 whereas it is lower between EOS/MODIS LAI at 1km (MOD15) and EOS/MODIS LAI at 250 m. The gap between MODIS LAI at 1 km and MODIS LAI at 250 m is explained by 1-the differences between preprocessing stages and particularly compositing methods and 2-the radiative transfer model used to retrieve biophysical variables. At 1km spatial resolution, biophysical variables time series are a complex mixture of the 3 main crops found on arable lands: corn, meadows and winter wheat. At 250 m, biophysical variables time series are driven by the phenology of the dominant land cover and highlight crop sequencing as well as climate induced changes. These changes were not detected using the 1km MODIS LAI. From this time, the fCOVER image time series derived from MODIS data at 250 m will be used to map land use and land cover changes and identify the main drivers of landscape changes in Brittany.

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