ESA STUDY CONTRACT REPORT

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ESA CONTRACT	**SUBJECT**	**CONTRACTOR**
No 20050/06/NL/HE	**CArbon flux Modeling using Earth observation Land products for Initiation and by Assimilation (CAMELIA)**	**NOVELTIS**

*** ESA CR ( ) No**	**No of Volumes: 7** **This is volume No: 1/7**	**CONTRACTOR'S REFERENCE** **NOV-3465-NT-8074** **Ed. 1 – Rév. 1**

ABSTRACT:

The primary objective of the study is to estimate the benefit of high resolution (HR) satellite observations (such as SPOT data) versus medium resolution (MR) observations (such as MERIS-RR data) to improve our knowledge of the carbon cycle. To answer the question we constructed a carbon-cycle data assimilation system (CCDAS) capable of ingesting a range of measurements including satellite and/or ground measurements at different spatial and temporal resolutions. The use of satellite or ground data into CCDAS allows estimating carbon model parameters to improve diagnostic and prognostic simulation performances.

To achieve our goal, we first compared the CCDAS system performances over 10 sites (around 20x20km²) spanning a range of vegetation types using fAPAR data either derived from high or medium spatial resolution and/or ground flux measurements. .We considered not only differences in the retrieved parameters but also in current and future fluxes predicted by the resulting model. In the second part of the study, we applied the parameters calibrated previously on the different plant functional types described by the 10 sites at the global level, including the use of atmospheric concentration measurements that integrate fluxes spatially.

Conclusions are provided on the assimilation of eddy-flux measurements and satellite fAPAR data as well as some incompatibilities between these types of data. The satellite data as a constraint on ecosystem model parameters, as well as the impact of difference at the local scale between HR and MR products onto simulations at the global scale were analysed. HR fAPAR data potentially bring more information at the site level than MR data for a combined use of flux and fAPAR information. This is related to the spatial heterogeneity of the vegetation at the sites we studied: HR satellite data provide fAPAR values that are closer to the *in situ* observations than MR satellite data. In this context, we could foresee a trade-off between having several sites observed from space at large temporal frequency (less than a week) and having a global coverage of the vegetation activity but at a lower frequency. Concerning relatively homogeneous regions (Siberia, North Canada, few tropical regions) the MR global products could bring sufficient information, if accurate and frequent enough to record the temporal fAPAR variations (rather small for most none deciduous ecosystems). For highly heterogeneous regions (like Western Europe), HR products (tens of meters) are probably more appropriate to capture the spatial variations in the temporal course of the vegetation activity.
Based on the study results, recommendations have been provided on satellite data accessibility, the consideration of image Point Spread Function, the harmonization of fAPAR products, the compromise between spatial resolution and temporal coverage, and the priorities for model improvements. Finally perspective is proposed to give value to obtained results.

The work described in this report was done under ESA Contract. Responsibility for the contents resides in the author or organization that prepared it.

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