SPATIALIZATION OF CROP LEAF AREA INDEX AND BIOMASS BY COMBINING A SIMPLE CROP MODEL SAFY AND HIGH SPATIAL AND TEMPORAL RESOLUTIONS REMOTE SENSING DATA.

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1. ABSTRACT

The recent availability of high spatial resolution sensors (IKONOS, SPOT5,) associated to high temporal resolution like FORMOSAT and, in the future, Venμs with high spatial, temporal and spectral resolutions (10 m / 2 days, Venμs, Sentinelle-2 and GMES-Continental programmes) offers new perspectives for terrestrial applications (agriculture, risks). This work aims to enhance multi-temporal observations at high spatial resolution used for crop model calibration. Thus, this study leads to derive biophysical variables (Leaf Area Index - LAI, Biomass)at a regional scale.
Crop models, like STICS [1], are accurate predictive models requesting a large set of input parameters (i.e. 132 parameters for STICS). Those input parameters are not easily available. Some of them can be empirically calibrated but it affects the general accuracy of the model. Spatialization of such a model is thus difficult due to the lack of input data. This study is focussed on a simpler model (Simple Algorithm For Yield estimates - SAFY from [2]) that can be spatialized. SAFY is based on a phenological approach [3], which associates daily biomass production as a function of solar radiation and air temperature. It includes not more than 14 parameters, and produces LAI and dry above-ground biomass (DAM) profiles throughout the growing season. LAI forcing method allows to optimize key parameters and consequently to spatialize the model outputs. For this study temporal LAI profiles are estimated from the FORMOSAT-2 optical sensor which provides high spatial (8m) and temporal(every 3 days) images. FORMOSAT-2 images were acquired over different crops growing season (maize, soybean and sunflower) in 2006, 2007 and 2008. Those multi-temporal series were used to produce Land Use and multi-temporal LAI maps. This latter were obtained from empirical relationship established between FORMOSAT-NDVI indices and in-situ LAI measurements derived from hemispherical photographs [4] for each crop. LAI maps were used to control the SAFY model.
Most of the SAFY parameters are crop related and have been fixed according to literature investigation. However some parameters are more specific to the study area: (a) the parameters that describe the leaf partitioning, (b) the parameters that describe the senescence phase, (c) the day of emergence and (d) the Effective light-use efficiency. Generic parameters (a and b) which describe the temporal LAI profile shape have been calibrated for each crop type based on LAI profiles derived from 2006 FORMOSAT-2 dataset (48 acquisitions). Specific parameters (c and d) are more related to farmer practices and have been calibrated for each field. Based on calibrated parameters, SAFY produces mapped temporal DAM and yield estimation. Those maps are finally compared with DAM in-situ measurements and farmer yields. Good agreement between estimated and measured 2006, 2007 and 2008 biomass have been found on maize (r^2 = 0.977) and on sunflower (r^2 = 0.927). Main limitations of this study come from the data availability. Indeed, remote sensing data acquisitions have to be well distributed over the crop growing and senescence periods. Combining remote sensing data and SAFY model makes an interesting tool for regional crop monitoring.

2. REFERENCES

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