Geophysical Research Abstracts
Vol. 14, EGU2012-10201, 2012
EGU General Assembly 2012

MCM'10: An Experiment for satellite Multispectral Crop Monitoring. From high to low resolution observations

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In a changing climate context, it becomes increasingly important to accurately estimate the physical processes involved in the surface-atmosphere interactions in order to predict climate changes and its impact on ecosystems. Increase of human pressure and changes in land use management contribute to alter water and energy budgets and carbon sequestration in the soils. Therefore, it is essential 1) to work towards a better understanding of the different processes governing water, carbon and energy exchanges between the continental biosphere in anthropised areas and the atmosphere, 2) to monitor land use, vegetation (crop) dynamics, soil and crop management.

The aim of this presentation is to give an overview of the MCM'10 (Multispectral Crop Monitoring) experiment which has been conducted in 2010 (from February to November) by the CESBIO laboratory, in France. This experiment is based on the use of multispectral satellite acquisitions (radar, thermal and optical) and the associated ground measurements performed over about 400 agricultural fields located in the south west of France (43°29'36"N, 1°14'14"E). Optical data are acquired by FORMOSAT-2 and SPOT4-5 satellites. Radar data are provided by SAR sensors onboard TERRASAR-X (X-band), RADARSAT-2, ENVISAT (C-band) and ALOS (L-band). Thermal data come from the LANDSAT-TM 5 and 7 sensors. Low resolution data have been also collected to further study upscaling and downscaling approaches over a strongly heterogeneous landscape. Analyses of satellite data are performed by comparing them with ground data collected from local to regional scale.

At the local scale, 37 fields are systematically monitored for each satellite overpass. Three of them are equipped with meteorological stations (radiations, water and carbon fluxes sensors...). Measures are performed over different soil types (clay, silt, gravels...) and for the main crops encountered in France and Europe (wheat, corn, sunflower, soybean, sorghum...). Soil conditions monitoring consists in measuring the soil surface moisture (SSM) and the soil surface roughness by using respectively a mobile theta probe sensor and a 2m profilometer. For each field, once a week, a mean of 30 SSM values are acquired and 4 roughness profiles are performed (for which correlation length, type of the autocorrelation function and rms height are estimated). For each crops, measurements consist in collecting wet and dry biomass, total water content and its vertical distribution. All these data are collected all along the growing period until harvest.
At regional scale, 350 fields are monitored to identify crop species, soil management, soil tillage orientation, crops residues... providing a wide dataset of contrasted surface states.

Spatio-temporal behaviours of the backscattering coefficient acquired at different frequency are analysed for different soil and vegetation conditions. First results show that multifrequency radar signal provides a wide range of applications for surface monitoring (see Fieuzal et al., 2012 submitted in this conference). An overview of future applications is given in this presentation in the framework of the following satellite missions: Sentinel and Radarsat-2 constellations, TerraSAR-L...
Authors would like to thank especially Space Agencies for their support and confidence they have in this project (ESA, CSA, DLR, JAXA and CNES)