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Monitoring soil water content and soil temperature simultaneously to thermal observations from airborne data within two different experiments: SEN2FLEX-2005 and AgriSAR-2006

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In the framework of its Earth Observation Envelope Programme the European Space Agency (ESA) carries out a number of ground-based and airborne campaigns that includes activities in support of the EC Water Framework Directive (WFD) EO projects for the improvement of protection and management of Europe's water resources. The integration of algorithms for biophysical parameters determination from remote sensing and mathematical modelling of soil water balance is a crucial point to face with for arid zone agriculture management. Both an advanced application of precision farming and a parsimonious use of scarcer water resources require detailed spatial and temporal data retrievals on vegetation and soil. This spatial information can be obtained by means of Earth Observation, integrated necessarily with ground data and modeling techniques of soil water dynamics.

The ESA SENtinel-2 and FLuorescence EXperiment (SEN2FLEX) and AgriSAR (Agricultural Bio-/Geophysical Retrievals from Frequent Repeat SAR and Optical Imaging) experiments were carried out respectively in La-Mancha (Spain) and Demmin (Germany), during 2005 and 2006. Both represented an excellent opportunity to develop field experiments within the extensive field campaigns allowing to explore the possibilities offered by the integration of remote sensing data and ground collected measurements on the estimation of superficial water content in vegetation and soil.

Within the overall context of the two ESA experiments, volumetric soil water content

(θ) and soil temperature (T) were monitored in the superficial soil horizon, simultaneously with the over flight of airborne imaging spectrometers (as AHS-INTA and CASI), and the overpass of sensors as CHRIS-PROBA and MERIS. Hydraulic and physical properties of main soil layers (i.e. saturated hydraulic conductivity, retention curve, bulk density, soil texture, O.M. content) were characterized at the test site areas at different scales. Different parcels were sampled along the airborne flight line, ranging from bare soil to corn, and spanning from no vegetated to densely vegetated surfaces. A monitoring system for soil water content based on a TDR system (Tektronix) was also installed at the Barrax test site, operating continuously along the two SEN2FLEX field campaigns from June 2nd to July 18th (2005).

The aim of this work is to describe the experimental procedure carried out and results from analysis after data processing, focusing on the problem of superficial water content estimation in vegetation and soil, under bare soil and vegetated field conditions. A complete characterization with ground collected measurements was accomplished during the two experiments: (i) soil sampling for hydraulic characterization; (ii) ground measurement of volumetric soil water content (θ) and soil temperature (T); (iii) measuring Leaf Area Index at vegetated surfaces. A first analysis on the data gathered was accomplished on spatial and temporal patterns of superficial water content and temperature along transects regularly spaced and grids. Furthermore, Land Surface Temperature (LST) was derived from the AHS (Airborne Hyperspectral Scanner) thermal infrared data. It was linked, at the pixel scale, to the soil water content (θ) and soil temperature (T), monitored in the superficial horizon simultaneously to the aircrafts over pass. Spatial and temporal variability of LST in the selected images was explored in order to test the quality of the dataset and to preliminary assess the variations observed in LST for different surface conditions. Results from the analysis have allowed correlating LST retrieved values with ground based measures of soil water content (θ) and soil temperature (T).