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Operational use of satellite remote sensing data for real-time application: Evaluation of the DEMETER project in the Italian study area

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Routine observations of the Earth surface by means of remote sensors have been used in recent years for monitoring land surface patterns. The potentiality of remote sensing techniques in irrigation and water resources management is now widely acknowledged. Remotely sensed information on land cover can be obtained with satisfactory accuracy and in a cost-effective way by means of multispectral high resolution sensors on board satellites, such as Landsat TM and IKONOS. Several studies have shown that the reflectance behaviour of vegetated surfaces depends on canopy architecture and ground cover. Algorithms for retrieving biophysical parameters of land cover, such as LAI, biomass density and canopy roughness, from remote sensing data with different spatial and temporal resolution have been tried out. These parameters also influence the water and energy exchanges between the surface and the atmosphere and they determine the value of the so-called crop coefficient Kc - expressed as the ratio between crop potential evapotranspiration, Ep, and the reference value, Eo - widely used in irrigation scheduling. A procedure was developed to derive the crop coefficient Kc from vegetation parameters like LAI and surface albedo, based on the schematisation of Penman-Monteith, now adopted within F.A.O. standards for crop water requirement calculations. Spatial and temporal variations of LAI and surface albedo derived from multispectral satellite data were used to map Kc and potential evapotranspiration according to the mentioned approach. The information on crop water requirements was implemented in a tool for nearly real-time services for supporting irrigation advisory services, on-farm scheduling and other precision-farming practices. By means of an

empirical approach defined by Clevers (1989) and based on the Weighted Differences Vegetation Index (WDVI), the LAI was retrieved from E.O. data. Similar approaches and analyses were applied for estimating the albedo and the surface roughness from atmospherically corrected images; in particular, the surface albedo values was determined from the weighted sum of surface reflectance over visible and near-medium infrared spectrum, assuming as weighting parameter the percentage of solar radiance for each bandwidth. This work summarizes nearly real-time demonstration campaign for the DEMETER (DEMonstration of Earth observation Technologies in Routine irrigation advisory services) project in an irrigation district in Southern Italy, covering an area of 2000 ha approximately. An evaluation of the following issues is described in this work: 1. Pilot zone and criteria for customers identification and end-users requirements definition; 2. Technical requirements adopted and EO data processing; 3. Results and evaluation of products, tools and services provided The main goal was to evaluate the feasibility of DEMETER prototype products and services in the Italian context providing weekly information to decision-makers for management at farm level and monitoring of water resources at level of irrigation association and extension services. To this aim, a group of eight farms were selected in the test-area for field measurement during the irrigation season 2005; in addition, a larger set of users (farmers involved in field irrigation procedures and Consortium technicians) within the test-site area were approached individually, through the offices of the Consortium. In order to provide weekly information on crop water requirements, multi-sensor EO data were acquired from two satellites (Landsat 5 TM, IKONOS and SPOT). The acquisitions were planned so that was possible to achieve a revisit time between 7-10 days: 3 consecutive acquisitions every sixteen days from Landsat 5 TM spaced out to 4 IKONOS acquisitions. Capability of rescheduling the plan during the campaign and the possibility to find alternative sources of EO data was also explored before the campaign and taken into account in order to overtake possible technical problems due to image acquisition failure or for unsuitable weather conditions during satellite overpass. Crop water requirements information were delivered successfully during the operative periods of seven weeks from June 20th to August 7th, 2005; the information was used by farmers for their irrigation scheduling, giving them the possibility of a comparison with consolidated practices. Communication channels such as MMS, SMS and paper-Information Sheet were used to reach all the selected farmers once a week, in less then 24 hours after satellite acquisition.