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Coupling satellite data and simple models to estimate crop water balance and irrigation requirements at regional scale

G. Dedieu (1), L. Coret (1), P. Maisongrande (1), A. Boone (2), P. Gouaux (1) and D. Ducrot (1)

(1) CESBIO, 18, avenue Edouard Belin, 31401 Toulouse Cedex 9, France, (2) CNRM, 42 avenue Gaspard Coriolis, 31057 Toulouse, Cedex 1, France (gerard.dedieu@cesbio.cnes.fr / Fax: +33 5 61 55 85 26)

In a number of world regions, agriculture consumes a large part of the available water for irrigating crops. Therefore, there is a need to estimate and model crop water requirements and irrigation amounts in order not only to improve water management but also to study scenarios and provide basis for discussion with the stakeholders.

In this study, we combined monthly SPOT satellite images and the model proposed by Allen et al.(1998) for computing crop water requirements and evapotranspiration over a 50x50 km area located in the Southwest of France. In this area, the main irrigated crop is corn. Irrigation water has three origins : ground water, small dammed lakes and large dams in the Pyrenees mountains. First, potential evapotranspiration ETP is computed from hourly meteorological data available over a regular grid with a 8x8km spacing. Then crop coefficients, Kc, are applied to ETP to estimate crop water requirements. This parameter represents an integration of the effects of the major crop characteristics (phenology, height, crop-soil surface resistance and albedo) which partly depend on the species. SPOT images are first used to derive a crop map of the area with a 20m ground resolution. They are also used to compute a monthly vegetation index, NDVI, further interpolated at a daily or weekly time step from which the temporal evolution of Kc throughout the growing season can be monitored. The result of this approach consists of daily or weekly 20 m resolution maps of irrigated and non-irrigated crop water requirements for the entire area.

In a further step, the simple water balance model also proposed by Allen et al. (1998),

precipitation data and soil maps were used to compute evapotranspiration and soil moisture. From this information, the date and the amount of irrigation water crop would need to limit water stress can also be estimated.

Crop water balance and irrigation requirements were computed for years 2002 and 2003. Summer 2002 was rather wet and mild, while spring and summer 2003 were very dry and warm which leads to severe impacts on crop yield. The results we obtained show the dramatic change in water requirements between the two years.

We will first present the method and data we used. Then, we will discuss the results and their validation. Comparison with the results of more detailed process models will also be presented. Finally, we will sketch out the possible uses and practical implementation of the method for tactic or strategic water management, including its coupling with distributed hydrological models. We will also summarise the potential and limits of. current satellite data to address agricultural water management issues.