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Retrieval of distributed irrigation scenarios with a SVAT model (ICARE) based on high and low resolution thermic data (ASTER, MODIS)

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In the current context of climatic change, and with the evolution of anthropogenic behaviors, the optimization of water use in irrigated agriculture, particularly in arid and semi-arid regions, has become a main issue in the management of water resources. Based on a mechanistic understanding of the exchanges between the land surface and the atmosphere, Soil-Vegetation-Atmosphere Transfer models (SVAT) simulate water and energy budgets at the soil-vegetation-atmosphere interface. Remote sensing data, especially land surface temperature, gives us distributed information about the water status of the surface. By assimilating this data at high and low resolution into SVAT models, we should be able to estimate with a good accuracy water use scenarios on cultivated zones. In this context, the MISTIGRI mission is developed in order to obtain high resolution thermal data (<100m) with high repetitiveness (daily revisit).

In this study, we use a distributed version of the ICARE model (100m resolution), forced with climatic and surface (vegetation and soil water content) data acquired from January to June 2008 on a 4x4km cultivated zone of the Yaqui Valley (Sonora, Mexico). The model has been evaluated at six locations were flux and soil water content measurements were available. The first step of the study is to evaluate the suitability of land surface temperature data in the retrieval of an irrigation scenario, based on synthetic data. The surface temperature outputs of 70 credible scenarios are compared to the original one and eliminated on the basis of a temperature error criterion. Given the good results shown by ICARE in the estimation of the energy fluxes (RMSE < 100 W/m^2 for turbulent fluxes) and the soil water content, the results of this study are expected to be quite good.

The next step is to use real remote sensing land surface temperature data to do the same open-loop study. The outputs of the 70 credible scenarios are now compared to high (ASTER) and low (MODIS) resolution thermal data. The low revisit rate of high resolution sensors (7 ASTER images in 5 months) and the loss of information due to low resolution of MODIS data are expected to significantly lower the accuracy of the results. Further studies with data assimilation techniques (Particle filtering) are planned in order to improve the retrieval process. Previous studies showed that surface energy balance models like SEBS (Su, 2002) and S-SEBI (Roerink, 2000), used with ASTER surface temperature images, provided a good estimation of the vegetation stress factor. Thus, assimilating other indexes, containing more information on the water status of the surface will be another way to improve our estimations.