Geophysical Research Abstracts
Vol. 17, EGU2015-5633, 2015
EGU General Assembly 2015


# Monitoring irrigation water consumption using high resolution NDVI image time series (Sentinel-2 like). Calibration and validation in the Kairouan plain (Tunisia)

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Water scarcity is one of the main factors limiting agricultural development in semi-arid areas. It is thus of major importance to design tools allowing a better management of this resource. Remote sensing has long been used for computing evapotranspiration estimates, which is an input for crop water balance monitoring. Up to now, only medium and low resolution data (e.g. MODIS) are available on regular basis to monitor cultivated areas. However, the increasing availability of high resolution high repetitivity VIS-NIR remote sensing, like the forthcoming Sentinel-2 mission to be lunched in 2015, offers unprecedented opportunity to improve this monitoring.
In this study, regional crops water consumption was estimated with the SAMIR software (Satellite of Monitoring Irrigation) using the FAO-56 dual crop coefficient water balance model fed with high resolution NDVI image time series providing estimates of both the actual basal crop coefficient (Kcb) and the vegetation fraction cover. The model includes a soil water model, requiring the knowledge of soil water holding capacity, maximum rooting depth, and water inputs. As irrigations are usually not known on large areas, they are simulated based on rules reproducing the farmer practices. The main objective of this work is to assess the operationality and accuracy of SAMIR at plot and perimeter scales, when several land use types (winter cereals, summer vegetables…), irrigation and agricultural practices are intertwined in a given landscape, including complex canopies such as sparse orchards.
Meteorological ground stations were used to compute the reference evapotranspiration and get the rainfall depths. Two time series of ten and fourteen high-resolution SPOT5 have been acquired for the 2008-2009 and 2012-2013 hydrological years over an irrigated area in central Tunisia. They span the various successive crop seasons. The images were radiometrically corrected, first, using the SMAC6s Algorithm, second, using invariant objects located on the scene, based on visual observation of the images. From these time series, a Normalized Difference Vegetation Index (NDVI) profile was generated for each pixel.
SAMIR was first calibrated based on ground measurements of evapotranspiration achieved using eddy-correlation devices installed on irrigated wheat and barley plots. After calibration, the model was run to spatialize irrigation over the whole area and a validation was done using cumulated seasonal water volumes obtained from ground survey at both plot and perimeter scales. The results show that although determination of model parameters was successful at plot scale, irrigation rules required an additional calibration which was achieved at perimeter scale.