Geophysical Research Abstracts
Vol. 12, EGU2010-15604, 2010
EGU General Assembly 2010

Assessment of Crop Water Requirement Methods for Annual Agricultural Water Allocation Planning

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The potential use of remote sensing in water resource and in particular in irrigation management has been widely acknowledged. However, in reality, operational applications of remote sensing in irrigation management are few. In this study, the applicability of the main available remote sensing based techniques of irrigation management is evaluated in a pilot area in Iran. The evaluated techniques include so called Crop Water Requirement "CWR" methods for the planning of annual water allocation in irrigated agriculture.

A total of 40 years of historical weather data were classified into wet, normal, and dry years using a Standardised Precipitation Index (SPI). For each of these three classes the average CWR was calculated. Next, by applying Markov Chain Process to the time series of precipitation, the expected CWR for the forthcoming planning year was estimated. Using proper interpolation techniques the expected CWR at each station was converted to CWR map of the area, which was then used for annual water allocation planning.

To estimate the crop water requirement, methods developed for the DEMETER project (DEMonstration of Earth observation Technologies in Routine irrigation advisory services) and Surface Energy Balance System "SEBS" algorithm were used, and their results were compared with conventional methods, including FAO-56 and lysimeter data amongst others. Use was made of both ASTER and MODIS images to determine crop water requirement at local and regional scales. Four methods of estimating crop coefficients were used: DEMETER Kc-NDVI, DEMETER Kc-analytical, FAO-56 and SEBS algorithm.

Results showed that DEMETER (analytical approach) and FAO methods with lowest RMSE are more suitable methods for determination of crop coefficient than SEBS, which gives actual rather than potential evapotranspiration. The use of ASTER and MODIS images did not result in significantly different crop coefficients in the pilot area for the DEMETER analytical approach (α=0.05). This is promising, as it implies that MODIS can be used for determination of CWR at regional "water user association" level. Sensitivity analysis of crop coefficient to crop height, leaf area index, incoming shortwave radiation, wind speed, relative humidity and temperature was carried out as well. The results showed that the crop coefficient is sensitive to (in order of most to least sensitive), temperature, leaf area index, incoming shortwave radiation and relative humidity, wind speed and crop height. Comparison between the planned values of crop water requirement and the realised values in 2004 were not significantly different (α=0.05).