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Estimation of irrigation requirement for wheat in the southern Spain by using a soil water balance remote sensing driven

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Abstract

This paper aims to evaluate the use of a remote sensing-driven soil water balance to estimate irrigation water requirements of wheat. The applied methodology is based on the approach of the dual crop coefficient proposed in the FAO-56 manual (Allen et al., 1998), where the basal crop coefficient is derived from a time series of remote sensing multispectral imagery which describes the growing cycle of wheat. This approach allows the estimation of the evapotranspiration (ET) and irrigation water requirements by means of a soil water balance in the root layer. The assimilation of satellite data into the FAO-56 soil water balance is based on the relationship between spectral vegetation indices (VI) and the transpiration coefficient (Campos et al., 2010; Sánchez et al., 2010). Two approaches to plant transpiration estimation were analyzed, the basal crop coefficient methodology and the transpiration coefficient approach described in the FAO-56 (Allen et al., 1998) and FAO-66 (Steduto et al., 2012) manuals respectively. The model is computed at daily time step and the results analyzed in this work are the net irrigation water requirements and water stress estimates.
Analysis of results has been done by comparison with irrigation data (irrigation dates and volume applied) provided by farmers in 28 plots of wheat for the period 2004-2012 in the Spanish region of La Mancha, southern Spain, under different meteorological conditions. Total irrigation dose during the growing season varies from 200 mm to 700 mm. In some of plots soil moisture sensors data are available, which allowed the comparison with modeled soil moisture.
Net irrigation water requirements estimated by the proposed model shows a good agreement with data, having in account the efficiency of the different irrigation systems. Despite the irrigation doses are generally greater than irrigation water requirements, the crops could suffer water stress periods during the campaign, because real irrigation timing and amount does not respond to the modeled crop irrigation water requirement.
The results indicate that the proposed methodology is a valid method for the assessment of irrigation performance and could provide a powerful tool for irrigation recommendations. Further improvements should consider the analysis of irrigation systems efficiency and uniformity.

References

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