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Validation of reference crop evapotranspiration derived from geostationary satellite MSG using in situ data from Andalusia (Spain)

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Reference crop evapotranspiration (ETo) is essential for determining irrigation water requirements. The ETo estimations are usually obtained from weather station networks. However, in numerous countries the development of these networks has been very deficient; station maintenance and therefore data quality are often very low. In the present study we analyze instead ETo derived from solar radiation Rs using the new revised Makkink equation. Rs or Down-welling Surface Short-wave Radiation Flux (DSSF) is provided operationally by LandSAF from the geostationary satellite Meteosat Second Generation.

The main objective of this study was to validate the incoming solar radiation data provided by LandSAF and the reference crop evapotranspiration, using accurate ETo data provided by a quality controlled weather station network. Thus, it has been developed a procedure of calibration and validation in order to check the capability of the LandSAF products to provide accurate reference ETo values for wide areas. For this task a weather station network located in Andalusia (Southern Spain) called RIA, has been used.

The RIA is composed by 100 weather stations located in the main irrigated areas of Andalusia (Spain). This network provides daily data of the main meteorological variables (temperature, radiation, humidity and evapotranspiration using Penman Monteith equation). The data collected by these stations underwent further scrutiny. In situ solar radiation was compared with theoretical radiation (expected values) in clear sky conditions (adjusting the transmissibility for each weather station) and with other neighbouring stations. As a consequence of this quality check, 43 weather stations were removed, since the deviation between the respective observed values and theoretical estimation and/or those of closest stations suggests problems related with malfunctioning of some sensors or bad maintenance. Thus, after the validation of weather data process, 57 stations were included in the study, where the incoming solar radiation and ETo values provided by LandSAF and the new revised Makin equation were compared. The results analysed here correspond to the period 2007, 2008 and 2009.

The comparison results indicated that there were very good correlations between estimated radiation and measured (R2=0.94). Equally, the comparison between ETo estimated with the new revised Makkink formula and that measured by the RIA (using PMFAO) provided very good results: average results for the 57 weather stations provided a R2 of 0.91 and RMSE of 0.74 mm day-1. These suggest that the described methodology is able to provide accurate ETo values for wide areas and in a very efficient way.