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Medium resolution mapping of evapotranspiration at the catchment scale based on thermal infra-red MODIS data and ERA-INTERIM reanalysis over North Africa. Application to irrigation monitoring

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Accurate quantification of evapotranspiration (ET) at the watershed-scale remains an important research challenge for managing water resources in arid and semiarid watersheds. However, it is difficult to accurately quantify ET at the regional scale, especially in the southern parts of the Mediterranean region, owing to the heterogeneity of the land surface including, in particular, the hydric status of irrigated crops and due to the low density of measurement network. Surface temperature is tightly linked to land surface hydric conditions in semi-arid areas. In this study, a method to obtain daily ET at the kilometer scale by combining data from the MODIS sensor and ERA-INTERIM re-analysis with the two-source energy budget (TSEB) model is evaluated from 2001 to 2015 on the Tensift catchment (Marrakech, Morocco). The instantaneous ET compared well to in situ measurements carried out within the frame of 15 annual experiments covering the main crops of the region (wheat, olive orchard and citrus) with a correlation coefficient r=0.70 and a reasonable bias=30 W/m^2. Monthly evapotranspiration is then compared to monthly irrigation water amounts provided by the local office of irrigation water management with a reasonable agreement: the relative error is more than 89% but the correlation coefficient r reaches 0.8. Finally, evapotranspiration seasonal and inter-annual is analyzed in relation to climate variability as well as with agricultural practices in the watershed and potential to improve early prediction of grain yields is also discussed. The proposed method provides a relatively simple way of obtaining spatially distributed daily estimates of ET over watershed-scale where ground data availability is limited.