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Surface soil moisture data assimilation for irrigation amounts and timing estimation in semi-arid regions

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Irrigation is the largest consumer of water in the world, with more than 70% of the world's fresh water dedicated to agriculture. In this context, we developed and evaluated a new method to predict daily to seasonal irrigation timing and amounts at the field scale using surface soil moisture (SSM) data assimilated into a simple land surface model through a particle filter technique. The method is first tested using in situ SSM before using SSM products retrieved from Sentinel-1. Data collected on different wheat fields grown in Morocco, for both flood and drip irrigation techniques, are used to assess the performance of the proposed method. With in situ data, the results are good. Seasonal amounts are retrieved with R > 0.98, RMSE <42 mm and bias<2 mm. Likewise, a good agreement is observed at the daily scale for flood irrigation where more than 70% of the irrigation events are detected with a time difference from actual irrigation events shorter than 4 days, when assimilating SSM observation every 6 days to mimics Sentinel-1 revisit time. Over the drip irrigated fields, the statistical metrics are R = 0.70, RMSE =28.5 mm and bias= -0.24 mm for irrigation amounts cumulated over 15 days. The approach is then evaluated using SSM products derived from Sentinel-1 data; statistical metrics are R= 0.64, RMSE= 28.78 mm and bias = 1.99 mm for irrigation amounts cumulated over 15 days. In addition to irrigated fields, the applicationof the developed methodover rainfed fieldsdid not detect any irrigation. This study opens perspectives for the regional retrieval of irrigation amounts and timing at the field scale and for mapping irrigated/non irrigated areas.