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Interpolation approaches based on auxiliary data to extend climatic series in space and in time for water stress retrieval in central Tunisia

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Water scarcity and the inter annual variability of water resources in semi arid areas are limiting factors for agricultural production. Characterization of plant water use is needed to better manage water resources. Plant water use is generally determined by estimating evapotranspiration. Furthermore, water stress derived from remote sensing data in the thermal infrared domain is particularly interesting for monitoring agrosystem health and adjusting irrigation requirements in irrigation deficit agrosystems. Evapotranspiration and water stress must be monitored at subdaily to daily scales. Both are simulated by a two source energy balance model from climatic observation time series (Air temperature, relative air humidity, global radiation and wind speed) and satellite information (NDVI, LAI, albedo and surface temperature obtained from the TERRA and AQUA sensors of the MODIS satellite). However, the gauge network is sparse and the observation periods are short. We seek to extend the observation series in space and in time to simulate evapotranspiration while accounting for its spatial and temporal variability. To extend the series in time, we rely on ERA interim re analysis which is a global dataset and cover the period from 1979 till now. Its spatial resolution is low (about 75 km). Therefore, we use bias correction methods to account for the difference in spatial resolution and to produce series which mimic observations at the station (point) scale. As several climatic variables are needed for the energy balance model, we assess the added value of a multivariate bias correction approach that corrects simultaneously all the variables in order to preserve the inter variable dependence. We compare the extended series produced by the multivariate bias correction approach with an extended series produced by univariate bias correction approach (for which each climatic variable is corrected independently). This comparison is twofold. First, we compare the ability of both bias correction approaches to reproduce the climatic series in terms of intensity and inter variable dependence. Second, we evaluate how the energy balance is simulated when the model is forced by either projected series. To extend this series in space, we use simulations from a regional climate model (Weather Research and Forecasting model WRF). The grid resolution is 3km and covers the whole study area. Spatial interpolation is performed using the information on the spatial structure contained in the simulation. Our analyses are carried on in the Kairouan area in central Tunisia which is subject to semi arid climate. Climatic series are collected at three stations at half hourly time step. One is located upstream in a mountainous area (the observation period goes from October 2012 to December 2015). The second and the third are located in the Kairouan footplain (with an observation period ranging from December 2011 to December 2016 and from May 2012 to December 2015 respectively). The validation data is set to a quarter of the observation period (split sample analysis).