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Multi-criteria evaluation of the AquaCrop model in a Mediterranean rainfall context

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The spatial organization of crops at the landscape scale is a promising solution to be explored within Mediterranean hilly agrosystems, for agroecological transition and adaptation to climate change. In this perspective, it is necessary to ensure the capacity of crop models to simulate a range of agro-hydrological processes within these agrosystems. The objective of this study is to perform a multi-criteria assessment of the FAO AquaCrop model to simulate crop functioning for a diversity of plant and soil combinations, by considering several hydro-climatic years. This multi-criteria assessment includes canopy cover (CC), dry above-ground biomass (biomass), soil water content (SWC), actual evapotranspiration (ET_a) and runoff (non-infiltrated rain). The study area is the small rainfed watershed of Kamech located within the Lebna regional watershed, Cap Bon Peninsula, North-eastern Tunisia. The data, collected in the framework of the OMERE Observatory, are derived from ten measurement campaigns between 2001 and 2013 that focus on (1) predominant soils (Cambisols, Luvisols, Vertisols), and (2) representative crops of the region (wheat and barley as grain cereals, oats as fodder and faba bean as legume). Except ET_a, which simulations are quite poor (R^2 of 0.3, RMSE of 0.9 mm/d and NRMSE of 44%), AquaCrop correctly simulates the water transfer within the soil-plant continuum along with crop growth, for the ten aforementioned campaigns. First, CC is correctly simulated (R^2 of 0.6, RMSE of 3% and NRMSE of 9%), as is runoff (R^2 of 0.5 and RMSE of 0.7) mm. Second, SWC is well simulated (R^2 of 0.88, RMSE of 8.34 mm and NRMSE of 2.34%), as is above-ground dry matter (R^2 of 0.83, RMSE of 0.17 ton/ha and NRMSE of 5.9%). These results indicate that AquaCrop is relevant for characterizing the water use efficiency under the influence of intra-plot runoff.