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The evaluation of the climate change effects on maize and fennel cultivation by means of an hydrological physically based model: the case study of an irrigated district of southern Italy

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The effect of climate change on irrigated agricultural systems will be different from area to area depending on some factors as: (i) water availability, (ii) crop water demand (iii) soil hydrological behavior and (iv) irrigation management strategy.
The adaptation of irrigated crop systems to future climate change can be supported by physically based model which simulate the water and heat fluxes in the soil-vegetation-atmosphere system.
The aim of this work is to evaluate the effects of climate change on the heat and water balance of a maize-fennel rotation. This was applied to a on-demand irrigation district of Southern Italy ("Destra Sele", Campania Region, 22.645 ha).
Two climate scenarios were considered, current climate (1961-1990) and future climate (2021-2050), the latter constructed by applying statistical downscaling to GCMs scenarios.
For each climate scenario the soil moisture regime of the selected study area was calculated by means of a simulation model of the soil-water-atmosphere system (SWAP). Synthetic indicators of the soil water regimes (e.g., crop water stress index - CWSI, available water content) have been calculated and impacts evaluated taking into account the yield response functions to water availability of different cultivars. Different irrigation delivering strategies were also simulated.
The hydrological model SWAP was applied to the representative soils of the whole area (20 soil units) for which the soil hydraulic properties were derived by means of pedo-transfer function (HYPRES) tested and validated on the typical soils in the study area. Upper boundary conditions were derived from two climate scenarios, i.e. current and future. Unit gradient in soil water potential was set as lower boundary condition. Crop-specific input data and model parameters were derived from field experiments, in the same area, where the SWAP model was calibrated and validated.
The results obtained have shown a significant increase of CWSI in the future climate scenario, and some spatial patterns strongly influenced by the soils characteristics. Adaptability of different maize cultivars has been evaluated.
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