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The effect of measured and estimated soil hydraulic properties on simulated water regime in the analysis of grapevine adaptability to future climate

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In the last years many research works have been addressed to evaluate the impact of future climate on crop productivity and plant water use at different spatial scales (global, regional, field) by means of simulation models of agricultural crop systems. Most of these approaches use estimated soil hydraulic properties, through pedotransfer functions (PTF). This choice is related to soil data availability: soil data bases lack measured soil hydraulic properties, but generally they contain information that allow the application of PTF . Although the reliability of the predicted future climate scenarios cannot be immediately validated, we address to evaluate the effects of a simplification of the soil system by using PTF. Thus we compare simulations performed with measured soil hydraulic properties versus simulations carried out with estimated properties. The water regimes resulting from the two procedures are evaluated with respect to crop adaptability to future climate. In particular we will examine if the two procedures bring about different seasonal and spatial variations in the soil water regime patterns, and if these patterns influence adaptation options.
The present case study uses the agro-hydrological model SWAP (soil-water-atmosphere and plant) and studies future adaptability of grapevine. The study area is a viticultural area of Southern Italy (Valle Telesina, BN) devoted to the production of high quality wines (DOC and DOCG), and characterized by a complex geomorphology and pedology.
The future climate scenario (2021-2050) was constructed applying statistical downscaling techniques to GCMs scenarios. The moisture regime for 25 soils of the selected study area was calculated by means of SWAP model, using both measured and estimated soil hydraulic properties. In the simulation, the upper boundary conditions were derived from the regional climate scenarios. Unit gradient in soil water potential was set as lower boundary condition. Crop-specific input data and model parameters were estimated on the basis of scientific literature and assumed to be generically representative of the species.
From the output of the simulation runs, the relative evapotranspiration deficit (or Crop Water Stress Index – CWSI) of the soil units was calculated. Since CWSI is considered an important indicator of the qualitative grapevine responses, its pattern in both simulation procedures has been evaluated.
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