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Spatial interpolation of soil physical properties for irrigation planning. A simulation study in northern Italy

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Abstract

To calculate water balances at a regional scale, a frequently adopted approach (choropleth mapping) consists of using soil profile observations to identify `homogeneous areas', to which simulation models are applied. However, spatial variability of soil properties within `homogeneous areas' is a potential source of error, if the relationship between model inputs and model outputs is not linear. The aim of this work is to assess the feasibility of using spatially variable soil information for providing more detailed inputs to simulation models and to evaluate its effects on calculated irrigation water requirements. Point observations of soil properties in the topsoil layer were collected in a plain area near Milano (northern Italy). Particle size distribution was determined on 154 samples. The cropping systems simulation model CROPSYST was applied at the study area by using four different sets of soil input data: the first one was derived from the soil map (1 datum per soil mapping unit), the other three were obtained by the use of geostatistical procedures applied to point observations (several data per soil mapping unit). The results of CROPSYST's multi-year simulation for grain-maize were used to calculate the amount of grain biomass produced, actual crop evapotranspiration (ET), irrigation water needed and soil water drainage (SWD) for each soil unit (SU), their standard deviation (S.D.) in time and their S.D. in space within each SU. A clear spatial structure could be identified for all georeferenced model inputs and for model outputs related to crop growth (yield, ET). Simulated values for grain yield (GY), actual ET, irrigation water applied (IWA) and SWD were very similar for choropleth mapping and for geostatistics-based procedures. The S.D. in time was low for variables related to crop growth and was increasing for IWA and SWD. For all simulated variables the S.D. in space was always very low. In general, the spatial variability of model results was much lower than the spatial variability of model inputs: this smoothing effect was due to the application of kriging, pedotransfer functions (PTF) and simulation modeling. These results suggest that for evaluating water management scenarios at this scale, when hydrological properties are not measured, georeferenced soil data are available only for topsoil, and variability of soil particle distribution within SUs is not too high, the choropleth mapping method can be successfully used.

Author Keywords: Geostatistics; Water balance models; Spatial interpolation techniques; Irrigation planning; Cropping systems simulation models; Regional scale model application; CROPSYST; Calculate first interpolate later; Interpolate first calculate later

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