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Simulation of Soil Water Content Variability in a Heavy Clay Soil under Contrasting Soil Managements

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Soil water content (SWC) is a key variable for numerous physical, chemical and biological processes that take place at or near the soil surface. Understanding the spatial and temporal variability of SWC at the field scale is of prime importance for implementing efficient measurement strategies in applications.

The aim of this study was to characterize the spatial and temporal variation of gravimetric SWC in a heavy clay soil, in a wheat-sunflower-legume rotation under conventional (CT) and no-till (NT) using a simple water balance model.

An experimental field in SW Spain, where conventional (CT) and no-till (NT) management of a heavy clay soil are being compared since 1983, was sampled for gravimetric SWC on 38 occasions during 2008 and 2009. Topsoil clay content across the six plots was on average 55%, with a standard deviation of 2.7%. The soil profile was sampled at 54 locations, evenly distributed over the three CT and NT plots, at depths of 0-10, 25-35, and 55-65 cm. Topsoil water retention curves (SWRC) were determined in the laboratory on undisturbed soil samples from each of the 54 locations. A weather station recorded daily precipitation and evapotranspiration, as calculated by the Penman-Monteith FAO equation.

The water balance was calculated using the Thornthwaite-Mather model with a daily time step. Three parameters, water holding capacity, and water evaporation corrector coefficients for each of the two years, were inversely estimated at the 54 SWC observation points and probability density functions were identified. Spatial variability of SWC was estimated using a Monte Carlo approach, and simulated and observed variability were compared.

This Monte Carlo scheme, using a simple water balance model with only three parameters, was found to be useful for evaluating the influence of soil management on the variability of SWC in heavy clay soils.