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Application and evaluation of the SWAP model for prediction of salinization in a cracking clay soil

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Decreasing amount of available water resources coupled with an increasing salinity of irrigation water is a significant factor affecting many arid and semi-arid regions of the world, leading to salinization and land degradation.

Bypass flow of water and solutes, occurring in cracking soils when water application rate exceeds the saturated hydraulic conductivity of soil matrix (k_{sat}), may affect not only water transport, but also the processes of salinization and salt-leaching.

In Sicily, the increasing scarcity of good quality waters is spreading irrigation with saline waters on soils having a high shrink-swell potential and susceptibility to cracking and to bypass flow. Previous investigations have shown that salinization may be the consequence of using these irrigation waters in clay soils.

Simulation models have been developed that can be used to evaluate the consequences of different management strategies on crop yield and salt distribution in the soil profile. However, most of these models are formulated to predict water flow and solute transport in homogeneous soils. In addition, accuracy of predicted variables by comparison with field measured values, which should be preliminary to applications finalised to simulate management scenario or to make long-term predictions, is generally lacking or limited to a small number of investigations.

In this paper, water flow and solute transport in some Sicilian cracking profiles irrigated with saline water was simulated by using the SWAP93 model. Accuracy of the predicted electrical conductivity of the saturated extract (EC_{sat}) was evaluated by calibrating the model with reference to the dispersivity (L_{dis}), the value of which may influence prediction of EC_{sat}.

The results obtained for the four profiles of the considered clay soil, having a swelling/shrinking potential ranging from medium to high, showed SWAP93 provided a satisfactory prediction of both θ and EC_{sat} .Further investigation is under way to validate SWAP93 for additional soil profiles located in the same irrigated field and to develop management options accounting for cracking and bypass flow.