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Comparison of SWAP and IDRAGRA models in Simulating Water Fluxes in an Agro-Ecosystem of Maize

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Modeling water dynamics in the Soil-Plant-Atmosphere (SPA) continuum is an important aspect of crop water management and water transfer through the unsaturated zone is a key hydrological process connecting atmosphere, surface water and groundwater . Many simulation models of water dynamics in the SPA and or/ soil crop system have already been developed (e.g. Feddes et al., 1979; Dierckx et al., 1988; Saxton et al., 1986; Gardner, 1991; Mc Gechan et al., 1997). (. In spite of the large number of existing hydrological models, there are two main approaches used for the mathematical representation of water flow in the unsaturated zone: numerical solutions of the Richards' equation and reservoir cascade schemes. Unfortunately, the physically based agro-hydrological models using numerical solutions of Richards' equations, although more reliable, cannot often be used because of the high number of required variables and the complex, computational analysis. Therefore, the use of simplified agro-hydrological models may represent a useful and simple tool to simulate water fluxes in the SPA. A physically based approach model SWAP (Van Dam et al., 1997) and a conceptual model IDRAGRA (Gandolfi et al., 2011) were selected to evaluate their performance in simulating water balance components such as soil water content (SWC) in the root zone and actual evapotranspiration (ETact). The models were selected on the basis of several criteria chosen by the authors and particularly because IDRAGRA is a novel model that has been developed recently in the Engineering Department of the University of Milan. It was intended to compare it to a more standardize widely used model (SWAP). For detailed analysis and understanding of the different components on field scale, data on various agronomic aspects required for IDRAGRA and SWAP were collected during 2011 growing season of spring-summer maize in two representative sites of the field (PMI-1 and PMI-5). SWAP showed a good performance in estimating ETact and SWC in the root zone in the two sites. Similarly, IDRAGRA showed good fitting with measured data. The root mean square error (RMSE) range of ETact was 0. 9 mm for IDRAGRA and 0.8-1 mm for SWAP. While for SWC the RMSE was 3-5% for both models. This led us to conclude that a simpler model like IDRAGRA can provide comparable performances to a more complex model, like SWAP, and could therefore be a good tool for estimating water balance components for practical applications, especially for irrigation management.

Keywords: Modeling, Water balance; Soil-Plant-Atmosphere (SPA) continuum; soil water content; actual evapotranspiration; comparison, reservoir model, Physically based model.