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Identification of active root zone by data assimilation techniques: monitoring and modelling of irrigation experiments

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The identification of active root distribution and the quantification of relevant water fluxes (root water uptake-RWU) are key elements in understanding the exchanges of mass and energy in soil-plant-atmosphere systems. In this contribution we present the assimilation of 3D time-lapse Electrical Resistivity Tomography (ERT) data, acquired around an orange tree during irrigation experiments, in a soil-plant model that accounts for soil moisture dynamics and root water uptake (RWU), whole plant transpiration, and leaf-level photosynthesis. The model is based on a numerical solution to the 3D Richards equation modified to account for a 3D RWU, trunk xylem, and stomatal conductances. The data assimilation procedure, assisted also by independent information concerning the soil properties, aims specifically at identifying the distribution and strength of active roots modelled as sinks in the unsaturated flow model. In addition the flow model is enhanced by a forward electrical current model in order to predict the electrical response measured by ERT in dependence of the soil water content distribution. Strengths and weaknesses of the proposed approach are discussed.