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Comparing different approaches for modelling root water uptake

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Root water uptake is a dynamic and non-linear process, which interacts with the soil natural variability and boundary conditions to generate heterogeneous spatial distributions of soil water. Soil-root fluxes are spatially variable due to heterogeneous gradients and hydraulic connections between soil and roots. In practical applications however, often very few information is available on the description of the root structure or on the soil variability and 1-D effective representation of the root water uptake is applied to predict transpiration, based on average water content profiles. In this study we investigate the effect of these small scale processes on the root water uptake under water stress conditions. A reference scenario was defined and run with a 3-D numerical model which considers the complete root structure and soil heterogeneity parameterization to predict plant water uptake based on water potential gradient. Alternative classical modelling approaches (1-D sink term approach, 2-D effective model, moving-sink approach) were subsequently used to predict the root water uptake under the same boundary conditions. Comparison between models demonstrates the tremendous effect of the underlying model hypotheses for predicting subscale processes in the prediction of effective root water uptake profiles.