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Deriving effective 1D root water uptake parameters from a 3D detailed model

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Despite their lack of physical bases, most effective 1-D approaches for modeling root water uptake perform relatively well when calibrated on a short period. On the other hand, detailed 3-D models with bio-physical meaning may suffer of over-parameterization and their predictive capabilities are not yet proven.

We used R-SWMS, a deterministic detailed 3-D model to simulate several uptake scenarios with plants characterized by different hydraulic properties. We subsequently tried to parametrize an effective 1-D model based on these thee-dimensional simulations. In particular, we aimed at characterizing an effective compensation factor and a stress function, given a perfect knowledge of soil hydraulic properties and boundary conditions. It is shown that compensation is always generated by the 3-D model, even when soil water is still available, in particular when soil has low conductivity or roots have large radial conductance.