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Root water uptake uncertainty: implications for modeling and observation strategy

A.J. Teuling (1), R. Uijlenhoet (1), F. Hupet (2), E.E. van Loon (3), and P.A. Troch (4)

(1) Hydrology and Quantitative Water Management Group, Wageningen University, Wageningen, The Netherlands, (2) Department of Environmental Sciences and Land Use Planning, Universite Catholique de Louvain, Louvain-la-Neuve, Belgium, (3) Institute for Biodiversity and Ecosystem Dynamics, University of Amsterdam, Amsterdam, The Netherlands, (4) Department of Hydrology and Water Resources, The University of Arizona, Tucson, Arizona, USA

Experiments have shown that plants can compensate for water stress in the upper, more densely rooted, soil layers by increasing the water uptake from deeper layers. By adapting root water uptake to water availability, plants are able to extend the period of unstressed transpiration. This strategy conflicts with the approach in many land surface schemes, where plant water uptake is treated as a static process. Here we derive analytical expressions for the typical drydown trajectories of evapotranspiration and soil moisture for both strategies. We show that the maximum difference in evapotranspiration between the two strategies during drydown can exceed 50%. This in turn leads to a difference in root zone soil moisture of up to 25%. A closely related problem is how the overall root water uptake relates to soil moisture in the near surface layer. This is a relevant issue since many forecast applications have to rely on information of (near)-surface soil moisture that is available from either in situ or remotely sensed observations. We investigate the sensitivity of the relation between root water uptake and (near) surface soil moisture for different root water uptake strategies with a 1-D Richards' equation based model.