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The role of hysteresis in modeling root water uptake, both for single root and root system models.

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The water retention curve obtained by progressive extraction of water from an initially saturated soil (desorption) differs from that obtained by gradual addition of water to air-dry soil (absorption). This phenomenon is called hysteresis (Koorevaar et al., 1983). Common as its occurrence is, it is often neglected in the modeling of root water uptake.

We will present here a model for the transport of water to a single root. The model solves Richard's equation in cylindrical coordinates where the water uptake rate is a function of the root water potential. The occurrence of hysteresis is accounted for by application of the modified dependent domain model developed by Mualem (1984) and used by Kool and Parker (1987). We will discuss the differences in results due to the inclusion of the hysteresis subroutine, when alternate wetting and drying cycles occur. The influence of soil type and transpiration reduction function will be discussed.

The findings obtained for the single root model were used to upscale root water uptake to a root system. This is a part of the FUSSIM2 model of Heinen and de Willigen (1998) and Heinen (2001), where water transport in a soil profile is calculated. We will use an example for a soil profile where the root length density decreases exponentially with depth, and where again wetting and drying cycles alternate.

References

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