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Hydraulic resistances and root geometry parameters in plant transpiration analysis

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Three approximate mesoscopic solutions of soil water flow towards roots: (1) finite difference approximation, (2) steady-state solution, and (3) steady-rate solution, were examined from the point of view of their ability to predict the pressure head variations in the vicinity of roots. The individual solutions were then alternatively used to determine the macroscopic soil hydraulic resistance between bulk soil and root surface. In the next step, macroscopic simulations of coupled soil water flow and root water uptake at a forest site under humid temperate climate were performed. The predicted soil water pressure heads and actual transpiration rates were compared with observed data. The simulation results illustrate uncertainties associated with the estimation of root geometric and hydraulic properties. Regarding the prediction of actual transpiration, the correct characterization of active root system geometry and its hydraulic properties seems far more important than the choice of a particular macroscopic soil hydraulic resistance formula.