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Influence of root length density on vertical water uptake profiles.

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Surface vegetation atmosphere transfer (SVAT) schemes calculate the water, energy and momentum flux between surface and the lower atmosphere. A great deal of the vapour flux between surface and the atmosphere is contributed by plant transpiration. SVAT schemes therefore contain parameterizations that allow for calculation of transpiration based on atmospheric demand and water availability in the soil. Most SVAT schemes model at least two or more soil layers, in order to allow for differential drying and representation of soil water flow. This also requires distribution of the transpirational flux among the soil layers. In most models this is achieved by multiplying the relative root abundance with a plant dependent soil moisture stress function (like the ones proposed by Feddes or van Genuchten) that are based on observations on whole plants.

We investigate the relationship between root density and root water uptake based on a model for water flow towards a single root, which is embedded into a plot scale bulk soil model. Using this model we track changes of soil moisture and modelled uptake during a drying period. We find that root density influences those parameters that define the water stress function, namely the critical point where soil moisture becomes limiting for water uptake, and the slope of the reduction function. Based on the results, we can construct a reduction function for the entire plant based on modelled daily transpiration and average soil moisture. However, the same reduction function does not equally apply to the individual soil layers. In other words, uptake from individual layers might be misrepresented, when calculating water uptake profiles based on a

single reduction function, for example obtained from observation on entire plants.