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Using measured soil water contents to extract information on summer evapotranspiration and root water uptake patterns

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Understanding the role of plants for soil water relations, and thus for ecosystem functioning, requires information about root water uptake. The most common root water uptake modeling methods rely on root distribution parameters. However, the accurate measurement of these parameters is tedious and it is not clear in how far they relate at all to root water uptake patterns. Here, we investigate (1) whether common soil water measurements contains sufficient information to estimate evapotranspiration and root water uptake patterns without the a priori assumption of root distribution parameters and (2) which data-driven methods are applicable with a sufficient precision. For this, we apply four different intricate data-driven models on numerical simulations for a grassland ecosystem. Using a Richards soil water flow model we produced a synthetic time series of water contents, which we sampled to derive root water uptake.

We analysed the model quality for different temporal resolutions and periods with wet and dry climate.

Our study reveals that the higher the time resolution of measurements and the higher the model intricacy the more precise are model results regarding evapotranspiration and root water uptake profiles. Models with a higher intricacy, like a numerical soil water flow model used in inverse mode, are applicable for wet and dry climate conditions. In contrast to this, less intricate models, such as water balance methods, can only be used for dry climate conditions. These results demonstrate the potential of using highly resolved soil water measurements for estimating evapotranspiration as well as root water uptake patterns without the a priori assumption of root distribution parameters.