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Can we estimate landscape-scale transpiration patterns from commonly available distributed data sets?

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Quantifying transpiration in landscapes remains a challenging task. Transpiration is usually measured at the tree scale or within the footprint of a flux tower. Landscape patterns of transpiration on the other hand are commonly estimated with hydrological models using simplified concepts such as the Feddes relationship which relates root water uptake to water availability. Bridging the gap between tree- or plot-scale measurements and information at the landscape scale which could be gathered from remote sensing, digital elevation models (DEMs) or forest inventories still poses considerable problems.

In this study we attempt to capture spatiotemporal patterns of transpiration and their controls at the landscape scale by first empirically analyzing a data set of sap flow measurements on 61 trees. We assess the main factors influencing measured sap flow patterns using multiple linear regression models at daily time steps. Results highlight the importance of tree-specific characteristics, but also some characteristics related to the stand structure and the location within the landscape are important for explaining spatial variation in transpiration. As this data set is exceptional and not readily available in other catchments we explore in a second step if it is possible to predict or reproduce these measured patterns by using statistical models based on commonly available distributed data sets such as DEMs and forest inventories.

The comparison of both approaches can help to bridge measurement scales and to assess the minimum need for in situ measurements to describe landscape-scale transpiration.