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The link between sap velocity, transpiration and the NDVI in space and time

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The Normalized Difference Vegetation Index (NDVI) is the most well-known and easy to derive metric to quantify vegetation vigour and greenness. Many studies use the satellite-derived NDVI to predict water fluxes, or scale water fluxes from in-situ measurements to the catchment level. In this study we investigated the link between in-situ measured tree transpiration and satellite derived NDVI in a temperate deciduous forest catchment in Luxembourg. We did so by combining sap velocity measurements with 30 meter resolution NDVI derived from Landsat. Using these data we had the opportunity to study small scale variability in sap velocity and NDVI, where other studies often used NDVI data with a spatial resolution of 250 m or 1 km. Our results show that the correlation between sap velocity and NDVI was positive in April, during the phase of vegetation green-up. After green-up, a significant negative correlation was found during half of the studied days, while no correlation was found for the other days. During a transient dry period, sap velocity was uncorrelated to NDVI. However, spatial variability in sap velocity was influenced by geology and aspect. In summary, the correlation between sap velocity and NDVI was not constant throughout the year. This time-variable correlation would also translate into an inconsistent correlation between tree transpiration and NDVI, when scaling up from sap velocity to whole tree transpiration. Therefore we conclude that, in our study area, the NDVI is not a good predictor of spatial variability in in-situ measured tree transpiration. We suggest that methods using the NDVI to predict or scale (evapo)transpiration should be limited to ecosystems and scales where the correlation was confirmed.