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Using in situ bark microrelief observations to explain intra- and interspecies variability of stemflow in a temperate beech-oak forest

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Stemflow generation and its temporal dynamics differ significantly between and within tree species. Besides micrometeorological influences, much variability in stemflow production can be ascribed to canopy structural properties. Those properties may be related to branch architecture, leaf hydrophobicity, or bark surface microstructure. Although structural properties are often qualitatively related to stemflow variability, few studies actually quantify them. This study quantifies and relates various bark microstructure metrics to the generation and inter-storm dynamics of stemflow from Fagus sylvatica L. (European beach) and Quercus robur L. (penduculate oak) trees in a temperate forest in Germany. Using a novel technique (LaserBark automated tree measurement system) the bark microrelief of monitored trees was measured at a high accuracy (0.01 mm vertical resolution and 0.1 degree radial resolution) and used to calculate bark metrics, such as the (1) spatial patterning of bark textures (microrelief), (2) peak-to-furrow amplitude (a measure of roughness), and (3) slope between peaks and furrows (another measure of roughness). Clear relationships between stemflow and bark microstructure (both microrelief and roughness) metrics can be seen during a monitoring period between 2012-2013. A significant enhancement of beech stemflow compared to oak due to the also significantly different bark peak-to-furrow amplitude and slope is clearly detectable. Regression analyses also show significant correlations ($p < 0.01$) between bark roughness and whole tree normative bark water storage capacity (BWSC). These results present a straight-forward method to quantify bark microstructural properties, use these to evaluate bark water storage capacities which can explain both intra- and interspecies stemflow variability.