Geophysical Research Abstracts
Vol. 20, EGU2018-13208, 2018
EGU General Assembly 2018

The challenge of measuring sap flow on trees in sloped terrain

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Sap flow measurements are used to estimate tree transpiration and, using suitable upscaling procedures, can also provide information about catchment-scale evapotranspiration. However, landscape properties at the tree locations such as slope or aspect can influence sap flow measurements considerably, depending on the respective methodology. For instance, trees growing on sloped terrain usually form reaction wood for stabilization. However, most measurement protocols suggest to install the sensors on the side of the stem facing away from sun exposure to avoid artifacts from stem heating. In trees on slopes this means the measurement might be located in reaction wood and little is known about the effects of these different wood properties on the measurement.
We conducted an experiment on Beech trees in Luxemburg, located in a valley with the slopes facing north and south direction. We installed 12 sap flow sensors based on the heat ratio method in 6 trees on the south-facing slope, on both the north-facing and south-facing side of the stem and took measurements for two weeks. Afterwards we switched to 6 trees on the north-facing slope and repeated the measurements. We also took wood samples at the sensor locations to get an idea about the wood properties and their dependence on the sensor position, and to relate them to the sap velocities we measured.
First results showed no influence of the sensor location on sap velocities, neither for the south-facing nor the north-facing phase of the experiment. Hence, whether or not the sensor is measuring in reaction wood might not have the anticipated strong effect. The next step is to determine wood characteristics such as pore distributions from microscopic images of the wood samples and relate them to sap velocity.