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Changes in temperature and stem water content evoke erroneous sap flux density estimates with Thermal Dissipation Probes

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Thermal Dissipation Probes are very popular in sap flow research worldwide because of their simplicity and low costs. However, literature reports large underestimations for this method. We conducted a field experiment on American sycamore (*Platanus occidentalis* L.) and combined it with lab experiments where (i) stem segments were dehydrated and (ii) temperature dynamics were simulated. We found a fluctuating dT during zero sap flow after leaf fall and dedicated this effect to dynamics in temperature difference between stem and air, caused by the thermal mass of the stem. This temperature difference is negative during the day and positive during the night. A part of the heat supplied by the upper needle dissipates to the air. When the surplus in gradient between needle and air compared to the gradient between needle and stem is larger, an increasing portion of applied heat will dissipate to the air and *vice versa*. As a consequence, the underestimated nocturnal dT combined with an overestimation of dT during the day results in an underestimated sap flux density, which might be a major issue in mature trees with large diameters. We propose a correction by means of a relationship between the deviation in dT and the temperature difference between stem and air during a period of zero sap flux. We also found that an additional error is caused by dynamics in stem water content. Changing water content in xylem and living tissues alters heat dissipation because of a modified conductivity for dissipation to the wood on the one hand and a modified insulating capacity for dissipation to the air on the other. The results of the dehydration experiment showed a decreasing dT with increasing water content and this corresponded with observations in the field as maximum dT was lower after a rain event caused by hydration of the wood tissue.