Using potential evapotranspiration to determine nighttime sap flow rate for Granier’s method

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INTRO:
Nighttime sap flow may remain undetected when using heat-based systems requiring a zero flow calibration, such as the Granier’s thermal dissipation technique. Since sap flux density is related to evapotranspiration, thermal dissipation probes (TDP) readings and micrometeorological data during daylight hours can be combined to predict the true temperature difference between a heated and an unheated probe when sap flow is zero ($\Delta T_{\text{max}}$).

METHODS:
The proposed method makes use of optimization techniques and a restatement of Granier’s original formula, implemented into a MatLab® user-friendly computer program.

The software requires air temperature, relative humidity, solar radiation, wind speed, $\Delta T$ time series, the maximum $\Delta T$ peak at nighttime ($\Delta T_{\text{night}}$), and the parameters for the Penman-Monteith approach.

RESULTS:
1. Software snapshots showing examples of $\Delta T_{\text{max}}$ determinations.

2. Potential evapotranspiration and tree transpiration for a selected period.


CONCLUSIONS:
The proposed method was shown to be useful for computing $\Delta T_{\text{max}}$, using Granier’s thermal dissipation technique, without the restriction of zero nighttime sap flux density. It has the potential of being applied not only to Granier’s principle, but to other heat-based sap flow systems which require a zero flow calibration, such as the Čermák et al. (1973) heat balance method and the T-max heat pulse system of Gent et al. (2003).


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