Plant-atmosphere interactions in frost prevention

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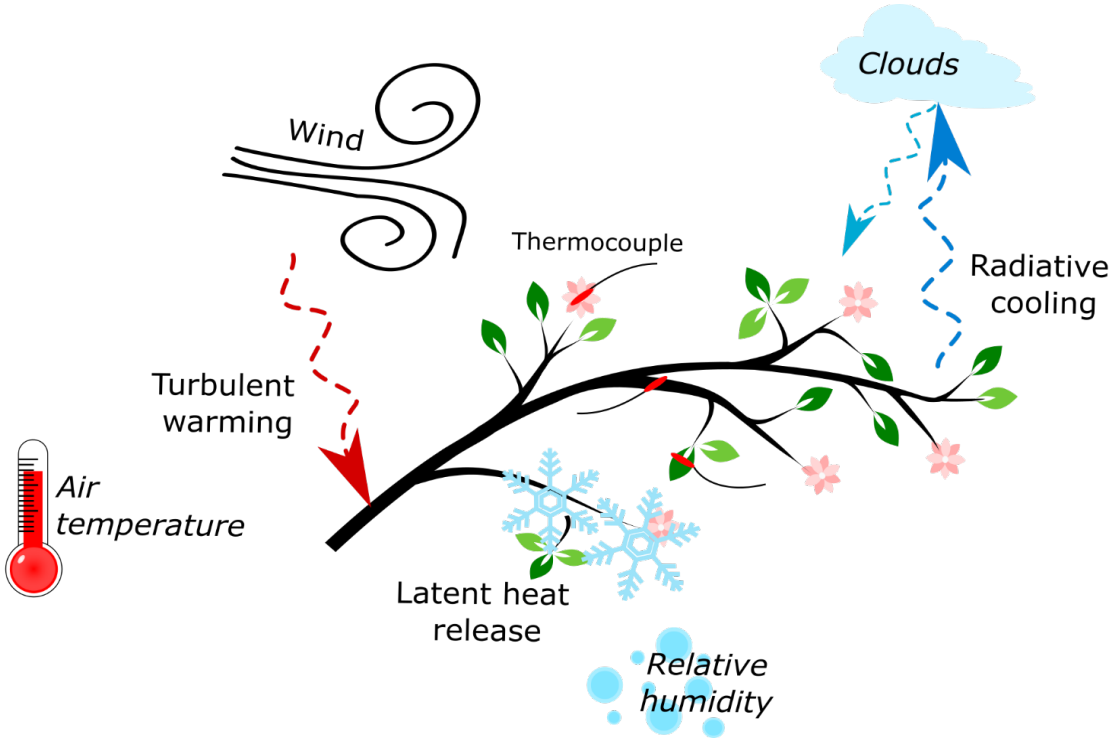
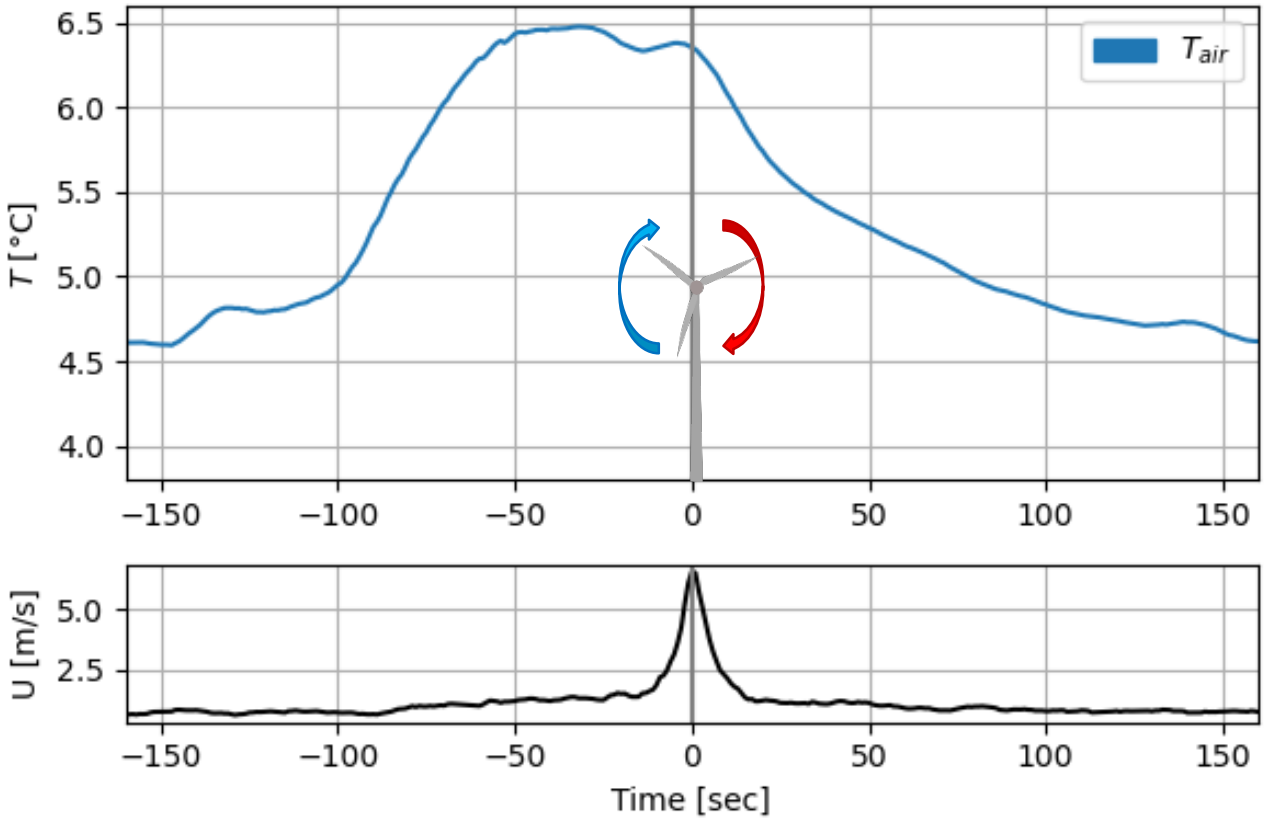
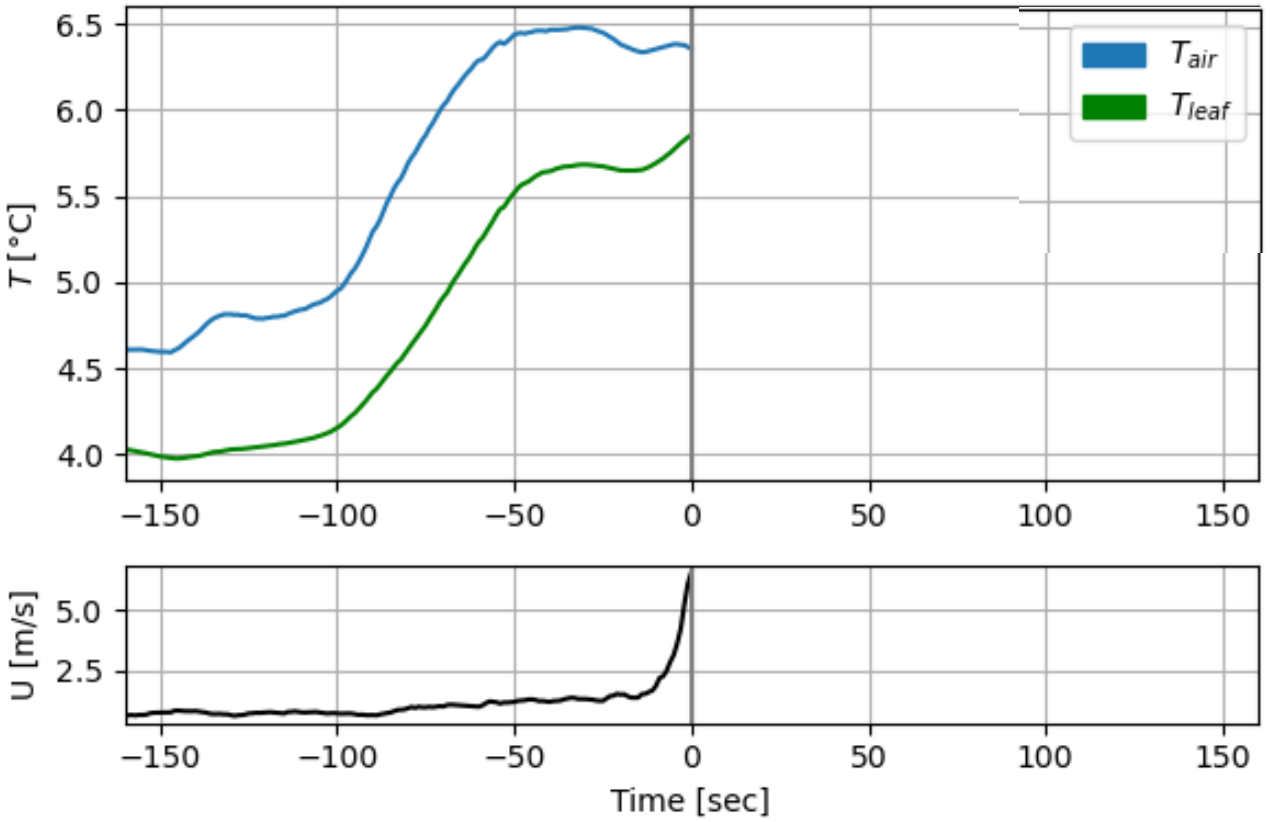
How does the *plant* temperature vary during a rotation cycle of the wind machine?

Thermocouple observations: flower, leaf, branch, air

Model: leaf energy balance

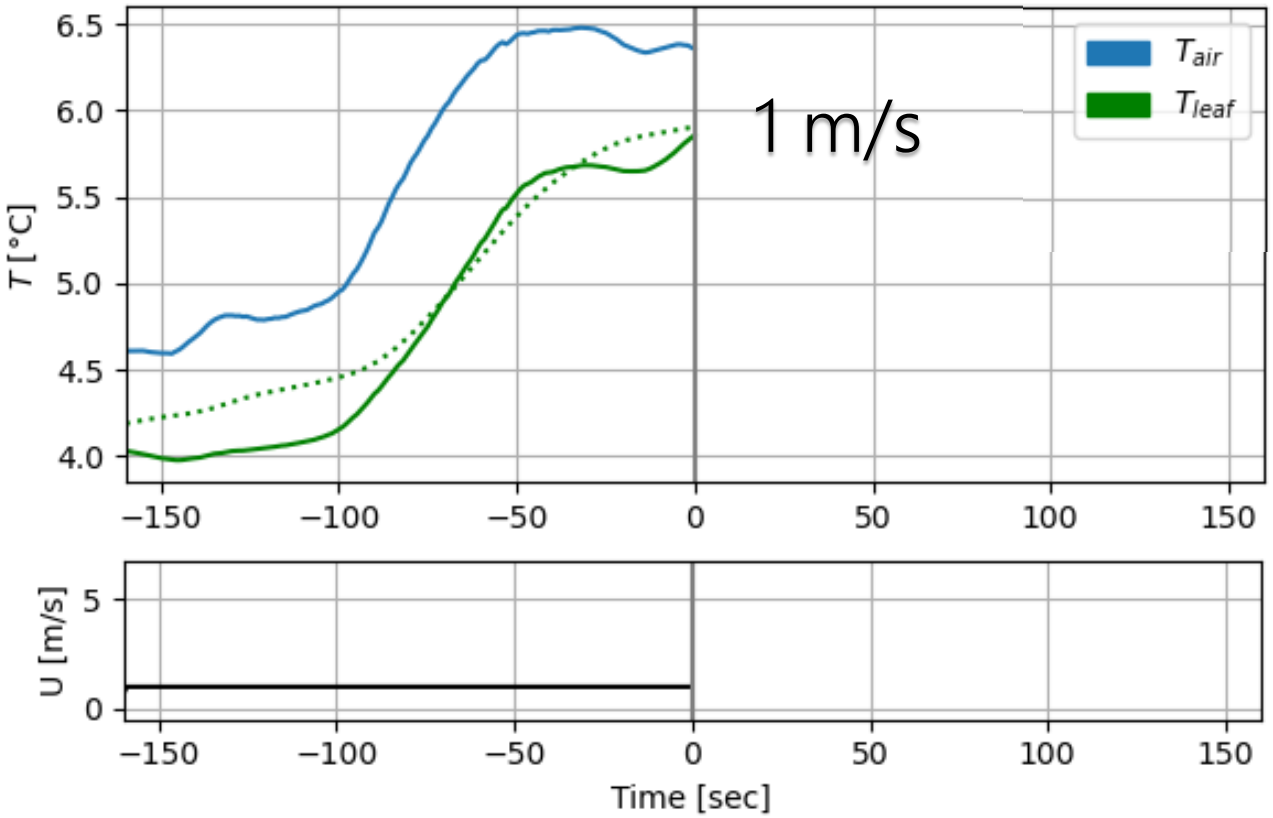



6.5
6.0
5.5
5.0
4.5
4.0
T [°C]
T_{air}
−150
−100
−50
0
50
100
150
5.0
2.5
U [m/s]
Time [sec]



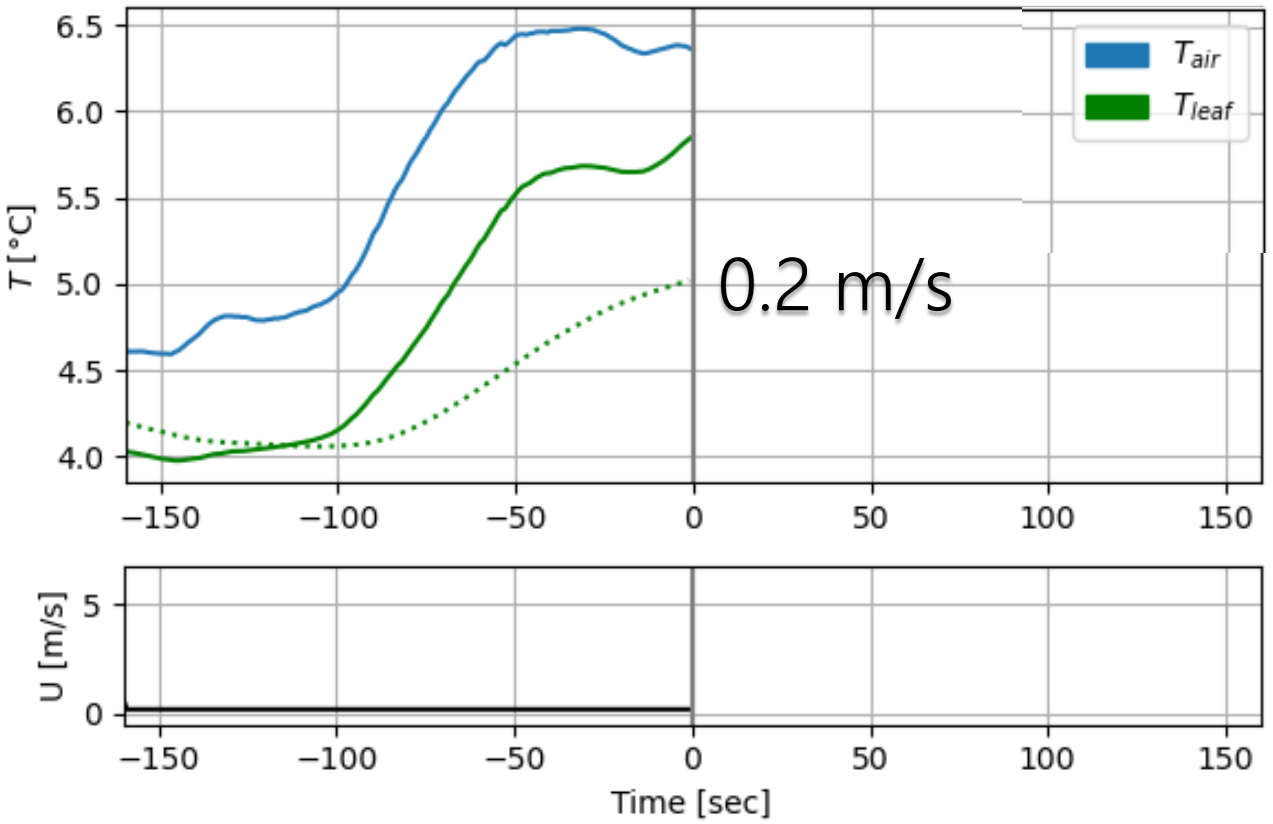
$$H = f(T_{air} - T_{plant}, U)$$

T_{air} rises: Turbulent warming



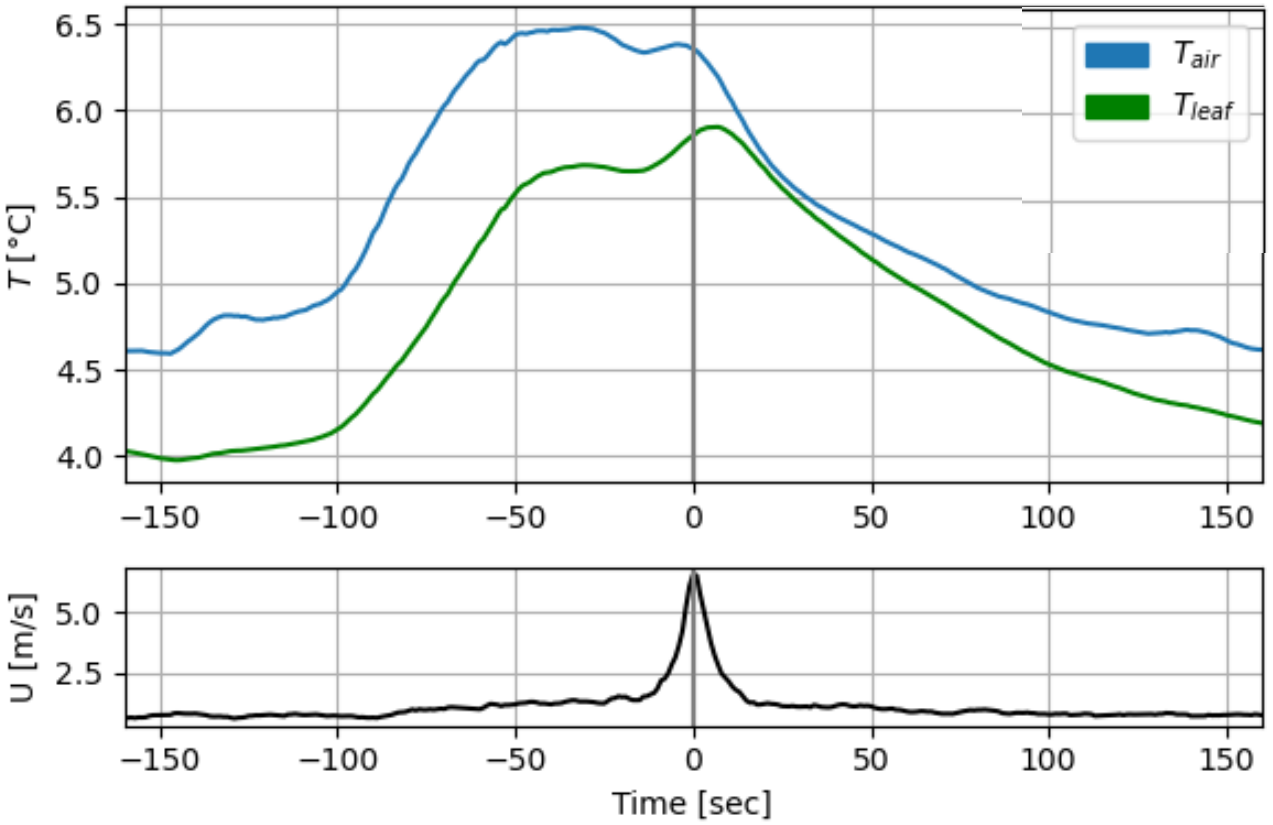
$$H = f(T_{air} - T_{plant}, U)$$

T_{air} rises: Turbulent warming



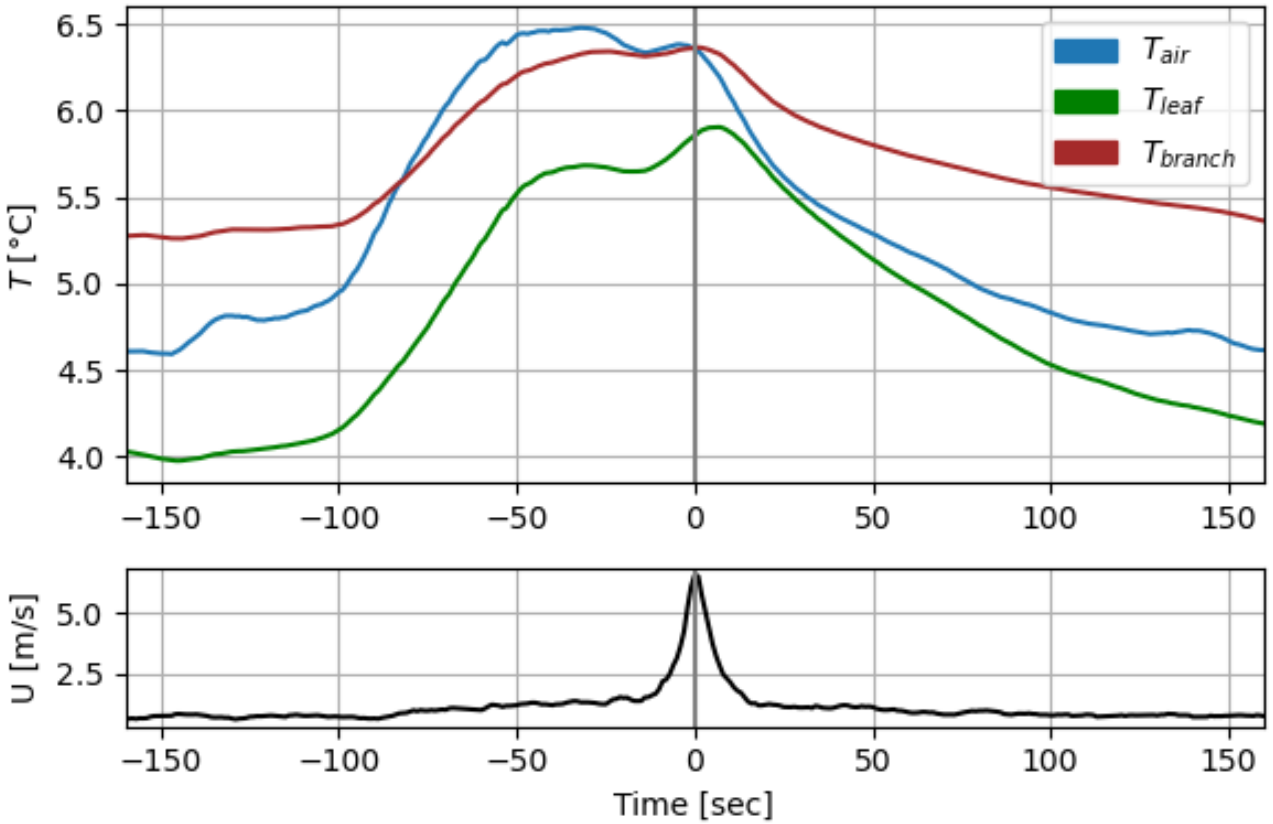
$$H = f(T_{air} - T_{plant}, U)$$

T_{air} rises: Turbulent warming



$$R = f(T_{plant})$$

T_{air} decreases: radiative cooling



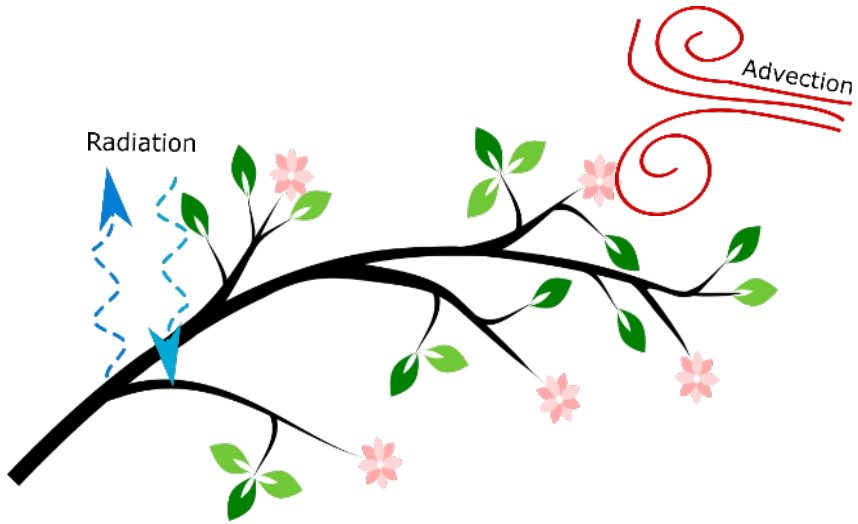
Branches have higher heat capacity:

damped signal

Take home message

Rotation cycle: turbulent warming followed by radiative cooling

A slight change in wind (< 1 m/s) can cause a ~ 1 ^{0}C difference in leaf temperature.



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