Using Distributed Temperature Sensing to get a better insight in heat fluxes and energy exchange in complex ecosystems

Schilperoort, Bart., Water Resources Section, Delft University of Technology, Stevinweg 1, Delft, the Netherlands; +31 6 49892460; b.schilperoort@tudelft.nl

With the increase in accuracy and resolution of distributed temperature sensing (DTS) machines, the possibility to use DTS for atmospheric sciences has opened up. Using DTS, the temperature of a fibre optic (FO) cable can be measured at a spatial resolution down to 0.30 m, for lengths up to 1.5 km, at a frequency of 1Hz. By using different FO cables in different configurations, different processes can be studied.

If the FO cable is placed vertically (along a flux tower), a high resolution vertical air temperature profile can be measured. By wrapping one stretch of the cable in cloth and wetting it, an estimate for the wet bulb temperature is available, which can be used to calculate the vapor pressure. This means that the vertical air temperature and vapor pressure profiles can be obtained above, through, and below the canopy. On our measurement site (a Douglas Fir forest) this shows thermal stratification below canopy, including the formation of a stable atmospheric layer during the day.

As the measurement frequency is high, the flux-variance method (and other schemes) can be applied to estimate the sensible heat flux using only the FO cable temperature data. By suspending the cable horizontally, the spatial heterogeneity of the sensible heat flux can be measured, to expand on the point measurements done using flux towers.

Lastly, by using the hot-wire anemometer principle, spatial estimates of the wind speed can be made, in a vertical profile, a horizontal profile or even in 2d or 3d setups.