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Studying atmospheric stability and decoupling in a dense pine forest with long term DTS measurements

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With Distributed Temperature Sensing (DTS) high resolution air temperature profiles can be measured with high accuracy at 1 minute resolution. By placing an armoured fibre optic cable vertically a temperature profile with a spatial resolution of 35 cm is measured. This vertical temperature profile can be used to analyse atmospheric stability and the possibility of decoupling of the below-canopy and above-canopy atmospheric layers, which can influence transport of water vapour and trace gasses, and the measurement of fluxes above the canopy.

In a dense patch of Douglas Fir in the 'Speulderbos' forest near Garderen, the Netherlands, we measured the vertical temperature profile along a flux tower. Above the canopy the boundary layer stability followed the expected pattern (stable during night-time, unstable during daytime). However, under the canopy the stability did not follow this pattern (or the inverse of it). During daytime sunlight mainly hit the canopy and barely reaches the forest floor (due to the low elevation at the sun at 52°N), while the canopy is open enough for the forest floor to radiate out a lot of heat during the day. In this study we analyse the high resolution vertical profile over multiple seasons, and discuss what effects this decoupling might have on the transport of water vapour and other gasses, what effect it can have on flux measurements, and how DTS can be used to get a better understanding of the system.