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Coupling of above and below-canopy flows for three towers in a spruce ecosystem site located on a hill

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The coupling of the wind direction below and above the canopy was compared for three towers installed at the Wetzstein site, in Thuringia, Germany. The site is a spruce ecosystem located on a hill and was chosen to be part of the CARBO-EUROPE-IP advection experiment, ADVEX, carried out between April and June, 2006. Additional towers (equipped with 3D sonic anemometers in several levels) were set-up around the main tower, as well as one at approximately 900 m distance, at a slope, in the main wind direction. For this work data measured at the main, at the slope, and at one of the four additional towers were used.

Wind directions between the lowest level below the canopy and the highest level above the vegetation were compared. The lowest level was located around 1/10 of the canopy height h for all the three towers; the highest level was located at approximately 1.4h for the towers at the hill top and at 1.3h for the slope tower.

Coupling for several classes of friction velocity $u*$ and atmospheric stratifications was compared. Preliminary results show that for the towers located at the top of the hill, on a plateau with a small slope, the coupling between the levels is best for a range of moderate values of $u*$ (0.3 – 0.5 ms^{-1}); the slope tower is still highly affected by decoupling for the same range of $u*$, due to the drainage of cold air during stable conditions. Decoupling was also observed in all towers for high values of $u*$, with different patterns for the towers at the plateau. Given that the coupling between levels is important for the validity of both, CO_2 eddy fluxes and storage correction, these results suggest that at the Wetzstein site extremely turbulent situations should be removed and gap filled when calculating annual sums of CO_2.