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Low-frequency coherent motions within the spruce canopy on the upwind vs. downwind side of a forested ridge

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Airflow and turbulence within and above the forest canopy determine the forest – atmosphere exchange of atmospheric constituents and pollutants. Our investigation is related to the existence of large-scale intermittent coherent structures, which have been detected in turbulence time series measured at the Experimental Ecological Study Site Bílý Kříž (800-900 m a.s.l.) in the Czech Republic. The site is situated on a steep (13°) SSW-faced slope near the top of a mountain ridge forested by a young Norway spruce plantation. Flow directions across the ridge (along the slope) strongly prevail at the site. Results based on a recent study reveal significant differences between the cases when the site is on the upwind vs. downwind side of the ridge. Typical downwind cases are characterized by a low wind speed above the canopy and by relatively higher friction velocity than in the upwind cases. This is explained by the flow retardation by the upslope-directed hydrodynamic pressure gradient and by the large wind shear in the upper part of the wake behind the ridge top.

This contribution concentrates on the vertical coherency of the turbulent flow within the forest canopy. Analysed variables include the high-frequency wind velocity components and sonic temperature measured during periods of neutral thermal stratification at two different levels. Wavelet analysis was used for detection of characteristic temporal scale of coherent structures, their persistence and effectivity parameter. Special attention is paid to the differences between the upwind and downwind cases.

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