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Wind shear, sensible heat flux and atmospheric stability within a forest canopy

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The scientific project "ROSALIA", carried out in co-operation between ZAMG and the Austrian Federal Research and Training Centre for Forests, Natural Hazards, and Landscape, investigated the meteorological impacts on pollen emission and spread in a typical Central European forest of mixed deciduous and coniferous trees. The study area is the "Lehrforst Rosalia" of BOKU University approx. 60 km south of the city of Vienna in undulating terrain (300 – 750 m altitude). In this area, two meteorological towers of similar construction, one at crest height, the other in the small valley of the river "Ofenbach" near a meteorological ground station, have been equipped with 3D ultrasonic anemometers: one has been placed on top of the upper tower to representatively measure the gradient flow; the tower in the valley has been equipped with 3 instruments, one at the lowermost platform near ground, the second in the middle of the forest canopy, the third on top of the tower situated within the transition zone between the canopy and the "free" boundary layer where the gradient winds dominate. The sonic anemometers measure the three-dimensional wind vector; in addition, the sound velocity is derived, from which the so-called "sonic temperature" is calculated to derive the sensible heat flux. Other quantities are the means, standard deviations, and covariances of the wind components and the momentum flux, the Monin-Obukhov stability parameter, and the friction velocity.

In the sloping dense forest canopy surrounding the tower, complex meteorological conditions and frequent decoupling of above-canopy and within-canopy flow has to be expected. The presence of a thick leaf canopy results in a stronger decoupling between the flow above and inside the canopy. As the investigation period covers April and May 2009, this gives the opportunity to discern between leaf-off (at the beginning) and leaf-on periods, with a proposed increase in decoupling with time. The aim of the study is to derive characteristic patterns of wind and atmospheric stability within the forest canopy for leaf-off and leaf-on periods as well as for days of intense versus negligible pollen production.