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# Influence of tall vegetation canopy on turbulence kinetic energy budget in the stable boundary layer

Karmen Babić (1,2) and Mathias W. Rotach (3)

(1) University of Zagreb, Faculty of Science, Department of Geophysics, Zagreb, Croatia (babick@gfz.hr), (2) Karlsruhe Institute of Technology (KIT), Karlsruhe, Germany, (3) Institute of Atmospheric and Cryospheric Sciences, University of Innsbruck, Innsbruck, Austria

While a considerable amount of research has been done on turbulence kinetic energy (TKE) budget studies in the surface layer over horizontally homogeneous and flat (HHF) surfaces, little research focused on budgets above heterogeneous and rough surfaces. Only few studies have investigated TKE budgets above fetch-limited forest focusing on statically neutral conditions, while studies in the stable boundary layer (SBL) are still scarce in the literature. Therefore, we present turbulence characteristics above tall, deciduous forest in the wintertime SBL and make a comparison with a well-known results of HHF terrain. Turbulence measurements performed at five levels above the canopy height (approximately $h = 18$ m) allowed the investigation of combined influence of the roughness sublayer (RSL) found above tall vegetation and the internal boundary layer (IBL) on the TKE budget terms. Each term of the TKE budget is investigated within the framework of local similarity theory. Kolomogorov's similarity hypothesis assumes local isotropy within the inertial subrange. Testing the local isotropy hypothesis more thoroughly resulted in a ratio of the horizontal spectral densities ($S_v/S_u$) approaching the $4/3$, while the ratio of the vertical to the longitudinal spectral density ($S_w/S_u$) was less than 1 for all levels indicating an anisotropic turbulence above the canopy. As a consequence, estimated values of TKE dissipation rate ($\varepsilon$) for the vertical component ($\varepsilon_w$) were smaller (underestimated) compared to the $\varepsilon$ estimates obtained from the horizontal velocity components. This finding has a direct influence on the applicability of classical Kansas spectral models valid for HHF terrain as well as on the budget of wind variances. Additionally, the dimensionless wind shear function associated with "Kolmogorov turbulence" (existence of a well-defined inertial subrange with $-5/3$ slopes) was found to depart from linear prediction suggesting that the stability is a stronger determinant of its behavior than the inertial subrange is. Finally, the local equilibrium between the production and destruction of TKE within the RSL and transition layer is analyzed.