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Determination of the correction function for the roughness sublayer for application of the aerodynamic method at a tall vegetation site

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The diel variability as well as the magnitude and direction of the aerodynamic gradient fluxes of reactive (NO-NO_2-O_3) and nonreactive (CO_2 and H_2O) trace gases were investigated on a 32 m flux measurement tower above a spruce forest canopy at the "Weidenbrunnen" research site (Fichtelgebirge, Germany). The measurements were done within the framework of the EGER project. Eddy covariance measurements were made at the top of the 32 m tower while the gradients for the aerodynamic flux calculations were derived from the mixing ratios of the trace gases at the 31.5 m and 25 m levels of a trace gas profile measurement system on the tower. The measurements were within the roughness sublayer, where the measured gradients are often underestimated and an enhancement factor has to be applied to correct for the error associated with measuring in the roughness sublayer. Therefore the profile and eddy covariance measurement data, measured at several heights within the roughness sublayer, were used to calculate φ_* values for each half hour. The resulting φ_* values were merged with φ_* values calculated from profile and eddy covariance measurements above a cornfield (COPS experiment). Furthermore, an equation was fitted and found to work best for $\varphi_* = \frac{z}{z_*}^{\eta}$, which was found to depend on the associated u_* values and is valid for $u_* > 0.2$ m/s with $\eta = 0.6$. In this process, each half hour gradient flux calculated from the aerodynamic gradient method was corrected for the roughness sublayer effect by applying the respective φ_* factor for that half hour period.