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Estimation of PBL model parameters from high resolution vegetation scans

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The spatial patterns of turbulent fluxes over forests are dominated by inhomogeneities like step changes in stand height and forest clearings. A major limitation in the application of turbulence closure models to plant canopies is the parameterization of plant architecture. Terrestrial laser scanning is a fast developing tool and appears to be an efficient method to record 3D models of the vegetation. Using the measured wind profiles this study aims to validate and develop estimates of parameters like mixing length, displacement height and roughness length from the plant area density profile.
Since May 2008 intensive measurements take place around a forest clearing („Wildacker“, Tharandter Wald, N 50°57’49", E 13°34’01") associated with this task. In total 25 measurement points, at 4 towers (heights: 40m, 40m, 40m, 30m) including five at ground level position (2 m), are used to record the turbulent flow at the same time.
The forest stands around the clearing (500 m x 60 m) were scanned applying a terrestrial laser scanner. Thereby scans from different ground positions and from the top of the main tower (height: 40m) were done. The scans were filtered and combined to a single 3D representation of the stands. The detection of trees was done automatically and mean tree distances were calculated. The 3D point cloud of a selected tree group was transformed into a 3D voxel space. The normalised point density of each voxel represents the plant area density. Then, the spatial arrangement of points inside the voxel can be used to derive a parameterization for the drag coefficients. Simultaneously, the drag coefficients are calculated from turbulence measurements at the positions of anemometers. Finally the dependency can be investigated between drag coefficients, plant area density and plant area distribution with respect to stability and wind speed.