Flow distortion at a dense forest edge

The flow near tall forest edges is complex, yet poorly described. A field experiment using two meteorological masts equipped with sonic anemometers and a horizontally staring lidar was performed upwind and downwind of the interface between an open flat farmland and a tall (hc = 24 m) beech forest. Data obtained during near-neutral conditions are presented for the wind direction towards the forest. Results from a high leaf area index period are compared with those from a low leaf area index period. For both periods, the wind speed increased above the forest and decreased within the forest, relative to the measurements upwind of the edge. The lidar data taken at several positions between the masts at 1.25hc show that the minimum wind speed occurred just upwind of the edge. At the 1.25hc level, at the forest mast, the momentum flux increased strongly over the forest and positive values were recorded during the high leaf area index period. A spectral analysis revealed that approximately half of this change was caused by low-frequency, positively correlated eddies along the streamline. The remaining increase can qualitatively be explained with the concept of eddy-blocking by the canopy top, which could also explain the observed increase in lateral variance and the decrease in the vertical variance. Despite the short distance to the edge of approximately 1.5hc, the beginning of a new internal boundary layer was visible at 1.04hc as a decrease in the vertical momentum flux. At this level, as well as within the forest, the results depended on the wind speed. The presented findings enhance the understanding of the forest edge flow and are useful for model verification and development.