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Flow distortion at a dense forest edge

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Results from a forest edge experiment with two masts and one horizontally pointed wind lidar are presented. The experiment was performed at a dense beech forest edge of the Tromnæs forest. This forest is a 24m tall mature beech forest on the island Falster, Denmark. The topography at the site is flat. The masts were placed approximately 1.5 canopy heights upwind and downwind of the edge and are two canopy heights tall. We present data showing how the forest edge distorts the flow when the flow is perpendicular to the edge and towards the forest during near-neutral atmospheric stratification. Despite that the wind gradient above the canopy is similar before and after the edge, the momentum flux is strongly reduced above the canopy. This is contrary to the results by standard Reynolds' averaged Navier Stokes models that predict an overshoot of the momentum flux. We explore theoretical frameworks that can explain this reduction of the momentum flux as well as the change of other terms in the covariance matrix. Another noteworthy result from the analysis was that the porosity of the canopy is wind-speed dependent. As a result, several aspects of the wind field at the edge depend on the mean wind speed.

The results are relevant for understanding the on-set and growth of the internal boundary layer of forested areas.