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Parameterisation of roughness effects of scattered forests for mesoscale modelling of the wind climate

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Arithmetical averaging of surface roughness seems to strongly underestimate the momentum flux over highly inhomogeneous surfaces. This is of particular importance for high-resolution mesoscale modelling of the wind climate. In particular, model-predicted wind speeds can be too high over surfaces with partial tree or forest cover.

New land-cover data with 30-100 meters horizontal resolution allows us to estimate partial forest cover at much greater accuracy than before. However, these databases still underestimate the effects of tree or forest patches with horizontal extensions smaller than 50% of this horizontal resolution.

New studies suggest that the influence of partial tree cover is much greater than previously thought. Indeed, surface roughness seems to increase approximately linear with tree cover up to a forested fraction of roughly 50%. Above that, surface roughness seems to stay approximately constant at the value usually assigned for completely forested areas.

In practice, however, surface roughness also depends on the location of the forest patches within a model grid cell (spread out forest patches should have a larger effect than coherent forest patches), on the location of the forest patches with respect to the subgrid-scale terrain within a model grid cell (forest in valleys should have a smaller effect than forest on hill tops), on the frequency distribution of tree heights within a model grid cell etc.

A comparison of mesoscale model simulations of the wind climate is carried out for the whole of the United Kingdom. Mesoscale model results are validated against measurements from 56 sites with anemometer heights of mostly 50 m above ground.

Agreement is indeed slightly improved when woodland from the UK Land Cover Map 2000 is taken into account using a simplified “forested fraction - surface roughness” approach.