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# 3D-Modelling of the destructive effects of windstorms on spatially complex forests

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Windstorms are a major disturbance factor in forests in Central Europe. The extent to which damage is caused to forests by windstorms depends on wind speed, forest structure (like tree height, LAI, gaps, clearings), topography and soil properties. The central modelled parameter for damage on forests by wind is the Turbulent Kinetic Energy (TKE) inherent in gusts, as mainly the gusts lead to tree stem-breaking or uprooting. Up to now it was supposed that patterns of TKE in forests do not change with wind speed, an assumption only based on 2D-comparisons, and therefore wind storms were modelled only with comparatively low wind speeds.
3D-simulations are advantageous to 2D-simulations as soon as changes in forest structure or topography occur in more than one horizontal direction and are therefore appropriate to spatially complex forests. For a 3D-simulation of windstorm Kyrill in January 2007 we used 87 m s-1 as a geostrophic wind speed in 3km height, resulting in 36 m s-1 at 10m height (comparable to measured maximum wind speeds in South-West-Germany). As a second geostrophic wind speed for the wind speed comparison a value of 10 m s-1 was taken, resulting in 5.5 m s-1 at 10m height. The two wind speeds were applied to a series of 3D situations of growing complexity with different combinations of forest structure and topography. The range spanned from plane quasi-2D (no change in the direction lateral to the wind direction) to complex topography with unevenly spread forest cover.
Our results show that patterns of TKE are already slightly different for the quasi-2D situations; for all 3D situations the patterns are distinctly different. We therefore see no possible upscaling method between patterns and values of TKE at low wind speeds to those at storm wind speeds. Following these results the destructive effects of wind storms on spatially variable forests on flat and on hilly terrain can only be modelled accurately with a combination of 3D-modells and storm-like wind speeds.