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Turbulent regime of the atmospheric surface layer at a small clear-cutting forest area: results of a modelling study.

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A three-dimensional boundary-layer atmospheric model SCADIS (Sogachev et al. 2002, 2005) was applied to describe the turbulent regime of the atmospheric surface layer within and around a small clear-cutting area at an experimental forest site in Solling mountains in Central Germany. The objectives of this study were: (1) to describe the spatial heterogeneity of the wind fields and turbulent kinetic energies within and around the clear-cutting area as function of both speed and directions of the geostrophic wind, (2) to quantify the changes in the turbulent regime of the atmospheric surface layer after clear cutting, and (3) to try estimating the risk of windthrows caused by clear cutting of forests. The importance of the last objectives was amplified by a windthrow at the north-eastern boundary of the study site in spring of 2004.

The applied SCADIS model is based on the Reynolds equations for turbulent flow, obtained by well known transformations of the Navier-Stokes equations. It is uses the two equation closure' approach (E–ω closure) and does not require a predefined value of mixing length. SCADIS was validated using results of continuous measurements of wind speeds and wind directions (at 2 m above ground) in 7 points located within and around the clear-cutting area, and this revealed adequate agreement of modelled and measured parameters.

Analysis of modelling results made for geostrophic wind of different speeds and di-

rections showed a very strong spatial heterogeneity of turbulent parameters within the small clear-cutting area. The risk of windthrow is maximal at the windward forest boundary. It can, however, be reduced by optimisation of the dimensions of clear-cutting area, its position and orientation in relation to dominating wind direction. This study was supported by the DFG (Grant Gr 738/16-1).