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Effects of Gap Size on Wind Damage Factors and on radiative Regime in a Boreal Forest Ecosystem.

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Recent studies of interactions between boreal forest ecosystems and changing climate reveal different vegetation responses and feedback mechanisms (Masek, 2001). One of the important effects of present as well as forecasted changing climatic conditions is the increased frequency of severe storms (Leckebusch et al., 2007) like Lothar in 1999 and Kyrill in 2007. The storms result in wide area damage events within forest ecosystems. Once a windthrow/clear cut gap occurs, it results in changes of microclimatological conditions and in increasing wind stress on remaining trees around the gap and in changes of surface albedo in particular. The self-induced growth of windthrow gap provides other positive as well as negative feedbacks to climate forcing at different spatial and temporal scales as shown in Vygodskaya et al., 2007, e.g. an increase of CO_2 efflux and an increase of surface albedo. This study characterizes the spatial variation of integral wind loading consisting of static and dynamic (gust) components and changes in radiative regime within the disturbed area, as a function of forest gap size. To describe the wind load the atmospheric boundary-layer two-equation closure model SCADIS based on transport equations for turbulent kinetic energy (E) and specific dissipation (ω) (E–ω model), which accounts for the flow dynamics within a plant canopy (Sogachev and Panferov, 2006) was used. To describe the radiative regime a three-dimensional radiation transfer model SPM3D (Panferov et al., 2005) was implemented. A series of numerical experiments with gap sizes from 3 to 75 tree heights, h,

have been carried out for a modelled boreal forest. To evaluate the changes produced by gaps relatively to undisturbed forest all characteristics were normalized by their values for the latter. The results of the modelling study show that the magnitude of integral wind load reaches its maximum at gap size of 20 tree heights, h, and remains almost constant for larger gaps, while the radiation characteristics continue to change significantly. The study has definitely show, however, that the spatial distribution of wind load and of short-wave radiation, depends strongly on the gap size and on mutual distribution of gaps within the modelled domain.

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