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Projected dynamics of abiotic risks in boreal forest ecosystems (SRES A1B, B1)

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The ongoing climate change causes an increasing frequency of weather extremes (Leckebusch et al., 2008), which can result in wide area damage events (drought, windthrows/breaks) within boreal forest ecosystem. The damage effects, however, depend not only on the strength of a driving force itself (e.g. wind speed) but also on combinations of effecting agents and forest structure. Thus, the present study investigates the projected future developments of abiotic risks in different boreal forests during the 21st Century under conditions of SRES scenarios A1B and B1. Climate scenario data of coupled ECHAM5-MPIOM were downscaled by the regional climate model (CLM) to the spatial resolution of 0.2° x 0.2°, using daily time- steps. With these input data the small-scale modelling with coupled process based sub-models (Jansen et al., 2008) was carried out e.g. for Solling region, (Germany) calculating the water and energy balance of forest ecosystems with modified BROOK 90 (Ahrends et al., 2009) and wind loading on trees with 3D ABL model SCADIS (Panferov and Sogachev, 2008). Norway spruce and Scots pine of various ages were chosen as typical tree species for boreal forest ecosystems and cambisols, podzolic cambisols and stagnosols as typical soil types. The risks of drought and windthrow/breaks for a certain forest stand result from daily combinations of soil water characteristics, static and gust wind loads and soil texture. Damaged stands show higher vulnerability and thus - positive feedback to climate forcing (Vygodskaya et al., 2008). Therefore differences of microclimatological conditions in the remaining stand after changes in forest structure (Radler et al, 2008) were taken into account. Modell output was aggregated to 30-years periods and compared to “present conditions” of 1981-2010. The results show an increment of drought risks towards 2100 caused by changes in precipitation pattern and increase of mean air temperature, whereas the A1B scenario is characterized by higher probability of drought than B1. The risks of windthrow change rather weakly in both scenarios, although there is a strong increase of windbreak risks towards 2100 under the conditions of B1.
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