Appendix A. Description of the used regional climate model simulations

Tables A1 and A2

Table A1
Main information on the used combinations of global and regional climate models.

	Global Climate Model		Regional Climate Model		
1	CM5A-MR	Institut Pierre-Simon Laplace, France (IPSL)	RCA4	Swedish Meteorological and Hydrological Institute, Rossby Centre, Sweden (SMHI)	Strandberg et al., 2014
2	CNRM-CM5	Météo-France / Centre National de Recherches Météorologiques, Franceű (CNRM)	RCA4	Swedish Meteorological and Hydrological Institute, Rossby Centre, Sweden (SMHI)	Strandberg et al., 2014
3	EC-EARTH	Irish Centre for High-End Computing (ICHEC)	HIRHAM5	Danish Meteorological Institute, Denmark (DMI)	Christensen et al., 2007
4	EC-EARTH	Irish Centre for High-End Computing (ICHEC)	RACMO22E	Royal Netherlands Meteorological Institute, De Bilt, The Netherlands (KNMI)	van Meijgaard et al., 2008
5	EC-EARTH	Irish Centre for High-End Computing (ICHEC)	RCA4	Swedish Meteorological and Hydrological Institute, Rossby Centre, Sweden (SMHI)	Strandberg et al., 2014
6	MOHC-HADGEM2-ES	Met Office Hadley Centre, United Kingdom (MOHC)	RCA4	Swedish Meteorological and Hydrological Institute, Rossby Centre, Sweden (SMHI)	Strandberg et al., 2014
7	MPI-ESM-LR	Max Planck Institute for Meteorology, Germany (MPI)	RCA4	Swedish Meteorological and Hydrological Institute, Rossby Centre, Sweden (SMHI)	Strandberg et al.,2014

Table A2
Projected changes of temperature and precipitation in the growing season (April-September) for 2030–2060 and 2071–2100 based on seven models and two RCP scenarios compared to the period 1971–2000.

	Expected changes for 2031–2060				Expected changes for 2071–2100			
Model	Temperature (IV-IX) [°C]		Precipitation (IV-IX) [%]		Temperature (IV-IX) [°C]		Precipitation (IV-IX) [%]	
RCP	RCP4.5	RCP8.5	RCP4.5	RCP8.5	RCP4.5	RCP8.5	RCP4.5	RCP8.5
1	2.2	2.7	−5.5	3.4	3.1	5.2	−10.4	−9.2
2	1.4	1.6	−13.6	2.4	2.3	3.9	−8.0	−6.8
3	2.1	2.2	1.1	11.2	2.1	3.9	20.8	20.2
4	1.4	1.9	11.6	9.8	2.2	3.9	12.2	5.4
5	2.0	2.6	−10.5	−3.4	2.8	4.8	−1.3	−11.9
6	2.3	3.0	−7.5	−9.1	3.3	5.3	−8.8	−16.9
7	1.9	2.3	−5.6	6.7	2.4	4.5	−9.8	−7.7

Appendix B. Main carbon pools simulated under disturbed and undisturbed forest development under reference climate

Disturbed development of carbon in living compartments is compared with three values taken from the forest management plans. A good match of simulated and observed values indicates proper implementation of the disturbance episode. The disturbance episode caused substantial differences in simulated C pools compared to the undisturbed simulations (Fig. B1).

Living – carbon amount in stems, branches, foliage, coarse and fine roots
Dead wood – carbon in downed woody debris (stems, branches and coarse root)
Soil – carbon in soil organic matter
Snags 1 – carbon in standing dead wood (stems)
Snags 2 – carbon in branches and coarse root of standing dead trees
Litter – carbon in litter (foliage and fine roots)

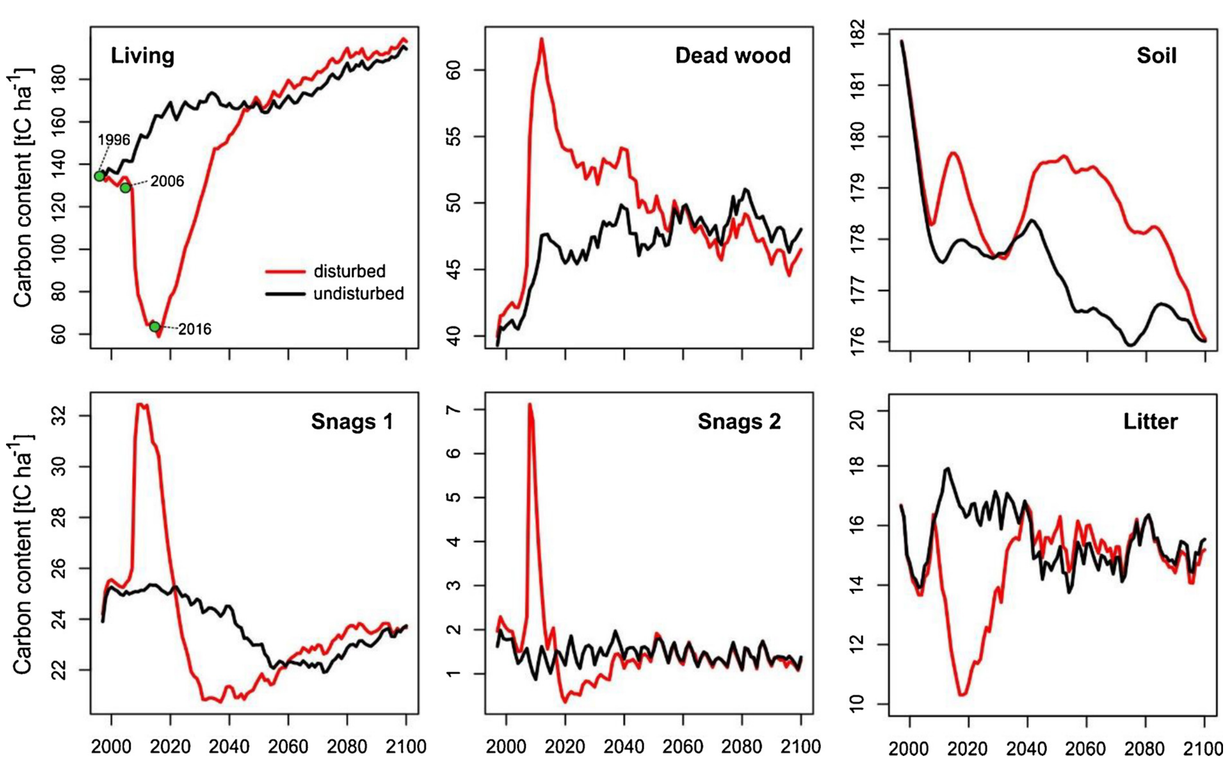

Fig. B1. Simulated development of main carbon pools under disturbed and undisturbed forest development. Green dots show C level of living compartments based on the forest management plans for years 1996, 2006 and 2016.

Appendix C. Vegetation dynamics

The carbon dynamics described in the main text is the result of detailed and interactive processes of vegetation dynamics, such as regeneration, competition, growth, mortality, etc. Therefore, we here present complementary information on two particular aspects of the post-disturbance vegetation dynamics, the development of species composition as indicated by species-specific basal area, and the species-specific natural mortality of

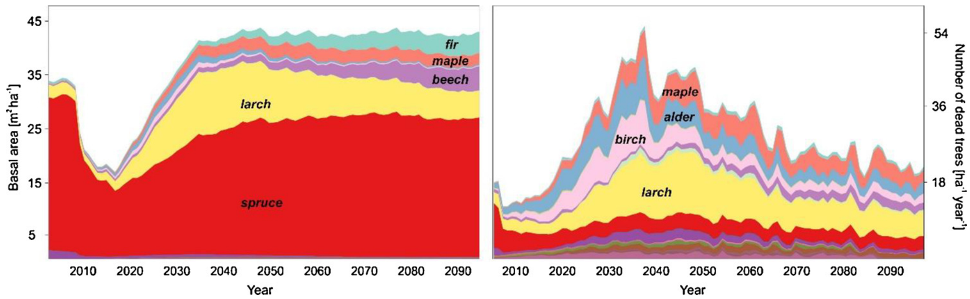

Fig. C1. Tree species composition during the simulation period indicated by species-specific basal area, and natural tree mortality indicated by the number of dead trees per hectare per species.

trees. The latter process includes mortality caused by stress and chance events (as opposed to mortality by disturbances or management), and is simulated combining the probabilistic approach of gap models with process-oriented carbon balance approach (for more details see Seidl et al., 2012a). The results are reported here for trees with a height of > 4 m.

Forest development was simulated under the currently applied management in the region, which includes intensive planting of desired tree species after disturbance. Therefore, natural post-disturbance succession was superimposed with a management signal in our study. The initial dominance of Norway spruce (*Picea abies*) decreased by 40% as a result of the studied disturbance episode (Fig. C1). The reduced canopy closure particularly favoured light demanding European larch (*Larix decidua*), which appeared in natural regeneration and was planted at suitable sites as one of the target tree species in the region. Silver fir (*Abies alba*) and European beech (*Fagus sylvatica*) were not actively planted after the disturbance episode, and (along with maple, *Acer pseudoplatanus*) increased their shares only gradually after 2050. Pioneer species such as birch and alder increased after the disturbance, but their relative share remained low due to the effect of management. In general, the simulated development mimics the managed post-disturbance development frequently observed in central European mountain forests.

Natural tree mortality substantially increased ca two decades after the disturbance event, which is mainly related to intensified competition during this stage of stand development (stem exclusion stage). Mortality peaked in 2039 (22 years after the end of disturbance periods), which was also the year in which mean basal area reached its post-disturbance maximum (42 m^2). For light-demanding larch mortality increased with increasing basal area. Mortality of other pioneers like birch (*Betula* sp.) and alder (*Alnus glutinosa*) started to increase earlier than mortality of the remaining species, though the peak mortality was reached 18–28 years after the end of disturbance period. Because the recovery period fell within the first decades of the 21st century, in which climate change was not yet very severe, species composition simulated under climate change differed only marginally from reference climate simulations until 2050 (data not shown).

Appendix D. Supplementary data

Supplementary material related to this article can be found, in the online version, at doi:https://doi.org/10.1016/j.agrformet.2018.08.028.