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Projected decrease in wintertime bearing capacity on different forest and soil types in Finland under a warming climate

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Table S1. The calibrated parameter values with standard deviations at 10 and 20 cm depths as averaged over all the validation stations (excluding the peat stations having no soil temperature observations from these depth) after the first calibration round.

Parameter	Calibrated values with standard deviations	
	10 cm depth	20 cm depth
Soil thermal conductivity, K_T (W m^{-1} K^{-1})	0.13±0.06	0.45±0.25
Specific heat capacity of soil, C_S (10^6 J m^{-3} K^{-1})	1.40±0.24	1.78±0.56
Specific heat capacity due to freezing and thawing, C_{ICE} (J m^{-3} K^{-1})	10.9±1.7	11.2±2.6
Empirical snow parameter, f_S (m^{-1})	7.6±3.9	8.5±2.1
Lower soil thermal conductivity, $K_{T,LOW}$ (W m^{-1} K^{-1})	0.74±0.19	0.63±0.32
Lower soil specific heat capacity, $C_{S,LOW}$ (J m^{-3} K^{-1})	1.89±0.62	1.39±0.60
Lower soil temperature depth, Z_l (m)	8.4±4.0	5.6±3.3

Table S2. The coefficients of determination (R^2) for modelled soil temperatures for different soil types at different depths when using in the model calculations the calibrated parameters listed in Table 3. The highest R^2 for each station and measurement depth is shown in bold.

Station name	Soil type	5 cm	10 cm	15 cm	20 cm	30 cm	40 cm	50 cm	70 cm	100 cm	150 cm	200 cm
Lettosuo	Clay/silt	0.93		0.90		0.86	0.81					
	Sand	0.88		0.85		0.80	0.72					
	Peat	**0.96**		**0.97**		**0.98**	**0.97**					
Anjala	Clay/silt		**0.97**		**0.98**	**0.98**		**0.98**	**0.99**	**0.98**	**0.94**	**0.87**
	Sand		0.95		0.97	0.98		0.97	0.97	0.94	0.91	0.83
	Peat		0.95		0.93	0.88		0.79				
Jyväskylä	Clay/silt		0.94		**0.97**	**0.98**			**0.98**	**0.98**	**0.95**	**0.91**
	Sand		0.90		0.93	0.94			0.94	0.93	0.91	0.89
	Peat		**0.98**		0.97	0.94						
Ylistaro	Clay/silt				**0.97**			0.97		**0.97**		**0.89**
	Sand				0.96			**0.98**		0.94		0.87
	Peat				0.94			0.74				
Maaninka	Clay/silt		**0.97**		**0.98**	0.98		0.98	**0.98**	**0.98**	**0.92**	**0.83**
	Sand		0.94		0.97	**0.98**		**0.99**	0.98	0.97	0.92	0.81
	Peat		0.93		0.90	0.85		0.74				
Apukka	Clay/silt		**0.96**		**0.98**	**0.97**		0.96	0.96	**0.97**	0.93	0.86
	Sand		0.92		0.95	0.97		**0.97**	**0.97**	0.96	**0.95**	**0.91**
	Peat		0.94		0.92	0.88		0.78				
Sodankylä	Clay/silt		0.94		0.95	0.95		0.97	0.97	0.94	0.87	0.81
	Sand		**0.95**		**0.96**	**0.97**		**0.98**	**0.98**	**0.98**	**0.95**	**0.89**
	Peat		0.90		0.89	0.84		0.73				
Lompolojänkkä	Clay/silt	**0.91**		0.93		0.87						
	Sand	0.91		0.93		0.82						
	Peat	0.89		**0.95**		**0.92**						
Kaamanen	Clay/silt	0.85		0.51		0.96						
	Sand	0.82		0.50		**0.97**						
	Peat	**0.85**		**0.55**		0.83						
Kevo	Clay/silt		0.88		**0.90**			0.92		0.87		0.66
	Sand		0.87		0.88			**0.92**		**0.88**		**0.66**
	Peat		**0.89**		0.86			0.75				

Table S3. The coefficients of determination (R^2) for modelled snow depths at different stations for the validation periods 1962–1980 and 1981–2005 (the second and third column from the left) and for the calibration period 2006–2014 (the fourth column from the left). The three columns in the right show the modelled snow depth compared to the observed snow depth in percents averaged over the periods 1962–1980, 1981–2005 and 2006–2014.

Station name	R^2 1962–1980	R^2 1981–2005	R^2 2006–2014	% of obs 1962–1980	% of obs 1981–2005	% of obs 2006–2014
Anjala	0.91	0.89	0.96	71	95	103
Jyväskylä	0.87	0.91	0.96	80	94	108
Ylistaro	0.80	0.87	0.96	50	68	83
Maaninka	0.79	0.92	0.96	60	84	96
Apukka	0.95	0.92	0.84	75	96	131
Sodankylä	0.91	0.93	0.95	51	65	85
Kevo	0.83	0.89	0.94	54	83	73

Table S4. Global climate model (GCM) simulations used in this study. More information about the models can be found in Flato et al. (2013).

Model	Institution	Resolution (Lon×Lat Levels)	Ensemble member
CanESM2	Canadian Centre for Climate Modelling and Analysis, Canada	128×64L35	r1i1p1
CNRM-CM5	National Centre for Meteorological Research, Meteo-France, France	256×128L31	r1i1p1
GFDL-CM3	Geophysical Fluid Dynamics Laboratory, USA	144×90L48	r1i1p1 for RCP8.5 r3i1p1 for RCP4.5
HadGEM2-ES	Met Office Hadley Centre, UK	192×145L38	r1i1p1
MIROC5	Atmosphere and Ocean Research Institute, National Institute for Environmental Studies and Japan Agency for Marine-Earth Science and Technology, Japan	256×128L40	r2i1p1
MPI-ESM-MR	Max Planck Institute for Meteorology, Germany	192×96L95	r1i1p1

Table S5. Bias-adjusted regional climate model (RCM) simulations used in this study. More information about the models can be found in Jacob et al. (2014).

Global model	Regional model	Bias adjustment name	CORDEX domain	Ensemble member
CNRM-CM5	CNRM-ARPEGE51	IPSL-CDFT22	EUR-11	r1i1p1
CNRM-CM5	SMHI-RCA4	IPSL-CDFT22	EUR-11	r1i1p1
EC-EARTH	DMI-HIRHAM5	IPSL-CDFT22	EUR-11	r3i1p1
EC-EARTH	KNMI-RACMO22E	IPSL-CDFT22	EUR-11	r1i1p1
EC-EARTH	SMHI-RCA4	IPSL-CDFT22	EUR-11	r12i1p1
HadGEM2-ES	KNMI-RACMO22E	IPSL-CDFT22	EUR-11	r1i1p1
HadGEM2-ES	SMHI-RCA4	IPSL-CDFT22	EUR-11	r1i1p1
IPSL-CM5A-MR	IPSL-INERIS-WRF331F	IPSL-CDFT22	EUR-11	r1i1p1
IPSL-CM5A-MR	SMHI-RCA4	IPSL-CDFT22	EUR-11	r1i1p1
MPI-ESM-LR	MPI-CSC-REMO2009	IPSL-CDFT22	EUR-11	r1i1p1
MPI-ESM-LR	SMHI-RCA4	IPSL-CDFT22	EUR-11	r1i1p1