

Supplement

Table S1. Model weights assigned to each climate model to calculate the mean, low and high variant for RCP 4.5 and RCP 8.5 (for model references c.f. Table 1, main article).

Climate models			RCP 4.5				RCP 8.5			
GCM	RCM	Realization	ΔT_{jja}^1	variant			ΔT_{jja}^1	variant		
				mean	low	high		mean	low	high
CNRM	CCLM	r1	1.22	0.1	0.2521	0.0005	2.70	0.1	0.1697	0.0041
CNRM	RCA4	r1	0.85	0.1	0.3573	0.0000	2.70	0.1	0.2521	0.0005
EC-Earth	CCLM	r12	1.68	0.1	0.1075	0.0138	3.88	0.1	0.0323	0.0626
EC-Earth	RCA4	r12	2.64	0.1	0.0005	0.2521	4.89	0.1	0.0005	0.2521
HadGEM2-ES	CCLM	r1	2.87	0.1	0.0000	0.3573	5.94	0.1	0.0000	0.3573
HadGEM2-ES	RCA4	r1	1.82	0.1	0.0323	0.0626	4.49	0.1	0.0041	0.1697
MPI-ESM-LR	CCLM	r1	1.77	0.1	0.0626	0.0323	3.31	0.1	0.1075	0.0138
MPI-ESM-LR	RCA4	r1	2.45	0.1	0.0041	0.1697	3.90	0.1	0.0138	0.1075
MPI-ESM-LR	REMO	r1	1.85	0.1	0.0138	0.1075	2.53	0.1	0.3573	0.0000
MPI-ESM-LR	REMO	r2	1.31	0.1	0.1697	0.0041	3.43	0.1	0.0626	0.0323

¹ ΔT_{jja} = difference in summer temperature between 2000 and 2100 (c.f. Table 2, main article).

Supplement

Table S2. NFI-plots = 1 km² grid cells with one or more NFI-(sub)plots [59]; forest area from *State of Europe's forests 2015*; plot representation area = average forest area per NFI plot.

Country	NFI plots	species occurrences	mean species occurrence/ NFI plot	forest area 2015 (km ²)	plot representation area (km ²)
Austria	3357	10213	3,0	38690	11,5
Czech Rep	10314	30910	3,0	26670	2,6
Denmark	2479	7215	2,9	6120	2,5
Estonia	2882	7962	2,8	22320	7,7
Finland	23327	61864	2,7	222180	9,5
France	31320	77893	2,5	169890	5,4
Germany	18278	64694	3,5	114190	6,2
Hungary	4365	15171	3,5	20690	4,7
Ireland	1413	2561	1,8	7540	5,3
Italy	6434	18955	2,9	92970	14,4
Latvia	3894	4793	1,2	33560	8,6
Lithuania	1970	6948	3,5	21800	11,1
Netherlands	2664	5689	2,1	3760	1,4
Norway	10785	24567	2,3	121120	11,2
Portugal	4532	6049	1,3	31820	7,0
Romania	3048	13160	4,3	68610	22,5
Slovakia	1290	3503	2,7	19400	15,0
Spain	72596	116204	1,6	184180	2,5
Sweden	9968	22255	2,2	280730	28,2
Switzerland	5491	13037	2,4	12540	2,3
United Kingdom	19399	42596	2,2	31440	1,6

Supplement

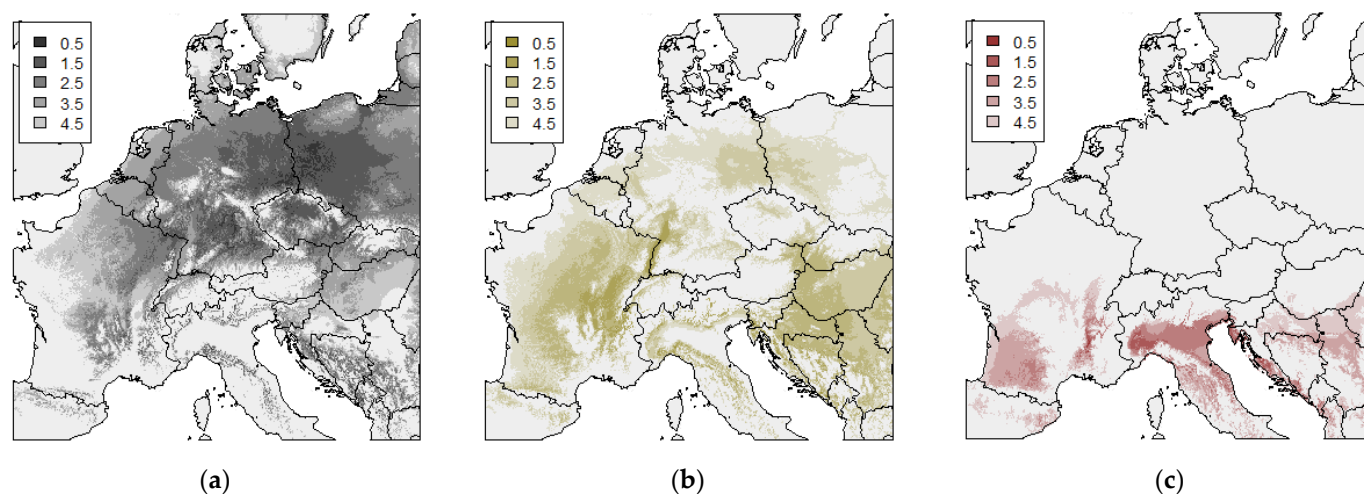


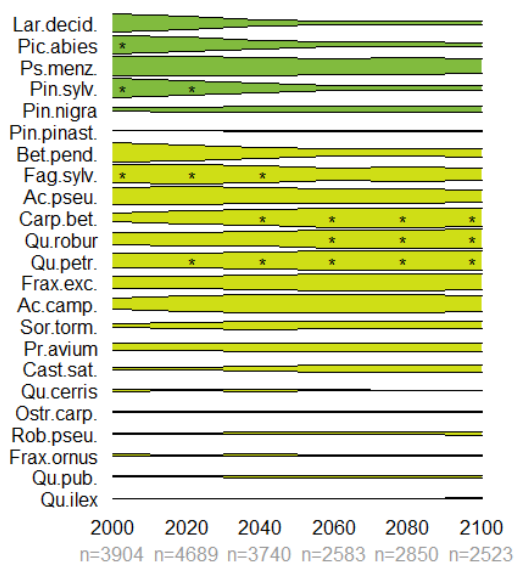
Figure S1. Climate distance maps of Europe for Roth RCP 8.5 mean variant: (a) 2000, (b) 2060, (c) 2100.

The climate distance maps in Figure S1 complement Figure 3 (b) (main article) by visualizing different thresholds of climatic distances for three selected 20-year time steps of the RCP 8.5 mean variant: 2000, 2060 and 2100. Five threshold distances are displayed through different color tones: from 0.5 (close analogue, dark color tones) to 4.5 (distant analogue, light color tones). For the definition of the climatic distance see Equation (1). The climate distance map for 2000 in Figure S1 (a) is the only one with regions within a 0.5 threshold distance. Together with the 1.5 threshold distance the regions correspond to the twin regions for 2000 in Figure 3 (b) (main article). Expanding the threshold distance to 2.5 includes areas of northern Germany and central Poland. The Netherlands and Belgium are still within a threshold distance of 3.5. The Hungarian plains are among regions within a threshold distance of 4.5. In the climatic distance maps for 2060 and 2100 in Figure S1 (b) and (c), the closest climatic distances start with a threshold distance of 1.5. The overall shift in the climate distance maps from 2000 to 2060 to 2100 is southwards. The climatic distance map for 2060 in Figure S1 (b) highlights regions in Central France – the Saone-Rhone valley remaining within the 1.5 threshold distance – and West Hungary/ North Croatia where a threshold distance of 2.5 applies. The upper Rhine valley with a threshold distance of 1.5 is the northernmost outlier within such a low threshold. The climate distance map for 2100 in Figure S1 (c) exhibits four regions with climatic distances within the threshold of 2.5: the Gascogne in Southwest France, the Rhone valley in East France, the Po-valley in North Italy and the Mediterranean coast of Croatia. The climatically closest regions are the already mentioned Rhone valley and upper Po valley within a threshold distance of 1.5. Besides the mentioned larger twin regions, mountain regions like the Massif Central, the Apennine or the Dinarian Alps can cover a wide range of analogues in a very small extent due to the orographic alteration of temperature and precipitation. This requires paying high attention towards the altitude when using the climate analogues.

Supplement

Roth (RCP 45 low)

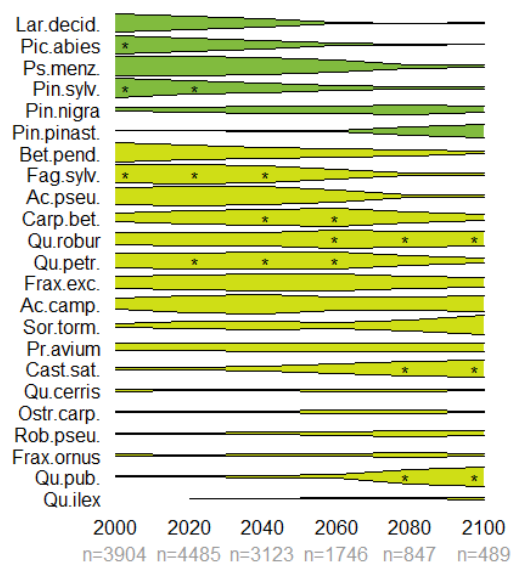
'icle'-graphic



(a)

Roth (RCP 85 low)

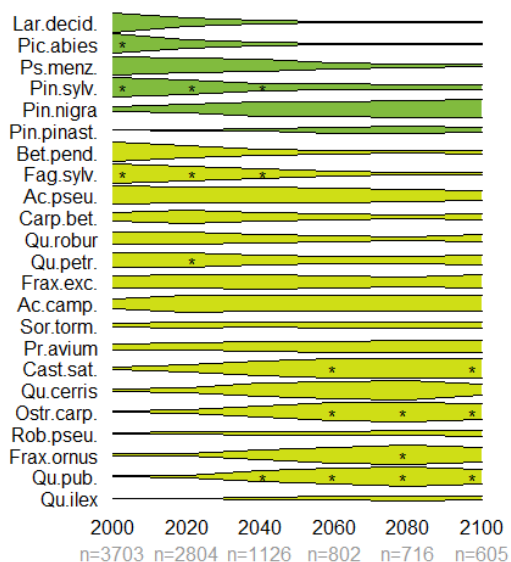
'icle'-graphic



(b)

Roth (RCP 45 high)

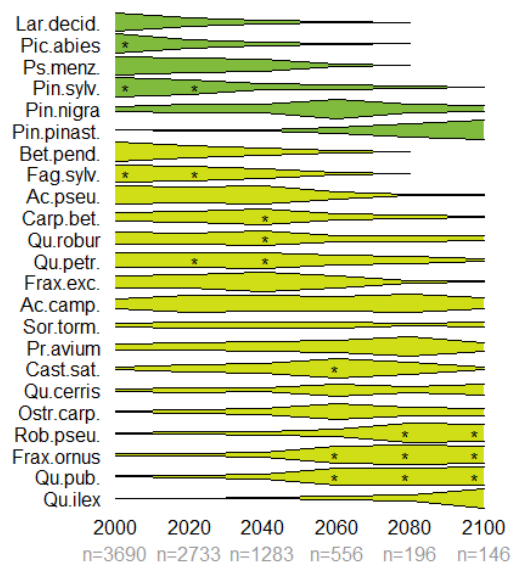
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(c)

Roth (RCP 85 high)

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(d)

Figure S2. Prevalence trajectory graphics showing relative prevalence from 2000 to 2100 of 23 major tree species in the twin regions of the RCP 4.5 and RCP 8.5 low and high variants for site Roth. Grey numbers below the x-axis indicate the number of NFI-plots in the twin regions of each time step; grey numbers on the right vertical axis the total number of species occurrence in the plots of all twin regions from 2000 to 2100. Asterisks <*> in the species cones mark the three species with the highest absolute prevalence in each 20-year time step. Species abbreviations as in Table 3 (main article).