

1. Supplement

Table S1 – Model structures and memory consumption as the estimated mean over a typical dense forest plot of one hectare, with 80 years climate forcing data and an additional 1,000 years initialising phase.

Structure	Substructure	Total for each element in structure [b]	Total in each simulation [kb]
Parameter		642	0.64
Weather ¹	Year(i)	390	31.2
Environment ²	Grid(i)	54	2,700
Trees ³	Tree(i)	120	3,000
Seeds ⁴	Seed(i)	98	9,016
Evaluation	Evaluation(i)	117	105.86
TOTAL			14,853.7

1: with 80 years of weather input data on a monthly basis;

2: 50,000 grid tiles at a resolution of 20 x 20 cm tiles on a hectare;

3: ~25,000 larch individuals appear per hectare in simulations of a typical dense forest plot;

4: ~92,000 larch seeds are present on a hectare of a typical dense forest plot simulation;

5: the length of the simulation is calculated with 1,000 years stabilization and 80 years simulation phase

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10 Table S2 – Comparison of simulated to directly estimated seed dispersal from the implemented functions of north and south winds at the same observed release heights.

Wind direction	Tree height [cm]	Significance value (p)	D.f.	Statistic value (t)	Distances percentile [m]						
					0%	1%	25%	50%	75%	99%	100%
<i>North</i>	215	0.405	1067	0.832	0.1	0.8	4.0	6.2	9.1	60.8	214,580.7
	274	0.272	1049	1.100	0.1	0.9	5.1	7.9	11.4	58.5	839,991.5
	337	0.317	1048	-1.001	0.1	1.2	6.2	9.7	13.9	65.4	106,316.3
	406	0.356	1034	-0.924	0.1	1.5	7.6	11.7	16.7	70.7	7,540,295.2
	486	0.119	1027	-1.561	0.2	1.7	9.0	13.8	19.9	75.6	1,800,875.2
	580	0.971	1038	-0.036	0.2	2.0	10.8	16.6	23.7	79.8	295,290.7
	698	0.815	1047	0.234	0.2	2.4	12.8	20.0	28.3	90.7	366,330.3
	860	0.393	1056	0.855	0.1	3.0	15.8	24.5	35.0	99.6	22,430,488.9
<i>South</i>	214	0.328	1081	0.979	0.1	0.8	4.0	6.3	9.1	54.8	142,464.5
	270	0.049	1054	1.969	0.1	0.9	5.0	7.8	11.3	56.0	1,386,968.5
	330	0.721	1054	-0.358	0.1	1.2	6.2	9.5	13.7	65.2	316,950.6
	397	0.796	1045	0.258	0.1	1.4	7.4	11.4	16.3	67.7	3,506,206.1
	476	0.440	1040	-0.772	0.1	1.7	8.8	13.6	19.4	69.2	15,711,413.0
	570	0.794	1036	0.262	0.1	2.0	10.6	16.4	23.3	78.3	160,559.1
	685	0.361	1033	-0.914	0.2	2.5	12.6	19.7	27.9	89.0	1,290,583.5
	851	0.306	1058	-1.025	0.2	2.9	15.7	24.3	34.6	104.8	1,459,702.6

Table S3 – Comparison of seed dispersal distances in simulations forced with winds from north and south directions.

Wind direction	Tree height [cm]	Distances percentile [m]							Significance value (p)	D.f.	Statistic value (t)
		0%	1%	25%	50%	75%	99%	100%			
North	215	0.1	0.7	4.0	6.2	9.0	60.2	21,4580.7	0.336	58956	-0.961
South		0.1	0.8	4.0	6.3	9.1	55.9	14,2464.5			
North	272	0.1	0.9	5.1	7.8	11.3	58.8	9,4025.3	0.235	88336	-1.189
South		0.1	0.9	5.1	7.9	11.3	58.3	138,6968.5			
North	333	0.1	1.2	6.1	9.6	13.8	65.0	10,6316.3	0.047	91926	-1.985
South		0.1	1.2	6.2	9.6	13.9	67.1	31,6950.6			
North	402	0.1	1.4	7.5	11.6	16.5	71.2	754,0295.2	0.164	100519	1.393
South		0.1	1.4	7.4	11.5	16.4	68.6	226,0443.8			
North	481	0.2	1.7	8.9	13.7	19.7	73.8	180,0875.2	0.388	101366	0.864
South		0.1	1.7	8.9	13.7	19.6	70.3	32,2285.9			
North	575	0.1	2.0	10.7	16.5	23.5	80.5	29,5290.7	0.565	101072	0.576
South		0.1	2.0	10.7	16.6	23.6	79.8	16,0559.1			
North	692	0.2	2.4	12.7	19.8	28.1	91.8	36,6330.3	0.230	92599	-1.201
South		0.2	2.5	12.8	19.9	28.2	89.8	129,0583.5			
North	856	0.1	3.0	15.7	24.4	34.8	99.3	2,243,0488.9	0.921	74922	0.100
South		0.2	2.9	15.7	24.5	34.7	105.8	145,9702.7			

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Table S4 – Comparison of pollination dispersal distances with Student’s t-test of the mean p-values at a significance level of 0.01. Only cases with >10 pollination events of the five trees producing most seeds were considered.

Cardinal direction of winds	Wind direction [°]	Mean p-value	Significance value (p)	d.f.	Statistic value (t)
North	165-195	0.449	<0.001	49	10.133
	135-165	0.277	<0.001	38	5.629
	195-225	0.406	<0.001	37	6.704
South	-15-15	0.415	<0.001	49	10.171
	15-45	0.302	<0.001	40	5.734
	315-345	0.408	<0.001	39	8.315

Table S5. Test statistics for generalised nonparametric regression analyses (significance level: *** $p < 0.001$).

Simulation version	Model formula	AIC	Dispersion parameter for Gaussian family	Model term	D.f.	SS	F	significance
+POLLEN_PAR A	$t \sim Nt$	1722	0.17	Nt	1	10160.4	59340.3	***
				Residuals	1076	184.2		
	$t \sim Ns$	1167	0.29	Ns	1	9093.8	31780.8	***
				Residuals	1076	307.9		
	$t \sim Nt + Ns$	1042	0.15	Nt	1	9879.2	65019.1	***
				Ns	1	7.3	48.2	***
				Residuals	1072	162.9		
				Nt	1	10688.2	75655.2	***
	$t \sim Nt + Ns + Nt:Ns$	964	0.14	Ns	1	705.7	4995.0	***
				$Nt:Ns$	1	1843.4	13048.4	***
Residuals				1071	151.3			
+POLLEN	$t \sim Nt$	1754	0.17	Nt	1	9730.8	56047.3	***
				Residuals	1077	187.0		
	$t \sim Ns$	1183	0.29	Ns	1	8857.5	30113.9	***
				Residuals	1077	316.8		
	$t \sim Nt + Ns$	975	0.14	Nt	1	9472.3	66387.8	***
				Ns	1	9.0	63.3	***
				Residuals	1073	153.1		
				Nt	1	10215.8	77934.1	***
	$t \sim Nt + Ns + Nt:Ns$	884	0.13	Ns	1	582.7	4445.4	***
				$Nt:Ns$	1	1647.4	12567.5	***
Residuals				1072	140.5			
+POLLEN_PAR B	$t \sim Nt$	1596	0.15	Nt	1	9923.8	64828.7	***
				Residuals	1075	164.6		
	$t \sim Ns$	1045	0.25	Ns	1	8939.3	35072.6	***
				Residuals	1075	274.0		
	$t \sim Nt + Ns$	833	0.13	Nt	1	9583.7	76495.4	***
				Ns	1	20.8	166.2	***
				Residuals	1071	134.2		
				Nt	1	10405.4	91086.0	***
	$t \sim Nt + Ns + Nt:Ns$	734	0.11	Ns	1	681.4	5964.8	***
				$Nt:Ns$	1	1705.2	14927.1	***
Residuals				1070	122.2			
SEED	$t \sim Nt$	40	0.05	Nt	1	1440.4	30730.1	***
				Residuals	1075	50.4		
	$t \sim Ns$	-233	0.06	Ns	1	1317.6	21817.7	***
				Residuals	1075	64.9		
	$t \sim Nt + Ns$	-375	0.04	Nt	1	1396.3	34099.6	***
				Ns	1	9.4	229.9	***
				Residuals	1071	43.9		
				Nt	1	1512.3	37915.5	***
	$t \sim Nt + Ns + Nt:Ns$	-403	0.04	Ns	1	37.9	950.9	***
				$Nt:Ns$	1	288.9	7243.1	***
Residuals				1070	42.7			