

Simulating the recent drought-induced mortality of European beech (*Fagus sylvatica* L.) and Norway spruce (*Picea abies* L.) in German forests

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Supplementary Material 1

SM 1 | Climate data

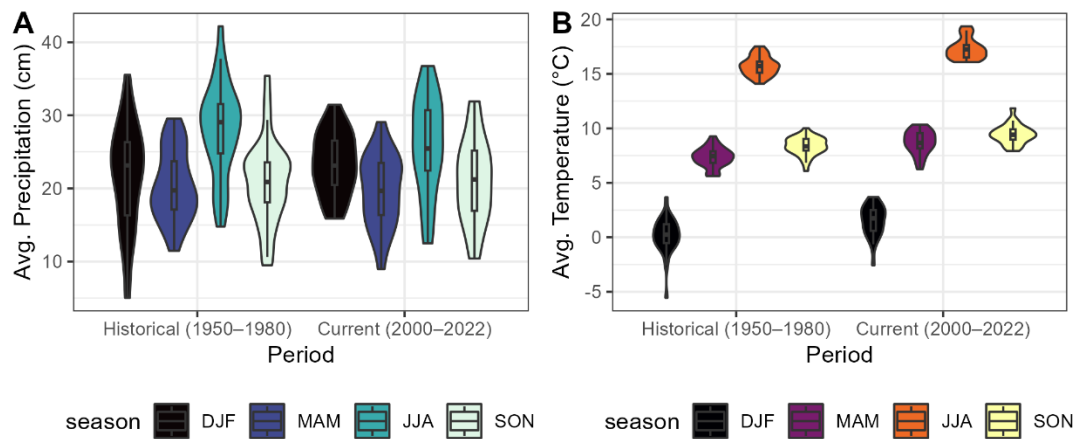


Figure S 1.1– Means of climatic variables (precipitation (A), temperature (B)) for the historical period (1950-1980) and the current climate period (2000-2022) averaged across the European beech dominated sites.

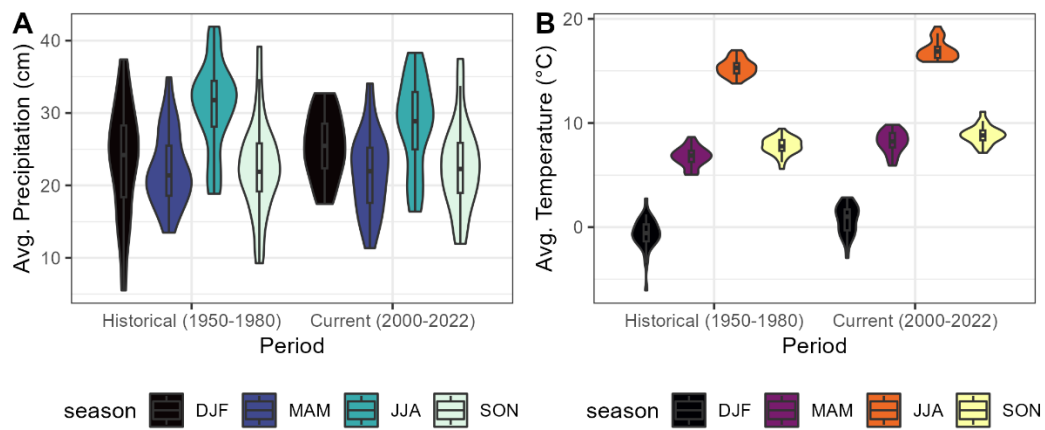


Figure S 1.2 Means of climatic variables (precipitation (A), temperature (B)) for the historical period (1950-1980) and the current climate period (2000-2022) averaged across the Norway spruce dominated sites.

2.1 Maps of Available Water Capacity

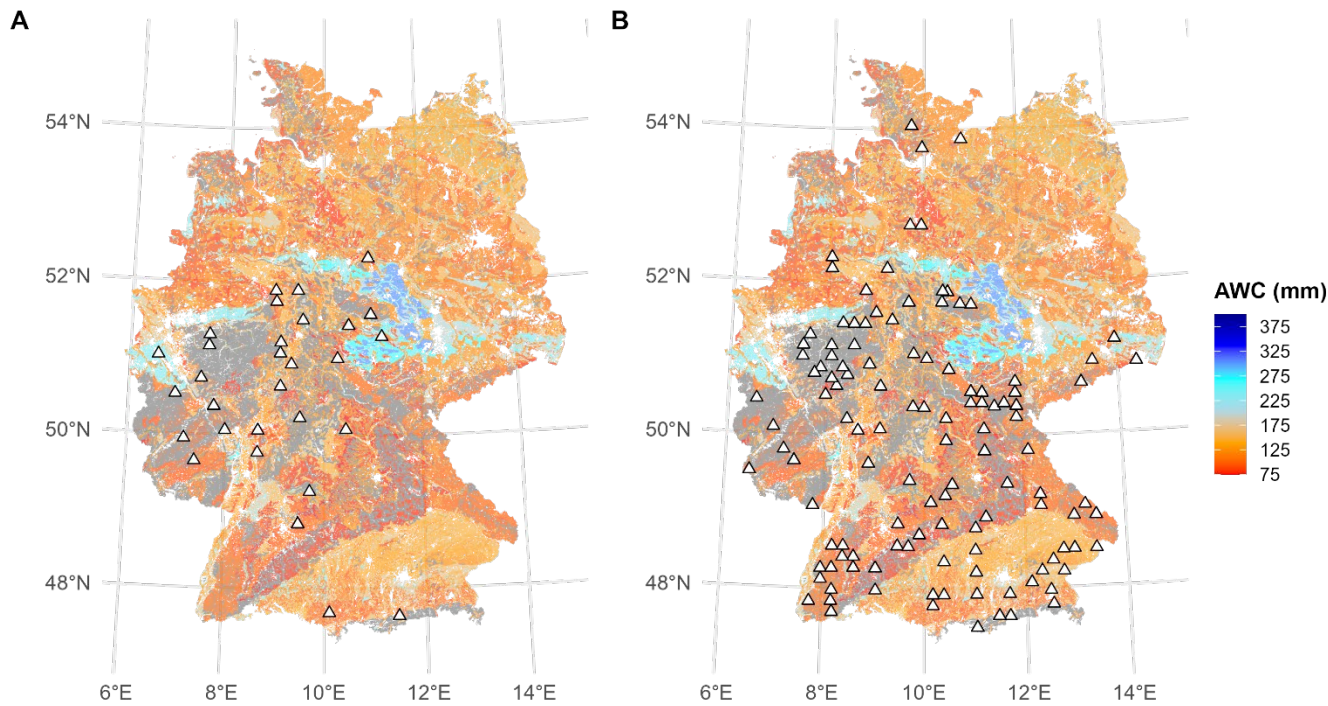


Figure S 2.1.1: Available Water Capacity (AWC, mm, source: BGD) maps and overlaid ICP-Level I (WZE) plots dominated by European beech (A) and Norway spruce (B).

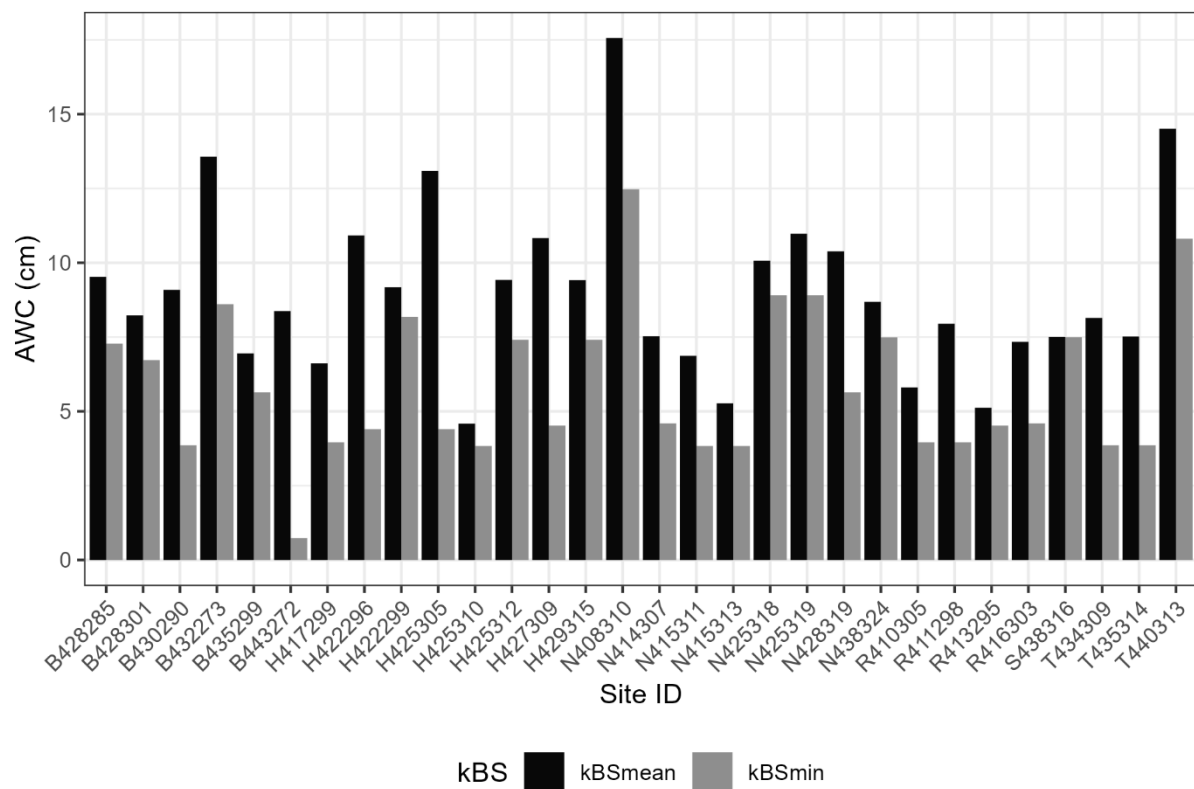


Figure S 2.1.2 – AWC values (cm, mean and minimum) extracted from the BGR map across the ICP-Level I beech dominated sites.

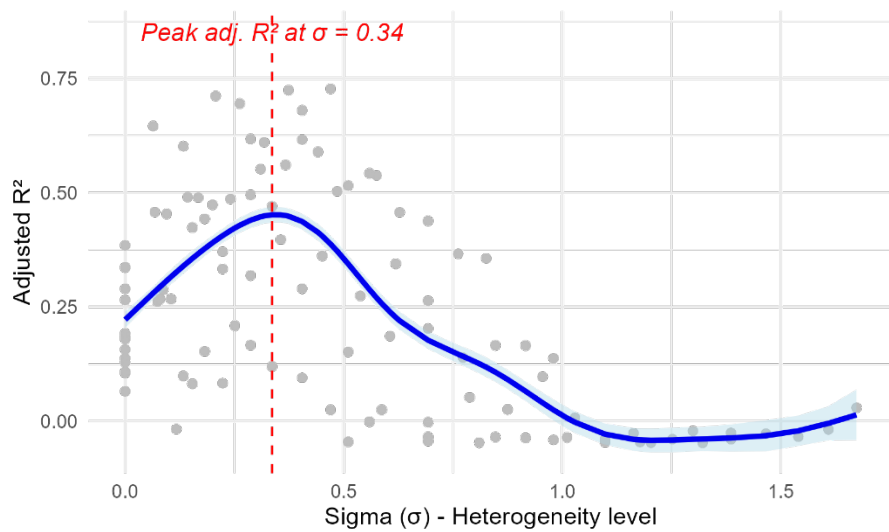
10 *Table S 2.1* – Soil moisture scenarios defined according to kBS_{min} and kBS_{mean} . The heterogeneity of each scenario is expressed via the sigma values (σ) of the lognormal distribution.

Scenario	kBS_{min}	kBS_{mean}	σ
1	7.5	7.5	0
2	7.5	10	0.287
3	7.5	12.5	0.510
4	7.5	15	0.693
5	7.5	17.5	0.847
6	7.5	20	0.980
7	7.5	22.5	1.098
8	7.5	25	1.203
9	7.5	27.5	1.299
10	7.5	30	1.386
11	7.5	32.5	1.466
12	7.5	35	1.540
13	7.5	37.5	1.609
14	7.5	40	1.673
15	10	10	0
16	10	12.5	0.223
17	10	15	0.405
18	10	17.5	0.559
19	10	20	0.693
20	10	22.5	0.810
21	10	25	0.916
22	10	27.5	1.011
23	10	30	1.098
24	10	32.5	1.178
25	10	35	1.252
26	10	37.5	1.321
27	10	40	1.386
28	12.5	12.5	0
29	12.5	15	0.182
30	12.5	17.5	0.336
31	12.5	20	0.470
32	12.5	22.5	0.587
33	12.5	25	0.693
34	12.5	27.5	0.788
35	12.5	30	0.875
36	12.5	32.5	0.955
37	12.5	35	1.029

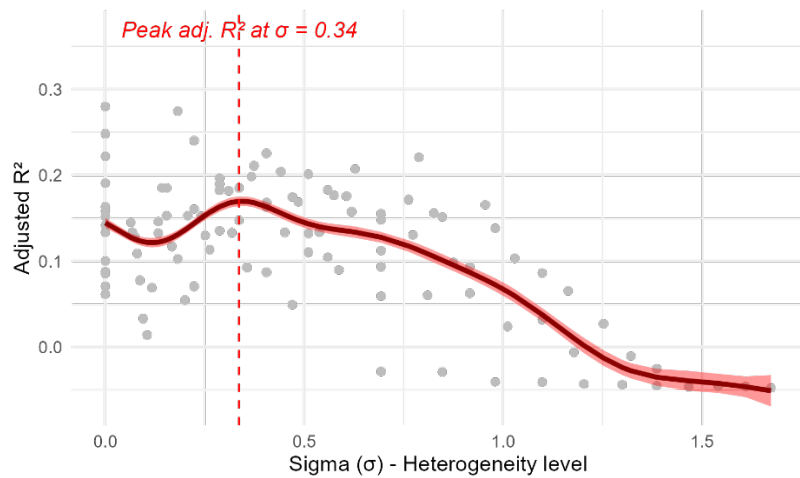
38	12.5	37.5	1.098
39	12.5	40	1.163
40	15	15	0
41	15	17.5	0.154
42	15	20	0.287
43	15	22.5	0.405
44	15	25	0.510
45	15	27.5	0.606
46	15	30	0.693
47	15	32.5	0.773
48	15	35	0.847
49	15	37.5	0.916
50	15	40	0.980
51	17.5	17.5	0
52	17.5	20	0.133
53	17.5	22.5	0.251
54	17.5	25	0.356
55	17.5	27.5	0.451
56	17.5	30	0.538
57	17.5	32.5	0.619
58	17.5	35	0.693
59	17.5	37.5	0.762
60	17.5	40	0.826
61	20	20	0
62	20	22.5	0.117
63	20	25	0.223
64	20	27.5	0.318
65	20	30	0.405
66	20	32.5	0.485
67	20	35	0.559
68	20	37.5	0.628
69	20	40	0.693
70	22.5	22.5	0
71	22.5	25	0.105
72	22.5	27.5	0.200
73	22.5	30	0.287
74	22.5	32.5	0.367
75	22.5	35	0.441
76	22.5	37.5	0.510
77	22.5	40	0.575

78	25	25	0
79	25	27.5	0.095
80	25	30	0.182
81	25	32.5	0.262
82	25	35	0.336
83	25	37.5	0.405
84	25	40	0.470
85	27.5	27.5	0
86	27.5	30	0.087
87	27.5	32.5	0.167
88	27.5	35	0.241
89	27.5	37.5	0.310
90	27.5	40	0.374
91	30	30	0
92	30	32.5	0.080
93	30	35	0.154
94	30	37.5	0.223
95	30	40	0.287
96	32.5	32.5	0
97	32.5	35	0.074
98	32.5	37.5	0.143
99	32.5	40	0.207
100	35	35	0
101	35	37.5	0.068
102	35	40	0.133
103	37.5	37.5	0
104	37.5	40	0.064
105	40	40	0

2.2 Spatial heterogeneity level (σ) and model performance



15 *Figure S 2.2.1* – Relationship between heterogeneity level (σ) and model performance (Adjusted R^2) for *Fagus sylvatica*. A generalized additive model (GAM) was fitted to predict R^2 as a smooth function of σ . The shaded area indicates the 95% confidence interval of the GAM smooth. Model performance peaked at $\sigma \approx 0.34$ and declined thereafter, suggesting optimal model fit under intermediate heterogeneity levels.



20 *Figure S 2.2.2* – Relationship between spatial heterogeneity (σ) and model performance (Adjusted R^2) for *Picea abies*. A generalized additive model (GAM) was used to estimate R^2 as a smooth function of σ . The shaded area represents the 95% confidence interval. Model fit peaked at $\sigma \approx 0.34$ and declined at higher heterogeneity levels.

25 *Table S 2.2* - Summary of Generalized Additive Models (GAMs) fitted to predict adjusted R^2 as a function of soil moisture heterogeneity (σ) for *Fagus sylvatica* and *Picea abies*. edf = estimated degrees of freedom, red.df = reference degrees of freedom. Parametric and smooth term estimates are provided along with model statistics including adjusted R^2 , deviance explained (D), generalized cross-validation (GCV) score, scale estimate (scale), and sample size (n). All smooth terms were highly significant ($p < 0.001$).

Species						
<i>Fagus sylvatica</i>	Parametric term	<i>Component</i>	<i>Estimate</i>	<i>Std. error</i>	<i>t-value</i>	<i>p-value</i>
		Intercept	0.24	0.003	70.28	<0.001
	Smooth term		<i>edf</i>	<i>red.df.</i>	<i>F-value</i>	
		σ	8.15	8.8	251	<0.001
	Model statistics					
	adj. R^2	<i>D</i>	<i>GCV</i>	<i>scale</i>	<i>n</i>	
	0.478	47.90%	0.028	0.028	2415	
<i>Picea abies</i>	Parametric term	<i>Component</i>	<i>Estimate</i>	<i>Std. error</i>	<i>t-value</i>	
		Intercept	0.113	0.001	102.3	<0.001
	Smooth term		<i>edf</i>	<i>red.df.</i>	<i>F-value</i>	
		σ	8.7	8.9	296	<0.001
	Model statistics					
	adj. R^2	<i>D</i>	<i>GCV</i>	<i>scale</i>	<i>n</i>	
	0.523	52.50%	0.003	0.003	2415	

30 2.3 Base annual probability of Bark beetle attack

We derived the base annual probability of bark beetle outbreaks (P_{bark}) by adapting the theoretical probability of bark beetle disturbance in spruce-dominated forests (Hlásny et al., 2021, their Fig. 4 and Appendix 2) to baseline climate conditions (1979–1990) in Germany.

35 The method we used combined fixed percentages for the lower classes and an exponential progression for the higher classes, as follows:

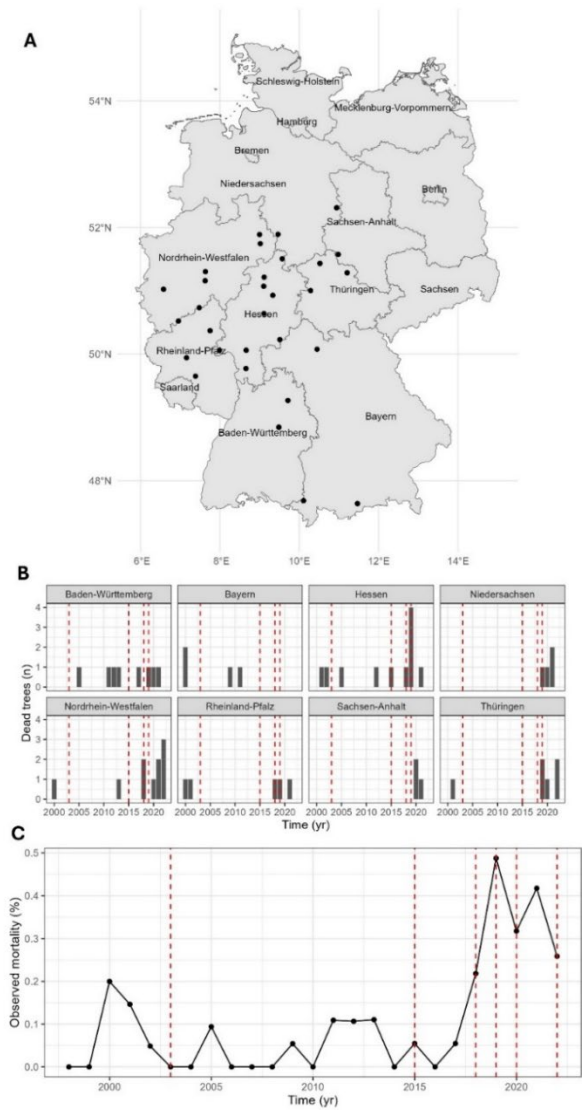
1. *No Spruce*: this category represents the absence of spruce; hence the base probability of a bark beetle outbreak is 0%.
2. *Very Low*: we assigned to this class the first 5% of the range to capture very rare occurrences of bark beetle attacks.
3. *Low*: this category covers the next 10% (from 6 to 15%), which reflects low but non-negligible occurrences of outbreaks.
- 40 4. *Medium, High, and Very High*: the remaining 85% of the scale (from 16 to 100%) was divided between the three categories using an exponential progression. This approach was chosen to reflect the increasing intensity or abundance of spruce in a smooth manner, with progressively larger ranges as we move towards the higher classes. Furthermore, it ensures that the higher classes have larger ranges, which is appropriate for a classification where higher abundances are typically more variable.

45 The progression was defined using a base factor that determines how the range grows as we move from one class to the next. The exponential progression R_k (Eq. SM 1) represents the upper range limit of the k^{th} class, with $k = 1, 2, 3$, which corresponds to the *Medium*, *High*, and *Very High* classes. R_0 represents the initial range size (e.g., 19 units for *Medium*, 31 units for *High* and 35 units for *Very High*), λ is the exponential growth factor and k is the index of the class and has a value of 1.5.

$$R_k = R_0 \cdot \lambda^k \quad (\text{SM 1})$$

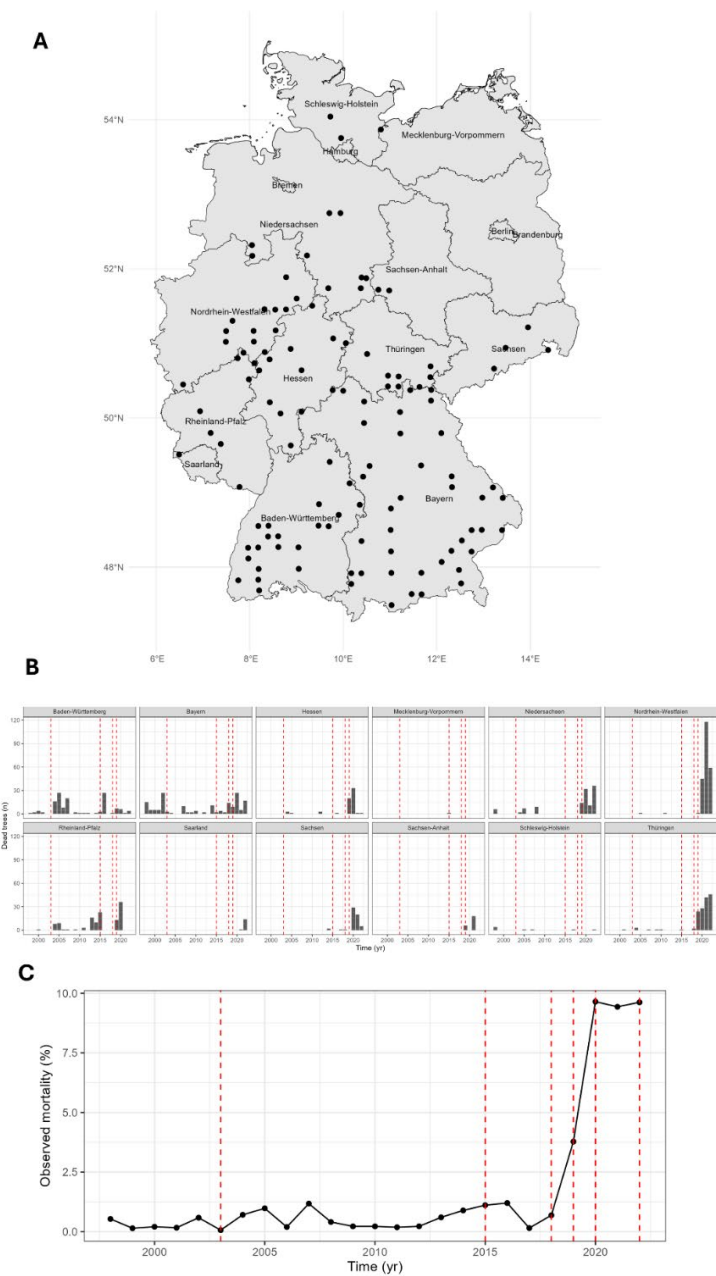
50 Given the fixed total span of 85 units for the remaining scale [16,100], we chose a factor λ such that the total sum of all ranges for *Medium*, *High*, and *Very High* equals 85 units. The range [16,100] is therefore split into three sections such that the total span is covered by the classes with exponentially increasing intervals.

3.1.1. Beech sites



60 Figure S 3.1.1 – (A) Locations of ICP Forest Level I network plots in European beech (*Fagus sylvatica* L.)–dominated stands across the study region. (B) Total number of dead beech trees recorded within these plots over the observation period. (C) Observed mortality rate of beech trees, derived from repeated assessments at the same network plots.

3.1.2. Spruce sites



65 *Figure S 3.1.2.* – (A) Locations of ICP Forest Level I network plots in Norway spruce (*Picea abies* L.)-dominated stands across the study region. (B) Total number of dead beech trees recorded within these plots over the observation period. (C) Observed mortality rate of beech trees, derived from repeated assessments at the same network plots.

70 3.2.1. Beech sites

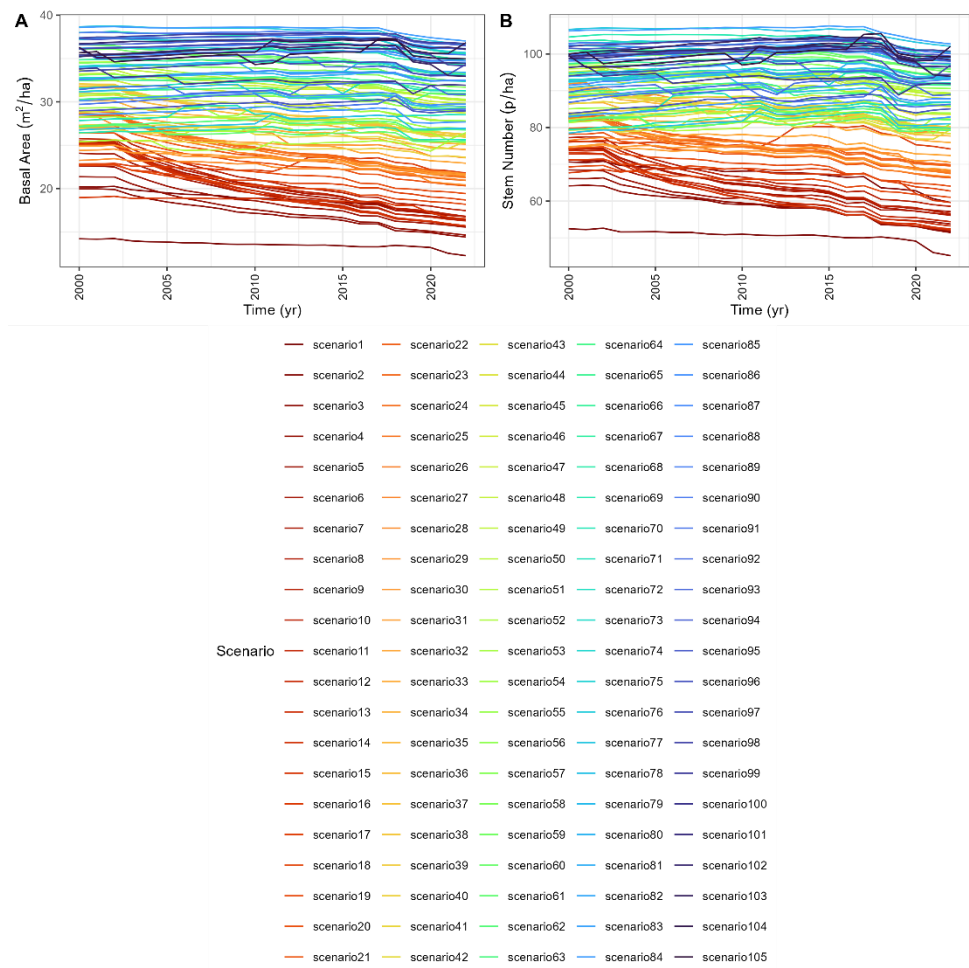
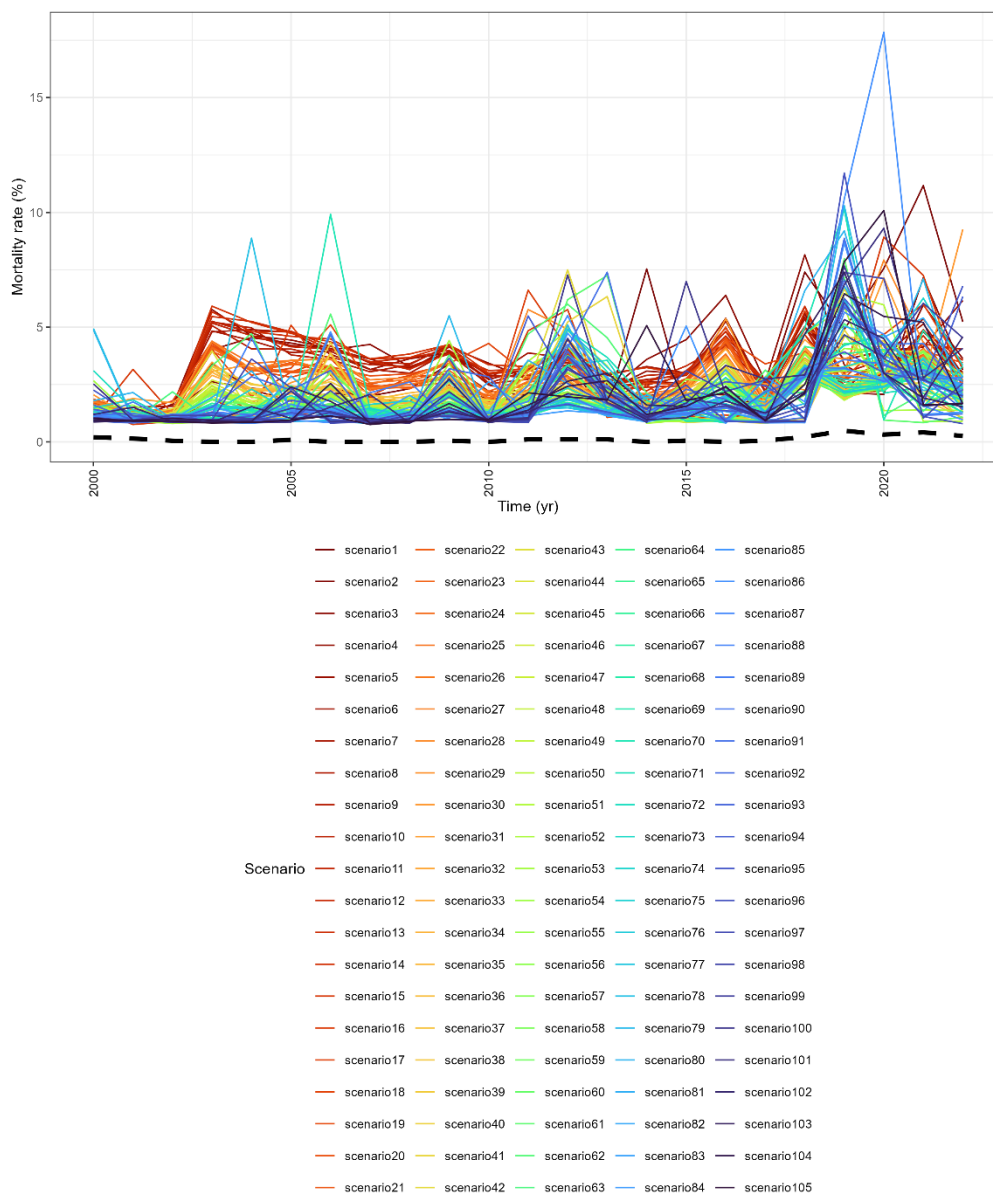


Figure S 3.2.1.1. – Stand dynamics averaged across the beech sites. (A) Basal area development over time. (B) Stem number of living trees over time. In both panels, we only show trees with a DBH > 40 cm.



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Figure S 3.2.1.2. – Simulated mortality rate over time averaged across beech sites and grouped by soil scenario. We only show trees with a DBH > 40 cm.

3.2.2. Spruce sites

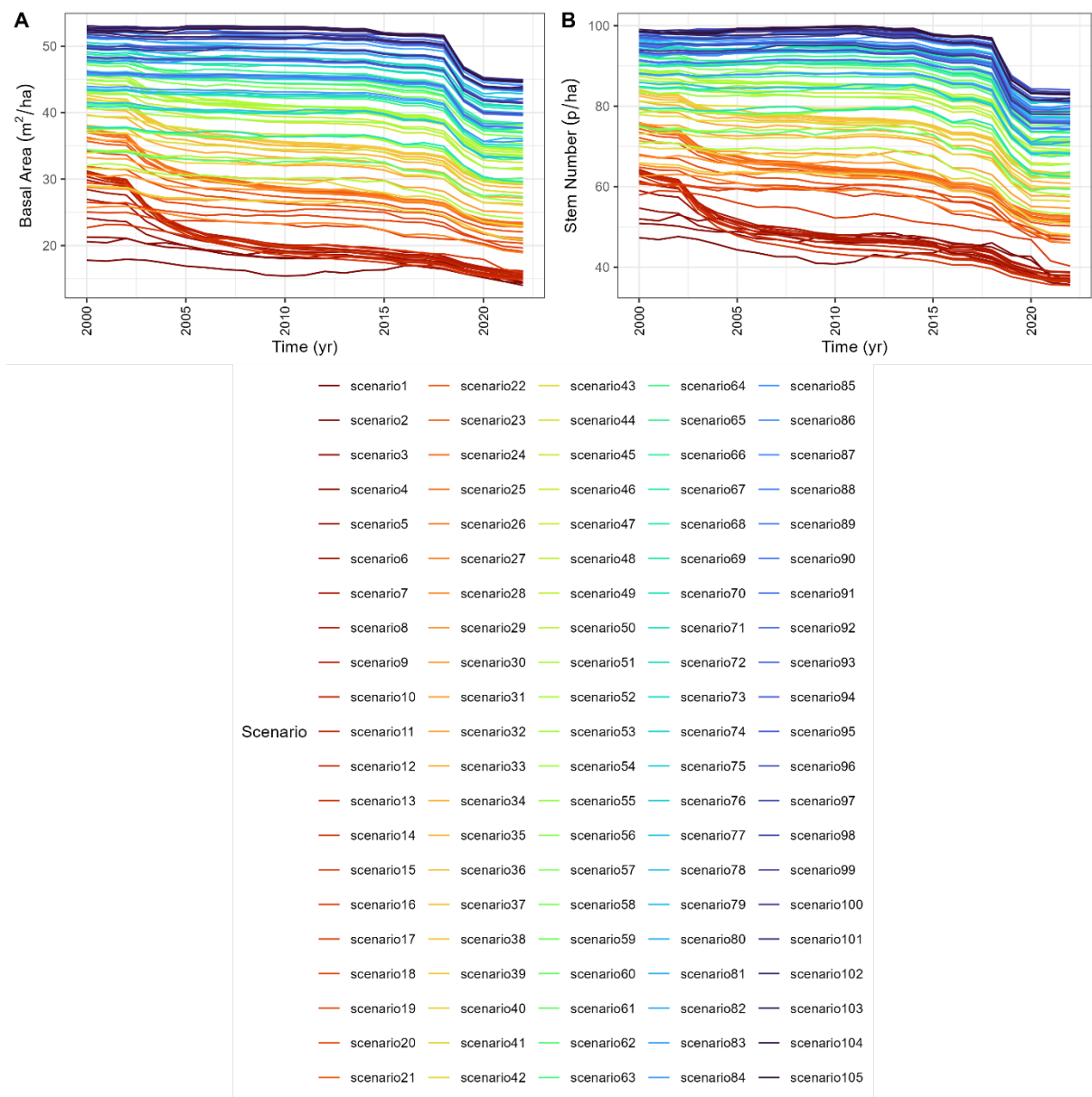
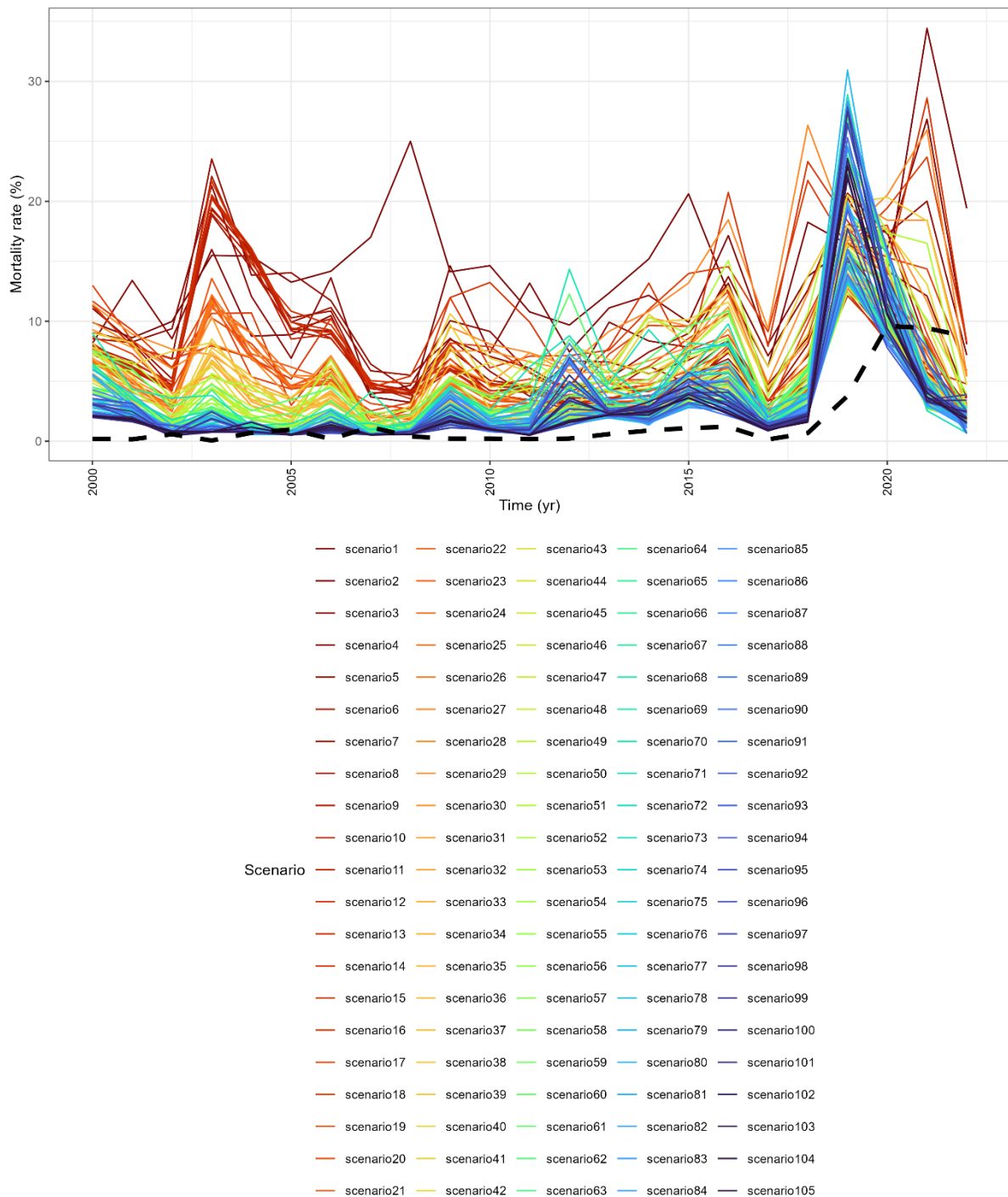
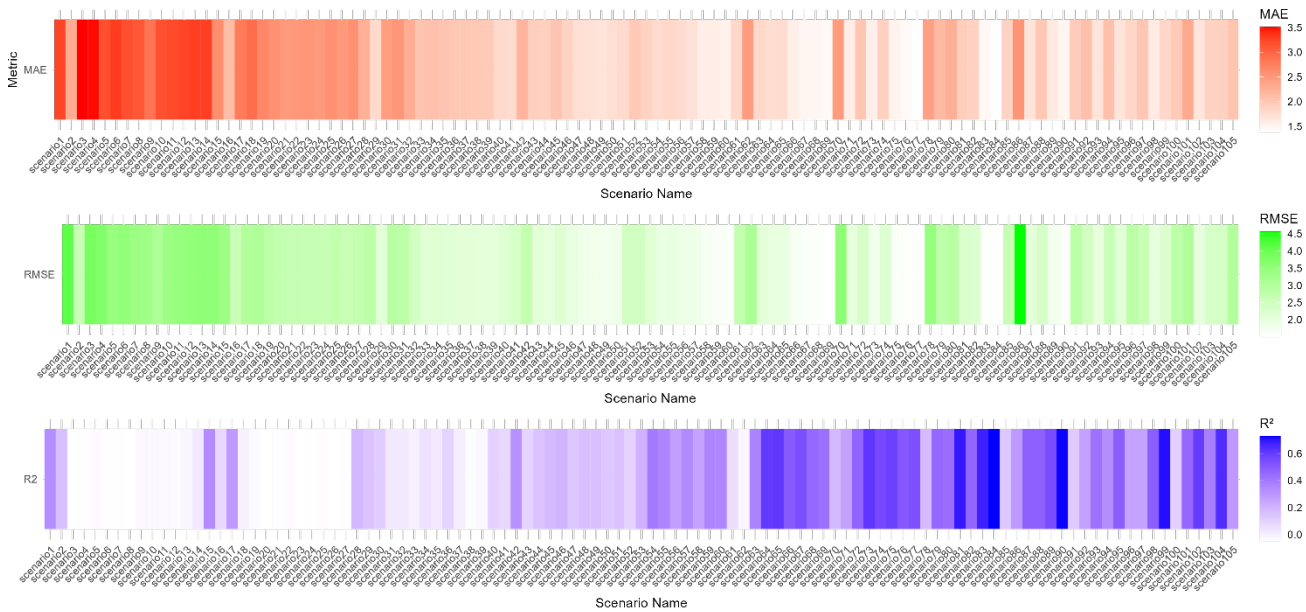


Figure S 3.2.2.1. – Stand dynamics averaged across the spruce sites (A) Basal area development over time. (B) Stem number of living trees over time. In both panels, we only show trees with a DBH > 40 cm.



85 *Figure S 3.2.2.2. – Simulated mortality rate over time averaged across spruce sites and grouped soil scenario. We only show trees with a DBH > 40 cm.*

3.3.1. Beech site statistics



90 *Figure S 3.3.1 – Model statistics MAE, RMSE and R^2_{adj} for each soil scenario for European beech.*

Table S 3.3.1 – Summary of the model statistics (MAE, RMSE, R^2_{adj} , Slope, Intercept and P-value) for each scenario for the beech dominated sites. Highlighted in red are the two best performing scenarios according to their R^2_{adj} .

Scenario	MAE	RMSE	R^2_{adj}	Slope	Intercept	P-Value
1	2.34	3.45	0.34	0.03	0.04	0
2	1.4	1.9	0.17	0.05	0.05	0.03
3	2.6	3.07	-0.05	0	0.11	0.83
4	2.58	2.9	-0.04	0.01	0.1	0.78
5	2.27	2.6	-0.03	-0.01	0.15	0.62
6	2.39	2.7	-0.04	-0.01	0.14	0.72
7	2.26	2.53	-0.04	0.01	0.1	0.74
8	2.2	2.5	-0.05	0	0.12	0.92
9	1.96	2.29	-0.02	-0.02	0.15	0.47
10	2.25	2.54	-0.03	-0.02	0.16	0.51
11	2.3	2.63	-0.03	-0.02	0.15	0.52
12	2.34	2.66	-0.03	-0.01	0.15	0.6
13	2.37	2.73	-0.02	-0.02	0.16	0.44
14	2.37	2.71	0.03	-0.03	0.19	0.21
15	1.71	2.69	0.34	0.04	0.05	0
16	1.23	1.92	0.08	0.03	0.07	0.1
17	1.87	2.21	0.29	0.06	-0.01	0
18	2.01	2.25	0	-0.03	0.18	0.34
19	1.76	2.01	-0.03	0.02	0.09	0.61
20	1.67	1.91	-0.05	0	0.11	0.9
21	1.58	1.83	-0.04	0.02	0.09	0.64
22	1.59	1.83	-0.04	0.02	0.09	0.62
23	1.62	1.85	-0.05	0.01	0.11	0.88
24	1.58	1.81	-0.05	0.01	0.1	0.84
25	1.68	1.9	-0.04	-0.01	0.14	0.69
26	1.58	1.79	-0.05	0	0.11	0.97
27	1.66	1.9	-0.04	-0.01	0.14	0.69
28	1.36	2.2	0.19	0.04	0.06	0.02
29	0.91	1.44	0.15	0.05	0.07	0.04
30	1.53	2.22	0.12	0.03	0.06	0.06
31	1.62	2.09	0.02	0.03	0.07	0.23
32	1.36	1.61	0.02	0.04	0.06	0.23
33	1.13	1.31	0	0.04	0.07	0.34
34	1.15	1.38	0.05	0.05	0.05	0.15
35	1.12	1.3	0.03	0.05	0.05	0.22
36	1.08	1.3	0.1	0.07	0.04	0.08

37	1.08	1.26	0.01	0.05	0.06	0.29
38	1.07	1.26	-0.04	0.02	0.09	0.67
39	1.06	1.22	-0.03	0.03	0.08	0.51
40	0.94	1.55	0.11	0.04	0.08	0.07
41	0.93	1.76	0.08	0.03	0.09	0.1
42	1.29	2.06	0.32	0.05	0.05	0
43	1.01	1.32	0.09	0.06	0.05	0.08
44	0.99	1.23	0.15	0.08	0.03	0.04
45	1.11	1.37	0.19	0.08	0.02	0.02
46	0.95	1.13	0.2	0.1	0.01	0.02
47	0.83	1.03	0.14	0.09	0.03	0.04
48	0.8	0.98	0.17	0.1	0.02	0.03
49	0.77	0.96	0.17	0.1	0.03	0.03
50	0.83	1.01	0.14	0.09	0.03	0.05
51	1	1.9	0.16	0.03	0.08	0.03
52	1.12	1.81	0.1	0.03	0.08	0.08
53	0.98	1.44	0.21	0.06	0.05	0.02
54	0.87	1.17	0.4	0.1	0.01	0
55	0.91	1.14	0.36	0.11	0	0
56	0.87	1.08	0.27	0.11	0.01	0.01
57	0.79	1.06	0.34	0.11	0.02	0
58	0.66	0.88	0.26	0.12	0.03	0.01
59	0.67	0.81	0.37	0.16	-0.01	0
60	0.62	0.79	0.36	0.15	0.01	0
61	1.03	2.24	0.07	0.02	0.09	0.13
62	1.6	2.47	-0.02	0.01	0.1	0.44
63	0.93	1.39	0.37	0.08	0.04	0
64	0.86	1.25	0.61	0.11	0.01	0
65	0.86	1.23	0.62	0.11	0.01	0
66	0.65	0.87	0.5	0.15	0	0
67	0.57	0.83	0.54	0.15	0.02	0
68	0.57	0.75	0.46	0.17	0	0
69	0.53	0.69	0.44	0.17	0.01	0
70	1.62	3.01	0.18	0.02	0.08	0.02
71	0.73	1.46	0.27	0.05	0.07	0.01
72	1.1	1.67	0.47	0.07	0.03	0
73	0.65	1.09	0.62	0.11	0.03	0
74	0.98	1.49	0.56	0.09	0.02	0
75	0.61	0.84	0.59	0.16	0	0
76	0.55	0.8	0.52	0.15	0.02	0

77	0.49	0.75	0.54	0.15	0.03	0
78	1.55	2.87	0.18	0.03	0.07	0.03
79	1.27	2.22	0.45	0.05	0.05	0
80	1.35	2.27	0.44	0.05	0.04	0
81	1.02	1.59	0.69	0.09	0.02	0
82	0.99	1.55	0.47	0.07	0.04	0
83	0.55	0.81	0.68	0.16	0.01	0
84	0.48	0.76	0.73	0.17	0.02	0
85	1.03	2.13	0.14	0.03	0.08	0.05
86	1.69	4.12	0.29	0.02	0.08	0
87	0.81	1.41	0.49	0.08	0.05	0
88	1.1	1.68	0.49	0.07	0.03	0
89	0.72	1.02	0.55	0.12	0.01	0
90	0.57	0.85	0.72	0.16	0.01	0
91	1.11	2.35	0.13	0.03	0.09	0.05
92	1.23	1.77	0.27	0.05	0.05	0.01
93	0.8	1.36	0.42	0.08	0.05	0
94	1.17	1.98	0.33	0.05	0.05	0
95	0.78	1.47	0.5	0.07	0.05	0
96	1.04	2.38	0.27	0.03	0.08	0.01
97	1.19	2.05	0.26	0.04	0.07	0.01
98	0.73	1.38	0.49	0.08	0.05	0
99	0.93	1.6	0.71	0.08	0.03	0
100	1.13	2.31	0.11	0.03	0.09	0.07
101	1.44	2.42	0.46	0.05	0.04	0
102	0.76	1.36	0.6	0.09	0.04	0
103	1.02	1.71	0.38	0.06	0.05	0
104	1.03	1.76	0.65	0.07	0.04	0
105	1.16	2.5	0.29	0.03	0.07	0

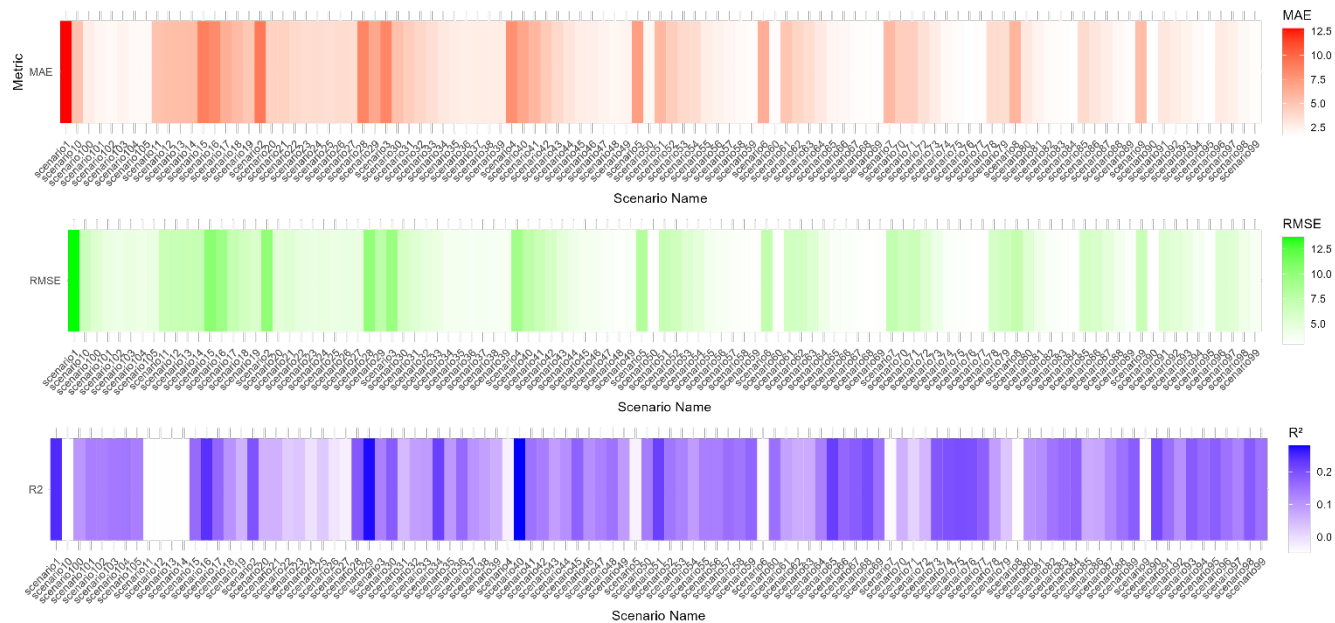


Figure S 3.3.2 – Model statistics (MAE, RMSE and R^2_{adj}) for each soil scenario for spruce.

100 *Table S 3.3.2 – Summary of the model statistics (MAE, RMSE, R^2_{adj} , Slope, Intercept and P-value) for each scenario for the spruce dominated sites. Highlighted in red are the two best performing scenarios.*

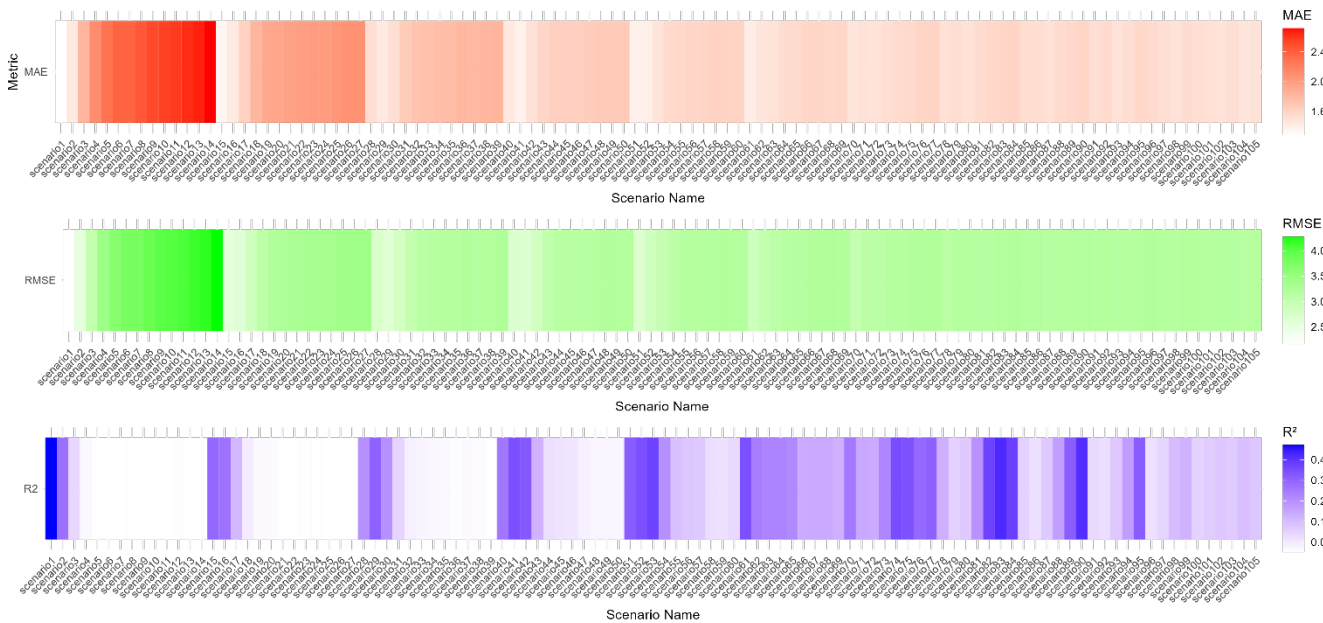
Scenario	MAE	RMSE	R^2_{adj}	Slope	Intercept	P-Value
1	12.8	13.72	0.25	0.27	-2.17	0.01
2	9.24	10.16	0.2	0.29	-1.35	0.02
3	8.53	9.56	0.13	0.25	-0.7	0.05
4	7.94	9.24	-0.03	0.08	1.06	0.54
5	7.22	8.32	-0.03	0.08	1.12	0.54
6	6.34	7.46	-0.04	0.06	1.4	0.71
7	5.74	7.3	-0.04	0.05	1.46	0.72
8	6.01	7.2	-0.04	0.04	1.5	0.77
9	5.57	6.87	-0.04	0.04	1.54	0.79
10	5.23	6.62	-0.05	0.03	1.6	0.83
11	5.23	6.79	-0.05	0.02	1.67	0.88
12	5.42	6.89	-0.05	-0.03	1.97	0.85
13	5.47	6.95	-0.05	-0.03	1.97	0.86
14	5.54	7.05	-0.05	0	1.83	0.98
15	8.89	10.4	0.16	0.22	-0.49	0.03
16	8.25	9.47	0.24	0.28	-0.96	0.01
17	6.31	7.11	0.17	0.33	-0.8	0.03
18	5.63	6.37	0.1	0.28	-0.07	0.07
19	4.95	5.77	0.06	0.25	0.31	0.14
20	4.29	5.05	0.06	0.28	0.36	0.14
21	4.3	5.36	0.06	0.25	0.46	0.13
22	3.87	4.74	0.02	0.24	0.67	0.23
23	3.68	4.53	0.03	0.27	0.6	0.2
24	3.72	4.65	-0.01	0.19	0.97	0.36
25	3.55	4.44	0.03	0.26	0.67	0.22
26	3.7	4.6	-0.01	0.19	0.99	0.39
27	3.69	4.59	-0.03	0.15	1.19	0.51
28	8.54	10.09	0.19	0.21	-0.34	0.02
29	6.74	7.61	0.27	0.34	-0.94	0.01
30	5.27	6.07	0.19	0.33	-0.34	0.02
31	4.58	5.45	0.05	0.23	0.56	0.16
32	4.03	4.85	0.09	0.29	0.45	0.09
33	3.56	4.51	0.09	0.29	0.58	0.08
34	3.04	3.82	0.22	0.47	-0.1	0.01
35	2.82	3.81	0.1	0.35	0.6	0.08

36	2.63	3.54	0.17	0.45	0.28	0.03
37	2.75	3.7	0.1	0.38	0.51	0.07
38	2.75	3.63	0.09	0.38	0.55	0.09
39	2.76	3.66	0.07	0.36	0.62	0.13
40	6.8	7.67	0.28	0.33	-0.87	0.01
41	5.85	6.76	0.15	0.28	-0.16	0.04
42	4.78	5.94	0.14	0.27	0.2	0.05
43	3.92	4.97	0.09	0.26	0.62	0.09
44	3.22	4.24	0.11	0.31	0.62	0.07
45	2.72	3.8	0.18	0.38	0.52	0.03
46	2.6	3.73	0.11	0.35	0.72	0.07
47	2.39	3.44	0.13	0.41	0.63	0.05
48	2.14	3.24	0.15	0.45	0.58	0.04
49	2.34	3.41	0.09	0.38	0.76	0.09
50	2.12	3.15	0.14	0.47	0.62	0.05
51	5.73	7.03	0.22	0.27	-0.1	0.01
52	4.61	6.46	0.15	0.23	0.42	0.04
53	3.92	5.46	0.13	0.25	0.63	0.05
54	3.7	4.89	0.09	0.25	0.77	0.09
55	2.74	3.88	0.13	0.34	0.72	0.05
56	2.49	3.61	0.13	0.37	0.73	0.05
57	2.21	3.38	0.16	0.41	0.74	0.03
58	2	3.21	0.15	0.44	0.8	0.04
59	1.9	3.08	0.17	0.48	0.67	0.03
60	1.92	3.08	0.16	0.48	0.7	0.04
61	4.98	6.32	0.09	0.22	0.49	0.1
62	4.16	6.16	0.07	0.18	0.97	0.12
63	3.66	5.42	0.07	0.2	0.99	0.12
64	2.95	4.18	0.13	0.31	0.75	0.05
65	2.28	3.44	0.23	0.43	0.57	0.01
66	2.12	3.38	0.17	0.41	0.77	0.03
67	1.88	3.08	0.18	0.48	0.73	0.02
68	1.82	2.99	0.21	0.51	0.66	0.02
69	1.79	3.05	0.16	0.48	0.83	0.04
70	4.55	6.45	0.06	0.17	0.89	0.13
71	4.51	6.75	0.01	0.12	1.21	0.27
72	3.49	5.44	0.05	0.18	1.14	0.15
73	2.78	4.3	0.19	0.31	0.82	0.02
74	2.1	3.34	0.2	0.42	0.73	0.02
75	1.88	3.11	0.2	0.47	0.75	0.02

76	1.7	3	0.2	0.5	0.82	0.02
77	1.77	3.01	0.18	0.49	0.84	0.03
78	3.74	5.99	0.09	0.19	0.98	0.09
79	3.64	6.47	0.03	0.13	1.28	0.2
80	3.02	5.45	0.1	0.2	1.11	0.07
81	2.39	4.16	0.11	0.28	1.06	0.06
82	1.93	3.4	0.15	0.39	0.95	0.04
83	1.86	3.16	0.16	0.44	0.91	0.03
84	1.7	3.03	0.17	0.48	0.91	0.03
85	3.78	6.1	0.07	0.17	1.12	0.12
86	3.16	5.81	0.08	0.18	1.17	0.11
87	2.68	4.95	0.12	0.23	1.09	0.06
88	2.14	3.96	0.15	0.32	0.99	0.04
89	1.85	3.3	0.18	0.42	0.93	0.02
90	1.69	2.96	0.21	0.51	0.86	0.02
91	3.07	5.5	0.16	0.23	0.98	0.03
92	2.74	5.12	0.11	0.22	1.11	0.07
93	2.4	4.63	0.19	0.28	0.97	0.02
94	2.01	3.77	0.16	0.34	1.01	0.03
95	1.71	3.16	0.18	0.44	0.97	0.02
96	2.89	5.57	0.15	0.22	1.02	0.04
97	2.6	5.26	0.13	0.22	1.15	0.05
98	2.06	4.19	0.19	0.31	1.03	0.02
99	1.89	3.59	0.15	0.36	1.05	0.04
100	2.69	5.4	0.1	0.2	1.17	0.08
101	2.3	4.53	0.13	0.26	1.1	0.05
102	2.01	4.3	0.13	0.27	1.18	0.05
103	2.36	4.65	0.14	0.26	1.11	0.04
104	2.01	4.29	0.15	0.28	1.13	0.04
105	2.04	4.45	0.13	0.26	1.17	0.05

3.3.3. Spruce with no bark beetle submodel

105 *Figure S 3.3.3 – Model statistics (MAE, RMSE and R^2_{adj}) for each soil scenario for spruce simulations in the absence of the bark beetle model.*

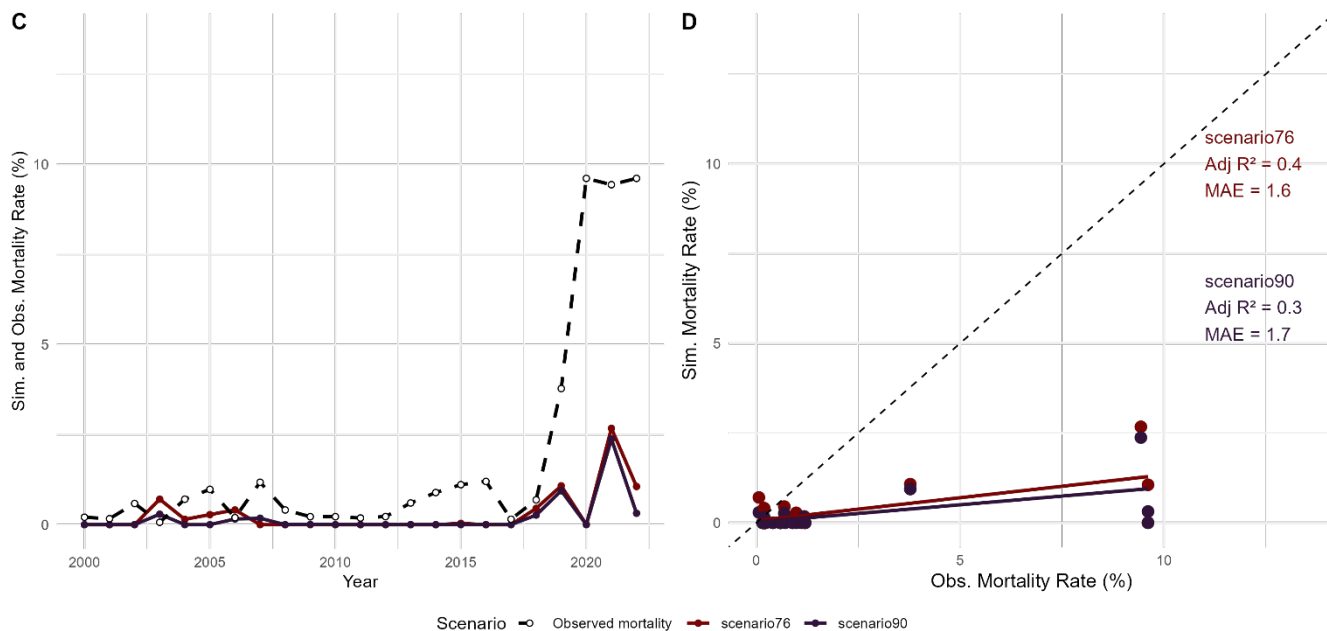


110 *Table S 3.3.3* – Summary of model statistics (MAE, RMSE, R^2_{adj} , Slope, Intercept and P-value) for each scenario for the spruce-dominated sites. In this case, the bark beetle routine was switched off. Highlighted in red are the two best soil moisture scenarios selected as best ones in the bark beetle simulations.

Scenario	MAE	RMSE	R^2_{adj}	Slope	Intercept	P-Value
1	1.29	2.17	0.47	1.11	0.3	0
2	1.44	2.54	0.27	0.91	0.63	0.01
3	1.83	3.03	0.04	0.47	1.08	0.18
4	2.13	3.45	-0.03	0.17	1.51	0.59
5	2.29	3.66	-0.04	0.07	1.67	0.81
6	2.38	3.79	-0.05	0.02	1.76	0.94
7	2.38	3.8	-0.05	0.03	1.74	0.91
8	2.45	3.91	-0.05	0.01	1.79	0.97
9	2.52	4	-0.05	-0.02	1.84	0.94
10	2.55	4.03	-0.05	-0.02	1.85	0.94
11	2.58	4.08	-0.05	-0.02	1.85	0.93
12	2.64	4.16	-0.05	-0.04	1.9	0.86
13	2.67	4.2	-0.05	-0.03	1.88	0.89
14	2.71	4.28	-0.05	-0.04	1.89	0.87
15	1.36	2.56	0.29	0.82	0.84	0
16	1.45	2.61	0.27	1	0.77	0.01
17	1.63	2.86	0.11	0.82	0.95	0.07
18	1.83	3.11	-0.01	0.42	1.32	0.37
19	1.93	3.23	-0.04	0.22	1.54	0.63
20	1.94	3.25	-0.04	0.2	1.57	0.66
21	1.98	3.3	-0.04	0.14	1.63	0.74
22	2	3.34	-0.04	0.1	1.68	0.81
23	2.01	3.35	-0.05	0.09	1.69	0.84
24	2.02	3.35	-0.05	0.09	1.69	0.84
25	2.06	3.39	-0.05	0.05	1.74	0.9
26	2.08	3.41	-0.05	0.04	1.74	0.91
27	2.08	3.41	-0.05	0.05	1.74	0.9
28	1.52	2.74	0.2	0.74	0.98	0.02
29	1.44	2.63	0.3	1.22	0.76	0
30	1.53	2.8	0.2	1.28	0.76	0.02
31	1.67	3.01	0.05	0.91	1.07	0.16
32	1.73	3.13	-0.01	0.58	1.35	0.4
33	1.75	3.16	-0.02	0.47	1.43	0.49
34	1.77	3.17	-0.03	0.4	1.48	0.56
35	1.79	3.18	-0.03	0.37	1.5	0.58

36	1.82	3.22	-0.04	0.23	1.61	0.72
37	1.81	3.2	-0.04	0.29	1.55	0.65
38	1.82	3.21	-0.04	0.24	1.59	0.69
39	1.84	3.25	-0.04	0.17	1.65	0.77
40	1.46	2.68	0.26	1.08	0.87	0.01
41	1.39	2.66	0.35	1.46	0.76	0
42	1.5	2.85	0.33	2.27	0.39	0
43	1.59	3.04	0.12	1.86	0.7	0.06
44	1.64	3.14	0.02	1.21	1.11	0.24
45	1.64	3.14	0.02	1.13	1.16	0.26
46	1.64	3.15	0.01	1.08	1.19	0.29
47	1.66	3.18	-0.01	0.84	1.32	0.41
48	1.67	3.2	-0.03	0.67	1.42	0.51
49	1.68	3.2	-0.02	0.7	1.4	0.48
50	1.68	3.21	-0.03	0.6	1.45	0.54
51	1.4	2.67	0.32	1.34	0.83	0
52	1.41	2.86	0.34	2.25	0.56	0
53	1.49	2.97	0.37	3.41	0.08	0
54	1.56	3.1	0.2	3.16	0.38	0.02
55	1.58	3.17	0.09	2.52	0.72	0.09
56	1.59	3.18	0.08	2.45	0.78	0.11
57	1.6	3.19	0.07	2.35	0.85	0.12
58	1.62	3.22	0.02	1.79	1.07	0.23
59	1.61	3.22	0.02	1.74	1.08	0.25
60	1.61	3.2	0.04	1.97	0.97	0.19
61	1.41	2.88	0.35	2.37	0.58	0
62	1.47	3.03	0.24	2.48	0.72	0.01
63	1.5	3.08	0.23	3.01	0.52	0.01
64	1.55	3.16	0.23	4.31	0.17	0.01
65	1.56	3.17	0.22	4.33	0.24	0.01
66	1.59	3.22	0.14	3.81	0.57	0.04
67	1.59	3.22	0.14	3.96	0.53	0.04
68	1.58	3.23	0.14	4.2	0.47	0.04
69	1.58	3.23	0.13	3.88	0.55	0.05
70	1.47	3.02	0.25	2.42	0.77	0.01
71	1.51	3.1	0.14	2.04	0.95	0.04
72	1.5	3.13	0.14	2.2	0.97	0.04
73	1.53	3.16	0.22	3.87	0.49	0.01
74	1.56	3.18	0.35	5.99	0.04	0
75	1.57	3.2	0.34	6.22	0.03	0

76	1.6	3.23	0.29	6.03	0.24	0
77	1.6	3.24	0.31	6.92	0.09	0
78	1.51	3.11	0.13	1.94	1	0.05
79	1.53	3.19	0.05	1.42	1.29	0.15
80	1.51	3.17	0.07	1.54	1.24	0.11
81	1.54	3.17	0.2	3.22	0.81	0.02
82	1.58	3.19	0.37	5.74	0.35	0
83	1.59	3.22	0.42	7.34	0.06	0
84	1.61	3.24	0.38	7.26	0.19	0
85	1.54	3.19	0.06	1.46	1.27	0.15
86	1.53	3.2	0.02	0.92	1.43	0.23
87	1.51	3.17	0.07	1.37	1.31	0.12
88	1.55	3.19	0.16	2.9	0.94	0.03
89	1.57	3.2	0.32	5.21	0.47	0
90	1.6	3.21	0.41	6.86	0.26	0
91	1.53	3.19	0.04	1.04	1.4	0.19
92	1.56	3.21	0.03	0.91	1.45	0.22
93	1.5	3.17	0.08	1.39	1.32	0.11
94	1.53	3.18	0.17	2.88	0.98	0.03
95	1.58	3.2	0.32	4.97	0.63	0
96	1.56	3.22	0.02	0.91	1.46	0.25
97	1.52	3.19	0.05	1.14	1.39	0.17
98	1.5	3.16	0.1	1.59	1.29	0.08
99	1.55	3.21	0.12	2.37	1.16	0.06
100	1.52	3.19	0.05	1.17	1.38	0.16
101	1.52	3.19	0.07	1.38	1.33	0.12
102	1.5	3.19	0.08	1.46	1.34	0.11
103	1.53	3.19	0.07	1.39	1.34	0.12
104	1.48	3.16	0.09	1.44	1.32	0.08
105	1.5	3.18	0.08	1.35	1.37	0.11



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Figure S 3.3.4. – Simulated and observed mortality rate over time averaged across spruce sites and grouped by soil scenario in the absence of the bark beetle model. Only the two best performing scenarios are shown.