

## Supplementary Material

### 1 Species parameters used for TreeMig simulations

Table S1: Species parameters relevant for the study of the 30 species modelled in the TreeMig simulations. Explanations of the parameters can be found in Table S2.

Spp	D <sub>max</sub>	H <sub>max</sub>	A <sub>max</sub>	G	DD <sub>min</sub>	WiT	DrT	L <sub>s</sub>	L <sub>a</sub>	seedGerm	maxSeed	minMat
<i>Abies alba</i>	187	60	700	171	650	-2	0.19	3	1	0.46	50000	7.0
<i>Larix decidua</i>	100	44	850	219	225	-11	0.40	8	9	0.39	133000	4.0
<i>Picea abies</i>	180	50	930	171	385	-7	0.19	3	6	0.71	96500	10.1
<i>Pinus cembra</i>	165	26	1050	115	225	-11	0.28	8	5	0.64	1000	2.4
<i>Pinus montana</i>	80	23	300	100	330	-11	0.25	8	9	0.54	11000	1.6
<i>Pinus sylvestris</i>	80	40	760	243	650	-4	0.4	7	9	0.91	22000	2.6
<i>Taxus baccata</i>	55	22	2110	171	1000	-5	0.05	4	2	0.6	23000	0.6
<i>Acer campestre</i>	55	23	170	177	1000	-2	0.1	5	5	0.8	193000	4.1
<i>Acer platanoides</i>	99	32	380	220	1000	-2	0.15	2	4	0.55	510000	3.1
<i>Acer pseudoplatanus</i>	121	37	550	240	615	-2	0.2	3	4	0.6	551500	2.6
<i>Alnus glutinosa</i>	90	31	240	227	900	-2	0.05	5	5	0.4	218500	4.5
<i>Alnus incana</i>	90	22	150	188	675	0	0.2	6	7	0.33	400000	2.6
<i>Alnus viridis</i>	11	4	100	60	272	-11	0.05	7	7	0.15	47000	2.3
<i>Betula pendula</i>	90	29	220	195	541	0	0.3	7	9	0.19	11775000	4.5
<i>Carpinus betulus</i>	90	27	220	202	1460	-5	0.1	4	3	0.67	154000	3.4
<i>Castanea sativa</i>	198	33	1510	146	1200	0	0.21	5	5	0.58	4000	2.2
<i>Corylus avellana</i>	22	10	70	95	900	-5	0.2	6	6	0.3	6000	0.7
<i>Fagus sylvatica</i>	154	45	430	279	620	-4	0.23	24	1	0.71	29000	14.7
<i>Fraxinus excelsior</i>	154	42	350	273	820	-2	0.23	5	6	0.6	42000	5.0
<i>Populus nigra</i>	100	36	280	258	1700	0	0.1	6	5	0.2	1890000	2.7
<i>Populus tremula</i>	90	30	140	199	850	0	0.23	6	7	0.4	1680000	4.8
<i>Quercus petraea</i>	110	45	860	281	900	0	0.2	7	7	0.69	47000	10.2
<i>Quercus pubescens</i>	66	25	500	142	1200	-4	0.5	7	7	0.7	18000	8.7
<i>Quercus robur</i>	143	52	1060	355	1100	0	0.15	5	9	0.75	27500	11.6
<i>Salix alba</i>	220	27	170	121	657	-5	0.15	6	5	0.2	1512000	15.6

<i>Sorbus aria</i>	70	22	180	171	650	-5	0.15	6	7	0.6	80500	2.6
<i>Sorbus aucuparia</i>	70	19	110	177	500	-3	0.15	4	7	0.7	3755000	3.6
<i>Tilia cordata</i>	110	30	940	199	950	0	0.25	5	5	0.45	720000	2.2
<i>Tilia platyphyllos</i>	110	39	960	235	850	0	0.2	4	3	0.48	380500	1.6
<i>Ulmus scabra</i>	100	43	480	277	957	0	0.15	4	3	0.35	372000	6.4

Table S2: Definition and unit of species parameters (cf. Table S1).

Parameter	Definition	Unit
$D_{max}$	Max. diameter at breast height (DBH)	cm
$H_{max}$	Max. height	m
$A_{max}$	Max. age	year
$G$	Max. growth rate	cm/year
$DD_{min}$	Min. early degree-day sum above 5.5°C	degree-day
$WiT$	Min. mean temperature of winter months (Dec, Jan, Feb)	°C
$DrT$	Drought tolerance: prob. of evapotranspiration deficit tolerated	
$Ls$	Sapling light parameter: shade-tolerant (1) to shade-intolerant (9)	
$La$	Adult light parameter: shade-tolerant (1) to shade-intolerant (9)	
$seedGerm$	Seed germination rate	year <sup>-1</sup>
$maxSeed$	Max. number of seeds	
$minMat$	Min. height for maturity	m

## **2 Parameters for quantification of the elements at risk**

Table S3: Standard values for the most frequent object categories of the considered elements at risk according to FOEN (2020).

<b>Object category</b>	<b>Base value</b>	<b>unity</b>
Stable	80	CHFm <sup>-3</sup>
Apartment house	550'000	CHFappartment <sup>-1</sup>
Single family house	650'000	CHFappartment <sup>-1</sup>
Industrial building	280	CHFm <sup>-3</sup>
Forest road	700	CHFm <sup>-1</sup>
Municipality road	2300	CHFm <sup>-1</sup>
Cantonal road	4100	CHFm <sup>-1</sup>
Railway (single-lane)	6300	CHFm <sup>-1</sup>

Table S4: Vulnerability values for objects ( $V_{obj}$ ) and persons ( $V_{pers}$ ) for the most frequent object categories of the element at risks for a low (0-30 kJ), medium (30-300 kJ) and high ( $> 300$  kJ) Intensity based on FOEN (2020).

Object category	$V_{obj}$ (low)	$V_{obj}$ (medium)	$V_{obj}$ (high)	$V_{pers}$ (low)	$V_{pers}$ (medium)	$V_{pers}$ (high)
Shed	0.01	0.8	0.9	0.0	0.03	0.5
Apartment house	0.01	0.1	0.3	0.0	0.0002	0.06
Single family house	0.01	0.1	0.3	0.0	0.002	0.06
Industrial building	0.01	0.1	0.3	0.0	0.0002	0.06
Public building	0.01	0.1	0.3	0.0	0.0002	0.06
Municipality road	0.1	0.5	1	0.1	0.8	1
Cantonal road	0.1	0.5	1	0.1	0.8	1
Railway (single lane)	0.1	0.3	0.6	$0.1*V_{pers}$ (high)	$0.6*V_{pers}$ (high)	$0.12/(1+\exp((124-v)/15))+0.004$

### 3 Evolution of basal area in spin-up simulations

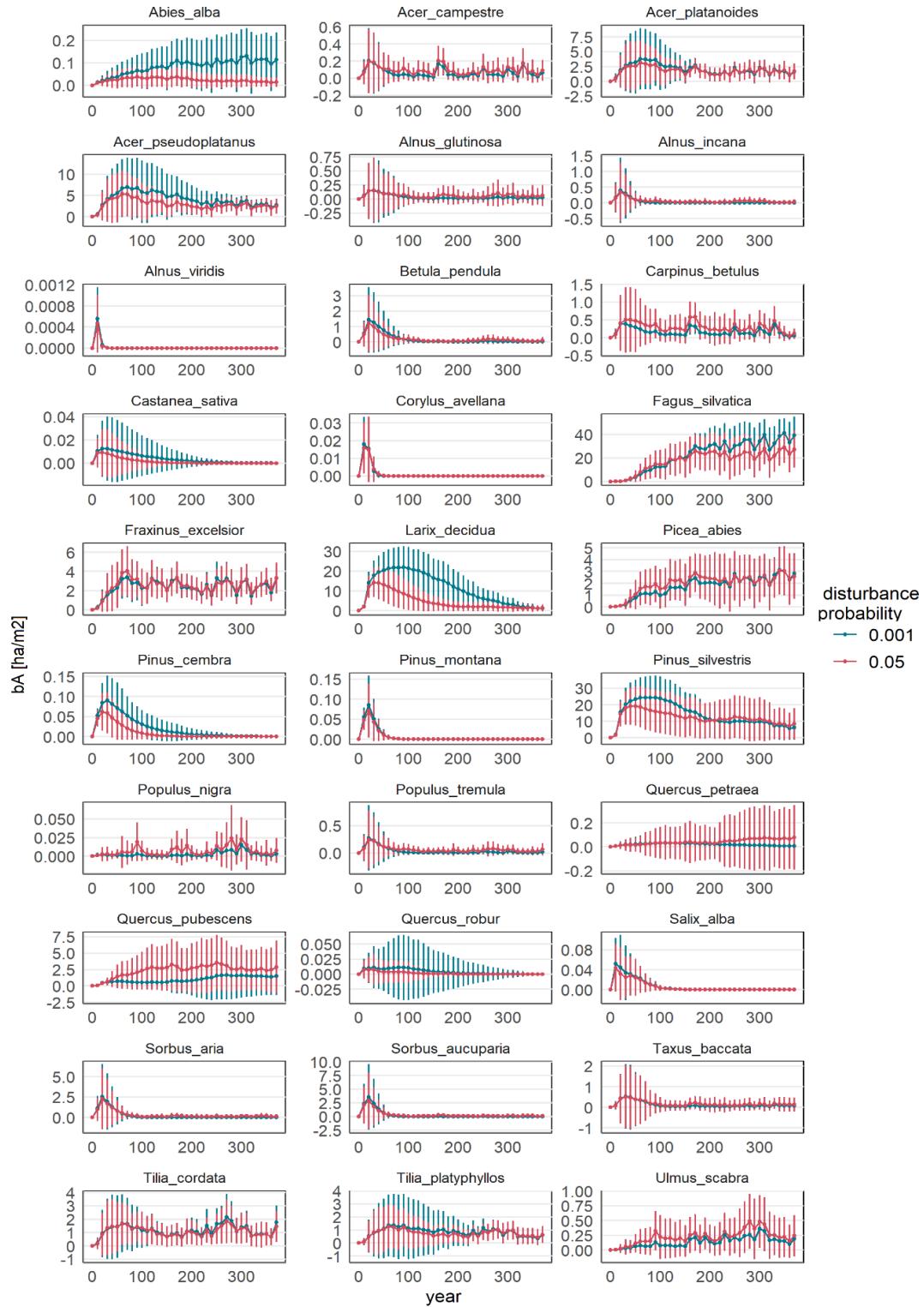


Figure S1: Evolution of basal area of all simulated species in the spin-up simulation with TreeMig (simulation from bare-ground for 400 years).

#### 4 Regeneration and tree density in intervention areas

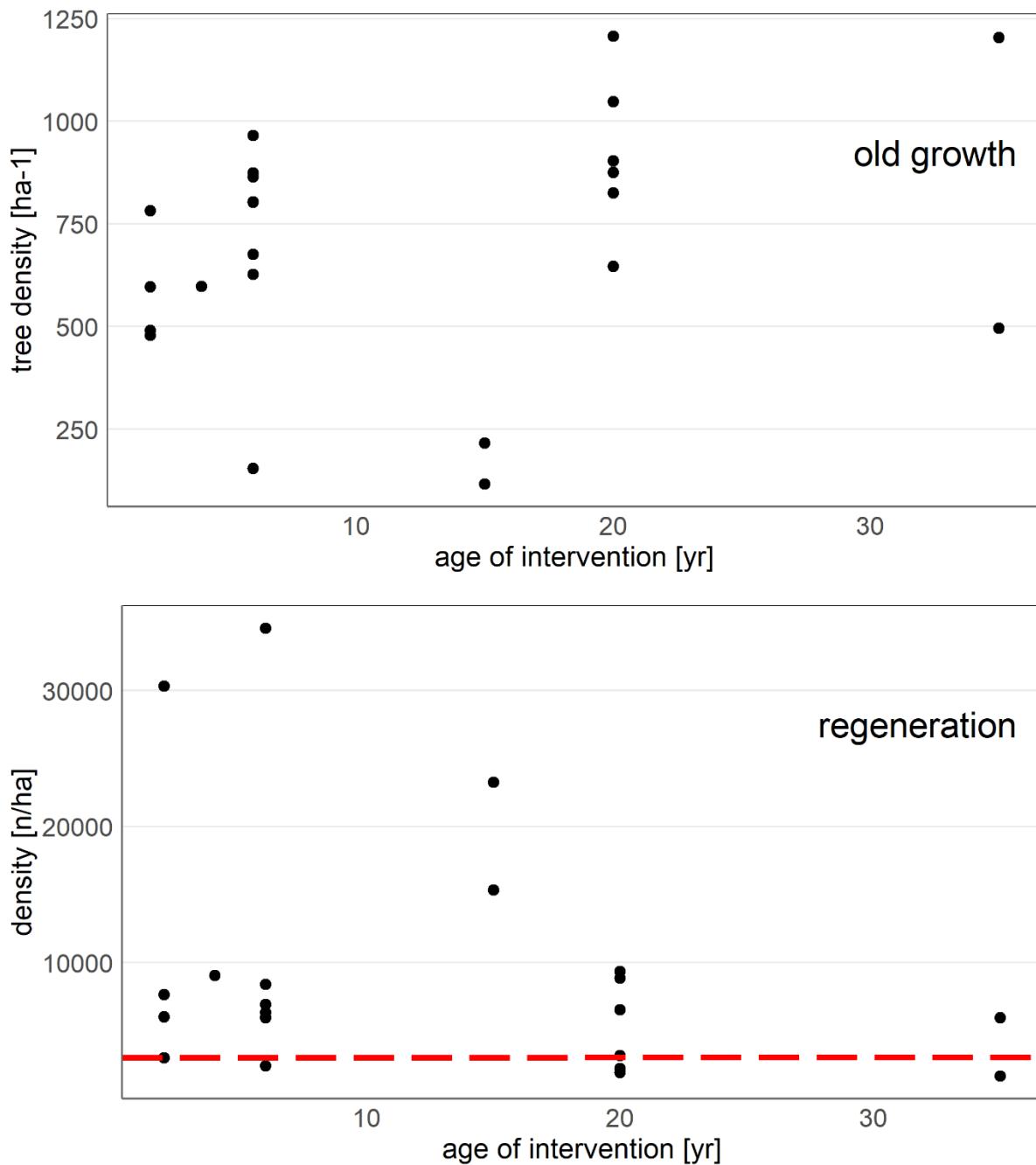


Figure S2: Density of adult trees (above) and of the regeneration in the sample plots depending on the age of intervention. The red line corresponds to a general regeneration target value according to Brang et al. (2020).

## 5 Expected risk per type of element at risk

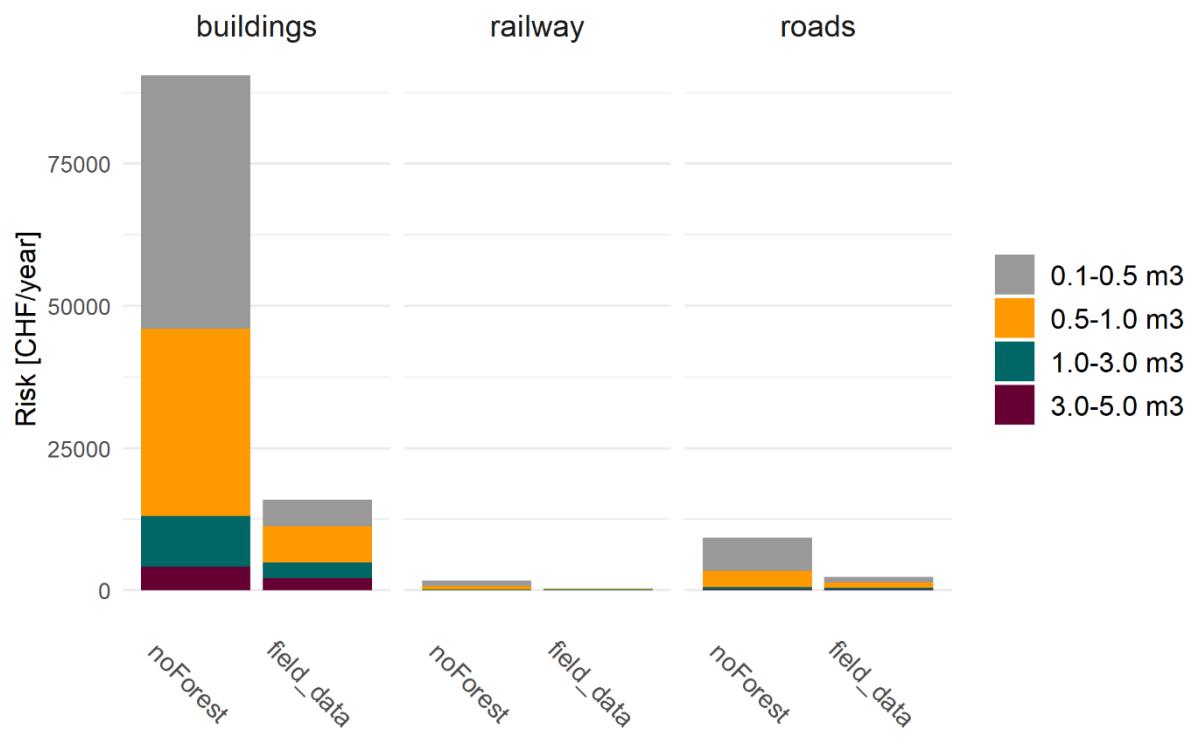


Figure S3: Yearly expected risk per element at risk (buildings, railway, roads) and block volume for the current forest (“field\_data”) and the situation without forest (“noForest”).

## 6 Risk maps

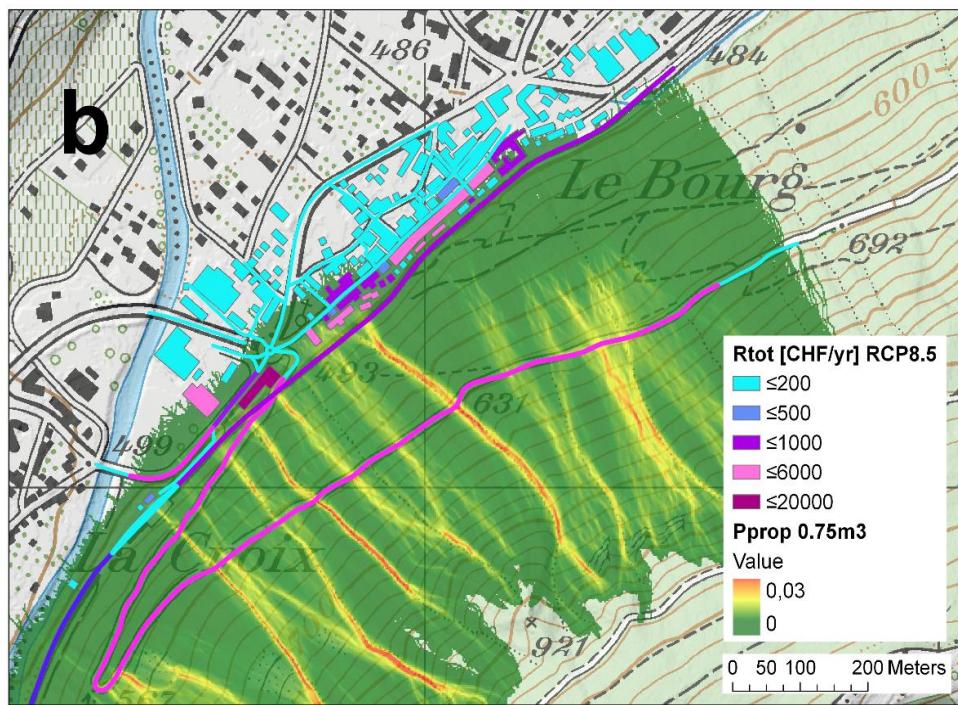
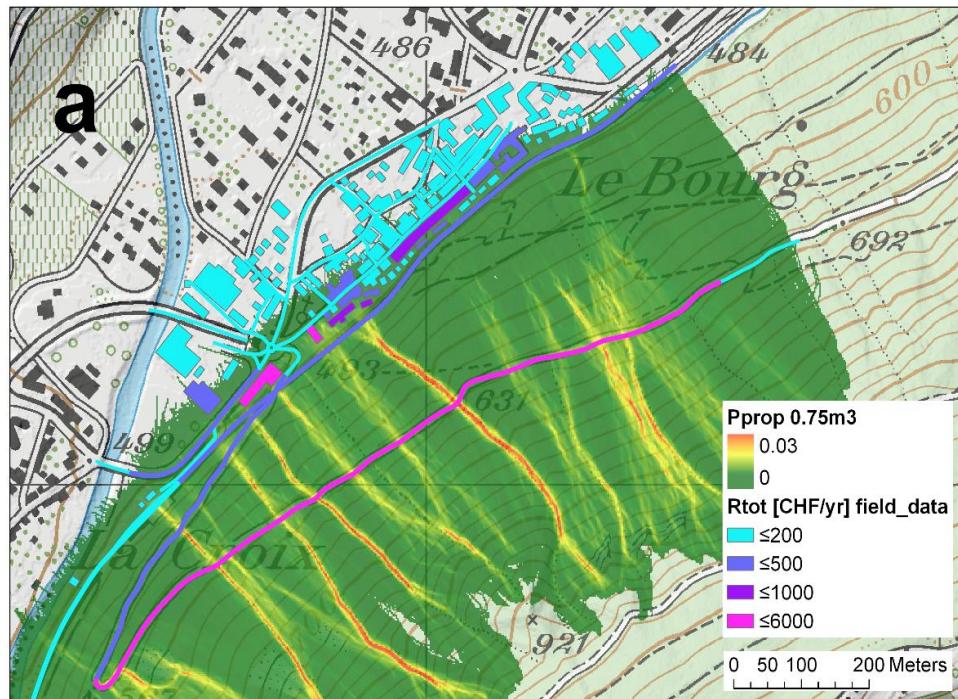


Figure S4: Map of total risk [ $\text{CHF yr}^{-1}$ ] for buildings, roads and railway in Martigny for the current forest based on field data (a) and the modelled forest under climate change scenario RCP8.5 (b), and the propagation probability of blocks with a volume of  $0.75 \text{ m}^3$ .