

Appendix A Supplementary Material

A.1 Application: simulation input maps

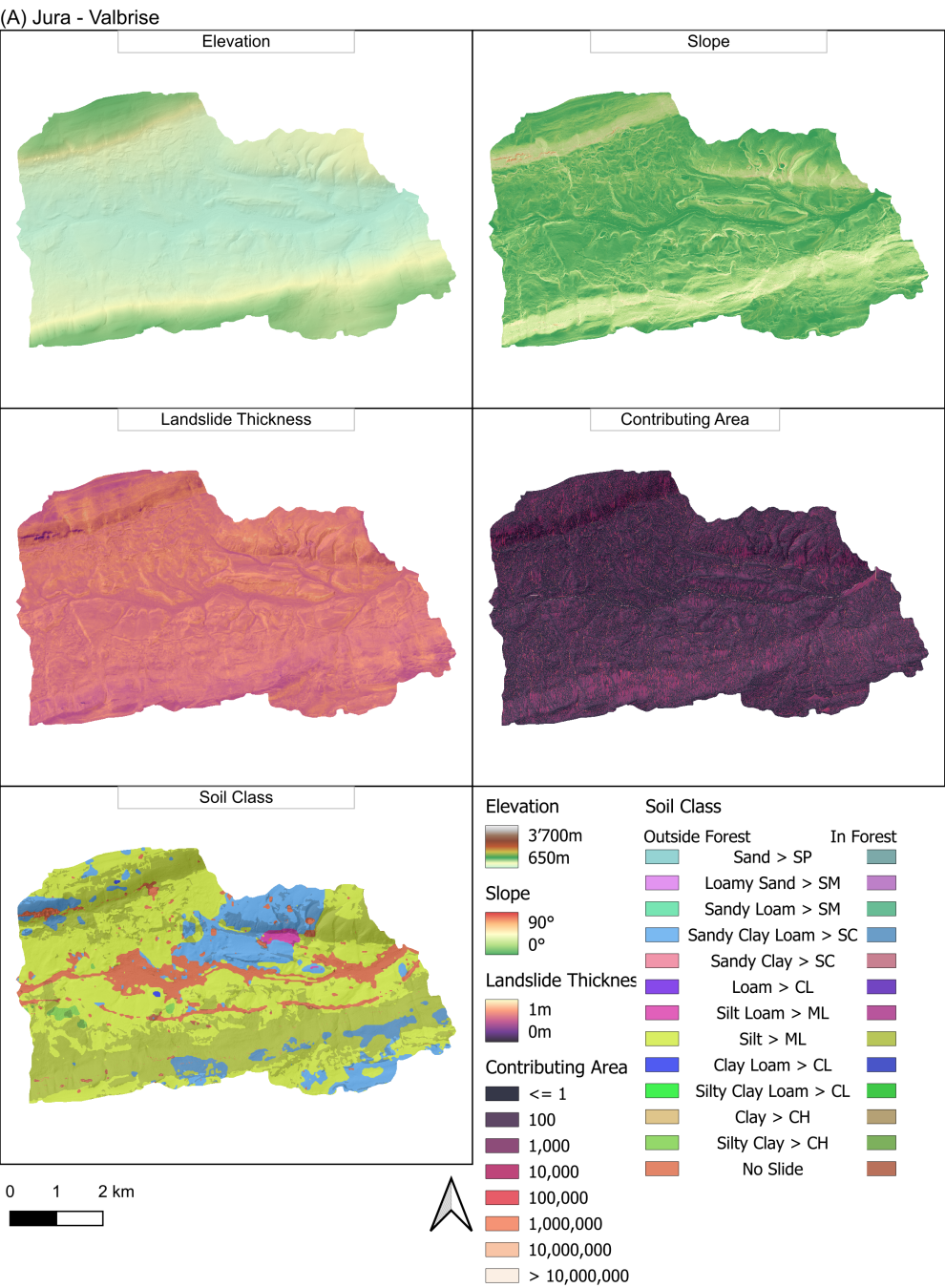


Fig. A1 Distribution of relevant simulation input data and derived factors for the Jura region catchment

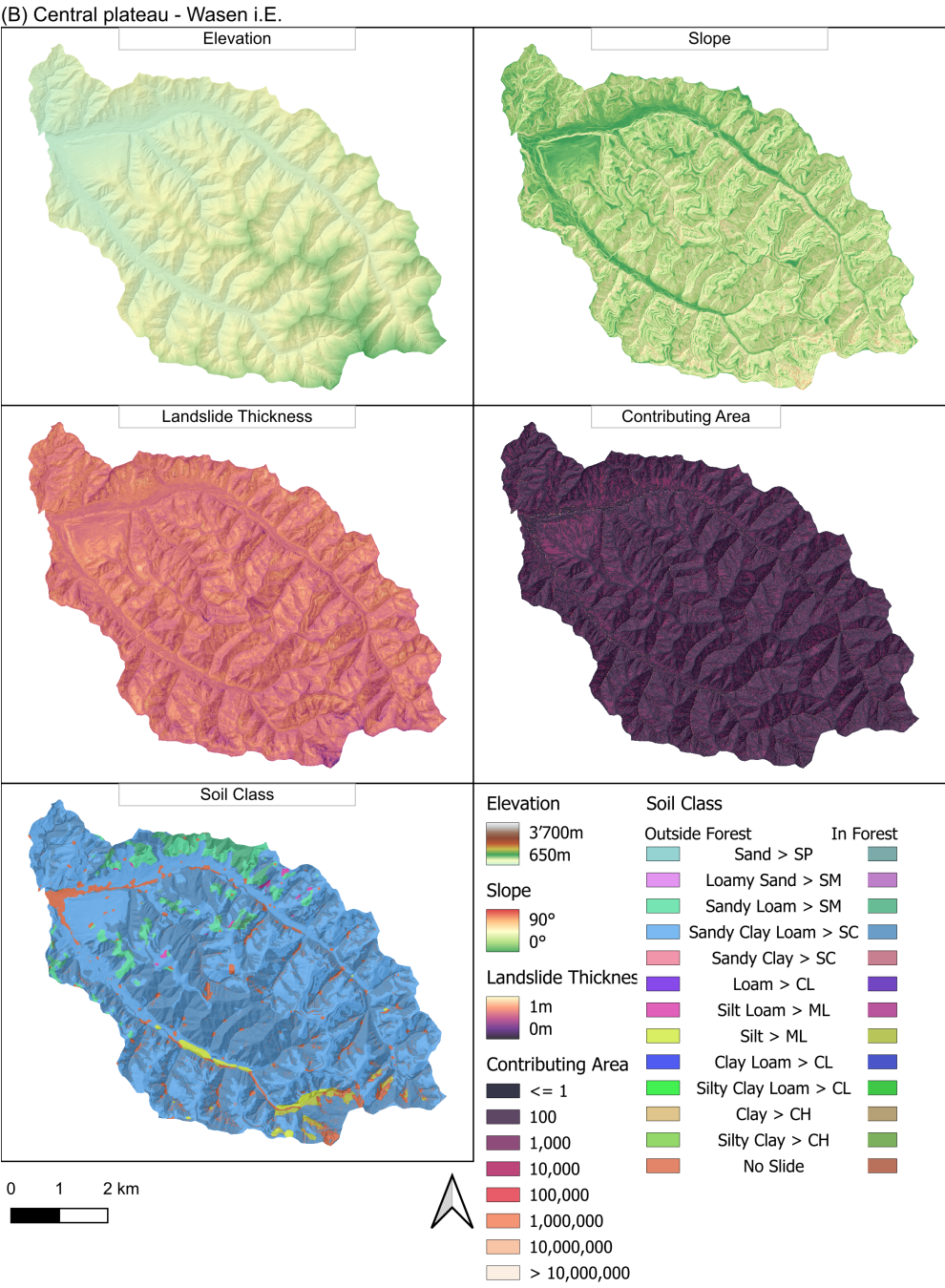


Fig. A2 Distribution of relevant simulation input data and derived factors for the Central Plateau region catchment

(C) Pre-Alps - Färnel

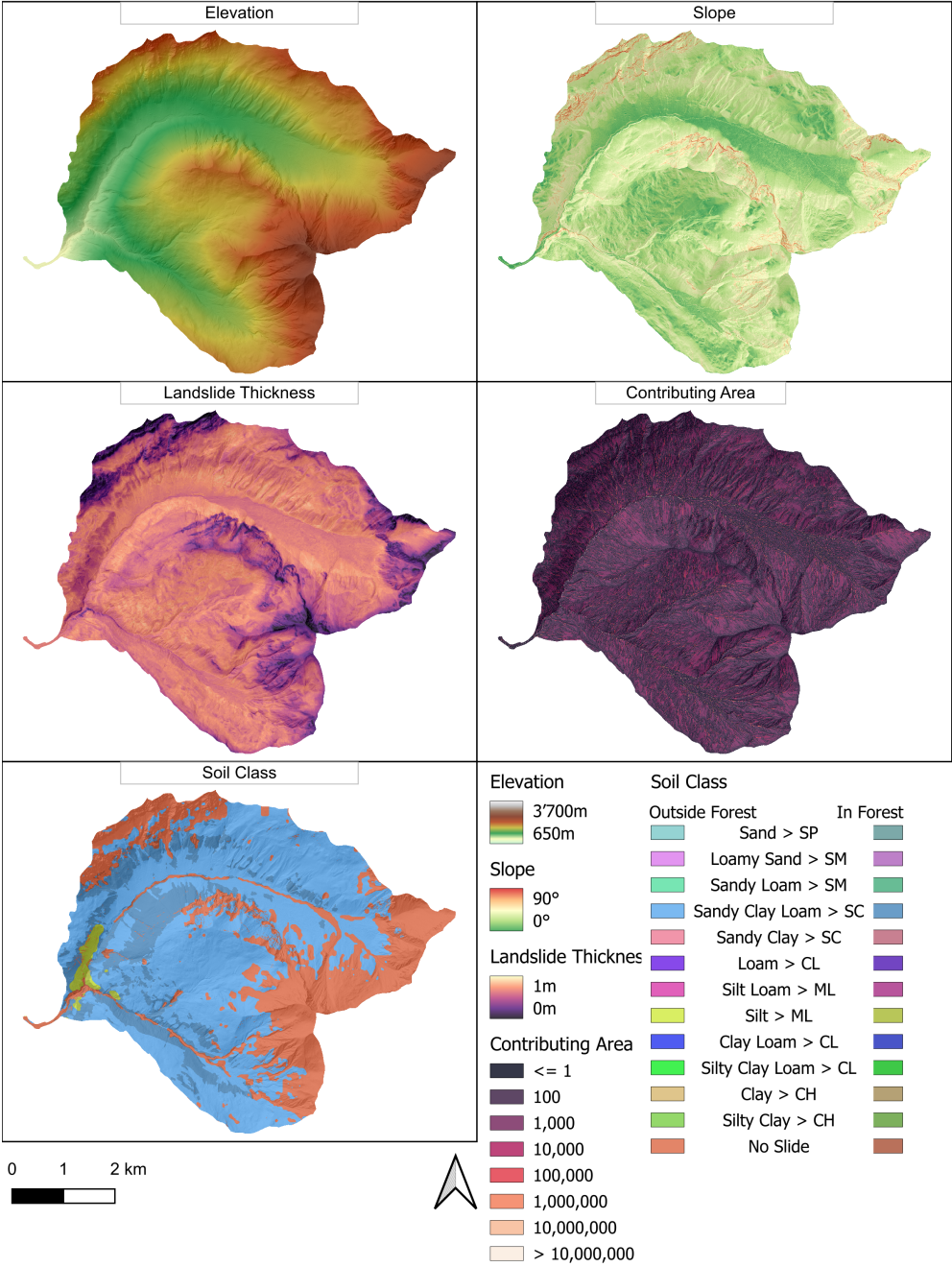


Fig. A3 Distribution of relevant simulation input data and derived factors for the pre-Alps region catchment

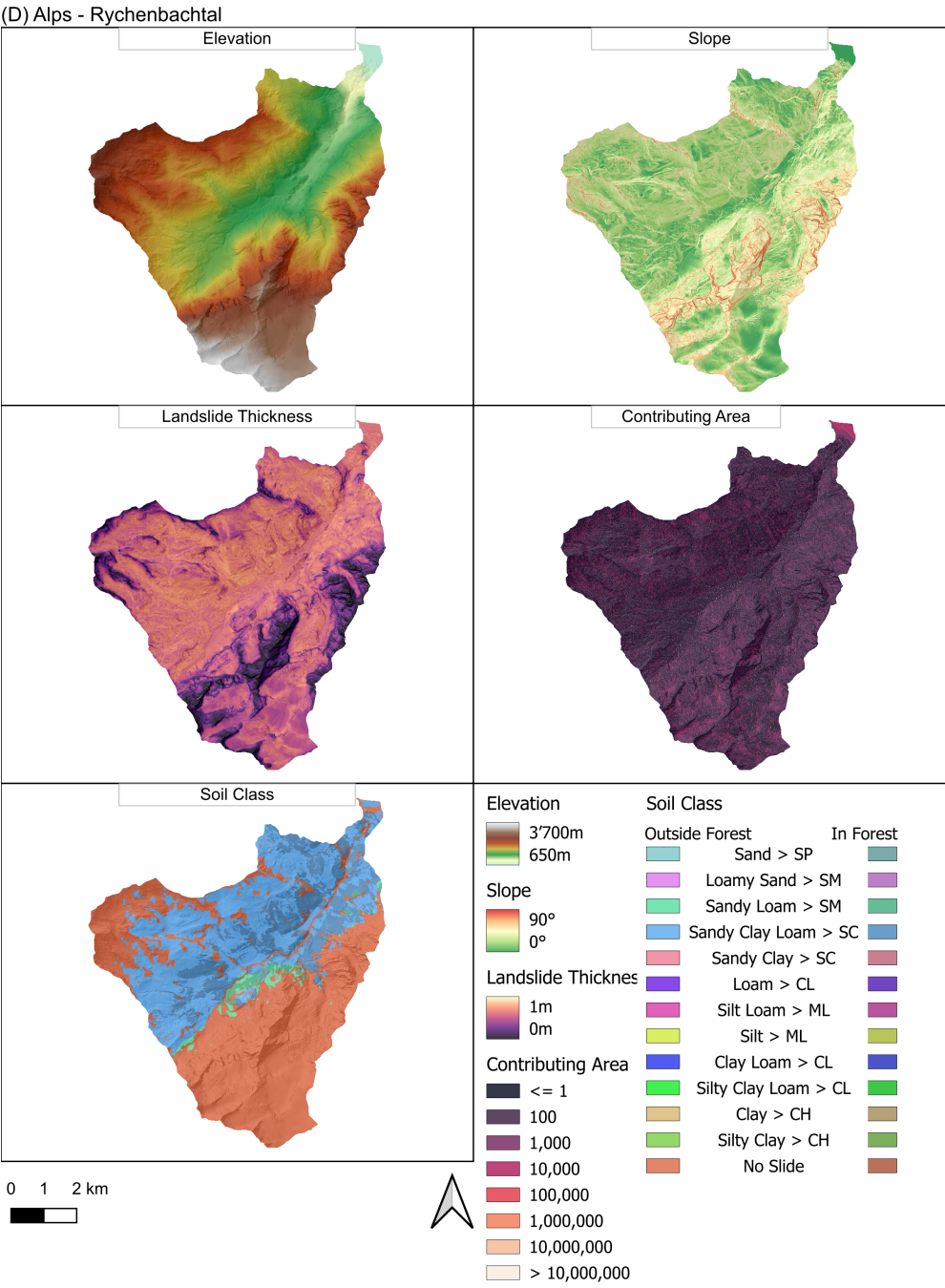


Fig. A4 Distribution of relevant simulation input data and derived factors for the Alps region catchment

A.2 USDA soil texture classes

Table A1 Mappings for sand, clay, and silt fractions to soil textures based on the multipoint triangle. (NRCS 2024)

Sand	A total of 25 per cent or more very coarse, coarse, and medium sand, a total of less than 25 per cent very coarse and coarse sand, and less than 50 per cent fine sand and less than 50 per cent very fine sand.
Loamy sand	A total of 25 per cent or more very coarse, coarse, and medium sand and a total of less than 25 per cent very coarse and coarse sand, and less than 50 per cent fine sand and less than 50 per cent very fine sand.
Sandy loam	A total of 30 per cent or more very coarse, coarse, and medium sand, but a total of less than 25 per cent very coarse and coarse sand and less than 30 per cent fine sand and less than 30 per cent very fine sand; or a total of 15 per cent or less very coarse, coarse, and medium sand, less than 30 per cent fine sand and less than 30 per cent very fine sand with a total of 40 per cent or less fine and very fine sand.
Loam	7 to 27 per cent clay, 28 to 50 per cent silt, and 52 per cent or less sand.
Silt loam	50 per cent or more silt and 12 to 27 per cent clay, or 50 to 80 per cent silt and less than 12 per cent clay.
Silt	80 per cent or more silt and less than 12 per cent clay.
Sandy clay loam	20 to 35 per cent clay, less than 28 per cent silt, and more than 45 per cent sand.
Clay loam	27 to 40 per cent clay and more than 20 to 46 per cent sand.
Silty clay loam	27 to 40 per cent clay and 20 per cent or less sand.
Sandy clay	35 per cent or more clay and 45 per cent or more sand.
Silty clay	40 per cent or more clay and 40 per cent or more silt.
Clay	40 per cent or more clay, 45 per cent or less sand, and less than 40 per cent silt.

A.3 Mappings for USDA soil texture classes to USCS classes

Table A2 Mappings of USDA soil texture classes to USCS soil classes based on consensus listed in Table 17 of [García-Gaines and Frankenstein \(2015\)](#)

USDA Classification	USCS Classification
Sand	SP
Loamy Sand	SM
Sandy Loam	SM
Sandy Clay Loam	SC
Sandy Clay	SC
Loam	CL
Silt Loam	ML
Silt	ML
Clay Loam	CL
Silty Clay Loam	CL
Clay	CH
Silty Clay	CH

A.4 Parameters for soil physical properties

Table A3 Parameters for the physical properties of the different soil texture classes. The *Expert* columns contain default values based on expert opinion. The *Min* and *Max* columns indicate the minimum and maximum bounds of the value ranges applied during optimisation

Soil ID	Soil Name	Porosity		Field capacity		Friction angle mean [°]			Friction angle std dev [°]		Cohesion mean [kPa]			Cohesion std dev [kPa]		Ks mean [m/d]			Ks std dev [m/d]	
		Expert		Expert		Expert	Min	Max	Expert		Expert	Min	Max	Expert		Expert	Min	Max	Expert	
1	Sand >SP	0.38	0.10	36					0		0			0		8600			0	
2	Loamy Sand >SM	0.37	0.16	34					0		0			0		20			0	
3	Sandy Loam >SM	0.37	0.21	34	29	34			0		0.5	0	5	0		20	10	100	0	
4	Sandy Clay Loam >SC	0.40	0.36	32	28	36			0		1.5	0	5	0		20	0	80	0	
5	Sandy Clay >SC	0.40	0.32	32					0		0			0		20			0	
6	Loam >CL	0.41	0.27	27					0		2			0		20			0	
7	Silt Loam >ML	0.47	0.3	33	28	34			0		0	0	5	0		20	0	80	0	
8	Silt >ML	0.47	0.29	33	29	37			0		0	0	5	0		20	0	80	0	
9	Clay Loam >CL	0.41	0.29	27					0		2			0		20			0	
10	Silty Clay Loam >CL	0.41	0.28	27					0		2			0		20			0	
11	Clay >CH	0.56	0.22	22					0		2.5			0		20			0	
12	Silty Clay >CH	0.56	0.20	22					0		2.5			0		20			0	
13	NoSlide	0	0.17	90					0		999			0		20000			0	
21	Sand >SP in Forest	0.38	0.1	36					0		0			0		9300			0	
22	Loamy Sand >SM in Forest	0.37	0.16	34					0		0			0		720			0	
23	Sandy Loam >SM in Forest	0.37	0.21	34 ¹					0		0.5 ¹			0		720 ¹			0	
24	Sandy Clay Loam >SC in Forest	0.40	0.36	32 ¹					0		1.5 ¹			0		720 ¹			0	
25	Sandy Clay >SC in Forest	0.40	0.32	32					0		0			0		720			0	
26	Loam >CL in Forest	0.41	0.27	27					0		2			1		720			0	
27	Silt Loam >ML in Forest	0.47	0.30	33 ¹					0		0 ¹			0		720 ¹			0	
28	Silt >ML in Forest	0.47	0.29	33 ¹					0		0 ¹			0		720 ¹			0	
29	Clay Loam >CL in Forest	0.41	0.29	27					0		2			1		720			0	
30	Silty Clay Loam >CL in Forest	0.41	0.28	27					0		2			1		720			0	
31	Clay >CH in Forest	0.56	0.22	22					0		2.5			1		720			0	
32	Silty Clay >CH in Forest	0.56	0.2	22					0		2.5			1		720			0	
33	NoSlide in Forest	0	0.17	90					0		999			0		20000			0	

¹ Parameter value is coupled with corresponding soil class outside forest.

A.5 Sensitivity analysis: second-order indices for interactions

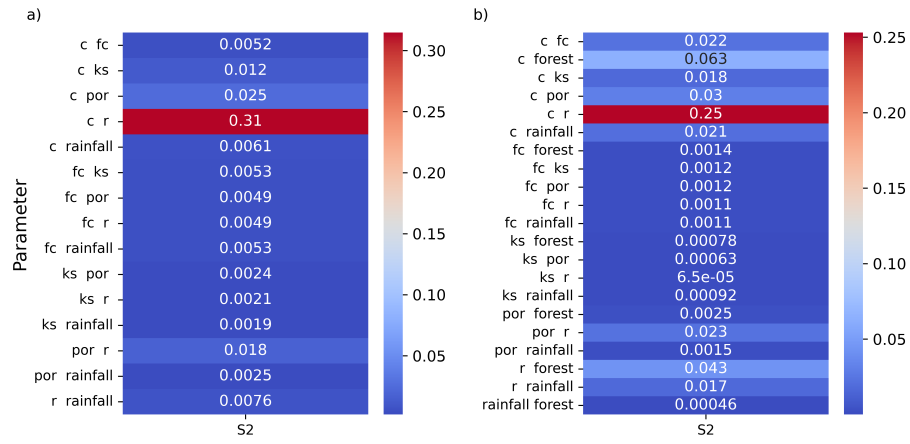


Fig. A5 Heatmap showing the aggregated Sobol second-order (S2) indices for parameter combinations for a) the general analysis with six parameters using all 612 plots and b) the analysis with an additional forest parameter using the 208 plots with at least 50% forest cover

A.6 Optimisation: detailed results

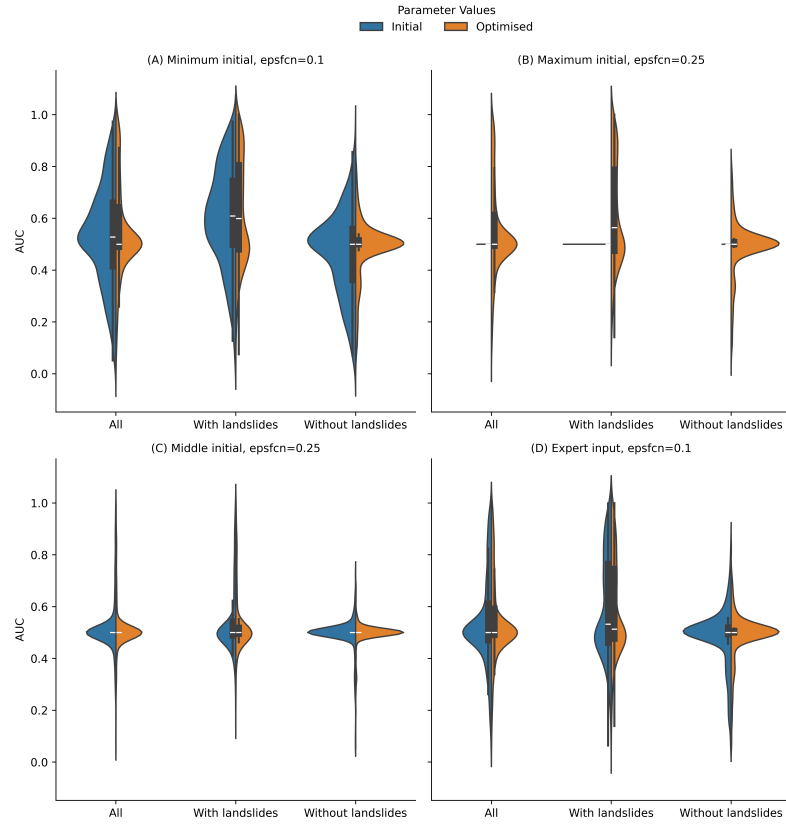


Fig. A6 Split violin plots showing the distribution of the *AUC* over the hectare plots for the initial values in blue vs. the optimised values for selected variants in orange, grouped according to the presence of observed landslides in the plot. The “All” group includes both plots with and without observed landslides

A.7 Application: detailed results

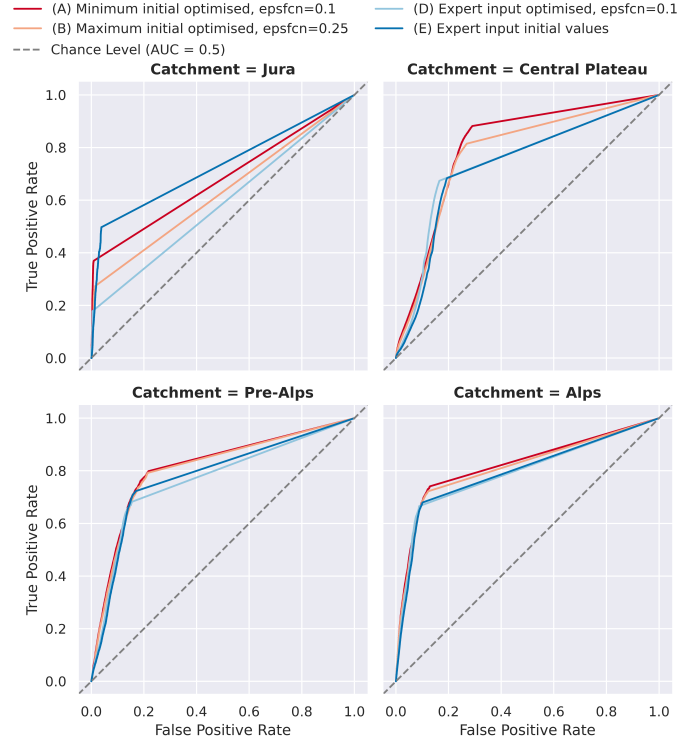


Fig. A7 ROC AUC curve plots for the application of four different sets of soil physical property parameters in the four selected catchments

Table A4 Table with the sum of the absolute landslide probability and the correction factors per catchment, simulation, and reference area for the calculation of the correction factor

Simulation	Reference area Variant	Sum of absolute landslide probability				Correction factor			
		Jura	Central Plateau	Pre-Alps	Alps	Jura	Central Plateau	Pre-Alps	Alps
(A) Minimum initial optimised, epsfcn=0.1	Catchment	3.46	178.32	36.35	38.88	0.000661	0.000370	0.000063	0.000084
	Hectares	86.44	974.20	440.10	786.55	0.016487	0.002020	0.000763	0.001694
	microcatchments	487.12	335.81	249.38	187.15	0.092906	0.000696	0.000433	0.000403
(B) Maximum initial optimised, epsfcn=0.25	Catchment	3.59	175.20	35.73	38.10	0.000480	0.000437	0.000066	0.000093
	Hectares	189.86	900.32	418.14	717.03	0.025404	0.002245	0.000773	0.001754
	microcatchments	867.49	337.77	254.12	170.63	0.116071	0.000842	0.000470	0.000417
(D) Expert input optimised, epsfcn=0.1	Catchment	4.03	183.18	31.21	35.95	0.000763	0.001244	0.000152	0.000199
	Hectares	3132.75	896.99	230.26	814.56	0.593447	0.006091	0.001120	0.004514
	microcatchments	84073.06	419.73	331.57	186.67	15.926234	0.002850	0.001613	0.001035
(E) Expert input initial values	Catchment	3.59	182.24	33.17	37.02	0.000129	0.000838	0.000131	0.000163
	Hectares	128.42	1313.05	301.86	950.80	0.004629	0.006038	0.001193	0.004187
	microcatchments	137.47	505.43	260.36	192.92	0.004955	0.002324	0.001029	0.000850

Jura - Valbrise

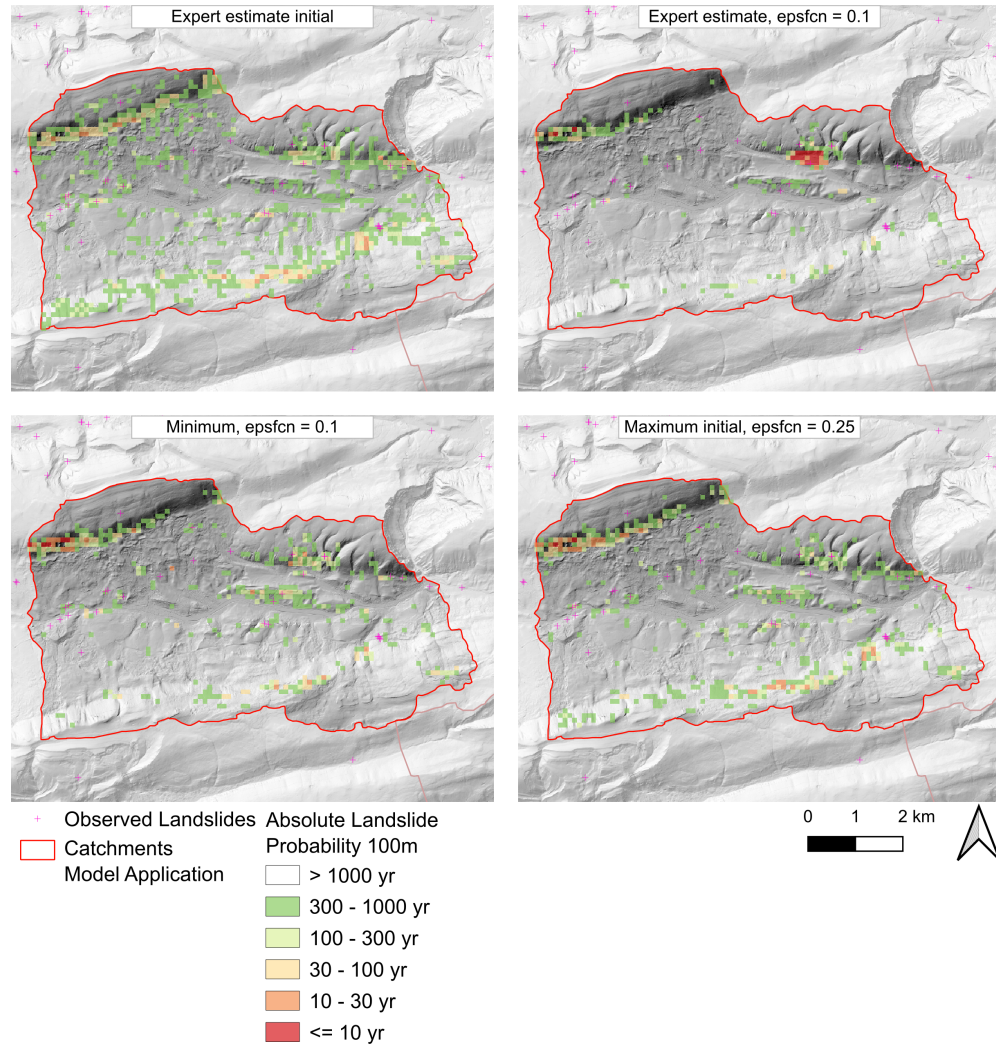


Fig. A8 Maps showing the absolute landslide occurrence probability from the application of selected optimisation results in the Jura region catchment. The probability was calculated using the entire catchment as the reference area and aggregated to 100 m cell size for visualisation purposes

Central Plateau - Wasen i.E.

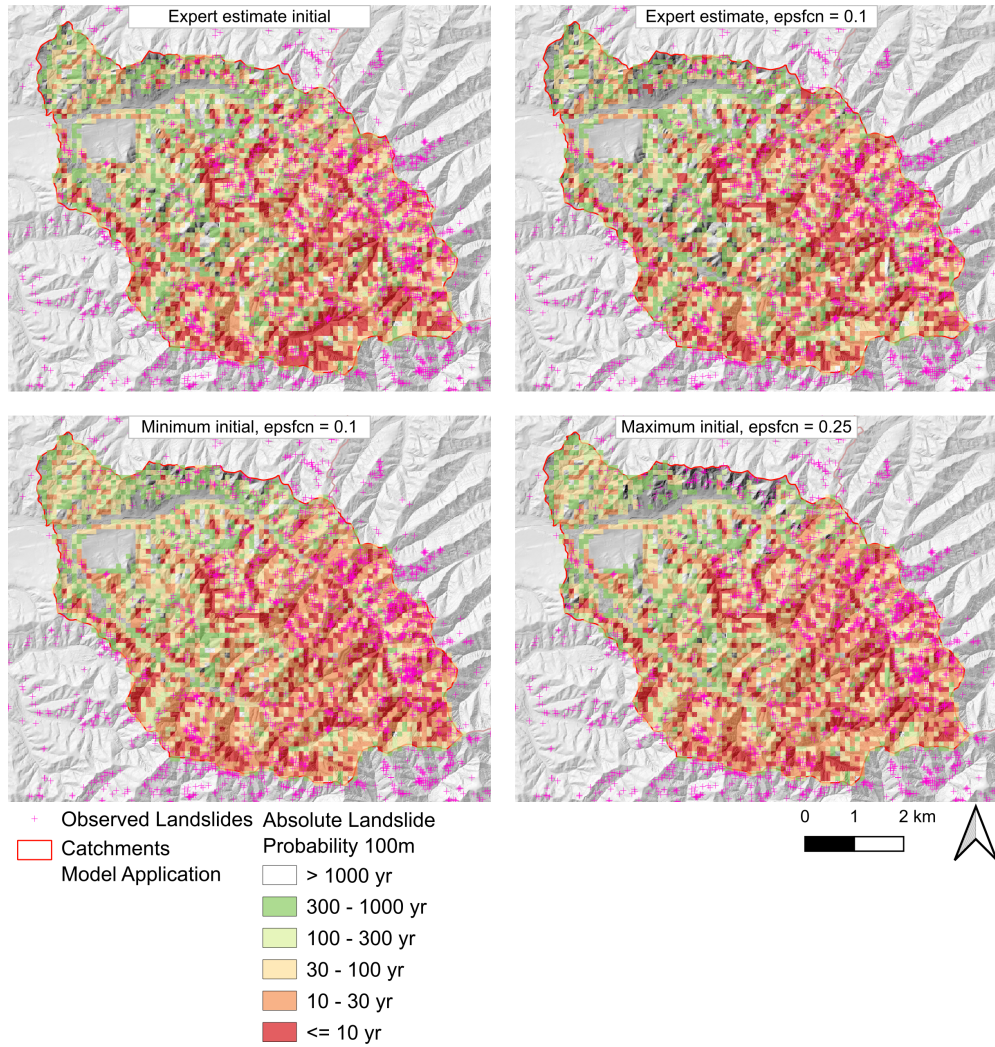


Fig. A9 Maps showing the absolute landslide occurrence probability from the application of selected optimisation results in the Central Plateau region catchment. The probability was calculated using the entire catchment as the reference area and aggregated to 100 m cell size for visualisation purposes

Pre-Alps - Färnel

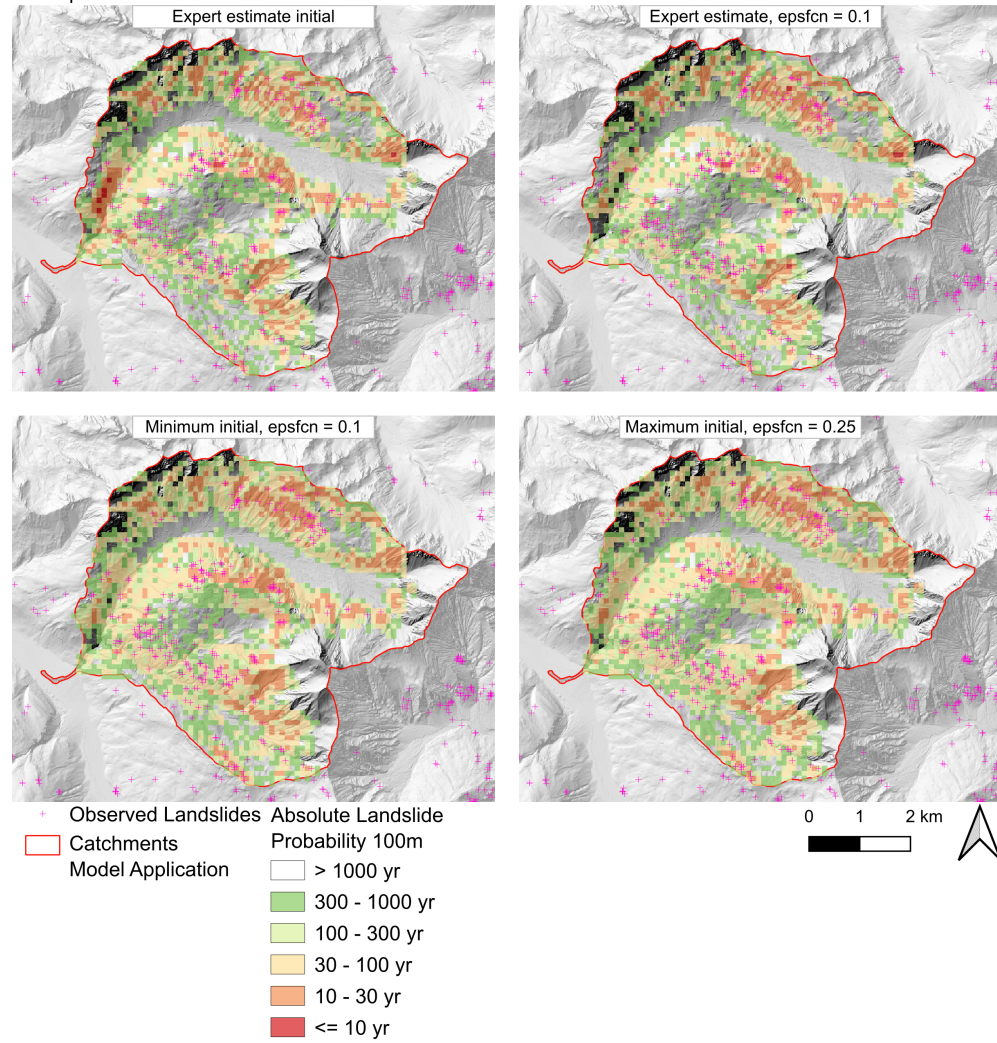


Fig. A10 Maps showing the absolute landslide occurrence probability from the application of selected optimisation results in the pre-Alps region catchment. The probability was calculated using the entire catchment as the reference area and aggregated to 100 m cell size for visualisation purposes

Alps - Rychenbachtal

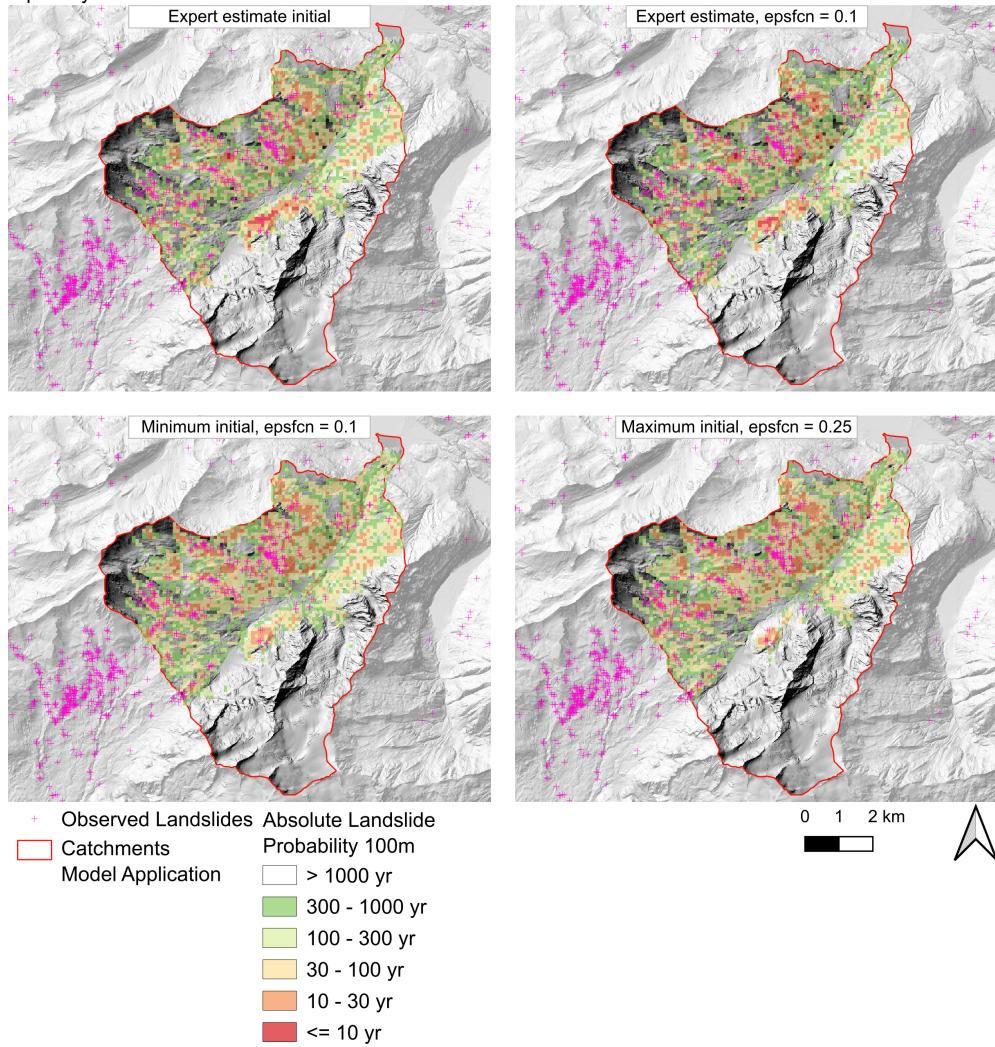


Fig. A11 Maps showing the absolute landslide occurrence probability from the application of selected optimisation results in the Alps region catchment. The probability was calculated using the entire catchment as the reference area and aggregated to 100 m cell size for visualisation purposes