Downscaling Switzerland Land Use/Land Cover Data Using Nearest Neighbors and an Expert System

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Abstract: High spatial and thematic resolution of Land Use/Cover (LU/LC) maps are central for accurate watershed analyses, improved species, and habitat distribution modelling as well as ecosystem services assessment, robust assessments of LU/LC changes and calculation of indices. Downscaled LU/LC maps for Switzerland were obtained for three time periods by blending two inputs: the Swiss topographic base map at a 1:25,000 scale and the national LU/LC statistics obtained from aerial photointerpretation on a 100m regular lattice of points. The spatial resolution of the resulting LU/LC map was improved by a factor of 16 to reach a resolution of 25m, while the thematic resolution was increased from 29 (in the base map) to 62 land use categories. The method combines a simple inverse distance spatial weighting of 36 nearest neighbours' information and an expert system of correspondence between input base map categories and possible output LU/LC types. The developed algorithm, written in Python, reads and writes gridded layers of more than 64 million pixels. Given the size of the analysed area, a High-Performance Computing (HPC) cluster was used to parallelize the data and the analysis and to obtain results more efficiently. The method presented in this study is a generalizable approach that can be used to downscale different types of geographic information.

Keywords: land cover; land use change; downscaling approach; Switzerland; geographic information system; aerial photo interpretation; topographic map; inverse distance weighting; expert system

Supplementary Material
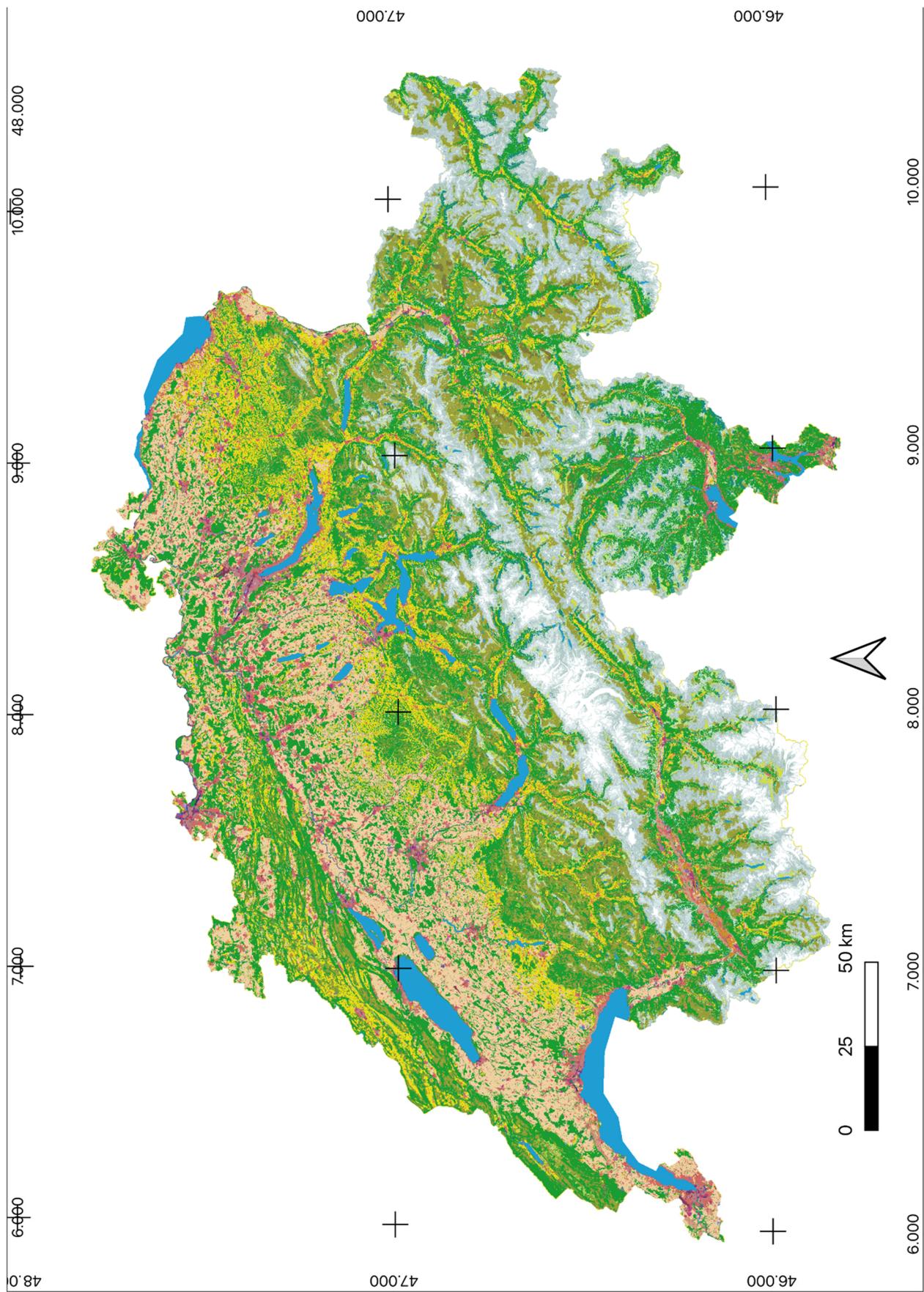
Figure S1. Final result of the downscaled Land Use/Land Cover at 25m for the period 2013/18.

Table S1. Full version of the expert table.

CODE	Landuse 100	Other type land cover	Forest	Habitation zone	Lake	River	Shrub	Open forest	Marshland in forest	Marshland	Orchard	Gravel pit	Rock	Stone drain in forest	Stone drain	Seedbed	Vignard	Quarry	Clay quarry	Marshland in open forest	Marshland and shrub	Stone drain and srhubs	Track on hard coating	Track on grass	Stone drain in open forest	Glacier	Concrete dam	Stone drain on glacier	Green dam	Building
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29
0	Undefined land use																													
1	Industrial buildings																													
2	Land around 1			1																										1
3	One- and two-family houses																													
4	Land around 3			1																										1
5	Terraced houses																													
6	Land around 5			1																										1
7	Blocks of flats																													
8	Land around 7			1																										1
9	Buildings in recreational areas																													
10	Land around 9			1																										1
11	Agricultural building																													
12	Land around 11			1																				1						1
13	Unspecified buildings																													
14	Land around 13			3																										3
15	Motorways																													
16	Land around 15																													
17	Roads and paths																													
18	Land around 17	1		1																										
19	Parking areas	1		1																										
20	Railway station grounds	1		1																										
21	Green railway environs	1		1																										
22	Airports																						2							
23	Airfields, green airport environs	1		1																					3					
24	Other energy building	1		1																										
25	Waste water treatment plants	1		1																										
26	Other supply or waste treatment plants	1		1																										
27	Discharges	1		1								1						1	1											
28	Quarries, mines, dumps	1		1								3						3	3											
29	Construction sites	1		1								1																		
30	Abandonned buildings	1		1																										
31	Public parks	1		1																										
32	Sport ground	1		1																				1						
33	Golf courses	1		1																										
34	Camping, caravan sites	1		1																										
35	Garden allotments	1		1																										
36	Cemeteries	1		1																										
37	Intensive orchards	1		1							2																			
38	Scattered fruit trees																													
39	Regular vineyards	1		1													2													

No.	Land use type																							
40	Horticulture	1		1									2											
41	Favourable arable land and meadows	1		1																				
42	Other arable land and meadows	3		1																				
43	Farm pastures	1		1																				
44	Brush meadows and farm pastures	1		1		1																		
45	Mountain meadows	1		1																				
46	Favourable alpine pastures	1		1		1	1																	
47	Brush alpine pastures	1		1		1	1																	
48	Rocky alpine pastures	1		1		1	1																	
49	Remote and steep alpine meadows and pastures	1		1																				
50	Normal dense forest		3																					
51	Forest stripes, edges	1	1	1			1																	
52	Cut forests	1	1	1																				
53	Forest fresh cuts	1	1	1																				
54	Devastated forests	1	1																					
55	Open forest (on agricultural areas)	1	1	1			1																	
56	Open forest (on unproductive areas)	1	1	1			3																	
57	Brush forest	1	1	1		1	1																	
58	Groves, hedges																							
59	Clusters of trees (on agricultural areas)	1	1	1			1																	
60	Trees on unproductive areas	1		1																				
61	Lake				2																			
62	River					2																		
63	Dam																					2		2
64	Scrub vegetation	1		1		3	1																	
65	Unproductive grass and shrubs	1		1		1	1																	
66	Avalanche protections																							
67	Wetlands	1	1	1		1	1	2	2							2	2							
68	Alpine sport infrastructure	1		1																				
69	Bare rock										2							2					2	
70	Landslides	1		1								2	2							2				
71	Landscape interventions	1		1																				
72	Glacier																			2				