

Figure S1. Physical environment and population distribution (2021) in the study area. Sources: Sniamb (<https://sniamb.apambiente.pt/>), snig); Beck et al. [59]; Statistics Portugal 2021 [60].

Table S1. Nomenclature of COS 2018 at the highest and lowest level.

Level 1	Level 4
1.Artificial surfaces	1.1.1.1 Continuous urban fabric predominantly vertical
	1.1.1.2 Continuous urban fabric predominantly horizontal
	1.1.2.1 Discontinuous urban fabric
	1.1.2.2 Sparse discontinuous urban fabric
	1.1.3.1 Parking lots and yards
	1.1.3.2 Abandoned sites in artificial areas
	1.2.1.1 Industrial units
	1.2.2.1 Commercial units
	1.2.3.1 Agricultural facilities
	1.3.1.1 Renewable energy production infrastructure
	1.3.1.2 Non-renewable energy production infrastructure
	1.3.2.1 Water supply infrastructure
	1.3.2.2 Waste and wastewater treatment infrastructure
	1.4.1.1 Road network and associated land
	1.4.1.2 Rail network and associated land
	1.4.2.1 Sea and river ports
	1.4.2.2 Ship construction and repairment docks
	1.4.2.3 Marinas and fishing harbours
	1.4.3.1 Airports
	1.4.3.2 Airfields
	1.5.1.1 Surface mines

	1.5.1.2 Quarries
	1.5.2.1 Landfills
	1.5.2.2 Dumps and scrap yards
	1.5.3.1 Construction sites
	1.6.1.1 Golf courses
	1.6.1.2 Other sports facilities
	1.6.2.1 Campsites
	1.6.2.2 Other leisure facilities
	1.6.3.1 Cultural facilities
	1.6.4.1 Cemeteries
	1.6.5.1 Public and private facilities
	1.7.1.1 Parks and gardens
2.Agricultural areas	2.1.1.1 Irrigated and non-irrigated arable land
	2.1.1.2 Rice fields
	2.2.1.1 Vineyards
	2.2.2.1 Orchards
	2.2.3.1 Olive groves
	2.3.1.1 Arable land or pastures associated with vineyards
	2.3.1.2 Arable land or pastures associated with orchards
	2.3.1.3 Arable land or pastures associated with olive groves
	2.3.2.1 Complex cultivation patterns
	2.3.3.1 Agriculture with natural and semi-natural vegetation
3.Pastures	2.4.1.1 Greenhouses and nurseries
	3.1.1.1 Permanent pastures
4.Agroforestry areas	3.1.2.1 Natural herbaceous vegetation
	4.1.1.1 AFS of cork oak
	4.1.1.2 AFS of holm oak
	4.1.1.3 AFS of other oaks
	4.1.1.4 AFS of Stone pine
	4.1.1.5 AFS of other species
	4.1.1.6 AFS of cork and holm oaks
	4.1.1.7 AFS of other mixtures
5.Forest land	5.1.1.1 Cork oak forests
	5.1.1.2 Holm oak forests
	5.1.1.3 Forests of other oaks
	5.1.1.4 Sweet chestnut forests
	5.1.1.5 Eucalyptus forests
	5.1.1.6 Forests of invasive species
	5.1.1.7 Forests of other broad-leaved species
	5.1.2.1 Maritime pine forests
	5.1.2.2 Stone pine forests
	5.1.2.3 Forests of other coniferous species
6.Shrubland	6.1.1.1 Shrublands
7.Open spaces with little or no vegetation	7.1.1.1 Inland beaches, dunes and sand plains
	7.1.1.2 Coastal beaches, dunes and sand plains
	7.1.2.1 Bare rock
	7.1.3.1 Sparsely vegetated areas
8.Wetlands	8.1.1.1 Inland marshes
	8.1.2.1 Salt marshes
	8.1.2.2 Intertidal flats

9. Water bodies	9.1.1.1 Natural water courses
	9.1.1.2 Artificial water channels
	9.1.2.1 Artificial inland lakes and lagoons
	9.1.2.2 Natural inland lakes and lagoons
	9.1.2.3 Barrage reservoirs
	9.1.2.4 Small dam reservoirs
	9.1.2.5 Artificial ponds
	9.2.1.1 Aquaculture
	9.3.1.1 Salines
	9.3.2.1 Coastal lagoons
	9.3.3.1 Rivers mouths

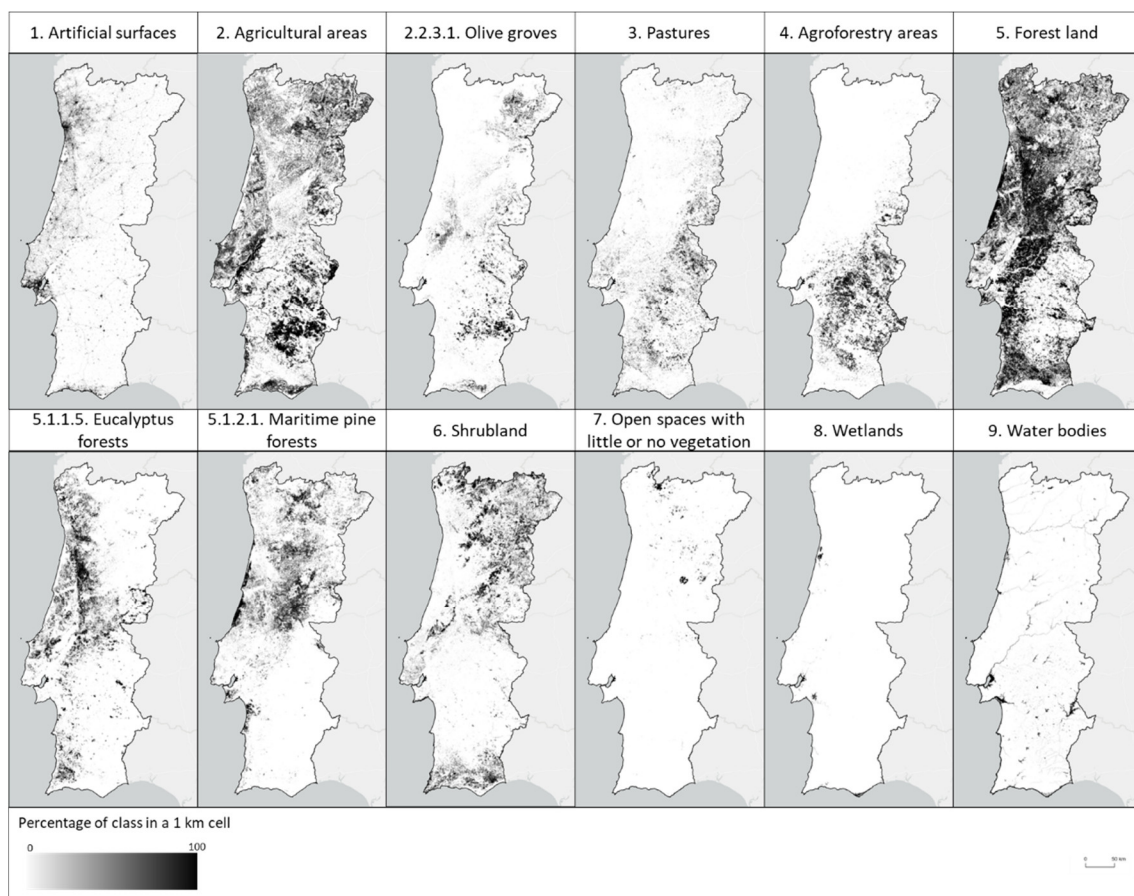


Figure S2. Percentage of each class in a 1 km² cell.

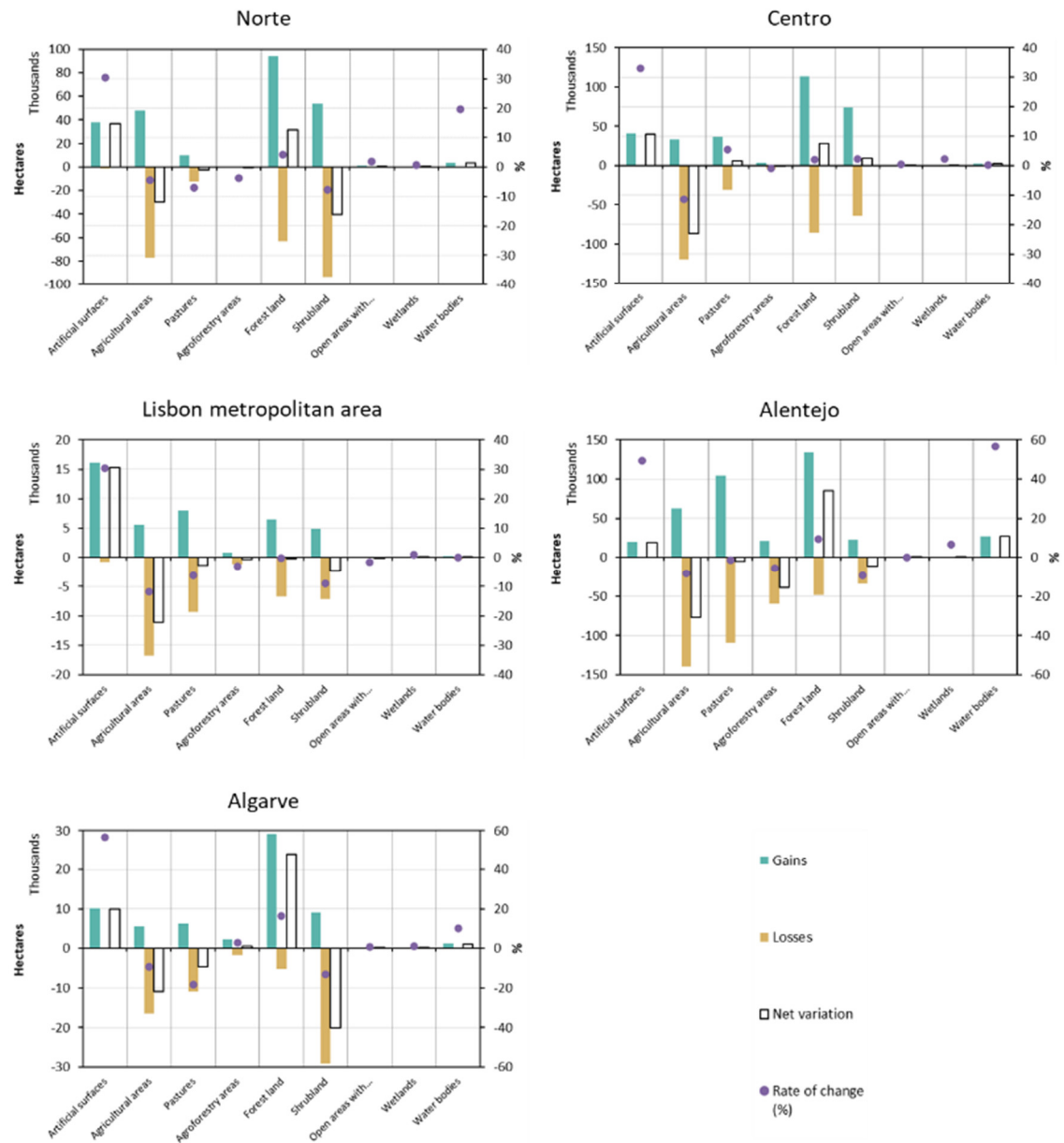


Figure S3. Absolute and relative variation of LUC at NUTS II level.

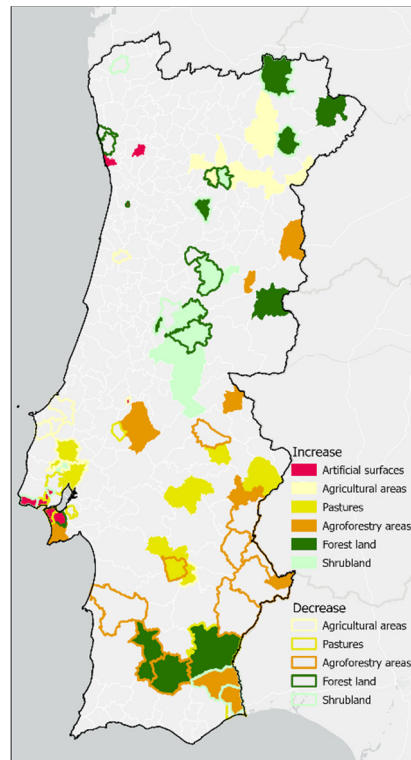


Figure S4. Top 10 trend 1995-2018 by municipality (variation in municipality area).

Table S2. Transition matrices between level 1 COS classes (1 – Artificial surfaces, 2 – Agricultural areas, 3 – Pastures, 4 – Agroforestry areas, 5 – Forest land, 6 – Shrubland, 7 – Open areas with little or no vegetation, 8 – Wetlands, 9 – Water bodies).

Continental Portugal											
	2007										
		1	2	3	4	5	6	7	8	9	Total
1995	1		296	322	11	1033	1150	19		268	3098
	2	43,966		130,094	2055	112,096	52,510	50	468	5632	346,871
	3	8940	43,955		1899	65,370	19,958	12	105	4990	145,229
	4	1821	5534	17,321		24,509	1052	1		7123	57,362
	5	30,215	21,162	5905	21,979		84,220	336	29	6789	170,635
	6	13,562	25,143	14,340	497	129,222		939	24	2458	186,185
	7	462	28	14	0	152	78		15	83	832
	8	33	5	124	0	21	8	4		50	245
	9	304	16	38	0	54	47	66	99		624
	Total	99,303	96,139	168,158	26,442	332,458	159,023	1427	740	27,392	911,082
	2018										
		1	2	3	4	5	6	7	8	9	Total
2007	1		470	400	5	1116	1437	28	1	631	4087
	2	7781		10,928	117	16,522	11,370	2	42	2146	48,909
	3	834	33,060		198	10,418	2599	6	34	1067	50,217
	4	476	3230	800		5944	12	0	0	295	10,758
	5	12,662	22,769	2460	2141		8928	50	8	1862	50,881
	6	5106	25,093	5101	50	23,935		103	1	1621	61,009
	7	92	9	3	0	49	0		6	9	167
	8	6	17	0	0	0	0	0		10	32
	9	80	216	13	0	4	4	5	6		327
	Total	29,036	84,865	19,704	2512	57,987	24,350	195	98	7641	226,387
	2018										
		1	2	3	4	5	6	7	8	9	Total
1995	1		432	388	13	1269	1530	27	1	305	3964

	2	52,292		123,007	2176	127,304	55,820	59	514	8522	369,695
	3	11,073	61,740		1926	73,125	19,487	18	136	5756	173,260
	4	2253	9006	17,042		30,410	848	1	0	7506	67,065
	5	41,282	40,562	7796	23,227		86,596	370	33	8567	208,434
	6	17,289	42,936	17,287	557	144,984		1037	24	4133	228,247
	7	526	30	16	0	174	102		22	91	962
	8	38	27	117	0	21	9	4		57	274
	9	365	187	22	0	74	33	69	104		854
	Total	125,118	154,919	165,677	27,899	377,362	164,426	1584	834	34,936	1,052,755
Norte											
	2007										
1995		1	2	3	4	5	6	7	8	9	Total
	1		133	6	0	320	269	7	0	19	755
	2	13,721		7488	18	29,471	19,539	7	3	93	70,340
	3	599	3400		4	3364	3887	0	0	49	11,302
	4	2	18	10		498	6	0	0	0	534
	5	10,758	8461	352	363		27,544	167	0	38	47,683
	6	4353	13,479	1463	30	54,391		729	2	94	74,541
	7	286	25	6	0	109	25		1	14	466
	8	0	1	0	0	0	0	0		0	1
9	28	0	6	0	19	2	23	2		79	
Total	29,747	25,517	9331	415	88,172	51,272	933	7	307	205,703	
	2018										
2007		1	2	3	4	5	6	7	8	9	Total
	1		120	15	0	339	428	16	0	98	1017
	2	2647		727	0	3452	4525	0	0	904	12,253
	3	152	1189		0	333	273	1	0	57	2005
	4	2	7	0		6	0	0	0	3	18
	5	4145	10,548	185	6		3491	2	0	1016	19,394
	6	1952	15,657	606	0	6060		82	0	1202	25,559
7	37	4	0	0	10	0		2	6	59	

	8	0	0	0	0	0	0	0		4	4
	9	17	0	0	0	1	1	0	0		20
	Total	8952	27,525	1533	6	10,200	8719	103	2	3289	60,329
2018											
1995		1	2	3	4	5	6	7	8	9	Total
	1		151	9	0	394	394	7	0	20	976
	2	16,534		7675	18	31,533	20,362	18	3	1136	77,277
	3	715	4622		4	3449	3431	1	0	120	12,342
	4	6	31	10		493	7	0	0	3	551
	5	14,501	17,256	424	368		29,233	169	0	952	62,902
	6	5790	25,643	1769	32	58,204		808	2	1340	93,588
	7	311	22	7	0	104	49		3	20	515
	8	0	1	0	0	0	0	0		4	6
	9	46	0	6	0	20	2	23	2		98
	Total	37,904	47,725	9899	422	94,198	53,478	1026	9	3595	248,256
Centro											
2007											
1995		1	2	3	4	5	6	7	8	9	Total
	1		93	82	1	452	223	6	0	56	913
	2	15,207		25,784	392	46,685	18,723	35	316	459	107,600
	3	1654	7644		207	11,503	4994	1	26	190	26,218
	4	117	297	1657		1678	67	0	0	8	3824
	5	12,304	7401	1530	2860		48,441	139	14	410	73,099
	6	3380	5900	4516	122	37,967		131	0	417	52,434
	7	112	2	5	0	40	43		0	2	205
	8	10	4	117	0	17	4	0		44	196
	9	29	3	5	0	18	29	5	27		116
	Total	32,813	21,344	33,697	3582	98,360	72,523	316	382	1588	264,605
2018											
2007		1	2	3	4	5	6	7	8	9	Total
	1		165	106	0	578	431	6	0	180	1466

	2	2059		4373	6	7017	3855	2	23	128	17,463
	3	694	4620		3	2683	422	5	0	35	8462
	4	8	81	58		339	2	0	0	2	490
	5	5551	6584	889	283		4174	45	8	501	18,036
	6	1243	6160	1523	13	10,375		16	0	47	19,377
	7	45	6	2	0	33	0		4	2	91
	8	2	13	0	0	0	0	0		3	17
	9	12	12	6	0	1	1	1	0		33
	Total	9614	17,642	6957	304	21,026	8885	75	36	896	65,436

2018

1995		1	2	3	4	5	6	7	8	9	Total
	1		131	100	1	585	317	10	0	78	1222
	2	17,501		27,092	401	53,310	19,999	34	340	728	119,405
	3	2150	10,147		209	13,393	4806	4	26	225	30,959
	4	124	391	1644		1946	62	0	0	11	4179
	5	17,074	12,836	2329	2991		48,857	175	19	907	85,188
	6	4226	9779	5641	150	44,087		145	0	476	64,503
	7	146	8	7	0	65	44		4	6	279
	8	9	23	111	0	17	6	0		46	213
	9	40	14	9	0	37	9	6	27		143
	Total	41,270	33,329	36,933	3751	113,439	74,102	374	417	2477	306,090

Lisbon metropolitan area

2007

1995		1	2	3	4	5	6	7	8	9	Total
	1		21	110	1	107	408	5	0	9	660
	2	4382		9333	135	1497	2273	0	19	14	17,653
	3	2595	2308		211	1468	1250	0	1	59	7891
	4	137	110	338		380	7	0	0	6	977
	5	2773	942	244	496		480	10	0	24	4969
	6	2967	352	307	8	2435		3	18	1	6092
	7	40	0	0	0	0	9		0	0	49

	8	7	0	6	0	5	4	4		4	29
	9	151	0	0	0	0	6	7	39		203
	Total	13,051	3733	10,339	851	5892	4436	29	77	117	38,525
2018											
2007		1	2	3	4	5	6	7	8	9	Total
	1		37	71	2	67	328	6	1	13	524
	2	803		606	7	355	579	0	1	0	2350
	3	507	3872		14	147	88	0	0	84	4711
	4	51	48	23		116	0	0	0	2	240
	5	1122	531	117	24		163	0	0	7	1964
	6	892	636	110	2	172		3	0	1	1816
	7	3	0	0	0	0	0		0	1	4
	8	2	1	0	0	0	0	0		0	3
	9	9	0	0	0	0	0	0	0		9
	Total	3388	5125	927	48	858	1158	8	2	108	11622
2018											
1995		1	2	3	4	5	6	7	8	9	Total
	1		48	123	1	121	503	8	1	10	815
	2	5245		6965	147	1797	2488	0	19	101	16,762
	3	3060	3310		205	1553	1181	0	1	61	9369
	4	181	165	307		491	7	0	0	8	1159
	5	3757	1433	290	480		635	10	0	39	6645
	6	3621	660	342	8	2495		6	19	1	7151
	7	41	0	0	0	0	9		0	2	51
	8	10	1	6	0	5	2	4		5	32
	9	154	0	0	0	0	11	7	39		212
	Total	16,070	5617	8032	842	6460	4838	35	78	225	42,196
Alentejo											
2007											
1995		1	2	3	4	5	6	7	8	9	Total
	1		45	105	8	134	212	1	0	130	636

	2	6566		83,988	1414	31,881	7092	8	128	4991	136,067
	3	3357	28,876		1459	44,971	6666	9	2	4662	90,002
	4	1491	5062	15,237		20,710	908	1	0	7105	50,513
	5	3225	4200	3706	16,313		7023	20	15	6035	40,537
	6	784	3649	5751	125	16,038		35	4	1748	28,134
	7	16	0	3	0	2	0		14	40	76
	8	0	0	0	0	0	0			0	0
	9	39	13	27	0	12	7	8	20		125
	Total	15,479	41,846	108,817	19,320	113,748	21,907	82	184	24,710	346,091
	2018										
2007		1	2	3	4	5	6	7	8	9	Total
	1		123	199	4	128	173	0	0	294	921
	2	1703		4573	98	5409	1757	0	19	1070	14,629
	3	1232	22,327		180	7013	1258	0	15	831	32,856
	4	391	3057	717		5269	10	0	0	288	9733
	5	1434	4729	1229	1812		1070	3	0	214	10,490
	6	346	1262	2166	31	5003		0	0	108	8916
	7	2	0	0	0	6	0		0	0	8
	8	0	3	0	0	0	0	0		2	5
	9	27	204	7	0	2	1	3	0		245
	Total	5136	31,705	8890	2124	22,830	4269	6	34	2808	77,803
1995	2018										
		1	2	3	4	5	6	7	8	9	Total
	1		71	147	10	149	259	1	0	144	781
	2	8255		77,675	1507	37,822	7985	7	149	6413	139,812
	3	4214	41,405		1488	50,452	6787	11	15	5276	109,648
	4	1861	8321	15,013		26,089	702	1	0	7472	59,459
	5	4401	8561	4650	17,500		7189	17	13	6252	48,583
	6	1032	4134	7002	152	19,603		35	4	1841	33,803
	7	16	0	3	0	5	0		14	38	76
	8	0	3	0	0	0	0	00		0	3

	9	60	172	8	0	13	7	9	20		288
	Total	19,839	62,667	104,498	20,657	134,133	22,929	80	216	27,435	392,455
Algarve											
2007											
1995		1	2	3	4	5	6	7	8	9	Total
	1		4	19	1	19	38	0	0	53	134
	2	4090		3501	96	2563	4883	0	2	74	15,210
	3	735	1727		19	4064	3161	3	76	30	9815
	4	75	47	79		1243	65	0	0	5	1514
	5	1155	158	71	1947		733	0	0	282	4347
	6	2078	1762	2303	212	18,390		41	0	198	24,984
	7	8	0	0	0	0	2		0	27	37
	8	16	0	0	0	0	0	0		1	18
	9	56	0	0	0	5	4	24	11		101
	Total	8214	3699	5974	2274	26,285	8885	68	89	670	56,158
2018											
2007		1	2	3	4	5	6	7	8	9	Total
	1		25	9	0	3	76	0	0	46	159
	2	569		650	7	289	655	0	0	44	2213
	3	249	1052		1	243	559	0	19	61	2183
	4	24	37	2		213	0	0	0	0	277
	5	409	376	40	16		30	0	0	125	997
	6	673	1378	695	5	2325		2	0	263	5342
	7	5	0	0	0	0	0		0	0	5
	8	2	0	0	0	0	0	0		1	3
	9	13	0	0	0	0	0	0	6		19
	Total	1945	2868	1396	29	3073	1319	2	25	541	11,197
2018											
1995		1	2	3	4	5	6	7	8	9	Total
	1		31	9	0	20	56	0	0	53	170
	2	4757		3601	104	2843	4986	0	2	144	16,437

	3	934	2256		19	4278	3281	3	95	75	10,942
	4	80	97	67		1391	69	0	0	11	1716
	5	1548	477	104	1889		681	0	0	418	5117
	6	2620	2720	2533	215	20,595		43	0	474	29,201
	7	13	0	0	0	0	2		0	27	41
	8	18	0	0	0	0	0	0		2	21
	9	65	0	0	0	4	4	24	17		113
	Total	10,036	5581	6314	2228	29131	9080	70	114	1204	63,758

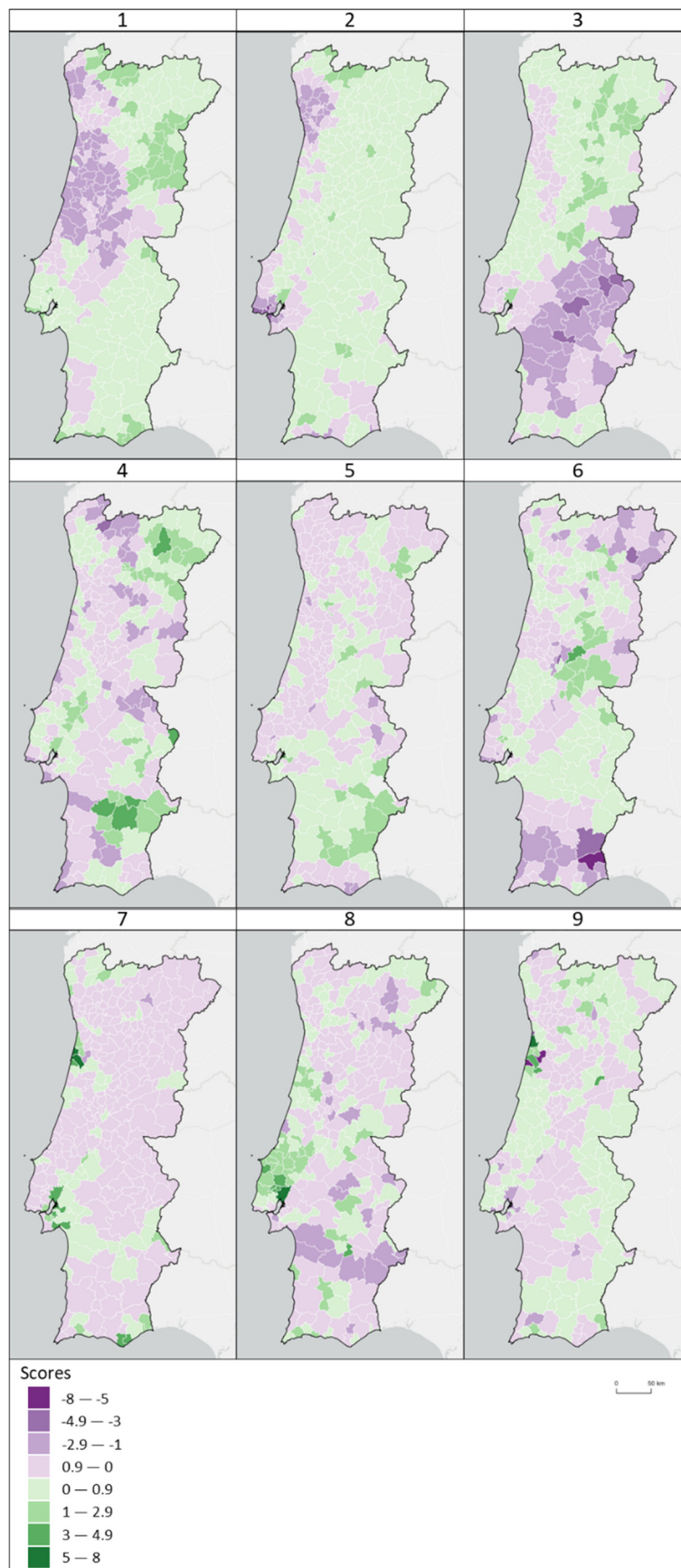


Figure S5. Principal Component Analysis scores.

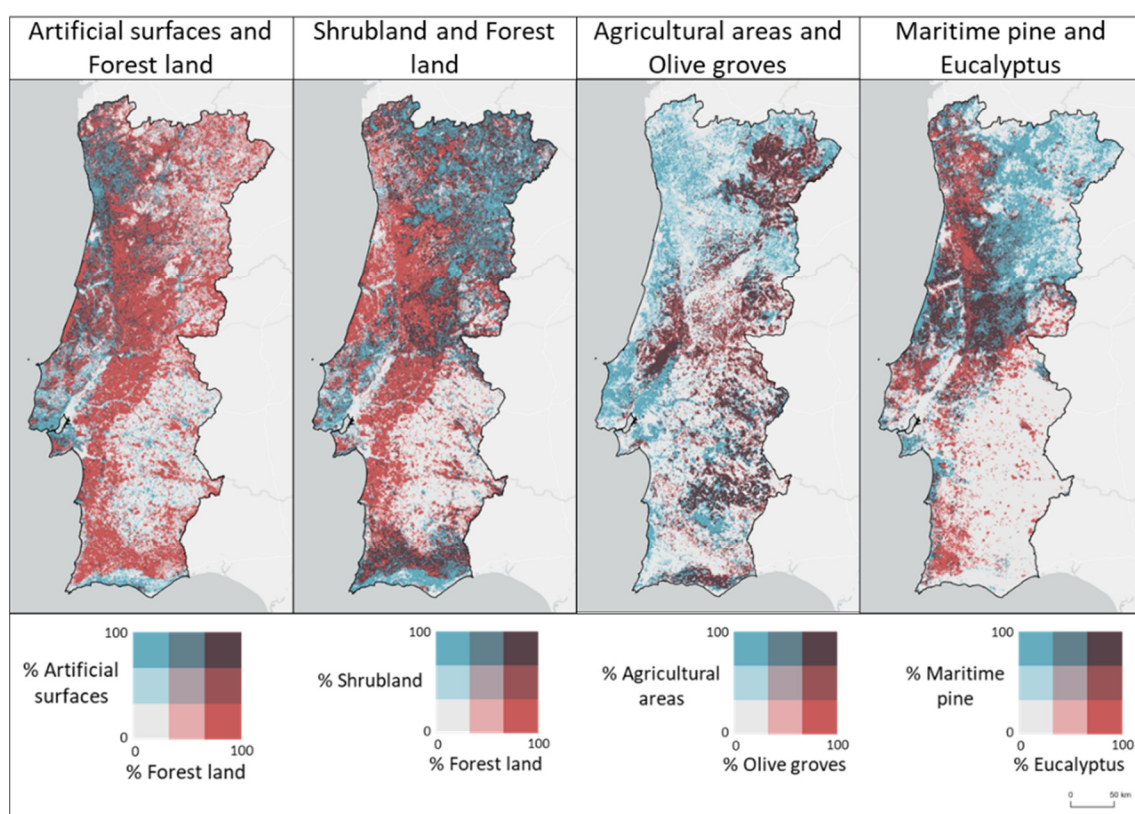


Figure S6. Bivariate representations of land-use patterns at 1 km² cells.