

Figure S1: The lithostratigraphic map legend adopted and translated to English from Geological Map of mainland Portugal at 1:1 000 000 scale produced by the National Laboratory of Energy and Geology [58, 59, 62]. The original can be found in https://geoportal.lneg.pt/media/p4wft3w5/cgp1m_2010.pdf (accessed on 22 of May of 2023).

		Meso-Cenozoic Basins	
Cenozoic	Quaternary	Holocene	Q ² : Sands, gravel, silts and clays
		Pleistocene	Q ¹ : Conglomerates, sandstones, siltites, and argillites
	Neogene	Pliocene	N ² : Sandstones, conglomerates, and siltites
		Miocene	N ¹ : Sandstones, argillites, conglomerates, and limestones (continental deposits); N ^{1a} : Conglomerates, sandstones, biocalcarenes, siltites and argillites
	Paleogene	E	E: Sandstones, arkoses, conglomerates, argillites and siltites
Mesozoic	Cretaceous	Upper	CVL: Basalts, pyroclastics, microgabbros, rare gabbros and sedimentary intercalations (Lisbon Volcanic Complex: 75-72 Ma); K ² : Sandstones and argillites
		Lower	K ¹⁻² : Limestones (with rudists at the top, south of Leiria), sandstones, marls, and dolomites; basic magmatism: 94-88 Ma
	Jurassic	Upper	K ¹ : Sandstones, limestones, marls, and dolomites; basic magmatism: 135-130 Ma
		Middle	J ³ : Limestones, marls, and sandstones
		Lower	J ² : Limestones, marls, and dolomites
	Triassic	Lower	J ¹ : Limestones, marls, and dolomites;
		Upper	TJ ¹ : Sandstones, argillites, and evaporites with carbonate intercalations; Basic magmatism: volcanics and dykes (200-180 Ma)

		Autochthonous, sub- autochthonous and allochthonous terrains (with allochthony <50km)			
Paleozoic	Carboniferous	Upper	C ² : Conglomerates, sandstones, argillites and coal	C ² : Conglomerates, sandstones, argillites and coal	C ²⁻² : Phyllites, metagraywackes and metaconglomerates (flysch)
		Lower	C ¹ : Phyllites and metacalcareous rocks	D ^{2C} : Acid and basic metavolcanics, metagillites and metacalcareous	C ¹ : Phyllites, metasiltstones and metacalcareous
	Devonian	Upper	D ³ : Phyllites, quartzites and metacalcareous rocks	D ^{3A} : Amphibolites, metaperidotites and metagabbros (oceanic crust)	D ^{3C1} : Acid and basic metavolcanics and phyllites (Iberian Pyrite Belt)
		Middle	D ^{3a} : Phyllites and metagraywackes (flysch)	D ^{3B} : Phyllites, metagraywackes and rare metaconglomerates (flysch)	D ^{3B} : Phyllites, metagraywackes, quartzites and metacalcareous rocks
	Silurian	Upper	S: Phyllites, schists, metacherts, and metacalcareous rocks	SD ¹ : Metagraywackes, quartzites, metasiltites, metacherts, phyllites, quartzophyllites, and acid and basic metavolcanics	D ^{3C2} : Phyllites, metasiltstones, metagraywackes (flysch) and associated acid and basic metavolcanics
		Lower	O ₂ : Quartzites, phyllites, quartzophyllites, metaconglomerates, metacalcareous, and metavolcanoclastites	OD ¹ : Marbles and basic metavolcanics	SD: Phyllites and quartzites
	Ordovician	Upper	O ₁ : Metamorphosed peridotites, gabbros, and basalts with intercalated metaradiolarites (oceanic crust)	O ₂ : Quartzites, phyllites, quartzophyllites, metaconglomerates, metacalcareous, and metabasalts	V: Green schists (oceanic crust), equivalent to D ^{3A}
		Lower	O ₁ : Metamorphosed peridotites, gabbros, and basalts with intercalated metaradiolarites (oceanic crust)	O ₂ : Quartzites, phyllites, quartzophyllites, metaconglomerates, metacalcareous, and metabasalts	
	Cambrian	Upper	NPep: Phyllites, metagraywackes, metagraywackes, metaconglomerates, metacalcareous rocks and schists (flysch), gneisses and migmatites	Ep ² : Phyllites, quartzophyllites and acid and basic metavolcanics	
		Lower	NPep: Phyllites, metagraywackes, metagraywackes, metaconglomerates, metacalcareous rocks and schists (flysch), gneisses and migmatites	Ep ¹ : Metacalcareous, phyllites, quartzophyllites, peralkaline and acid and basic metavolcanics; Ep ¹ : Metacalcareous	
Neoproterozoic	Upper	NP ² : Phyllites, metagraywackes, metacherts, metaconglomerates, metacalcareous, and schists	NP ² : Phyllites, metagraywackes, metacherts, metaconglomerates, metacalcareous, and schists		
	Lower	NP ¹ : Schists, gneisses, migmatites, amphibolites, granulites, and retrograded eclogites	NP ¹ : Schists, gneisses, migmatites, amphibolites, granulites, and retrograded eclogites		

		Allochthonous (with allochthony <50km) and associated para-autochthonous terrains	
Neoproterozoic—Cambrian	Galicía-Trás-os-Montes Zone	Ep ₁ : Micaschists with intrusions of metamorphosed basalt and gabbro	Ep ₁ : Micaschists with intrusions of metamorphosed basalt and gabbro
		NP ₁ : Ocellated orthogneisses with intrusions of basalts and gabbros, metamorphosed	NP ₁ : Ocellated orthogneisses with intrusions of basalts and gabbros, metamorphosed
		NP ₂ : Quartz-feldspathic gneisses with intercalated eclogites	NP ₂ : Quartz-feldspathic gneisses with intercalated eclogites
		NP ₃ : Metaperidotites with garnet, mafic granulites, and quartz-feldspathic gneisses	NP ₃ : Metaperidotites with garnet, mafic granulites, and quartz-feldspathic gneisses
Silurian—Devonian	Upper Allochthonous Complex	SD _{1a} : Amphibolites, green schists, acid and basic metavolcanics, retrograded metagabbros	SD _{1a} : Amphibolites, green schists, acid and basic metavolcanics, retrograded metagabbros
		SD _{1b} : Serpentinites, peridotites, and pyroxenites retrotransformed	SD _{1b} : Serpentinites, peridotites, and pyroxenites retrotransformed
Ordovician—Devonian	Middle Allochthonous Complex (ophiolitic)	D ₁ : Metaquartzites, quartzophyllites and basic metavolcanics	D ₁ : Metaquartzites, quartzophyllites and basic metavolcanics
		S ₁ : Phyllites, quartz-feldspathic schists, green schists, basic and acid and Peralkaline (σ ₁) metavolcanics	S ₁ : Phyllites, quartz-feldspathic schists, green schists, basic and acid and Peralkaline (σ ₁) metavolcanics
		O ₁ : Quartzophyllites, quartzites, and metavolcanics	O ₁ : Quartzophyllites, quartzites, and metavolcanics
Ordovician—Devonian	Lower Allochthonous Complex	OD ₁ : Xistoid quartzites and quartzophyllites with intercalations of quartzites, metacherts, and metacalcareous rocks	OD ₁ : Xistoid quartzites and quartzophyllites with intercalations of quartzites, metacherts, and metacalcareous rocks
		SD ₂ : Phyllites and metagraywackes with intercalations of quartzites, metacherts, and metacalcareous rocks	SD ₂ : Phyllites and metagraywackes with intercalations of quartzites, metacherts, and metacalcareous rocks
		Para-Autochthonous Complex	

- Structural symbols**
- Geological boundary
 - - - Fault
 - - - - Probable Fault
 - · - · - Hidden Fault
 - ▲ - ▲ - Overthrusting
 - ▲ - ▲ - Probable Overthrusting
 - ▲ - ▲ - Thrust faulting
 - ▲ - ▲ - Probable Thrust faulting

		Intrusive and phyllonian magmatic rocks		
Alpine/"Atlantic" cycle	Late to post-orogenic	sigma ² : Sienites from Sintra and Sines and Nepheline sienites from Monchique	sigma ² : Sienites from Sintra and Sines and Nepheline sienites from Monchique	f ² : Basic dykes (230-72 Ma)
		g ⁴ : Biotite granite from Sintra	g ⁴ : Biotite granite from Sintra	
Hercynian cycle	Late to post-orogenic	GAMA ² : Diorites and gabbros from Sintra and Sines	GAMA ² : Diorites and gabbros from Sintra and Sines	f ¹ : Basic dykes
		Central-Iberian Zone (310-290 Ma)	Ossa-Morena Zone (310-290 Ma)	qt: Quartz dykes
	Syn-orogenic	g ³ : Biotite granites	g ³ : Biotite granites	pi: Granophyres, porphyries, and rhyolite
		g ^{3a} : Two-mica granites	g ^{3a} : Biotite granites with calcic plagioclase	GAMA ¹ : Diorites and gabbros
Pre-orogenic	g: Granites and migmatitic gneisses	GAMA: Gabbros, anorthosites, and diorites	GAMA ¹ : Diorites and gabbros	f: Granitic porphyries
	sigma: Granitic orthogneisses and peralkaline metasyenites	sigma: Granitic orthogneisses and peralkaline metasyenites	GAMA ₂ : Deformed gabbros and peridotites	

Table S1: Summary of number of features representing lithology (Singlefeature and Multifeature) per Age and per Geotectonic Zone and correspondent Area, used to assess the lithological diversity of mainland Portugal. Source: Geological Map of Portugal at 1:1 000 000 scale [59].

Geotectonic Zone	Age	Multifeature (n°)	Singlefeature (n°)	Area (Km ²)
Meso-Cenozoic Basins	Holocene	1	115	3986.9
	Pleistocene	1	188	2191.8
	Pliocene	1	173	6628.1
	Miocene	2	151	4463.9
	Paleogene	1	115	2903.5
	Upper Cretaceous	1	25	165.0
	Upper Cretaceous	1	26	436.9
	Lower Cretaceous	1	38	466.7
	Cretaceous	1	59	1199.8
	Upper Jurassic	1	43	2690.2
	Middle Jurassic	1	40	1000.9
	Lower Jurassic	1	45	669.4
	Upper Triassic to Lower Jurassic	1	46	544.5
	100-72 Ma	2	8	38.5
Total	13	16	1072	23399.2 (28%)
Central-Iberian Zone	Lower Carboniferous	1	1	17.1
	Lower Devonian	2	16	379.5
	Silurian	1	42	401.3
	Ordovician	1	93	1761.9
	Ediacarian to Cambrian	1	96	10782.8
	320-310 Ma	2	119	6284.9
Total	6	8	367	19627.5 (23%)
Central-Iberian Zone and Ossa-Morena Zone	Upper Carboniferous	1	12	68.0
	490-470 Ma	4	68	1190.3
	310-290 Ma	6	153	12507.8
	360-310 Ma	1	23	1151.5
Total	4	12	256	14917.6 (18%)
Galicia-Trás-os-Montes Zone	Silurian-Devonian	2	11	343.0
	Ordovician to Devonian	6	68	5076.0
	Proterozoic-Cambrian	4	18	387.1
Total	3	12	97	5806.1 (7%)
Ossa-Morena Zone	Middle Devonian to Lower Carbonic	2	7	196.5
	Lower to Middle Devonian	1	3	319.3
	Lower Devonian	1	9	36.9
	Ordovician to Lower Devonian	1	14	425.9
	Upper Ordovician to Lower Devonian	1	43	1945.1
	Ordovician	2	30	728.7

	Upper Cambrian	1	21	1279.2
	Lower Cambrian	2	31	692.1
	Neoproterozoic	2	64	1967.5
	360-310 Ma	2	62	2175.9
	310-290 Ma	2	10	534.0
Total		11	17	294
				10301.1 (12%)
South-Portuguese Zone	Lower Carboniferous	1	2	44.9
	Carboniferous	1	21	7064.6
	Upper Devonian to Lower Carboniferous	1	30	652.1
	Middle Devonian to Lower Carbonic	2	35	855.1
	Upper Silurian to Lower Devonian	2	12	932.7
Total		5	7	100
				9549.3 (11%)
Intrusive and phyllonian magmatic rocks	100-72 Ma	1	3	78.3
	230-72 Ma	1	20	48.3
Total		2	2	23
				126.6 (0%)
Soma(Total)		44	74	2209

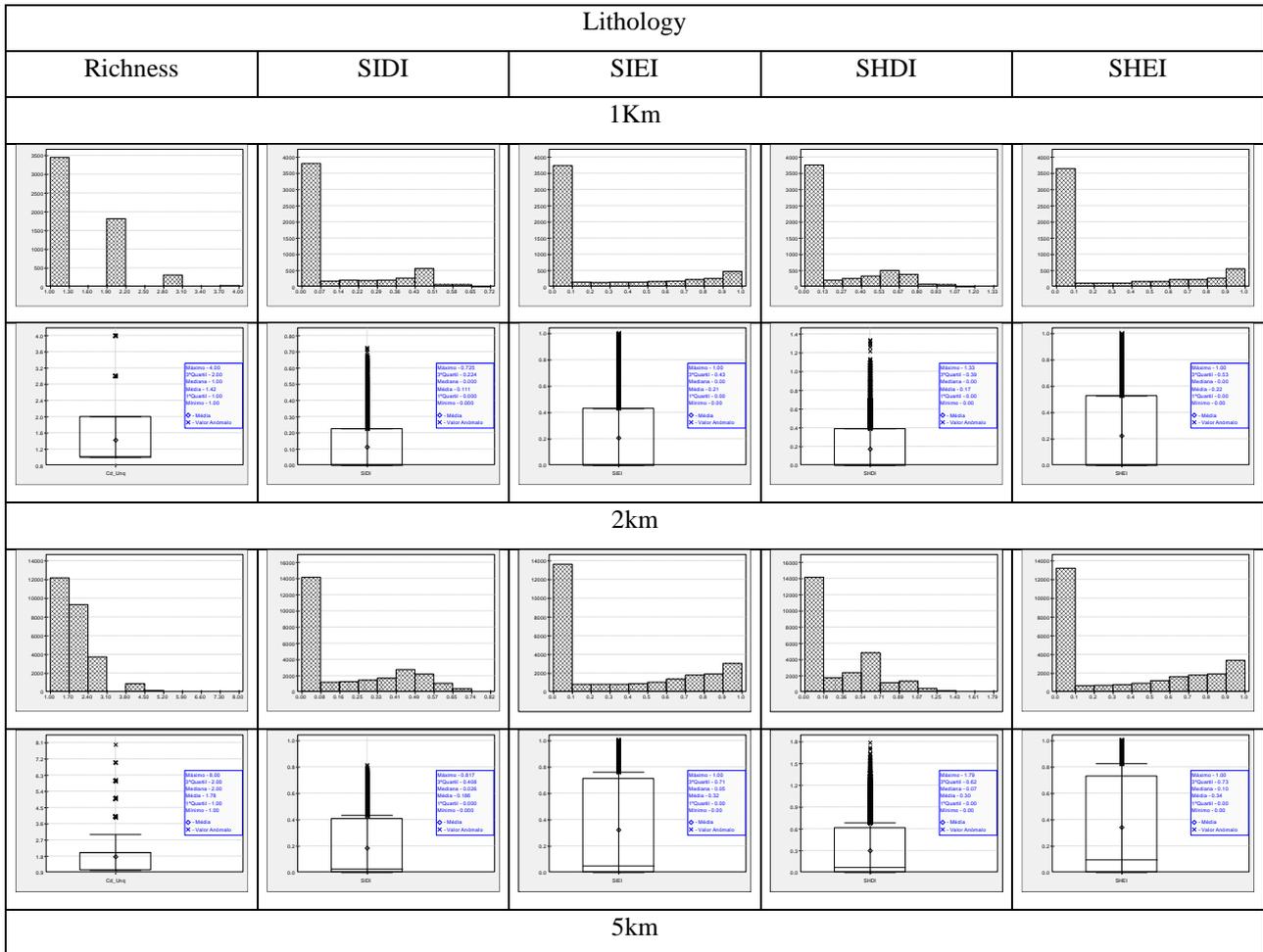
Table S2: Summary of classes and number of features per class within the distinct hierarchical levels of information. Number of classes (NC) and number of features per class (NF), used to assess the geomorphological diversity of mainland Portugal. Total number of features: 686. Source: geomorphological units map of mainland Portugal at 1:500 000 scale (Figure. 2b).

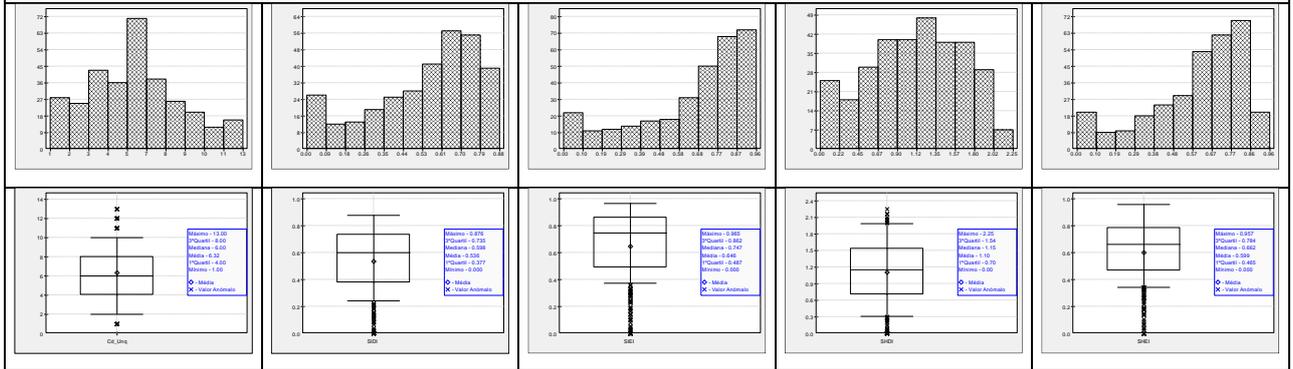
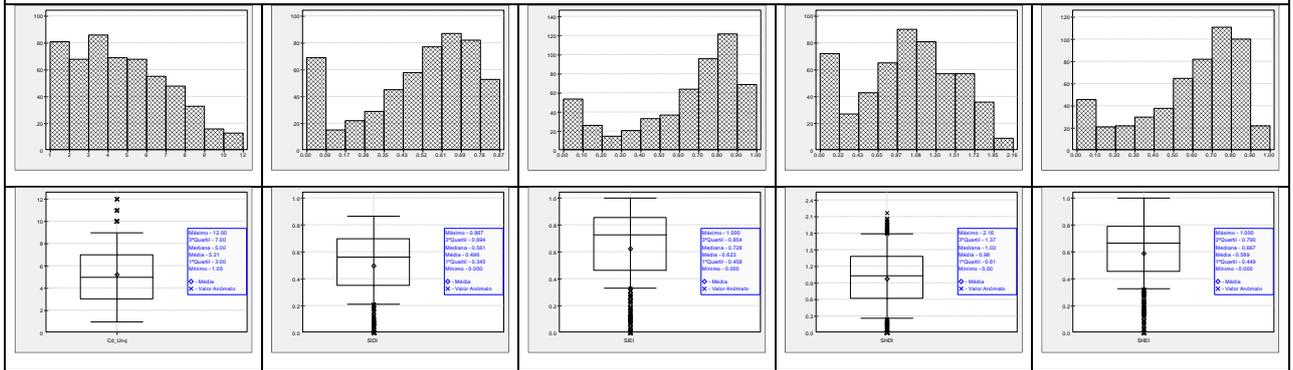
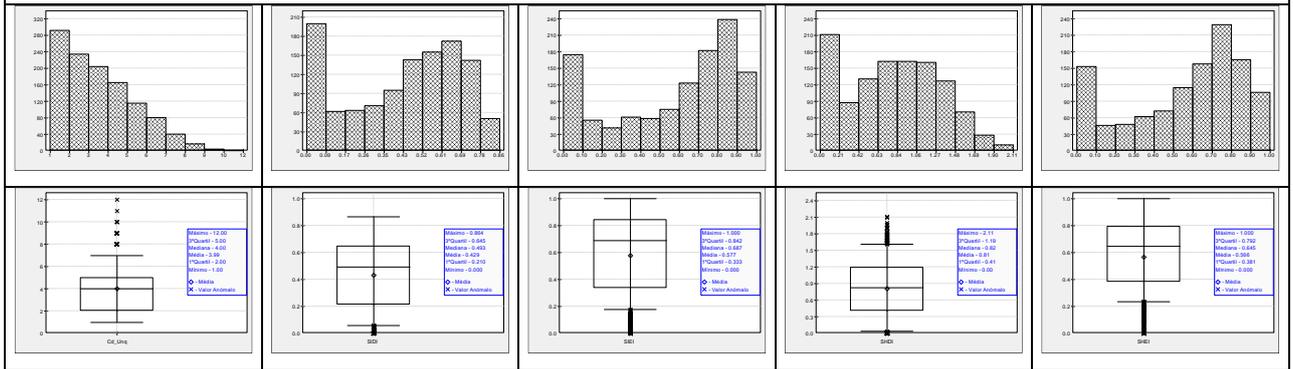
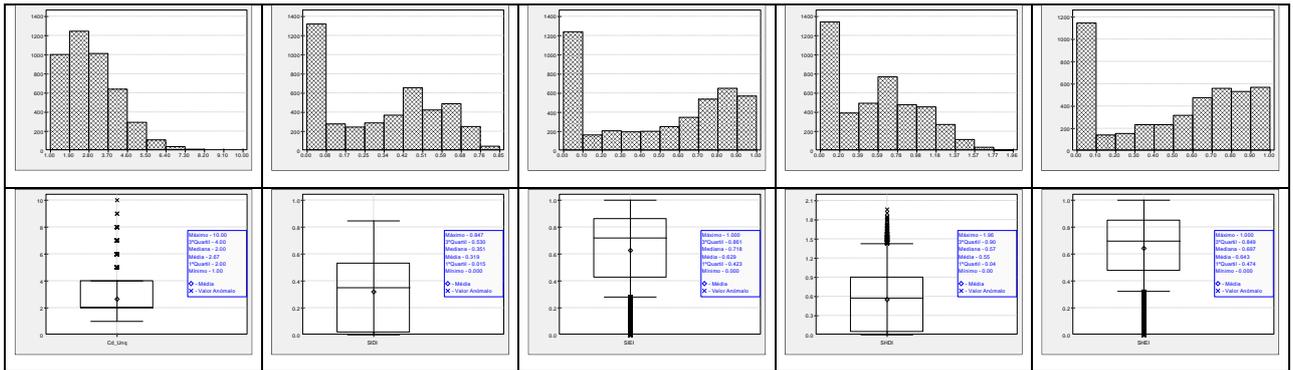
First Level: 4 classes		Second Level: 12 classes			Third level: 72 classes (686 forth level features)
classes	classes	NF	NC3		
1 Hesperian Massif	1.1 NW Iberian Plateaus and Mountains	259	24		
	1.2 Central Mountain Range	25	3		
	1.3 SW Iberian Plateaus and Hills	138	15		
2 Slightly deformed Mesozoic Basins	2.1 Lusitanian Basin	68	14		
	2.2 Algarve Basin	7	2		
3 Cenozoic Basins	3.1 Lima, Cávado and Douro Rivers Estuaries	11	1		
	3.2 Mondego River Estuary	1	1		
	3.3 Cenozoic Basins of Baixo Tejo and Alvalade	54	5		
	3.4 Cenozoic Douro Basin	1	1		
	3.5 Cenozoic Guadiana Basin	1	1		
4 Coastal Plains	4.1 Coastal Plains	96	3		
	4.2 Coastal Plains	25	2		

Table S3: Mode, Multiplicity of mode and correspondent % of Richness, SIDI, SIEI, SHDI, and SHEI, used to assess the lithological diversity of mainland Portugal. Source: Geological Map of Portugal at 1:1 000 000 scale [59].

Lithology																
Cell Km (L)	N filled	Richness			SIDI			SIEI			SHDI			SHEI		
		Multiplicity Mode	%	Mode												
30	150	23	15.2	8	3	2.0	0	3	2.0	0	3	2.0	0	3	2.0	0
25	212	25	11.7	6	9	4.2	0	9	4.2	0	9	4.2	0	9	4.2	0
20	315	43	13.7	4	12	3.8	0	13	4.1	0	13	4.1	0	13	4.1	0
15	536	86	16.0	4	37	6.9	0	37	6.9	0	37	6.9	0	37	6.9	0
10	1156	234	20.3	3	114	9.9	0	114	9.9	0	114	9.9	0	114	9.9	0
5	4366	1248	28.6	2	1002	23.0	0	1002	23.0	0	1002	23.0	0	1002	23.0	0
2	26390	12193	46.3	1	12193	46.3	0	12193	46.3	0	12193	46.3	0	12193	46.3	0
1	104222	67147	64.6	1	67147	64.6	0	67148	64.6	0	67147	64.6	0	67148	64.6	0

Table S4: Histograms and boxplots of Richness, SIDI, SIEI, SHDI, and SHEI used to assess the lithological diversity of mainland Portugal. Outliers were identified by Median \pm 1.25 \times IQR. Data were processed in Andad 7.12 (CVRM/IST, 2000). Source: Geological Map of Portugal at 1:1 000 000 scale [59].





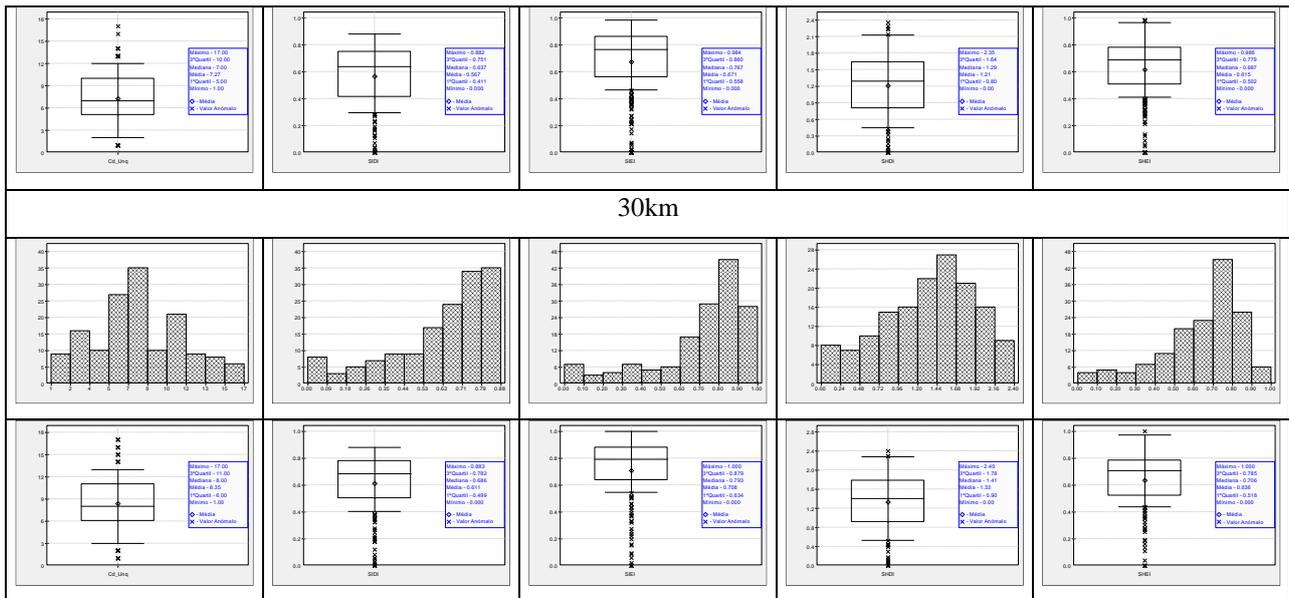
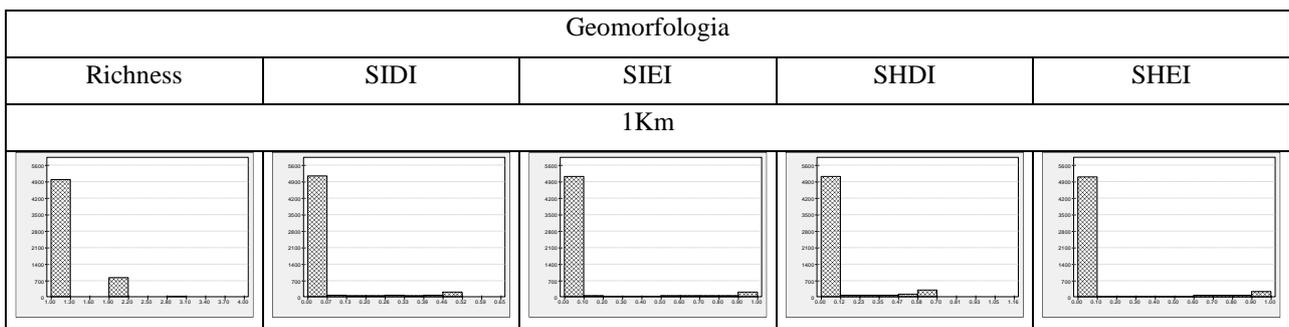
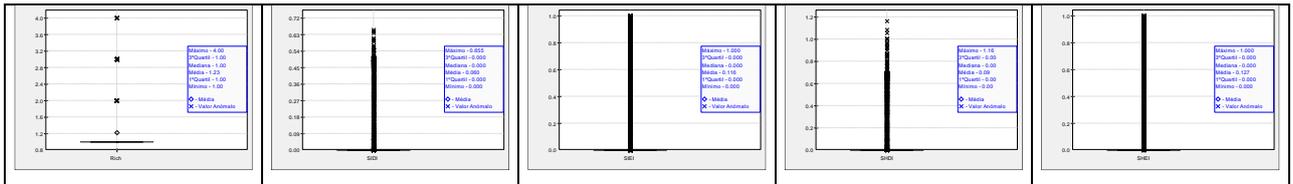


Table S5: Mode, Multiplicity of mode and correspondent % of Richness, SIDI, SIEI, SHDI, and SHEI used to assess the geomorphological diversity of mainland Portugal. Source: geomorphological units map of mainland Portugal at 1:500 000 scale (Figure 2b).

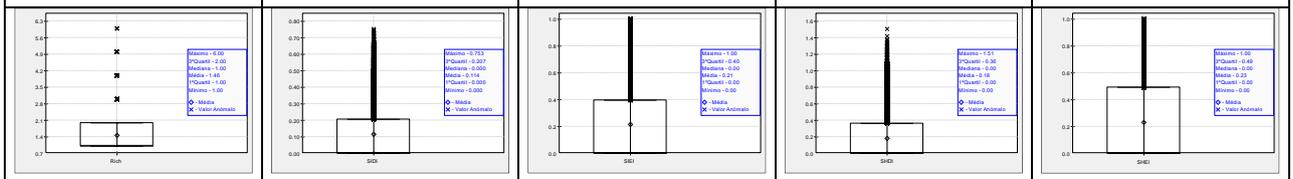
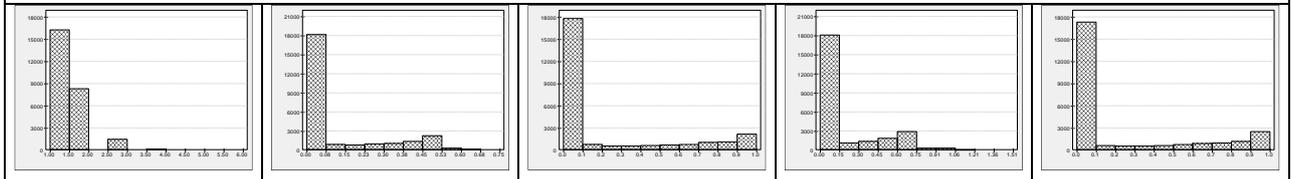
Geomorphology																
Cell Km (L)	N filled	Richness			SIDI			SIEI			SHDI			SHEI		
		Multiplicity	%	Mode												
30	150	16	10.7	6	6	4.0	0	6	4.0	0	6	4.0	0	6	4.0	0
25	212	22	10.4	8	12	5.7	0	12	5.7	0	12	5.7	0	12	5.7	0
20	315	39	12.4	4	15	4.8	0	15	4.8	0	15	4.8	0	15	4.8	0
15	536	90	16.8	3	38	7.1	0	38	7.1	0	38	7.1	0	38	7.1	0
10	1156	249	21.5	2	151	13.1	0	151	13.1	0	151	13.1	0	151	13.1	0
5	4366	1627	37.3	2	1353	31.0	0	1353	31.0	0	1353	31.0	0	1353	31.0	0
2	26390	16309	61.8	1	16309	61.8	0	16309	61.8	0	16309	61.8	0	16309	61.8	0
1	104222	82317	79.0	1	82317	79.0	0	82317	79.0	0	82317	79.0	0	82317	79.0	0

Table S6: Histograms and boxplots of Richness, SIDI, SIEI, SHDI, and SHEI used to assess the geomorphological diversity of mainland Portugal. Outliers were identified by Median $\pm 1.25 \times IQR$. Data were processed in Andad 7.12 (CVRM/IST, 2000). Source: geomorphological units map of mainland Portugal at 1:500 000 scale (Figure.2b).

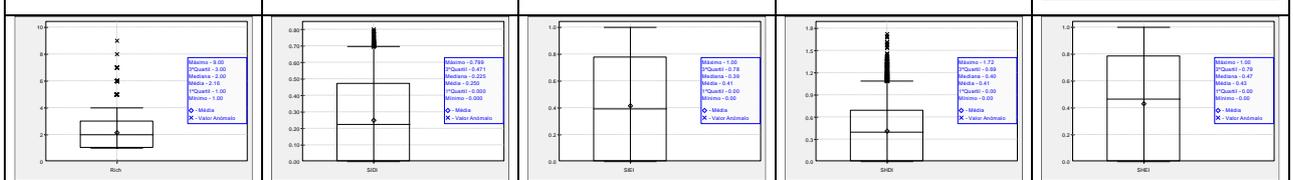
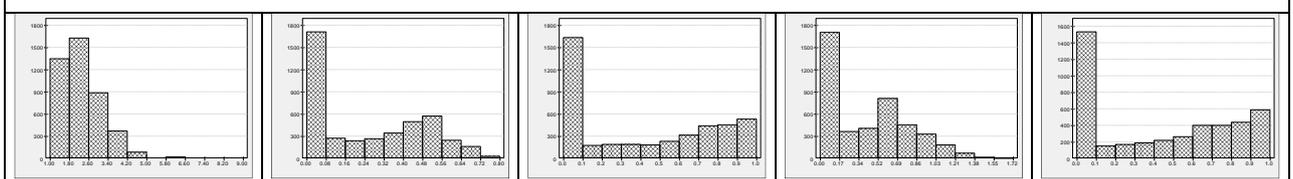




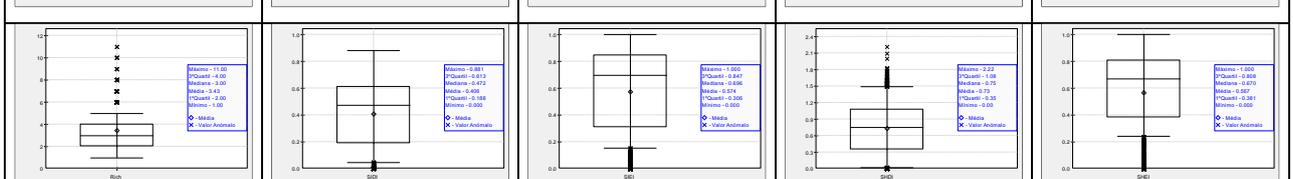
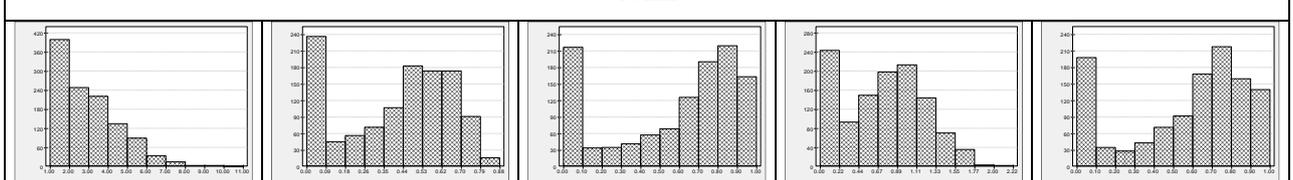
2km



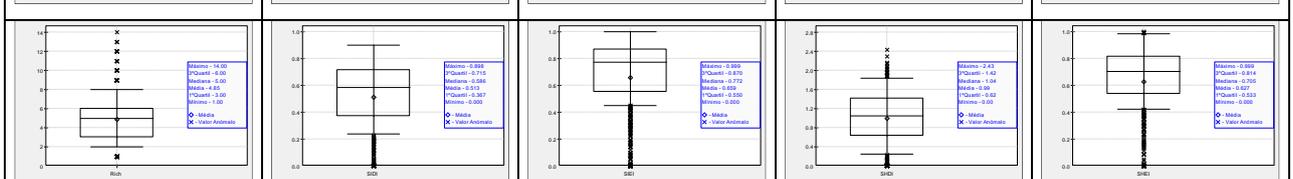
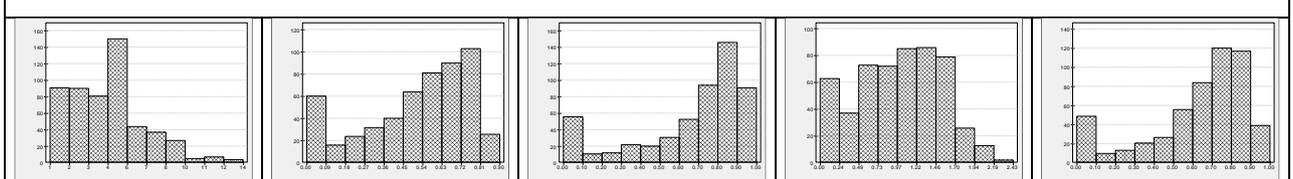
5km



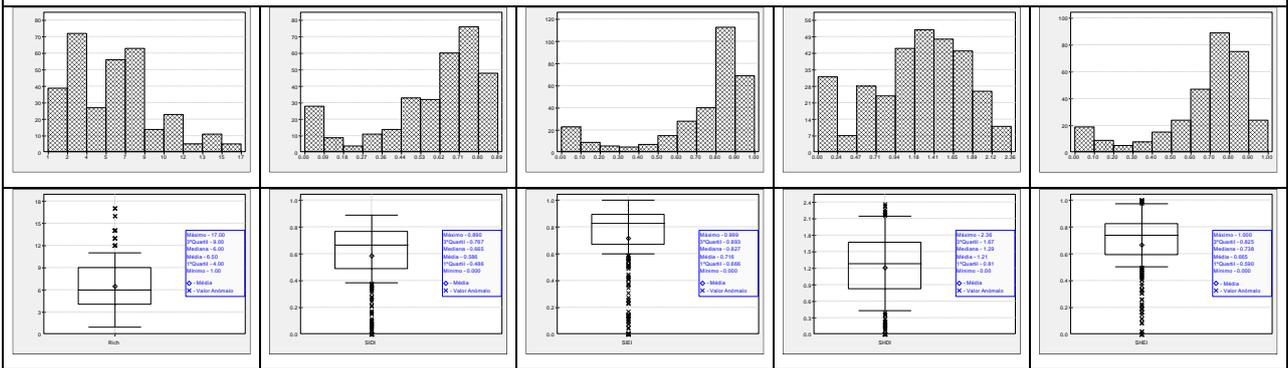
10km



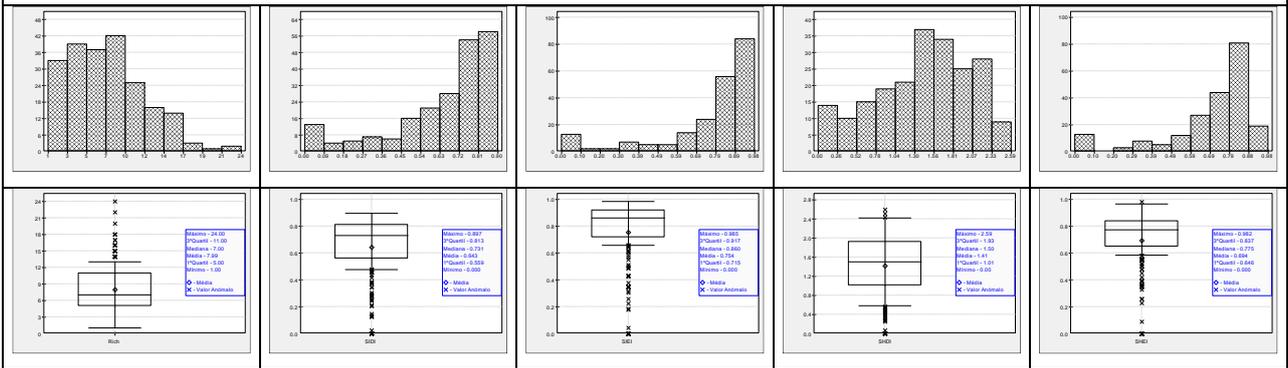
15km



20km



25km



30km

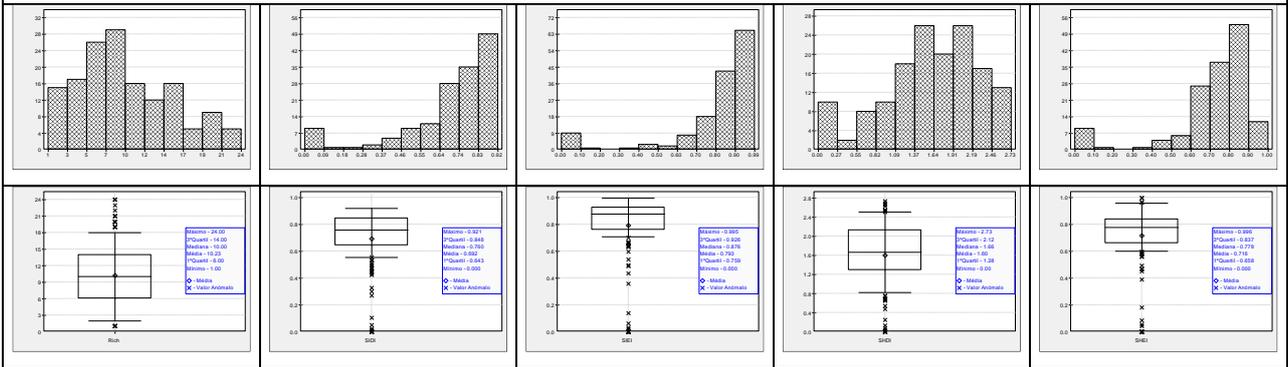
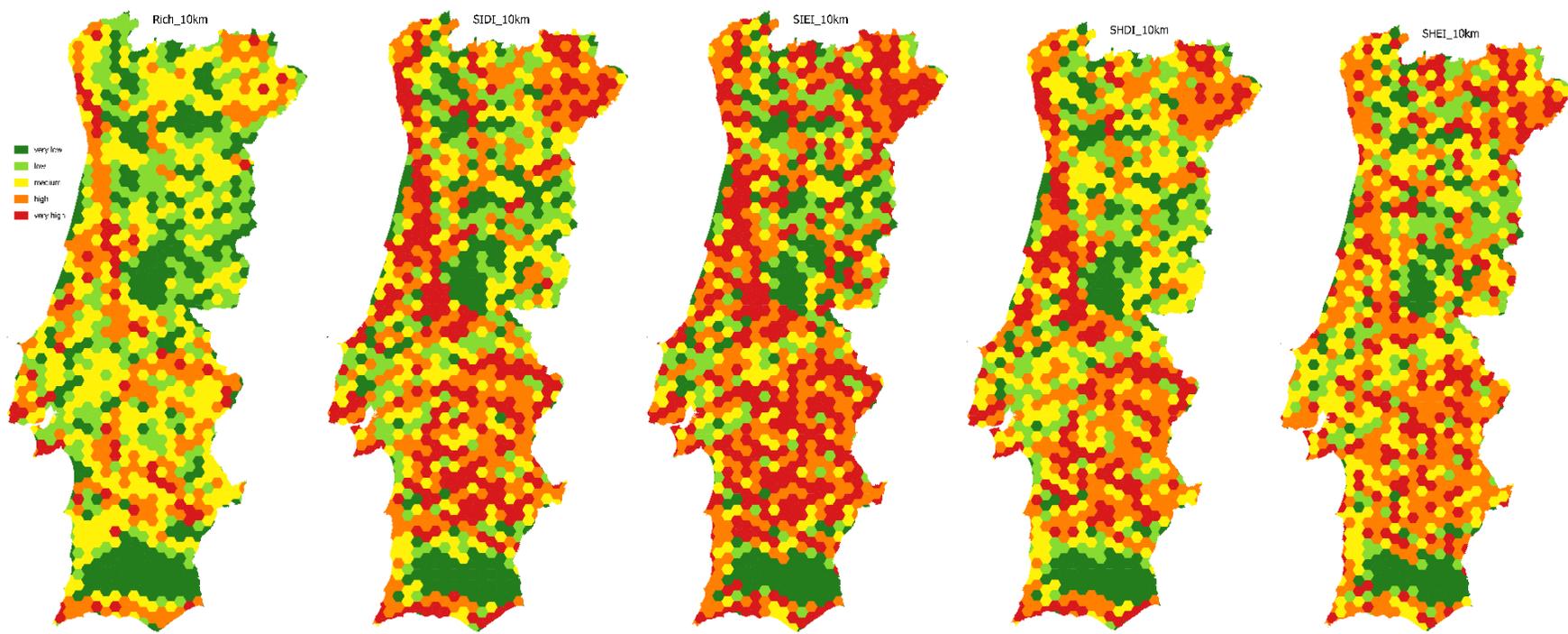
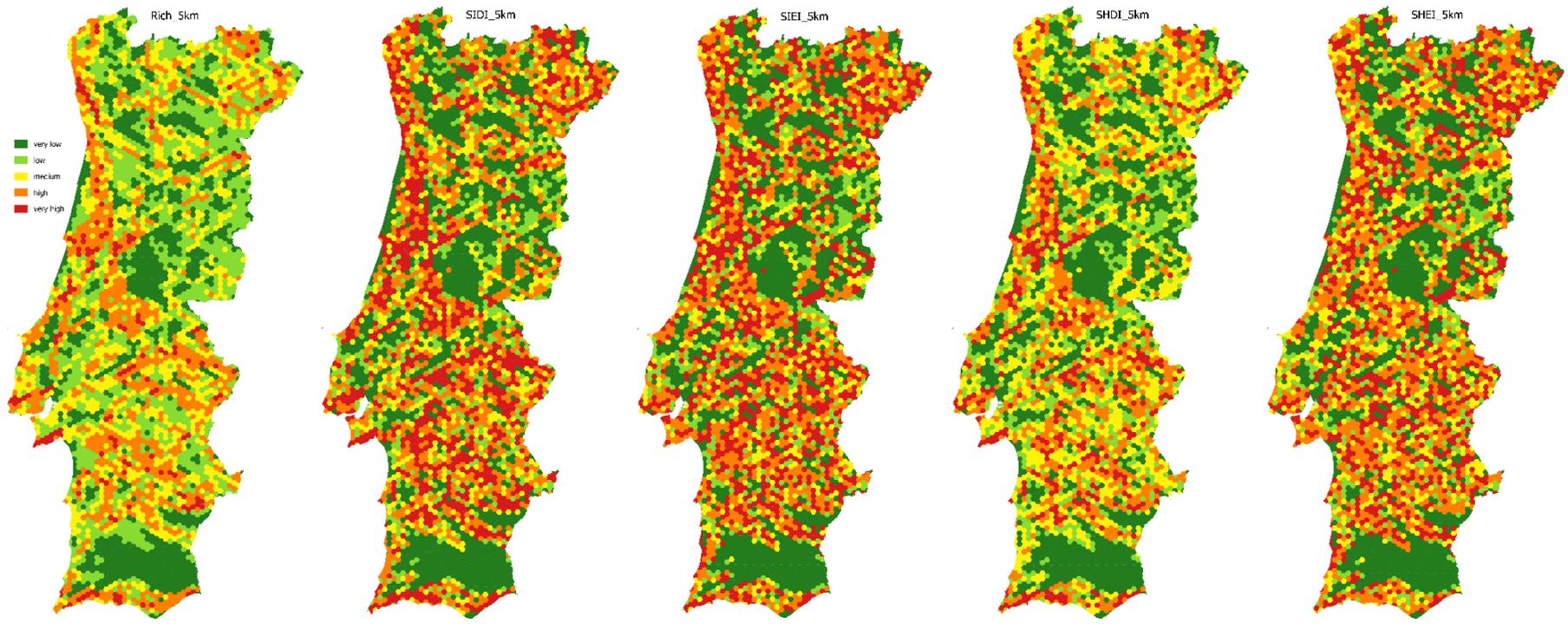


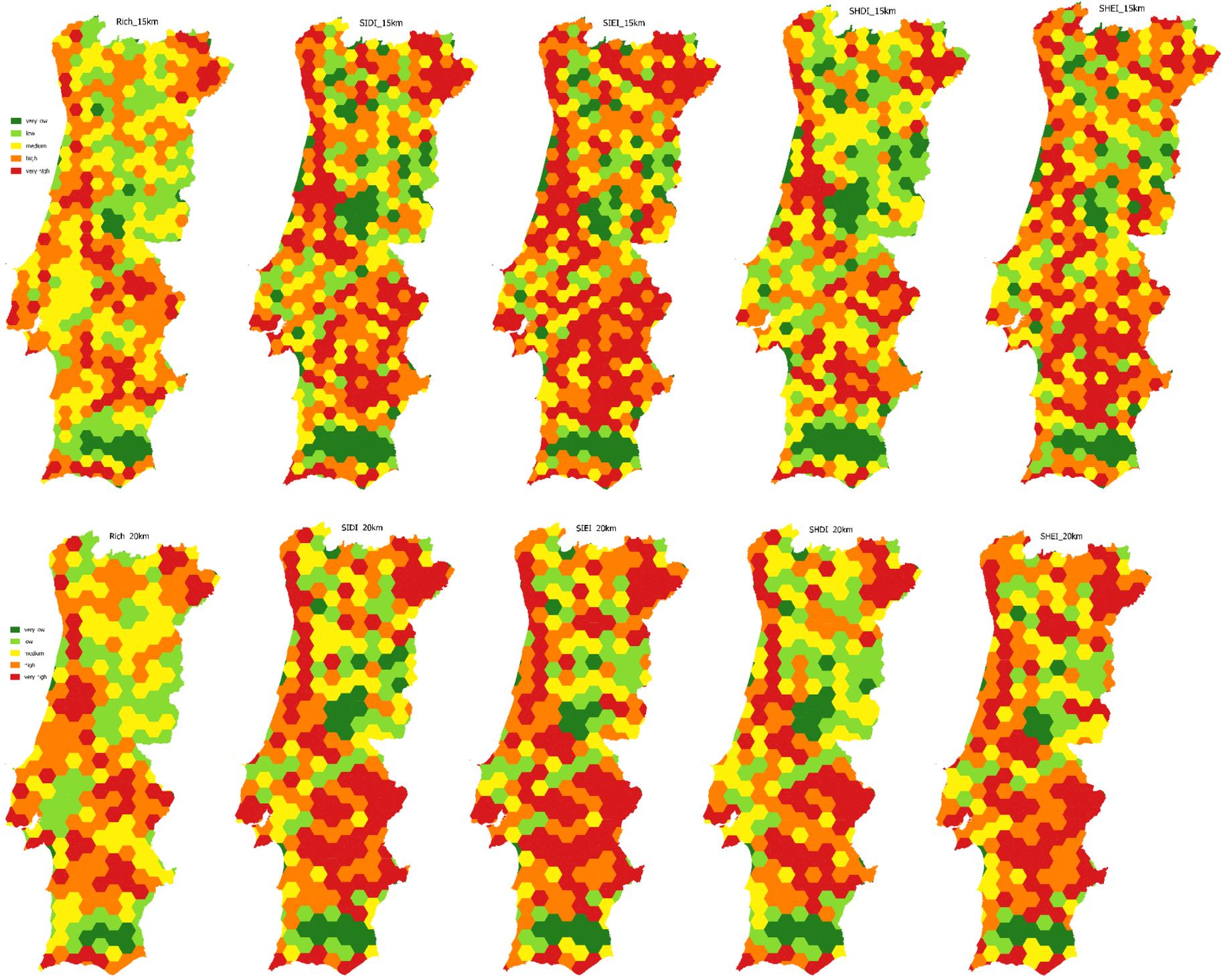
Figure S2: Bivariate analysis with Pearson and Spearman correlation coefficients between Richness, SIDI, SIEI, SHDI, and SHEI, along eight distinct cell sizes, regarding geology and geomorphology datasets used to assess the lithological and geomorphological diversity of mainland Portugal.

Grid size	Geology				Geomorphology			
	Rich_SIDI		Rich_SIEI		Rich_SIDI		Rich_SIEI	
	Pearson	Spearman	Pearson	Spearman	Pearson	Spearman	Pearson	Spearman
1	0.824394		0.77162		0.819814		0.794794	
2	0.81293	0.926524	0.714791	0.870561	0.796133	0.963367	0.741049	0.950468
5	0.791511	0.851006	0.632267	0.662659	0.76693	0.85291	0.62557	0.724578
10	0.766553	0.799447	0.592692	0.55243	0.764156	0.810793	0.575326	0.528057
15	0.745437	0.764636	0.583943	0.530307	0.774543	0.844843	0.602292	0.596859
20	0.717223	0.738608	0.576988	0.546155	0.732449	0.830201	0.526431	0.485601
25	0.739971	0.749057	0.579883	0.550428	0.735432	0.860638	0.585124	0.643729
30	0.734176	0.778669	0.582563	0.582683	0.717525	0.85844	0.515493	0.545695
Grid size	Rich_SHDI		Rich_SHEI		Rich_SHDI		Rich_SHEI	
	Pearson	Spearman	Pearson	Spearman	Pearson	Spearman	Pearson	Spearman
	1	0.867661		0.785048		0.859166		0.820146
2	0.866679	0.940093	0.708616	0.854841	0.843799	0.967069	0.756633	0.946903
5	0.866379	0.891258	0.587897	0.600718	0.836172	0.885801	0.599391	0.684633
10	0.85757	0.863251	0.519296	0.45016	0.853228	0.874242	0.498603	0.422473
15	0.839943	0.841698	0.496735	0.409462	0.875492	0.89658	0.508418	0.438581
20	0.828329	0.824687	0.499033	0.415851	0.857743	0.895421	0.403611	0.283459
25	0.851707	0.838025	0.484197	0.396418	0.872621	0.919941	0.489823	0.439335
30	0.858205	0.856064	0.493604	0.443142	0.881731	0.926151	0.403872	0.311188
Grid size	SIDI_SIEI		SIDI_SHDI		SIDI_SIEI		SIDI_SHDI	
	Pearson	Spearman	Pearson	Spearman	Pearson	Spearman	Pearson	Spearman
	1	0.988173		0.993819		0.994741		0.995151
2	0.976071	0.982318	0.99056	0.997222	0.987829	0.996473	0.993373	0.999297
5	0.958191	0.932921	0.983442	0.992097	0.96528	0.958671	0.9869	0.993054
10	0.95653	0.914585	0.976693	0.987024	0.950248	0.888082	0.978301	0.984639
15	0.962256	0.921604	0.973293	0.984432	0.955819	0.908887	0.971325	0.988668
20	0.973627	0.952616	0.970885	0.983404	0.940446	0.834313	0.962128	0.98492
25	0.959778	0.935127	0.967507	0.981249	0.965864	0.926868	0.956602	0.98279
30	0.964558	0.936068	0.961551	0.982935	0.931337	0.833134	0.943419	0.979884
Grid size	SIEI_SHEI		SHDI_SHEI		SIEI_SHEI		SHDI_SHEI	
	Pearson	Spearman	Pearson	Spearman	Pearson	Spearman	Pearson	Spearman
	1	0.978997		0.971129		0.988827		0.9849
2	0.959842	0.972777	0.944386	0.972392	0.978294	0.994487	0.969837	0.99429
5	0.92571	0.894325	0.901153	0.897691	0.939926	0.933974	0.920136	0.93297
10	0.912539	0.852569	0.886128	0.858648	0.904532	0.815052	0.879683	0.82194
15	0.916901	0.850412	0.889839	0.861127	0.900941	0.804118	0.876554	0.857172
20	0.934093	0.877893	0.897558	0.903739	0.871175	0.692304	0.835799	0.765966
25	0.902965	0.836859	0.880194	0.87403	0.913822	0.791658	0.866898	0.864472
30	0.910798	0.850246	0.879099	0.881892	0.860017	0.666926	0.79768	0.758669
Grid size	SIEI_SHEI		SHDI_SHEI		SIEI_SHEI		SHDI_SHEI	
	Pearson	Spearman	Pearson	Spearman	Pearson	Spearman	Pearson	Spearman
	1	0.995645		0.967037		0.996065		0.985364
2	0.99434	0.998024	0.931162	0.962108	0.995363	0.999652	0.965856	0.992019
5	0.990538	0.989561	0.867607	0.858083	0.992112	0.994083	0.896568	0.907385
10	0.986109	0.979064	0.839702	0.796745	0.986868	0.977305	0.830456	0.750981
15	0.984225	0.973847	0.842527	0.78737	0.981297	0.958997	0.818364	0.75139
20	0.970839	0.983937	0.819279	0.863735	0.977581	0.946316	0.757897	0.619212
25	0.979627	0.956571	0.822214	0.7688	0.979848	0.943281	0.809277	0.720787
30	0.977738	0.960415	0.830666	0.793578	0.978156	0.928415	0.717883	0.584414

Figure S3: Maps expressing lithological diversity, richness and evenness of mainland Portugal through five indices (Richness, SIDI, SIEI, SHDI, SHEI) along eight cell sizes (1km, 2km, 5km, 10km, 15km, 20km, 25km, 30km). Each map represents five classes (very low, low, medium, high, very high) based on the Jenks natural breaks classification.







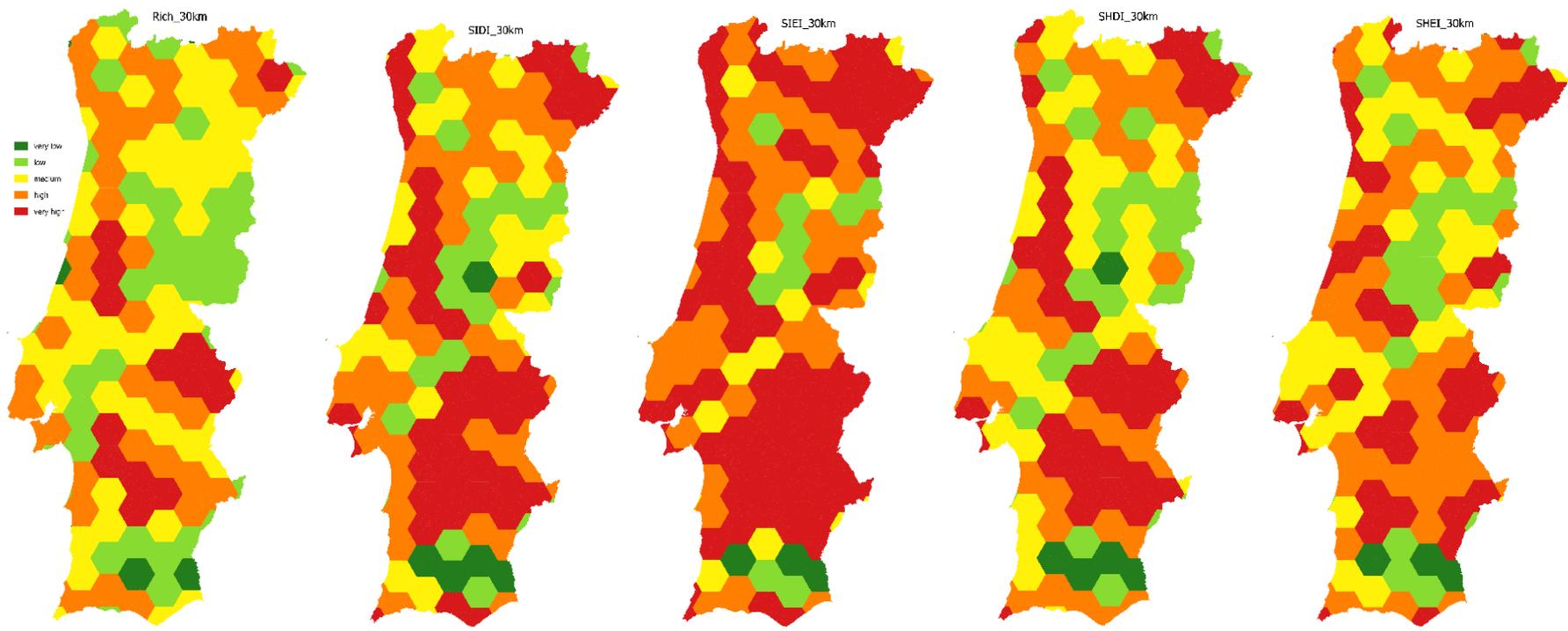
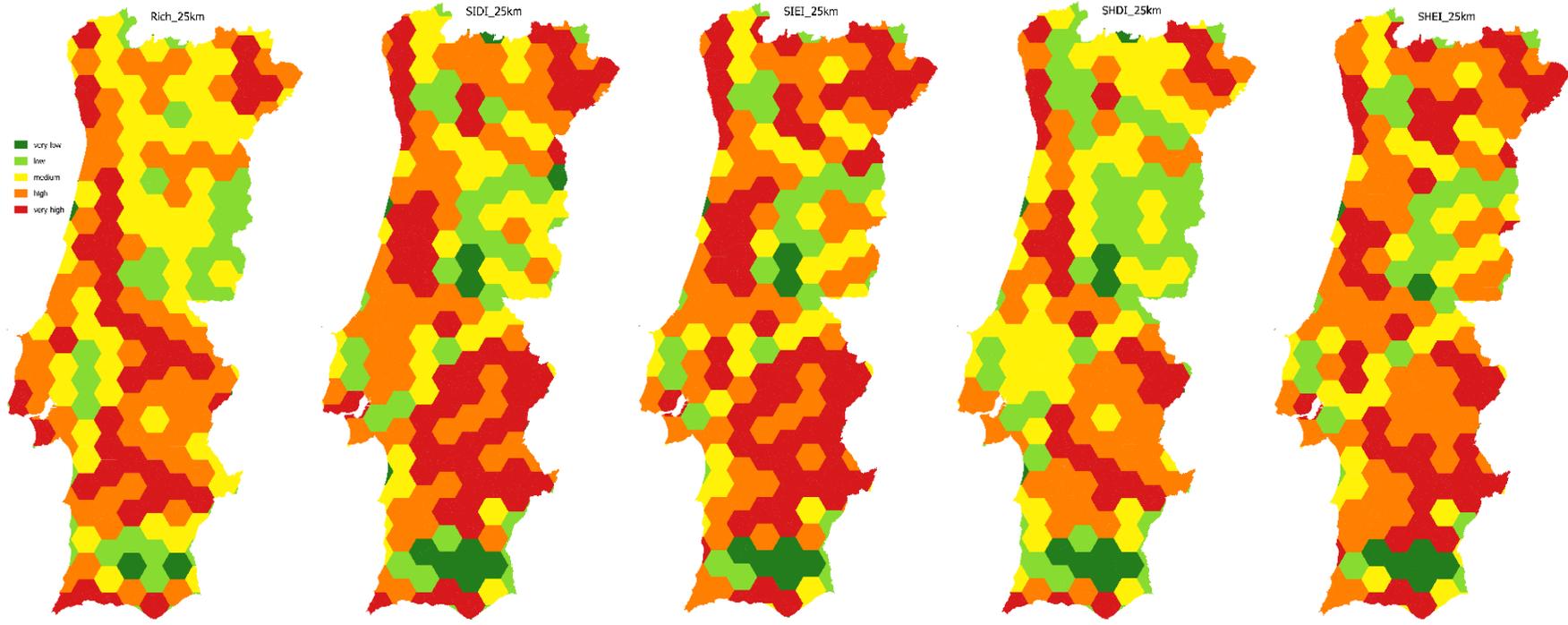


Figure S4: Maps expressing geomorphological diversity, richness and evenness of mainland Portugal through five indices (Richness, SIDI, SIEI, SHDI, SHEI) along eight cell sizes (1km, 2km, 5km, 10km, 15km, 20km, 25km, 30km). Each map represents five classes (very low, low, medium, high, very high) based on the Jenks natural breaks classification.

