

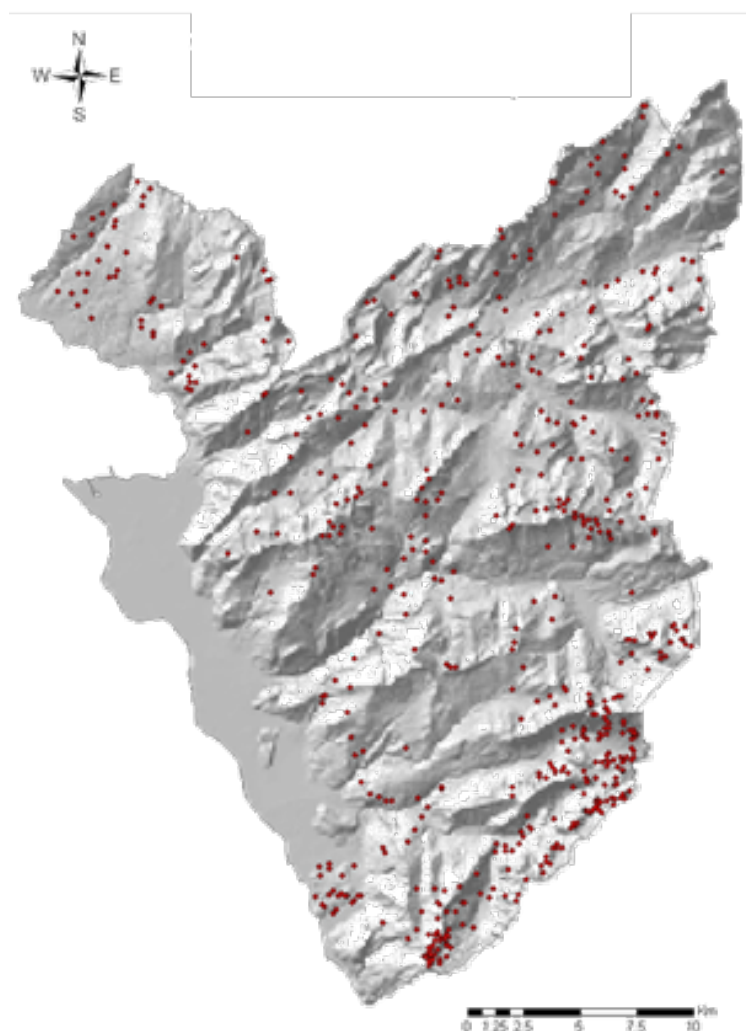
Improving spatial predictions of taxonomic, functional and phylogenetic diversity

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Supporting informations

Appendix S1: Map of the study area and the sampling plots



Appendix S2: SDMs evaluation results.

Species	TSS			AUC		
	GAM	GBM	GLM	GAM	GBM	GLM
<i>Achillea atrata</i>	0.736	0.556	0.705	0.848	0.818	0.91
<i>Achillea millefolium</i>	0.488	0.501	0.494	0.799	0.789	0.801
<i>Acinos alpinus</i>	0.372	0.393	0.439	0.707	0.718	0.728
<i>Agrostis capillaris</i>	0.471	0.461	0.482	0.783	0.79	0.781
<i>Agrostis rupestris</i>	0.789	0.735	0.786	0.935	0.902	0.917
<i>Agrostis schraderiana</i>	0.399	0.584	0.605	0.731	0.72	0.773
<i>Agrostis stolonifera</i>	0.465	0.278	0.434	0.672	0.641	0.681
<i>Ajuga reptans</i>	0.448	0.458	0.435	0.701	0.748	0.744
<i>Alchemilla conjuncta</i>	0.514	0.47	0.429	0.78	0.789	0.759
<i>Alchemilla glabra</i>	0.268	0.267	0.216	0.626	0.627	0.575
<i>Alchemilla vulgaris</i>	0.432	0.436	0.438	0.773	0.778	0.758
<i>Androsace chamaejasme</i>	0.554	0.389	0.501	0.815	0.731	0.807
<i>Anthoxanthum odoratum</i>	0.297	0.335	0.335	0.694	0.687	0.679
<i>Anthyllis vulneraria</i>	0.389	0.402	0.405	0.745	0.735	0.727
<i>Aposeris foetida</i>	0.503	0.43	0.518	0.759	0.757	0.774
<i>Arabis alpina</i>	0.773	0.745	0.811	0.914	0.902	0.921
<i>Arnica montana</i>	0.575	0.378	0.526	0.8	0.726	0.816
<i>Arrhenatherum elatius</i>	0.598	0.569	0.583	0.849	0.85	0.843
<i>Aster bellidiastrum</i>	0.487	0.339	0.451	0.773	0.709	0.745
<i>Astrantia major</i>	0.489	0.503	0.508	0.791	0.784	0.811
<i>Bartsia alpina</i>	0.504	0.531	0.486	0.782	0.787	0.792
<i>Bellis perennis</i>	0.553	0.581	0.55	0.82	0.835	0.837
<i>Brachypodium pinnatum</i>	0.657	0.658	0.652	0.874	0.874	0.863
<i>Briza media</i>	0.49	0.491	0.482	0.794	0.792	0.799
<i>Bromus erectus</i>	0.745	0.696	0.708	0.928	0.9	0.925
<i>Calamagrostis varia</i>	0.474	0.536	0.463	0.814	0.812	0.787
<i>Campanula barbata</i>	0.637	0.54	0.637	0.818	0.778	0.8
<i>Campanula scheuchzeri</i>	0.63	0.625	0.627	0.878	0.871	0.872
<i>Carduus defloratus</i>	0.461	0.417	0.438	0.78	0.757	0.787
<i>Carex atrata</i>	0.706	0.485	0.666	0.849	0.756	0.825
<i>Carex ferruginea</i>	0.46	0.446	0.493	0.787	0.782	0.804
<i>Carex flacca</i>	0.416	0.43	0.44	0.719	0.747	0.734
<i>Carex pallescens</i>	0.446	0.446	0.469	0.777	0.759	0.782
<i>Carex sempervirens</i>	0.563	0.568	0.547	0.845	0.845	0.834
<i>Carex sylvatica</i>	0.572	0.469	0.583	0.806	0.75	0.714
<i>Carlina acaulis</i>	0.549	0.462	0.525	0.849	0.788	0.841
<i>Carum carvi</i>	0.55	0.567	0.583	0.832	0.831	0.846
<i>Centaurea jacea</i>	0.485	0.468	0.496	0.775	0.785	0.771
<i>Centaurea montana</i>	0.288	0.323	0.302	0.637	0.654	0.632
<i>Centaurea scabiosa</i>	0.23	0.533	0.519	0.693	0.754	0.769
<i>Cerastium arvense</i>	0.471	0.188	0.576	0.687	0.594	0.795

<i>Cerastium_fontanum</i>	0.424	0.365	0.413	0.733	0.713	0.725
<i>Chaerophyllum_hirsutum</i>	0.41	0.461	0.406	0.765	0.793	0.759
<i>Cirsium_acaule</i>	0.354	0.27	0.439	0.696	0.645	0.711
<i>Cirsium_spinosissimum</i>	0.531	0.486	0.582	0.801	0.81	0.812
<i>Clinopodium_vulgare</i>	0.68	0.392	0.779	0.874	0.743	0.918
<i>Crepis_aurea</i>	0.498	0.443	0.465	0.777	0.756	0.758
<i>Crepis_pyrenaica</i>	0.437	0.524	0.485	0.78	0.788	0.792
<i>Cruciata_laevipes</i>	0.389	0.512	0.47	0.732	0.811	0.777
<i>Cynosurus_cristatus</i>	0.634	0.618	0.632	0.856	0.842	0.856
<i>Dactylis_glomerata</i>	0.633	0.658	0.624	0.879	0.868	0.881
<i>Daucus_carota</i>	0.743	0.767	0.721	0.905	0.941	0.887
<i>Deschampsia_cespitosa</i>	0.398	0.443	0.359	0.74	0.755	0.711
<i>Doronicum_grandiflorum</i>	0.793	0.69	0.769	0.908	0.839	0.904
<i>Dryas_octopetala</i>	0.584	0.449	0.606	0.839	0.744	0.849
<i>Euphorbia_cyparissias</i>	0.536	0.49	0.551	0.817	0.79	0.823
<i>Festuca_pratensis</i>	0.556	0.547	0.568	0.819	0.809	0.819
<i>Festuca_quadriflora</i>	0.67	0.568	0.723	0.861	0.858	0.867
<i>Festuca_rubra</i>	0.436	0.424	0.447	0.789	0.797	0.784
<i>Festuca_violacea</i>	0.656	0.712	0.687	0.891	0.88	0.897
<i>Fragaria vesca</i>	0.74	0.681	0.565	0.878	0.867	0.798
<i>Galium_album</i>	0.549	0.42	0.534	0.799	0.769	0.809
<i>Galium_anisophyllum</i>	0.338	0.357	0.399	0.691	0.704	0.7
<i>Galium_pumilum</i>	0.265	0.235	0.217	0.645	0.622	0.626
<i>Gentiana_acaulis</i>	0.768	0.512	0.681	0.923	0.833	0.88
<i>Gentiana_campestris</i>	0.449	0.439	0.583	0.798	0.77	0.834
<i>Gentiana_lutea</i>	0.458	0.474	0.473	0.762	0.794	0.769
<i>Gentiana_purpurea</i>	0.578	0.478	0.605	0.849	0.795	0.861
<i>Gentiana_verna</i>	0.429	0.278	0.339	0.656	0.654	0.701
<i>Geranium_sylvaticum</i>	0.388	0.42	0.383	0.74	0.75	0.734
<i>Geum_montanum</i>	0.659	0.592	0.694	0.883	0.865	0.888
<i>Geum_rivale</i>	0.43	0.359	0.309	0.707	0.688	0.689
<i>Glechoma_hederacea</i>	0.55	0.671	0.567	0.823	0.885	0.773
<i>Globularia_cordifolia</i>	0.489	0.529	0.509	0.794	0.777	0.805
<i>Globularia_nudicaulis</i>	0.664	0.344	0.708	0.887	0.623	0.85
<i>Hedysarum_hedysaroides</i>	0.688	0.418	0.53	0.846	0.763	0.815
<i>Helianthemum_nummularium</i>	0.421	0.448	0.445	0.768	0.757	0.764
<i>Helictotrichon_versicolor</i>	0.651	0.619	0.613	0.864	0.844	0.858
<i>Heracleum_sphondylium</i>	0.498	0.455	0.487	0.786	0.769	0.787
<i>Hieracium_bifidum</i>	0.27	0.229	0.289	0.626	0.605	0.682
<i>Hieracium_lactucella</i>	0.388	0.444	0.384	0.762	0.782	0.75
<i>Hippocrepis_comosa</i>	0.632	0.548	0.579	0.845	0.809	0.824
<i>Holcus_lanatus</i>	0.722	0.756	0.644	0.897	0.894	0.883
<i>Homogyne_alpina</i>	0.589	0.546	0.571	0.855	0.838	0.862
<i>Hypericum_maculatum</i>	0.396	0.327	0.359	0.735	0.716	0.724
<i>Hypochaeris_radicata</i>	0.58	0.629	0.511	0.857	0.829	0.81
<i>Knautia_arvensis</i>	0.523	0.463	0.516	0.803	0.767	0.8

<i>Knautia_dipsacifolia</i>	0.569	0.486	0.576	0.814	0.816	0.814
<i>Laserpitium_latifolium</i>	0.758	0.607	0.663	0.914	0.871	0.883
<i>Lathyrus_pratensis</i>	0.65	0.63	0.645	0.868	0.87	0.862
<i>Leontodon_autumnalis</i>	0.56	0.385	0.411	0.784	0.743	0.752
<i>Leontodon_helveticus</i>	0.57	0.406	0.571	0.831	0.732	0.821
<i>Leontodon_hispidus</i>	0.31	0.329	0.247	0.689	0.693	0.652
<i>Leucanthemum_vulgare</i>	0.295	0.332	0.335	0.698	0.706	0.718
<i>Ligusticum_mutellina</i>	0.594	0.613	0.622	0.862	0.845	0.871
<i>Linum_catharticum</i>	0.584	0.46	0.603	0.821	0.763	0.819
<i>Lolium_perenne</i>	0.626	0.681	0.661	0.902	0.886	0.886
<i>Lotus_corniculatus</i>	0.382	0.416	0.4	0.741	0.761	0.768
<i>Luzula_multiflora</i>	0.432	0.277	0.395	0.738	0.701	0.734
<i>Medicago_lupulina</i>	0.588	0.564	0.587	0.845	0.84	0.834
<i>Myosotis_alpestris</i>	0.587	0.51	0.545	0.845	0.793	0.838
<i>Nardus_stricta</i>	0.573	0.533	0.568	0.854	0.838	0.858
<i>Parnassia_palustris</i>	0.396	0.225	0.414	0.721	0.624	0.722
<i>Pedicularis_foliosa</i>	0.569	0.545	0.573	0.836	0.804	0.846
<i>Phleum_hirsutum</i>	0.582	0.546	0.561	0.82	0.773	0.798
<i>Phleum_pratense</i>	0.426	0.478	0.581	0.771	0.776	0.8
<i>Phleum_rhaeticum</i>	0.57	0.576	0.568	0.838	0.826	0.831
<i>Phyteuma_orbiculare</i>	0.324	0.328	0.34	0.702	0.672	0.689
<i>Phyteuma_spicatum</i>	0.482	0.389	0.481	0.785	0.729	0.795
<i>Pimpinella_major</i>	0.404	0.519	0.357	0.773	0.814	0.741
<i>Plantago_alpina</i>	0.618	0.615	0.633	0.855	0.845	0.85
<i>Plantago_atrata</i>	0.58	0.555	0.579	0.827	0.81	0.822
<i>Plantago_lanceolata</i>	0.69	0.683	0.684	0.914	0.909	0.901
<i>Plantago_major</i>	0.561	0.603	0.596	0.782	0.832	0.756
<i>Plantago_media</i>	0.465	0.461	0.39	0.793	0.791	0.718
<i>Poa_alpina</i>	0.534	0.555	0.535	0.819	0.825	0.81
<i>Poa_minor</i>	0.777	0.767	0.756	0.912	0.926	0.912
<i>Poa_pratensis</i>	0.55	0.525	0.5	0.783	0.801	0.776
<i>Polygala_chamaebuxus</i>	0.789	0.734	0.659	0.919	0.89	0.877
<i>Polygonum_bistorta</i>	0.434	0.553	0.438	0.758	0.784	0.765
<i>Polygonum_viviparum</i>	0.47	0.481	0.5	0.792	0.811	0.798
<i>Potentilla_aurea</i>	0.482	0.472	0.493	0.802	0.798	0.802
<i>Potentilla_crantzii</i>	0.66	0.557	0.634	0.873	0.817	0.869
<i>Potentilla_erecta</i>	0.533	0.55	0.457	0.811	0.82	0.782
<i>Primula_elatior</i>	0.344	0.33	0.252	0.684	0.656	0.652
<i>Pritzelago_alpina</i>	0.725	0.782	0.75	0.912	0.913	0.913
<i>Prunella_grandiflora</i>	0.624	0.624	0.606	0.857	0.828	0.845
<i>Prunella_vulgaris</i>	0.555	0.586	0.447	0.827	0.857	0.78
<i>Pulsatilla_alpina</i>	0.564	0.564	0.612	0.811	0.848	0.851
<i>Ranunculus_aconitifolius</i>	0.529	0.439	0.379	0.802	0.758	0.698
<i>Ranunculus_acris</i>	0.566	0.543	0.54	0.857	0.833	0.847
<i>Ranunculus_alpestris</i>	0.704	0.687	0.706	0.888	0.884	0.898
<i>Ranunculus_montanus</i>	0.556	0.573	0.529	0.805	0.812	0.805

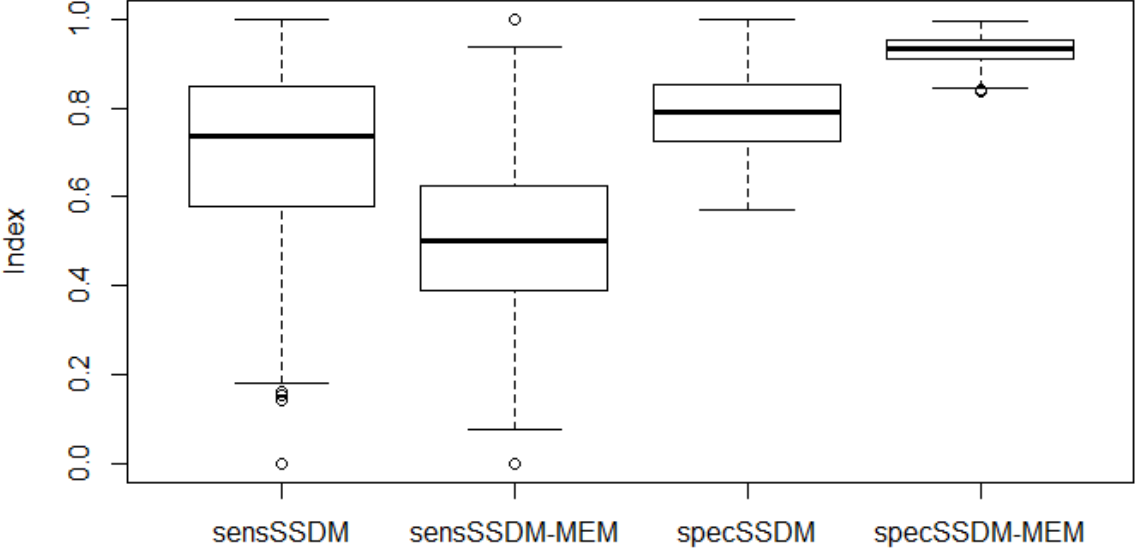
<i>Ranunculus_repens</i>	0.579	0.484	0.33	0.761	0.765	0.668
<i>Rhinanthus_alectorolophus</i>	0.318	0.308	0.294	0.688	0.684	0.681
<i>Rhinanthus_minor</i>	0.656	0.719	0.691	0.842	0.867	0.883
<i>Rumex_acetosa</i>	0.583	0.622	0.605	0.832	0.822	0.836
<i>Salix_herbacea</i>	0.598	0.646	0.755	0.789	0.768	0.846
<i>Salix_reticulata</i>	0.669	0.659	0.69	0.867	0.844	0.852
<i>Salix_retusa</i>	0.589	0.573	0.578	0.858	0.848	0.865
<i>Sanguisorba_minor</i>	0.614	0.65	0.606	0.865	0.864	0.857
<i>Saxifraga_aizoides</i>	0.657	0.772	0.651	0.879	0.879	0.883
<i>Saxifraga_moschata</i>	0.692	0.553	0.64	0.878	0.794	0.835
<i>Saxifraga_oppositifolia</i>	0.804	0.738	0.807	0.944	0.923	0.938
<i>Saxifraga_paniculata</i>	0.738	0.569	0.648	0.91	0.832	0.872
<i>Scabiosa_lucida</i>	0.447	0.481	0.502	0.793	0.808	0.791
<i>Sesleria_caerulea</i>	0.559	0.534	0.544	0.836	0.815	0.83
<i>Silene_acaulis</i>	0.842	0.818	0.856	0.937	0.931	0.932
<i>Silene_vulgaris</i>	0.179	0.267	0.231	0.594	0.625	0.617
<i>Soldanella_alpina</i>	0.534	0.564	0.527	0.841	0.856	0.836
<i>Solidago_virgaurea</i>	0.452	0.427	0.487	0.698	0.703	0.708
<i>Stachys_officinalis</i>	0.681	0.372	0.524	0.829	0.746	0.796
<i>Taraxacum_alpinum</i>	0.847	0.738	0.823	0.899	0.893	0.902
<i>Taraxacum_officinale</i>	0.569	0.553	0.583	0.869	0.856	0.86
<i>Thesium_alpinum</i>	0.454	0.354	0.494	0.772	0.659	0.777
<i>Thymus_praecox</i>	0.418	0.407	0.353	0.73	0.68	0.725
<i>Tragopogon_pratensis</i>	0.314	0.509	0.396	0.688	0.741	0.737
<i>Trifolium_badium</i>	0.463	0.329	0.491	0.725	0.682	0.765
<i>Trifolium_medium</i>	0.579	0.644	0.51	0.837	0.846	0.804
<i>Trifolium_pratense</i>	0.418	0.453	0.453	0.77	0.768	0.784
<i>Trifolium_repens</i>	0.611	0.595	0.555	0.87	0.858	0.841
<i>Trifolium_thalii</i>	0.496	0.573	0.528	0.781	0.832	0.801
<i>Trisetum_flavescens</i>	0.543	0.528	0.527	0.778	0.797	0.777
<i>Trollius_europaeus</i>	0.428	0.407	0.407	0.71	0.746	0.698
<i>Vaccinium_gaultherioides</i>	0.688	0.526	0.67	0.884	0.777	0.877
<i>Vaccinium_myrtillus</i>	0.52	0.404	0.487	0.797	0.759	0.81
<i>Vaccinium_vitisidaea</i>	0.618	0.494	0.608	0.8	0.741	0.813
<i>Valeriana_montana</i>	0.366	0.387	0.362	0.662	0.717	0.663
<i>Veratrum_album</i>	0.627	0.571	0.611	0.858	0.834	0.864
<i>Veronica_alpina</i>	0.708	0.663	0.719	0.893	0.867	0.887
<i>Veronica_chamaedrys</i>	0.607	0.598	0.582	0.851	0.837	0.82
<i>Veronica_officinalis</i>	0.552	0.393	0.548	0.822	0.736	0.8
<i>Vicia_cracca</i>	0.501	0.505	0.512	0.741	0.766	0.745
<i>Vicia_sepium</i>	0.505	0.487	0.499	0.736	0.78	0.734
<i>Viola_biflora</i>	0.495	0.365	0.512	0.748	0.698	0.768

Appendix S3: Macroecological models results

All model techniques had a R-squared comprised between 0.6 and 0.7. The table ranks the importance of the variables for each modelling technique from the most important to the least (1 to 5): growing degree-days (GDD), moisture index over the growing season (MI), the sum of solar radiations over the year (RAD), slope (S), and topography (T).

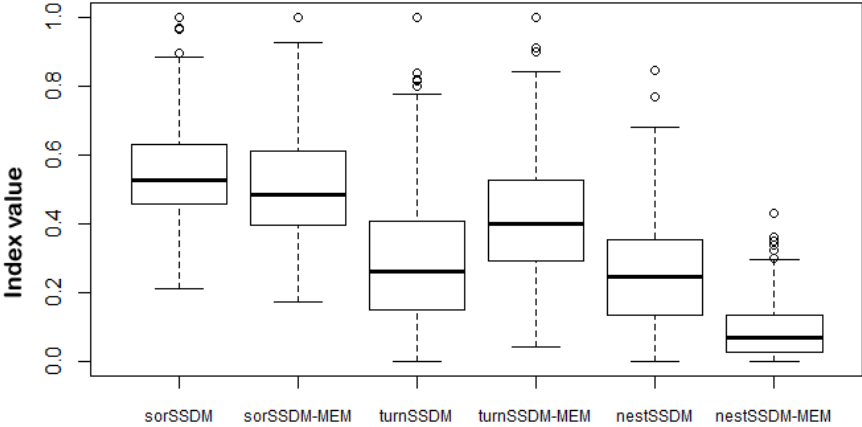
	GLM	GAM	GBM
1	GDD	GDD	GDD
2	T	S	MI
3	S	MI	T
4	RAD	RAD	S
5	MI	T	RAD

Appendix S4: Boxplots comparing predictions from SSDM and SSDM-MEM on the basis of Sensitivity (sens) and Specificity (spec) indices.

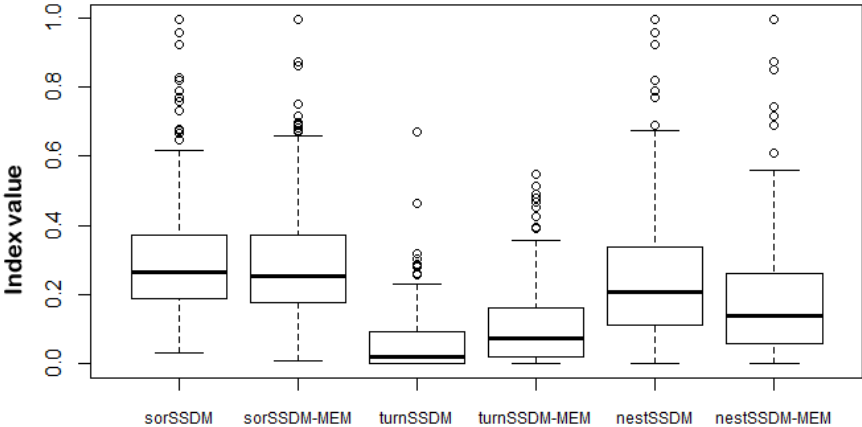


Appendix S5. Boxplots comparing predictions from SSDM and SSDM-MEM for the taxonomic (A), functional (B) and phylogenetic (C) diversity components, on the basis of the Sørensen dissimilarity index (sor) and its components, richness difference (turn) and species replacement (nest).

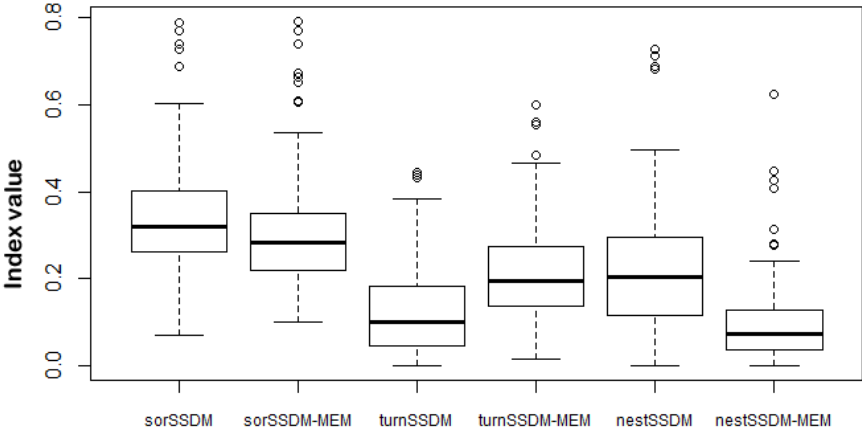
A



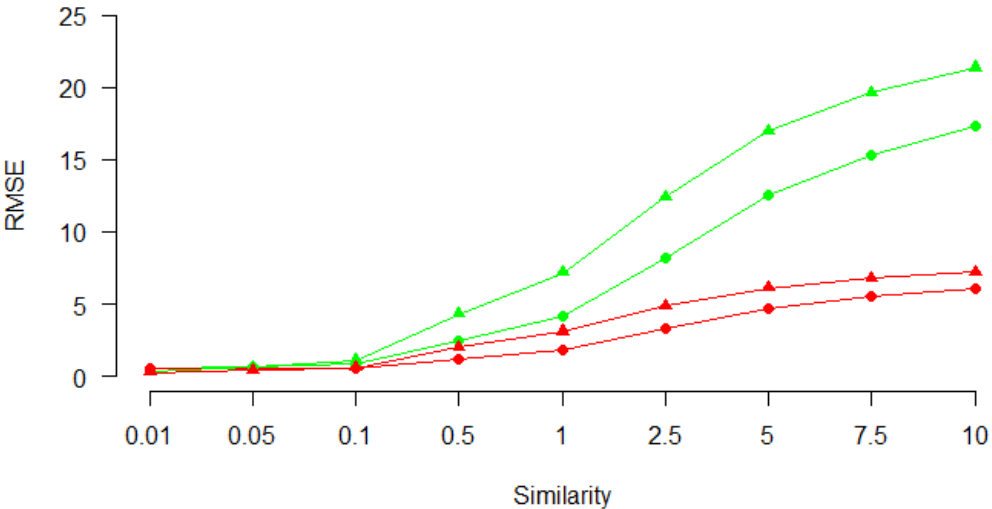
B



C



Appendix S6. Variation of the root mean square error (RMSE) for SSDM (green) and SSDM-MEM (red) predictions for the functional (circles) and phylogenetic (triangles) diversity indices for different similarity δ values.



Appendix S7: Values of ρ Spearman correlation between observed and predicted FD and PD indices, both for SSDM-MEM and SSDM approaches, at each similarity parametrization (δ values).

δ values	FD		PD	
	SSDM-MEM	SSDM	SSDM-MEM	SSDM
0.01	0.55	0.52	0.51	0.52
0.1	0.55	0.52	0.52	0.52
0.05	0.55	0.52	0.52	0.52
0.5	0.59	0.55	0.53	0.52
1	0.59	0.56	0.53	0.52
2.5	0.55	0.54	0.52	0.51
5	0.53	0.53	0.51	0.50
7.5	0.52	0.52	0.51	0.50
10	0.52	0.51	0.51	0.50