Ecography

ECOG-03636
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Supplementary material

Appendix 1

Contents:

Table A1. Proportion of species in vertical strategies (arboreal, terrestrial or fossorial) within biomes specific to biogeographic realms. We used the biome classification from Olson et al., (2001) and the biogeographic realm classification from Holt et al., (2013).

Realm	Biome	Arboreal	Terrestrial	Fossorial
Afrotropical	Deserts & Xeric Shrublands	0.22	0.43	0.35
	Flooded Grasslands & Savannas	0.46	0.34	0.19
	Mangroves	0.56	0.28	0.16
	Mediterranean Forests, Woodlands & Scrub	0.26	0.51	0.24
	Montane Grasslands & Shrublands	0.39	0.4	0.22
	Trop. & SubTrop. Dry Broadleaf Forests	0.5	0.35	0.15
	Trop. & SubTrop. Grasslands, Savannas & Shrublands	0.46	0.36	0.18
	Trop. & SubTrop. Moist Broadleaf Forests	0.58	0.36	0.06
Australian	Deserts & Xeric Shrublands	0.29	0.14	0.56
	Mediterranean Forests, Woodlands & Scrub	0.3	0.28	0.42
	Montane Grasslands & Shrublands	0.59	0.36	0.05
	Temperate Broadleaf & Mixed Forests	0.53	0.33	0.14
	Temperate Grasslands, Savannas & Shrublands	0.45	0.2	0.35
	Trop. & SubTrop. Grasslands, Savannas & Shrublands	0.5	0.2	0.3
	Trop. & SubTrop. Moist Broadleaf Forests	0.47	0.35	0.18
Madagascan	Deserts & Xeric Shrublands	0.45	0.29	0.26
	Trop. & SubTrop. Dry Broadleaf Forests	0.58	0.24	0.18
	Trop. & SubTrop. Moist Broadleaf Forests	0.66	0.29	0.05
Nearctic	Boreal Forests/Taiga	0.06	0.6	0.34
	Deserts & Xeric Shrublands	0.2	0.36	0.44
	Flooded Grasslands & Savannas	0.32	0.3	0.38
	Mangroves	0.27	0.4	0.33
	Mediterranean Forests, Woodlands & Scrub	0.22	0.58	0.19
	Temperate Broadleaf & Mixed Forests	0.17	0.53	0.29
	Temperate Conifer Forests	0.2	0.44	0.37
	Temperate Grasslands, Savannas & Shrublands	0.2	0.34	0.46
	Trop. & SubTrop. Coniferous Forests	0.38	0.36	0.26
	Trop. & SubTrop. Dry Broadleaf Forests	0.38	0.4	0.21
	Trop. & SubTrop. Grasslands, Savannas & Shrublands	0.26	0.25	0.49
	Trop. & SubTrop. Moist Broadleaf Forests	0.49	0.33	0.18
	Tundra	0.14	0.57	0.29
Neotropical	Deserts & Xeric Shrublands	0.42	0.35	0.22
	Flooded Grasslands & Savannas	0.34	0.46	0.2
	Mangroves	0.51	0.35	0.15
	Montane Grasslands & Shrublands	0.33	0.6	0.07
	Temperate Broadleaf & Mixed Forests	0.18	0.8	0.02
	Temperate Grasslands, Savannas & Shrublands	0.13	0.55	0.32
	Trop. & SubTrop. Dry Broadleaf Forests	0.42	0.42	0.16
	Trop. & SubTrop. Grasslands, Savannas & Shrublands	0.37	0.41	0.22
	Trop. & SubTrop. Moist Broadleaf Forests	0.51	0.35	0.15
Oceanian	Mangroves	0.53	0.37	0.11
	Trop. & SubTrop. Grasslands, Savannas & Shrublands	0.53	0.35	0.12
	Trop. & SubTrop. Moist Broadleaf Forests	0.47	0.37	0.15

Oriental	Deserts & Xeric Shrublands	0.31	0.26	0.42
	Mangroves	0.32	0.43	0.24
	Montane Grasslands & Shrublands	0.57	0.32	0.11
	Temperate Broadleaf & Mixed Forests	0.49	0.34	0.16
	Temperate Conifer Forests	0.43	0.46	0.11
	Trop. & SubTrop. Coniferous Forests	0.37	0.37	0.25
	Trop. & SubTrop. Dry Broadleaf Forests	0.29	0.38	0.33
	Trop. & SubTrop. Grasslands, Savannas & Shrublands	0.42	0.37	0.21
	Trop. & SubTrop. Moist Broadleaf Forests	0.35	0.48	0.17
Palearctic	Boreal Forests/Taiga	0.14	0.73	0.13
	Deserts & Xeric Shrublands	0.43	0.29	0.29
	Flooded Grasslands & Savannas	0.44	0.45	0.12
	Mediterranean Forests, Woodlands & Scrub	0.27	0.43	0.29
	Temperate Broadleaf & Mixed Forests	0.25	0.53	0.22
	Temperate Conifer Forests	0.3	0.51	0.19
	Temperate Grasslands, Savannas & Shrublands	0.23	0.54	0.23
Panamanian	Deserts & Xeric Shrublands	0.53	0.36	0.11
	Mangroves	0.56	0.35	0.09
	Trop. & SubTrop. Coniferous Forests	0.54	0.36	0.1
	Trop. & SubTrop. Dry Broadleaf Forests	0.5	0.41	0.1
	Trop. & SubTrop. Moist Broadleaf Forests	0.54	0.35	0.1
Saharo-Arabian	Mediterranean Forests, Woodlands & Scrub	0.19	0.5	0.31
	Montane Grasslands & Shrublands	0.24	0.54	0.22
	Temperate Conifer Forests	0.17	0.5	0.33
	Trop. & SubTrop. Coniferous Forests	0.33	0.5	0.17
Sino-Japanese	Flooded Grasslands & Savannas	0.43	0.43	0.14
	Montane Grasslands & Shrublands	0.56	0.31	0.12
	Temperate Broadleaf & Mixed Forests	0.42	0.48	0.09
	Temperate Conifer Forests	0.62	0.29	0.09
	Trop. & SubTrop. Coniferous Forests	0.33	0.4	0.27
	Trop. & SubTrop. Grasslands, Savannas & Shrublands	0.41	0.38	0.22
	Trop. & SubTrop. Moist Broadleaf Forests	0.36	0.57	0.06

Table A2. Correlations between amphibian richness and verticality (vertical niche position, arboreality and fossoriality). We show global and regional correlations. Regional correlations were performed across grid cells within biogeographical realms (Holt et al. 2013). Correlations were calculated using Pearson's correlation coefficient. Significance of Pearson's correlations were assessed using Dutilleul's modified t-test to account for spatially independent degrees of freedom (Dutilleul et al. 1993). Significance levels: * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$; NS, not significant.

Model	Vertical niche position	Arboreality	Fossoriality
Global	0.24 *	0.52 ***	-0.41 *
Regional			
Afrotropical	0.42 **	0.63 **	-0.49 *
Australian	0.63 *	0.53 **	-0.62 *
Madagascan	0.83 ***	0.68 ***	-0.84 ***
Nearctic	-0.14 NS	0.27 *	-0.17 NS
Neotropical	0.6 **	0.81 ***	-0.41 *
Oceanian	0.19 *	-0.08 NS	0.27 NS
Oriental	0.29 **	-0.17 NS	-0.52 NS
Palearctic	-0.22 NS	0.03 NS	0.42 ***
Panamanian	0.31 ***	0.15 *	0 NS
Saharo-Arabian	0.26 NS	0.33 NS	-0.28 NS
Sino-Japanese	0.25 *	-0.11 NS	-0.47 **

Table A3. A sensitivity analyses performed with a reduced dataset (only Anura) to identify the relationship between amphibian richness and verticality metrics (vertical niche position, arboreality and fossoriality). We show global and regional correlations. Regional correlations were performed across grid cells within biogeographical realms (Holt et al. 2013). Correlations were calculated using Pearson's correlation coefficient. Significance of Pearson's correlations were assessed using Dutilleul's modified t-test to account for spatially independent degrees of freedom (Dutilleul et al. 1993). Significance levels: * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$; NS, not significant.

Model	Vertical niche position	Arboreality	Fossoriality
Global	0.27 **	0.53 ***	-0.47 **
Regional			
Afrotropical	0.4 NS	0.64 ***	-0.52 *
Australian	0.64 *	0.53 **	-0.62 *
Madagascan	0.82 ***	0.66 **	-0.83 ***
Nearctic	-0.29 NS	0.44 ***	0.28 NS
Neotropical	0.62 **	0.81 ***	-0.45 *
Oceanian	0.19 *	-0.06 NS	0.19 NS
Oriental	0.22 **	-0.13 NS	-0.54 NS
Palearctic	0.14 *	0.21 *	-0.02 NS
Panamanian	0.56 ***	0.36 *	-0.44 **
Saharo-Arabian	-0.66 NS	-0.33 NS	0.59 NS
Sino-Japanese	0.15 *	-0.19 NS	-0.3 NS

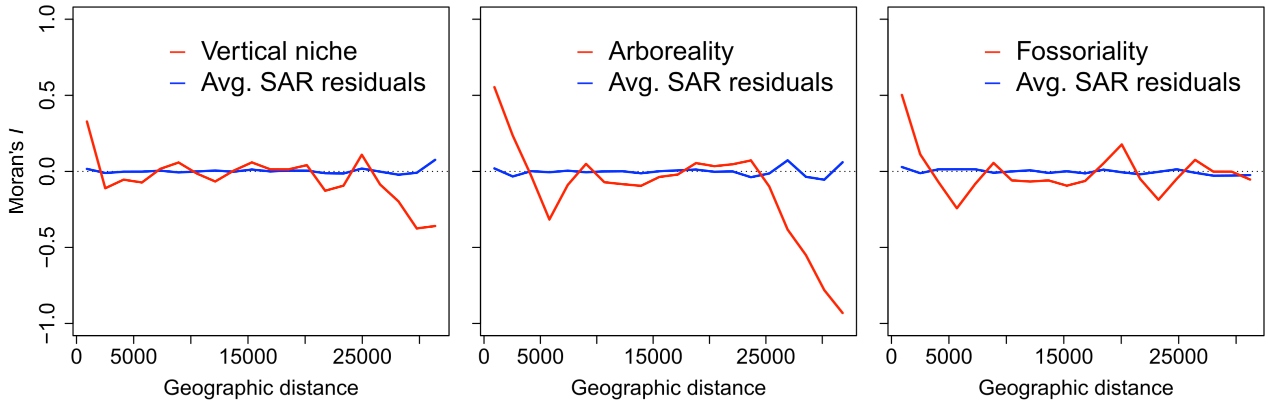

Figure A1. Global autocorrelograms. Red lines represent spatial autocorrelation in response variables (vertical niche position, arboreality or fossoriality). Blue lines represent spatial autocorrelation in averaged residuals of global simultaneous autoregressive (SAR) models. Averaged residuals represent the difference between raw values from an explanatory variable and the averaged fitted values (weighted AICc x fitted values) from SAR models. See methods for details in model averaging procedure.

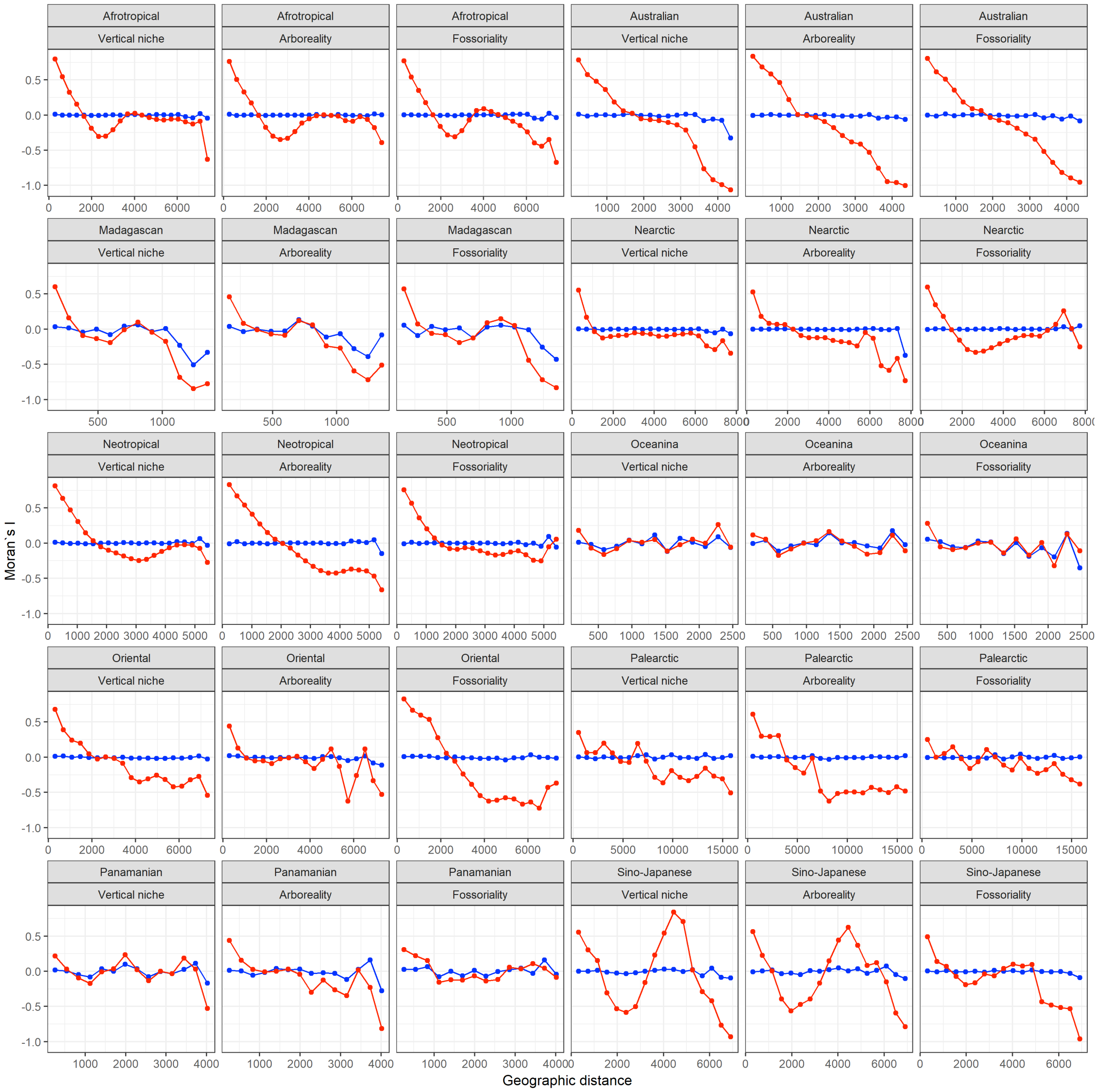

Figure A2. Regional autocorrelograms. Regional simultaneous autoregressive (SAR) models were run for each biogeographic realm (Holt et al. 2013). Red lines represent spatial autocorrelation in response variables (vertical niche position, arboreality or fossoriality). Blue lines represent spatial autocorrelation in averaged residuals of SAR models. Averaged residuals represent the difference between raw values from an explanatory variable and the averaged fitted values (weighted AICc x fitted values) from SAR models. See methods for details in model averaging procedure.

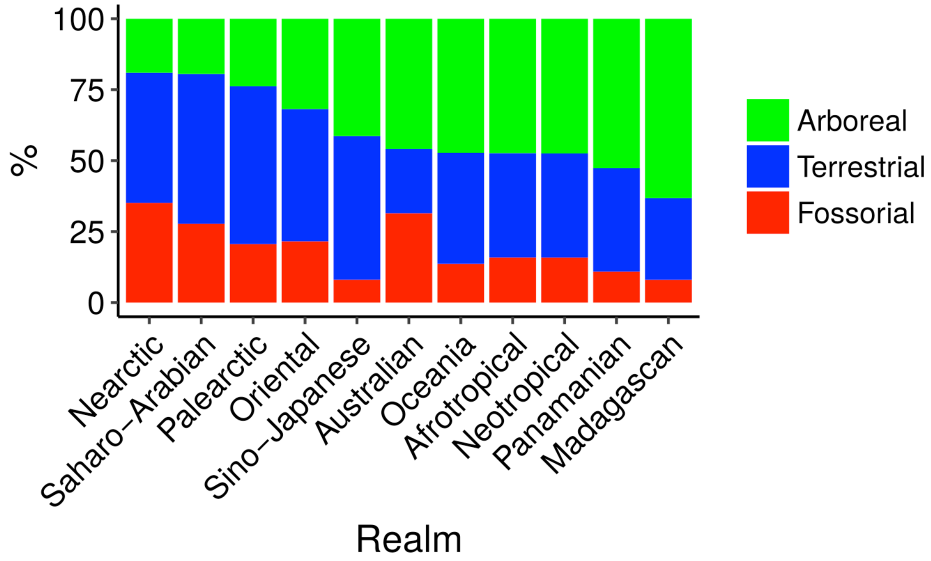

Figure A3. Proportion of vertical strategies for each biogeographic realm.

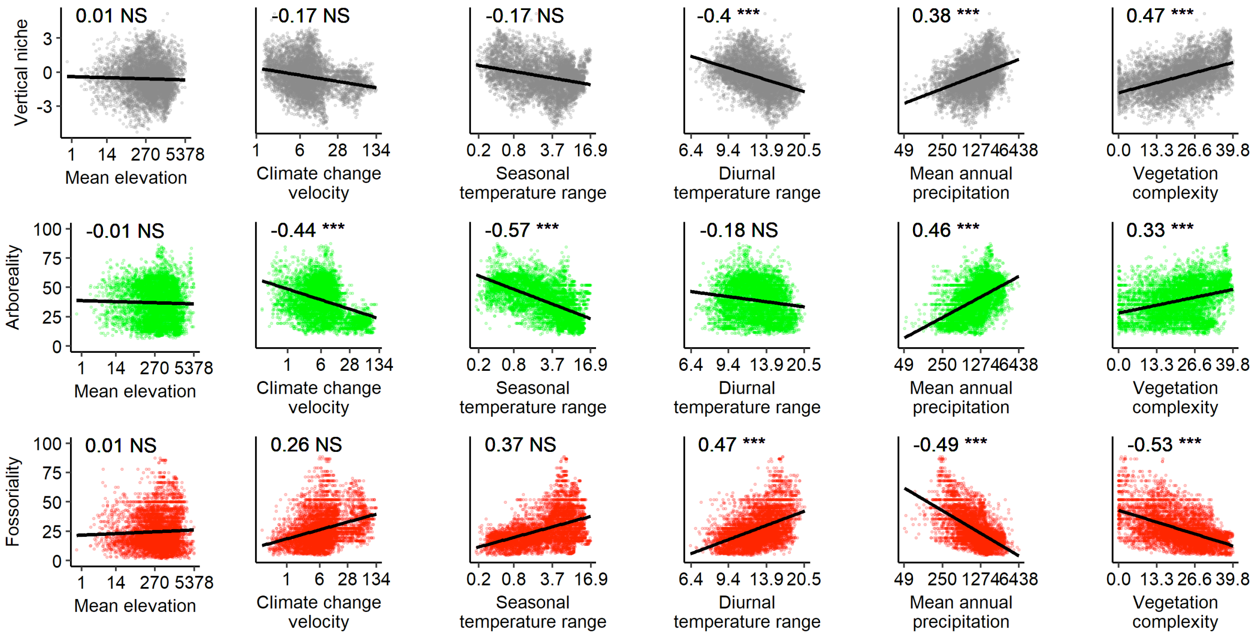

Figure A4. Relationships between key predictor variables and amphibian verticality (vertical niche position, arboreality and fossoriality). Values on the top-left corner represent Pearson`s r correlation coefficients. Significance of Pearson's correlations were assessed using Dutilleul's modified t-test to account for spatially independent degrees of freedom (Dutilleul et al. 1993). Significance levels: * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$; NS, not significant.

Figure A7. A sensitivity analyses performed with a reduced dataset (only Anura) to test the influence of predictor variables in amphibian verticality (vertical niche position, arboreality and fossoriality) within regional assemblages (biogeographical realm scale). Regional simultaneous autoregressive (SAR) models were run for each biogeographic Realm (Holt et al. 2013). Variable influence was accessed using a model averaging approach (Burnham and Anderson 2002) based on SAR models built with all possible combination of variables. Bars represent unconditional 95% confidence intervals. Avg. Std. Coeff., averaged standardized coefficient. Vert, vertical niche position. Arb, arboreality. Fos, fossoriality. Rel. Importance, variable relative importance. See methods for further details on model averaging.

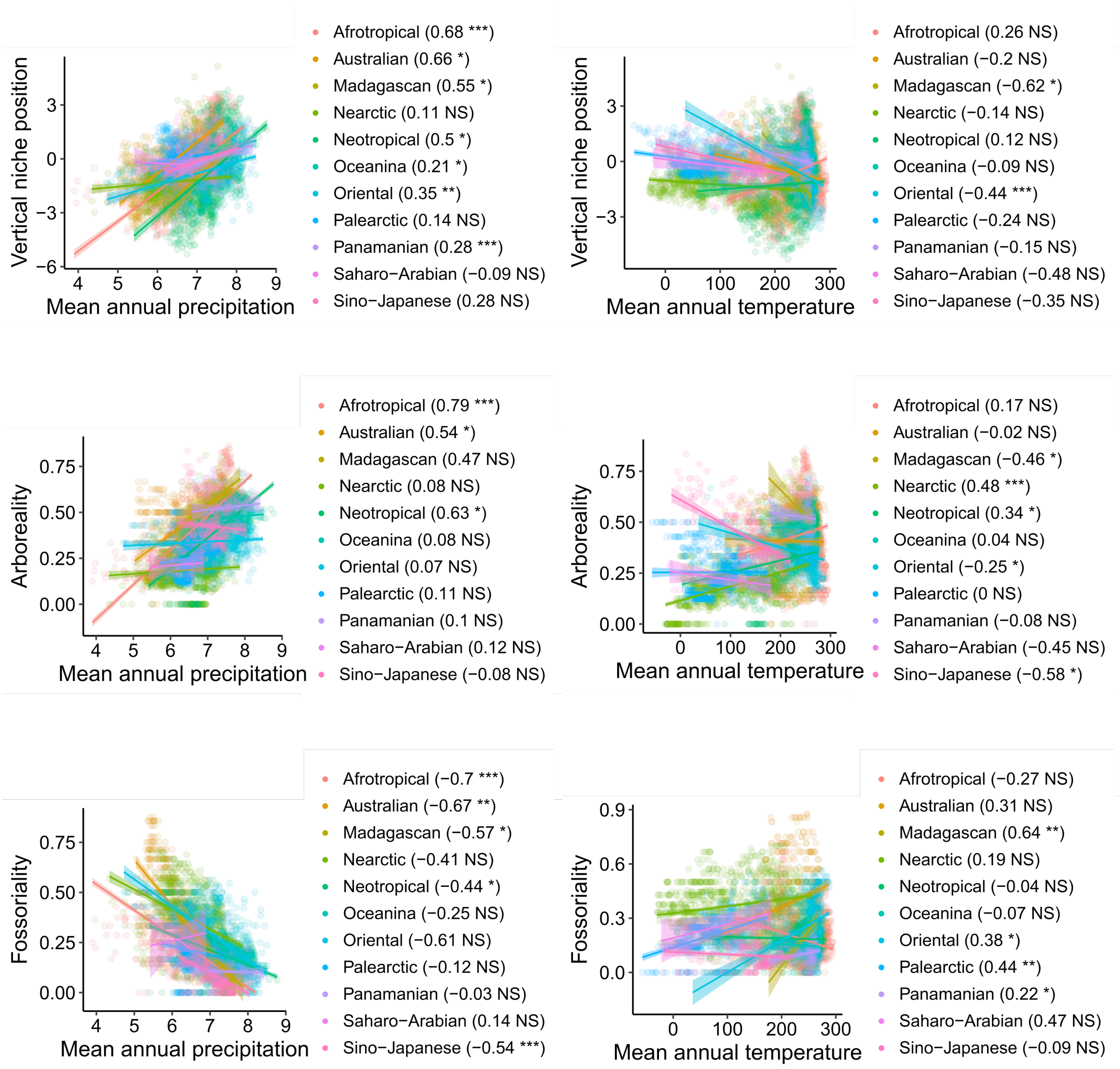

Figure A8. Correlations between verticality metrics and mean annual mean precipitation, and between verticality metrics and mean annual temperature. For most of the biogeographic realms, vertical niche position and arboreality increases with precipitation (left panels), but there is little correlation of these variables with temperature (right panels). In contrast, fossoriality tends to decrease with precipitation, and increase with temperature, in most biogeographic realms. Dots and regression lines are color coded to match biogeographic realms [*sensu* Holt et al. (2013)]. Numbers and symbols between parentheses represent Pearson's r correlation coefficients and significance levels. Significance of Pearson's correlations were assessed using Dutilleul's modified t-test to account for spatially independent degrees of freedom (Dutilleul et al. 1993). Significance levels: * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$; NS, not significant.

References

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