Table 1 (UVMs summary)

Response	Model type	Predictor	Main effect		SWAFR effect		SWAFR interaction	
(a) S_{QDS}	Main effect × region	Elevation	140.2	***	124.4	***	-56.1	*
		MAP	172.0	***	54.5	**	-54.1	**
		PDQ	73.4	***	55.6	*	61.9	**
		NDVI	154.9	***	-7.8		-102.2	***
	Main effect + region	PC1	67.0	***	92.5	***		
	Main effect only	Surface T	62.1	***				
		CEC	14.7					
		Clay	42.1	***				
		Soil C	62.9	***				
		pH	21.9	*				
(b) S_{HDS}	Main effect × region	MAP	399.0	***	-41.5		-185.0	**
		Clay	-12.8		-216.1	**	173.6	*
	Main effect only	Elevation	163.7	***				
		PDQ	226.3	***				
		Surface T	135.9	***				
		NDVI	246.6	***				
		Soil C	159.4	***				
		PC1	123.1	***				
	Region only	CEC	-26.3		-251.9	**		
		pH	53.8		-193.0	*		
(c) S_{DS}	Main effect × region	Elevation	-1455.9	*	-2278.4	**	1668.5	*
		MAP	683.3	***	-519.1	**	-382.1	*
		CEC	-933.3	**	-1043.4	***	837.1	*
	Main effect + region	Clay	273.0	*	-542.8	*		
		Soil C	246.5	*	-615.4	*		
	Main effect only	PDQ	363.1	**				
		Surface T	336.7	**				
		NDVI	475.3	***				
		pH	448.4	***				
		PC1	231.1	***				

Table 2 (Comparing PC1Ms and MVMs) […] All correlation coefficients were significant ($P < 0.05$; two-sided *t*-test).

	Correlation	
Spatial scale	Predicted *S*	Residual *S*
QDS	0.680	0.908
HDS	0.699	0.834
DS	0.723	0.369

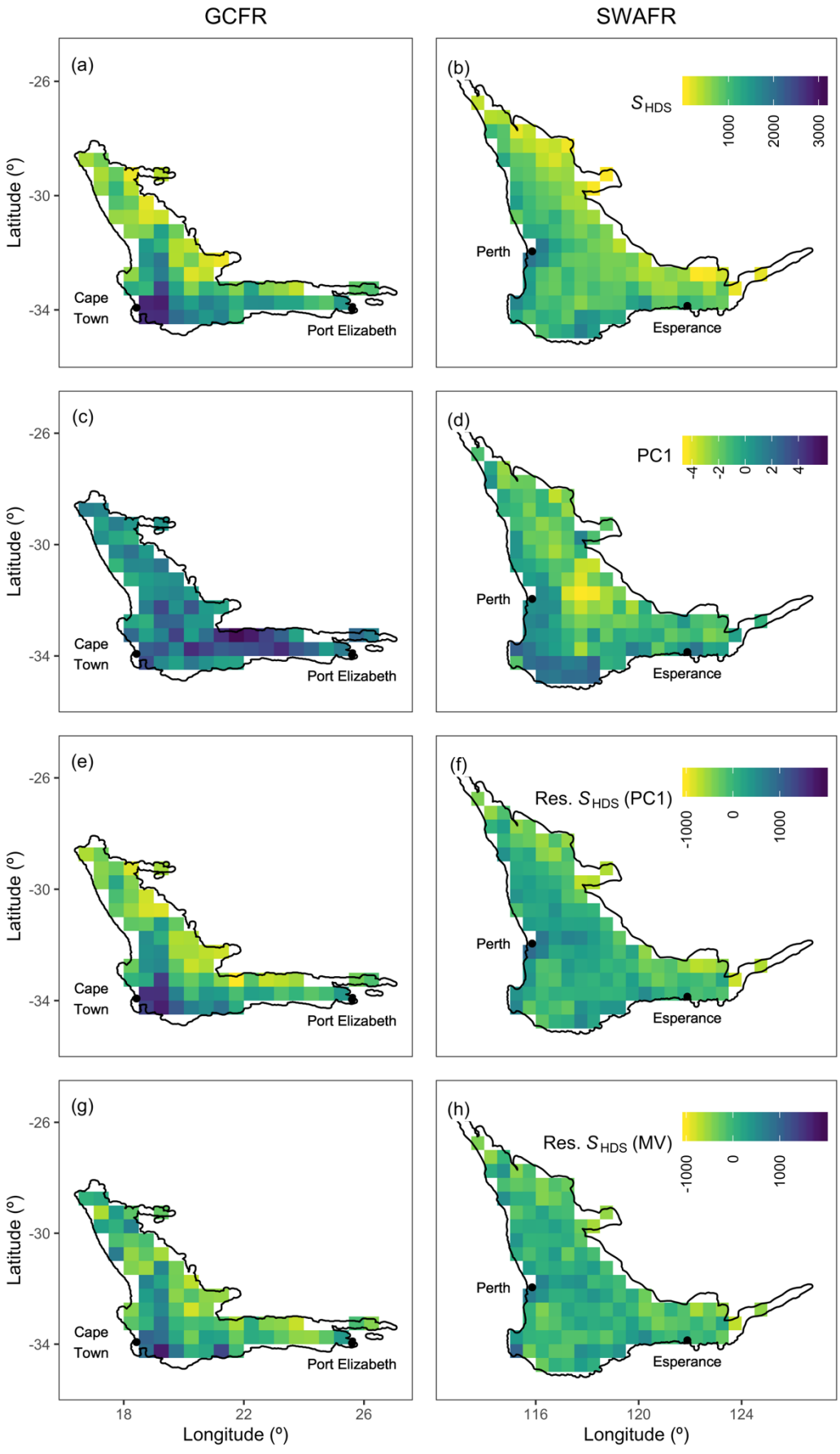

Figure 1 (HDS maps)

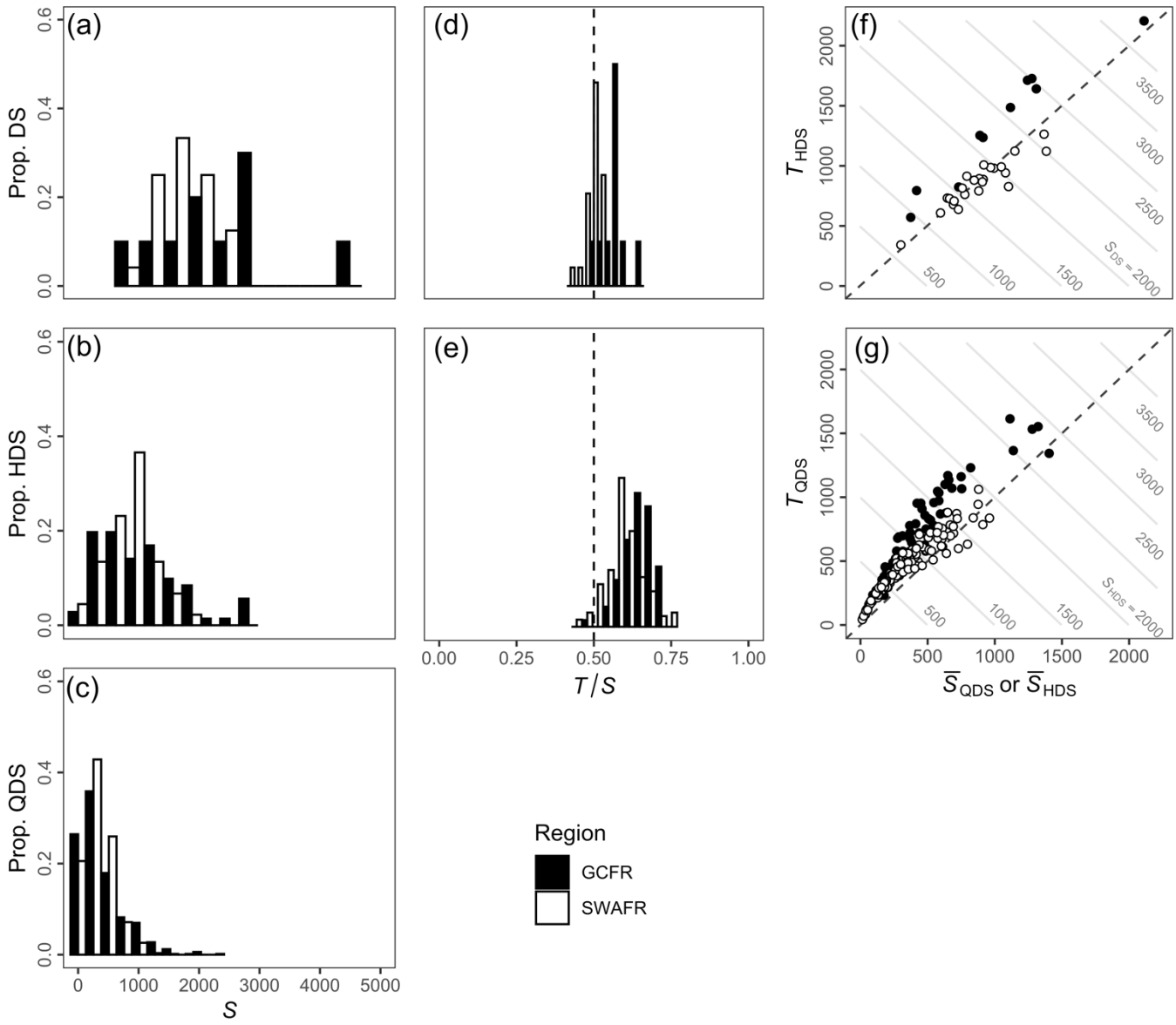

Figure 2 (S distributions and partitions)

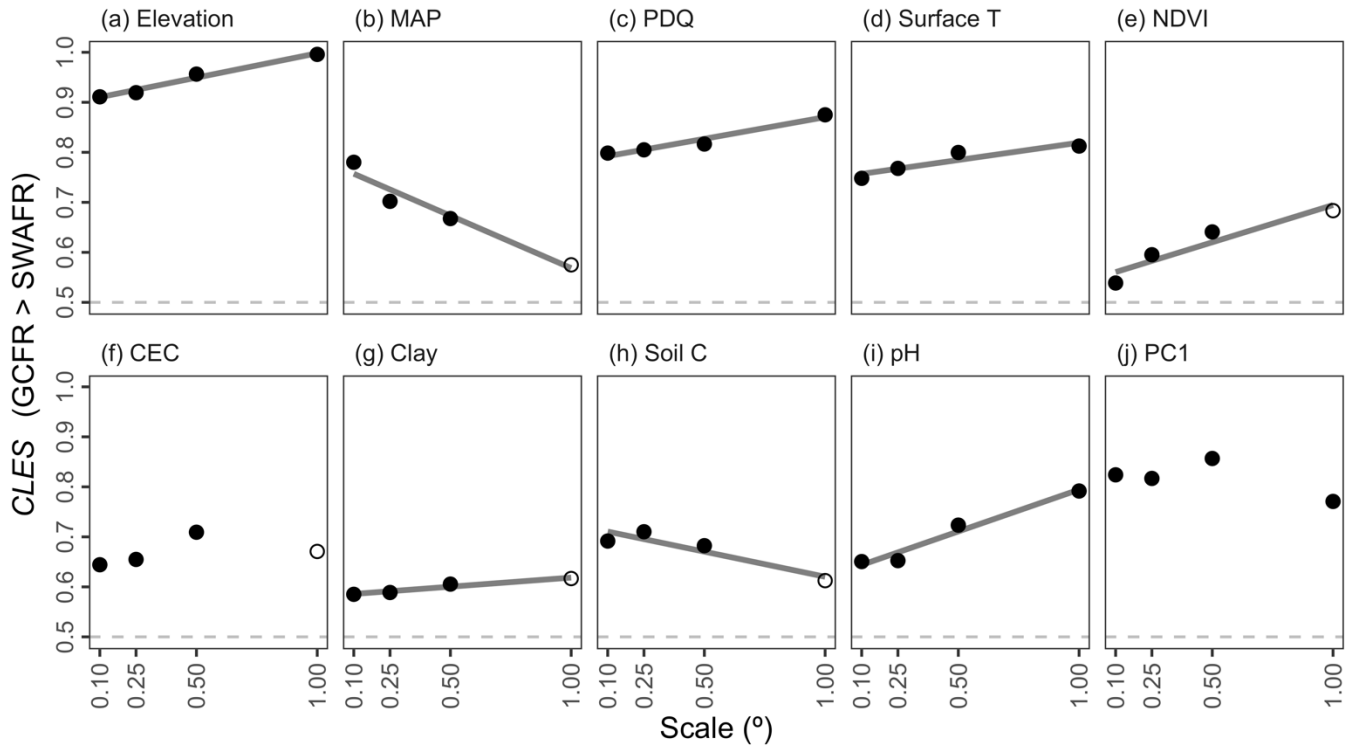

Figure 3 (CLES plots)

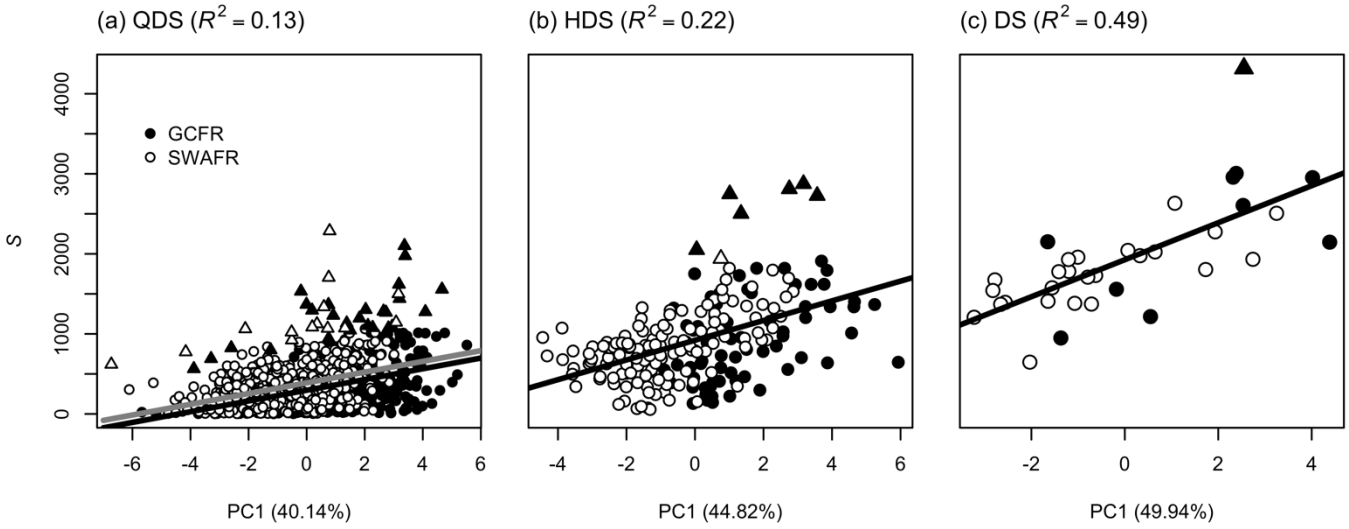

Figure 4 (PC1Ms)

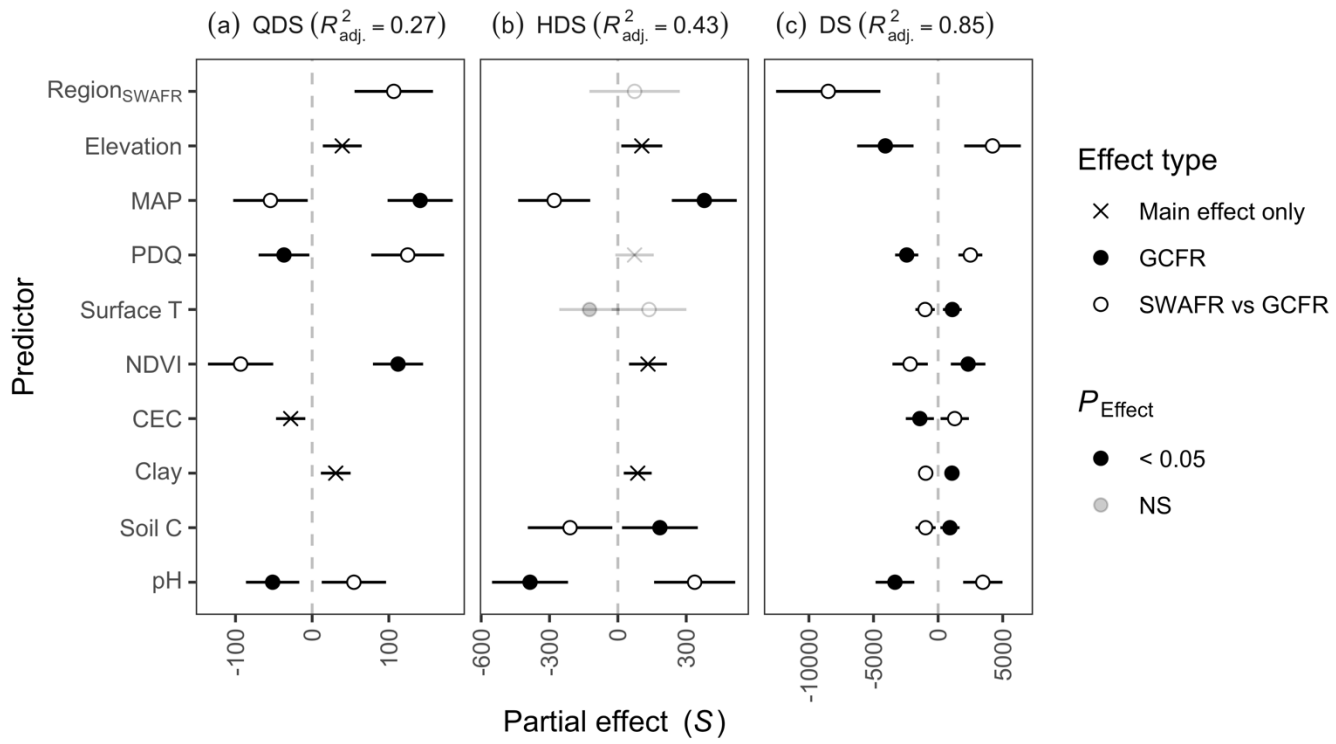

Figure 5 (MVMs)

Table S2 (MVMs' ANOVAs)

Response	Term	Variance explained	
(a) S_{QDS}	(Residuals)	0.72	-
$R^2_{adj.} = 0.27$	MAP	0.13	***
	Elevation	0.06	***
	NDVI	0.03	***
	PDQ × Region	0.02	***
	region	0.02	***
	NDVI × Region	0.01	***
	Clay	0.01	**
	pH	0.01	**
	CEC	0.01	*
	pH × Region	0.01	*
	PDQ	< 0.01	
	MAP × Region	< 0.01	
(b) S_{HDS}	(Residuals)	0.54	-
$R^2_{adj.} = 0.43$	MAP	0.21	***
	Elevation	0.1	***
	pH × Region	0.04	***
	NDVI	0.02	**
	MAP × Region	0.02	**
	pH	0.02	*
	Clay	0.02	*
	PDQ	0.02	*
	Surface T × Region	0.01	*
	Surface T	0.01	
	Soil C: × Region	< 0.01	
	region	< 0.01	
	Soil C	< 0.01	
(c) S_{DS}	NDVI	0.17	***
$R^2_{adj.} = 0.85$	Elevation	0.15	***
	PDQ	0.14	***
	pH × Region	0.11	***
	Clay	0.07	***
	(Residuals)	0.07	-
	NDVI × Region	0.06	**
	Clay × Region	0.06	**
	Soil C × Region	0.04	**
	Surface T	0.04	**
	CEC	0.03	*
	Soil C	0.02	.
	Elevation × Region	0.02	.
	PDQ × Region	0.01	
	pH	0.01	
	Surface T × Region	< 0.01	
	region	< 0.01	
	CEC × Region	< 0.01	

Table S3 (Comparing GCFR and SWAFR residual SDs) […] All pairs of GCFR and SWAFR *SD*-values differed significantly ($P < 0.01$; two-sided *F*-tests).

		SD of model residuals			
		Including hotspots		Excluding hotspots	
Scale	Region	PC1	MV	PC1	MV
(a) QDS	GCFR	343.46	312.89	234.93	217.56
	SWAFR	245.77	223.05	203.91	174.97
(b) HDS	GCFR	638.62	519.19	460.39	360.47
	SWAFR	334.15	290.90	326.06	273.31
(c) DS	GCFR	811.89	6.22	588.58	*NA*
	SWAFR	311.80	226.50	297.22	*NA*

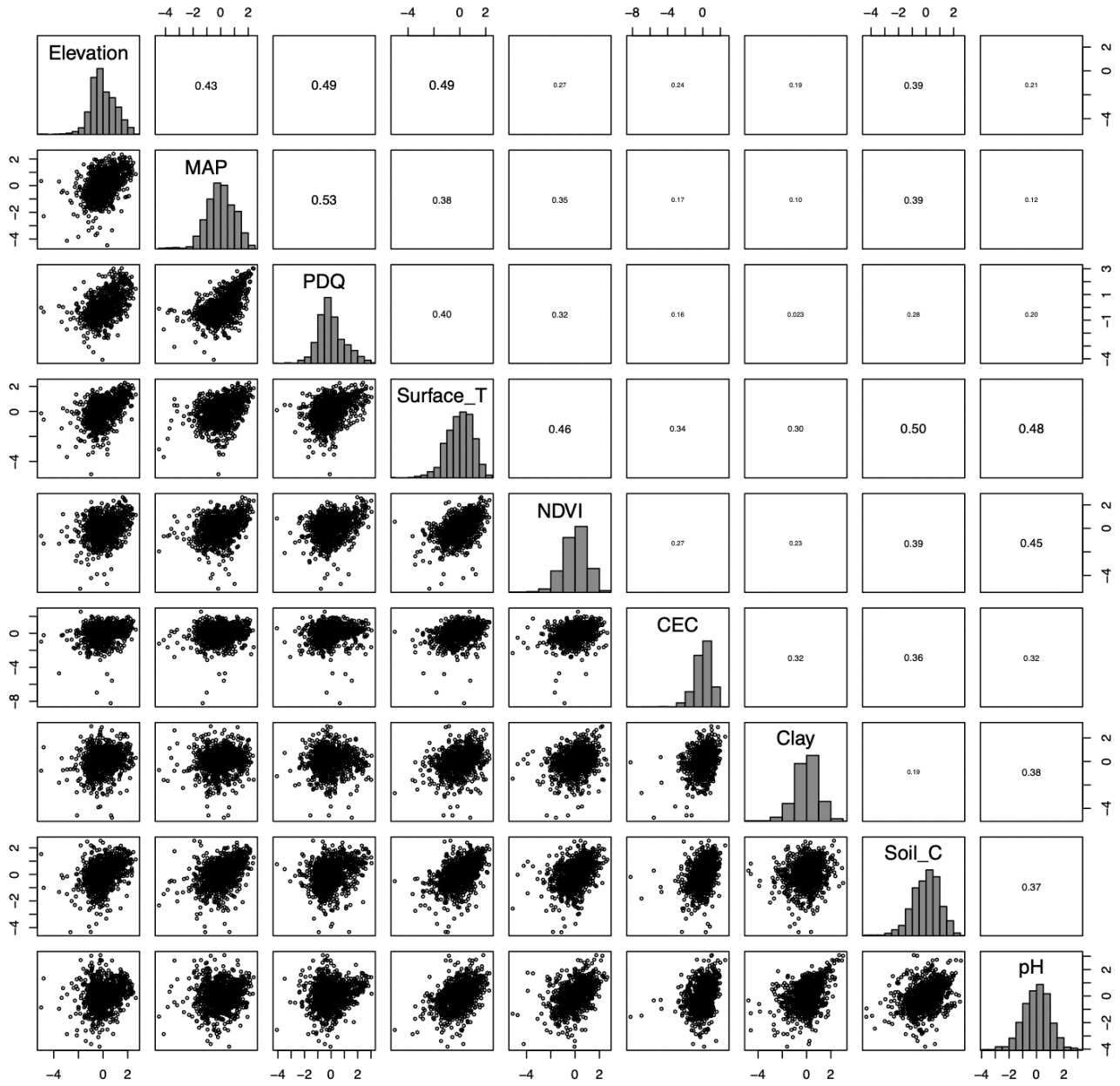

Figure S1 (QDS collinearity checks)

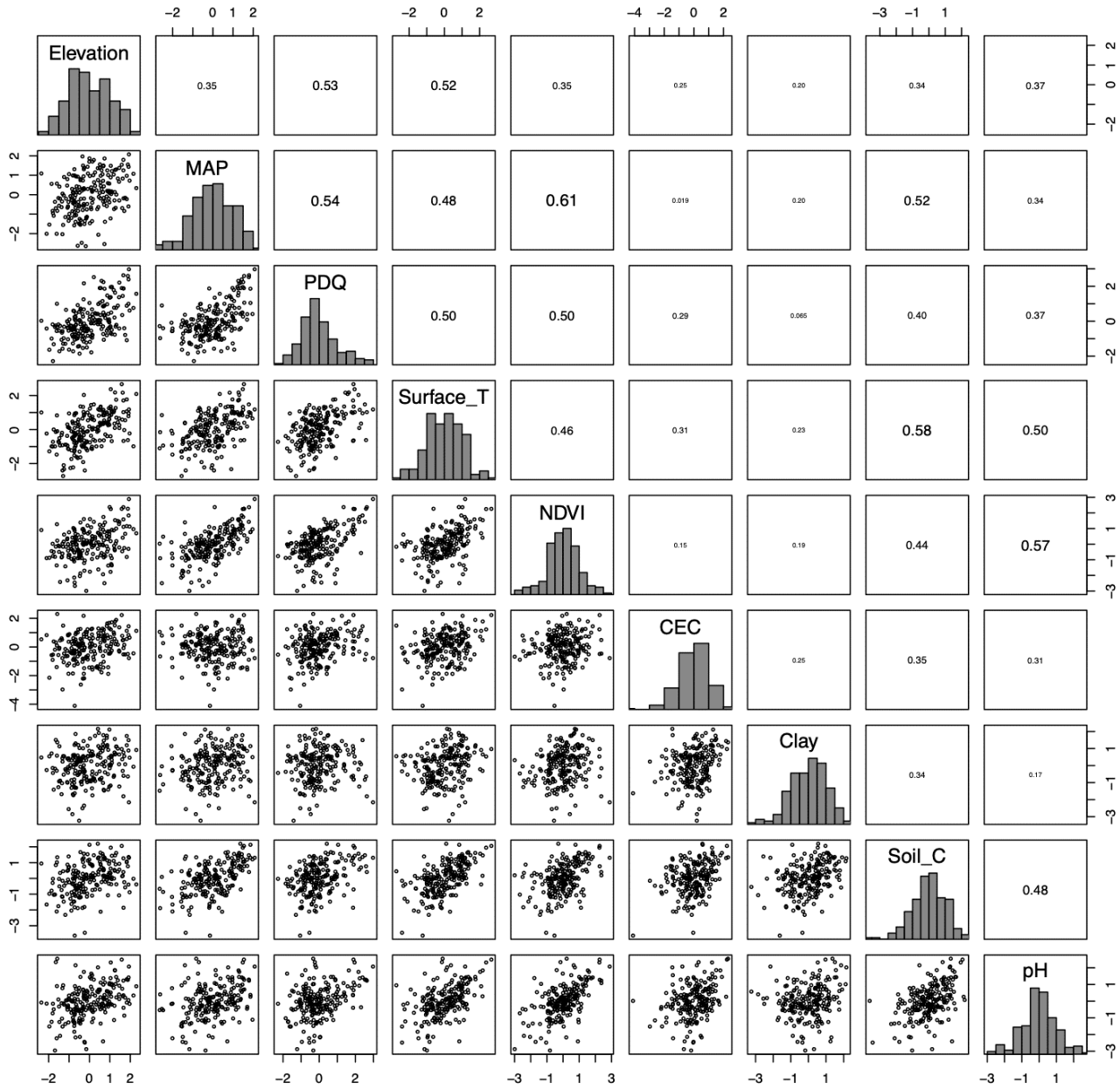

Figure S2 (HDS collinearity checks)

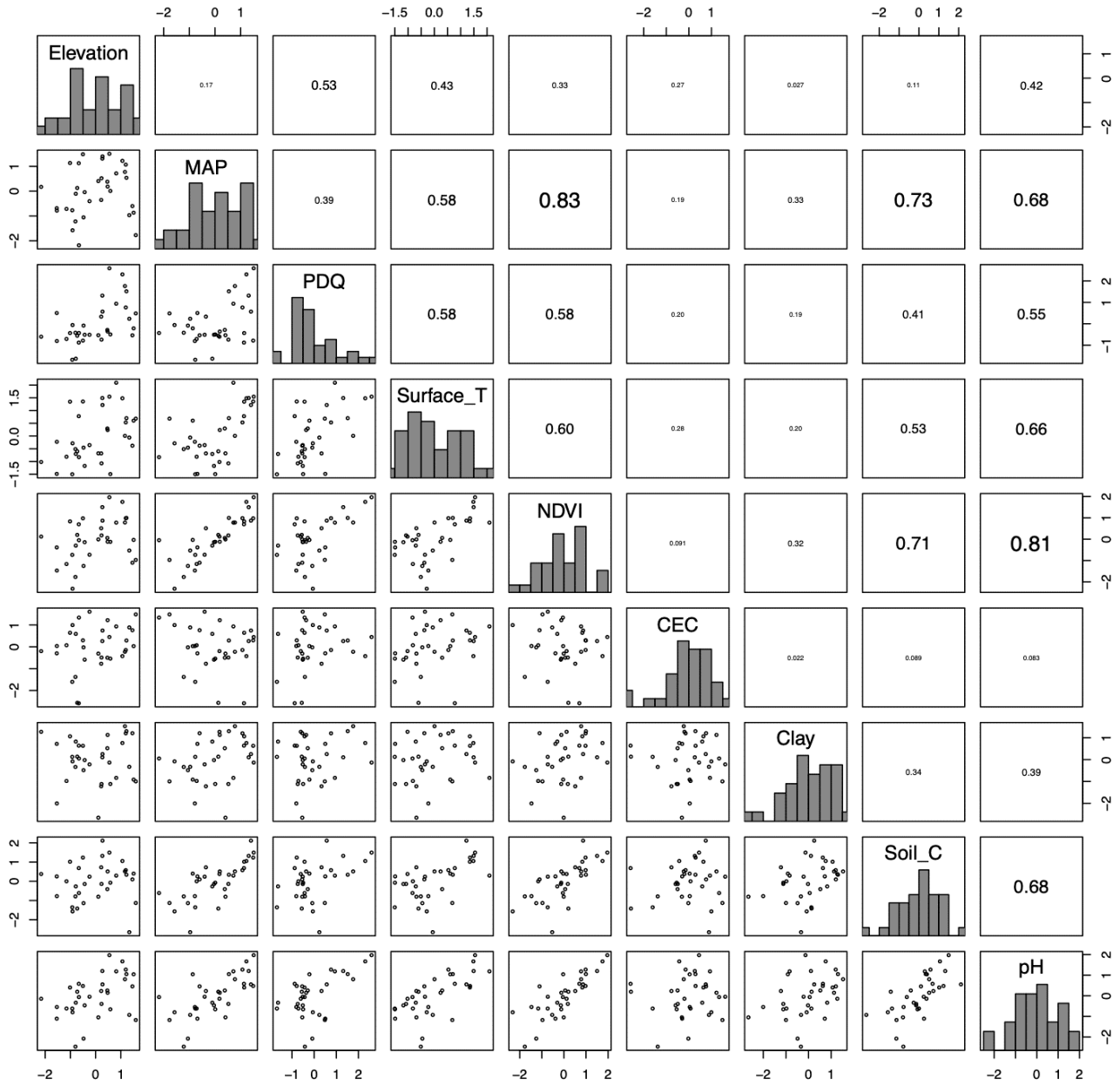

Figure S3 (DS collinearity checks)

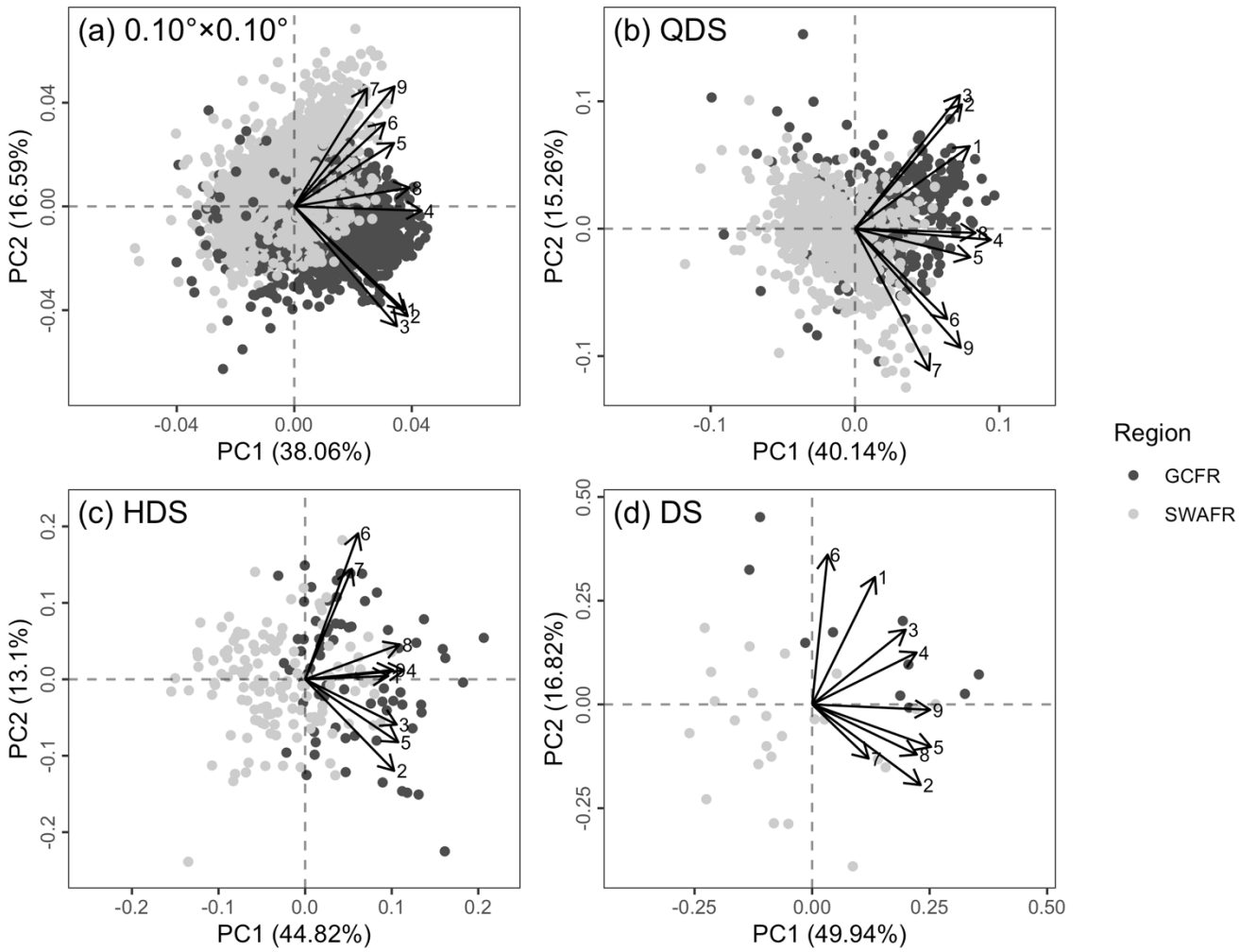

Figure S4 (PCA biplots) […] Environmental heterogeneity variables' loadings are labelled as follows: 1, elevation; 2, MAP; 3, PDQ; 4, surface T; 5, NDVI; 6, CEC; 7, clay; 8, soil C; 9, pH.

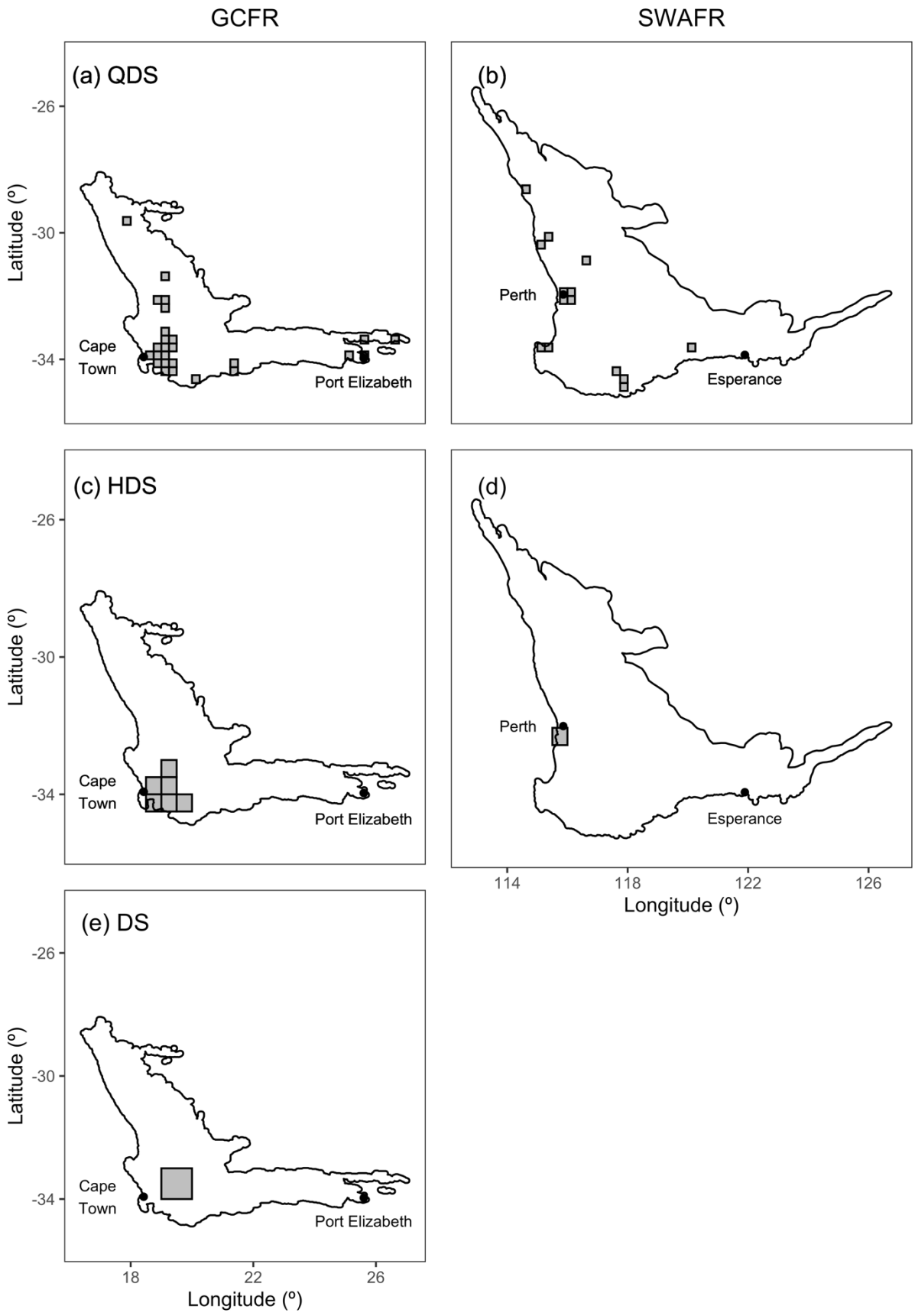

Figure S5 (PC1-outliers)

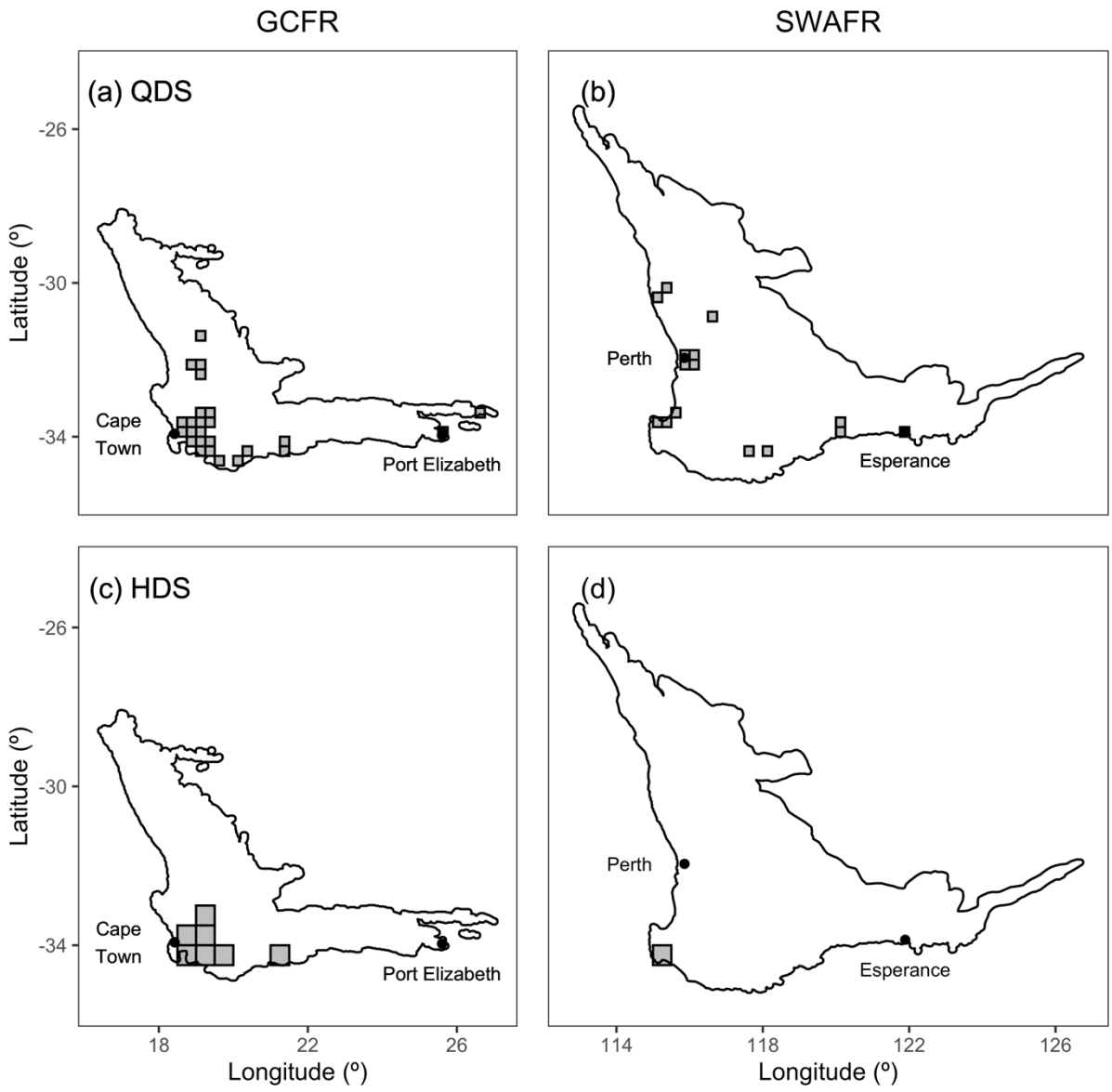

Figure S6 (MV-outliers)

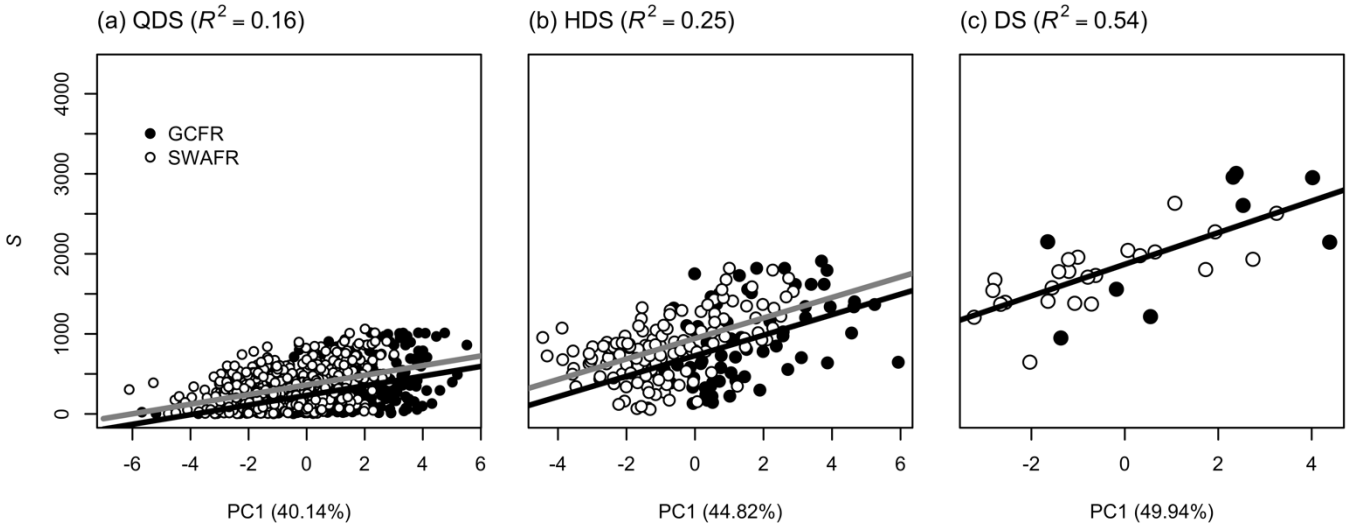

Figure S7 (PC1Ms w/o outliers)

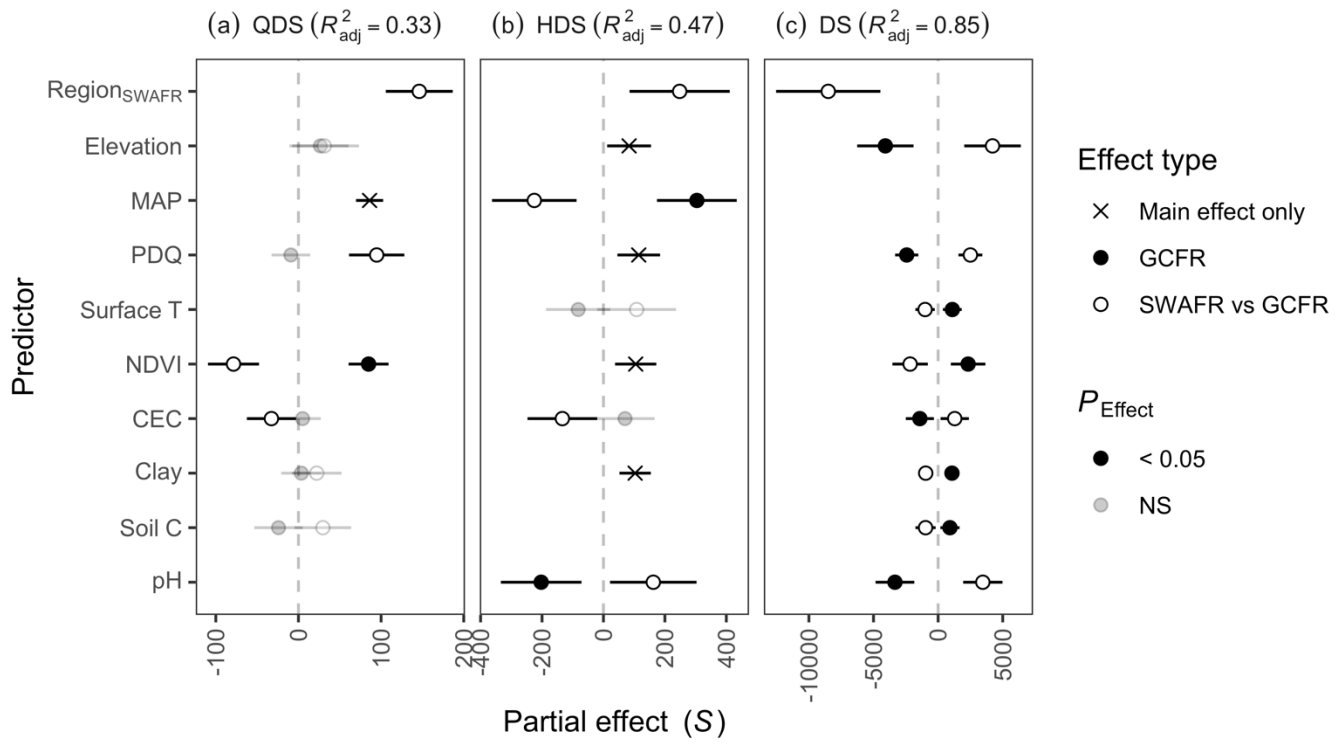

Figure S8 (MVMs w/o outliers)

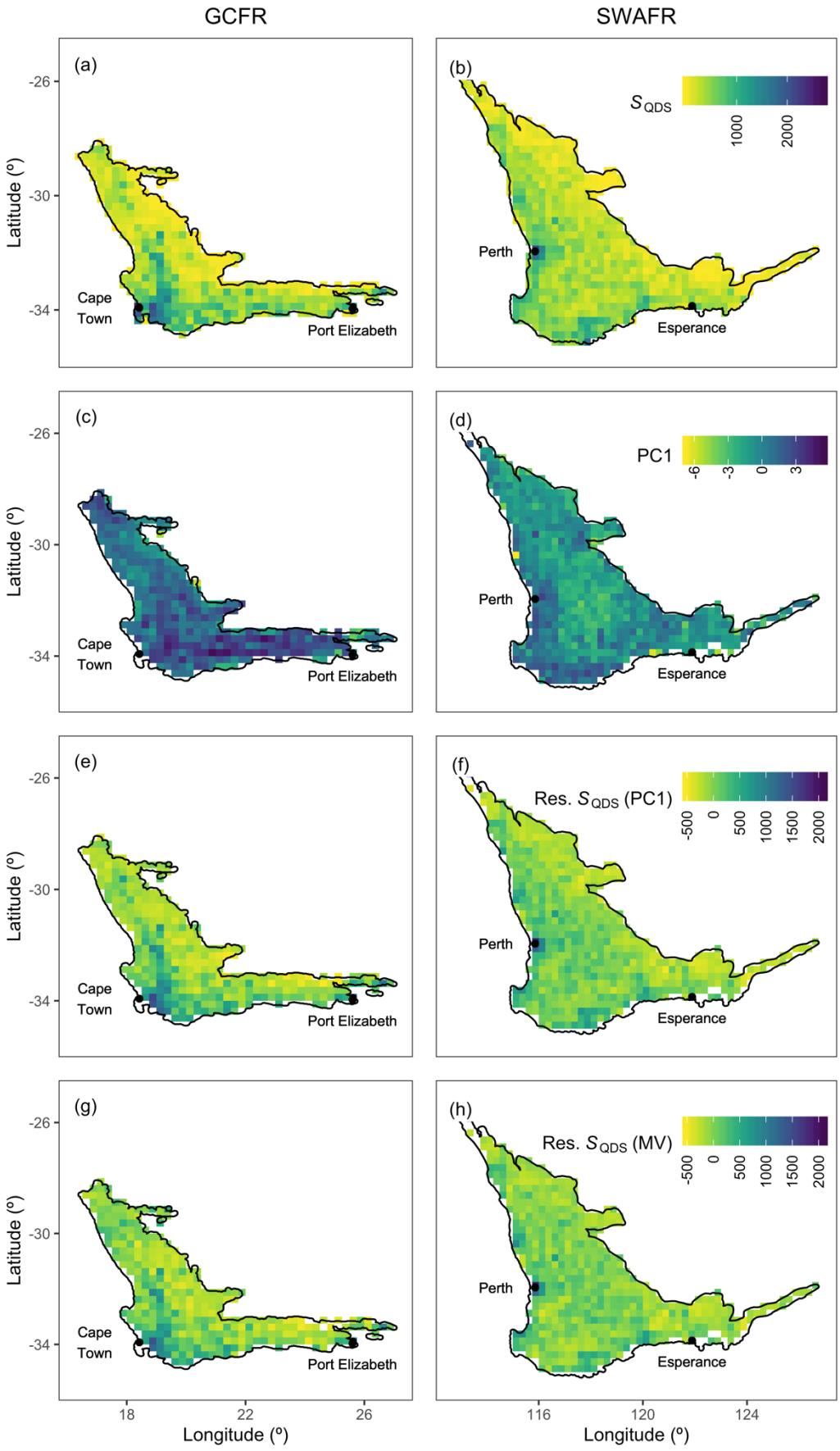

Figure S9 (QDS maps)

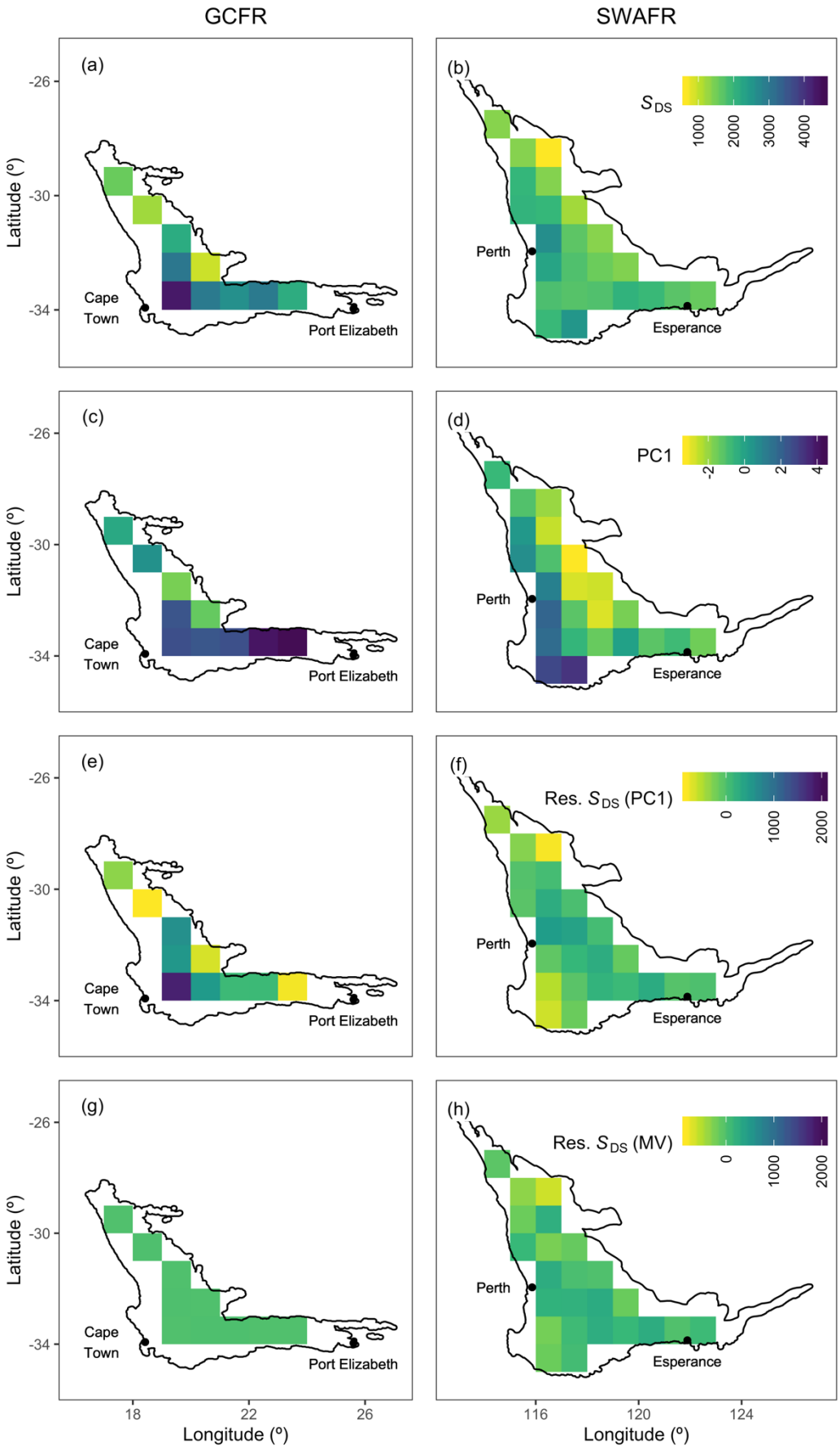

Figure S10 (DS maps)