

Analyses v2

Cape vs SWA

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1. Environmental heterogeneity & scale

Is the Cape for environmental heterogeneity more heterogeneous than SWA, and does the scale of that heterogeneity differ to that of SWA?

For this question, environmental roughness in both regions was calculated, in moving 3 x 3 cell windows, as the average absolute difference between cells and their (usually) 8 neighbours. Alternatively, for a focal cell x^* , the roughness is based on $x_1, x_2, \dots, x_i, \dots, x_8$ neighbour cells as:

$$Roughness(x^*) = f \begin{pmatrix} x_1 & x_2 & x_3 \\ x_4 & x^* & x_5 \\ x_6 & x_7 & x_8 \end{pmatrix} = \frac{1}{n} \sum_{i=1}^n |x^* - x_i|$$

In R, I have implemented this as follows:

```
roughness <- function(x) {  
  raster::focal(x, matrix(1, nrow = 3, ncol = 3), function(x) {  
    focal_cell <- x[5]  
    neighbour_cells <- x[  
      !is.na(x) &  
      !is.nan(x) &  
      x != focal_cell  
    ]  
    ifelse(!is.na(focal_cell) & !is.nan(focal_cell),  
      mean(abs(focal_cell - neighbour_cells)),  
      NA  
    )  
  })  
}
```

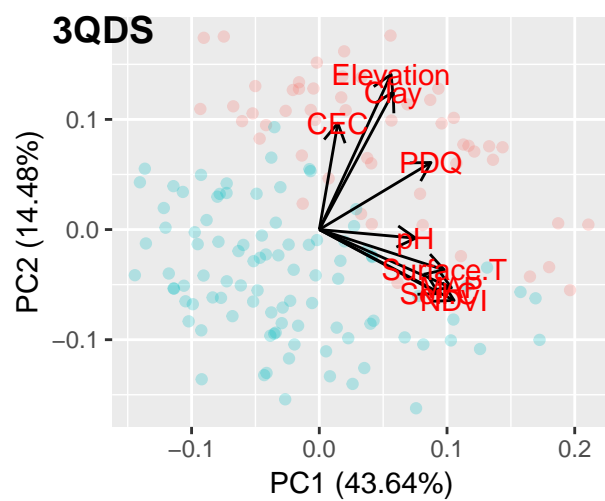
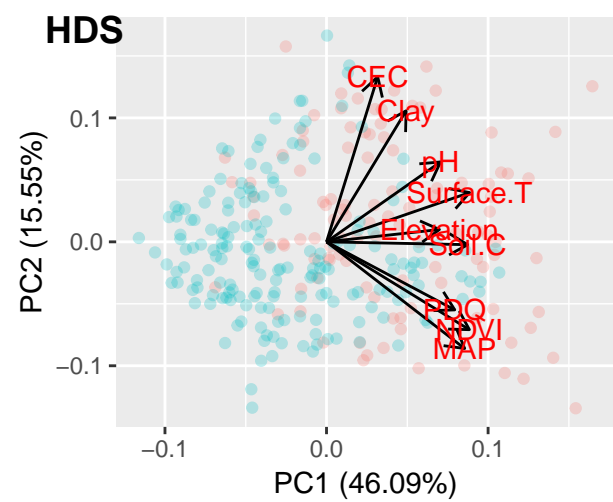
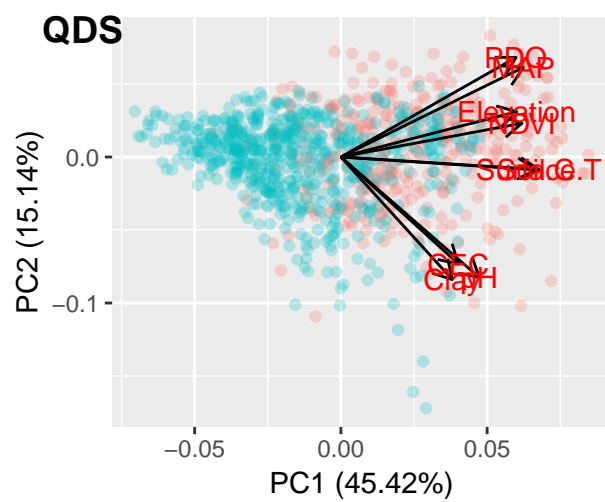
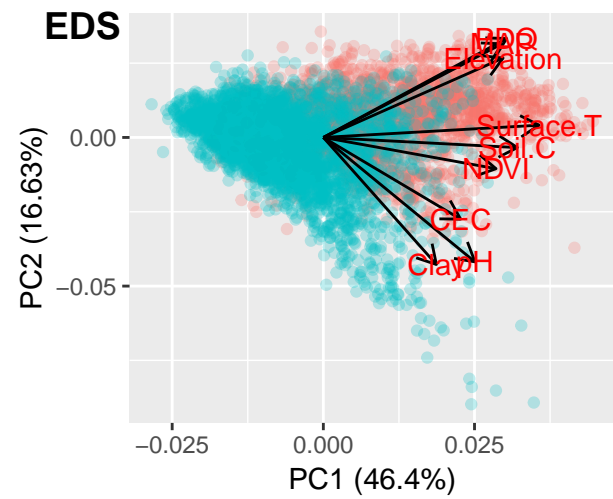
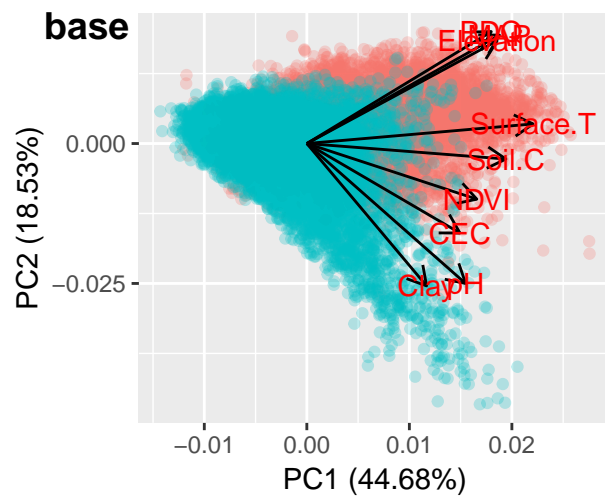
1.1 Ordinating environmental heterogeneity

Here, I $\log(x + 1)$ -transform and perform a scaled and centred PCA of the roughness values as defined above, at each of five spatial scales: the base data resolution ($0.05^\circ \times 0.05^\circ$), eighth- (EDS), quarter- (QDS), half- (HDS) and three-quarter-degree-squares (3QDS).

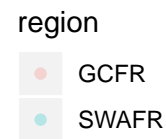
The data matrices for each scale for this PCA look like this (and obviously thr region is excluded from the PCA proper):

region	Elevation	MAP	PDQ	Surface.T	NDVI	CEC	Clay	Soil.C	pH
GCFR	5.19	2.52	0.72	1.32	15.13	1.14	1.2	2.46	1.36
GCFR	5	2.7	0.61	1.16	15.01	1.11	1.11	1.74	1.83
GCFR	4.86	2.55	0.72	1.17	15.08	1.18	1.4	1.79	1.65
GCFR	4.44	2.58	0.89	1.1	14.83	1.32	1.12	2.12	2.03
GCFR	4.62	1.98	0.91	0.71	14.35	1.35	0.86	1.54	1.46
GCFR	4.15	2.23	0.62	1.04	13.64	1	0.99	1.21	1.33
...
SWAFR	3.27	2.77	1.1	0.71	14.91	0.31	1.19	1.59	0.48
SWAFR	2.36	2.41	1.15	0.7	14.28	0.67	1.29	2.03	1.3
SWAFR	2.86	1.98	1.17	1.09	13.58	0.73	2.27	2.4	2.58
SWAFR	2.29	2.65	1.09	1	14.83	0.58	1.3	3.04	1.58
SWAFR	2.61	3.22	1.44	0.61	15.34	0.5	1.6	2.26	1.89
SWAFR	2.39	2.56	1.78	0.49	16.07	0.45	2.64	2	3.14

Plot PC1 vs PC2 at each scale:



my_legend



1.2 Effect size of Cape vs SWA heterogeneity

I calculated the *CLES* of Cape > SWA untransformed roughness and PC1 values (from the analysis above data).

Plot *CLES* vs scale for each variable¹:

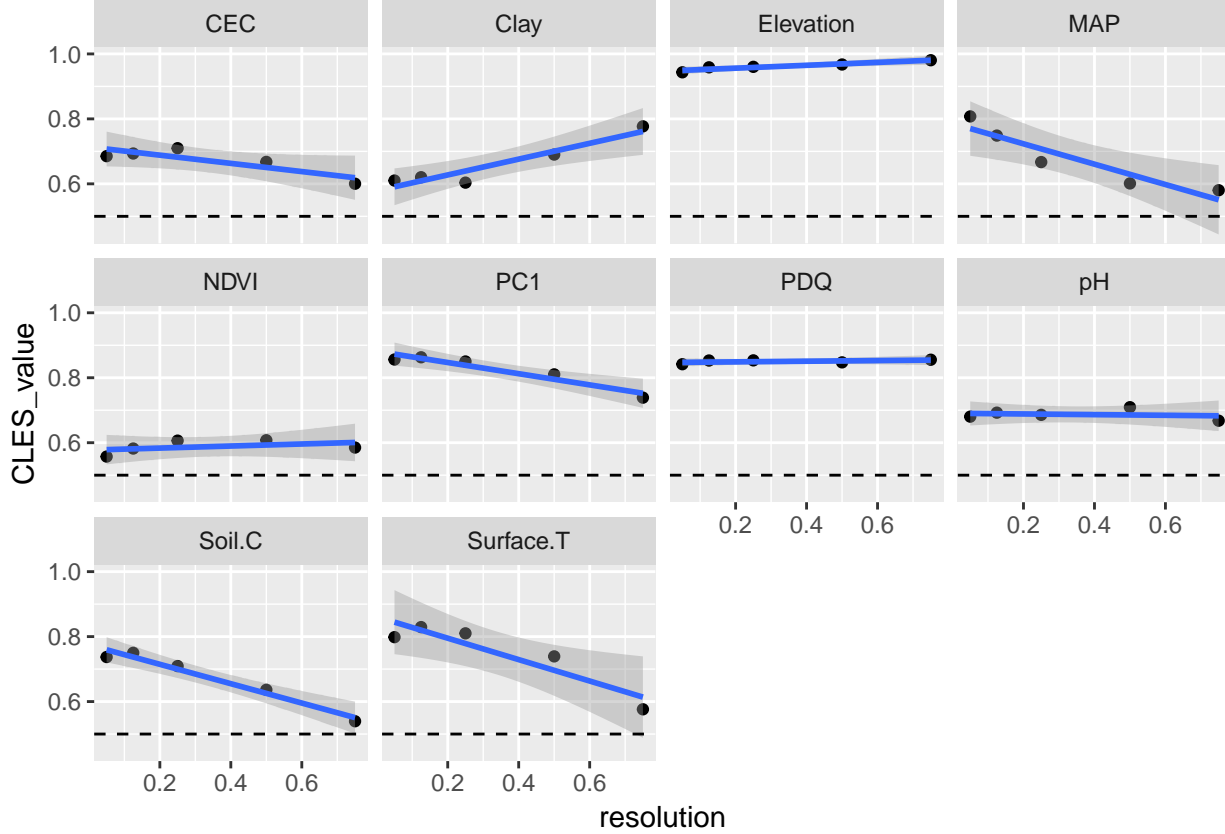


Table 2: Slopes, significances and R^2 -values from regressions of *CLES* against each form of environmental roughness.

variable	slope	p.value	r.squared	sig	slope_sign
MAP	-0.3133372	0.0196994	0.8742197	*	-
PC1	-0.1722784	0.0095094	0.9217950	*	-
Soil.C	-0.2982591	0.0025401	0.9672541	*	-
Surface.T	-0.3296743	0.0264504	0.8478189	*	-
Clay	0.2434699	0.0134121	0.9020604	*	+
Elevation	0.0444385	0.0158791	0.8906629	*	+
CEC	-0.1262943	0.0633207	0.7349260		
NDVI	0.0315088	0.4590602	0.1931048		
PDQ	0.0098998	0.3873406	0.2533355		
pH	-0.0103120	0.7557454	0.0372656		

¹Note: fits of *CLES* scale plotted regardless of significance (see Table 1)—will remove non-significant ones later.