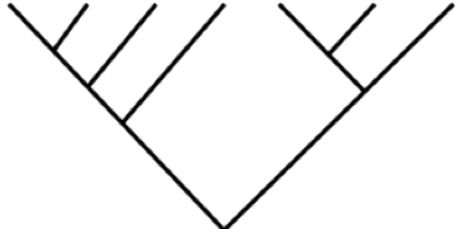
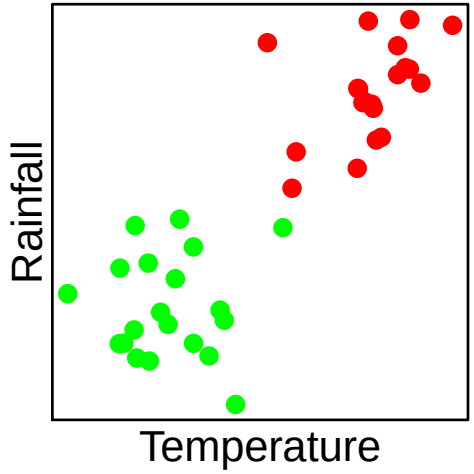
TODO: Add Powerpoint coverslide manually

Species richness (S)

Speciation along ecological gradients



Co-existence within ecological space



How to explain extremely high S?

Environmental heterogeneity[1][2][3]

- ↑ gradients : ↑ speciation
- ↑ habitats : ↑ co-existence

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[1] Cramer & Verboom 2016. *J. Biogeography* 44(3)
[2] Kreft & Jetz 2007. *PNAS* 104(14)
[3] Thuiller et al. 2006. *Ecography* 29(5)

The Cape & SWA

TODO: maps of regions

The Cape & SWA

- Similar
  - Environments — *mediterranean, winter rainfall*
  - Plant ecologies — *serotiny, sclerophylly*
- Different
  - S per unit area — *Cape > SWA*
  - Topographies — *mountainous vs flat*

The Cape & SWA

- Wide range of environmental conditions → supports diverse flora.
- Environmental stability through evolutionary time
  - (Pleistocene LGM in Cape, ??? in SW Australia).
  - This means that the ecological gradients have persisted longer, facilitating greater degrees of ecological speciation, and thus species richness, along those gradients and barriers to gene flow.

The Cape & SWA

Thus, spatially heterogeneous that is stable through deep time $\rightarrow$ support and produce more diverse biota.

Environmental heterogeneity then has roles in the ecological present and over evolutionary time in stimulating species richness[1][2][3].

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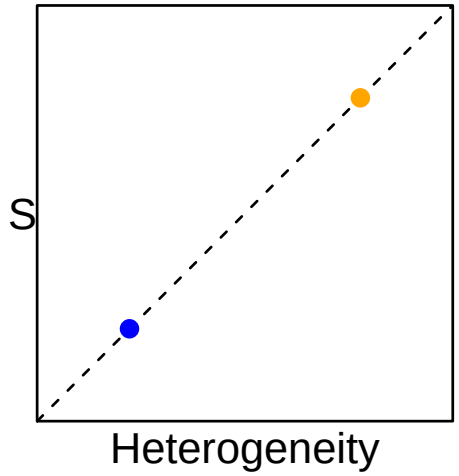
[1] Cramer & Verboom 2016. *J. Biogeography* 44(3)

[2] Kreft & Jetz 2007. *PNAS* 104(14)

[3] Thuiller et al. 2006. *Ecography* 29(5)

Hypotheses

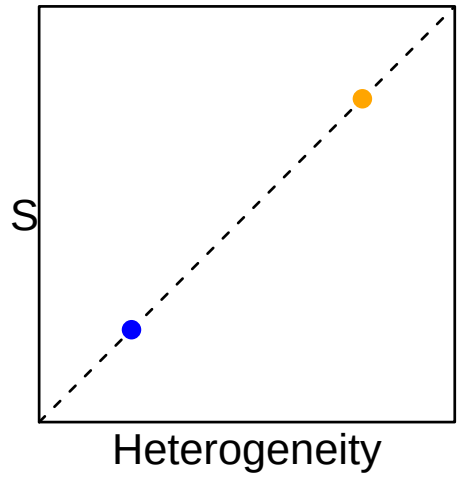
- Cape richness previously shown to depend on heterogeneity[1]
- Does this extend to SWA?



[1]Cramer & Verboom 2016. *J. Biogeography* 44(3)

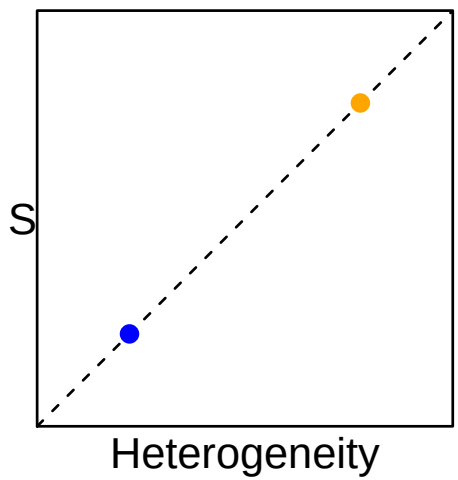
Hypotheses

i. The Cape has ↑ environmental heterogeneity (EH),
ii. and at a finer spatial scale



Hypotheses

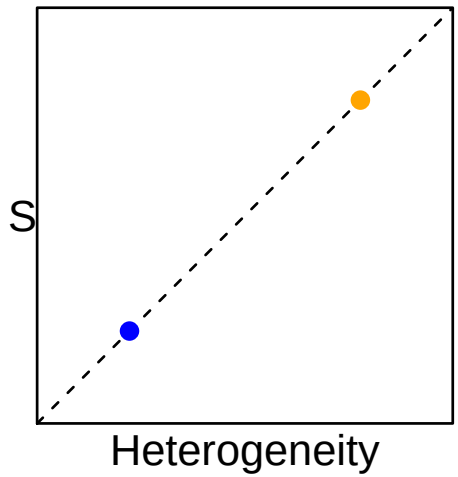
iii. The Cape has ↑ species turnover



Hypotheses

iv. S and turnover are explained by EH
v. Different axes of EH are NB in the Cape and SWA

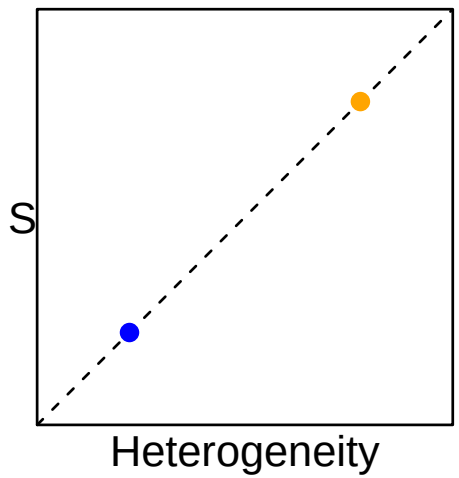
(Soil?)



Hypotheses: Summary

i–iii. The Cape should be more environmentally heterogeneous

iv–v. Different forms of heterogeneity should matter in the Cape and SWA



Data sources

- Each region's boundaries
- Environmental data

NASA MODIS
CHIRPS
SoilsGrid250m

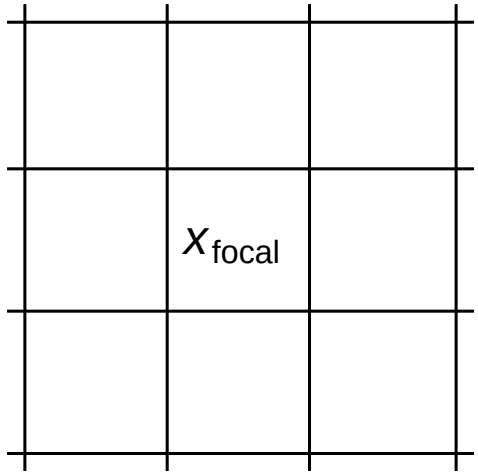
- Vascular plant occurrence records

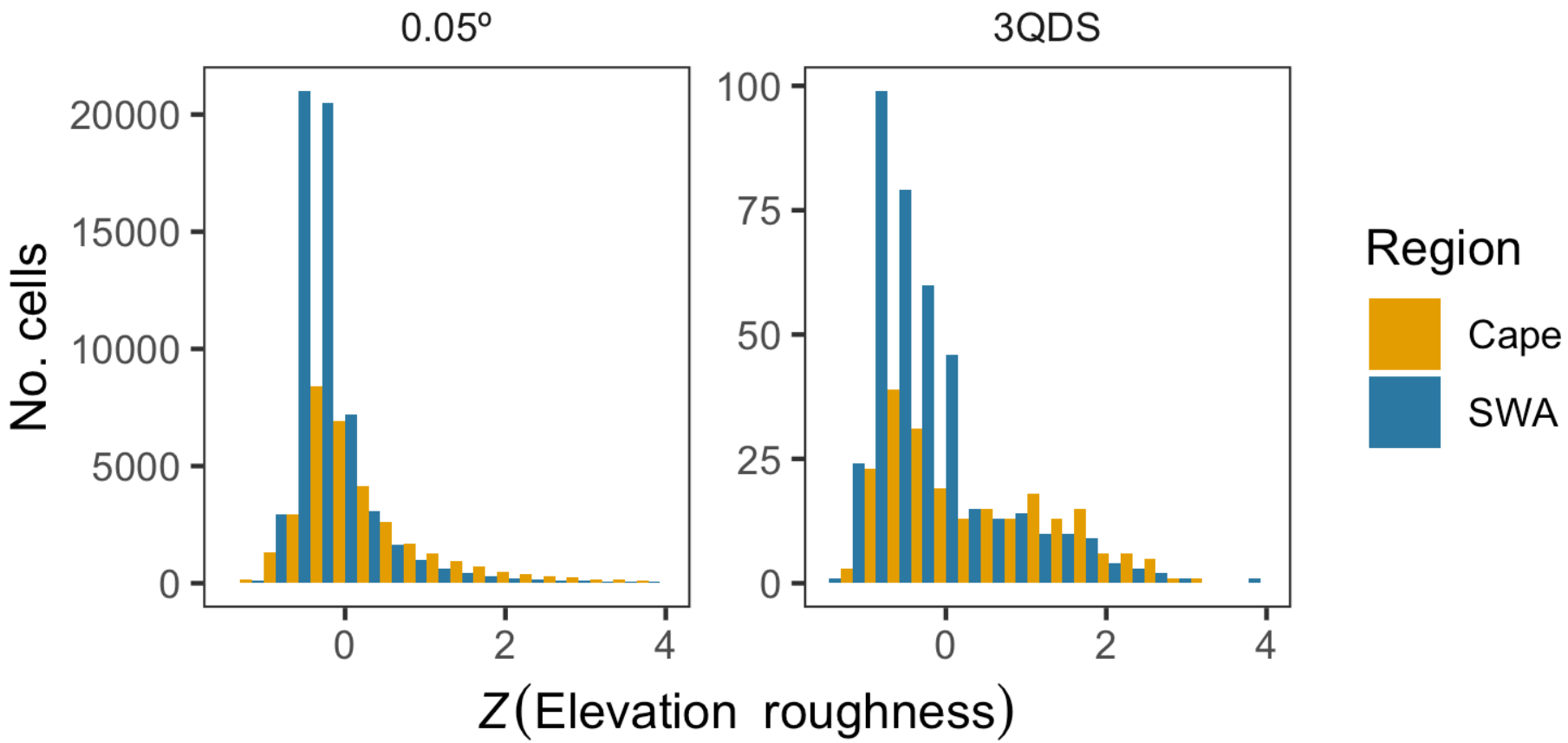
GBIF

Environmental heterogeneity

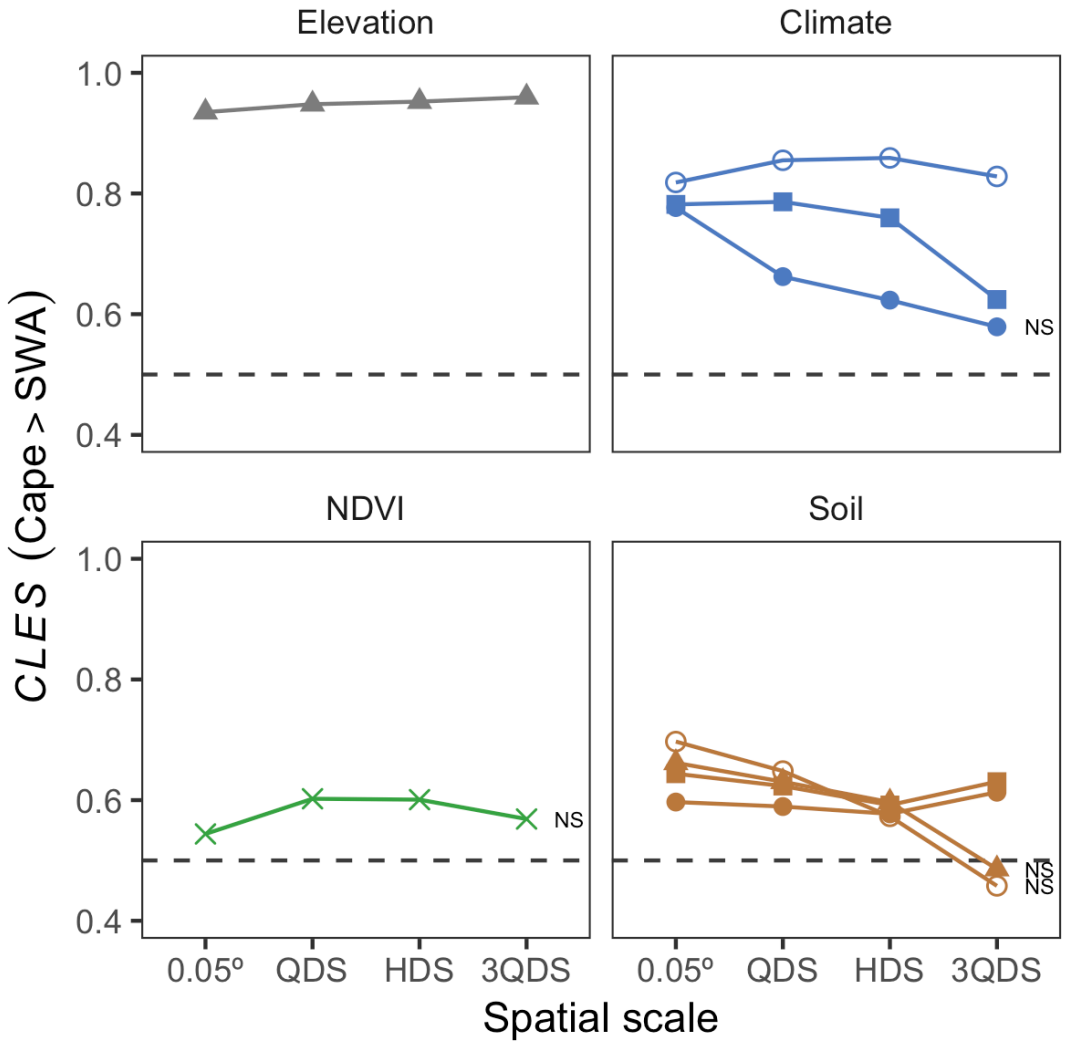
Local neighbourhood N about cell x_{focal}

$$Roughness(N) = SD_{focal}(N)$$





- Roughness varies with scale
- And differently so for the Cape and SWA

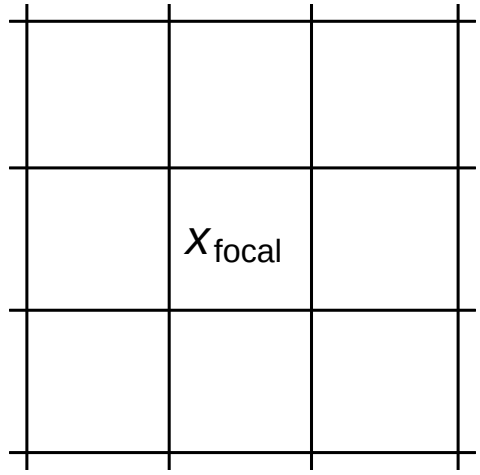


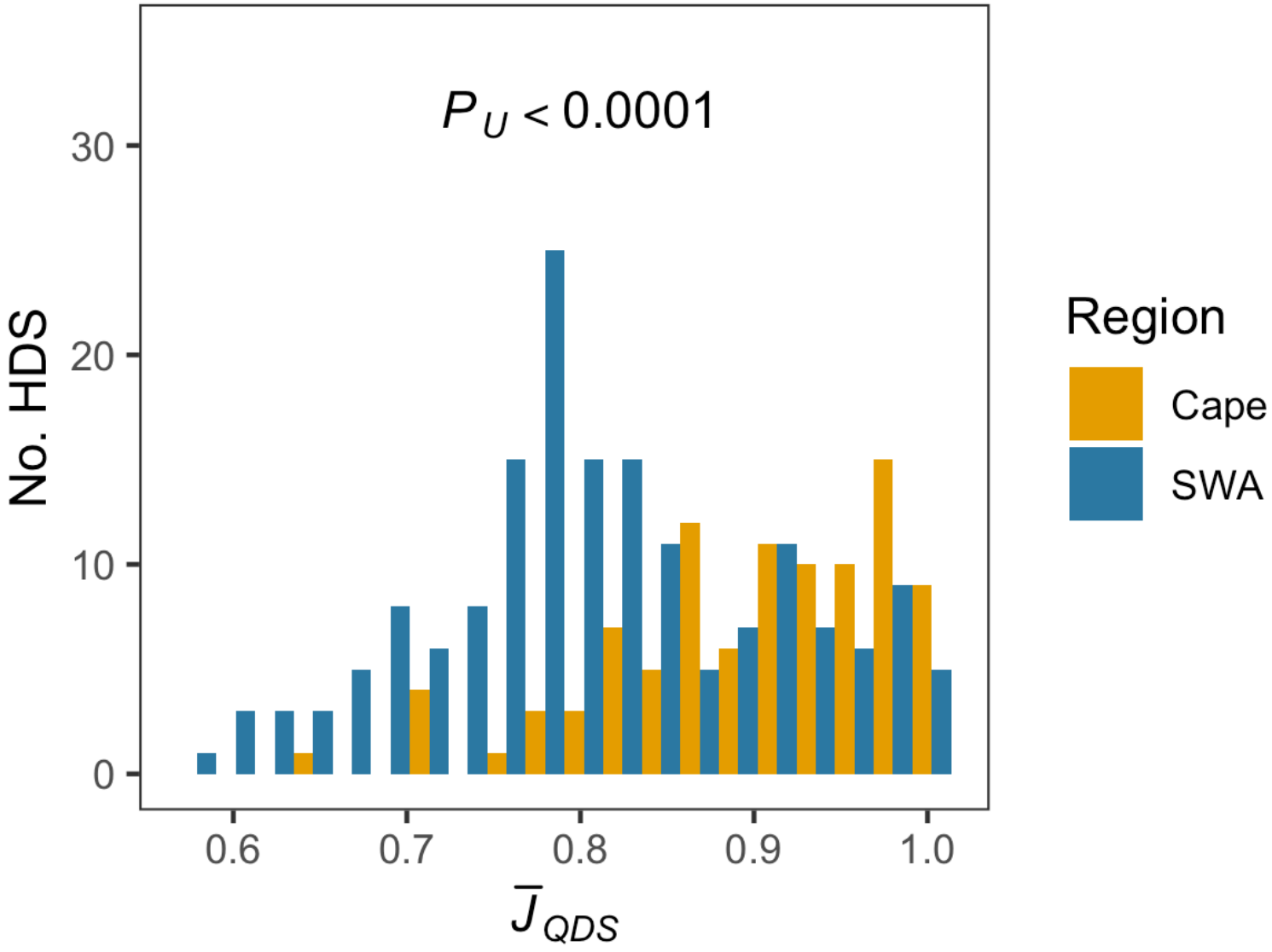
- Different forms of roughness scale differently
- And differently so for the Cape and SWA

Species turnover

Local neighbourhood N about cell x_{focal}

$\overline{J}(N) =$ average Jaccard distance between cells





– The Cape has ↑ species turnover

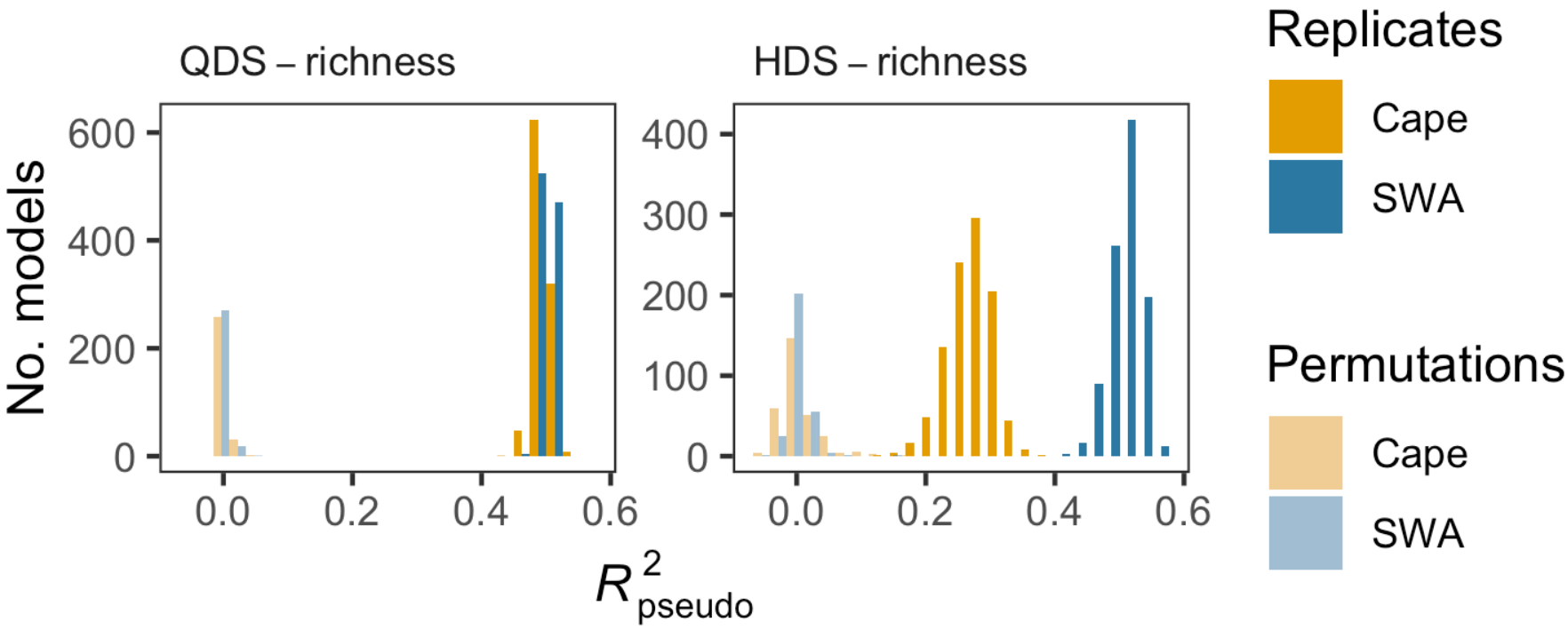
BRT-modelling

- Machine-learning
- Non-linear, complex and multivariate datasets

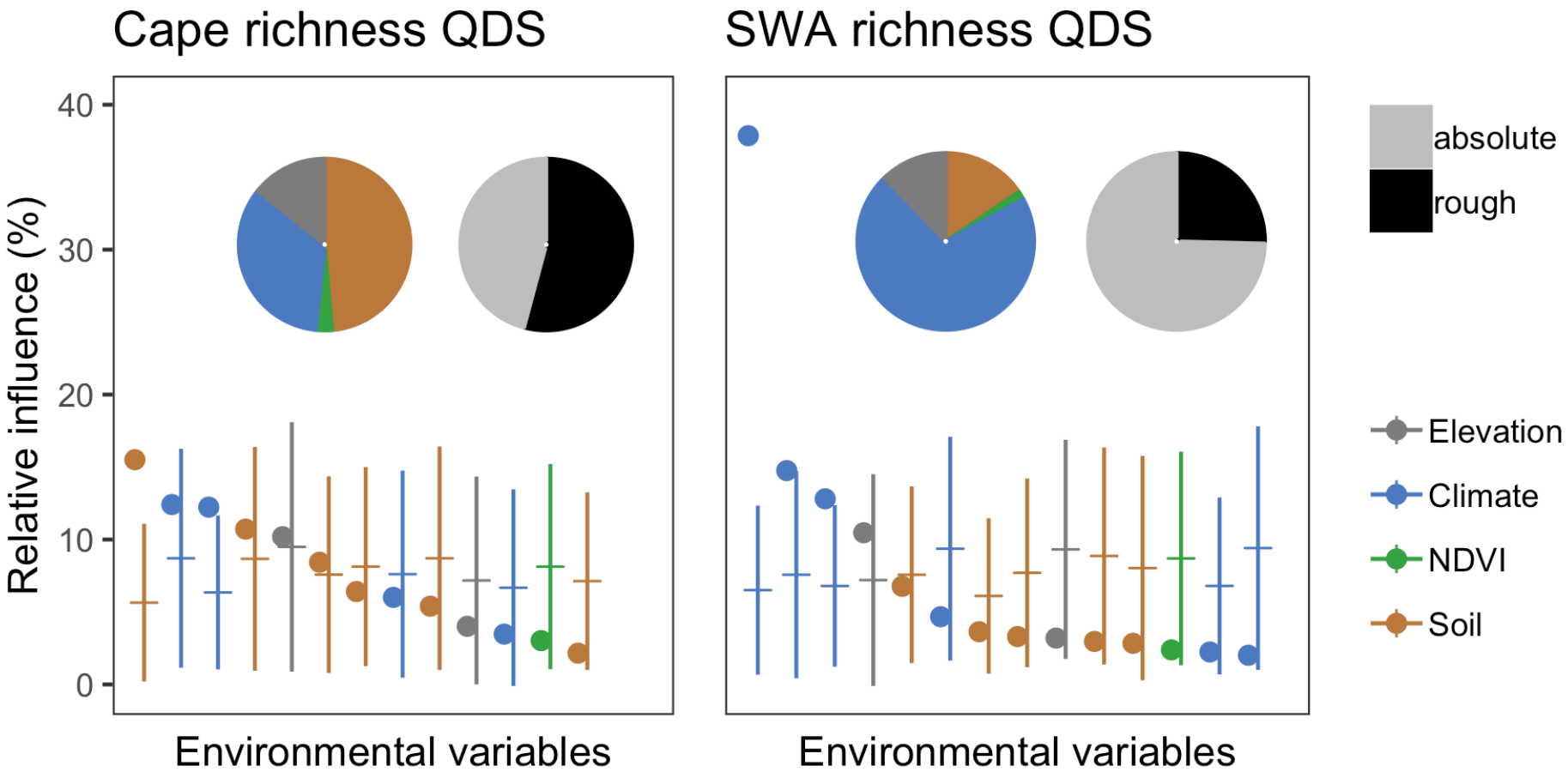
$$\hat{S} = w_1 t_1 + w_2 t_2 + w_3 t_3 + \cdots + w_n t_n$$

where t_i = *TODO: Insert regression-tree image*

TODO: Change $\hat{S}$-equation to version from Protea-SDMs slides



- Patterns different from chance (permuted null) ✓
- Cape patterns breakdown at coarser scales ✓
- SWA patterns do not ✓



- Broad suite of variables vs MAP
- Roughness and soil vs absolute and climate

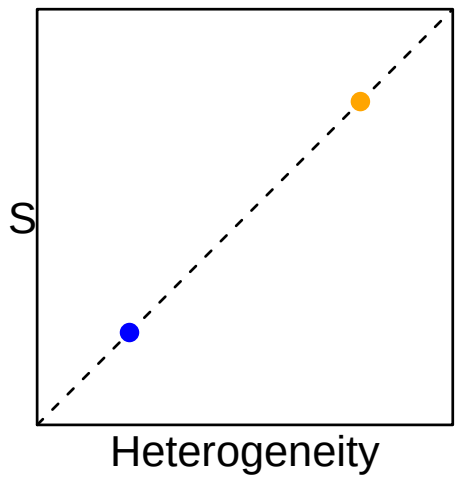
Conclusions

i. The Cape has ↑ EH, ✓
ii. and at a finer spatial scale ✓
iii. The Cape has ↑ species turnover ✓
iv. S and turnover are explained by EH ✓
v. Different axes of EH ✓

Conclusions: Summary

i–iii. The Cape **is** more environmentally heterogeneous ✓

iv–v. Different forms of heterogeneity **do** matter in the Cape and SWA ✓



Soil?

Thank you[1]!

[1] And an extra thank you to Mike and Tony