

Jet Propulsion Laboratory
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Intrinsic Dimensionality and Spectral Diversity



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Spectral variability hypothesis: ID

The mathematical concept of intrinsic dimensionality provides a metric for spectral diversity that does not inherently require training data, making its development and validation important for the future of global biodiversity mapping.

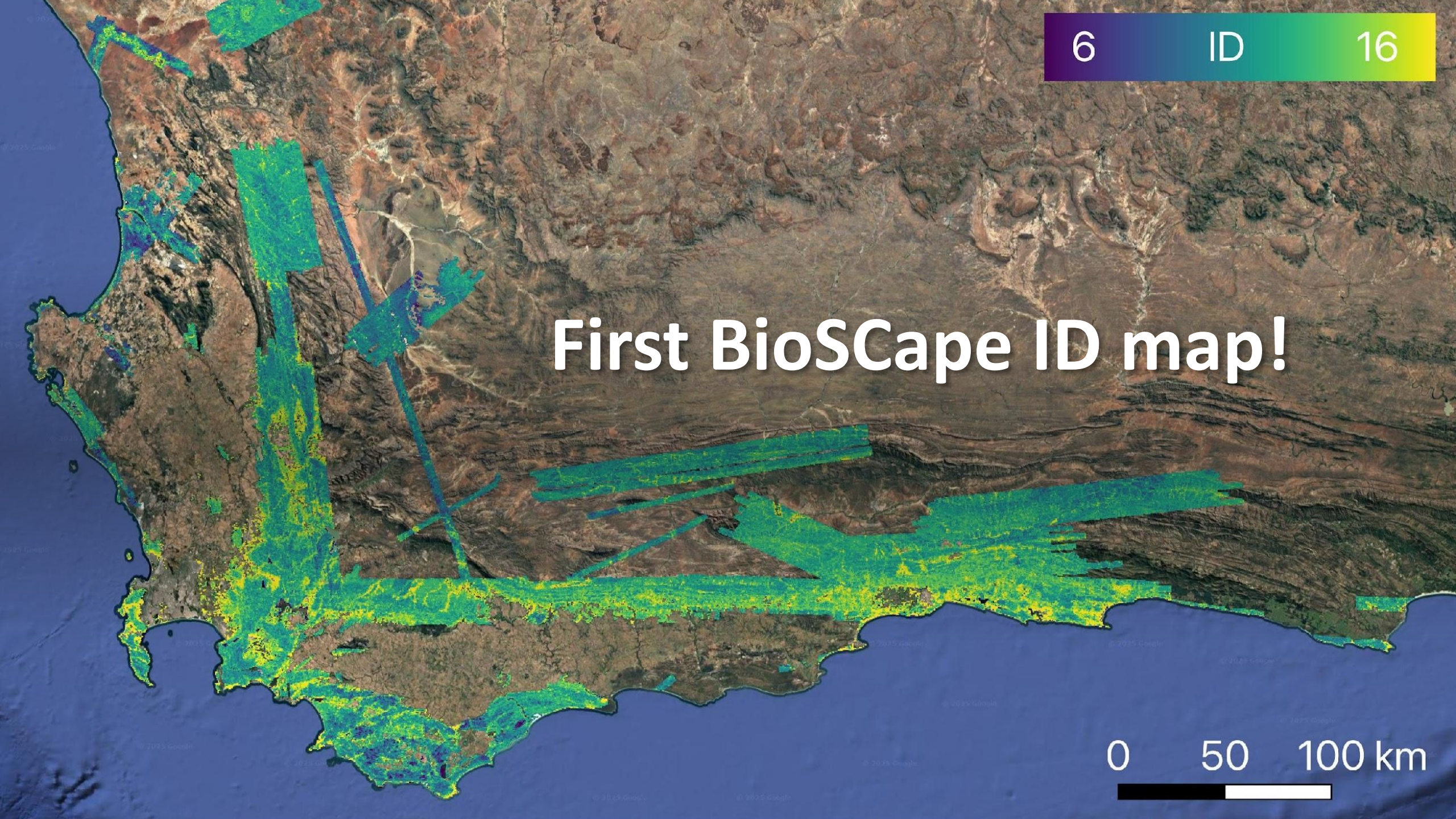
6

ID

16

First BioSCape ID map!

0 50 100 km

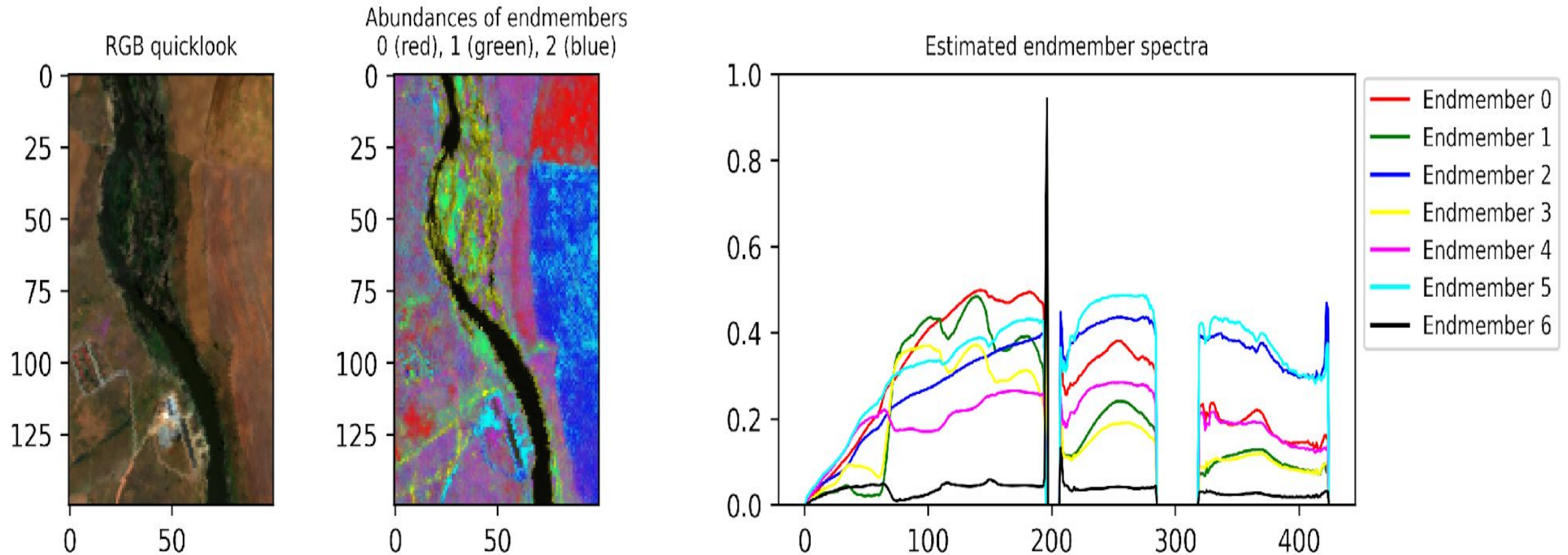


First attempt matched well with landcover



Both veg and soil/rock contributing to ID

ID is very good at picking up
residuals...



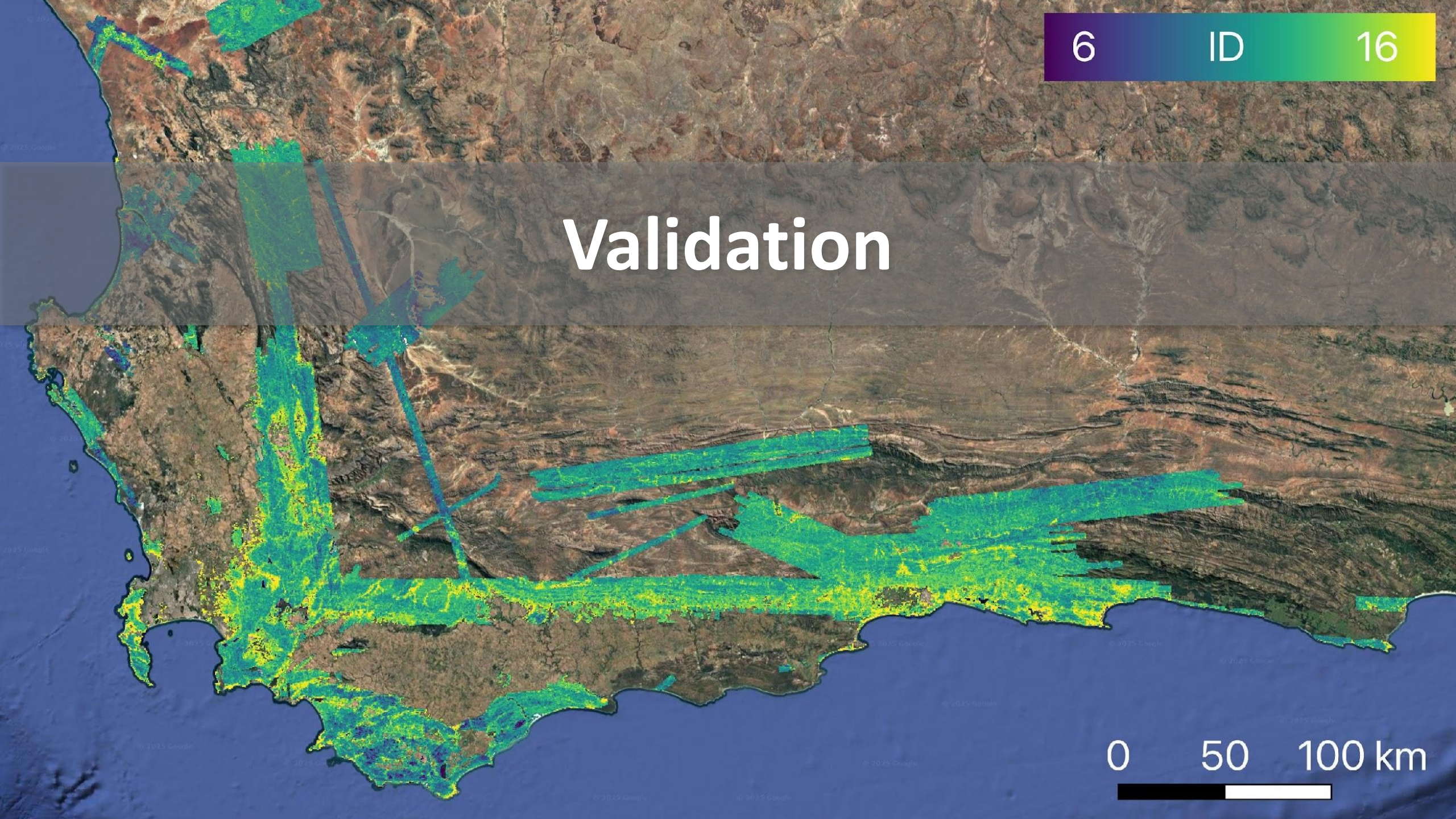
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ID

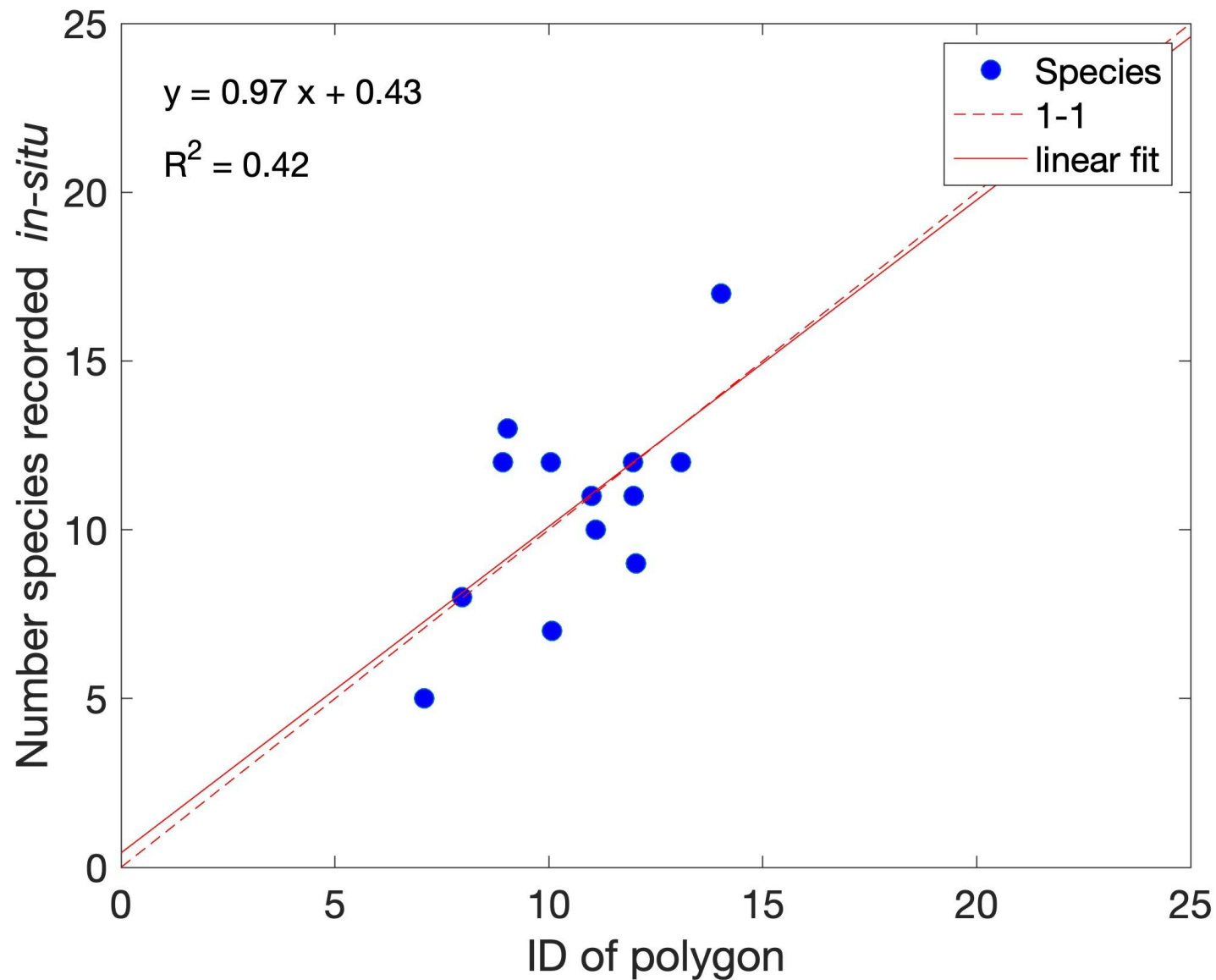
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Validation


0 50 100 km



Promising
correlation
for highly
veg sites



Percent live vegetation $\geq 80\%$



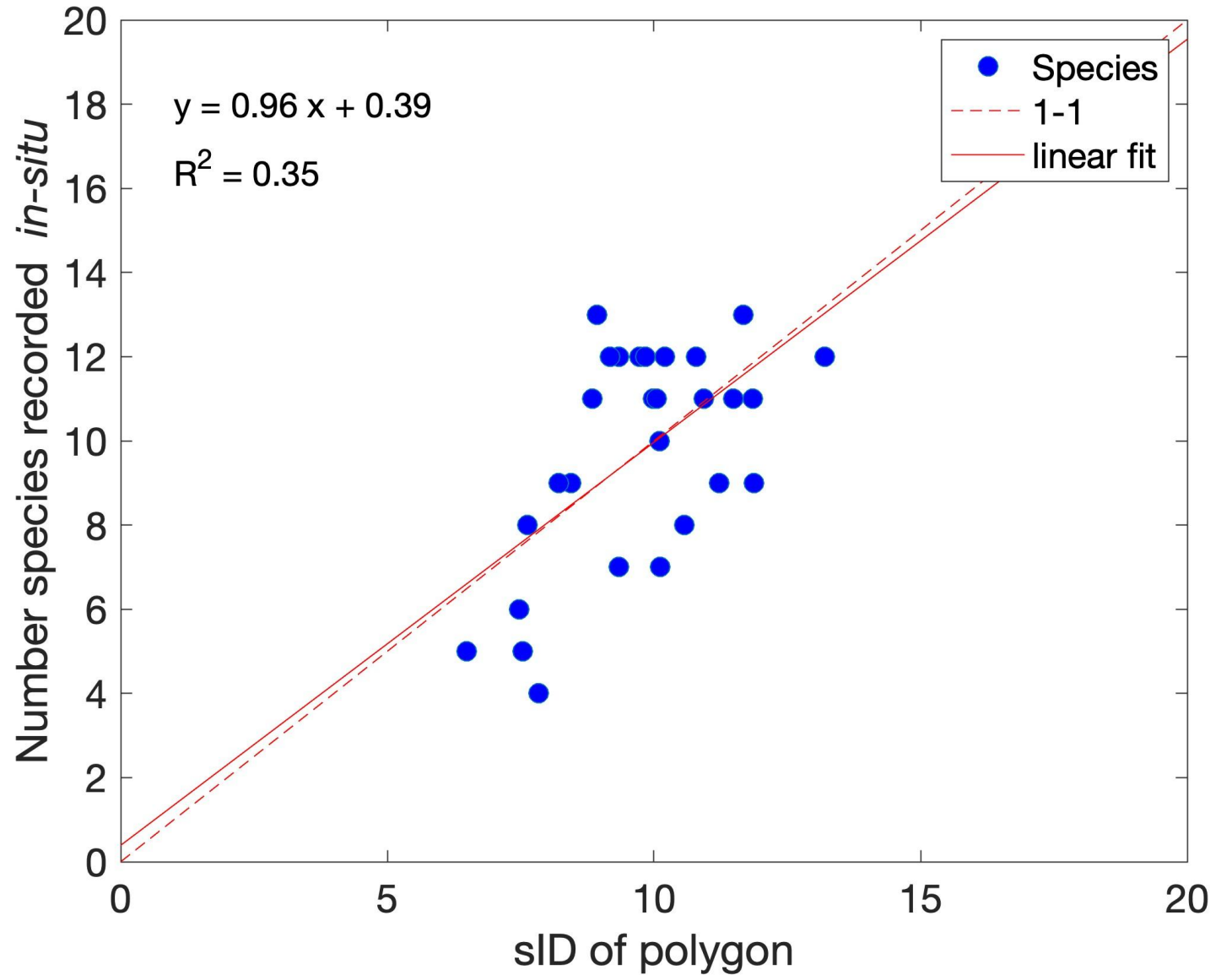
Solution =
scaling by
fractional
cover



Scaling =>
promising
correlation
with all sites!

$$sID = \frac{ID}{2(1 - 0.55v)}$$

Where v is veg fractional cover





100 ET (kg/m²/yr) 1000

This figure is a map of Europe and its surrounding regions, color-coded to represent evapotranspiration (ET) rates. The color scale ranges from dark blue (low ET) to red (high ET). High ET values (red/orange) are concentrated in the Mediterranean basin, North Africa, and parts of Western Asia. Moderate ET values (yellow/green) are found in Central Europe and Northern Africa. Low ET values (blue) are seen in Northern Europe and parts of Northern Africa. The map includes a scale bar at the bottom right indicating distances of 0, 50, and 100 km.

Correlations with dimensionality

0 50 100 km

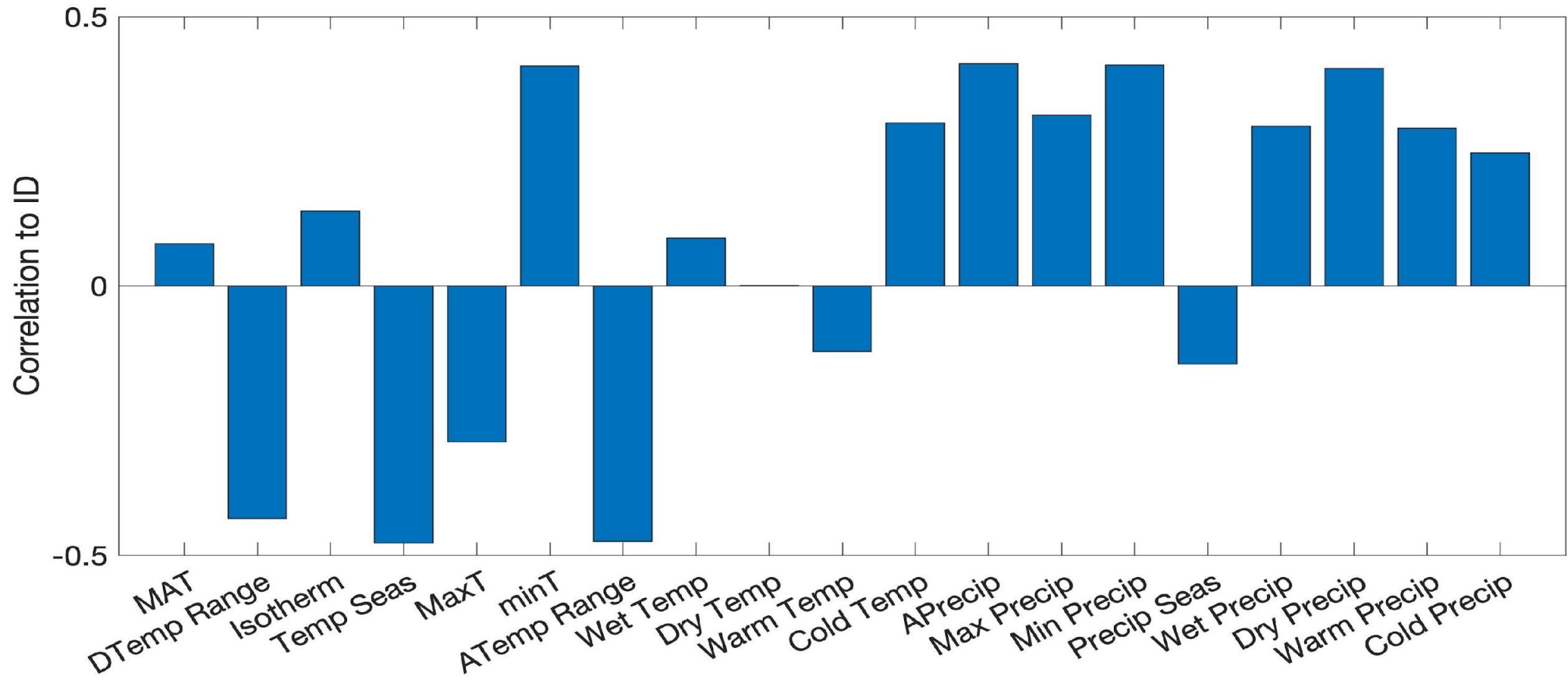


A horizontal scale bar with a black segment on the left and a white segment on the right, corresponding to the 0, 50, and 100 km markings.

sID Correlations

- Most significant predictors are the mean annual temperature and the temperature of the wettest quarter

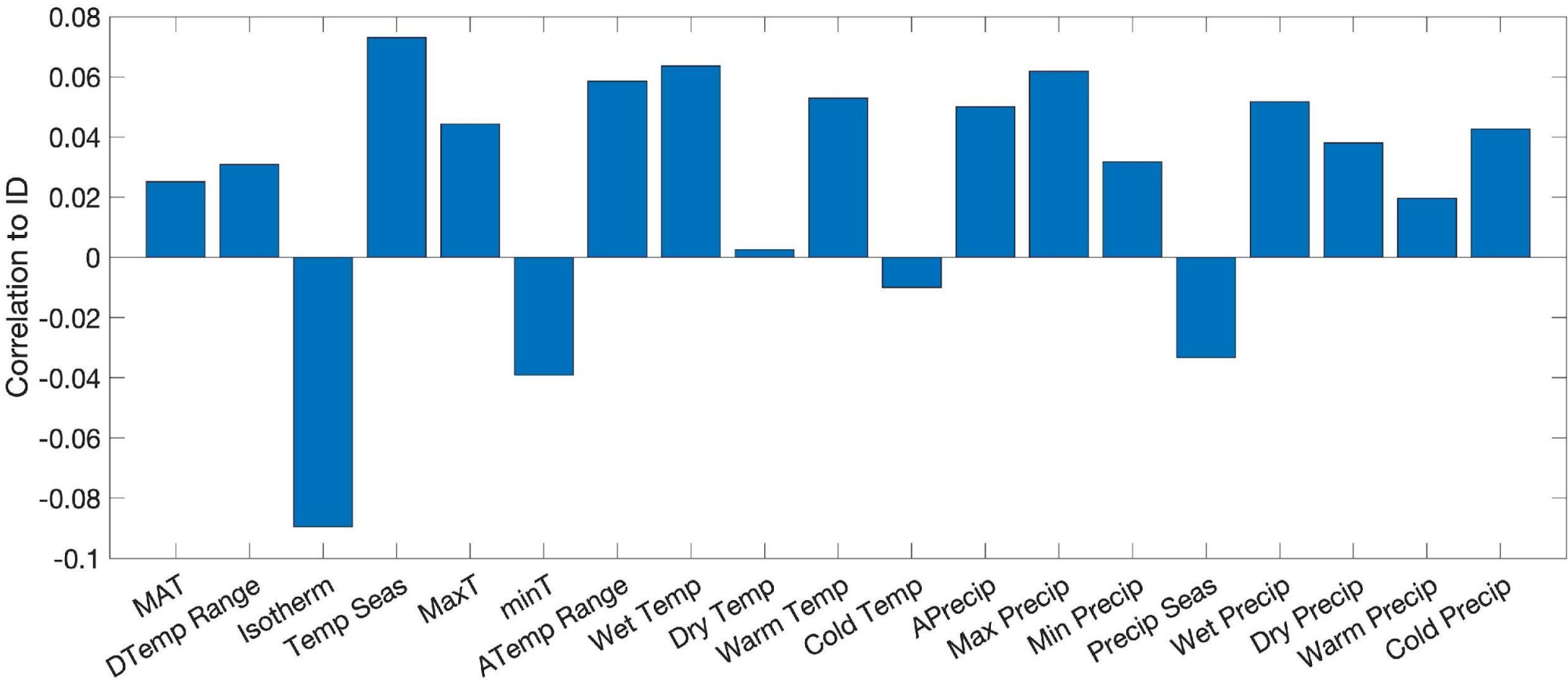
Veg only



ID Correlations

- All BioClim variables high significant except the average temperature of the driest quarter and coldest quarter
- MAT, temperature and precipitation during the wettest quarter have significant (but small) impacts

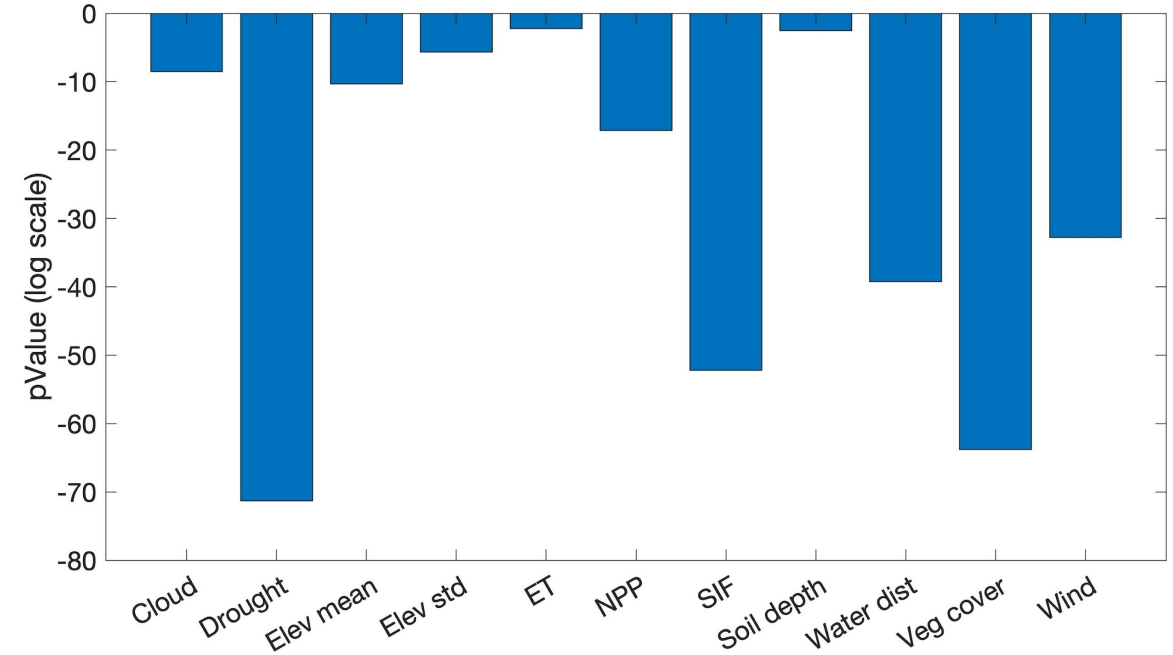
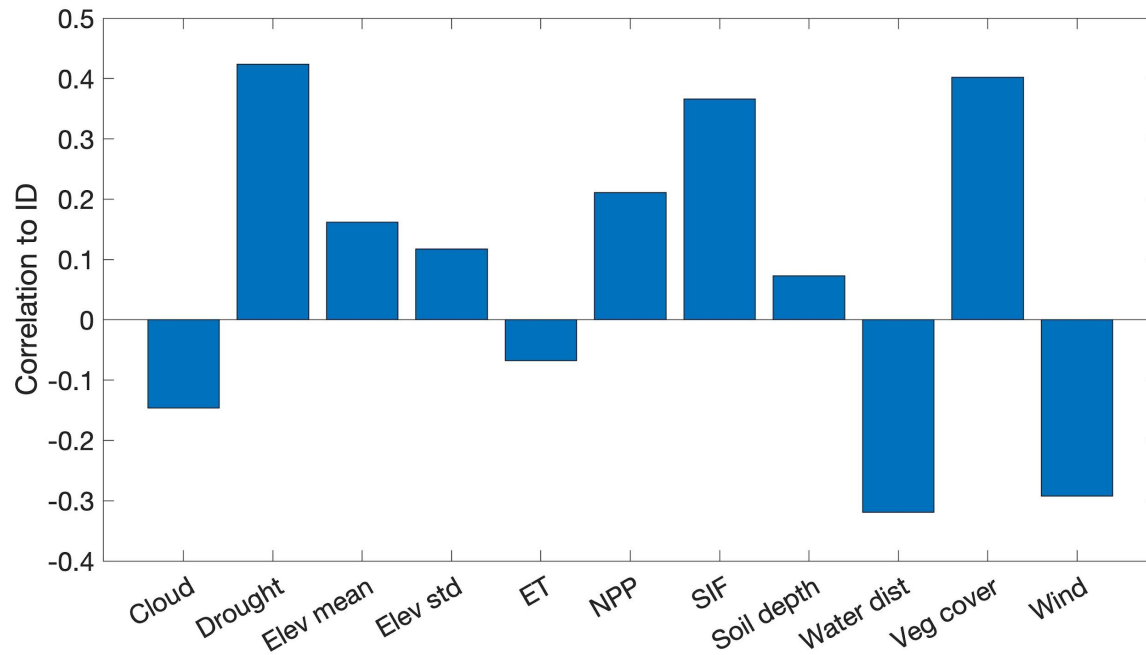
Soil + veg



sID Correlations

- Drought, veg cover and SIF are most significant
- Areas with higher drought index have higher ID
- Areas with higher veg cover have higher ID (by design)
- Areas with high SIF (small sample) have higher ID
- If we filter to pixels with >50% veg, distance to water becomes second most significant

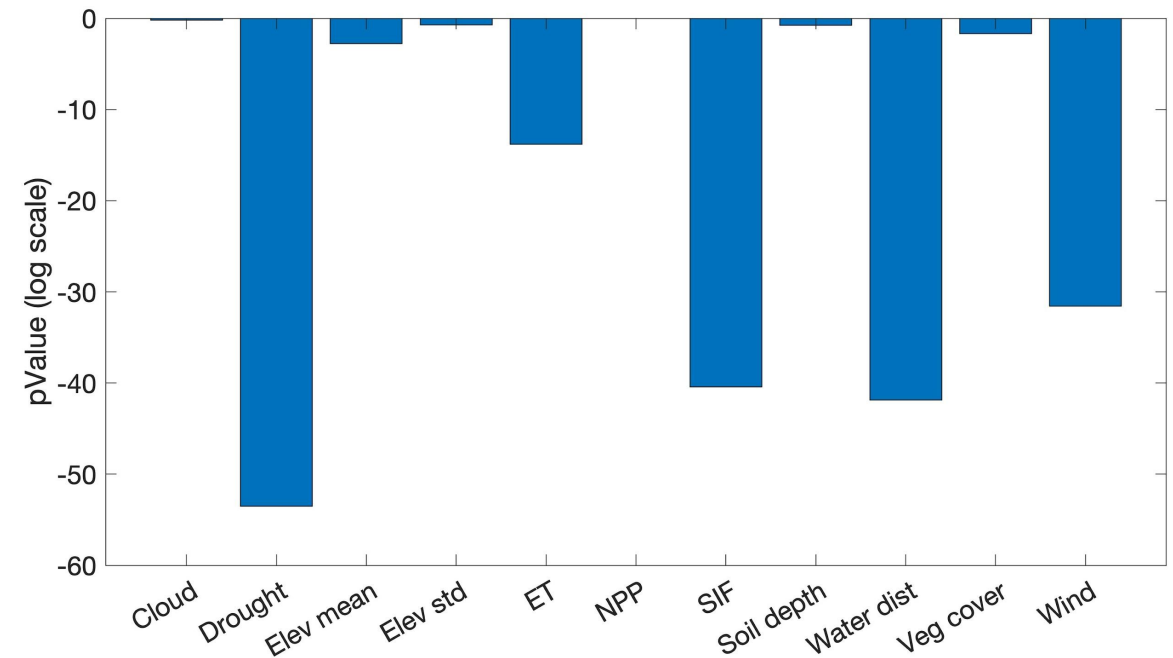
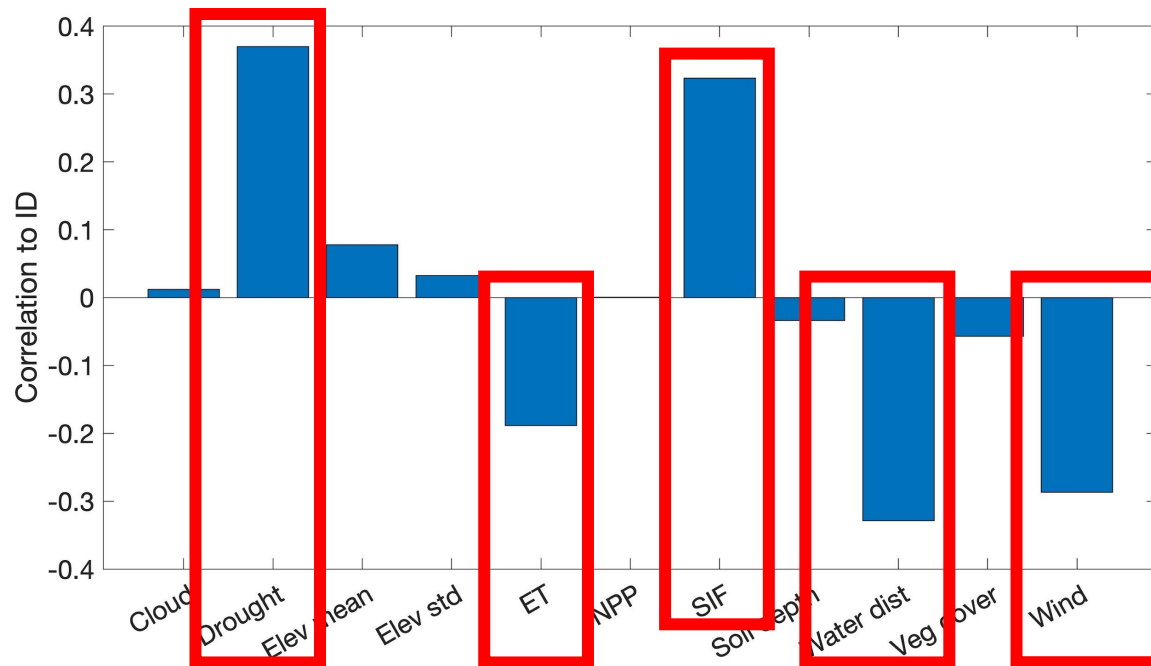
Veg only



ID Correlations

- Drought, veg cover and SIF are most significant
- Areas with more droughts have higher ID
- Areas with high SIF (small sample) have higher ID
- Areas further from water, windy areas, and high ET areas have lower ID

Soil + veg



Drought = the number of droughts since 2000, quantified as the number SPEI values less than -1 since 2000

100 ET (kg/m²/yr) 1000

Correlations with dimensionality

More droughts => higher ID

Higher SIF correlated with higher ID (small sample)

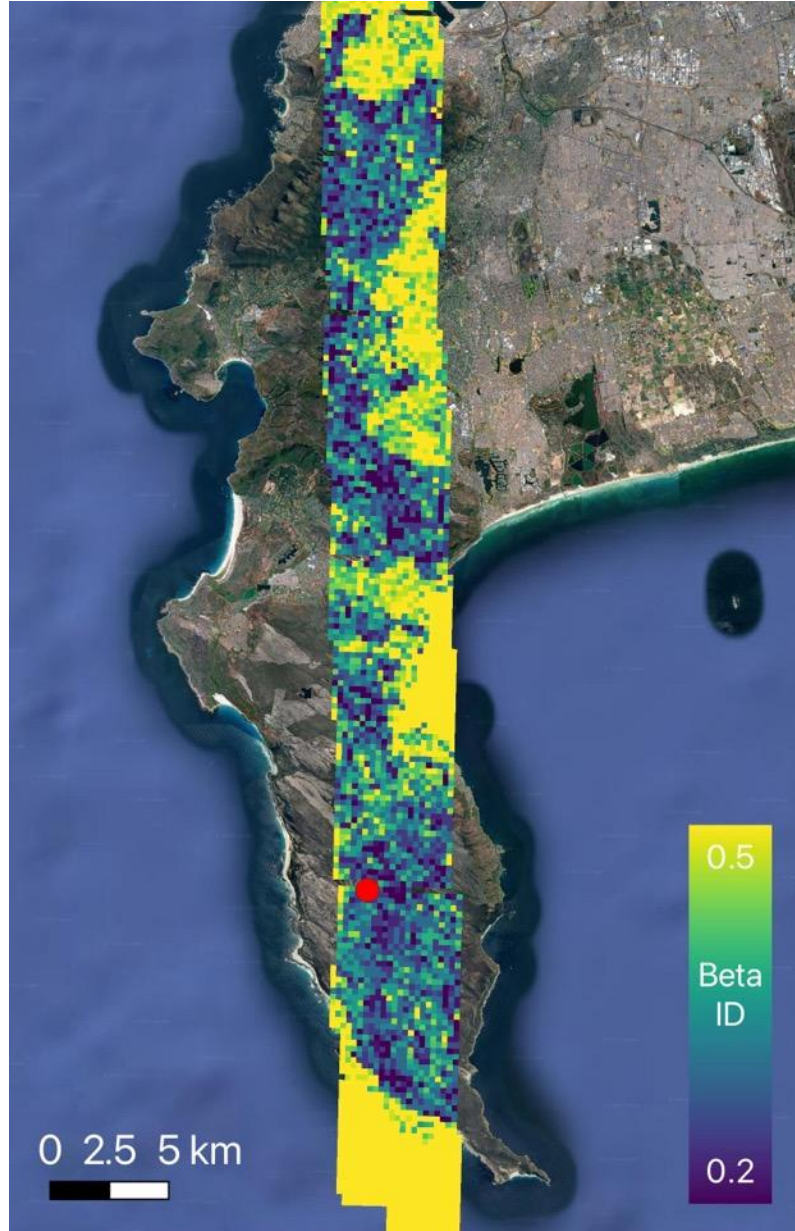
Further from water => lower ID

Windy => lower ID

Higher ET => lower ID

0 50 100 km

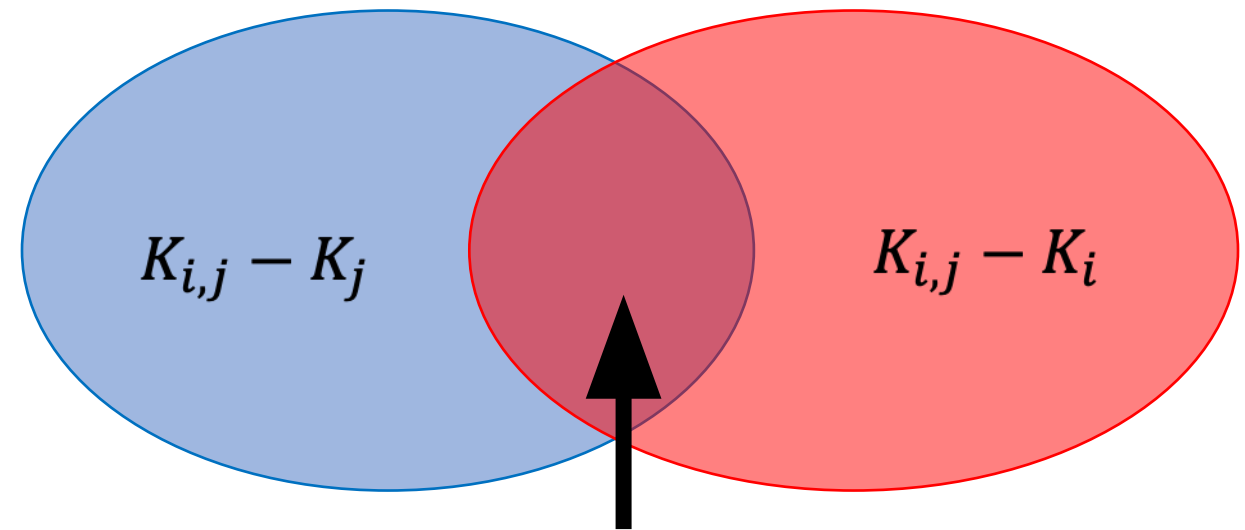
Sneak peak: first beta diversity results over Cape Peninsula



ID-dissimilarity

$$d_{i,j} = 1 - \frac{2D}{K_i + K_j}$$

$$D = K_i + K_j - K_{i,j}$$



$$D = K_i + K_j - K_{i,j}$$

Next steps



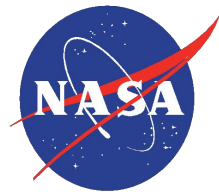
STUDY DRIVERS OF
DIVERSITY



BETA VALIDATION
AGAINST FIELD PLOTS



SCALABILITY



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