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Biodiversity of benthic communities and resilience of continental shelves

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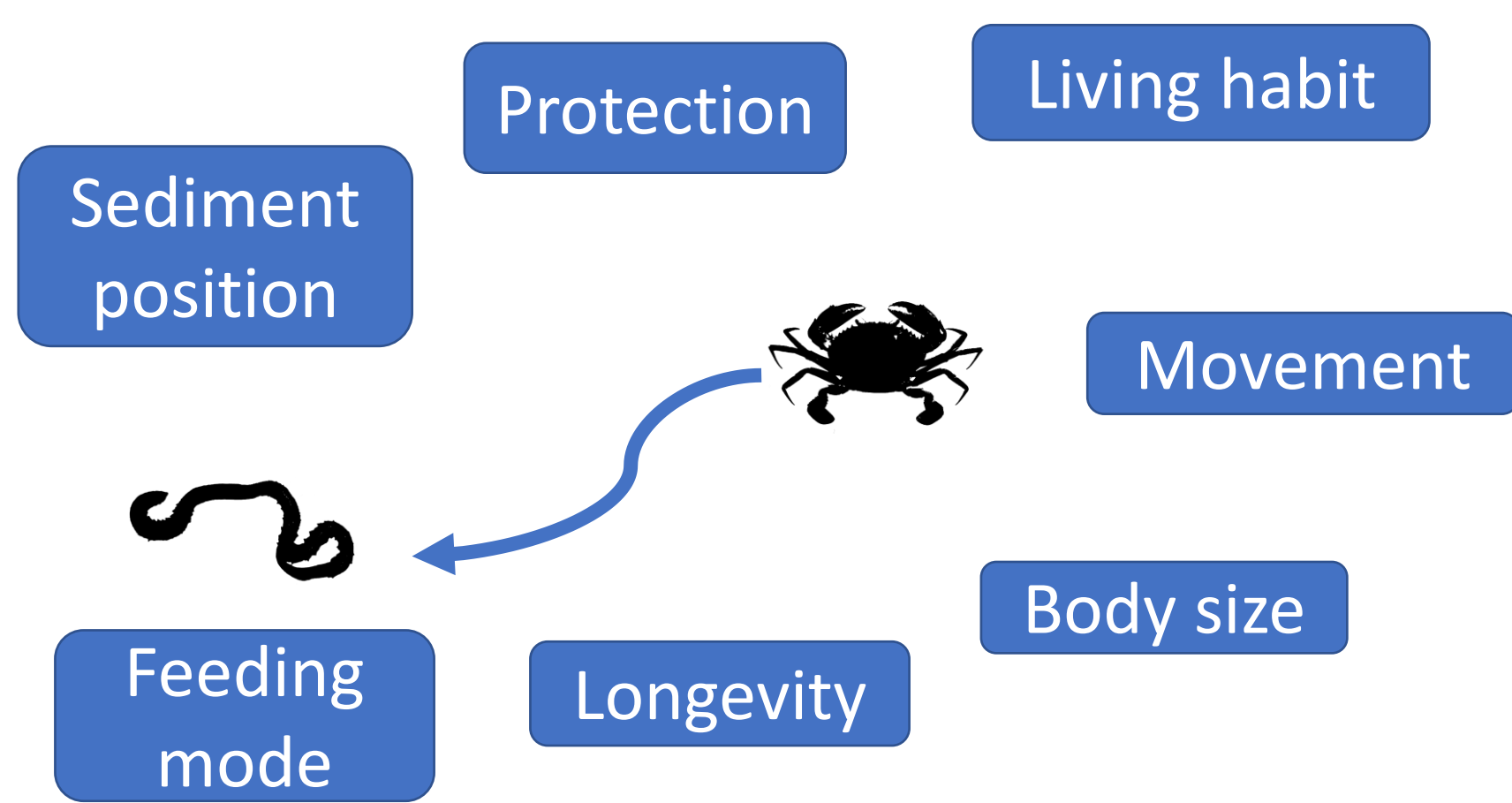
- Continental shelves → ecosystem under strong anthropogenic pressure (Halpern *et al.*, 2008)
- Benthic fauna → Major component of the trophic functioning of continental shelf ecosystems (Lassalle *et al.*, 2011)
- Trophic functioning stability and resilience may depend on functional features (Sanders *et al.*, 2021)

How benthic biodiversity structures the resilience of trophic functioning though continental shelves ?

Materials & Methods

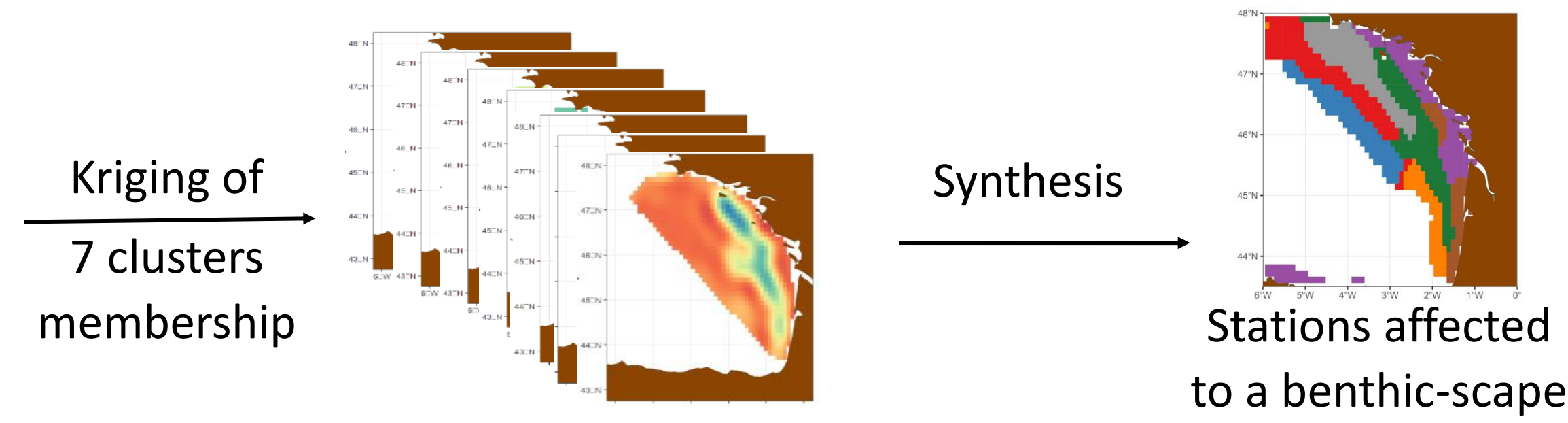
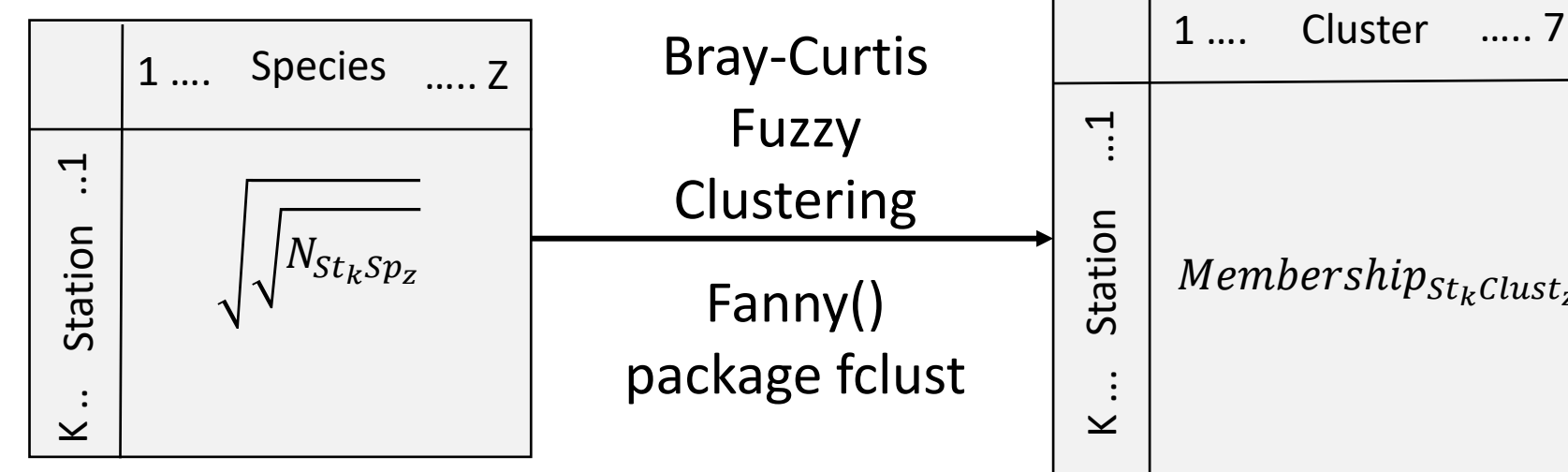
Step 0 : Data required

1. Invertebrate epi-megafauna: Trawling abundance data (IBTS EVHOE 2008-2020, depth: 20-200m, Bay of Biscay)
2. Trophic related functional traits (Clare *et al.*, 2022)



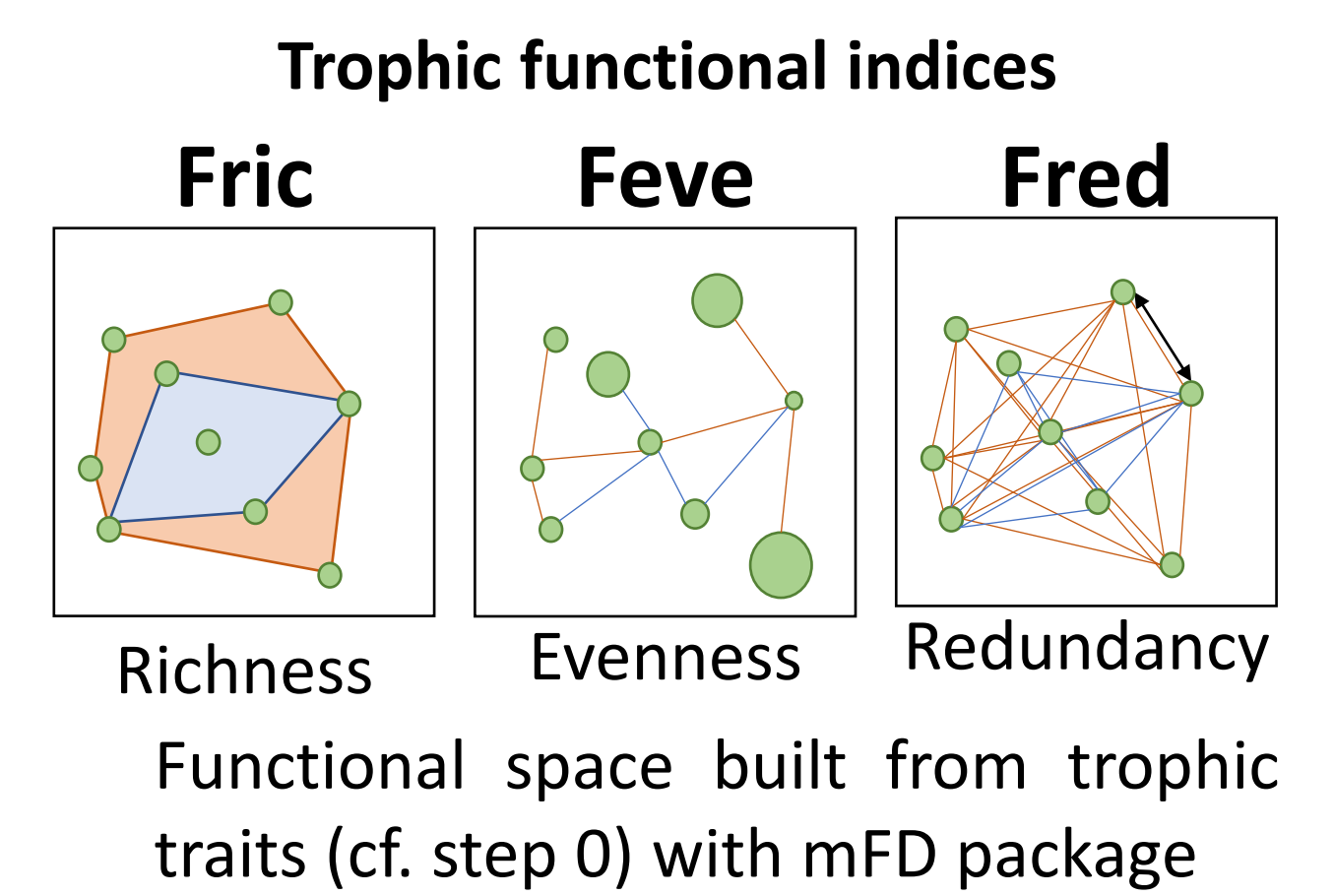
3. Vulnerability to trawling pressure (Beauchard *et al.*, 2021)
4. Drivers of diversity and vulnerability: Trawling disturbance (average swept area) (ICES, 2022) and benthic-scapes defined.

Step 1 : Delineation of benthic-scapes



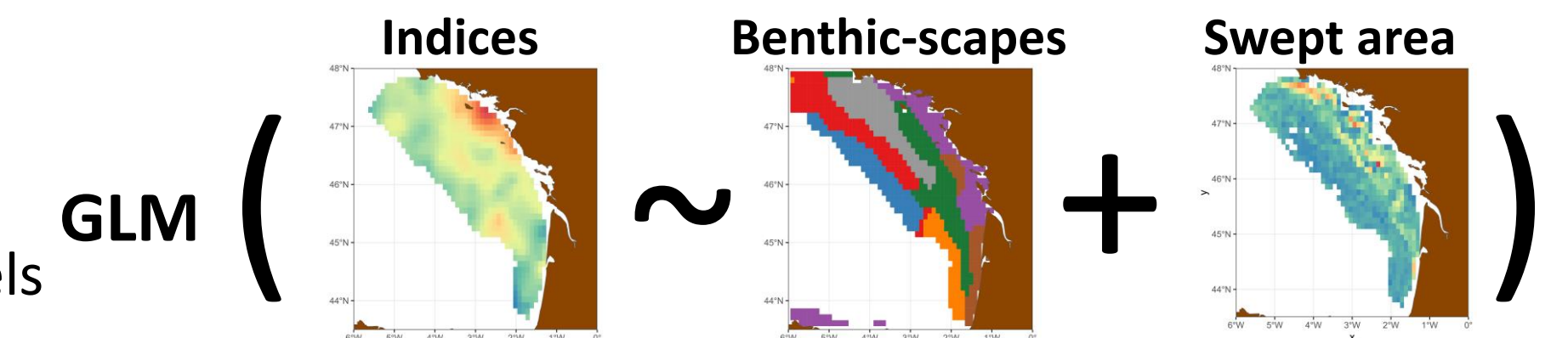
Step 2 : Functional diversity indices of benthic-scapes and vulnerability index

- ✓ High functional diversity (richness and evenness) → High resistance to pressure
- ✓ High functional redundancy → High resilience to disturbance
- ✓ Major anthropogenic benthic pressure: bottom trawling
- Vulnerability (VU) index to bottom trawling
- Low vulnerability → Low sensitivity and/or high resilience to bottom trawling
- 4 indices: Functional richness (Fric), Functional evenness (Feve), Functional redundancy (Fred), Vulnerability (VU)



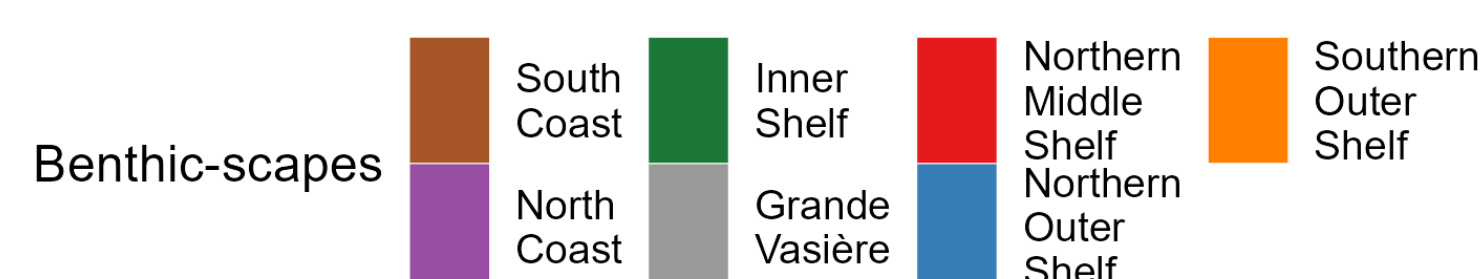
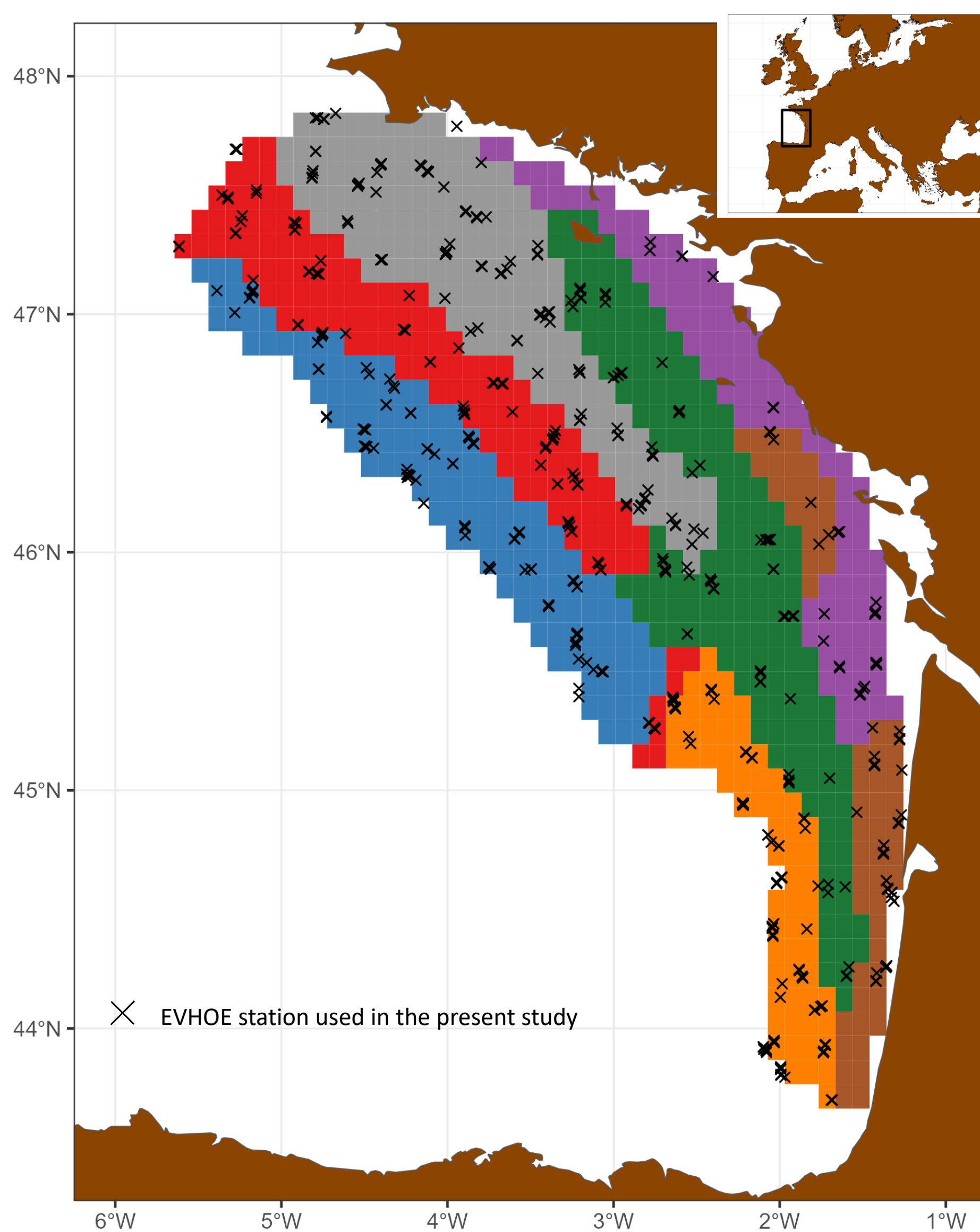
Step 3 : Drivers of spatial structuration

- ✓ Kriging of 4 indices (Fric, Feve, Fred, VU)
- ✓ Drivers of indices assessed with Generalized Linear Models

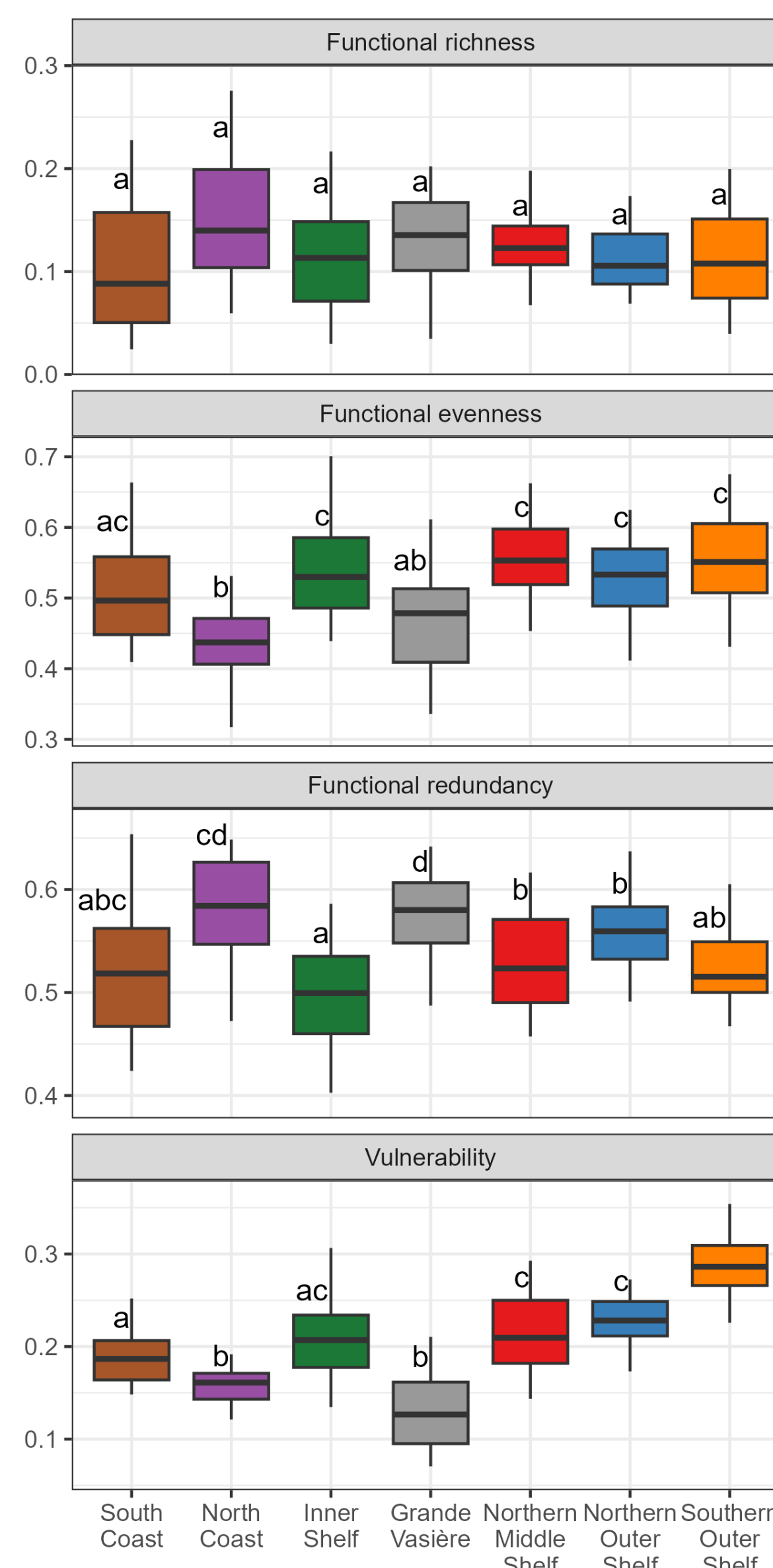


Results

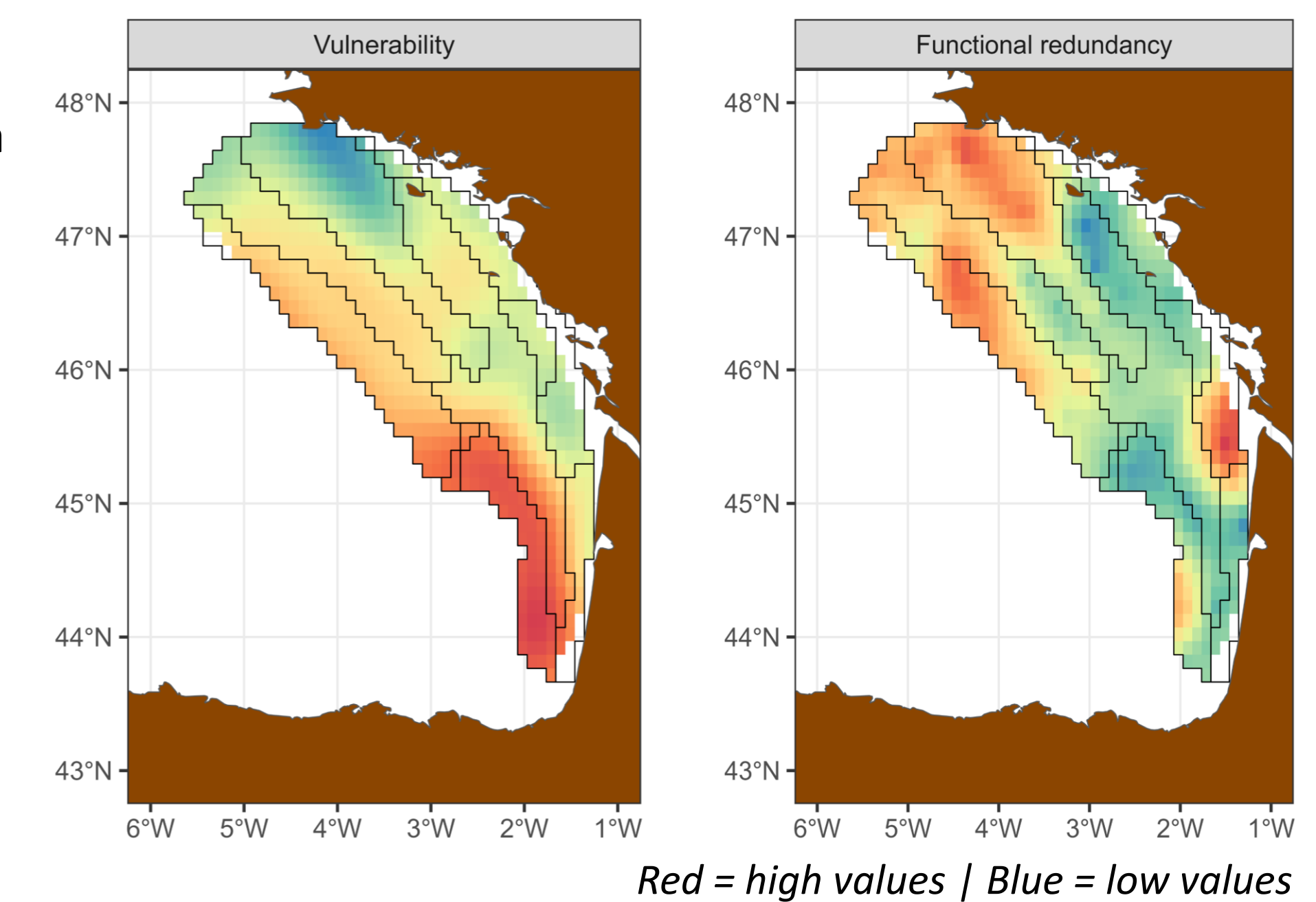
Step 1 : Delineation of benthic-scapes



Step 2 : Functional diversity indices of benthic-scapes and vulnerability index



- Higher functional richness and lower evenness in coastal area
- Lower richness and higher evenness within offshore benthic-scape
- Three benthic-scapes with high functional redundancy
- Low vulnerability within coastal benthic-scapes and Grande vasière



- Southern outer shelf = high vulnerability to trawling pressure
- 3 hotspots of functional redundancy :
 - North coast
 - North outer shelf
 - Grande vasière
- High intra-benthic-scape variability

Step 3 : Drivers of spatial structuration

- Indices variability strongly explained by benthic-scapes
- Functional indices less structured by fishing pressure than vulnerability index

Table 1: Amount of variability explained by each factor

	Benthic-scapes	Swept-area surface
Functional richness	26,1%	0,5%
Functional evenness	50,3%	0%
Functional redundancy	32%	0,1%
Vulnerability	81,2%	7,8%

×% : non-significative factor within glm

Discussion

- Decrease of resistance and increase of vulnerability from coast to continental margin (lower functional richness offshore)
- Resilience does not decrease linearly : 3 hotspots identified (North coast, Grande Vasière and Northern outer shelf)
 - Resistance and vulnerability correlated with continental shelves gradient, but trophic functioning resilience depends on benthic-scapes
- Benthic-scapes = suitable scale for integrating the spatial structuring of benthic ecosystems and dissociating environmental variability, trophic functioning and vulnerability to fishing pressure.

References:



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The interdisciplinary graduate school for the blue planet