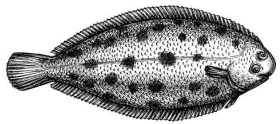
Can we trust commercial landings data to identify essential habitats of harvested fish ?

Application to several species in the Bay of Biscay





Baptiste Alglave[1,4], Youen Vermard[1],
Marie-Pierre Etienne[2], Mathieu Woillez[3], Etienne Rivot[4]

[1]EMH, Ifremer Nantes
[2]IRMAR, Université de Rennes
[3]STH, Ifremer Brest
[4]UMR ESE, INRAE, Rennes

Ecological context

Marine spatial planning

⇒ finding a balance between :

- human activities
- preserving ecosystems and habitat functions

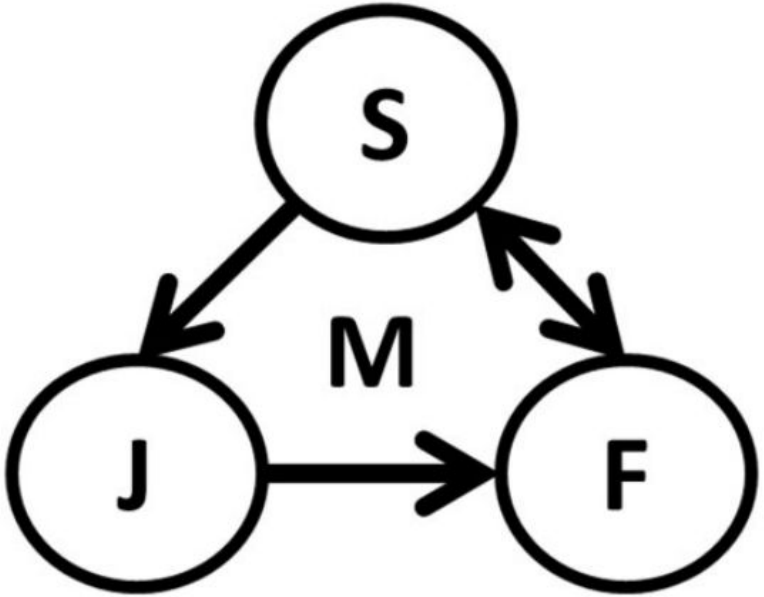
Preserving essential habitats of harvested species

→ Fishery sustainability

→ Ecosystem functions

Identify and characterise these areas ?

Delage and Le Pape (2016)
Regimbart et al. (2018)



Conceptual diagram of common life-history stages of fish in coastal habitats

S = mature adults during spawning, J = immature juveniles, and F = feeding adults not in spawning. Arrows represent migrations (M)

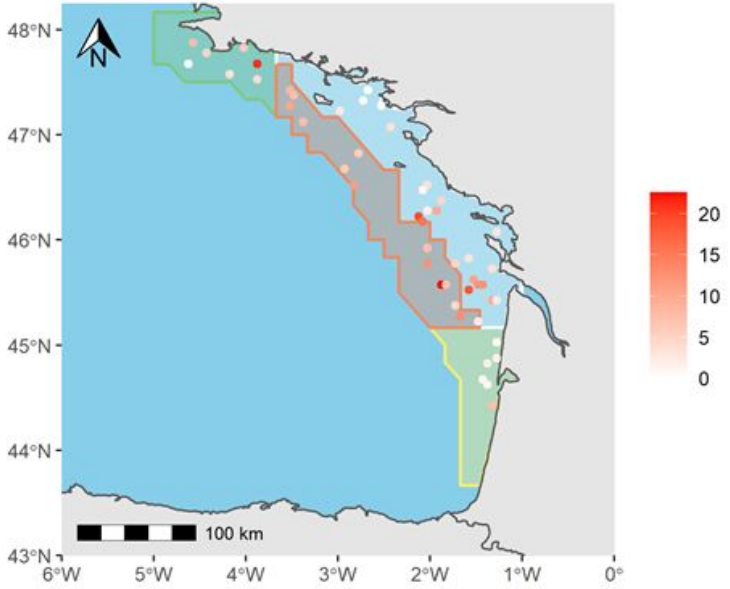
Brown et al. (2018)

Available data

Scientific survey

\+ - Standardised sampling plan

\- - Expensive
- Sparse and limited spatio-temporal coverage



Scientific data

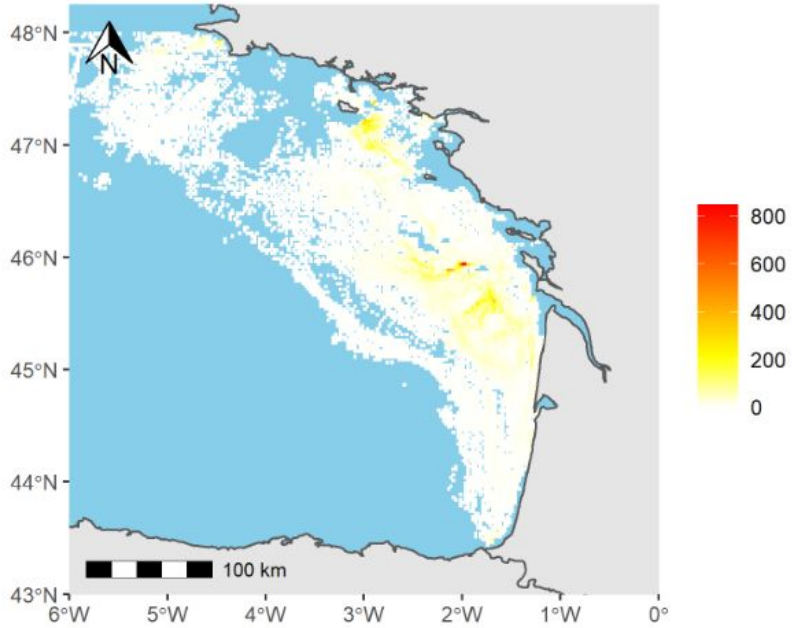
Common sole - ORHAGO survey.
Unit : kg. Year: 2018.

Available data

Landings data
(logbooks x VMS)

- Available data on the full year and dense coverage of the study area
- Costless (for scientists)

- Preferential sampling towards higher abundance area
- Non-homogeneous fleets (varying catchability and targeting behavior)

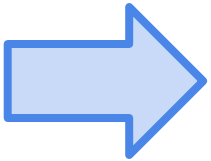


Commercial data

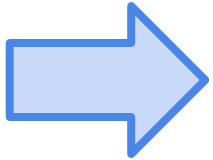
Common sole - Otter trawls targeting demersal species.
Unit: kg. Year: 2018.

Scientific question

Development of a **spatio-temporal modelling framework** fitting to both scientific data and commercial data

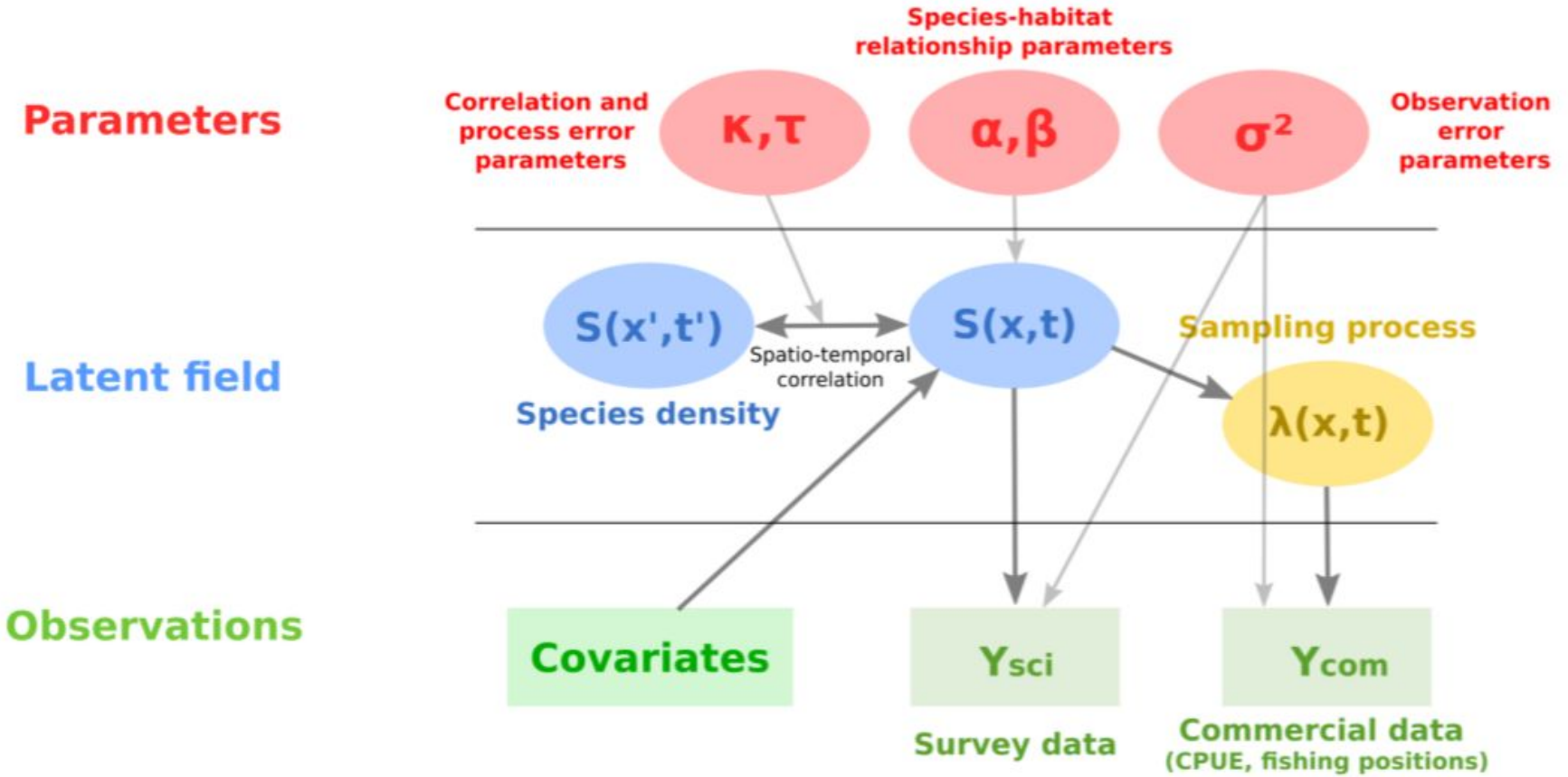


Predict fish spatial distribution at a fine spatio-temporal scale

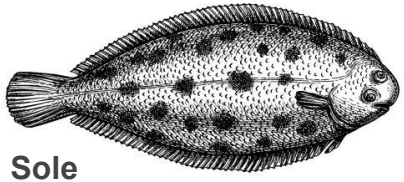


Identification of **Essential Fish Habitats**

(with a focus on spawning grounds)


Parameters
Latent field
Observations
Species-habitat relationship parameters
Correlation and process error parameters
κ,τ
α,β
σ²
Observation error parameters
S(x',t')
Spatio-temporal correlation
S(x,t)
Species density
Sampling process
λ(x,t)
Covariates
Ysci
Survey data
Ycom
Commercial data
(CPUE, fishing positions)

Species of interest

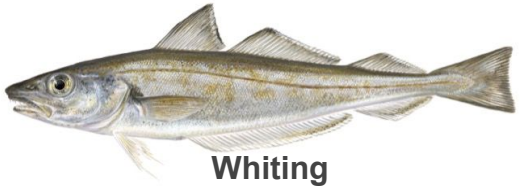


Sole

Anglerfish

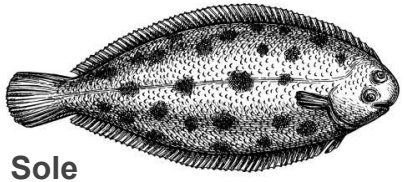
Hake

Sea bass



Whiting

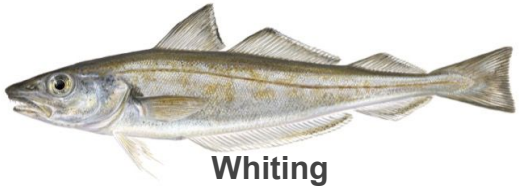
Species of interest


Sole


Anglerfish


Hake

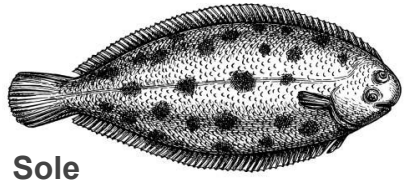

Sea bass


Whiting

Filtering commercial data

- **Métier/fleet:** Otter trawls targeting demersal species in the Bay of Biscay (OTB_DEF)
- **Spawning fraction of catches** (when biological data are available)

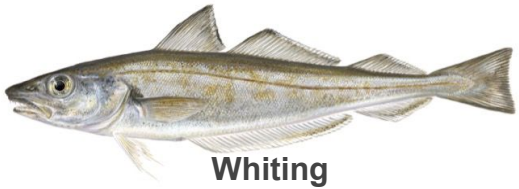
Species of interest


Sole


Anglerfish


Hake


Sea bass

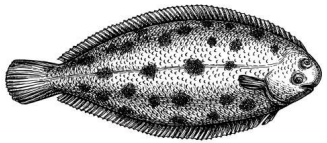

Whiting

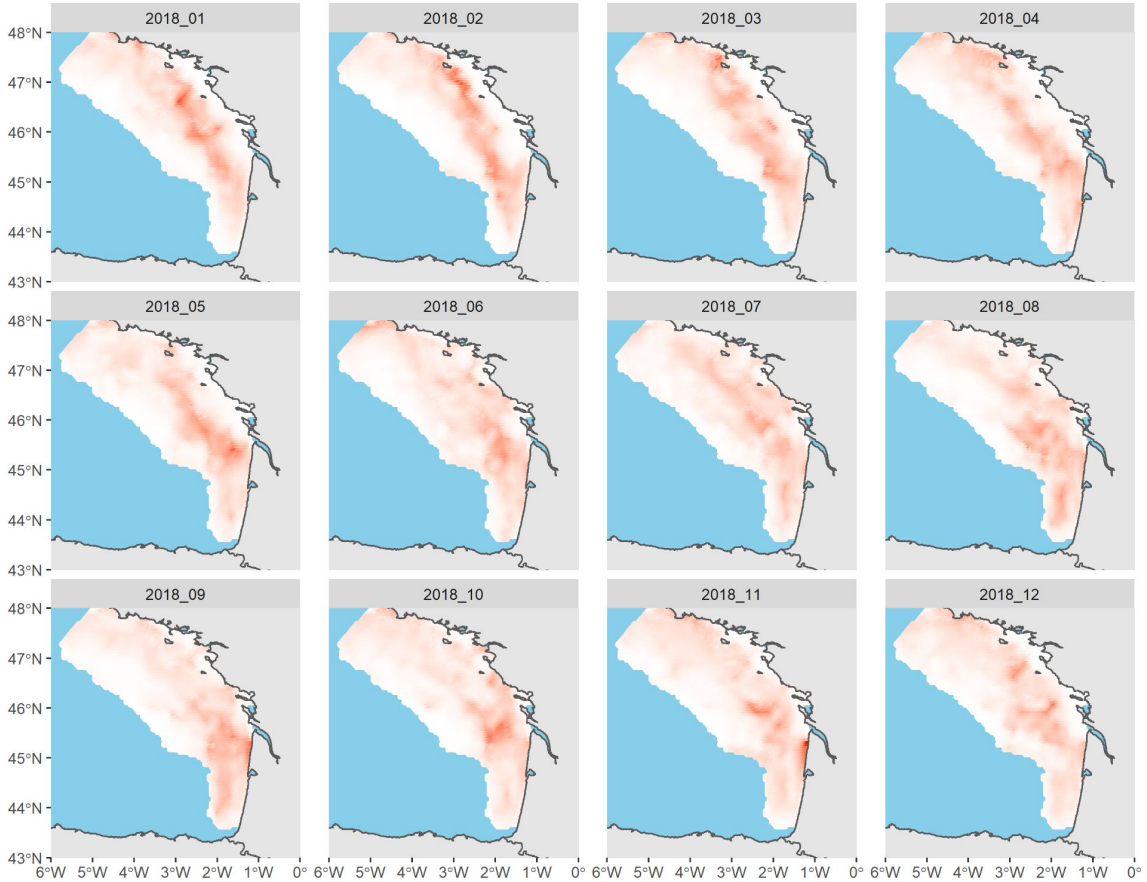
Filtering commercial data

- **Métier/fleet:** Otter trawls targeting demersal species in the Bay of Biscay (OTB_DEF)
- **Spawning fraction of catches** (when biological data are available)

Model predictions for the year 2018

(relative distribution)

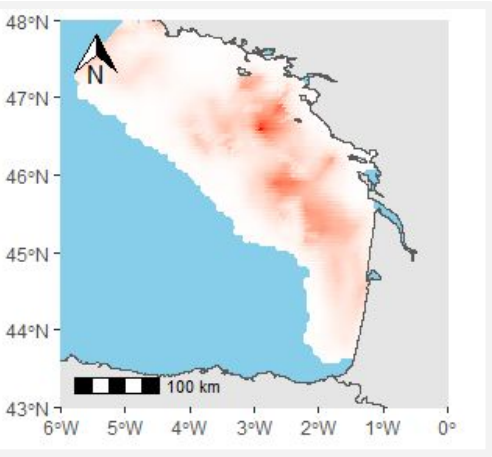


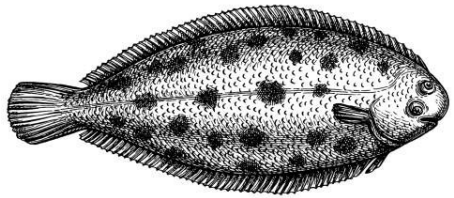


Spatio-temporal model

Model fitting on the period 2008 - 2018

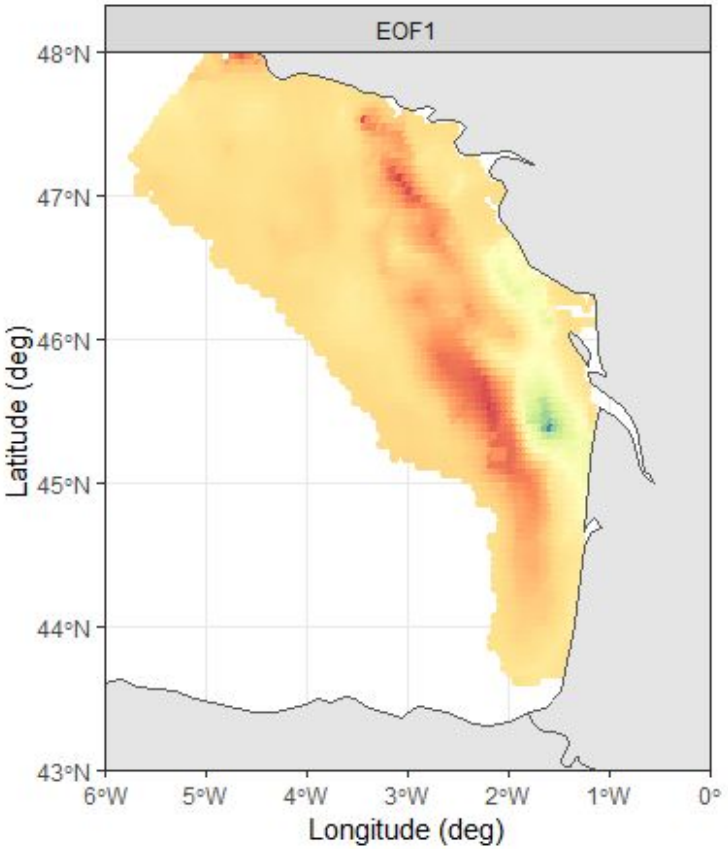
Monthly time step = 132 maps

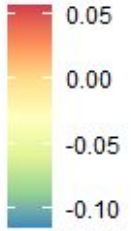




EOF

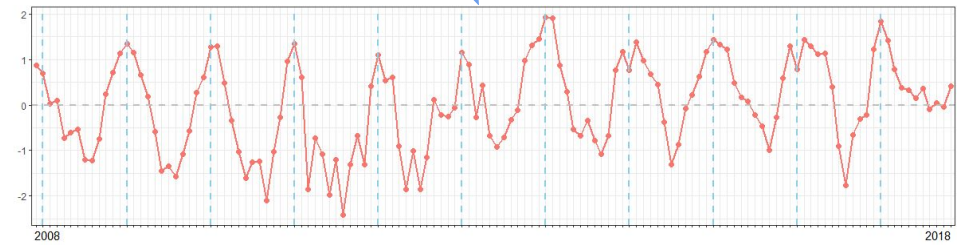
Captures principal spatial patterns
=
1 map + 1 time series

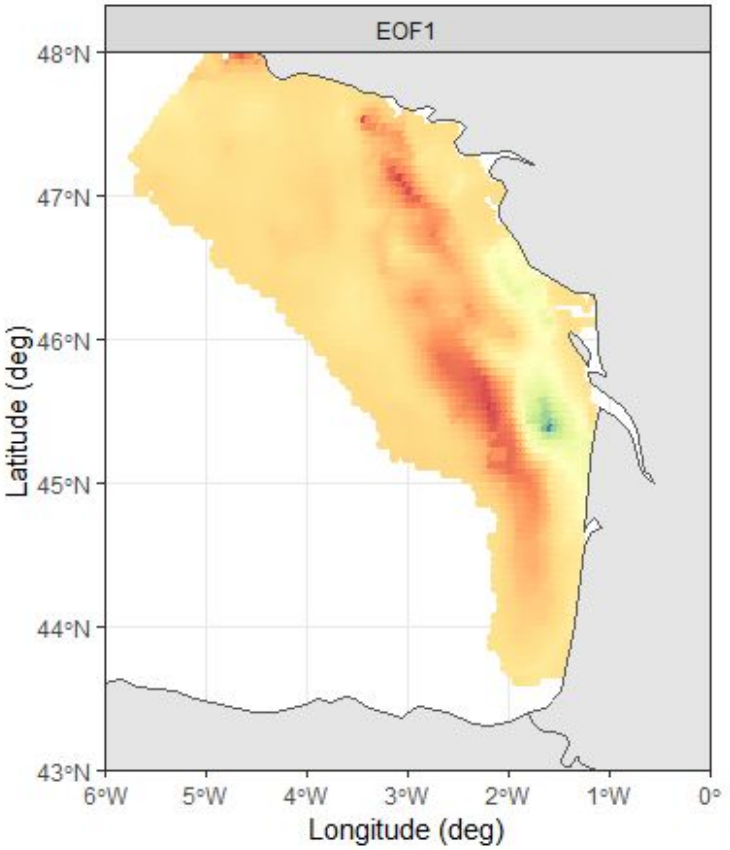




=

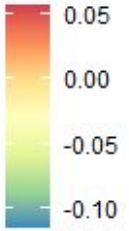
Spatial patterns capturing the maximum variability





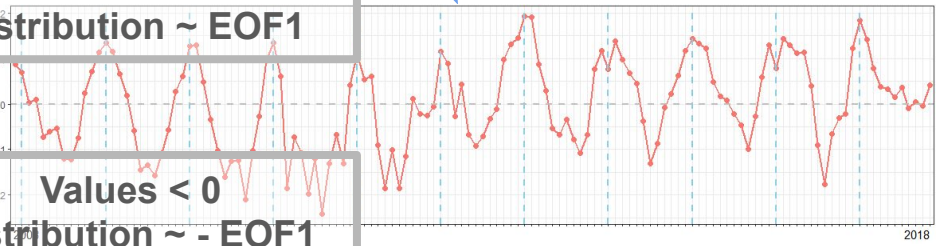
=

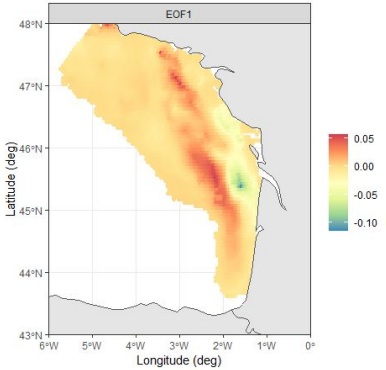
Spatial patterns capturing the maximum variability



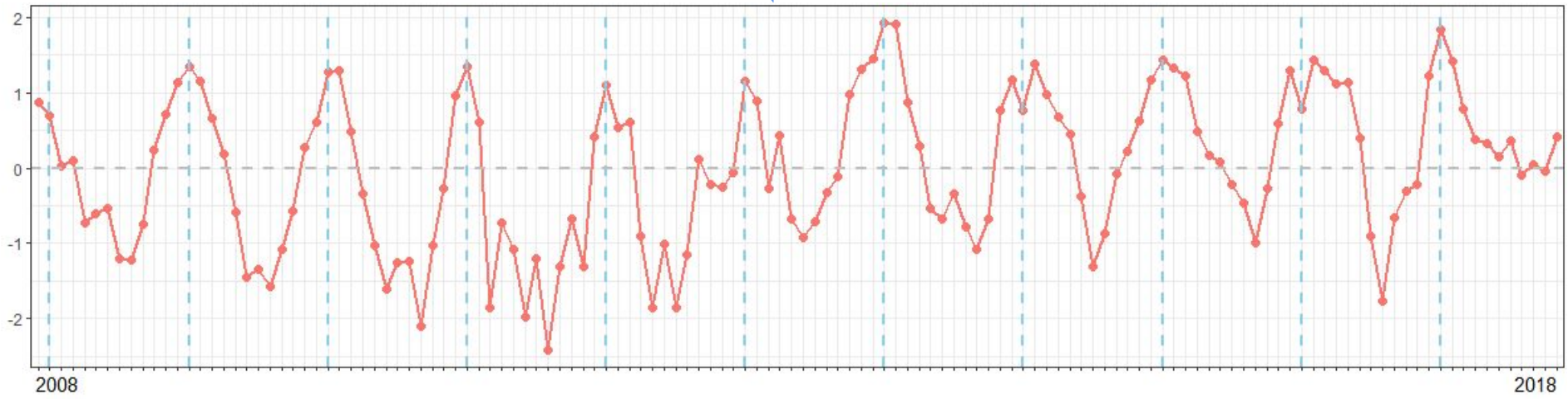
Values > 0
Distribution ~ EOF1

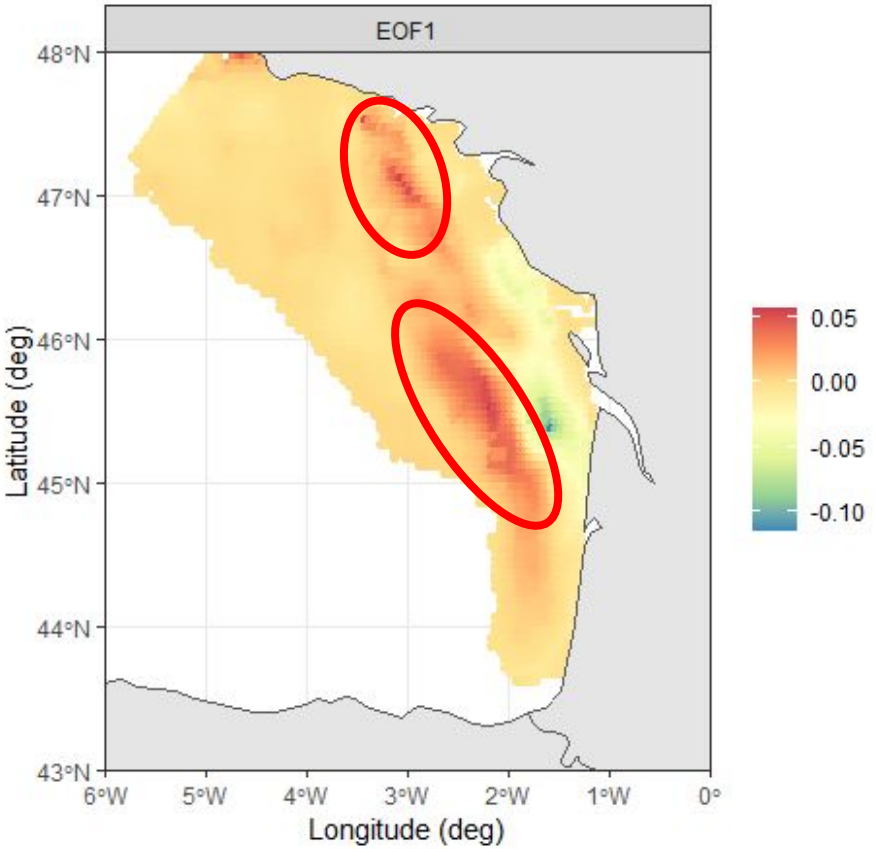
Values < 0
Distribution ~ - EOF1





Blue line : february ~ reproduction period of sole





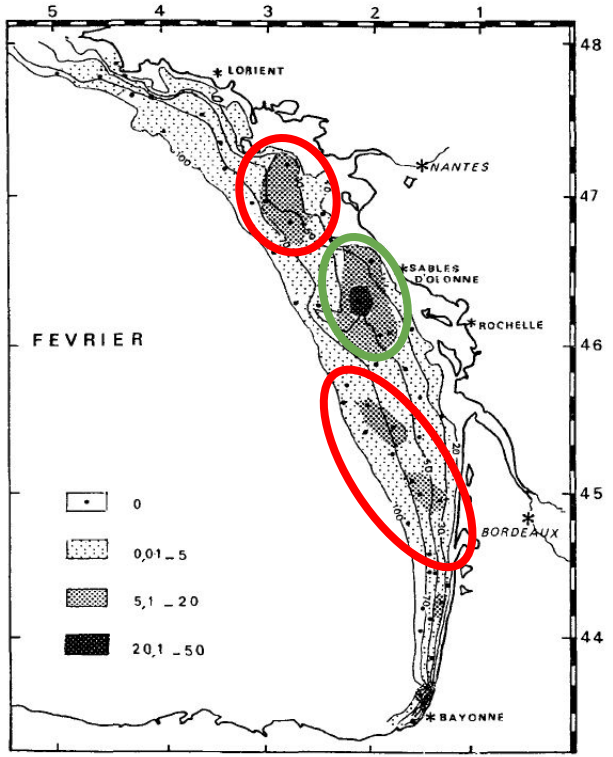
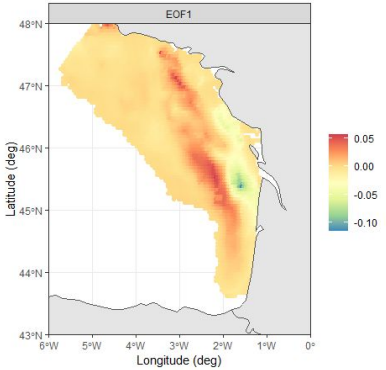


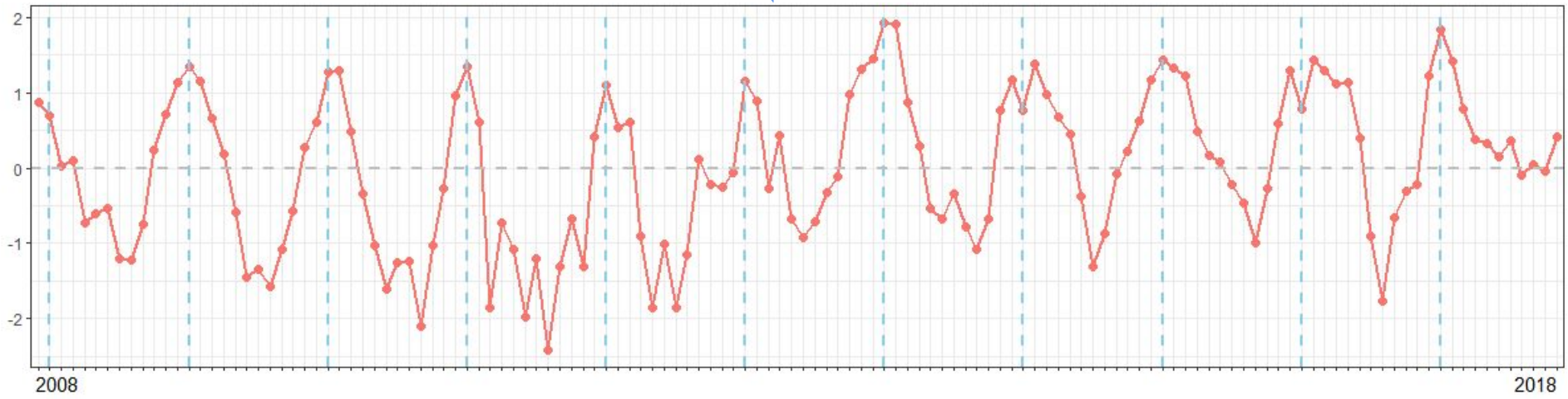
Fig. 2b

– en février (fig. 2b), la ponte s'est intensifiée. La zone de reproduction se situe au large de La Rochelle et des Sables d'Olonne (13 à 29 œufs/m²) sur des fonds de 30 à 50 mètres. A cette époque, les œufs sont répartis sur de nombreuses stations: on observe d'autres secteurs de concentration d'œufs entre Arcachon et la Gironde ainsi qu'au large de la Loire.

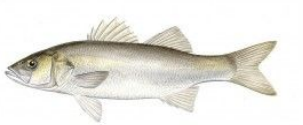


⇒ Evidence seasonal patterns
⇔ reproduction area / period

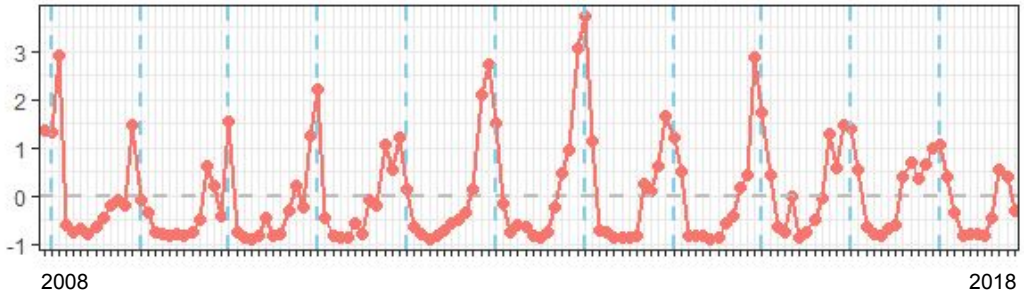
Blue line : february ~ reproduction period of sole

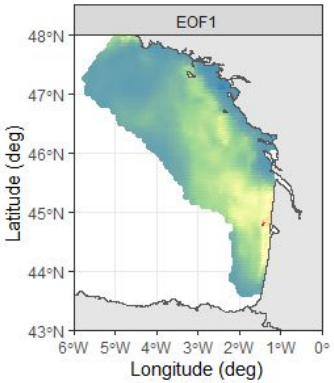


What about other species ?

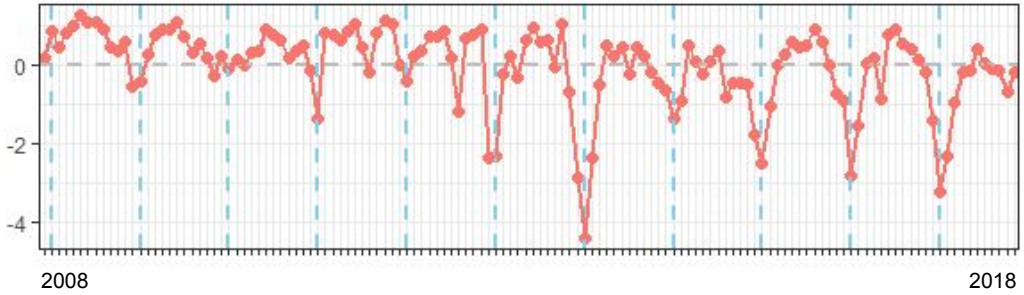


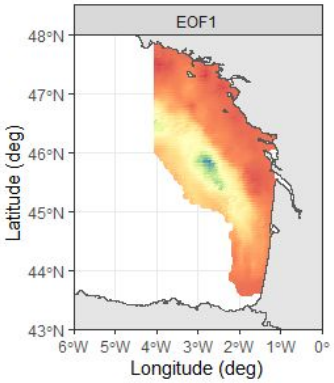
Sea bass





Hake

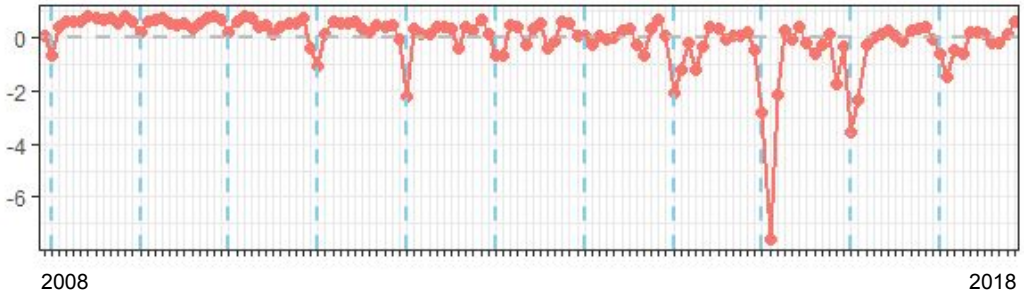


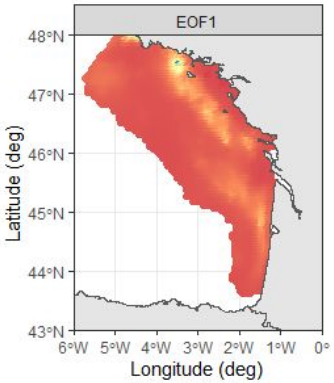


Blue line : february

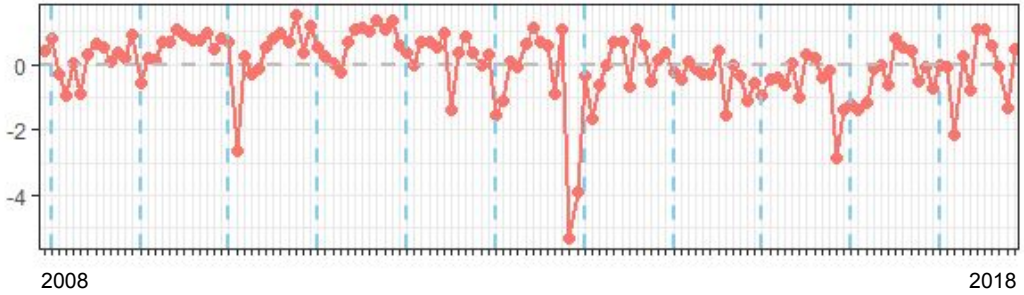
What about other species ?

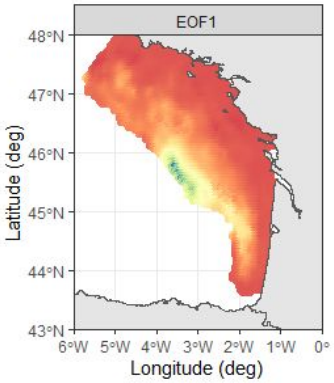
Whiting





Anglerfish





Blue line : february

- **Main conclusion**

  commercial data allow to identify main spatial patterns

  ⇔ reproduction ecology of species ?

- **Add other fleets in the model fitting**

- **Application to pelagic species ?**

- **Application to management (Marine Spatial Planning)**

  Which are the critical areas for populations renewal ? For fishers' income ?
  Based on these results, how to define fishery conservation areas ?

Thank you for your attention !