What controls the spatial distribution of spawning anchovy in the Bay of Biscay ?

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a multi-model approach

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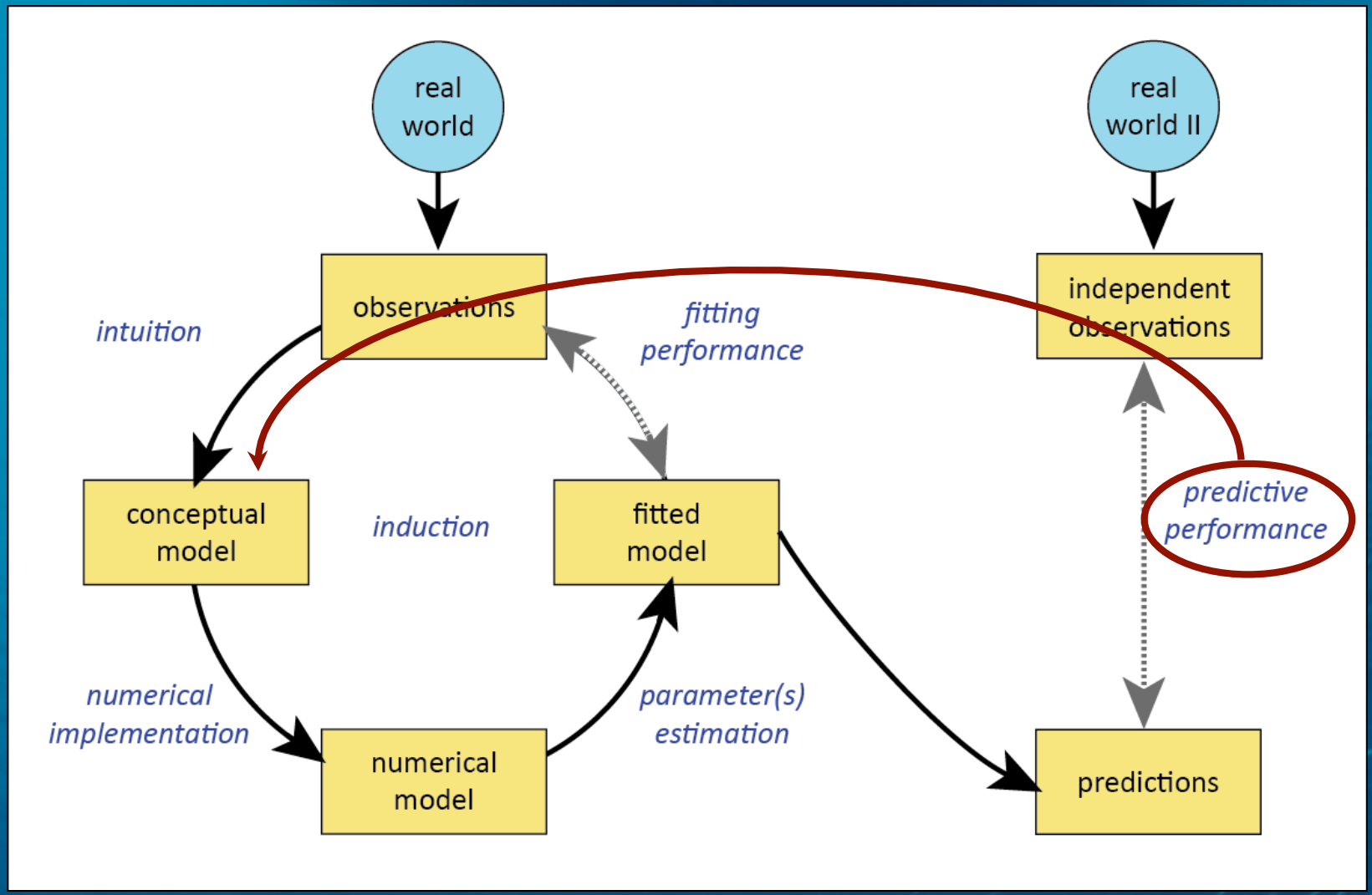
RECLAIM

A general view of the modelling method

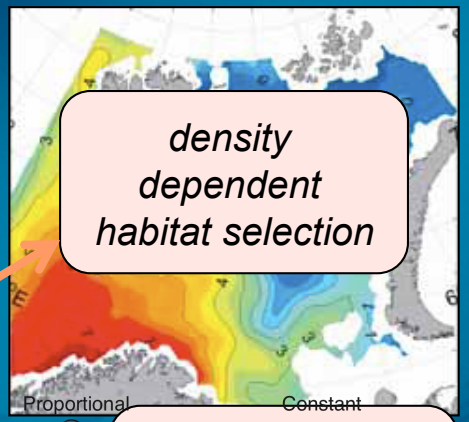


candidate conceptual models

environmental conditions

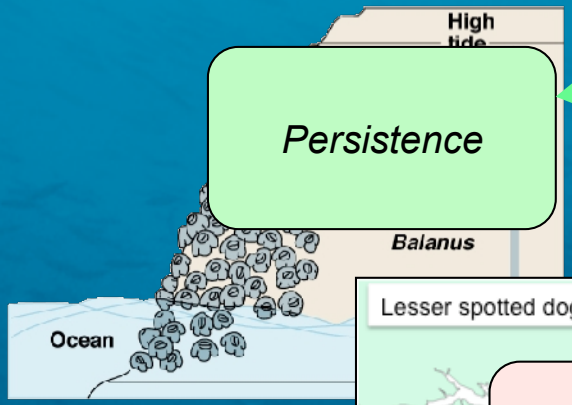
geographical attachment

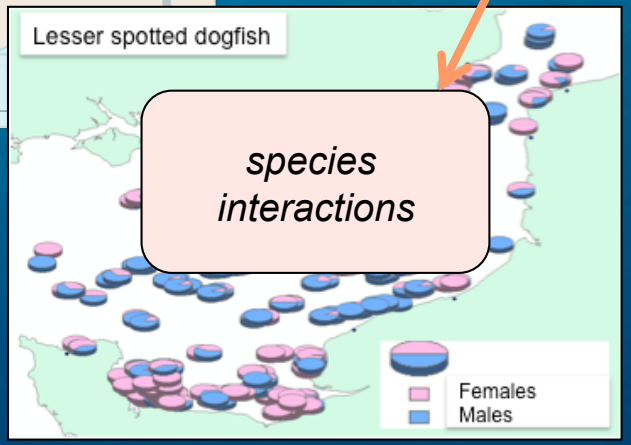
density dependent habitat selection



spatial distribution

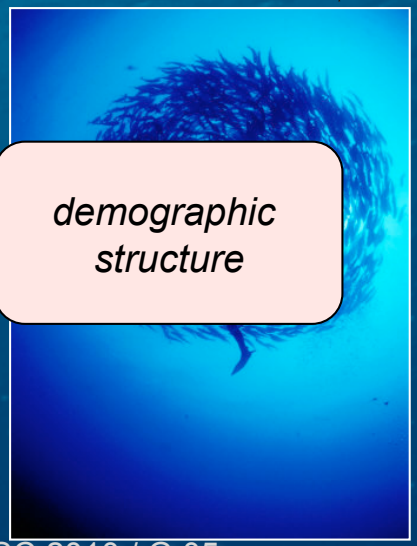
Persistence





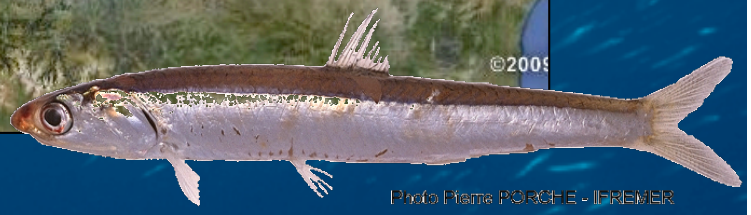
species interactions

demographic structure



Anchovy in the Bay of Biscay

- Smal pelagic fish
- Lives 3-4 years
- Spawn in spring
- Batch spawner



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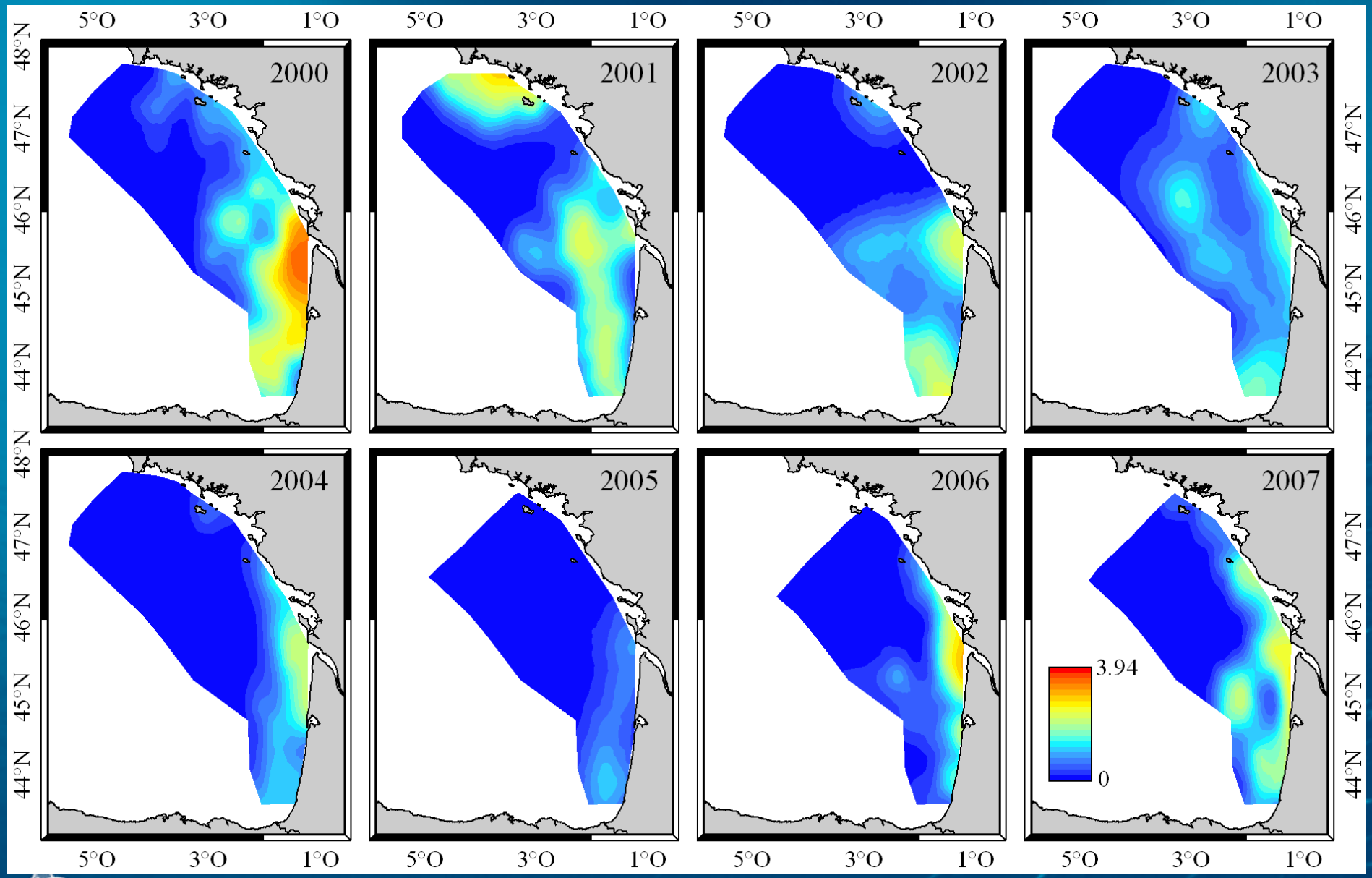
Observed distributions of spawning anchovy



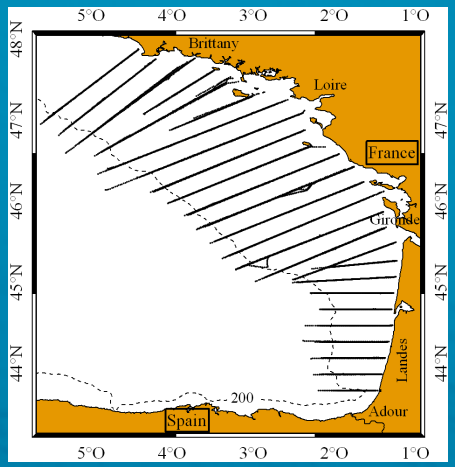
Candidate models, hypotheses and variables

Controls	Hypotheses	Variables
Site attachment	Geographical position	Knot of the grid
Environment	Environment 1	Front, Upwelling, DiffSal
	Environment 2	Pycnocline, Eddies, PrimProd
	Environment 3	PotEnerDef, SurfTemp, DiffTemp
	Environment 4	Depth, SalSurf, SalFond, MLD
	Environment 5	Bottom temperature
	Environment 6	Sediments
Spatial dependency	Broad scale	PCNM
	Medium scale	
	Small scale	
Density dependence	Population size	Annual SSB
Age structure	Annual structure	Annual proportions@age
	Spatial structure	Spatial proportions@age
Population persistence	Past distribution	local abundance in previous year

Available data on controlling variables

In situ data: PELGAS surveys 2000-2007

Day: Accoustic



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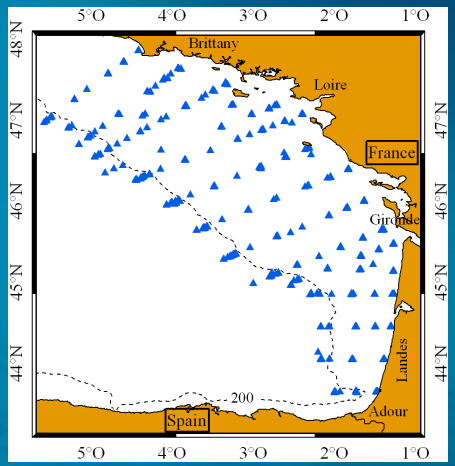
Night: CTD



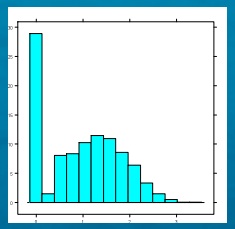
- Total abundances, abundances by age class
- Temperature, salinity, depth
- Mixed-layer depth, potential energy deficit

External data

- Spawning biomass (ICES WG ANC)
- Map of seafloor sediments
- Outputs of hydrodynamical model (MARS-3D): upwelling, frontal and eddies index, pycnocline depth, primary production

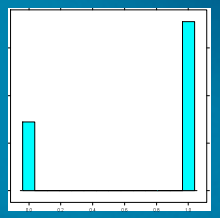
parallel modeling of spatial occupancy and local densities

Observed abundances =



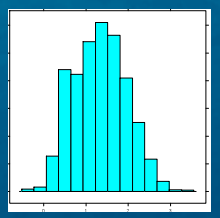
Binomial models

0/1 = Σ

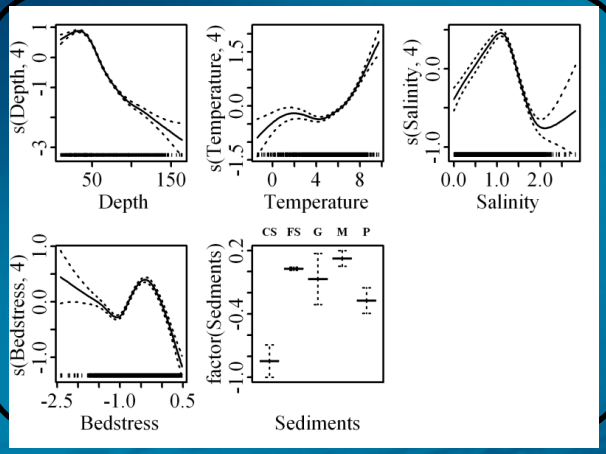


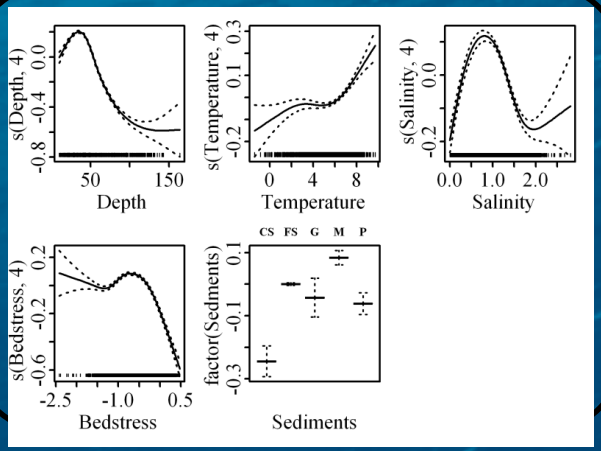
Gaussian models

$Log(Ab^{+}) = \Sigma$

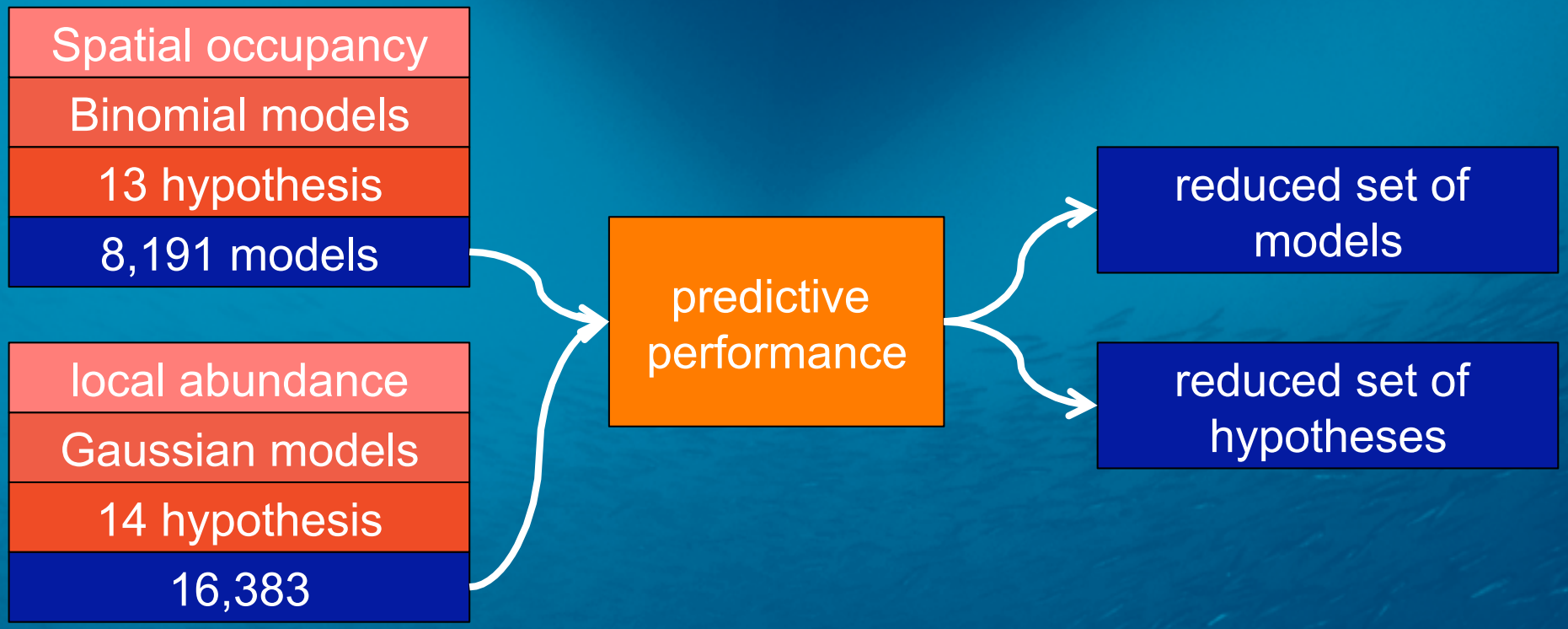


Smoothing functions

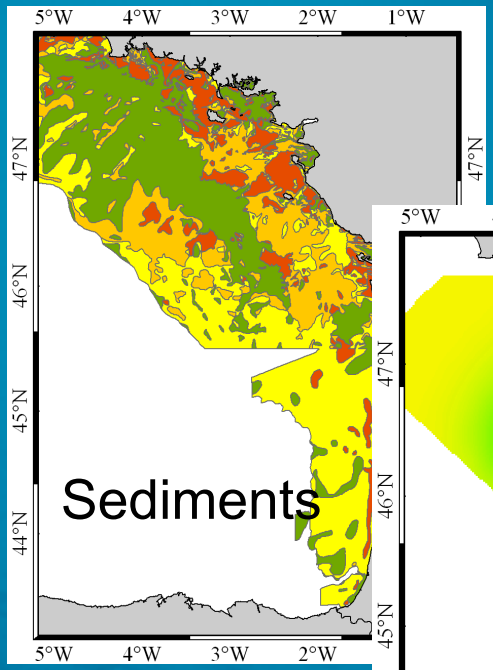


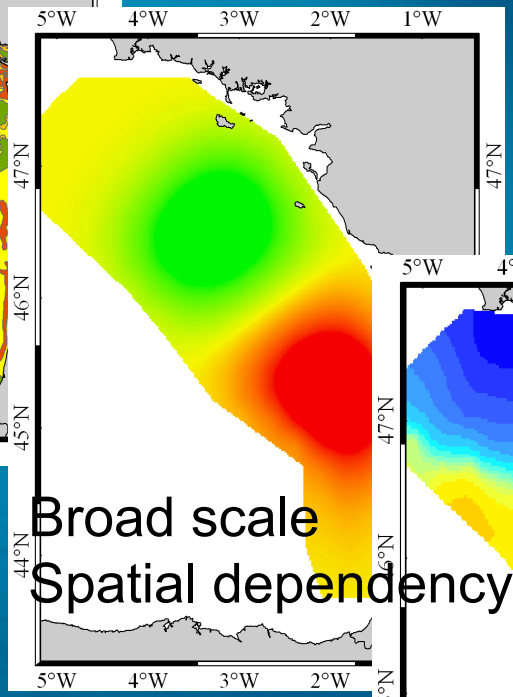


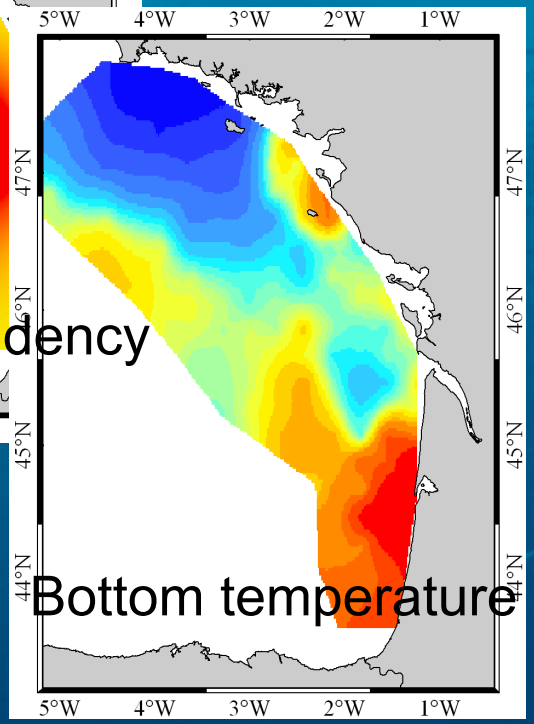
mutli-model selection

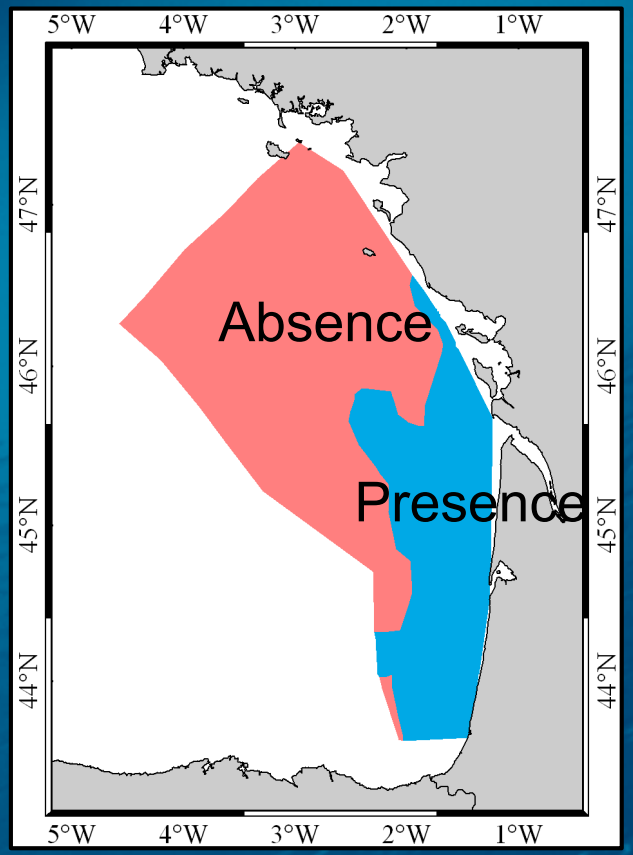


Results (1): controls of spatial occupancy

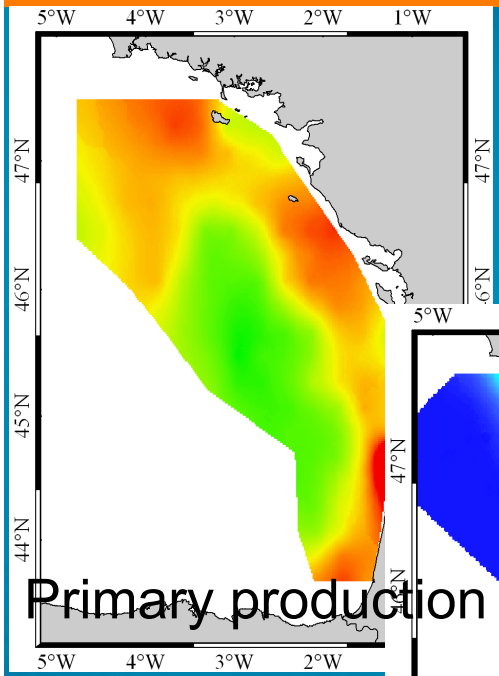




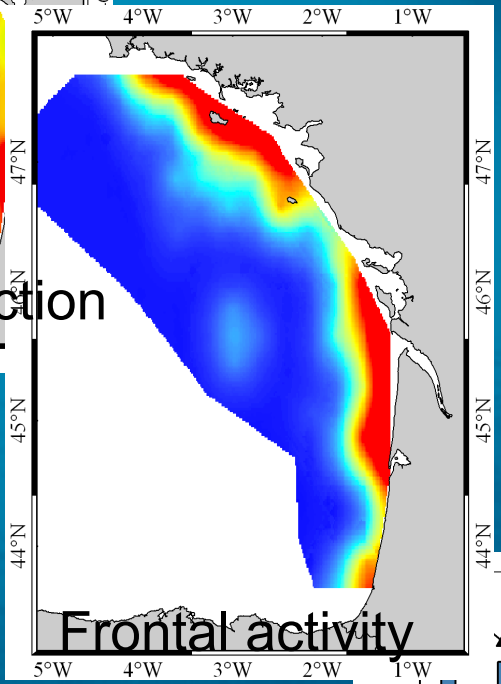




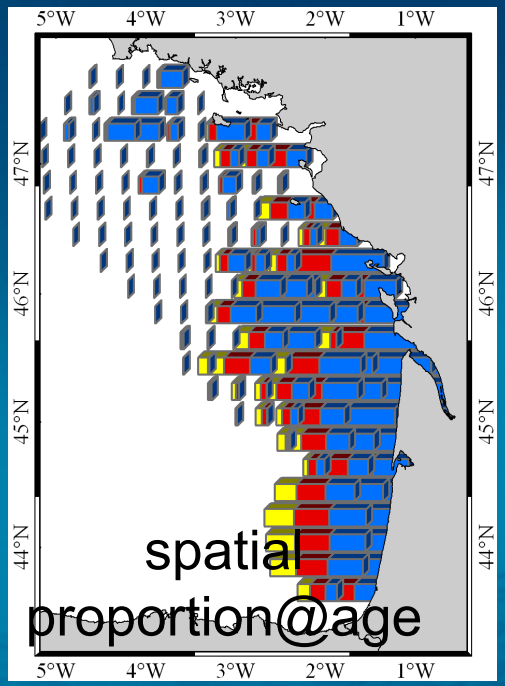
Results (2): controls of local abundance



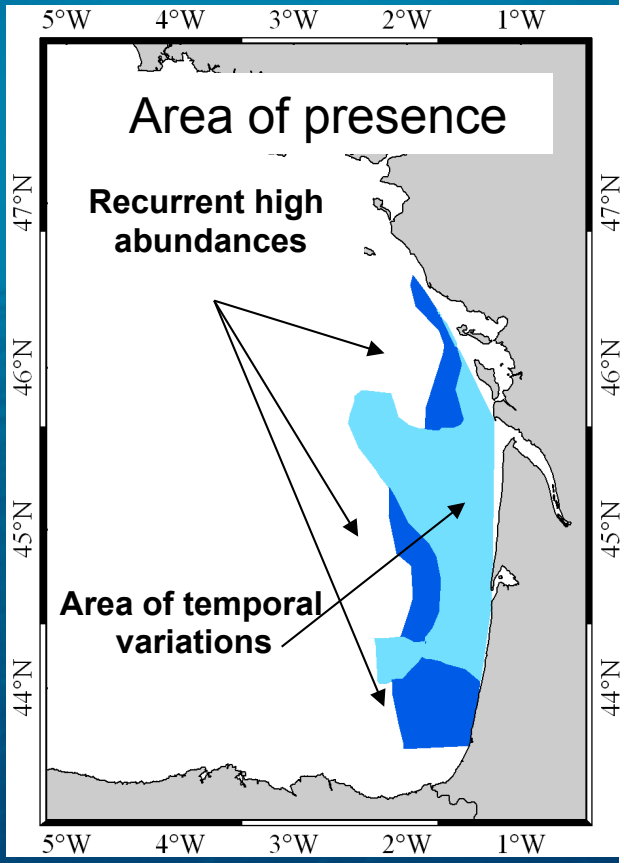
Primary production

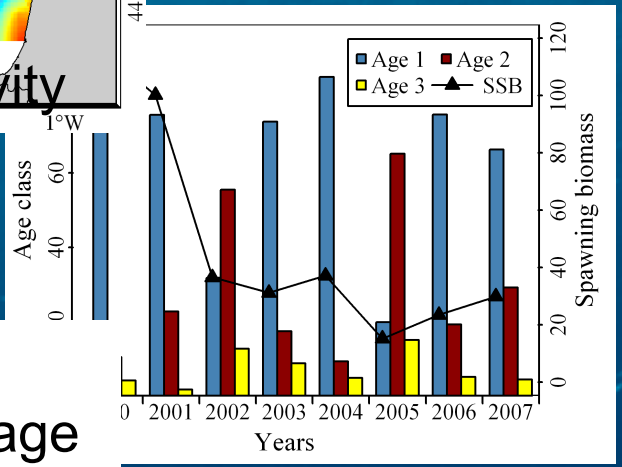


Frontal activity



spatial proportion@age





annual proportion@age

Conclusions (1)

- Spatial occupancy and local abundance can be predicted from several processes of different nature
- spatial occupancy can be predicted by
  - bottom temperature (i.e. below thermocline)
  - sediment types (reflecting average water column conditions)
  - spatial dependency
- local abundances can be predicted by
  - trophic environment: areas of food production and concentration (fronts) for adults' feeding
  - population demographic structure

Conclusions (2)

- The multi model approach presented here provides a workable framework for evaluating competing conceptual models of species distributions
- A number of limitations remain:
- predictive performance is not equivalent to process understanding
- Even if the conceptual models are correct, we found that conceptual uncertainty can be reduced but not fully resolved
- projections of spatial distribution under scenarios should account for the remaining conceptual uncertainty

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