Ecological Geography of the Mediterranean Sea

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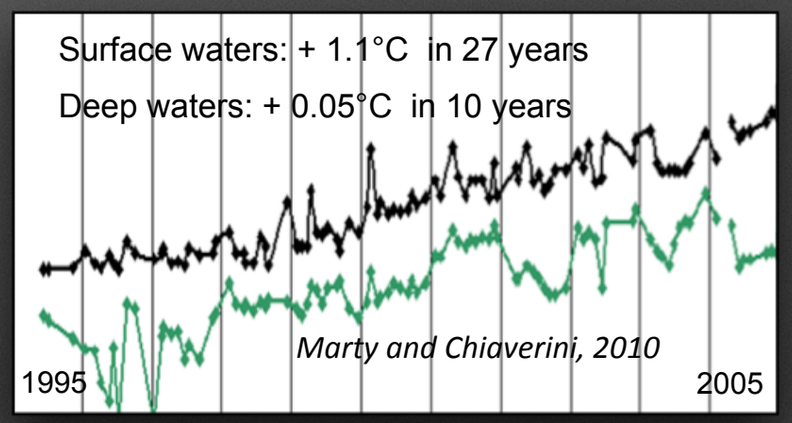
Context of the study

- A complex coupled system (Mermex group, 2011)

- A biotope in mutation:
. Climate change
. Increasing anthropogenic pressures



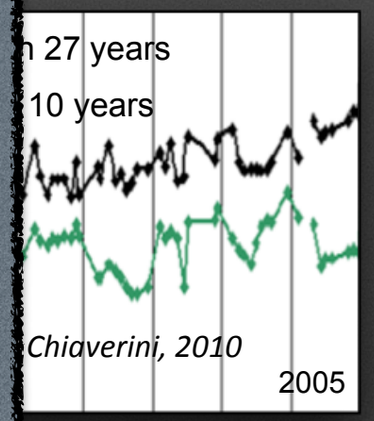
- An important endemism of marine species and emblematic species already **endangered**

Context of the study

Tools for conservation and ecosystem management are needed

- A complex (
  2011)

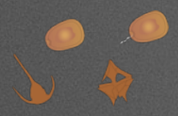
- A biotope ir
. Climate cha
. Increasing anthropogenic pressure



- An important endemism of marine species and emblematic species already **endangered**

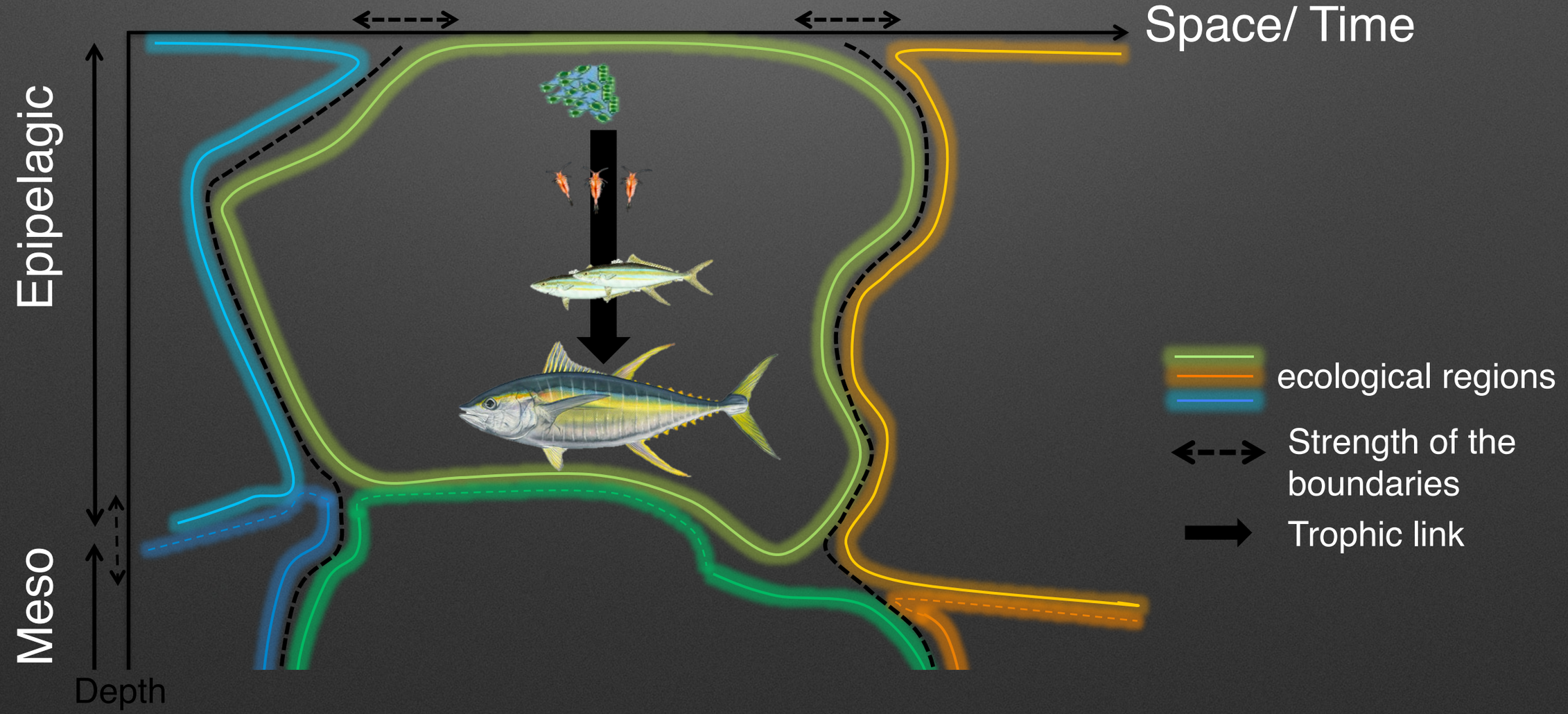
Objectives

1) **Evaluate the ecosystems characteristics of the Mediterranean sea**

+ from  **to** 

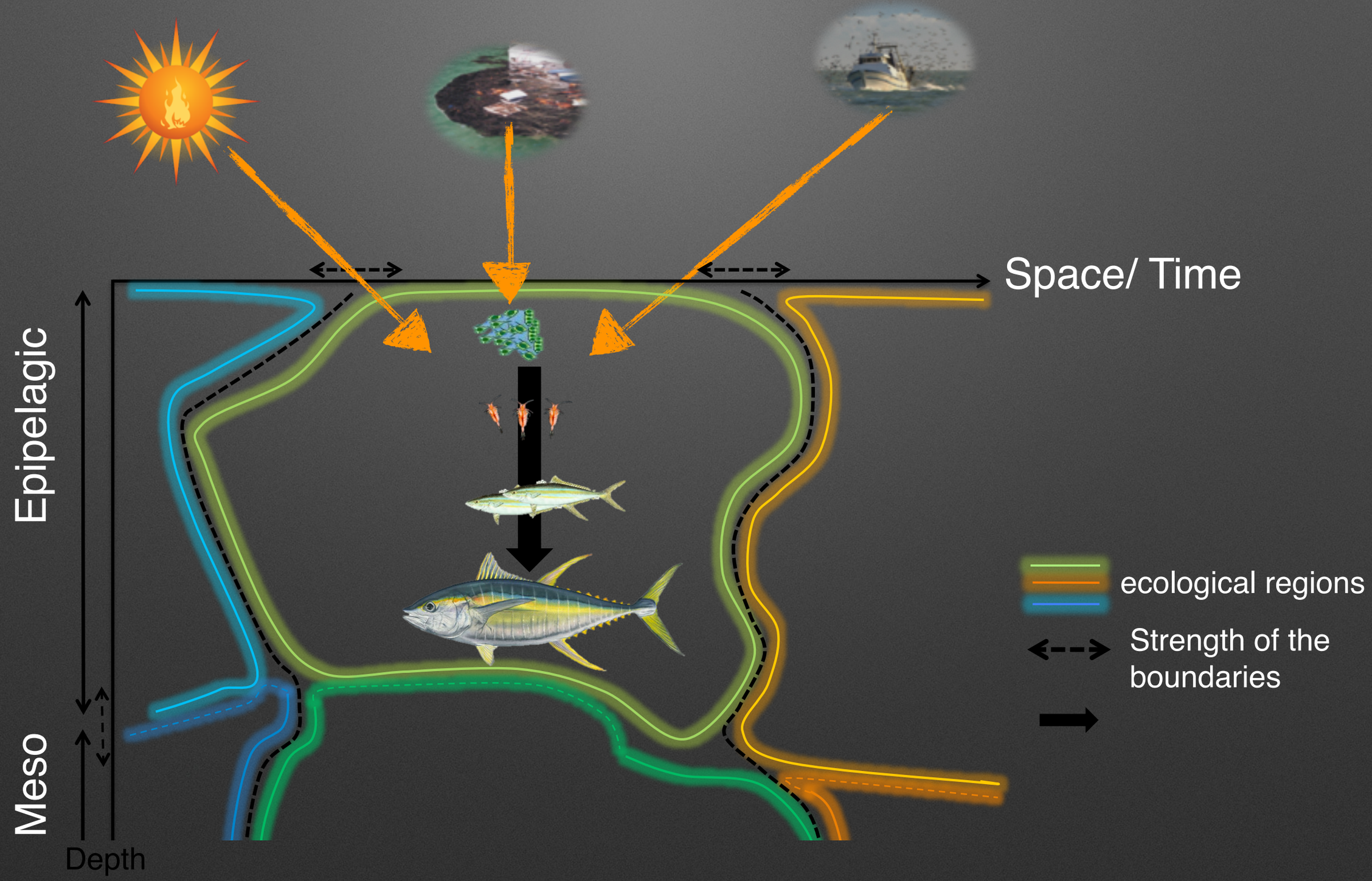
+ Quantify the biodiversity and ecological traits patterns

An ecological division of the mediterranean sea



Objectives

2) Quantify the main **anthropogenic pressures for each ecosystem**



Materials : Environmental conditions

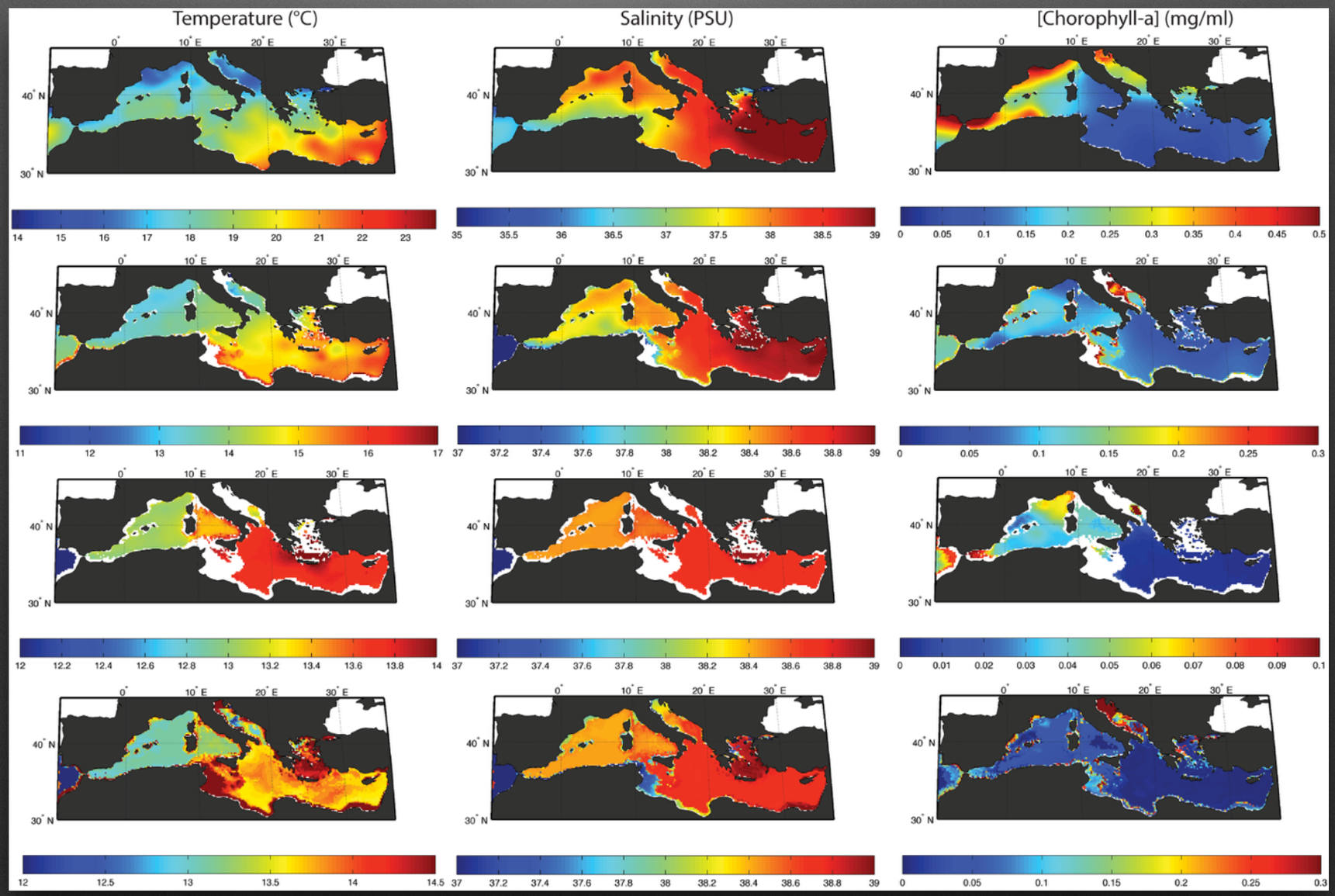
Environmental conditions for each layers (annual mean)

Epipelagic

Mesopelagic

bathypelagic

Seafloor

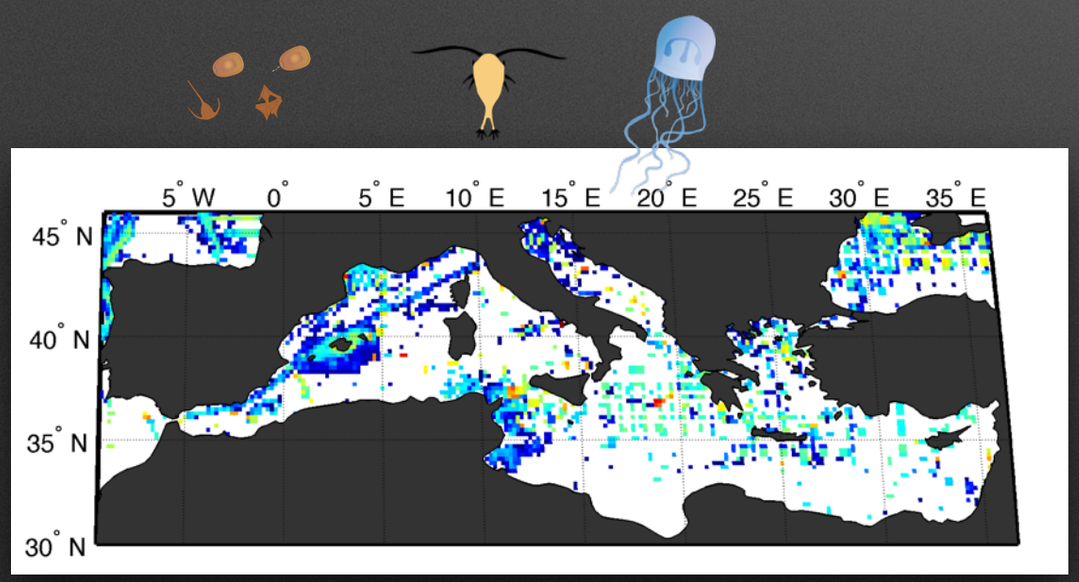


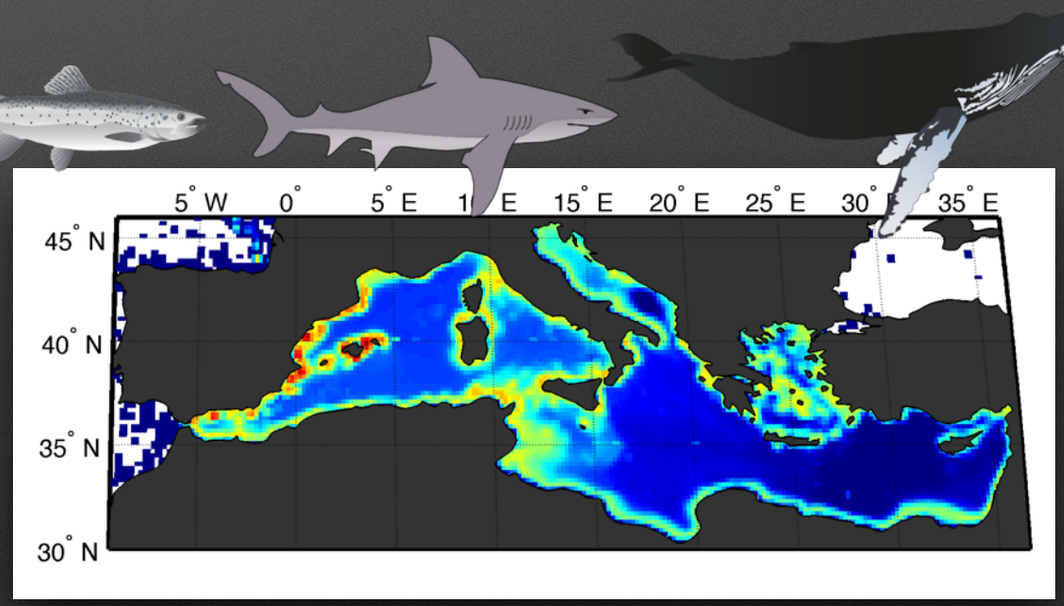
Also : [NO3], [PO4] , [SiO2], [Oxygen], pH, MLD, Thermocline depth and intensity, Wind stress, Euphotic depth

Materials : Biological observations

Gather all biological informations from:

+ International database (Obis, Gbif, Pangea …)
+ Atlas (fisheries and mammals distributions)
+ Online campaign (Sesame)
+ pers. com (Publications)





Materials : Biological observations

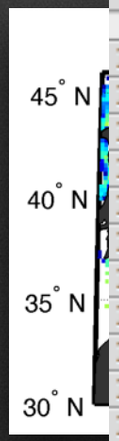
Gath
+ Int
+ Atl
+ Or
+ pe

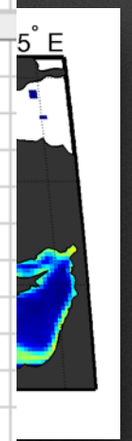
Number of observations:
> 20.000.000 presence

Number of species (sp. and spp.)
>2000

Mean trophic level, mean size, depth range and ecology are retrieved for each species

	A	B	C	D	E	F	G	H
1	name (genus_species) if not informed	size min (mm)	size max (mm)	Trophic Level (see Fishbase)	depth range min	depth range max	Habitat	zone PELAGIQUE
1066	Lepadogaster_purpurea	NaN	75	3.3	1	20	BENTHIC	SEAFLOOR
1067	Lepidion_guentheri	NaN	810	3.6	750	800	DEMERSAL	SEAFLOOR
1068	Lepidion_lepidion	150	300	3.6	150	2000	DEMERSAL	SEAFLOOR
1069	Lepidopus_caudatus	1800	2100	3.8	30	400	PELAGIQUE	MESOPELAGIQUE
1070	Lepidorhombus_boscii	300	400	3.7	150	400	BENTHIC	SEAFLOOR
1071	Lepidorhombus_whiffiagonis	425	600	4.2	50	400	BENTHIC	SEAFLOOR
1072	Lepidotrigla_cavillone	115	200	3.2	30	450	BENTHIC	SEAFLOOR
1073	Lepidotrigla_dieuzeidei	100	150	3.7	60	250	BENTHIC	SEAFLOOR
1074	Lestidiops_jayakari_jayakari	NaN	NaN	4.2	50	2000	PELAGIQUE	BATHYPELAGIQUE
1075	Lestidiops_sphyrenoides	NaN	NaN	4.5	50	600	PELAGIQUE	MESOPELAGIQUE
1076	Lesueurigobius_friesii	50	100	3.2	10	130	BENTHIC	SEAFLOOR
1077	Lesueurigobius_sanzi	NaN	NaN	3.6	40	100	BENTHIC	SEAFLOOR
1078	Lesueurigobius_suerii	50	80	3.5	20	100	BENTHIC	SEAFLOOR
1079	Leucoraja_circularis	700	1200	3.5	70	250	BENTHIC	SEAFLOOR
1080	Leucoraja_fullonica	950	1150	3.5	100	400	BENTHIC	SEAFLOOR
1081	Leucoraja_melitensis	NaN	NaN	3.3	60	600	BENTHIC	SEAFLOOR
1082	Leucoraja_naevus	650	720	3.9	50	200	BENTHIC	SEAFLOOR



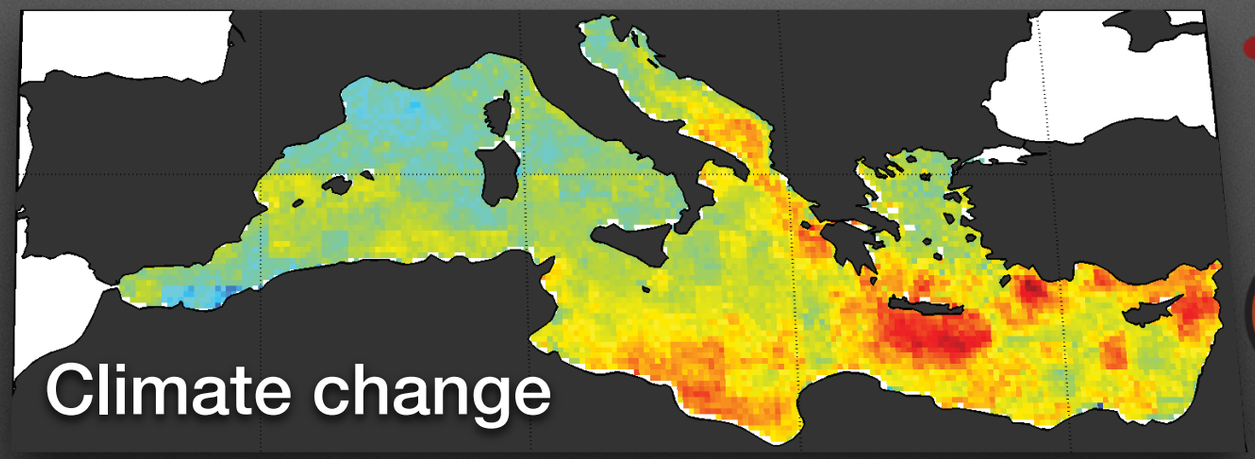


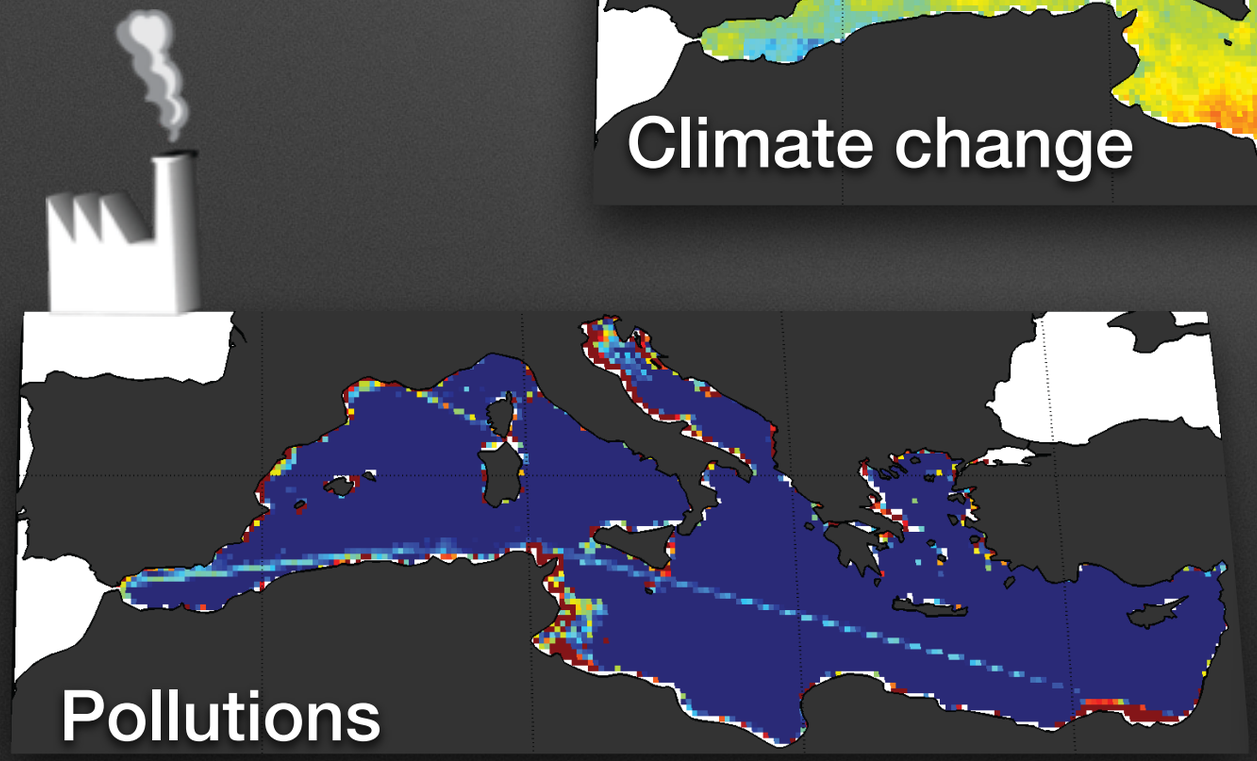
Materials : Anthropogenic pressures

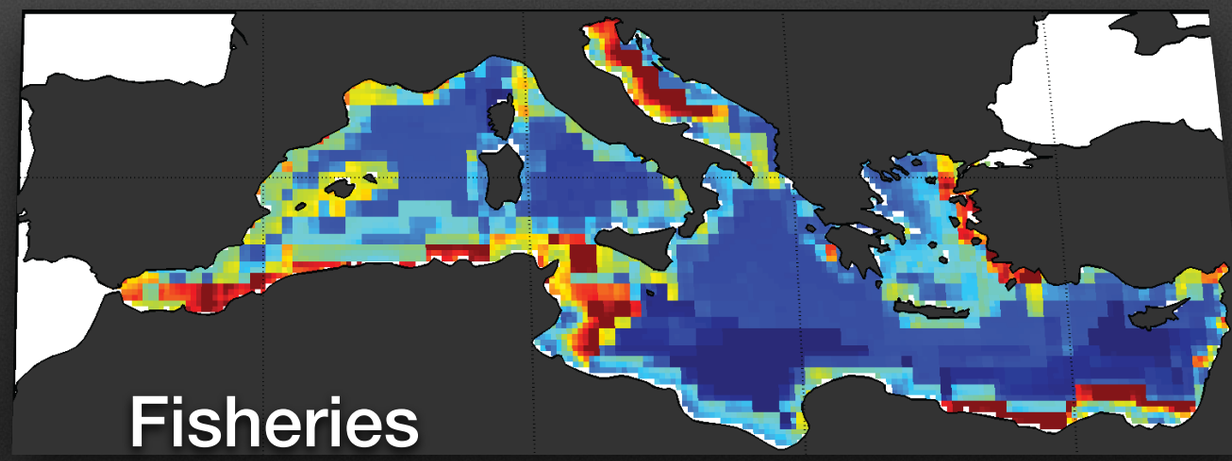
Human pressures are gathered:

+ Halpern et al. (2008) and Coll et al. (2010)
+ IUCN (2013)

14 Parameters gathered and summarized into 3 categories:

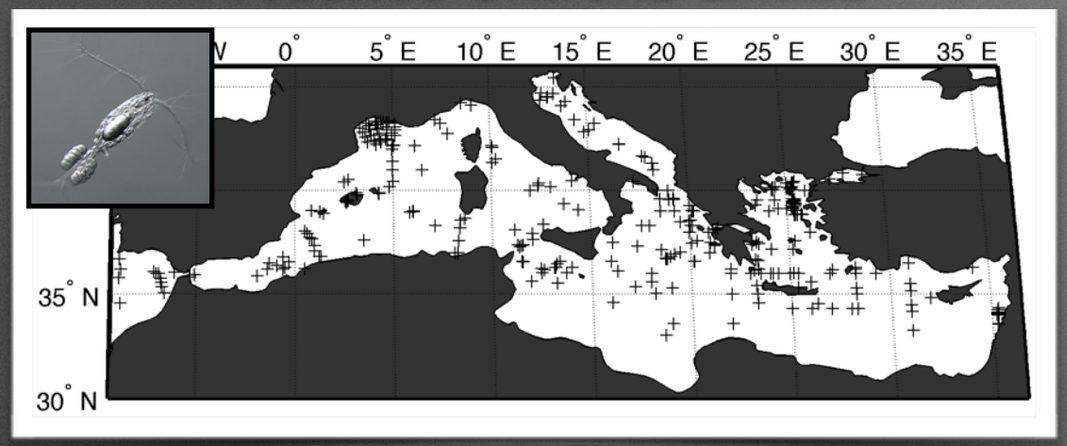






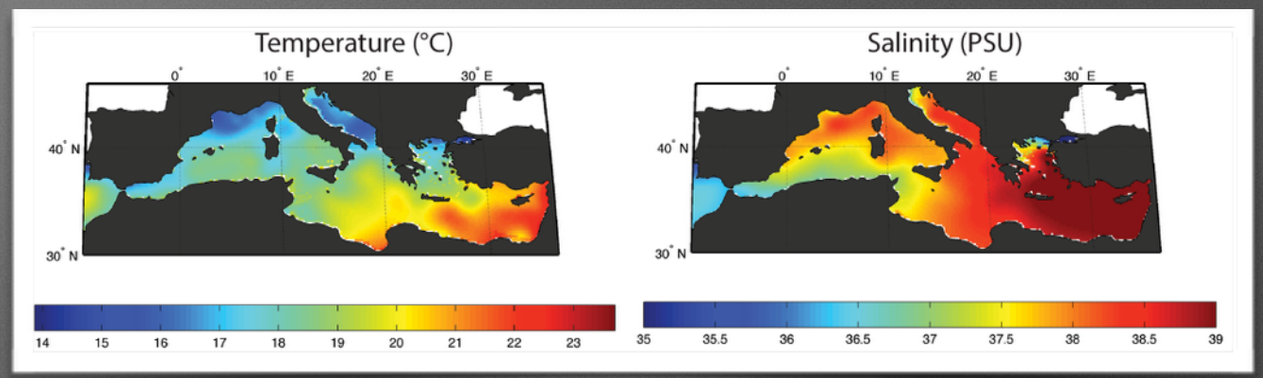
Methods: spatial distribution models

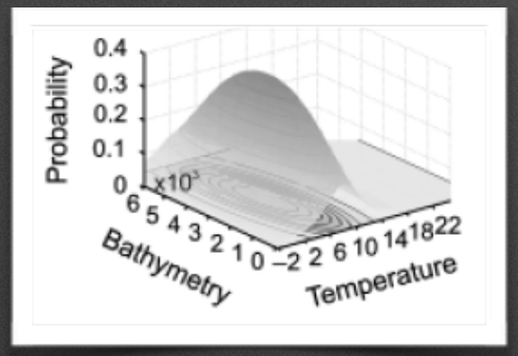
Presence Oithona similis



+

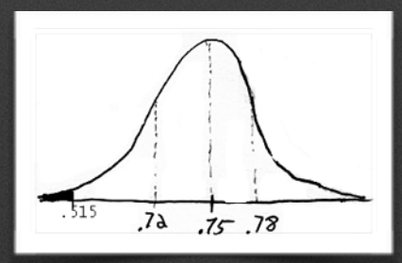
Best Environmental parameters and layer





Six environmental niche models (Hutchinson,1957) used: Enfa, Gower, NPPEN, Maxent, GARP, BioClim

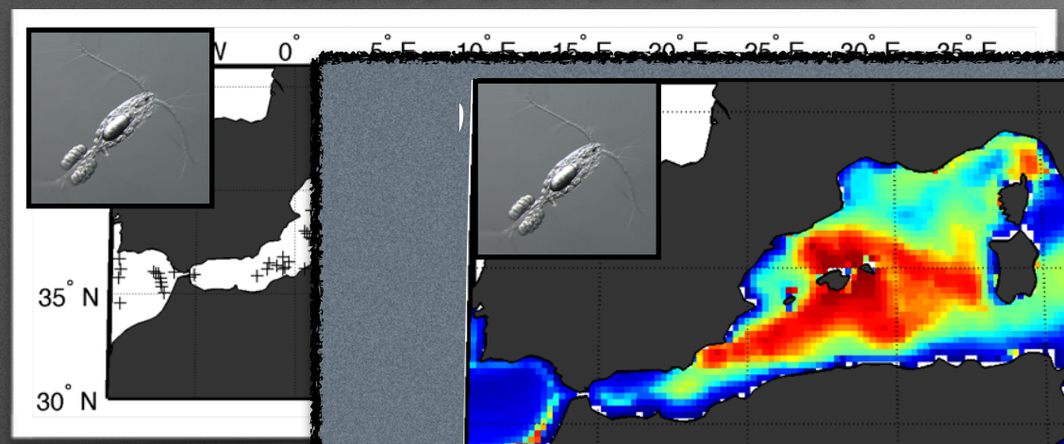
Index of Hirzel et al. (2006) to evaluate the probability of presence for each model and species + Expert knowledge

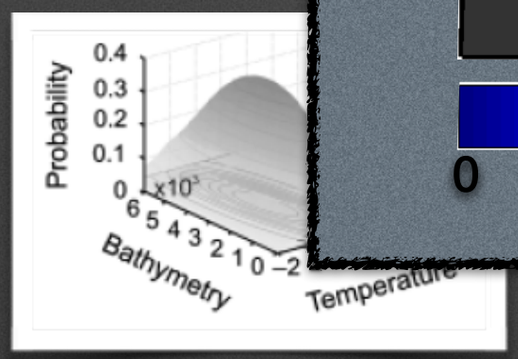


Model averaging weighted by Hirzel index

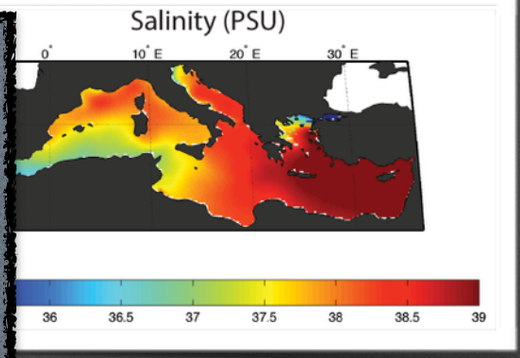
Methods: spatial distribution models

Presence Oithona similis



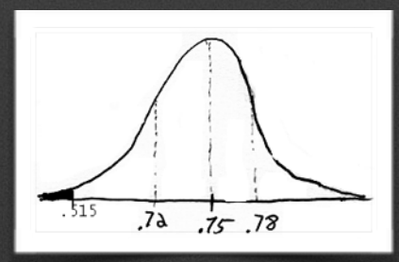


Best Environmental parameters and layer



inson,1957)
RP, BioClim

Index of Hirzel et al. (2006) to evaluate the probability of presence for each model and species + Expert knowledge

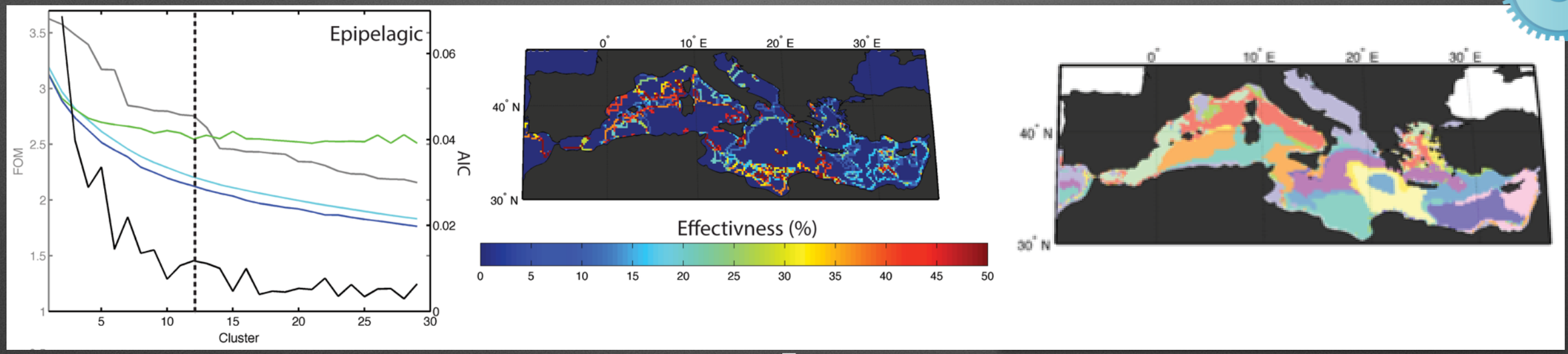


Model averaging weighted by Hirzel index

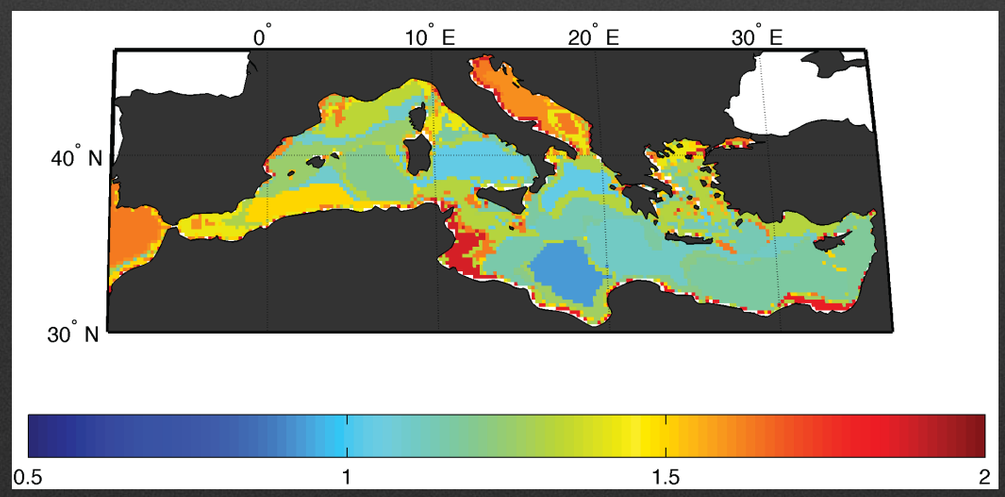
Methods: Ecoregionalisation

Step 1 : Spatial distribution of each species at a given or all trophic level

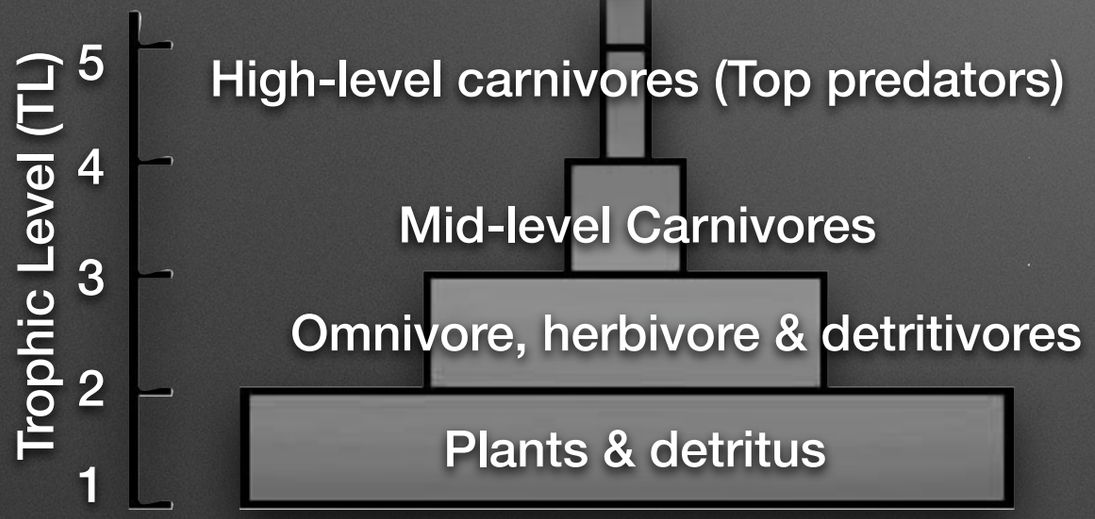
Step 2 : Objective Multi Agglomerative Hierarchical Analysis (OMAHA)

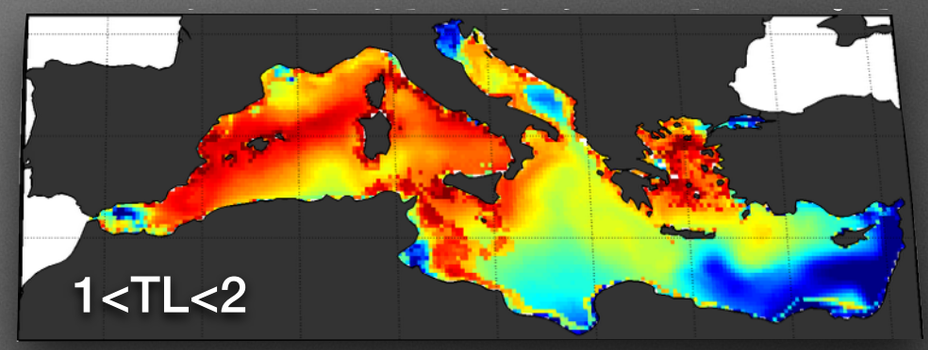


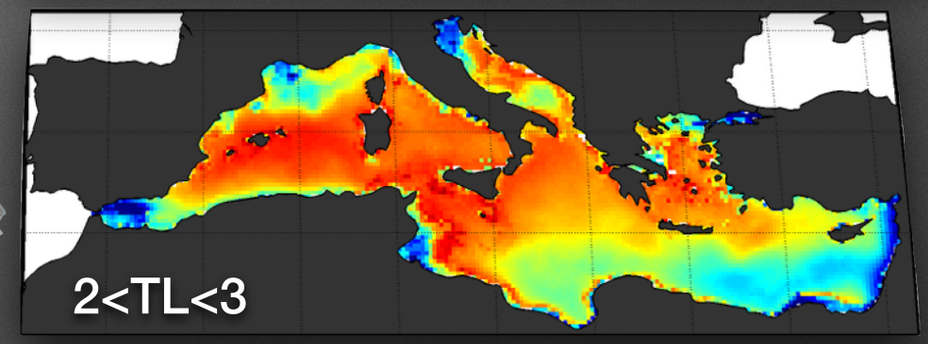
Step 3 : Quantification of the mean anthropogenic pressure per ecoregion

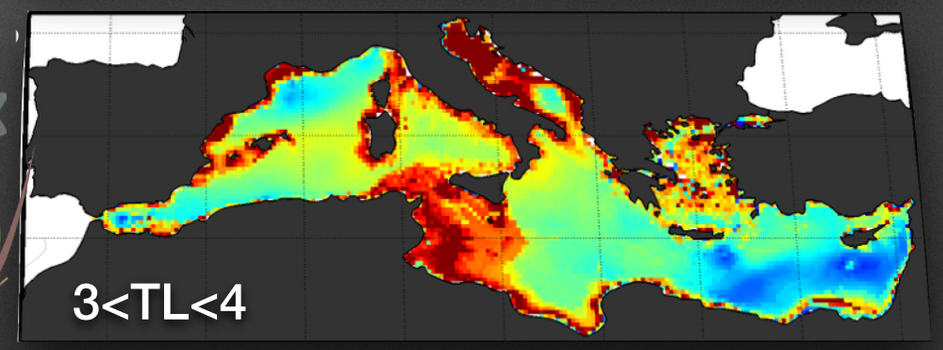


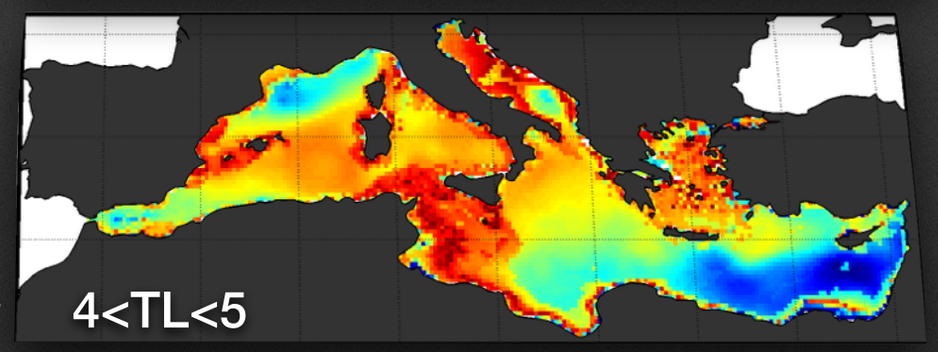
Biodiversity of the Mediterranean sea











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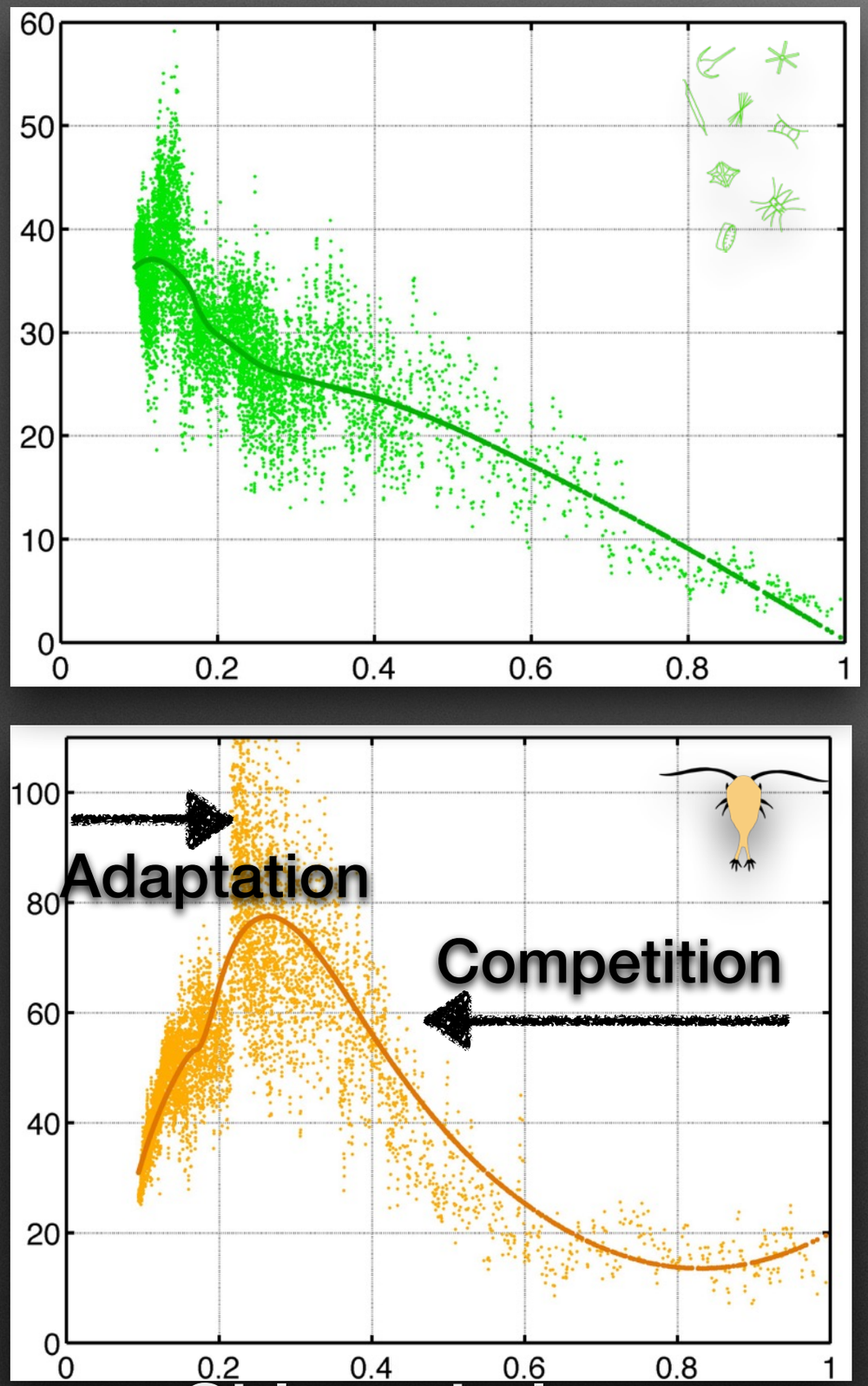
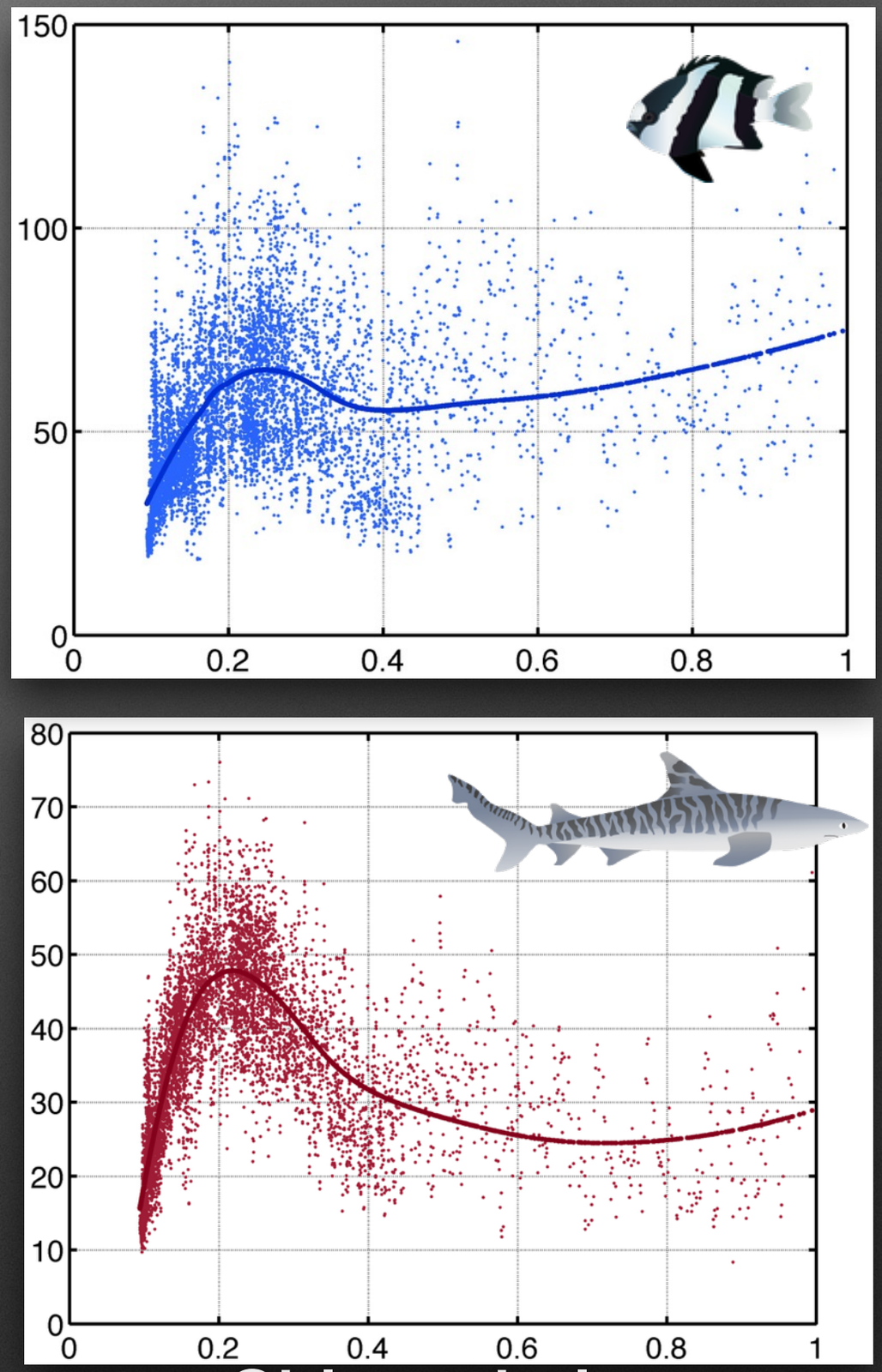
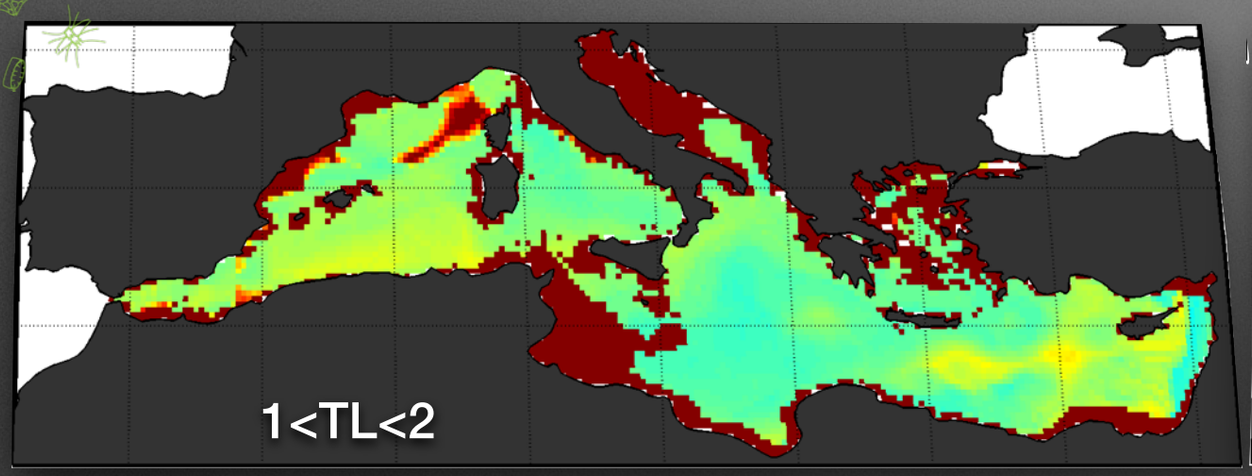


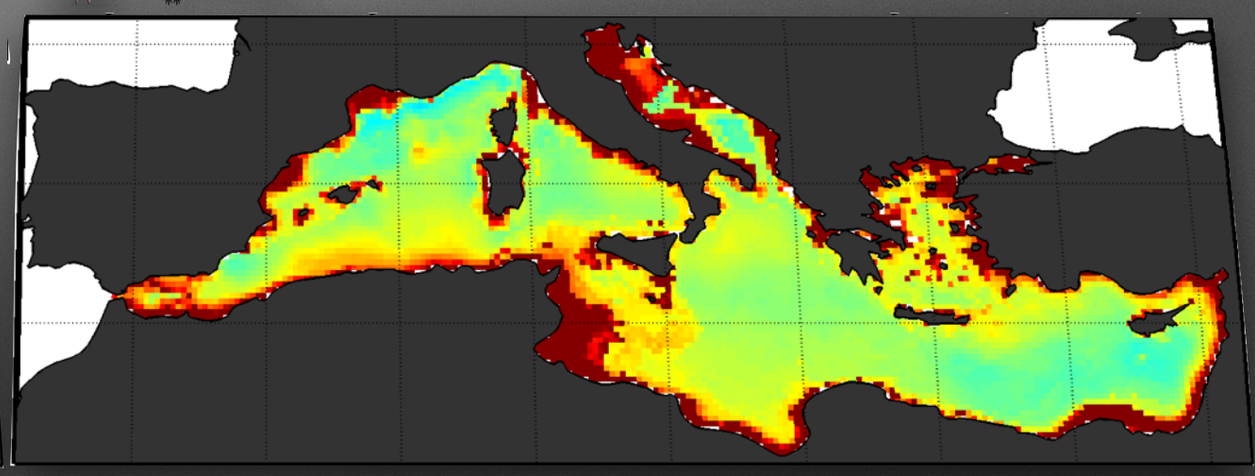


Ecological traits of the Mediterranean sea

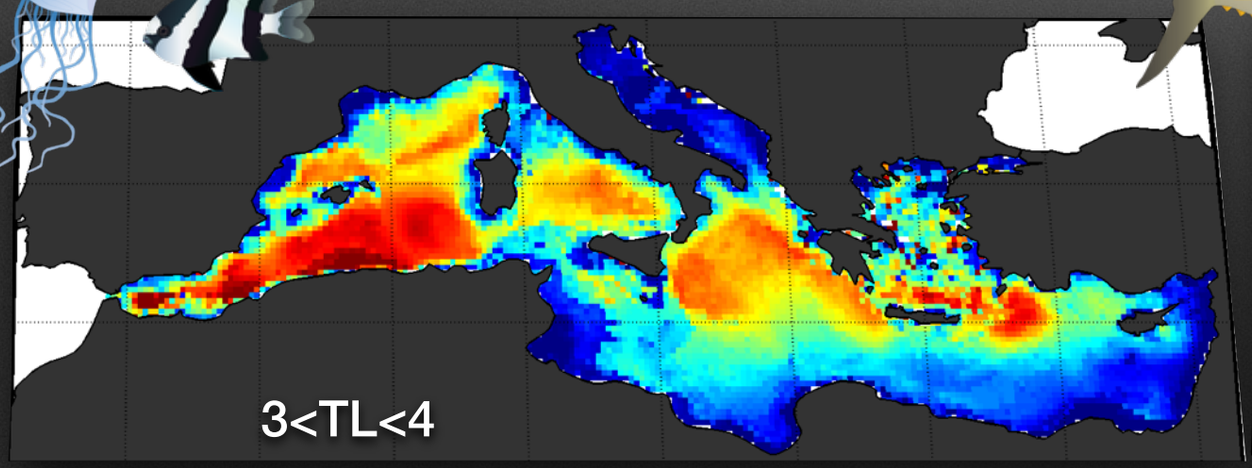
Mean size of each trophic level



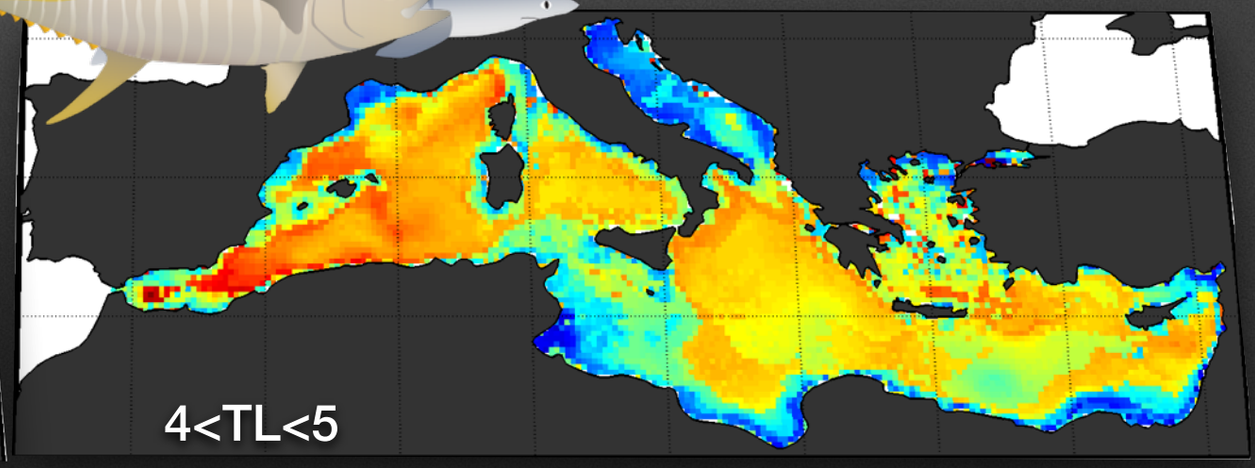
0 mm 0.1



0.1 mm 40

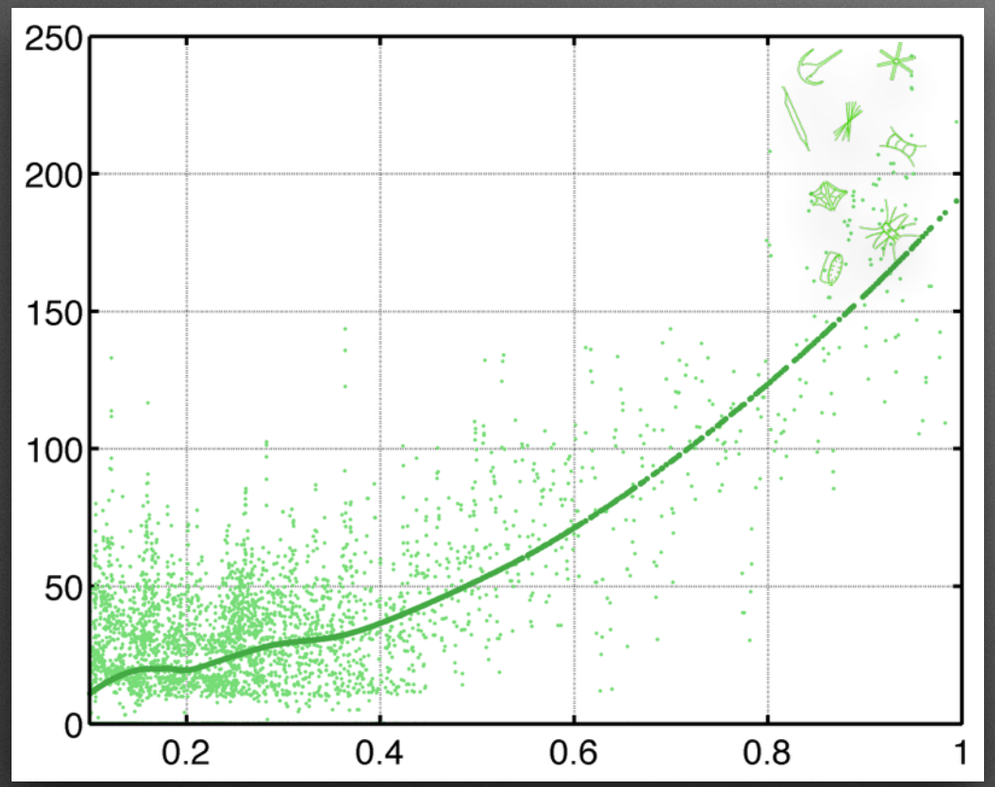


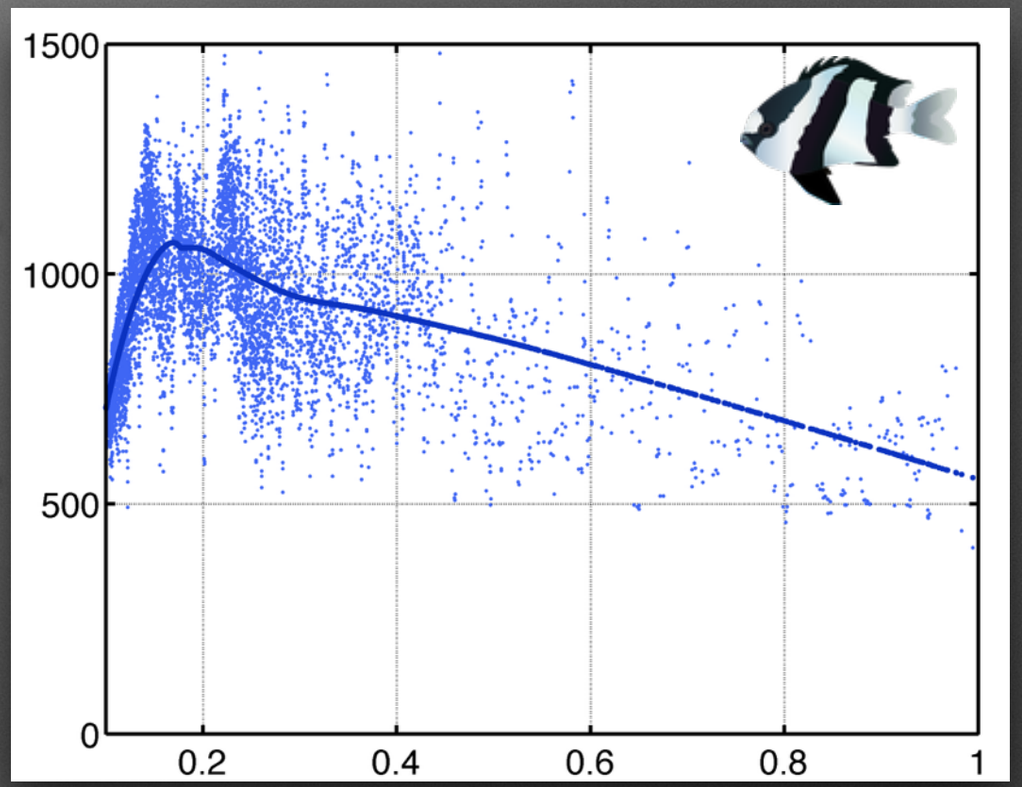
500 mm 1500

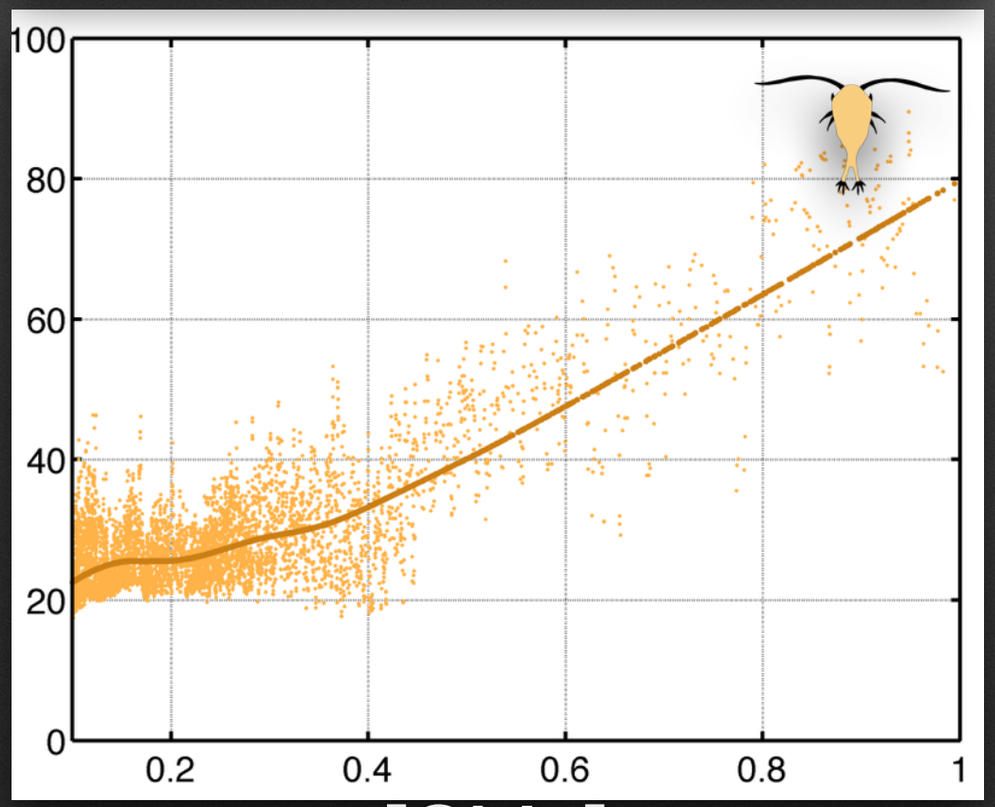


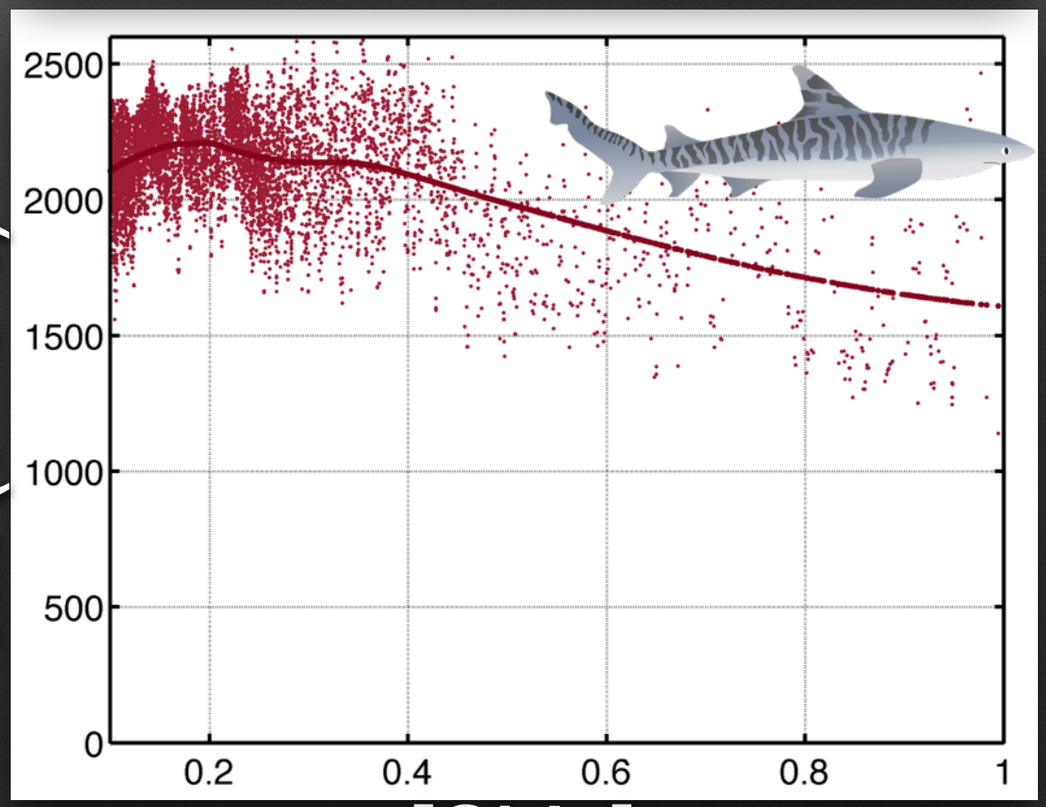
1000 mm 3000

Ecological traits of the Mediterranean sea



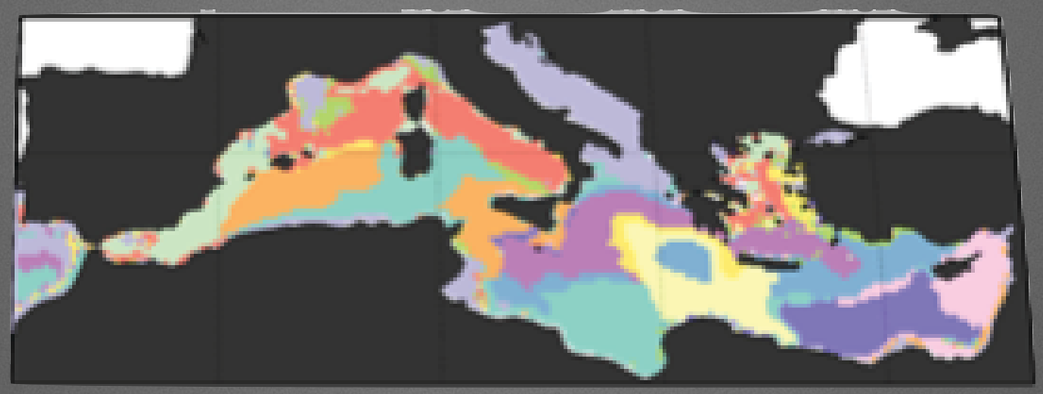


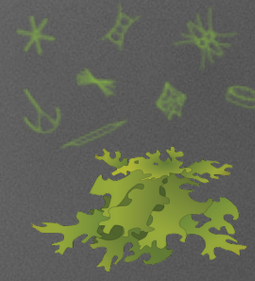




Communities of the Mediterranean sea

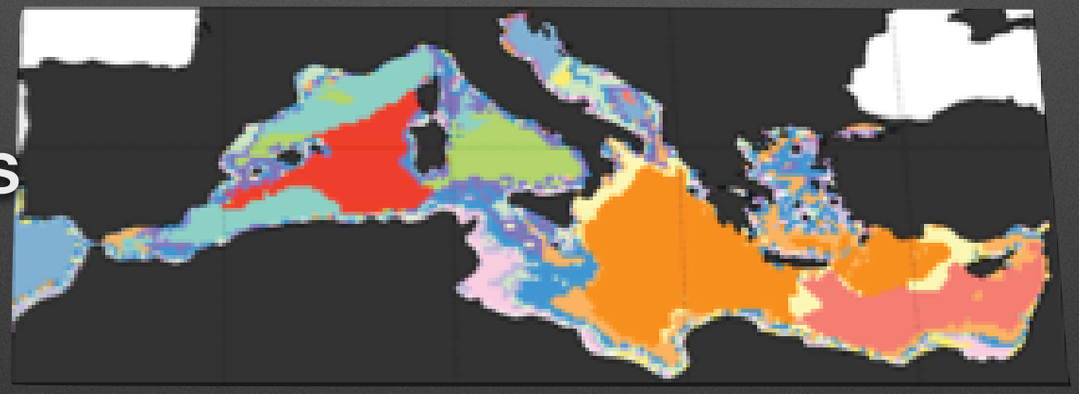
Primary producers communities



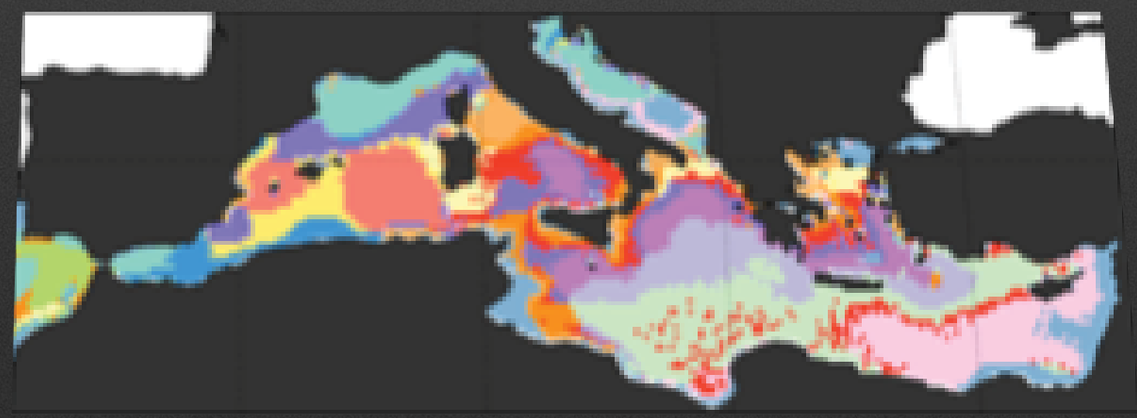


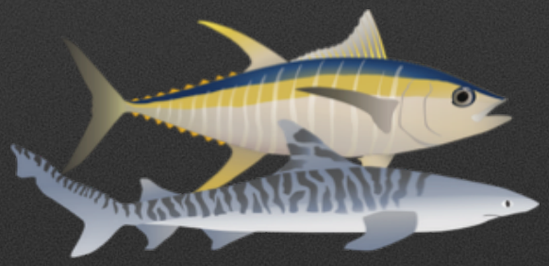
Primary consumers communities

Secondary consumers communities

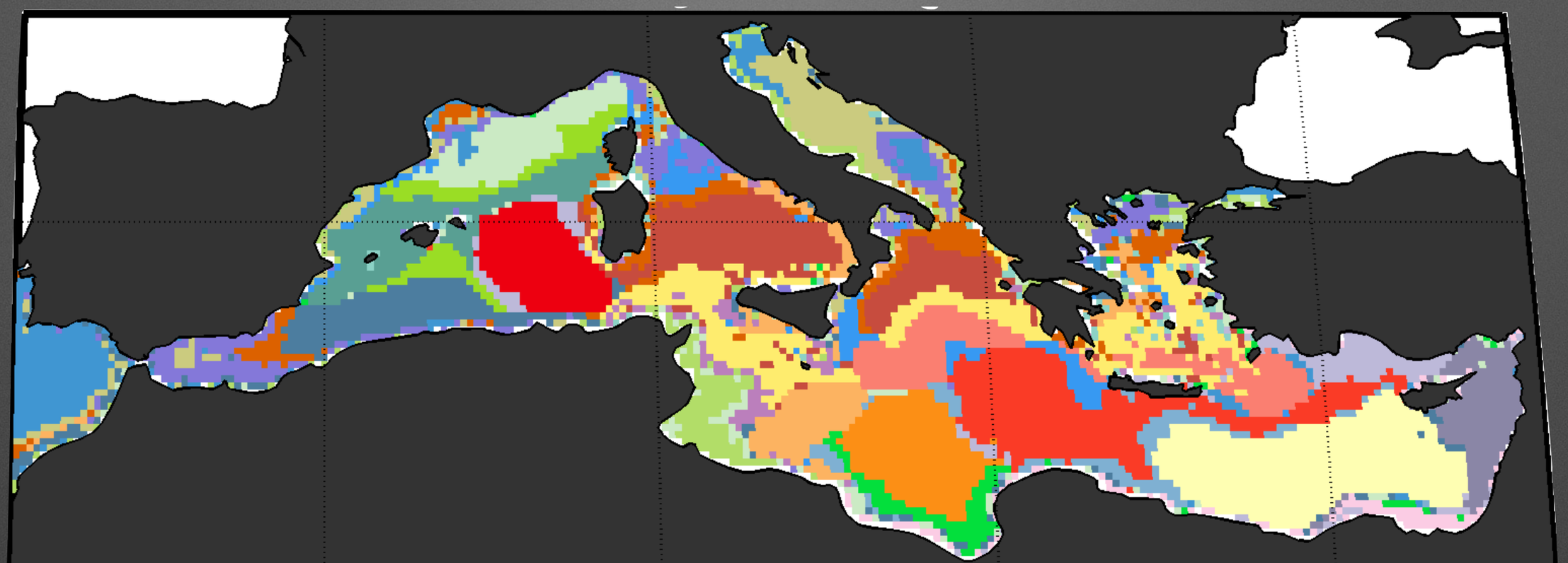


Top predators communities





Ecoregionalisation of the Mediterranean sea



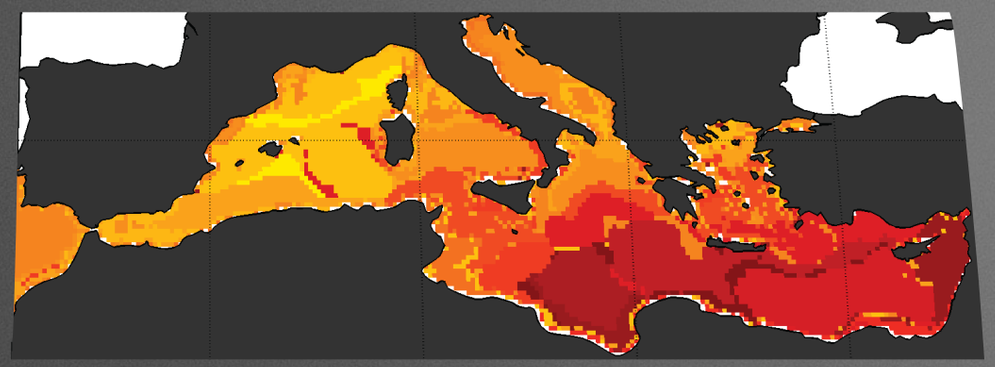
25 ecosystems are found in the Mediterranean sea:

- Species association and dominant species at each trophic level are identified

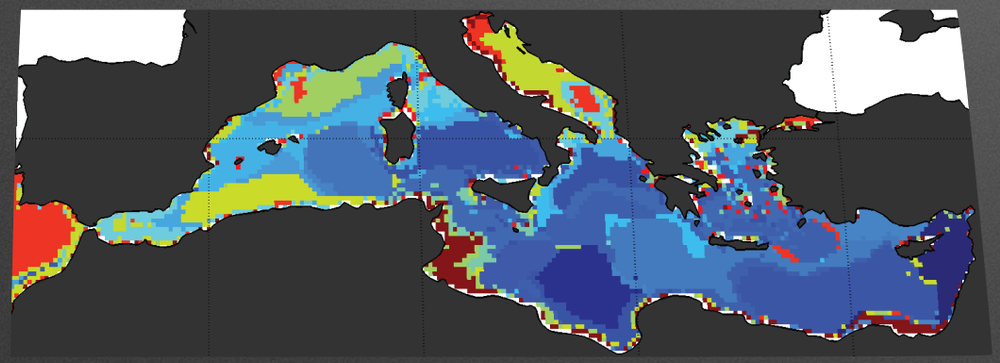
- Biodiversity and ecological traits are characterized for each regions

N.B this work was also realized only with benthic species

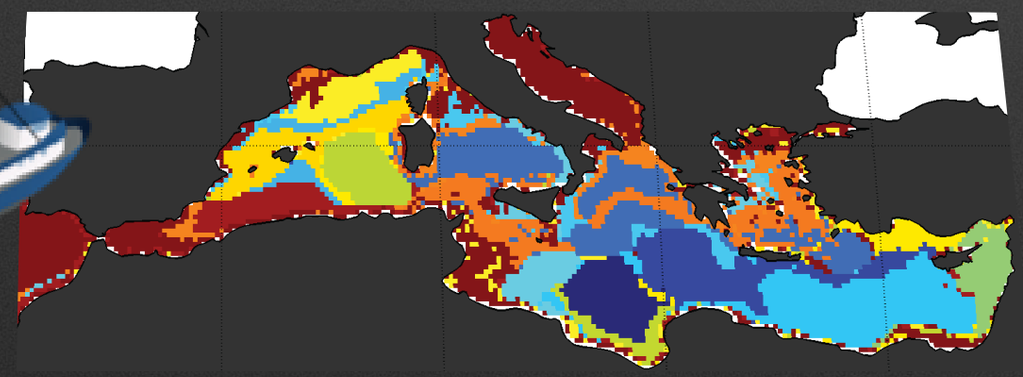
Anthropogenic Impact



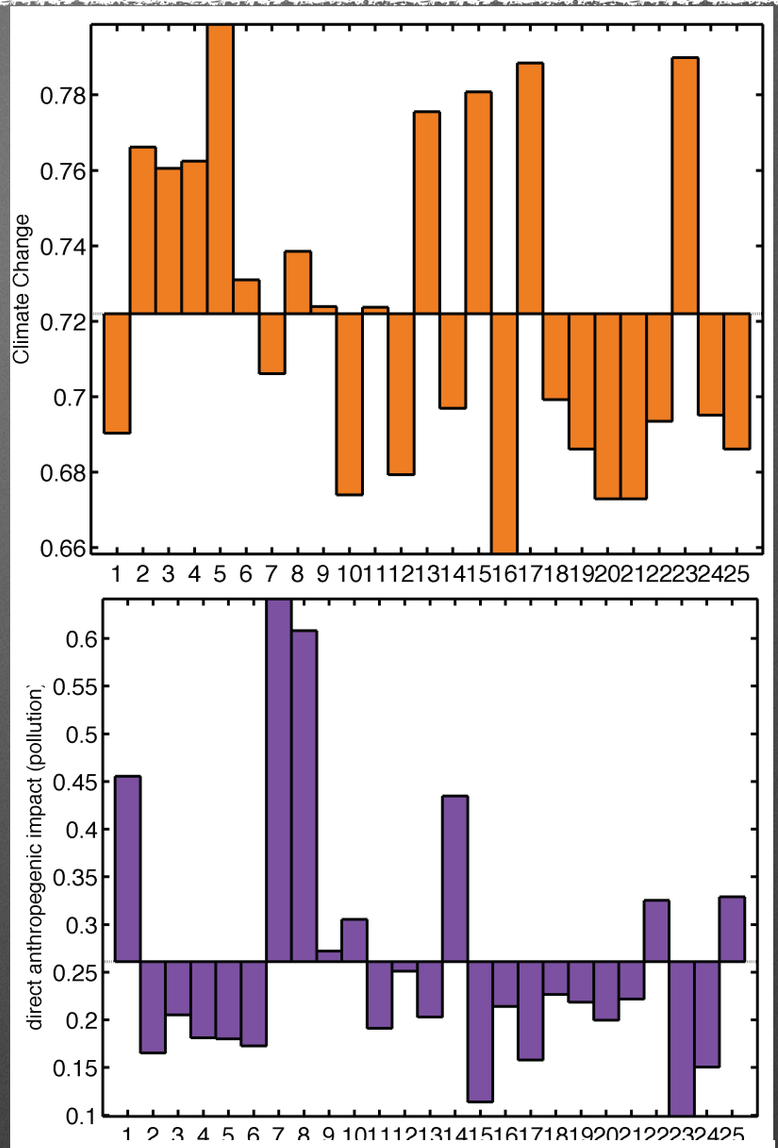
Climate change

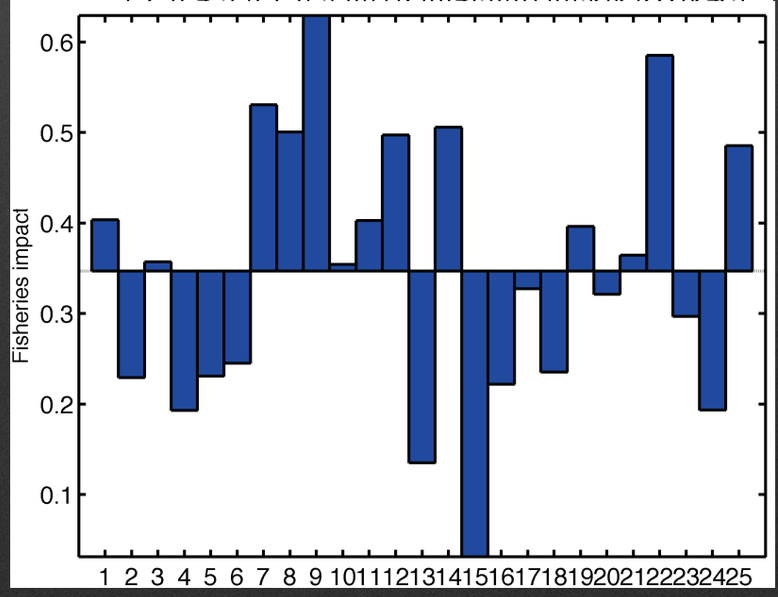


Pollutions

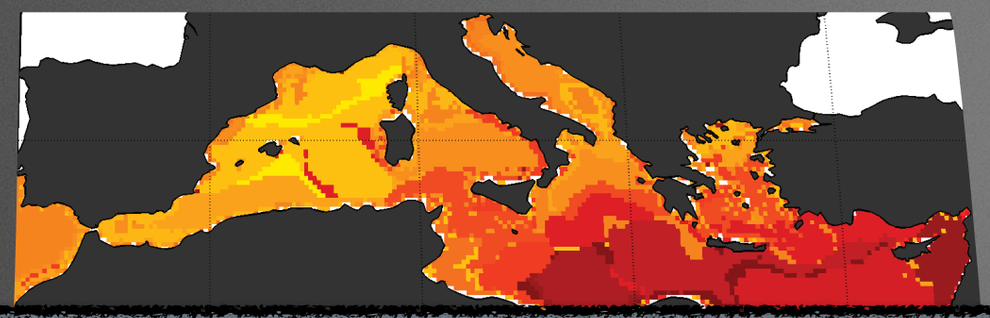


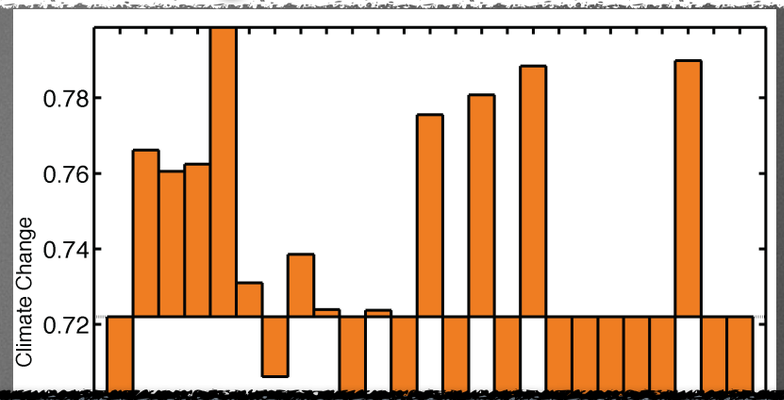
Fisheries activity

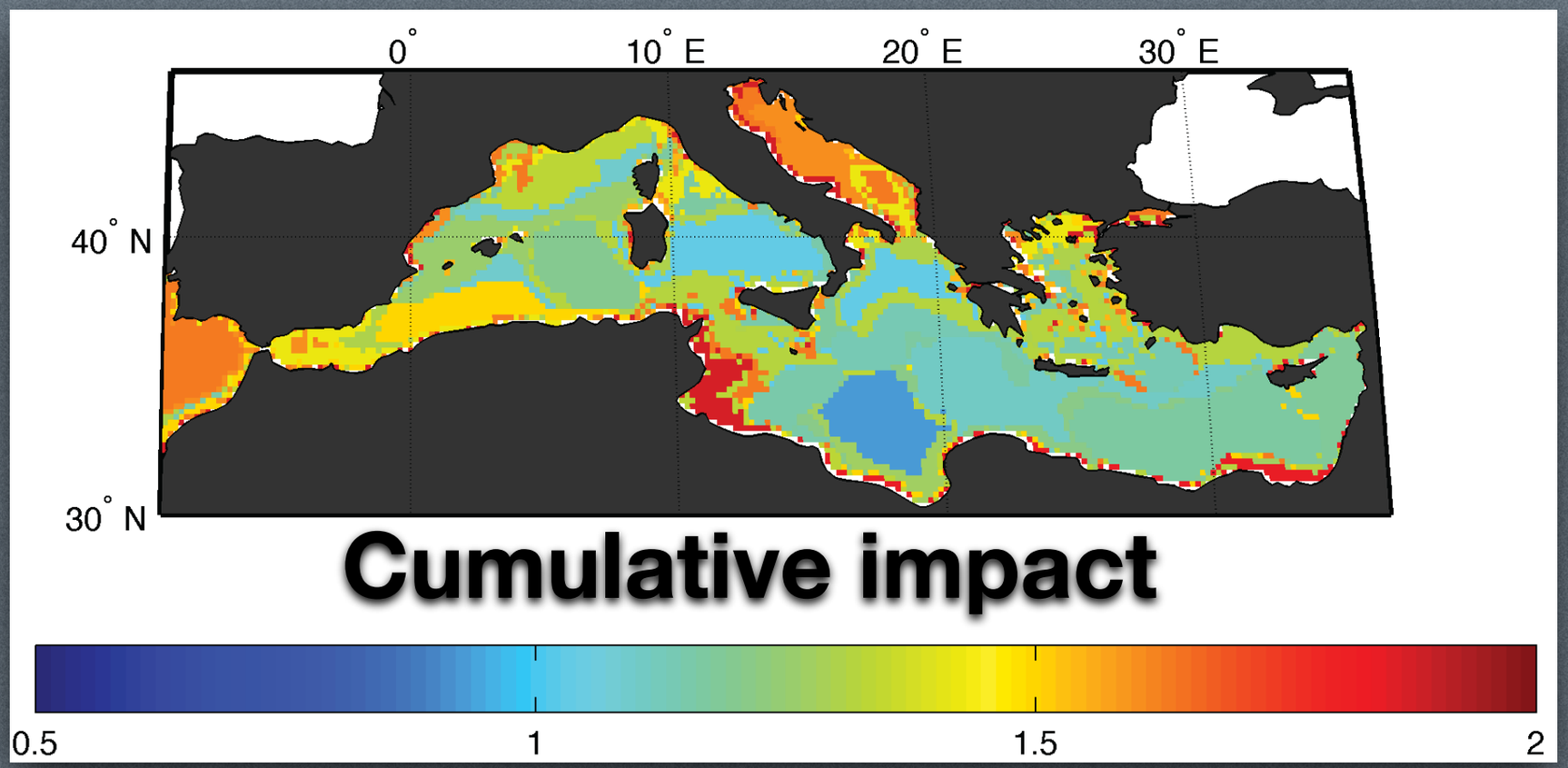


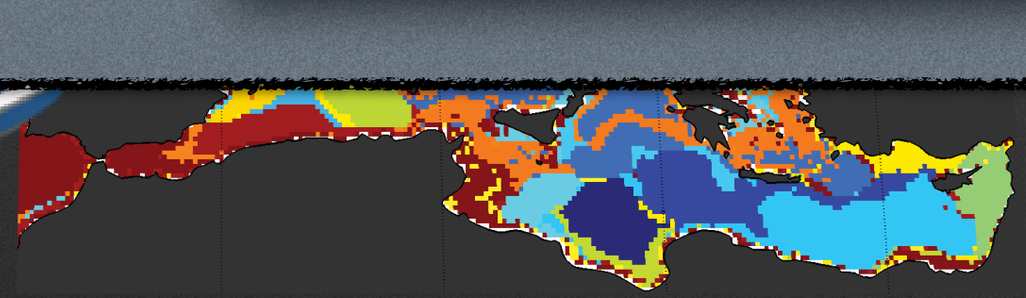


Anthropogenic Impact

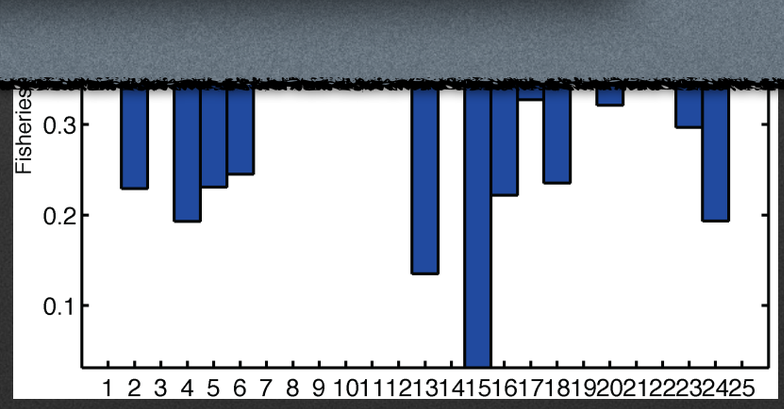




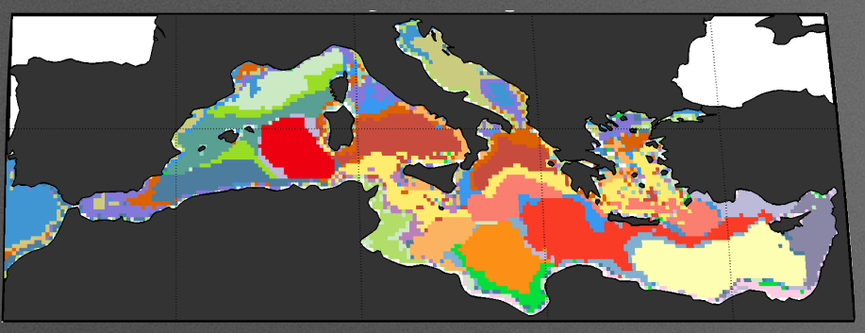


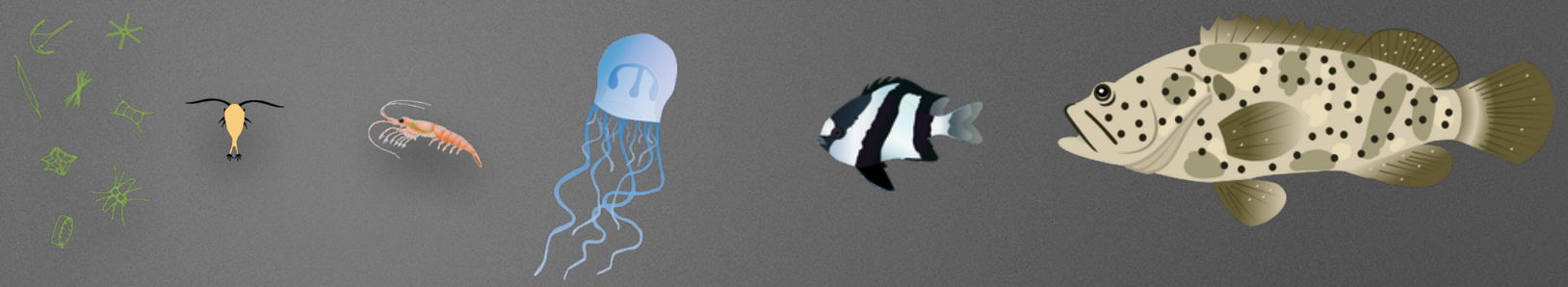


Fisheries activity



Perspective & Caveat





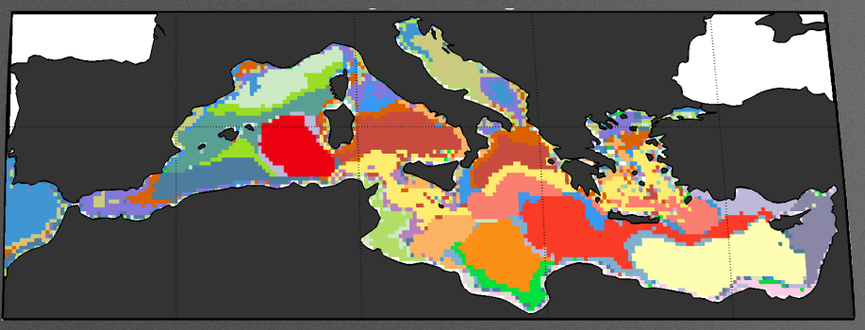
Caveat

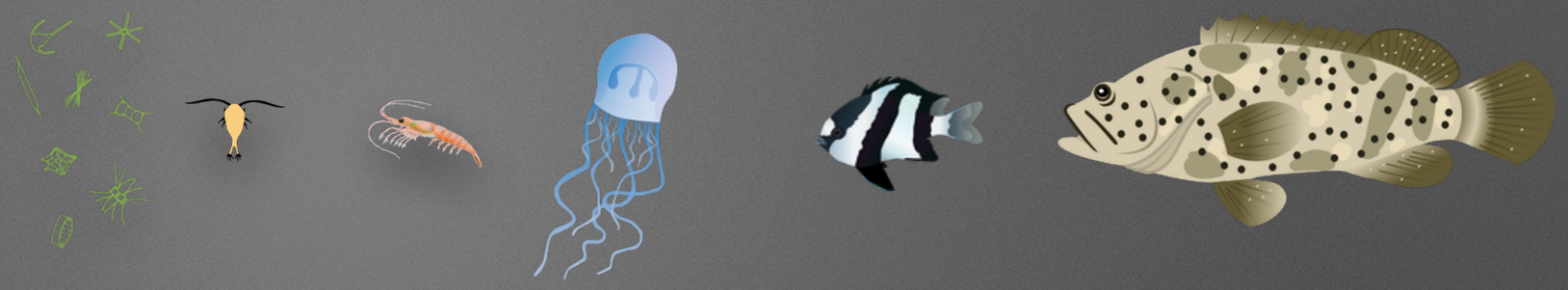
- Environmental data: no seasonal variation

- Observations: not enough information on lower trophic level

- No abundance data that could be used

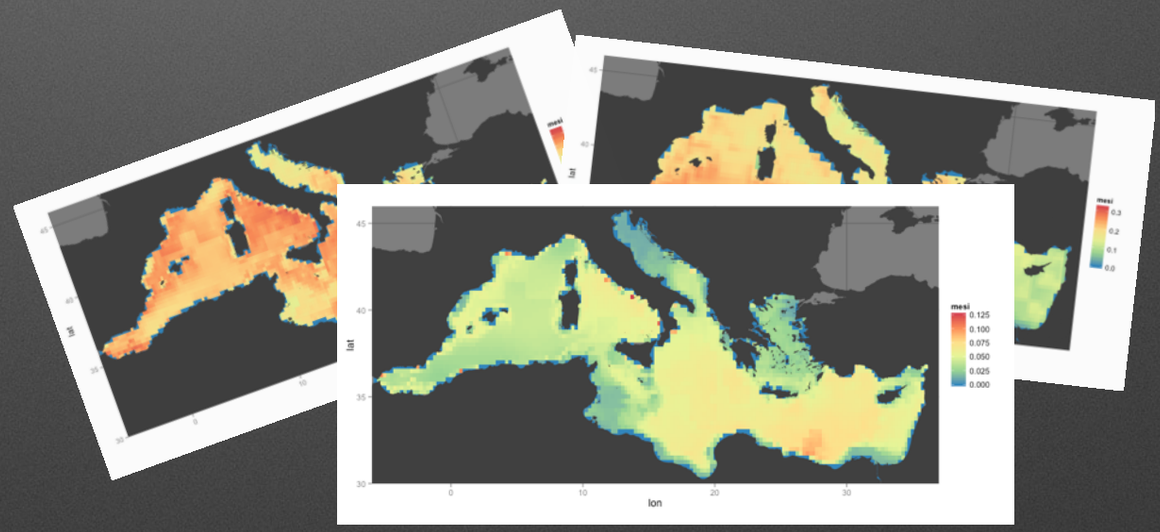
Perspective & Caveat





Perspective

- Implementation of Ecosystem services index: MESI (AMEMR, june 2014)



- Rebuilding potential trophic web in each ecoregion

- Forecast all species distribution according to AOGCM outputs:
  Study on future change in biodiversity, species association and change in ecosystem services

Thank you for your attention
Any questions ?

Gabriel Reygondeau

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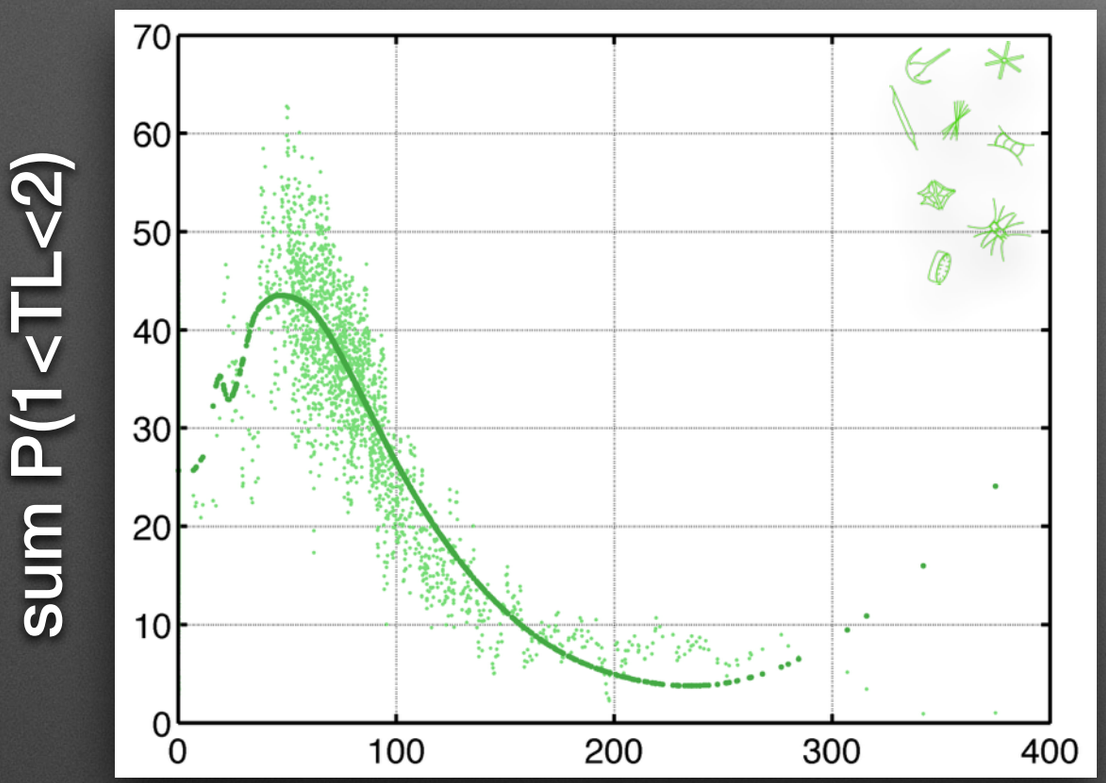
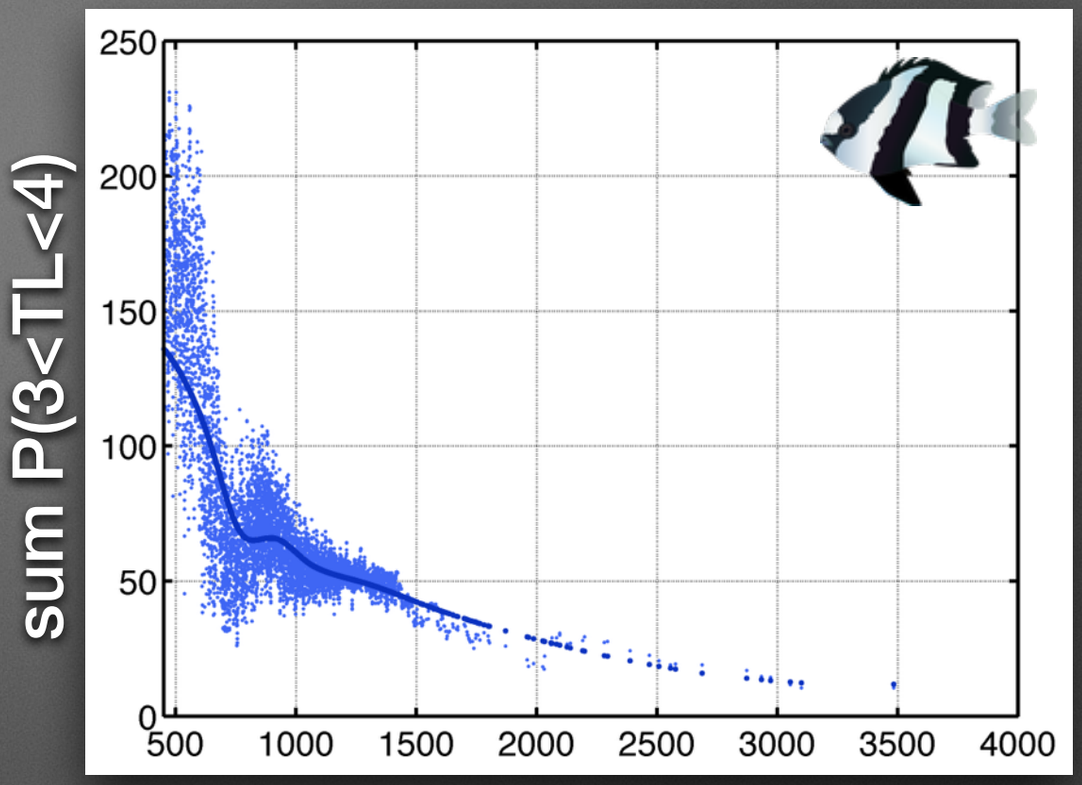
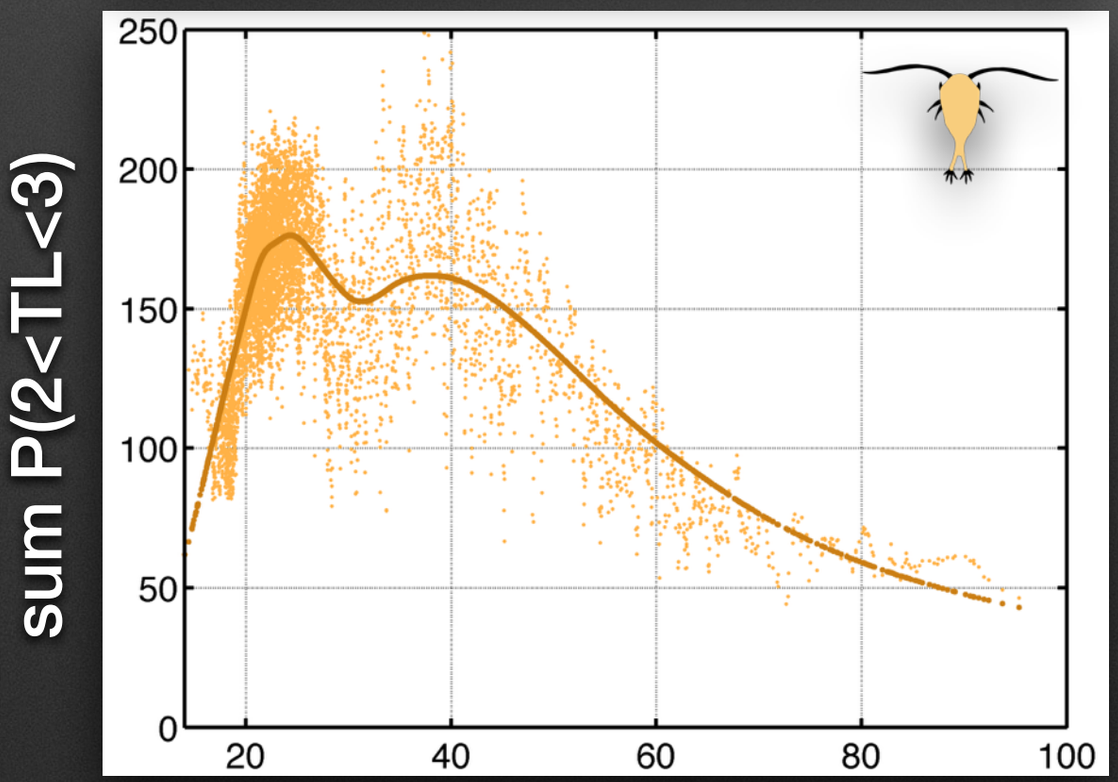
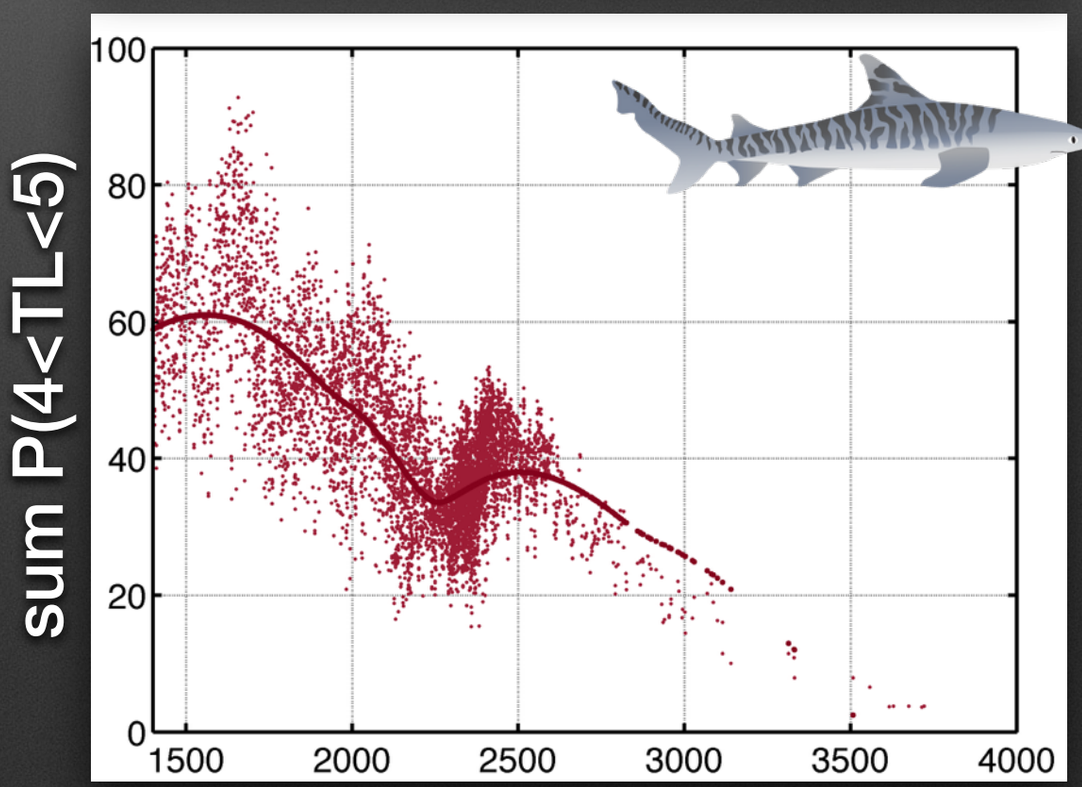
Biodiversity vs size: a E2E ecological relation









Methods: spatial distribution models

Examples of habitat suitable index of mediterranean species