COASTAL ECOSYSTEMS AND CLIMATE

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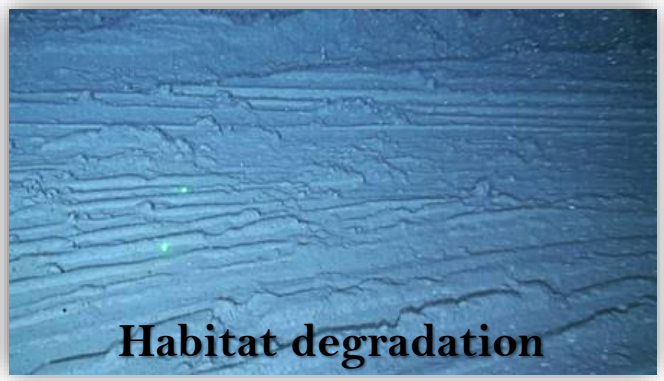
Research Associate SAHFOS

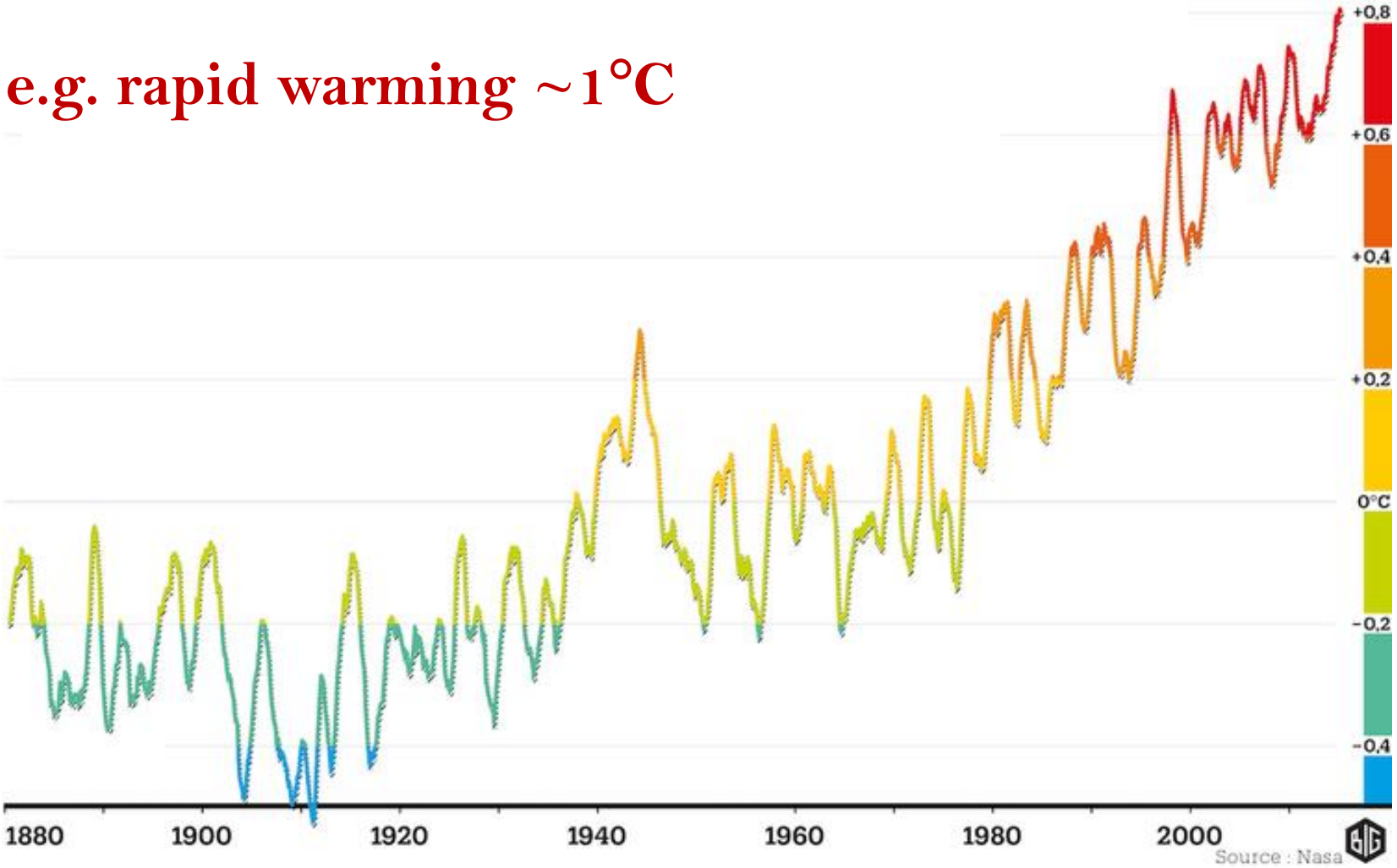
Ifremer ulco LOG cnrs

A clear anthropogenic influence …



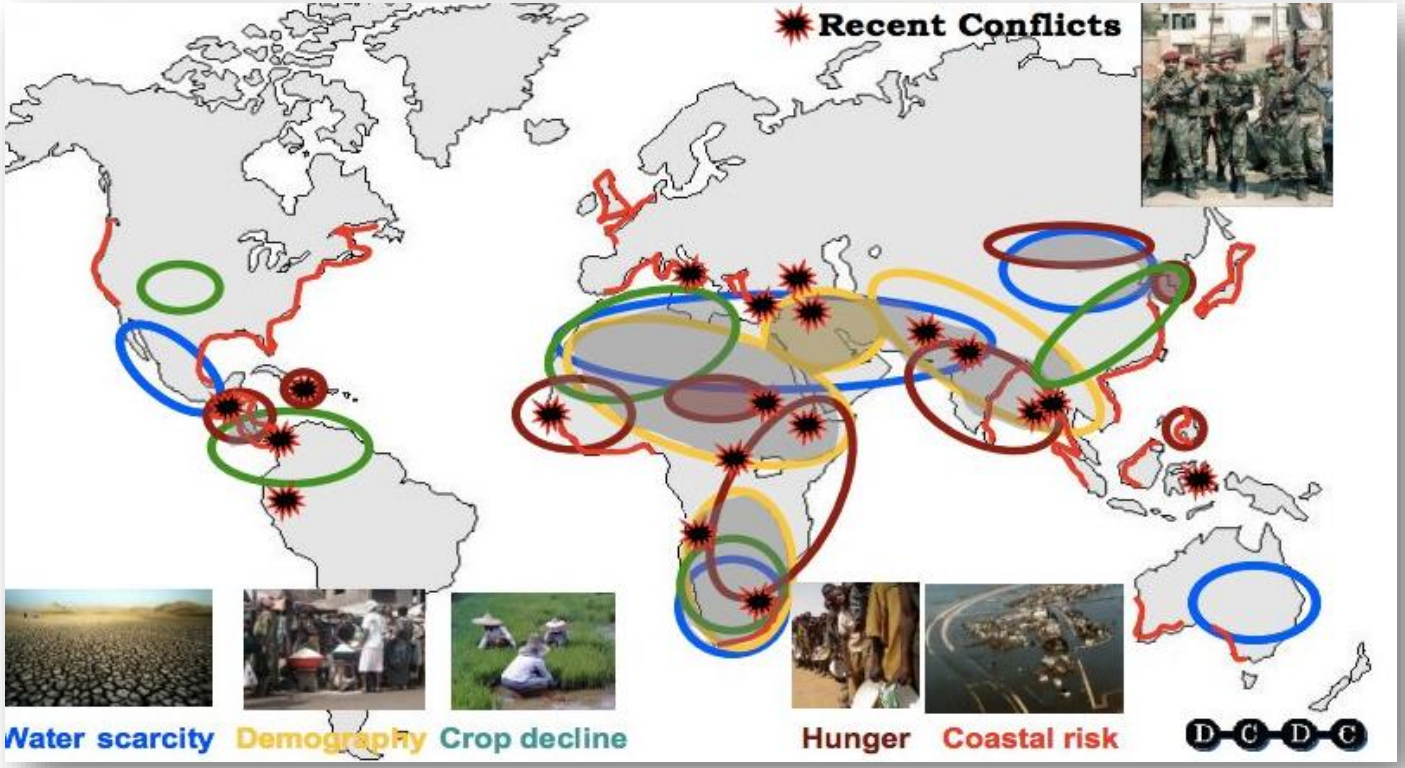
… in combination with a climate change context …

e.g. rapid warming ~1°C



Source: NASA

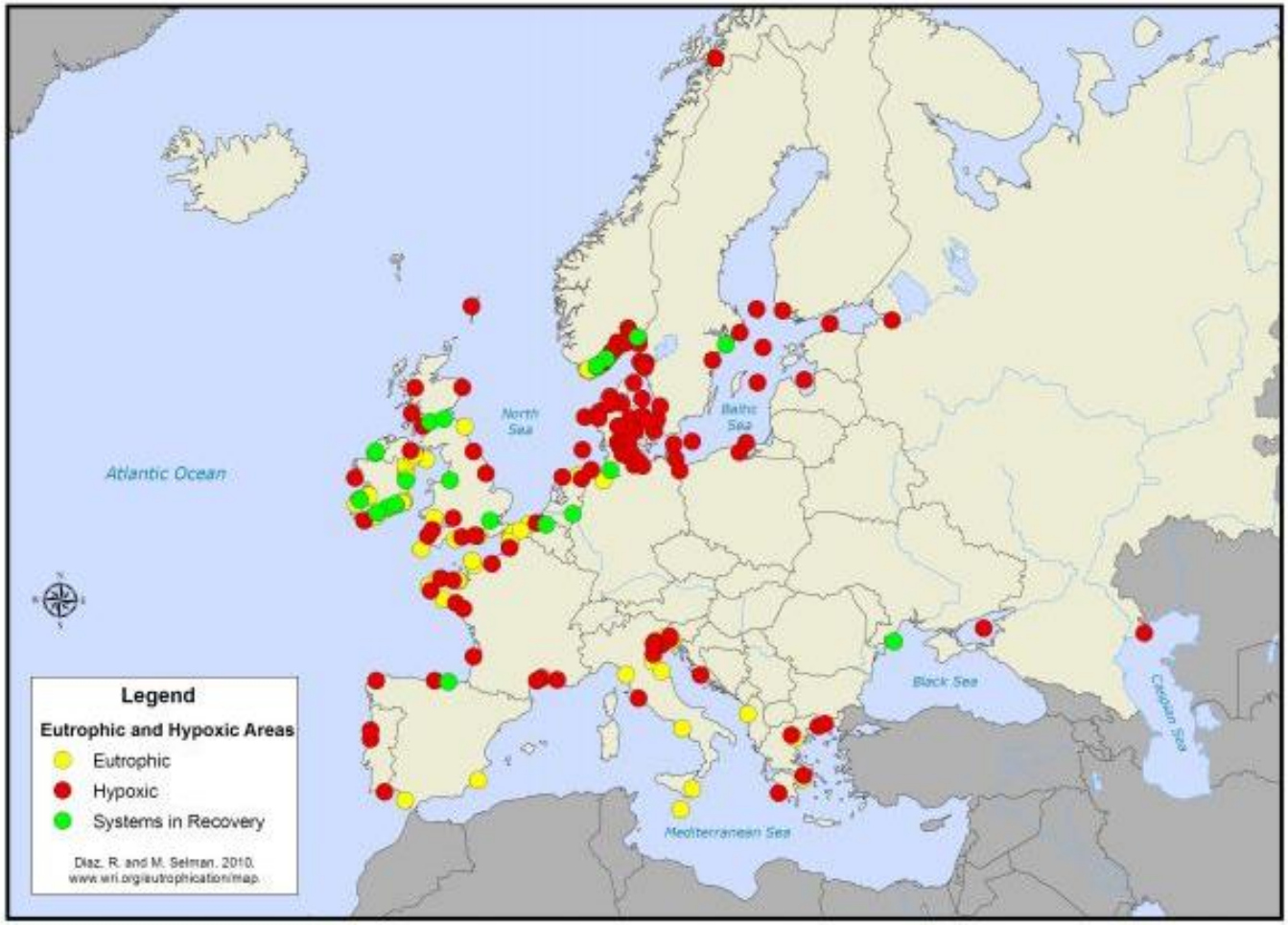
… induce that coastal systems are 'under pressure' …



Coastal marine systems of Western Europe are highly sensitive to the combined effects of natural climate variability and anthropogenic activities

IPCC, 2014

… with alterations such as hypoxia, eutrophication …



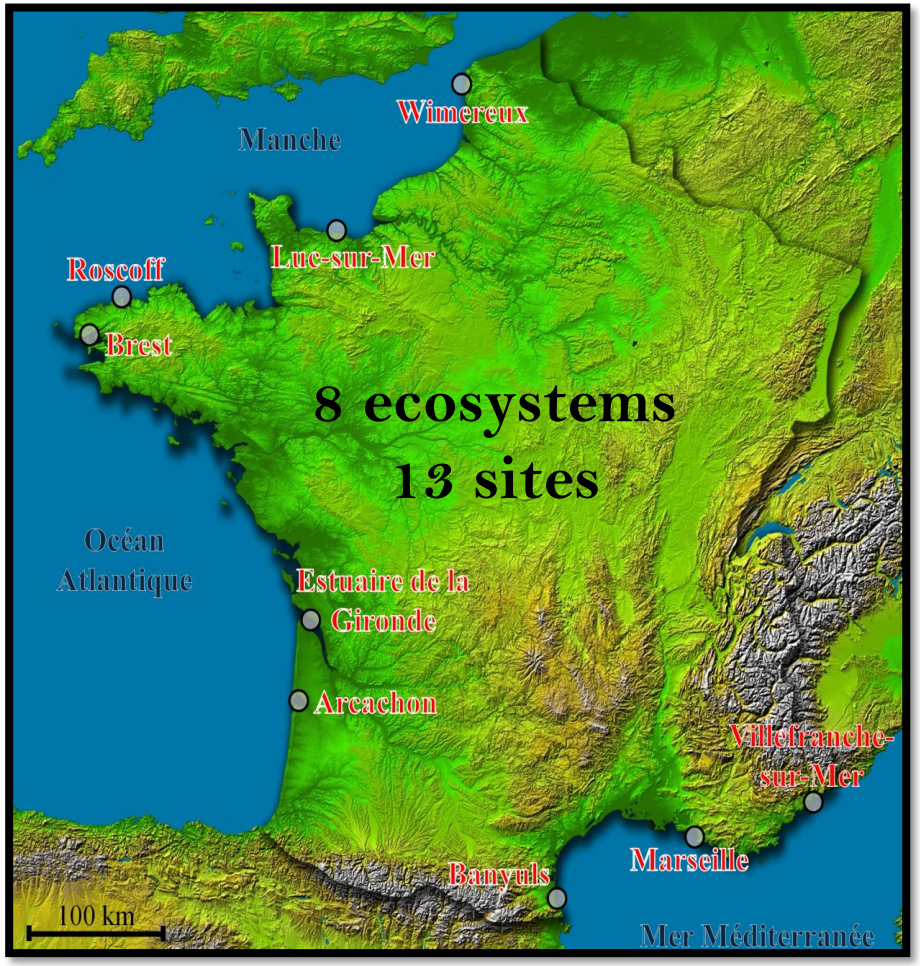
http://www.wri.org/resources/maps/coastal-eutrophic-and-hypoxic-areas-europe

Questions …

1) Long-term changes in coastal ecosystems ?

2) Spatial and temporal scales at which forcing operate ?

Characterising changes in coastal ecosystems

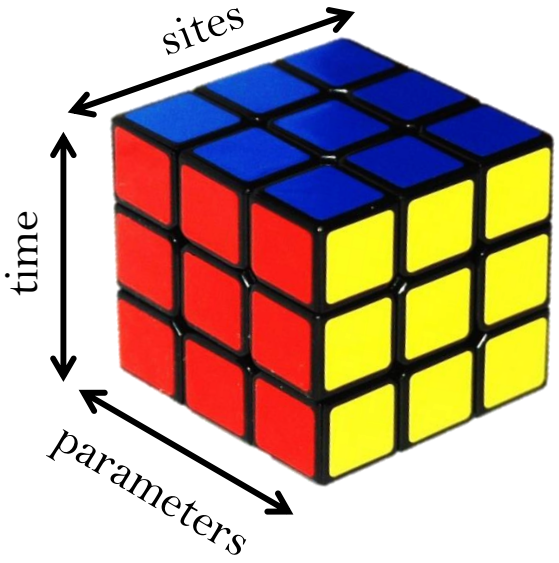


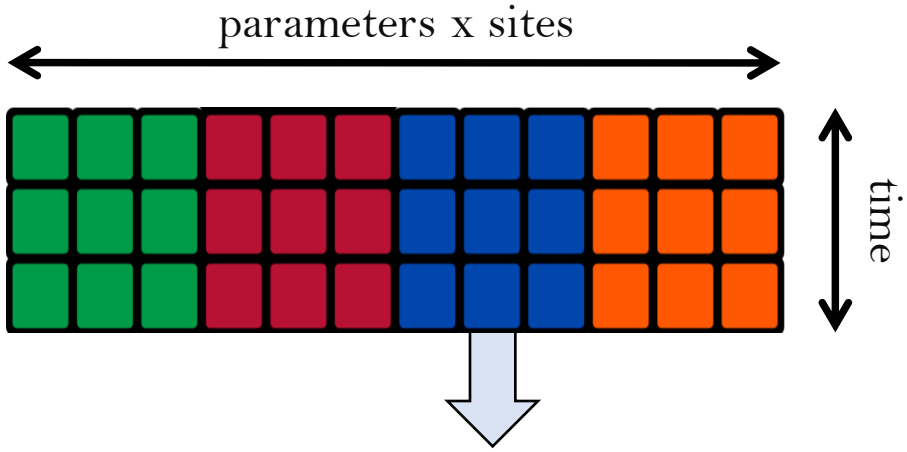
Temperature
Salinity
Oxygen
pH

NH^{4+}
NO^{3-}
NO^{2-}
PO_4^{3-}
$SiOH_4$

POC, PON
SPM
Chlorophyll *a*

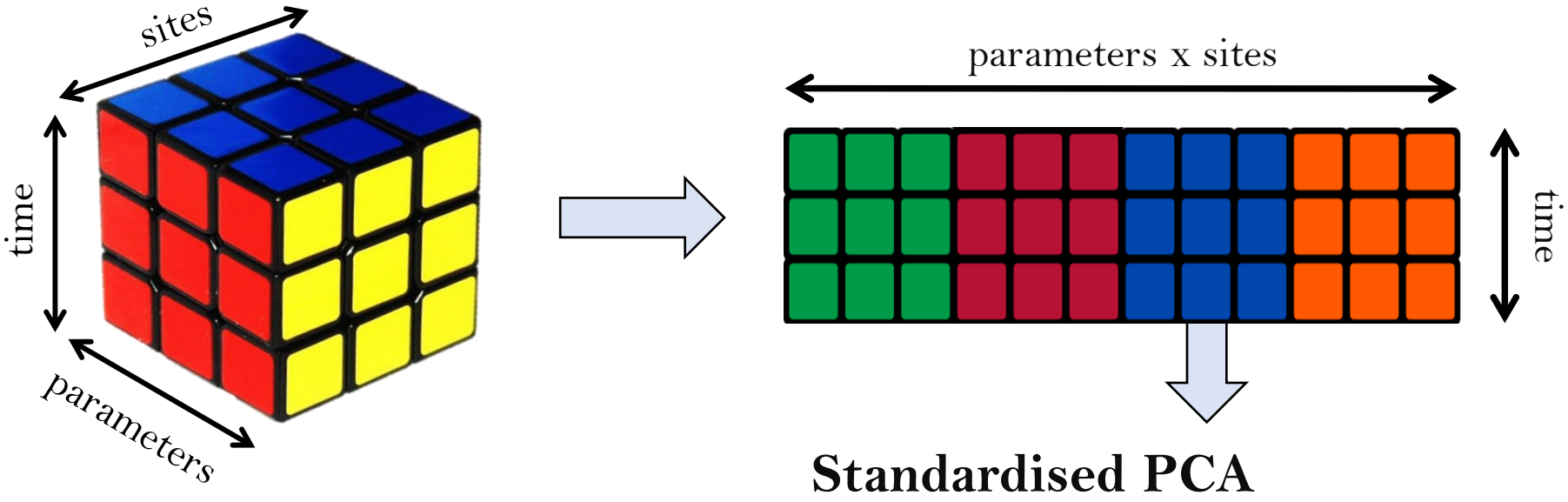
Characterising changes in coastal ecosystems





Standardised PCA

Characterising changes in coastal ecosystems



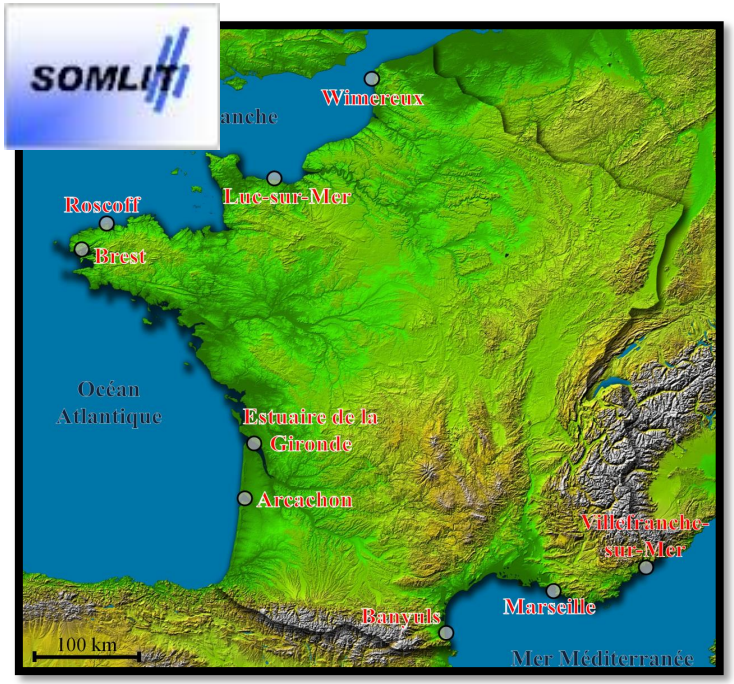
✓ **to characterise temporal changes**

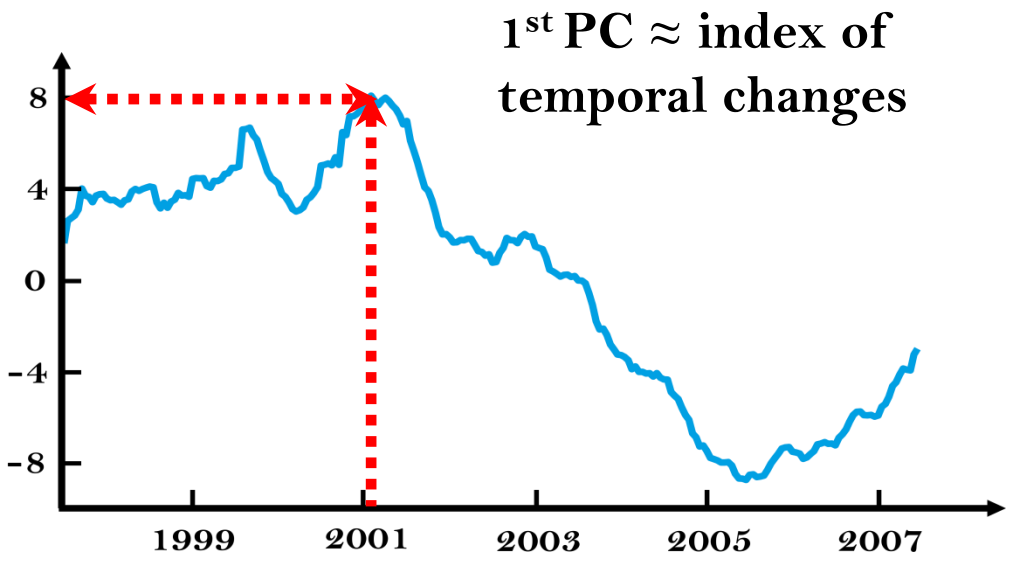
examination of principal components

✓ **to identify parameters / sites that contribute to changes**

eigenvectors as correlation values

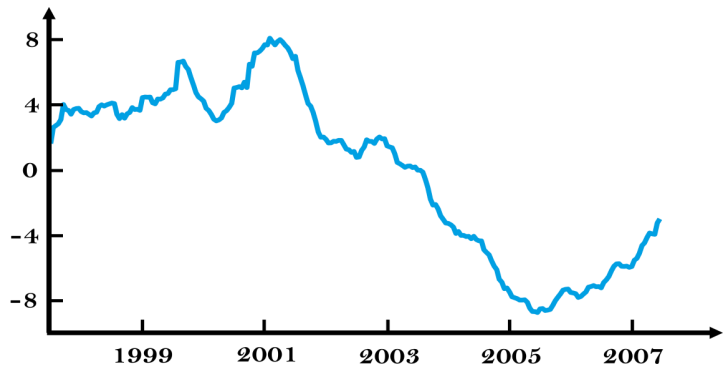
Year-to-year changes in coastal ecosystems



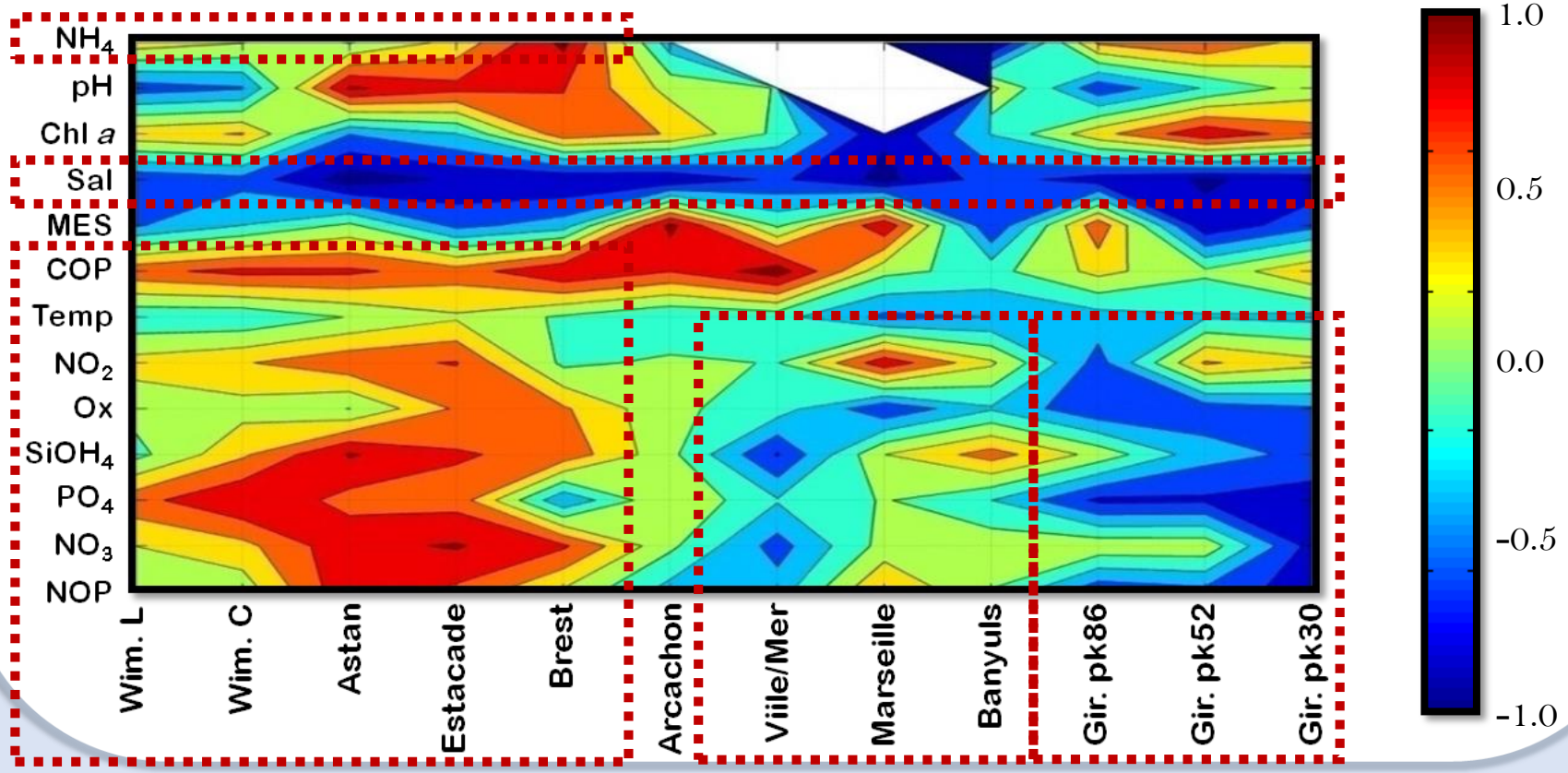


Goberville et al. (2010) MEPS

Year-to-year changes in coastal ecosystems



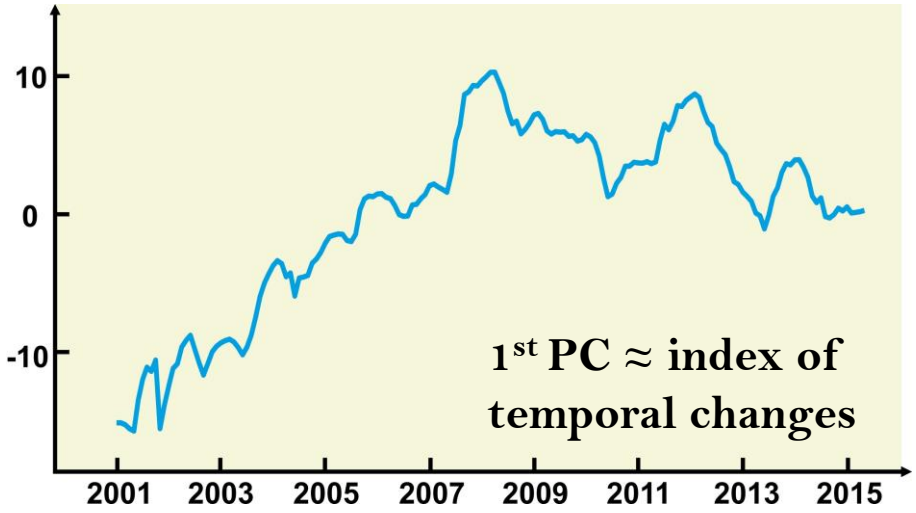
Parameters/Sites contributing to the main changes

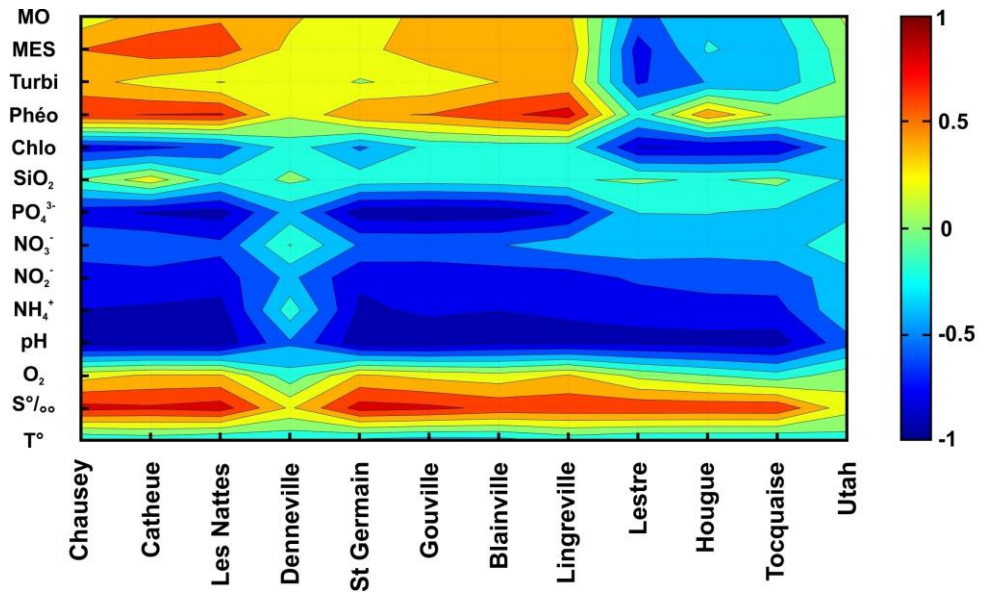


A ‘picture’ due to the SOMLIT strategy ?

Smel
Synergie Mer Et Littoral
Recherche & développement

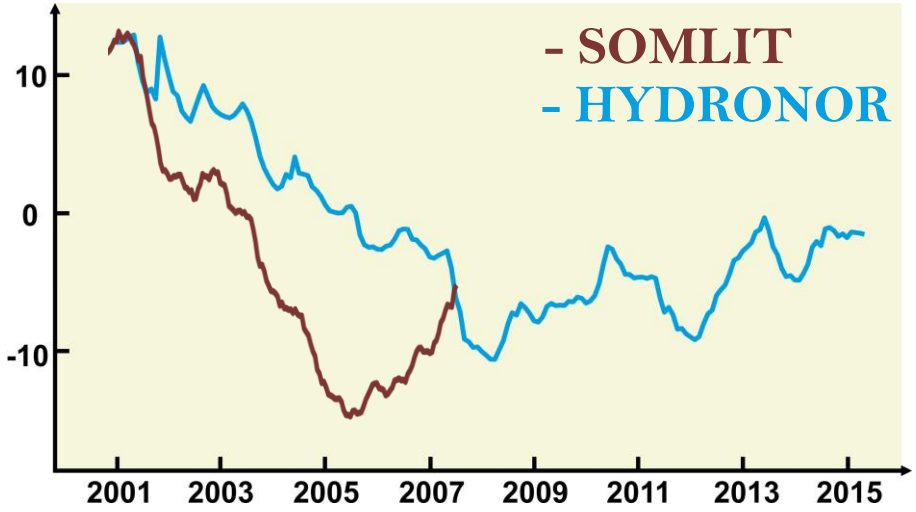
A ‘picture’ due to the SOMLIT strategy ?





Goberville et al. (unpub.)

A ‘picture’ due to the SOMLIT strategy ?



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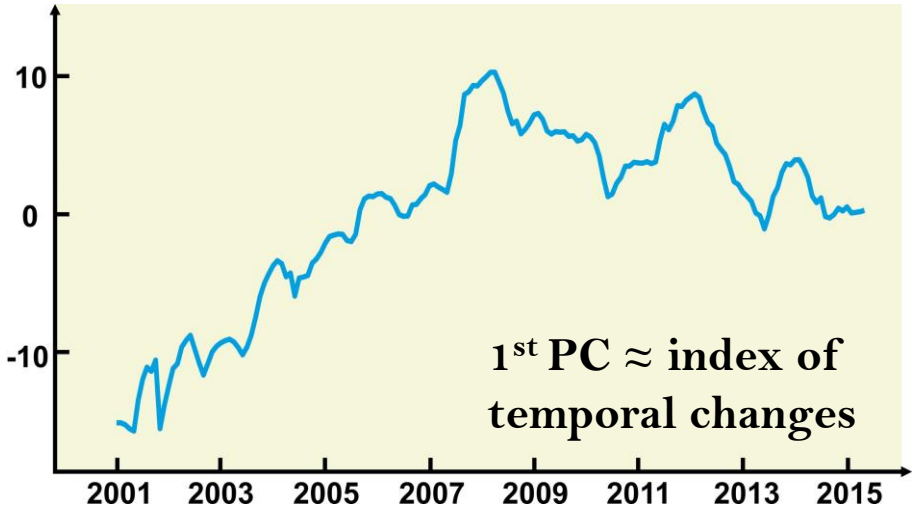
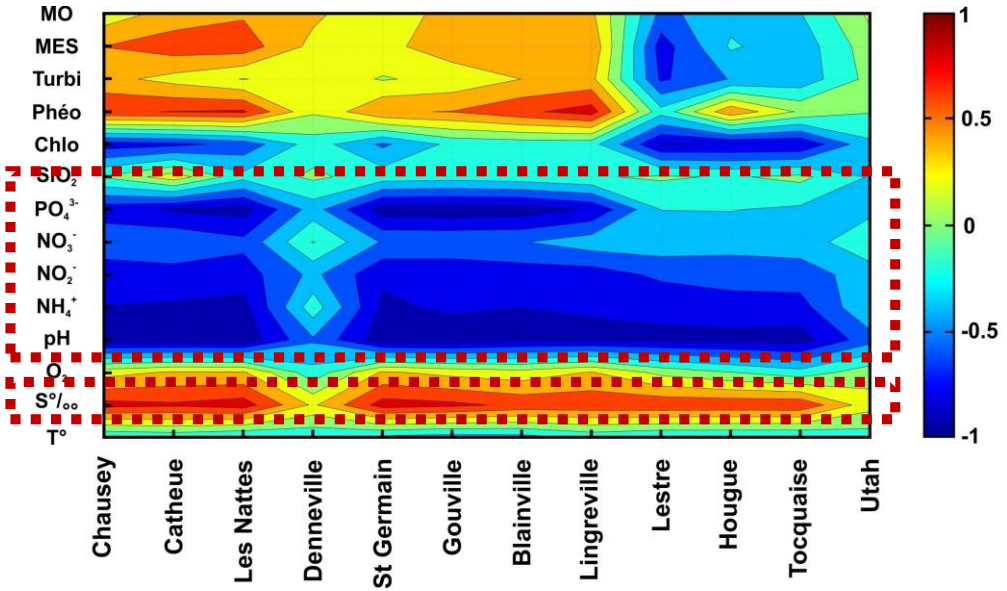
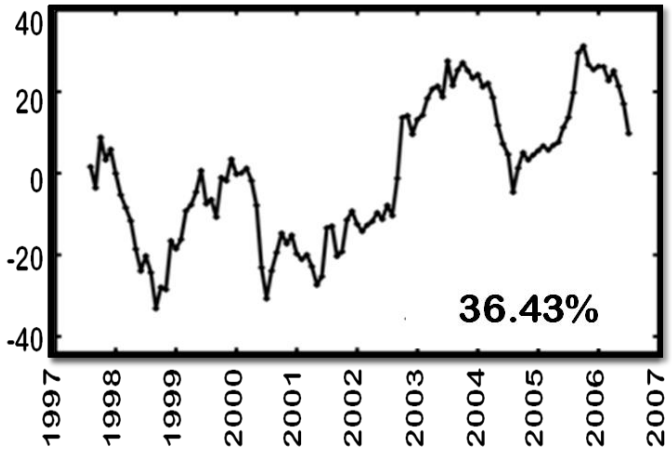


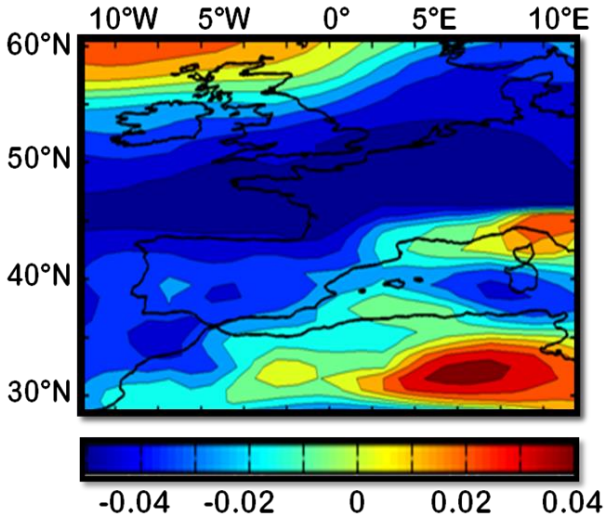


Goberville et al. (unpub.)

Climate influence on coastal ecosystems

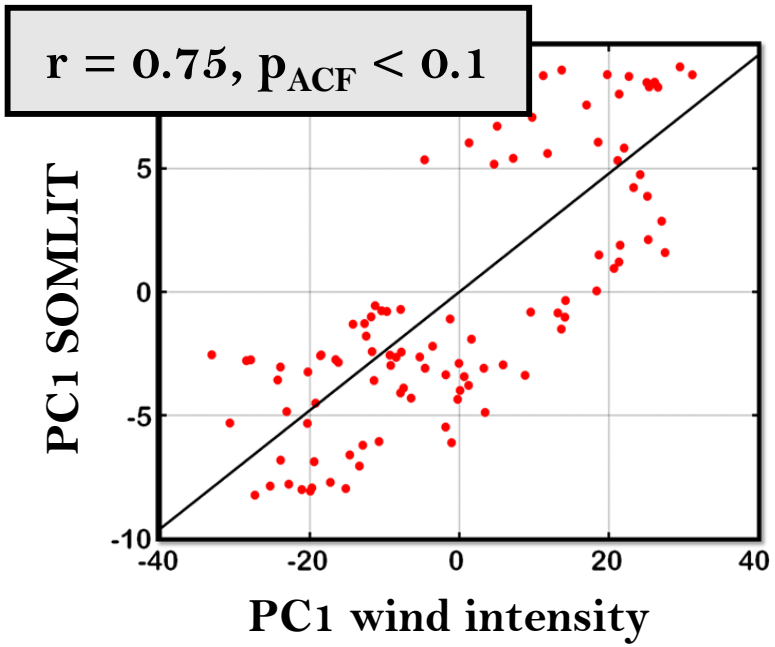
Regional climate (PCs)	
Sea level pressure	1 2
Zonal wind	1 2
Meridional wind	1 2
Wind intensity	1 2
Sea surface temperature	1 2
Precipitation	1 2

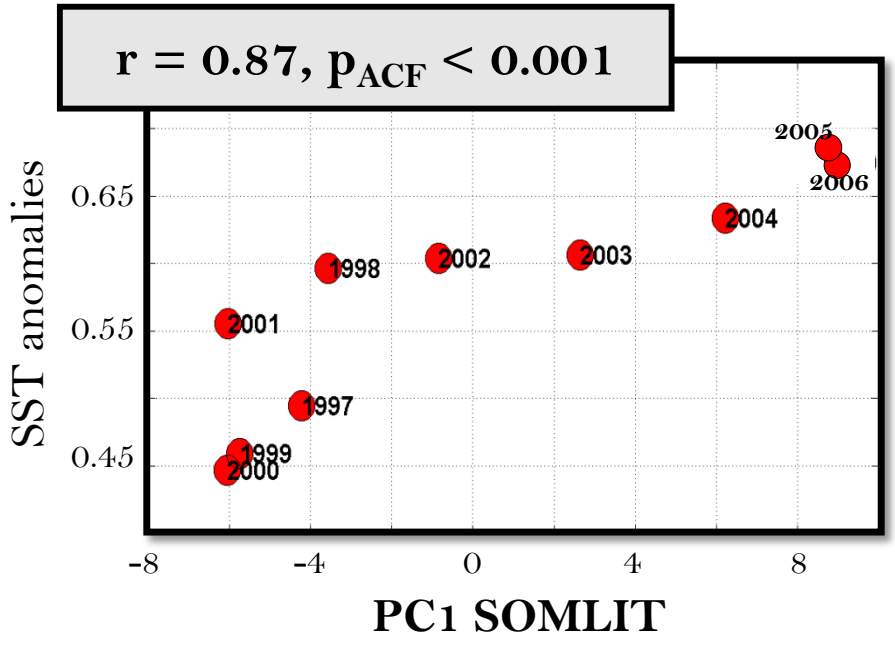


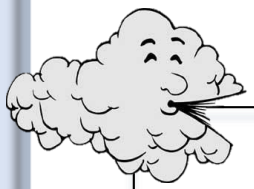


Goberville et al. in MEPS (2010)

Climate influence on coastal ecosystems







Regional scale

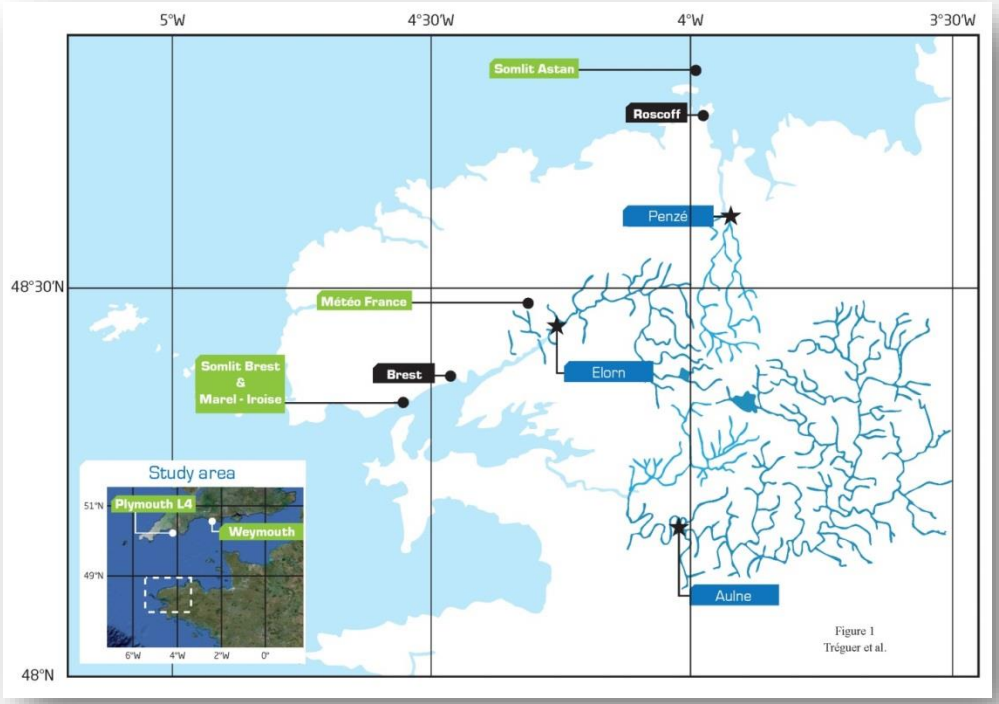
atmospheric and oceanic circulations, precipitation

Large-scale

Sea surface temperature (NHT anomalies & AMO)

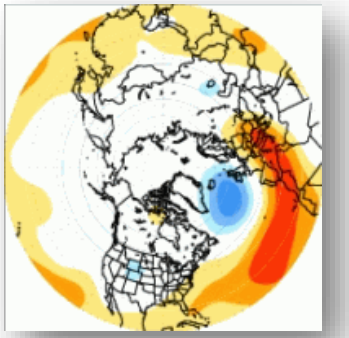
Goberville et al. in MEPS (2010)

At a more local scale …



Tréguer et al. 2014

Martin Visbeck



www.cpc.ncep.noaa.gov

SOMLIT

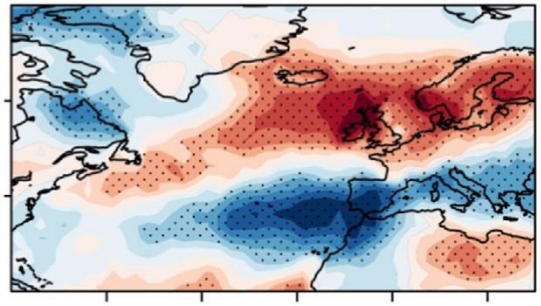
wwz.ifremer.fr

METEO FRANCE

Toujours un temps d'avance

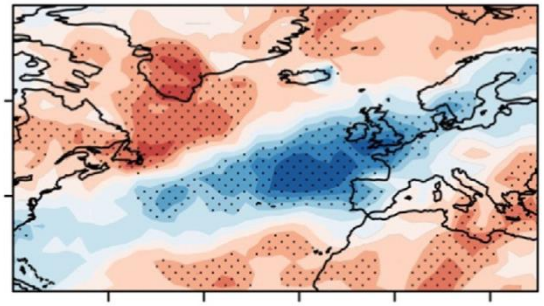
… large & local-scale influences are also detected…

NAO



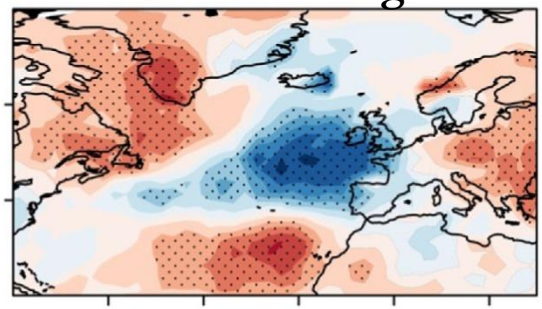
r	p
+0.03	0.87

EAP



r	p
+0.67	<0.00

Atlantic Ridge

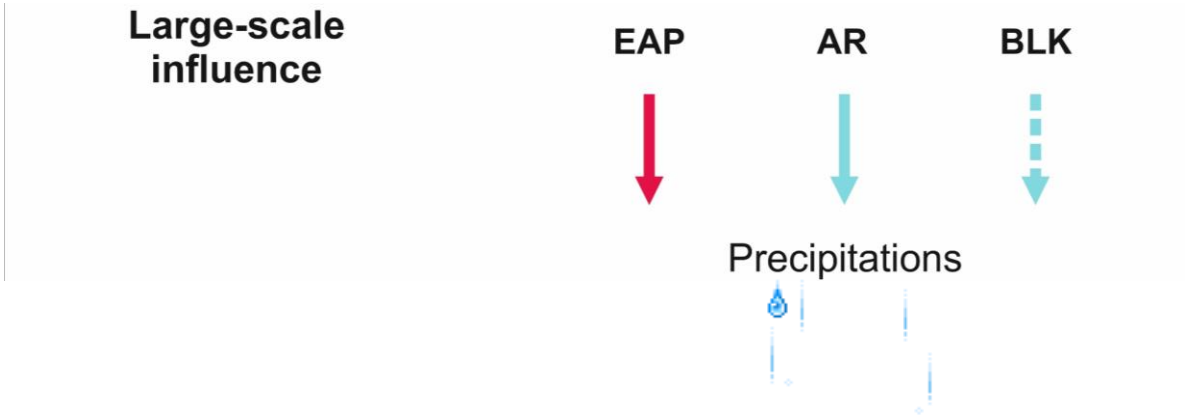


r	p
-0.49	<0.00

Adapté de Tréguer et al. in JMS (2014)

… large & local-scale influences are also detected…

During the winter period

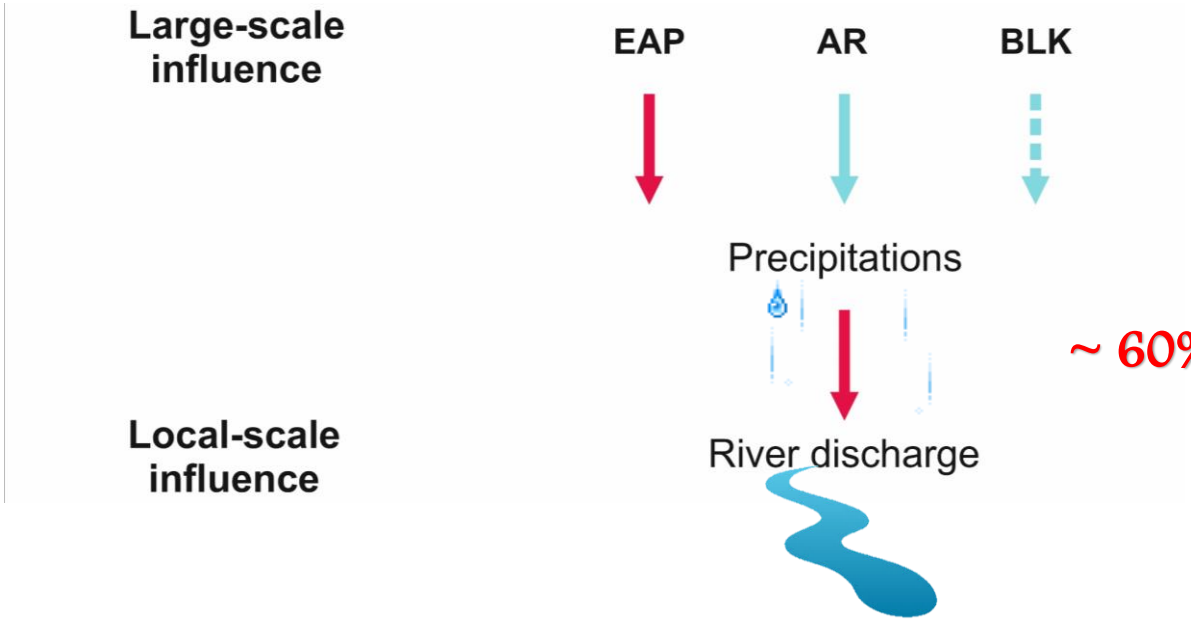


from 24 to 45% of the variability

Adapté de Tréguer et al. in JMS (2014)

… large & local-scale influences are also detected…

During the winter period

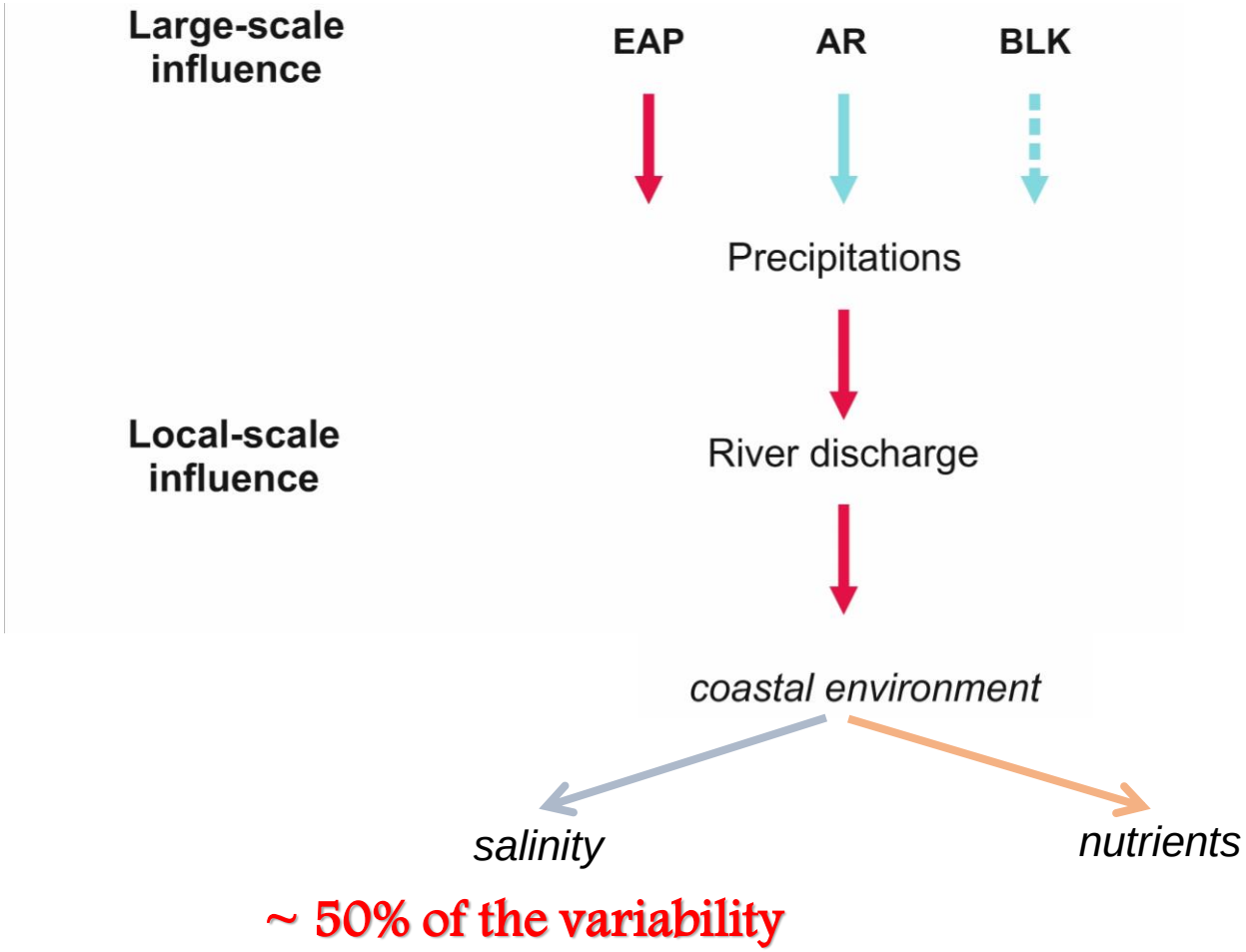


~ 60% of the variability

Adapté de Tréguer et al. in JMS (2014)

… large & local-scale influences are also detected…

During the winter period



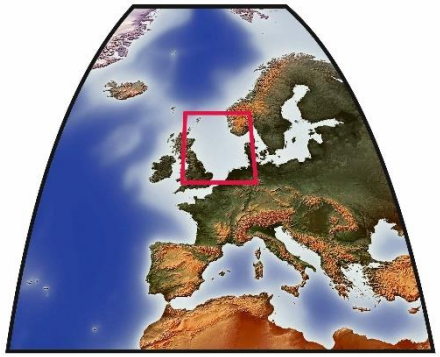
~ 50% of the variability

Adapté de Tréguer et al. in JMS (2014)

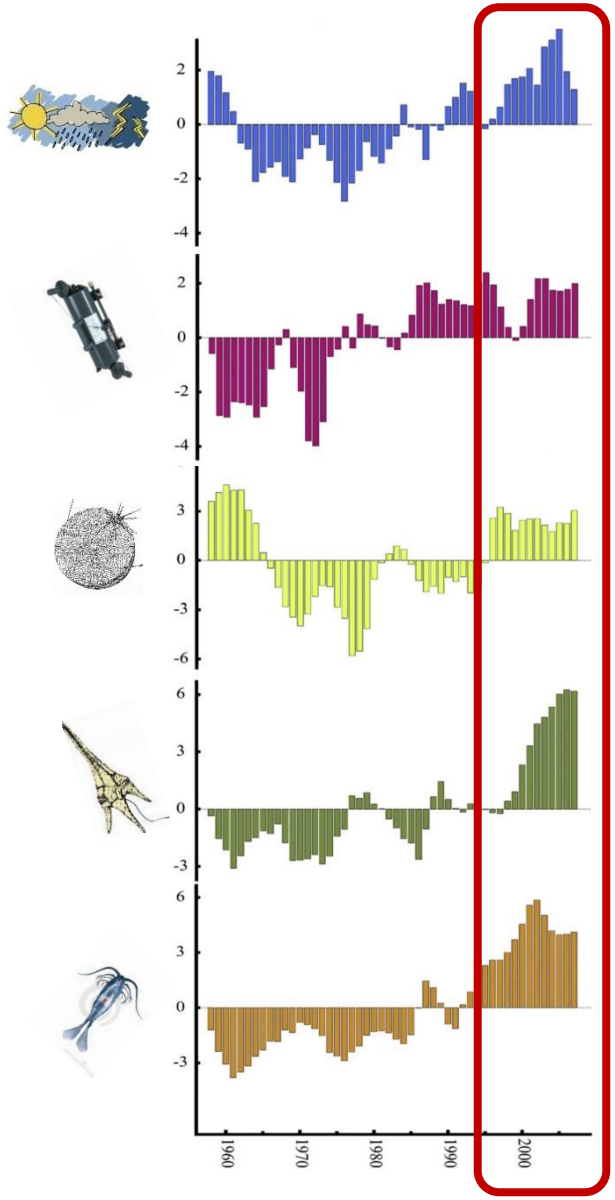
Environmental changes and plankton assemblages ?

Plankton eats holographic meatloaf for dinner because holograms are projections of light and plankton gain energy thru photosynthesis

Cascading and synchronous effects…



North Sea
(1958-2007)



↗ SST

↗ nutrients, chlo*a*

↗ Diatoms

↘ Dinoflagellates

↗ *C. helgolandicus*
↘ *C. finmarchicus*

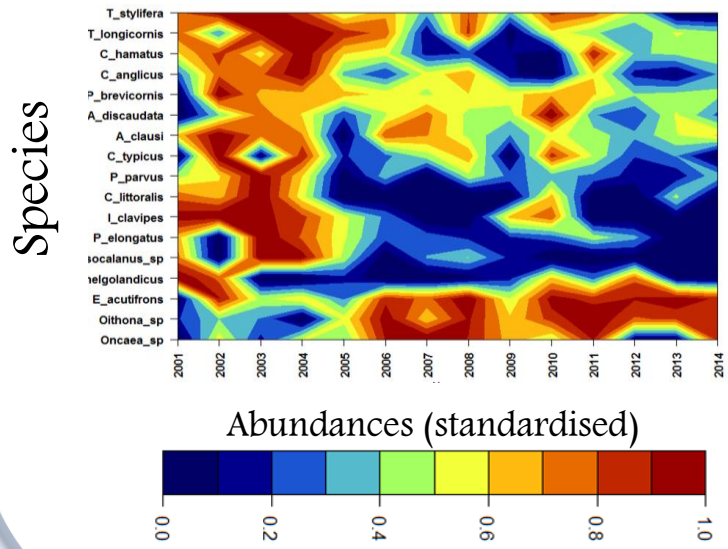
Goberville et al. (2014) JMS

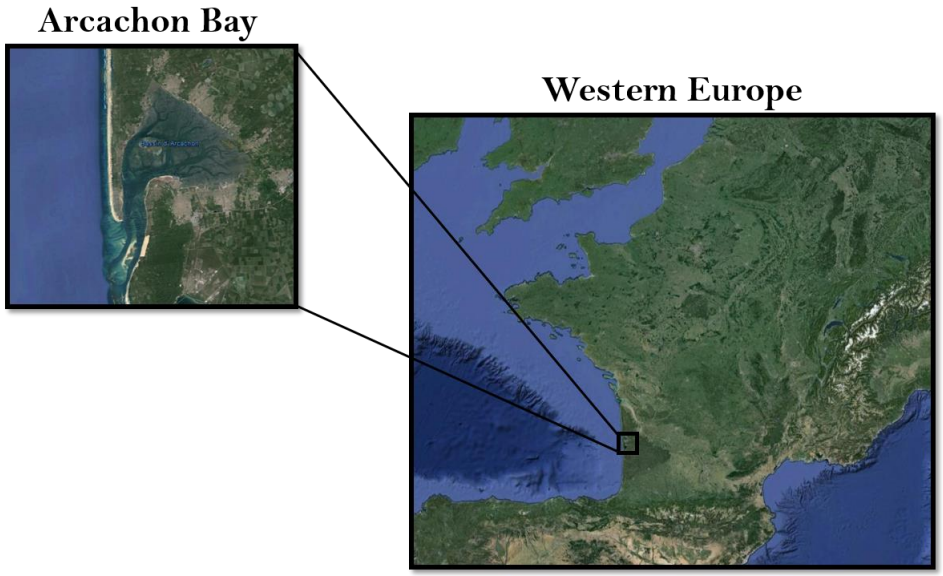
Environmental changes and plankton assemblages ?

Copepod species

- ✓ Dominant members of the zooplankton
- ✓ Prominent role in the dynamic and stability of ecosystems
- ✓ Integrate rapidly environmental signals

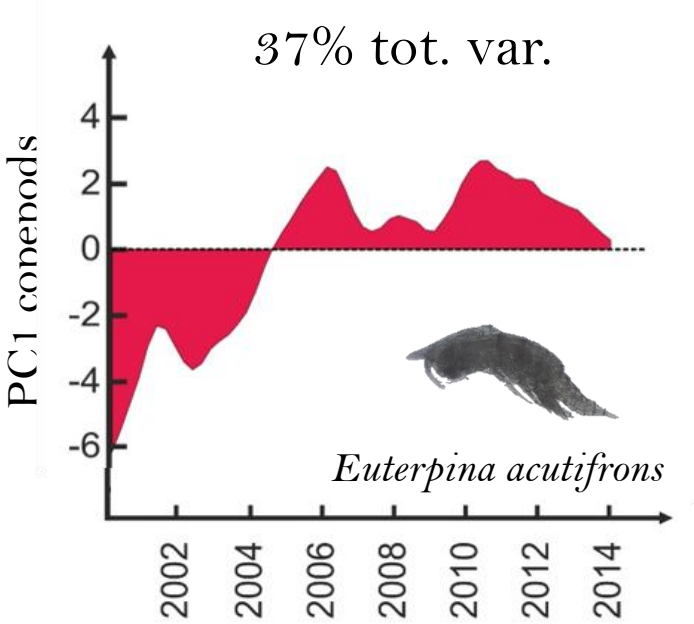
SOARC data

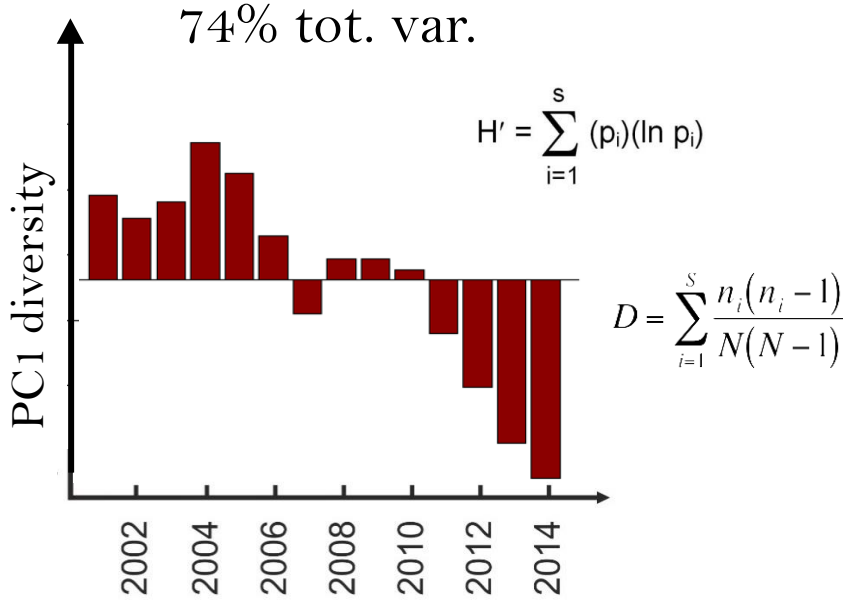




Richirt et al. (submitted)

Changes in copepod assemblages





Change in copepod assemblages detected circa 2005

WHY and HOW ?

Ruiz-Gonzalez et al., in prep; Richirt et al., (submitted)

Large and local-scale influences ?

EAP

NAO

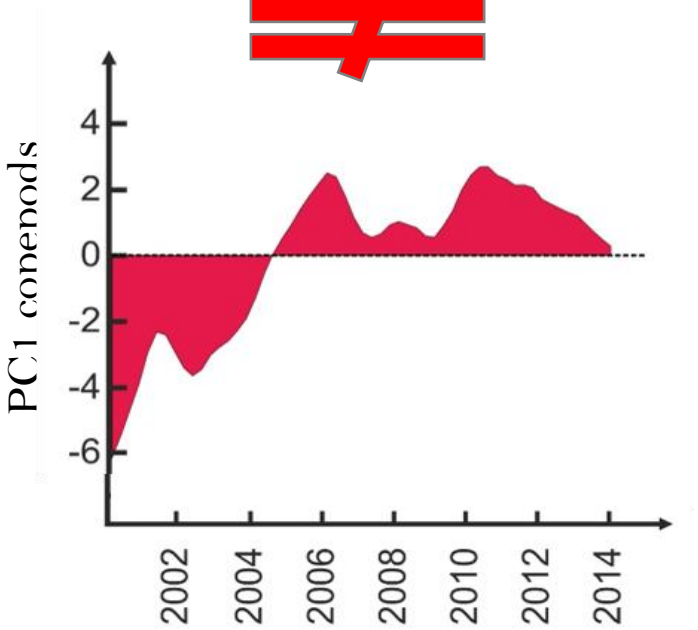
NHT

AO

No direct influence of large-scale processes

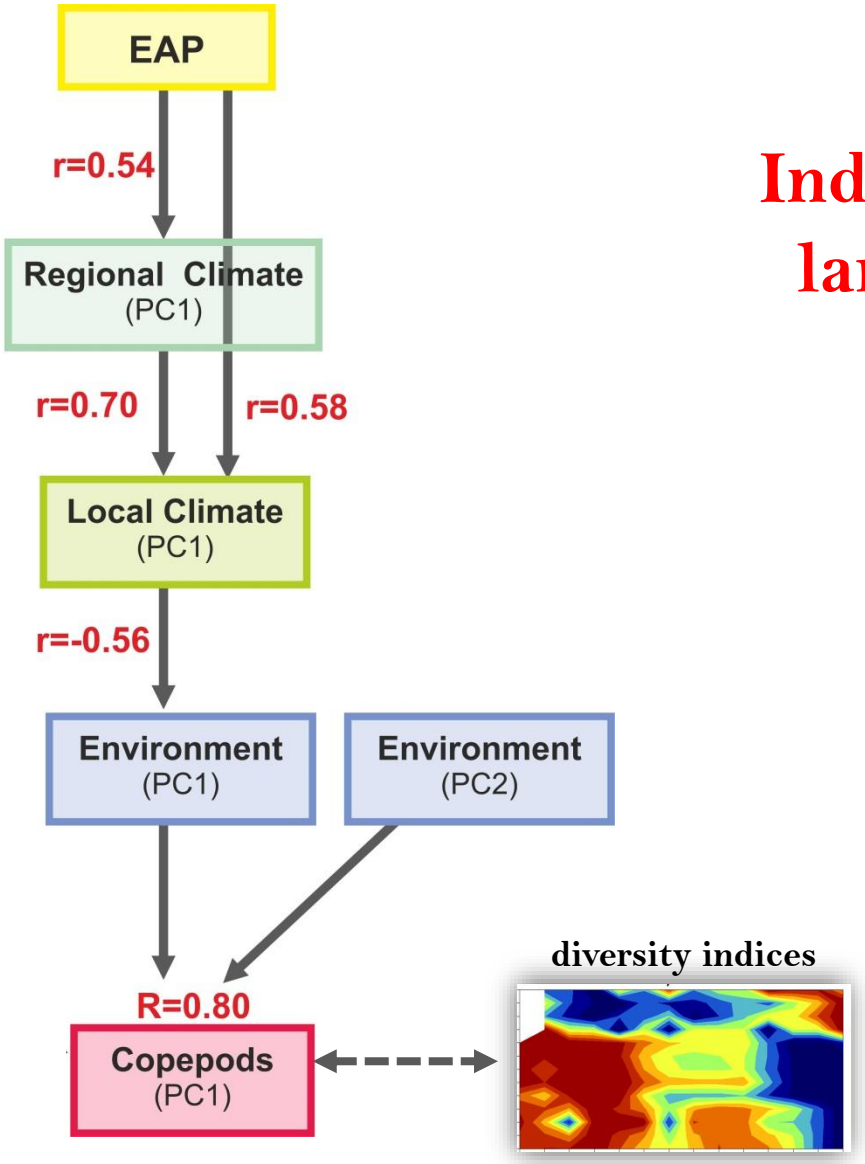
EAP	NAO	NHT	AO
r=-0.11	r=0.38	r=-0.34	r=0.20
p=0.66	p=0.21	p=0.26	p=0.51

≠



No direct influence of large-scale processes

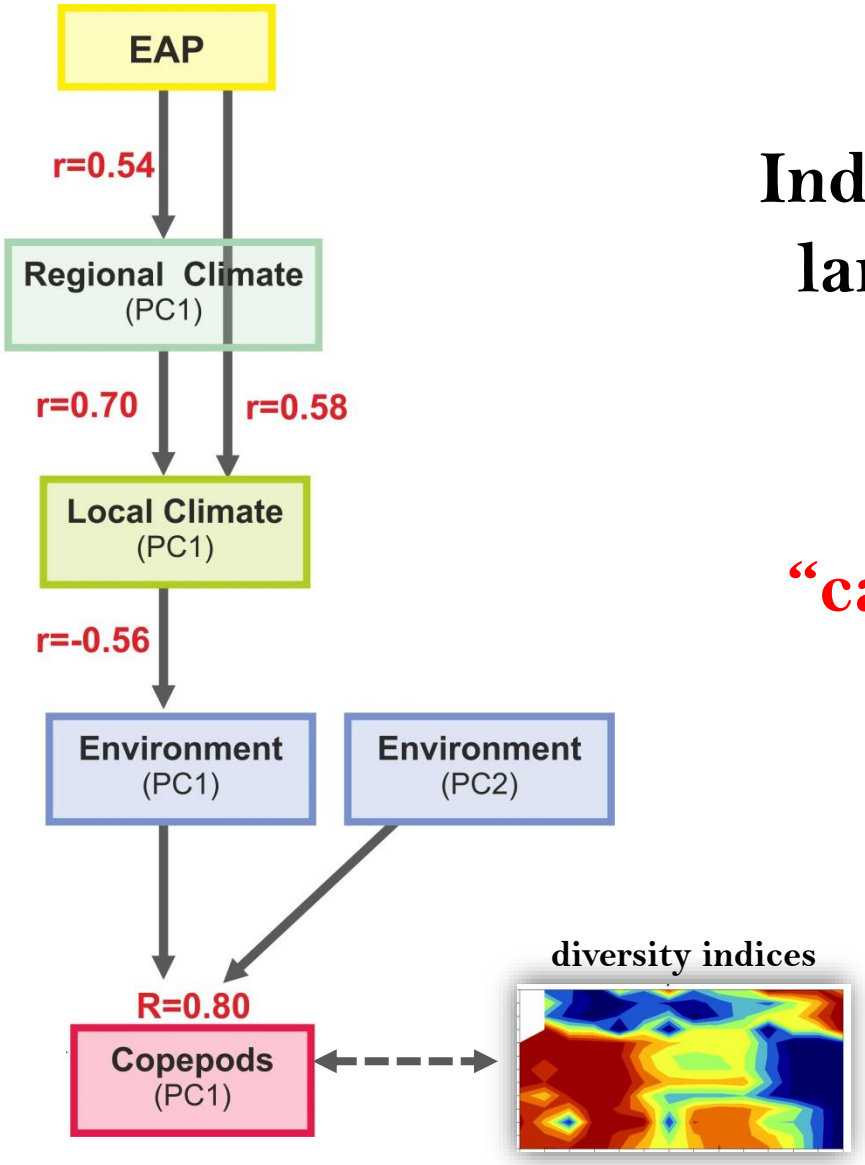
But an indirect influence: a “cascade effect”



Indirect influence of large-scale indices

Ruiz-Gonzalez et al., in prep

But an indirect influence: a “cascade effect”



Indirect influence of large-scale indices

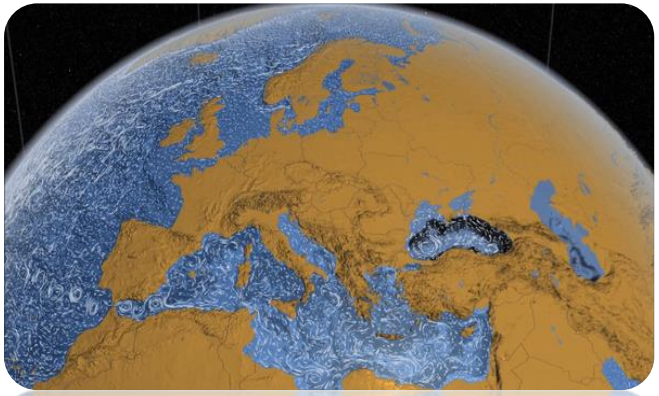
“cascading effects”

Ruiz-Gonzalez et al., in prep

East Atlantic Pattern

Atlantic Ridge

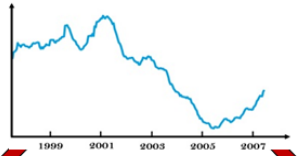
Oscillation Multidécennale Atlantique



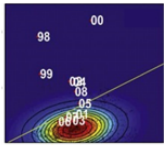
Circulation atmosphérique et océanique
(échelle régionale)

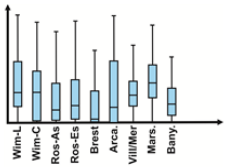
Régimes de vent, précipitations et débits
(échelle locale)

Environnement côtier

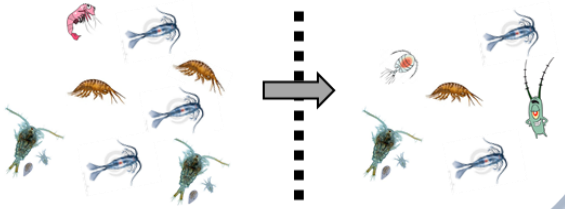


↘ **perturbation anthropique**
(eutrophisation)





modification des assemblages/diversité pélagiques



Goberville et al. 2010, 2011a,b, 2014; Tréguer et al., 2014; Richirt et al., subm.; Ruiz-Gonzalez et al., in prep

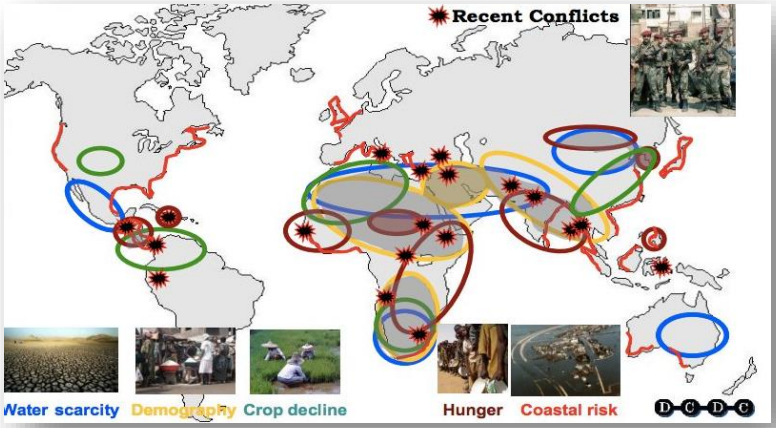
Some perspectives (amongst others…)

Influence of extreme weather events ?

(G. Charria et al.)

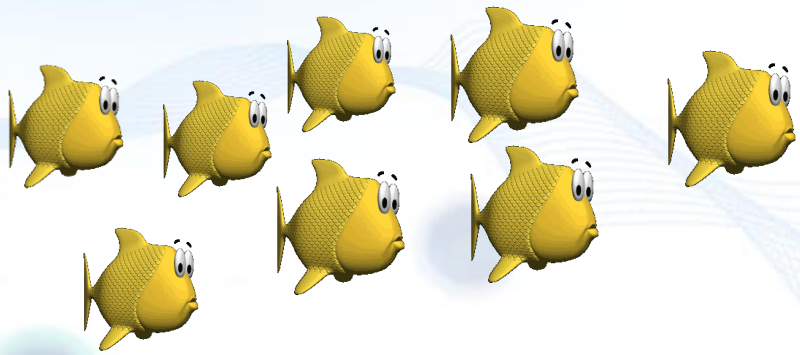
A large-scale approach

(similarities, differences, synchronous events…)



Thanks to all my colleagues who have leaded and/or contributed to these studies.

And many thanks to the entire SOMLIT team: technicians, researchers, students, captains, crews, etc… who have contributed to the collection of samples since 1997…



'Alone we can do so little, together we can do so much' (Helen Keller)