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Trends in phytoplankton species abundance in shelf waters of the Galician upwelling (NW Spain)

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UN OCÉANO, UN FUTURO
1914-2014 I CENTENARIO INSTITUTO ESPAÑOL DE OCEANOGRAFÍA

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Introduction:

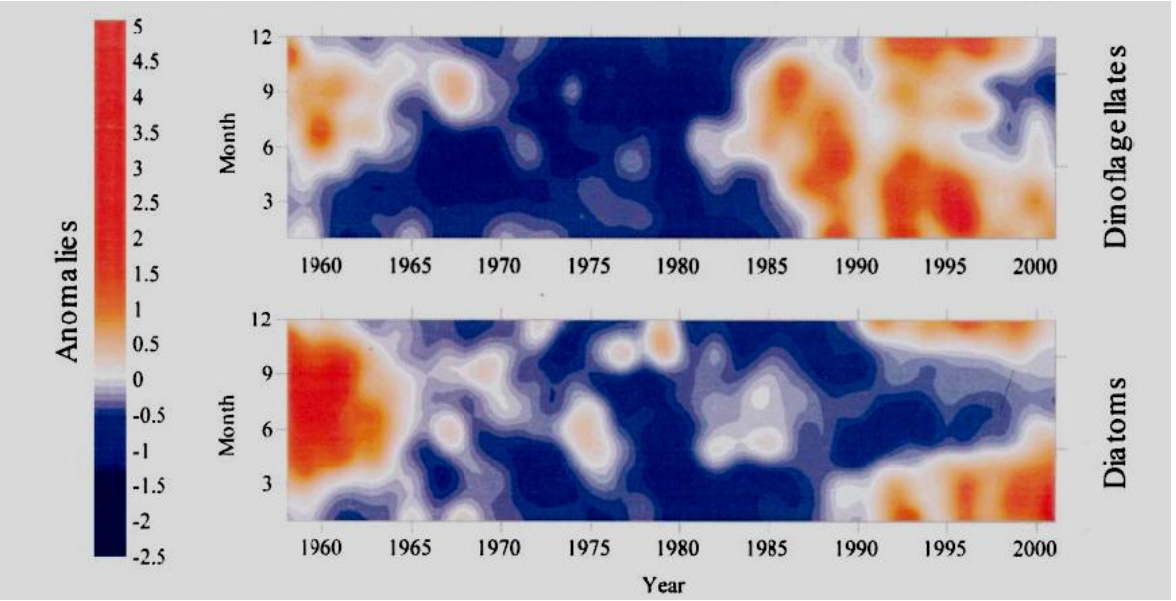
Phytoplankton: sentinel of marine ecosystem change

many species & different life-history strategies

rapid response to environment changes

Example:

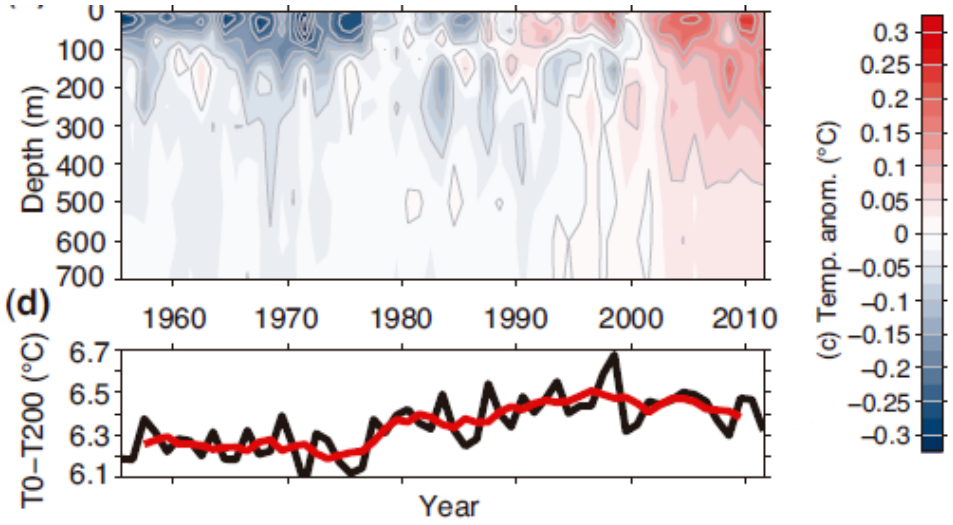
The North Sea



Edwards et al. 2006, Limnol. Oceanogr. 56: 820-829

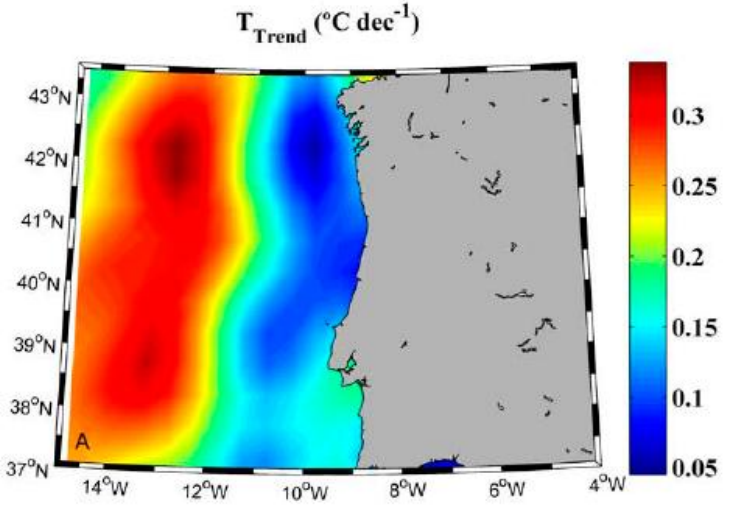
Introduction:

The ocean is warming at unprecedent rates during the anthropocene



IPCC AR5, 2013

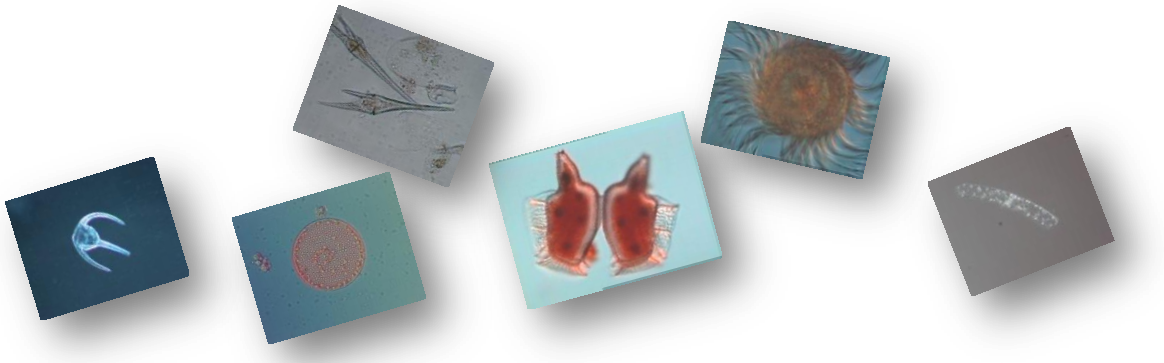
upwelling regions may display different trends because of reduced or no warming



Santos et al. PlusOne 2012, doi:10.1371/journal.pone.0050666.g002

Objective:

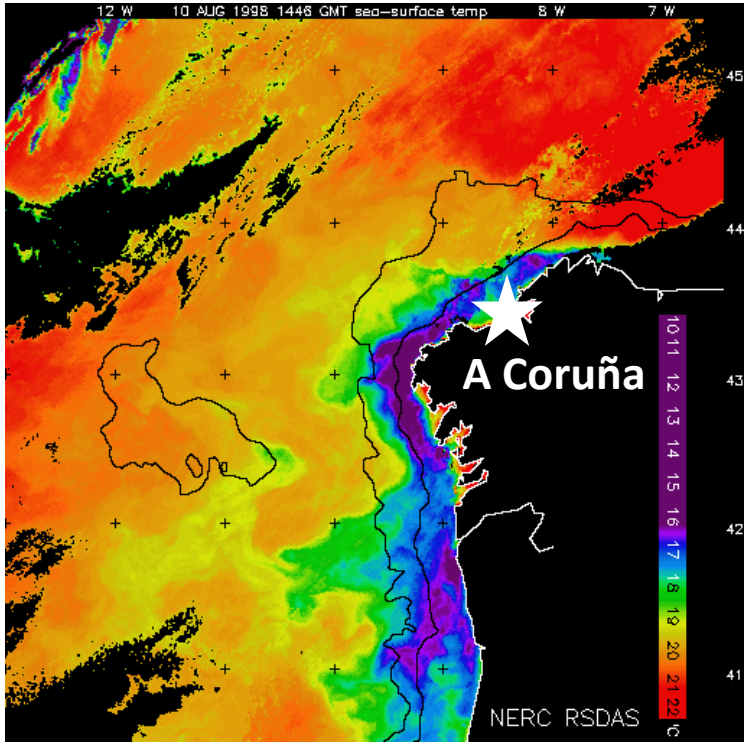
To determine the main trends in phytoplankton species composition in relation to climate and upwelling



Analysing time series of Galicia (NW Spain)

Methods:

Phytoplankton time-series from A Coruña (St. 2, RADIALES) 1989-2008



INSTITUTO ESPAÑOL DE OCEANOGRAFÍA 1914

http://www.seriestemporales-ieo.com/

Methods:

sampling & determinations

- Sampling: Niskin bottles (rossete)
- Abundance: Uthermohl microscope counts, taxonomical groups (or species)
- SST and nutrients: CTD casts, segmented flow analysis
- Upwelling index: Ekman transport

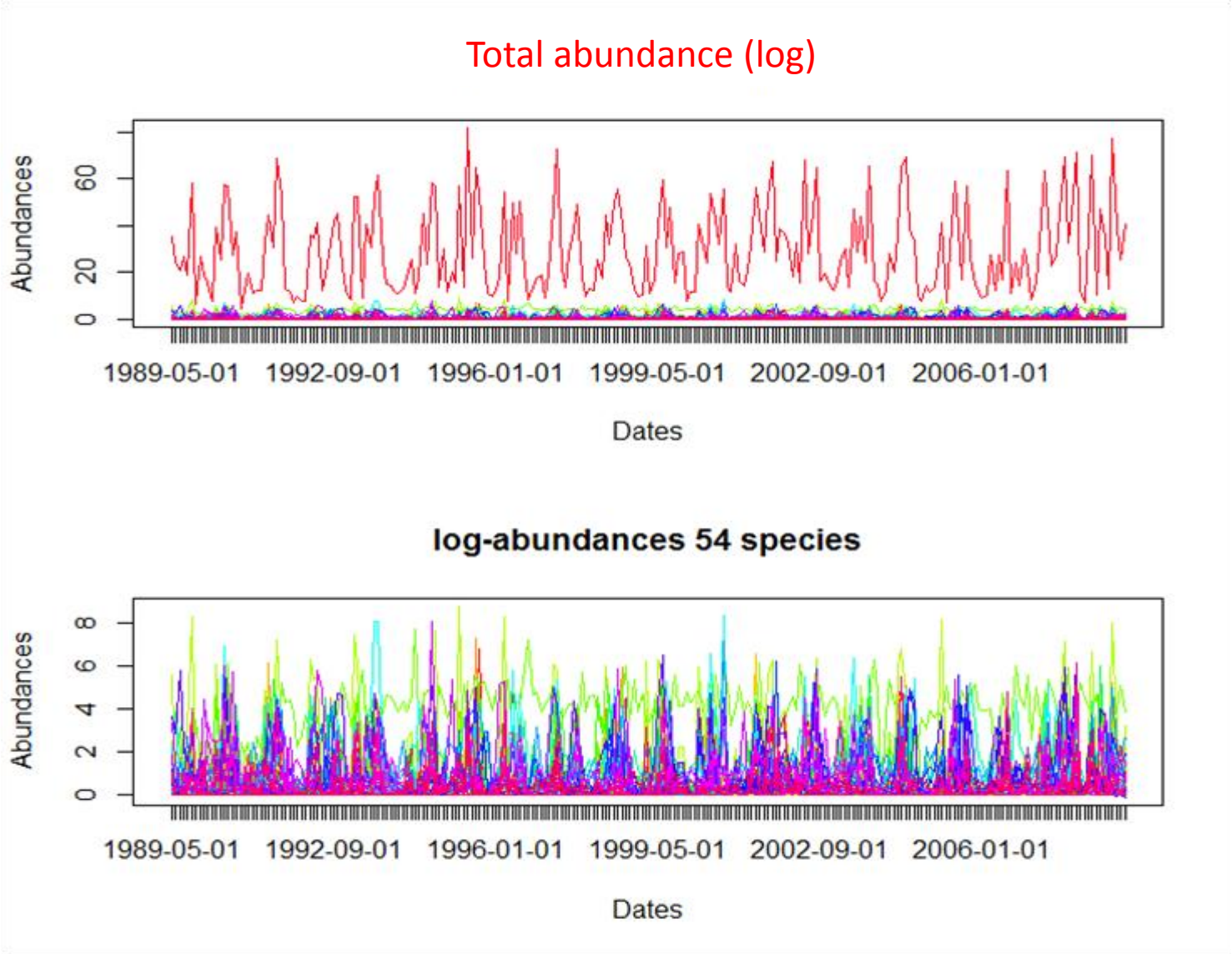
(http://www.indicedeafloramiento.ieo.es/)

statistics

- Species groups using functional methods and wavelets (clustering)
- Description of temporal variability (trends)
- Relationships between phytoplankton and environmental variables

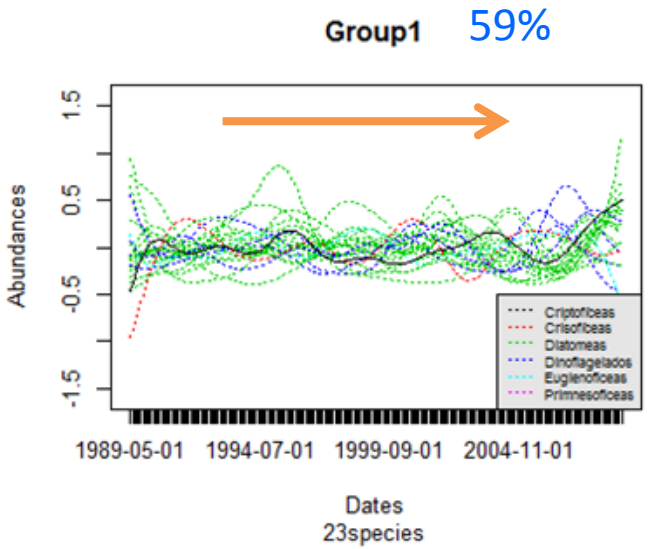
(variable selection: correlation, additive models)

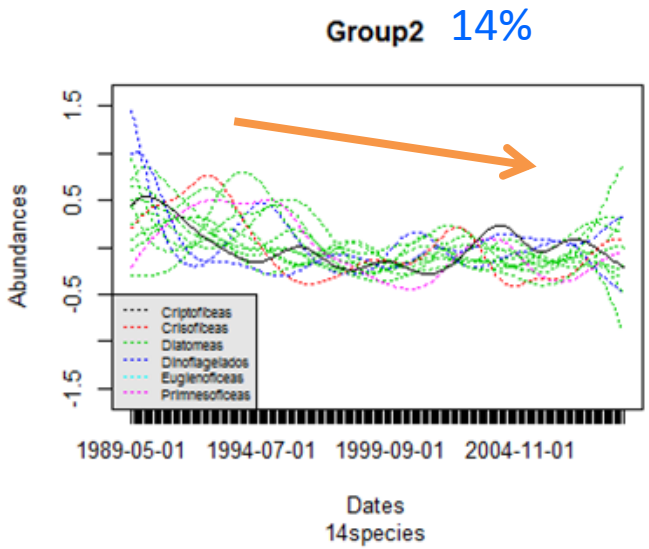
Results: raw series

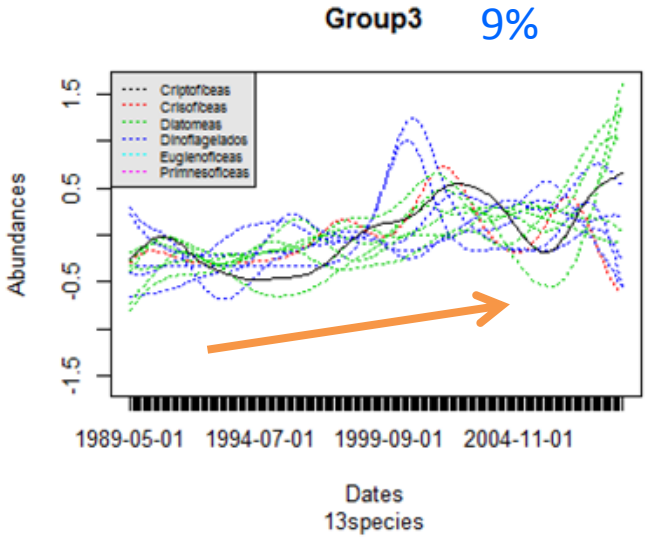


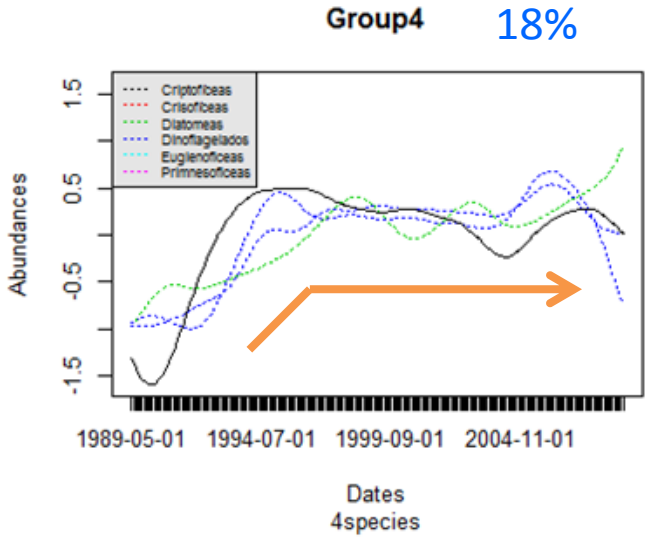
Results: species groups by trend

standardized abundance







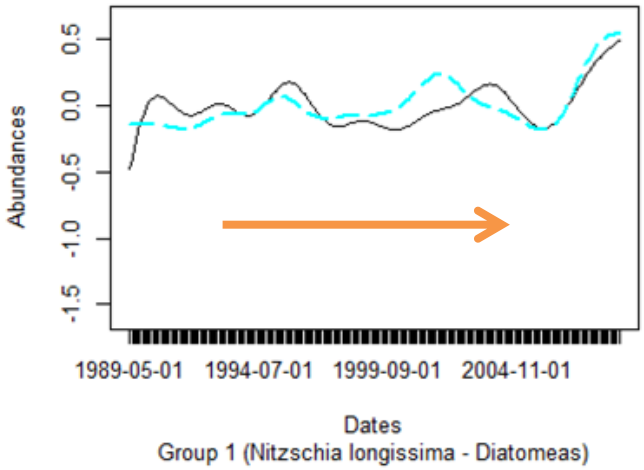


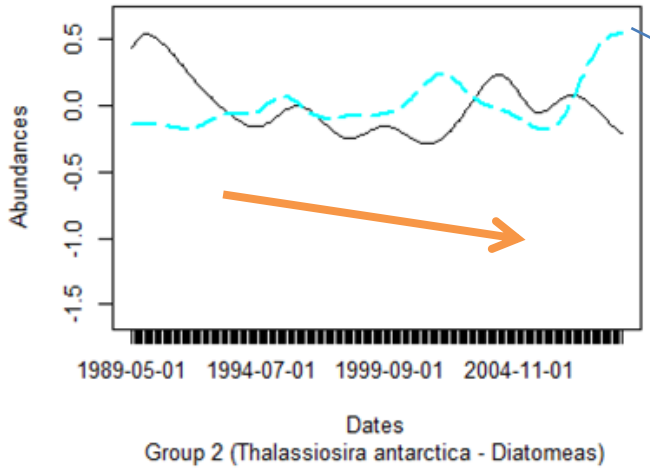
Diatoms
Dinoflagellates
Crysophyceae
Cryptophyceae
Euglenophyceae
Prymnesophyceae

% contribution to total abundance

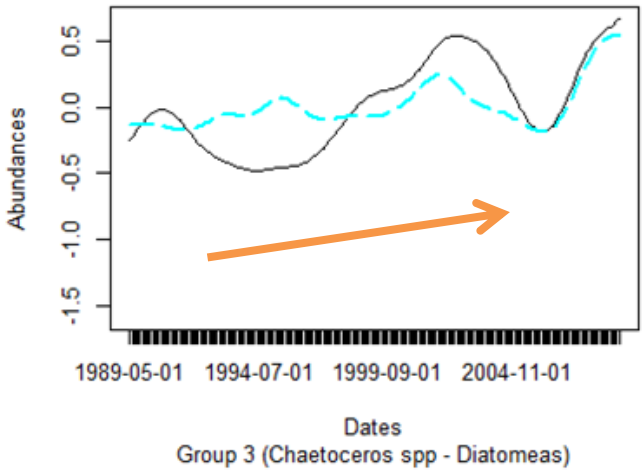
Results: representative (pattern) species

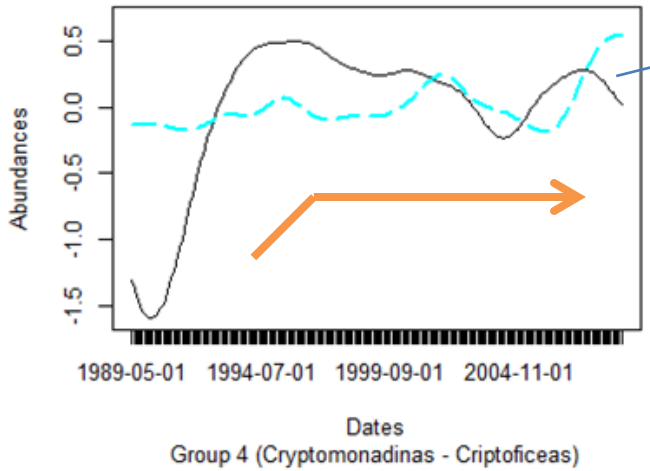
standardized abundance





total abundance

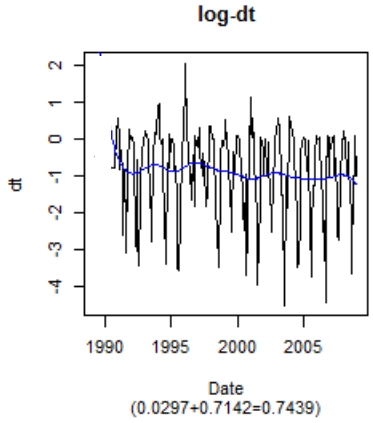




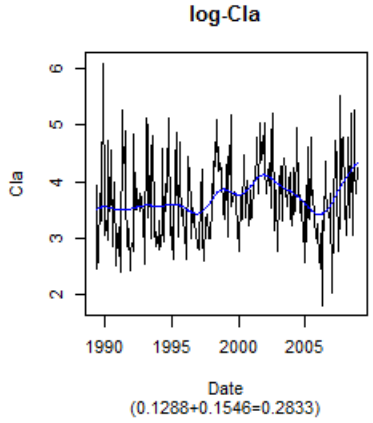
medioid

Results: environmental variables

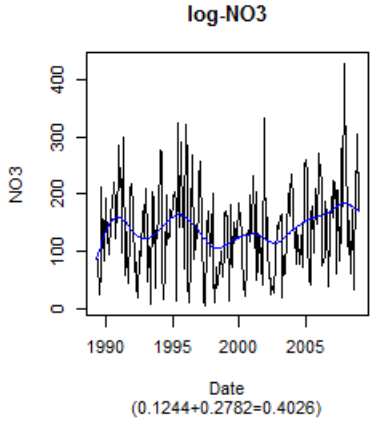
stratification



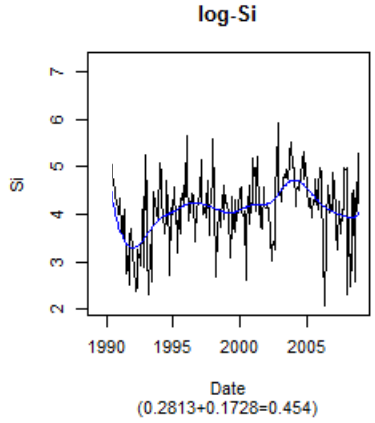
chlorophyll

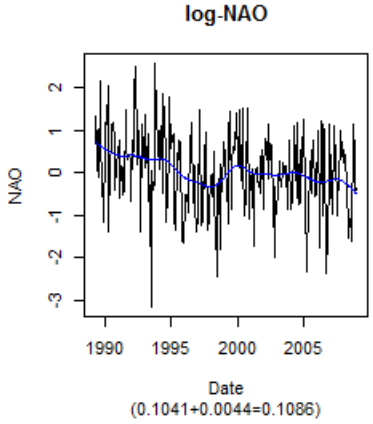


nitrate

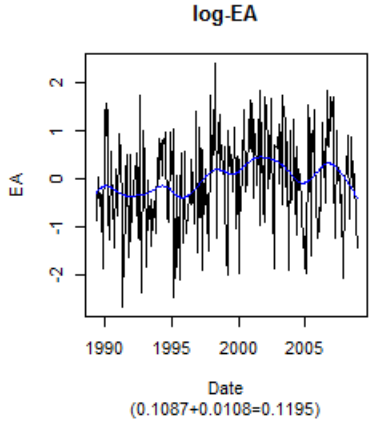


silicate

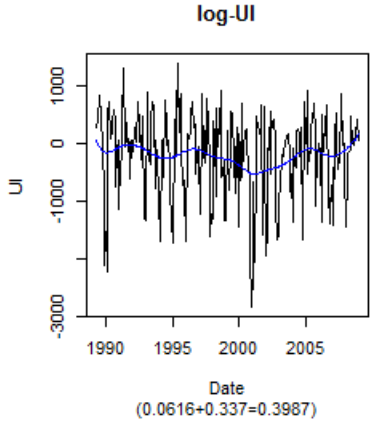




NAO



EA

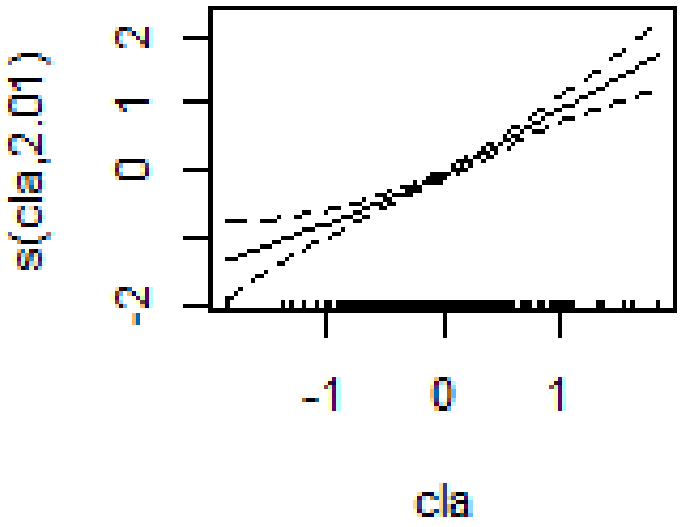


upwelling

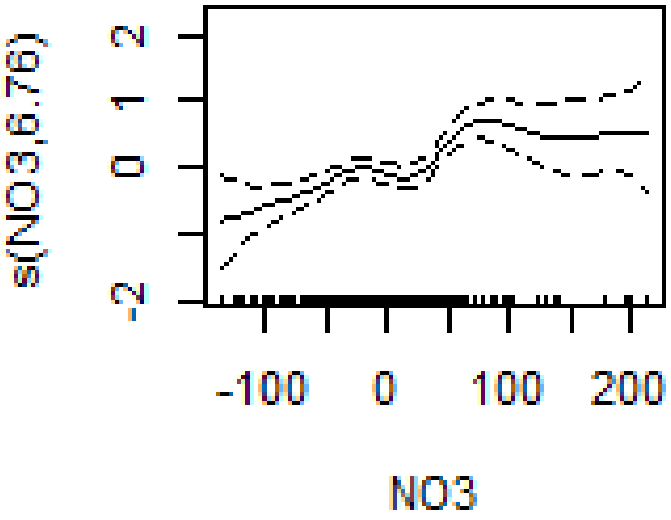
Results: additive models

total abundance

chlorophyll

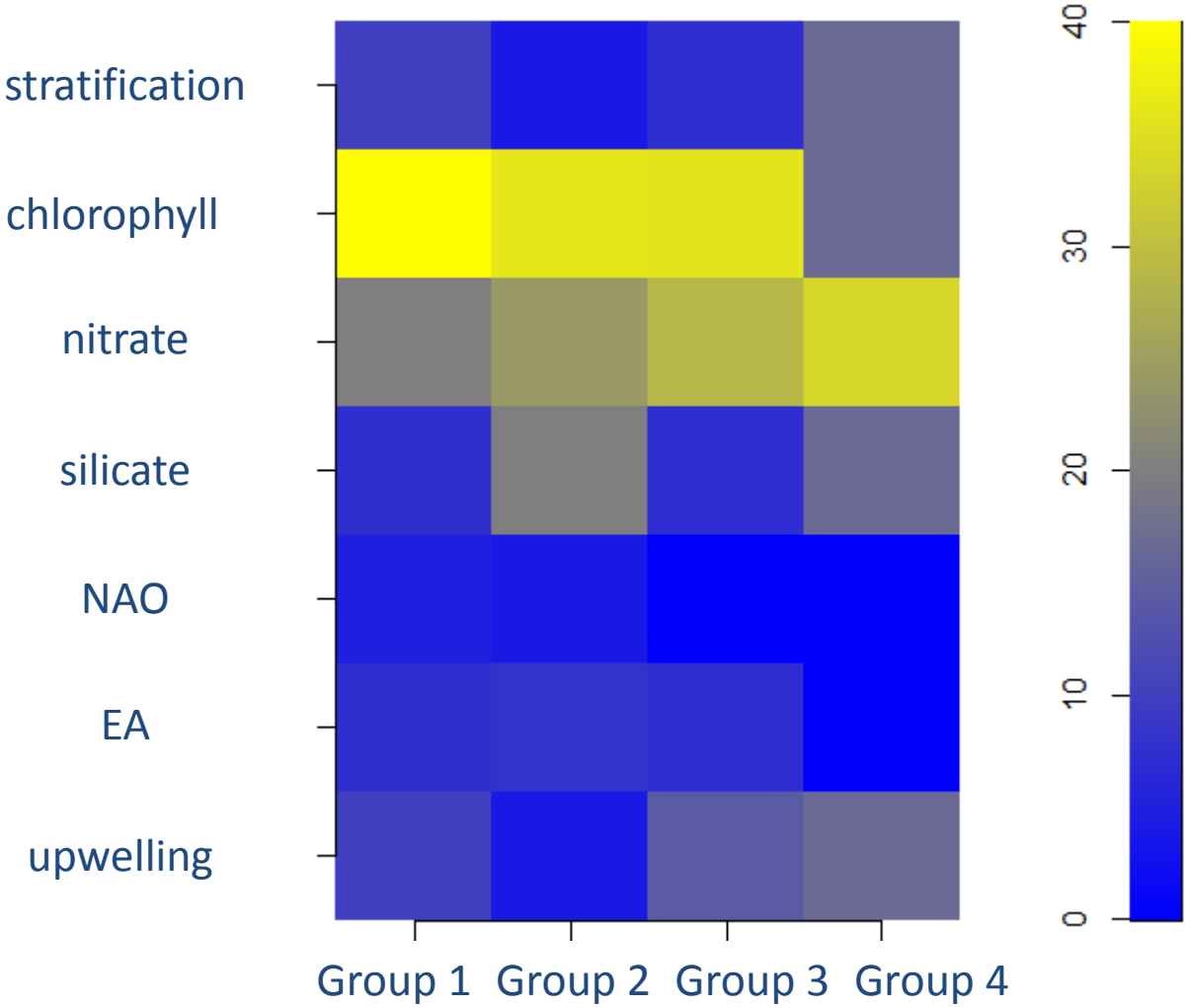


nitrate



Results: additive models

Significance of variables by groups (%)

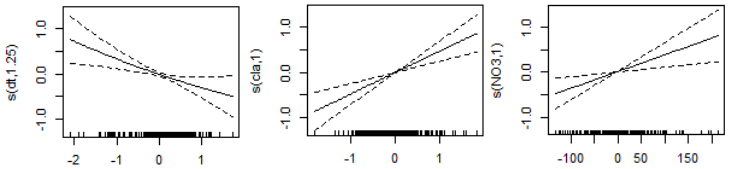


Results: additive models

stratification chlorophyll nitrate silicate EA upwelling

Nitszchia longissima

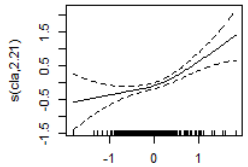
Group 1



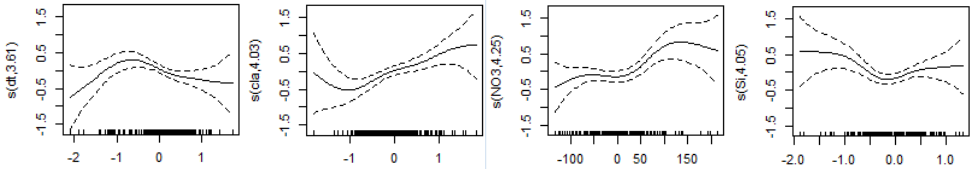
Chaetoceros socialis

Thalassiosira antarctica

Group 2

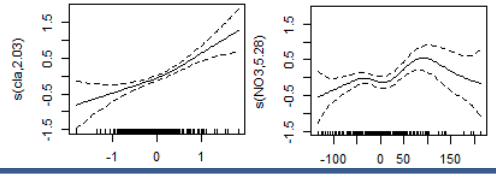


Pseudonitzschia pungens



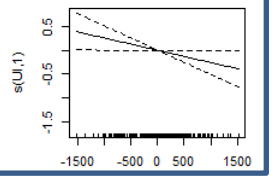
Chaetoceros spp.

Group 3

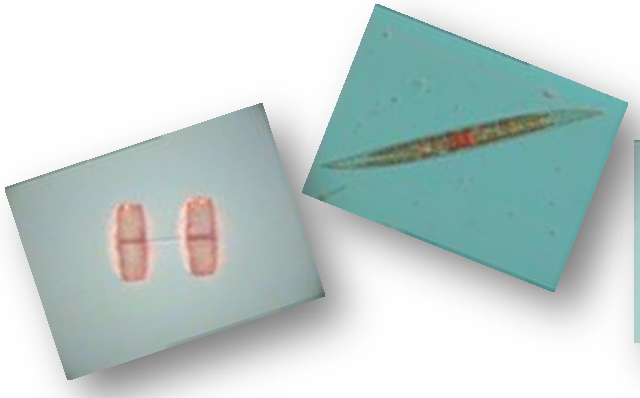


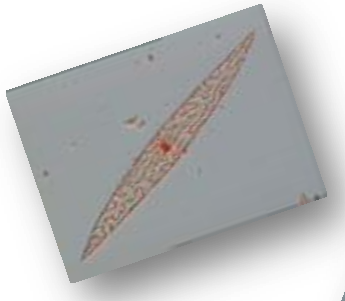
Cryptophyceae

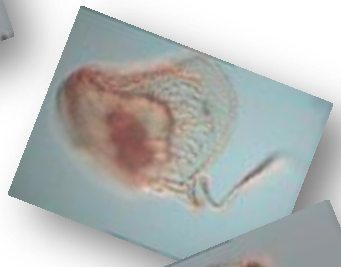
Group 4

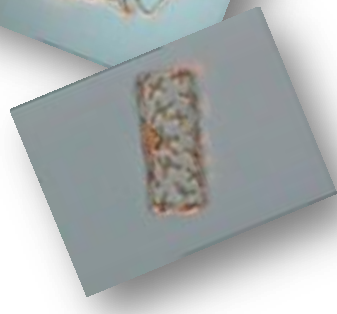


Conclusions:









- Weak long term trends of phytoplankton species
- Characteristic changes due to diatoms
- Weak effects of regional climate (e.g. NAO) and local stratification (no changes in upwelling)
- Phytoplankton adapted to local disturbance
- Phytoplankton communities in upwelling ecosystems are less sensitive to changes in regional climate