

# Identifying the undefinable

Identifying ecological regime shifts in the Northeast Atlantic from phyto- and zooplankton records, and using machine learning to predict when they will occur in future



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## Background and motivation

I have always been interested in how the environment influences the diversity, abundance and behaviour of plankton, especially phytoplankton. After completing my PhD focussed on improving how well harmful algal blooms can be predicted around Shetland, I became interested in how changes in the environment can cause abrupt changes in planktonic ecosystems. The project and team advertised in the SEAS programme catered to this interest.

## Project description

I have developed a new method to identify ecological regime shifts. Regime shifts are large, abrupt and persistent changes in the function and structure of an ecosystem, and the risk of them occurring is increasing as the Ocean is changed by human actions. It is therefore important that past regime shifts can be identified correctly, and hopefully forecasted. Accurate forecasting of regime shifts will allow us to interact with the Ocean in a sustainable manner.

## Main questions

When have regime shifts occurred in the past (using the North Sea as a case study)?

Are there underlying structures in plankton abundance data which preceded these regime shifts?

Are timings of regime shift predictions affected by choosing regions of the North Sea with different hydrodynamic regimes?

## Marine sustainability

Changes to phytoplankton and zooplankton related to regime shifts have been associated with changes in the abundance of fish and even marine mammals. A change in abundance or species of phytoplankton can also influence how well the ocean acts as a carbon sink. Regime shifts are therefore directly related to three UN sustainable development goals:

- 2 Zero hunger
- 13 Climate Action
- 14 Life below water

## Highlighted results (and/or activities)

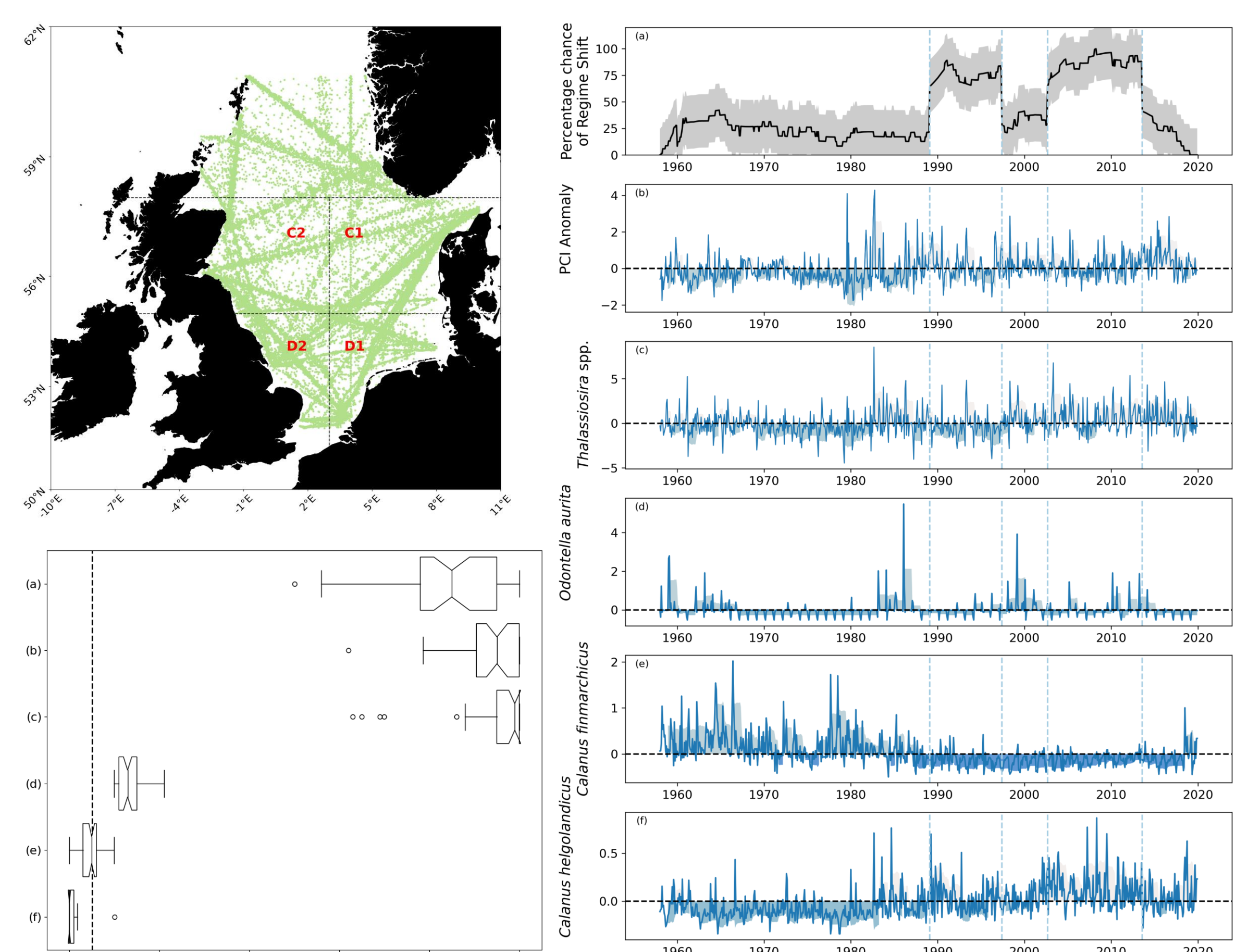
Collaboration within SEAS

- Coauthored a commentary piece concerning deep sea mining activities and the International Seabed Authority
- Have begun exploring the use of my model on past ecological data from foraminifera shells, with help from several other SEAS fellows

Written several blog posts on the SEAS blog and recorded a SEAS podcast episode with fellow Juan Manuel Valero

## Aims (and/or milestones)

- Obtain ecological data from long-term datasets ✓
- Develop reliable method to detect past regime shifts ✓
- Write methodology paper describing model for publication, with fully commented code 90%
- Obtain physical data ✓
- Write application paper showing difference in regime identification for different North Sea regions 75%
- Develop machine learning method which can detect regime shifts in testing data and predict future regime shifts 50%
- Finish collaborative project with Aiste Klimasauskaite, Ola Gunhildrud Berta and other authors 99%



## Supervisory team

Christoph Heinze (retired from GFI)  
Frederike Frøb (GFI)  
Truls Johannessen (GFI)  
Morten Skogen (IMR)



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