Long term changes in North Sea physics and phytoplankton

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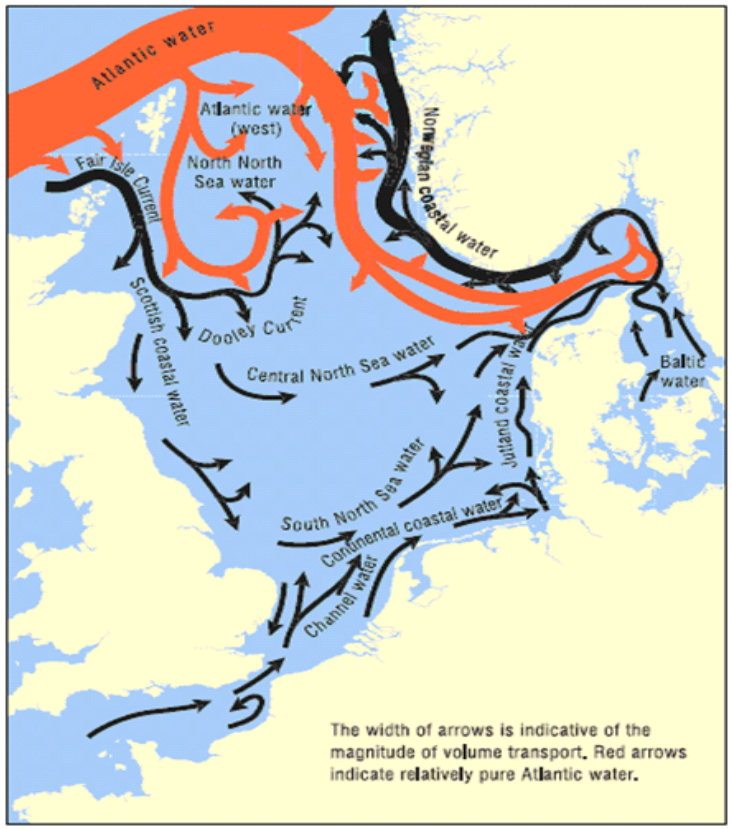
INSTITUTE OF MARINE RESEARCH
HAVFORSKNINGSINSTITUTTET

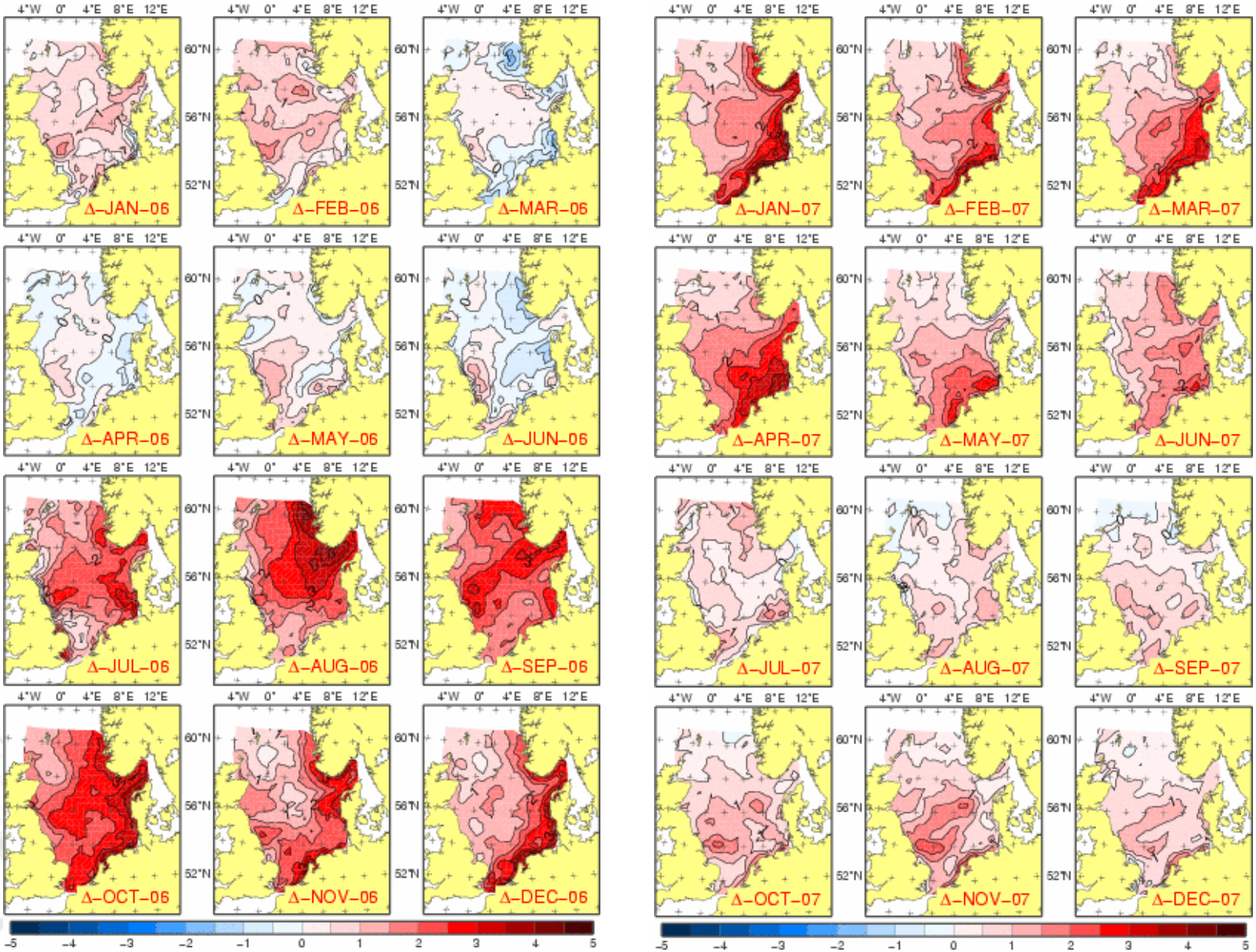
The North Sea



The North Sea is a semi-enclosed, highly productive (>300 g C m^{-2} yr^{-1}), relatively shallow, temperate sea.

A variety of human activities affect the marine ecosystem:

- nutrient enrichment
- coastal developments
- the fisheries
- climatic drivers



http:///www.bsh.de

Coastal warming: Poster S1.1-4752

Forcing factors affecting the biology of chosen exploited species in the North Sea

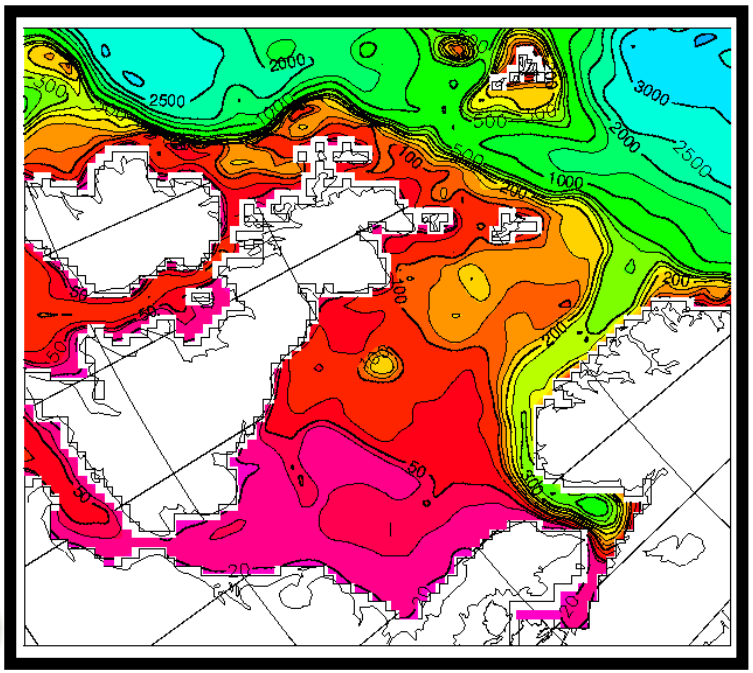
	herring	sandeel	cod	flatfish	nephrops
temperature	1	1	1	1	1
salinity	1	1	1	1	1
nao indices	1	1	1	0	
prey abundance	1	1	1	1/0	
predation	1	1	1	1	
natural mortality	1	1			
habitat modification	1	1		0	1
poll ED/PCB	0		1	1	
nutrient enrichment	1/0	0		1	
fishing	1	1	1	1/0	1

1 =significant effect on biological processes like recruitment, growth. 0=analysis refutes/inconclusive

IN EX FISH Wp1 report
Frid et al, 2008

NORWECOM

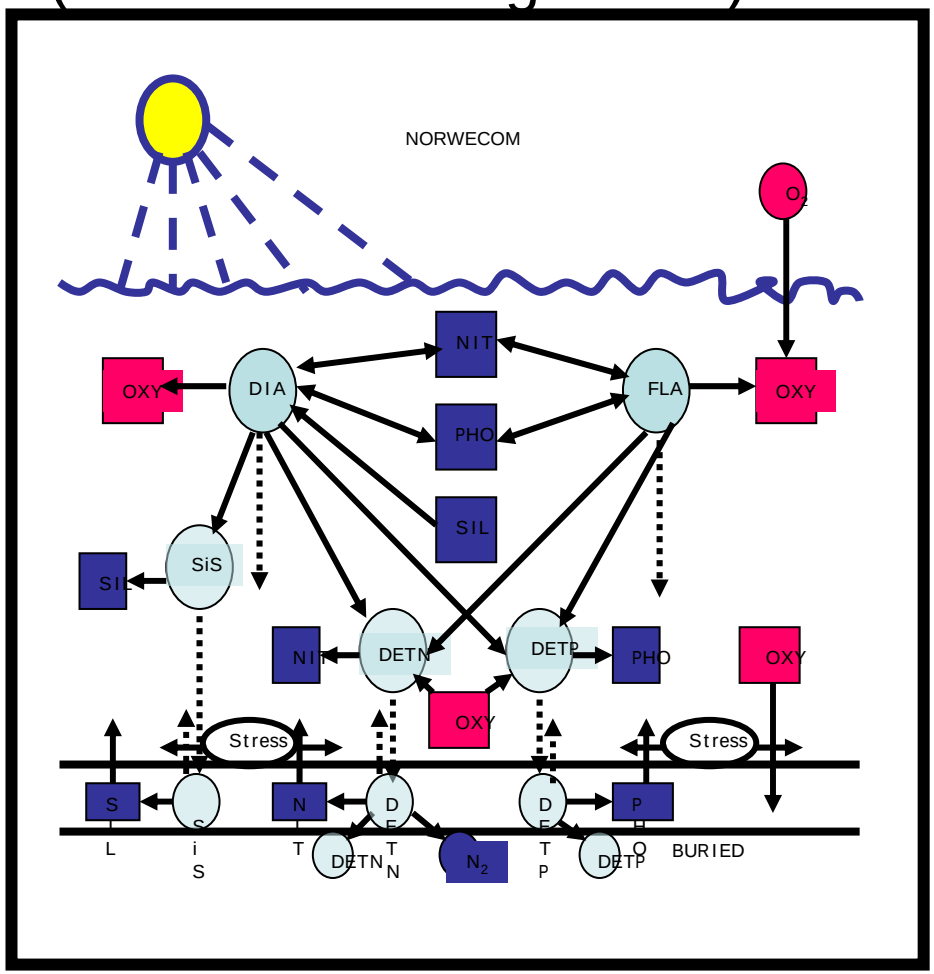
Ocean model: POM



Horisontal res: 10km
Vertical: 21σ-layers

Period: 1985-2007

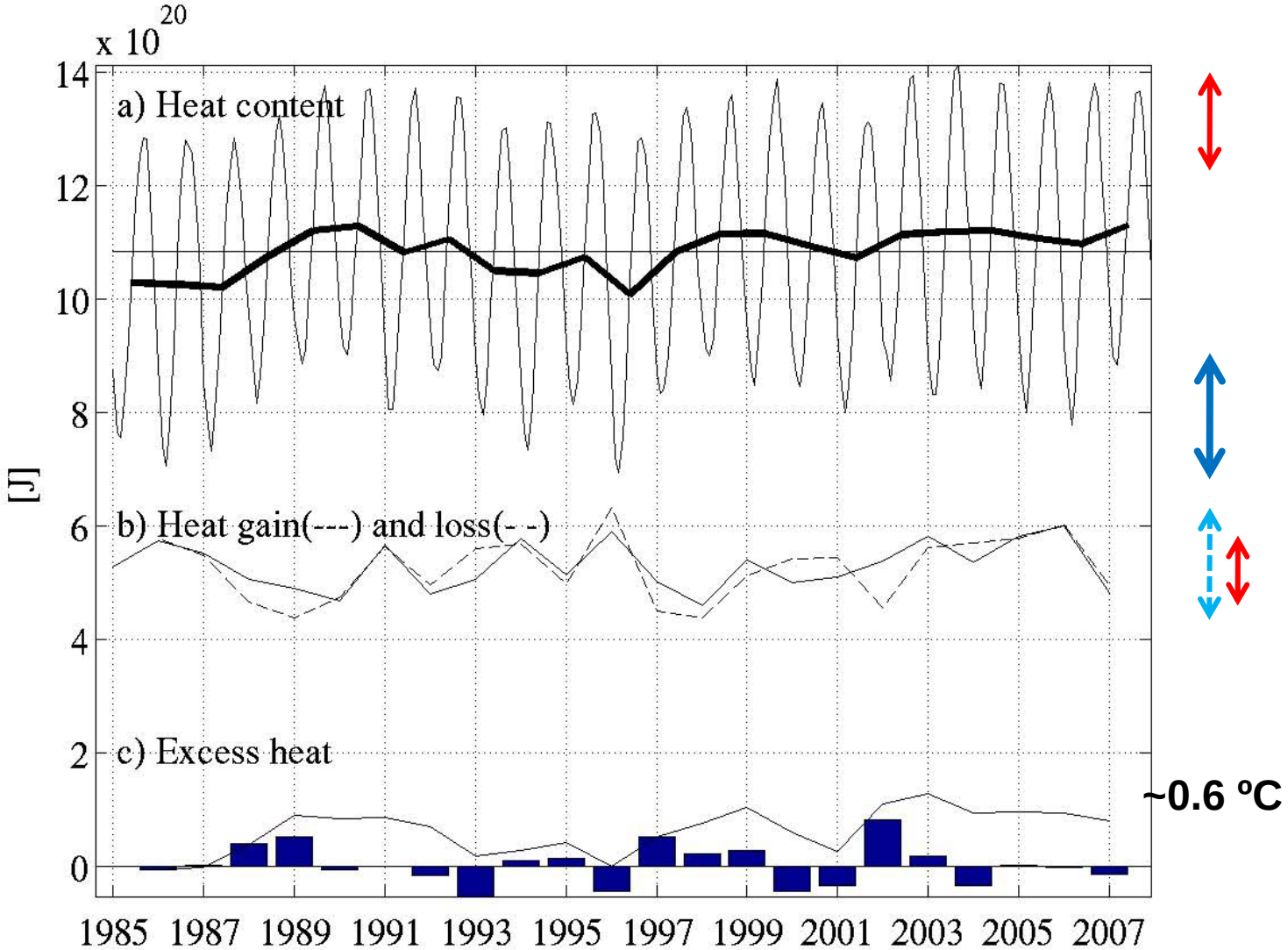
Biological modul
(diatoms and flagellates)

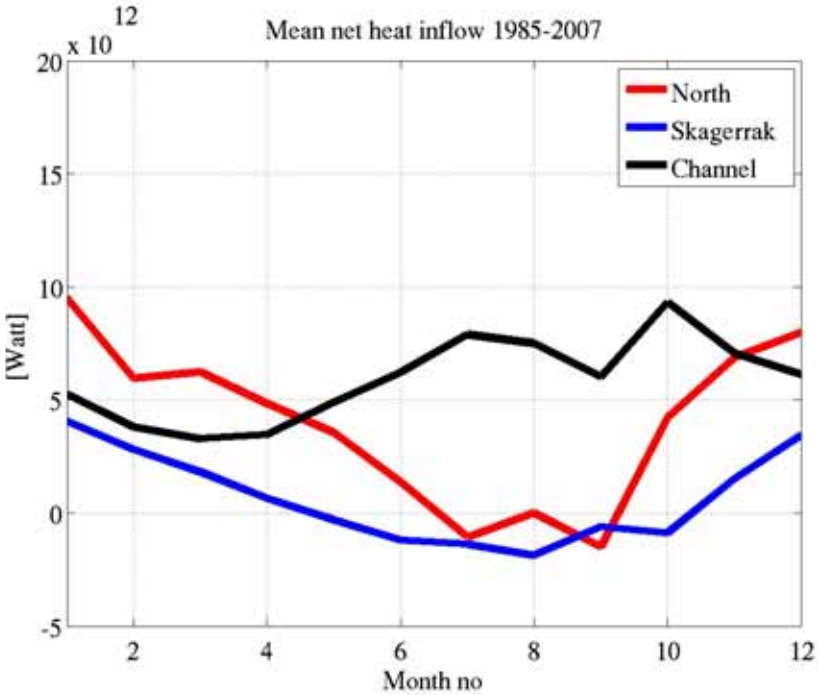


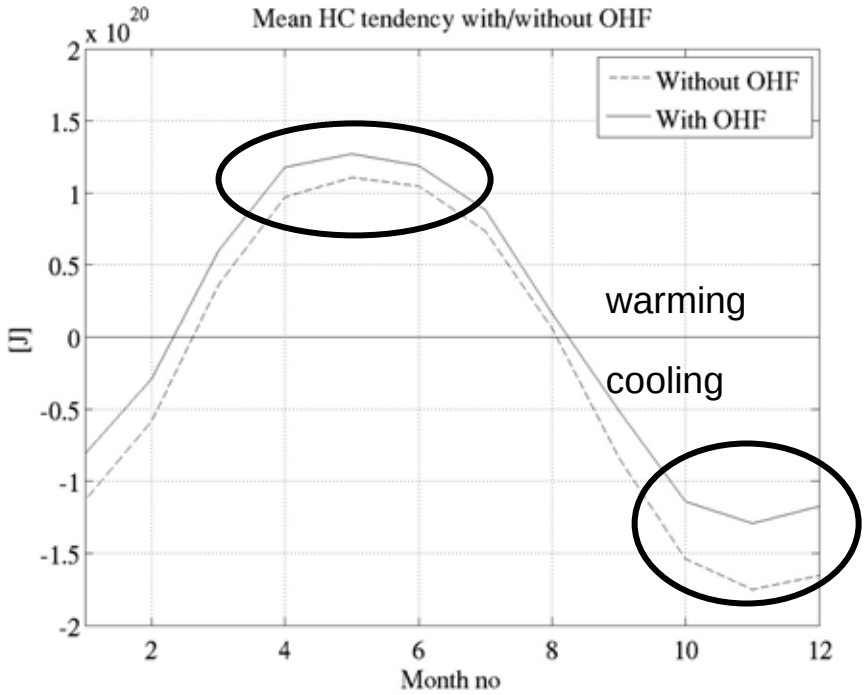
Forcing factors examined

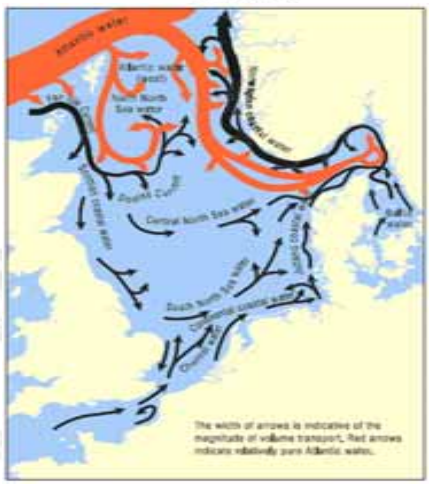
1. Temperature
   - Storage of heat
   - Heat inflow through boundaries
2. Atmospheric forcing (NAO) and its effect on circulation
3. Nutrient enrichment and net North Sea primary production

1: Temperature



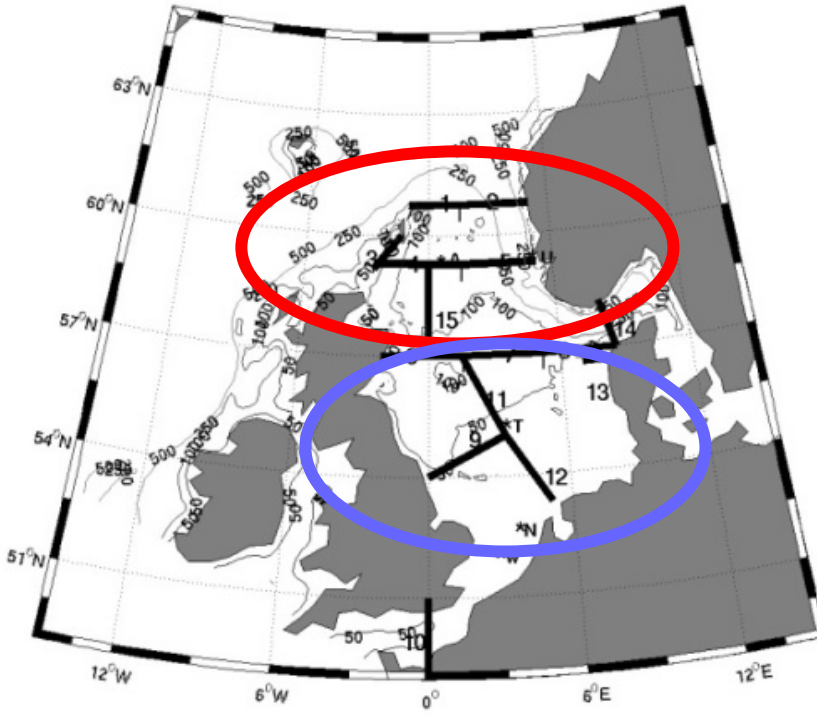


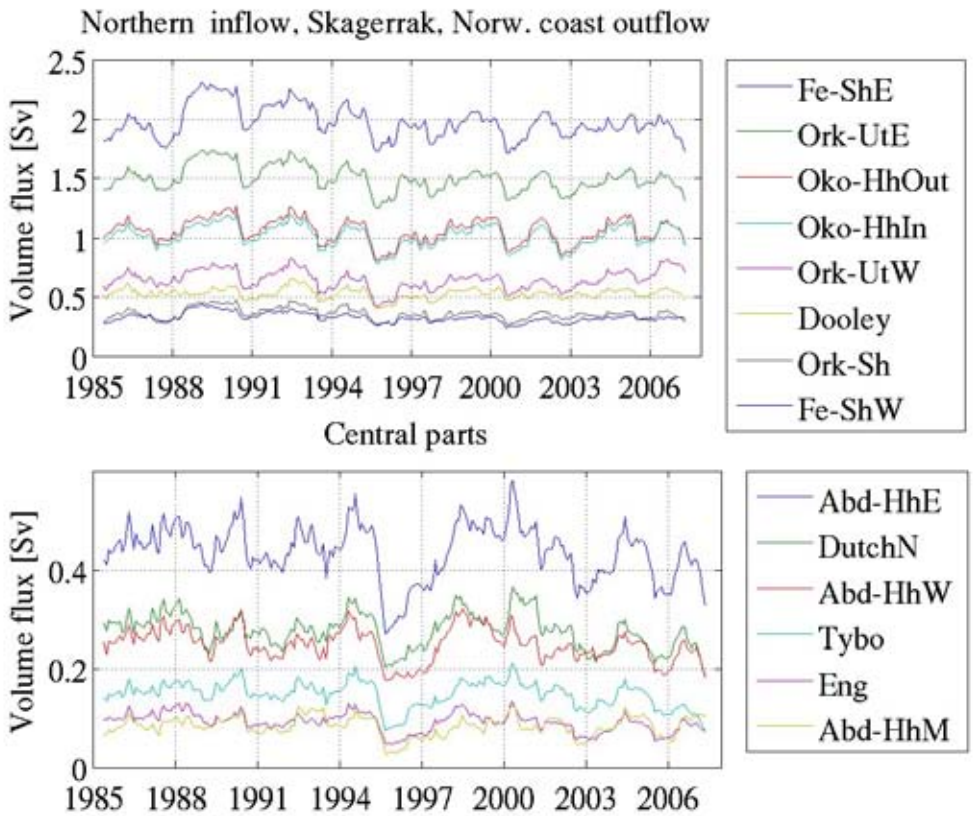


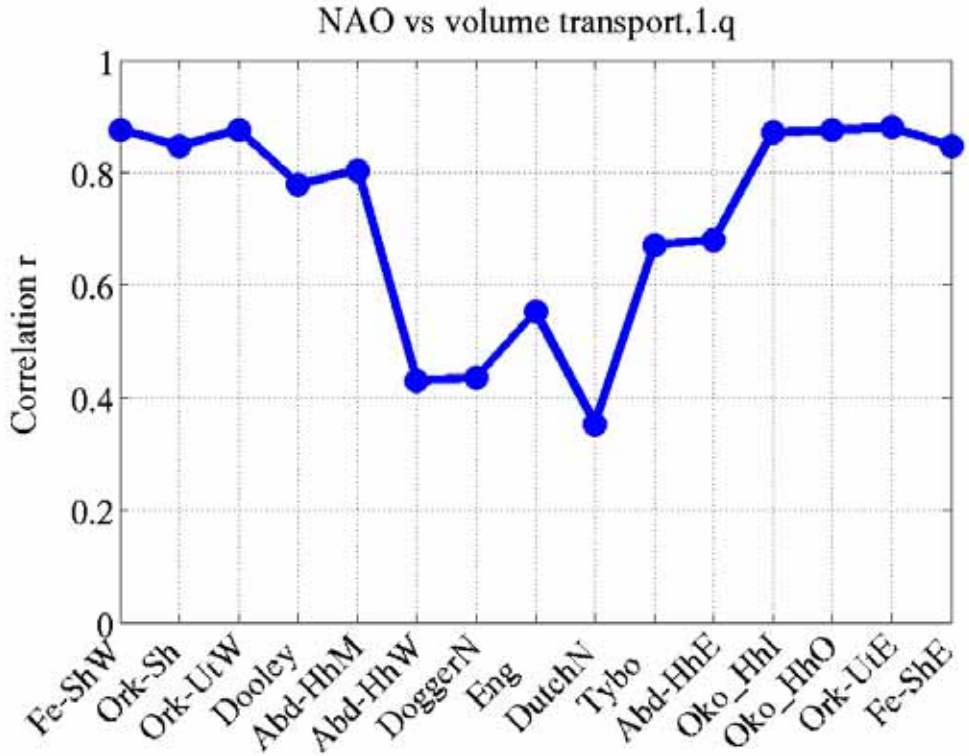


Oceanic heat flux: some extra summer warming, but greatly reduced winter cooling

2: NAO and circulation

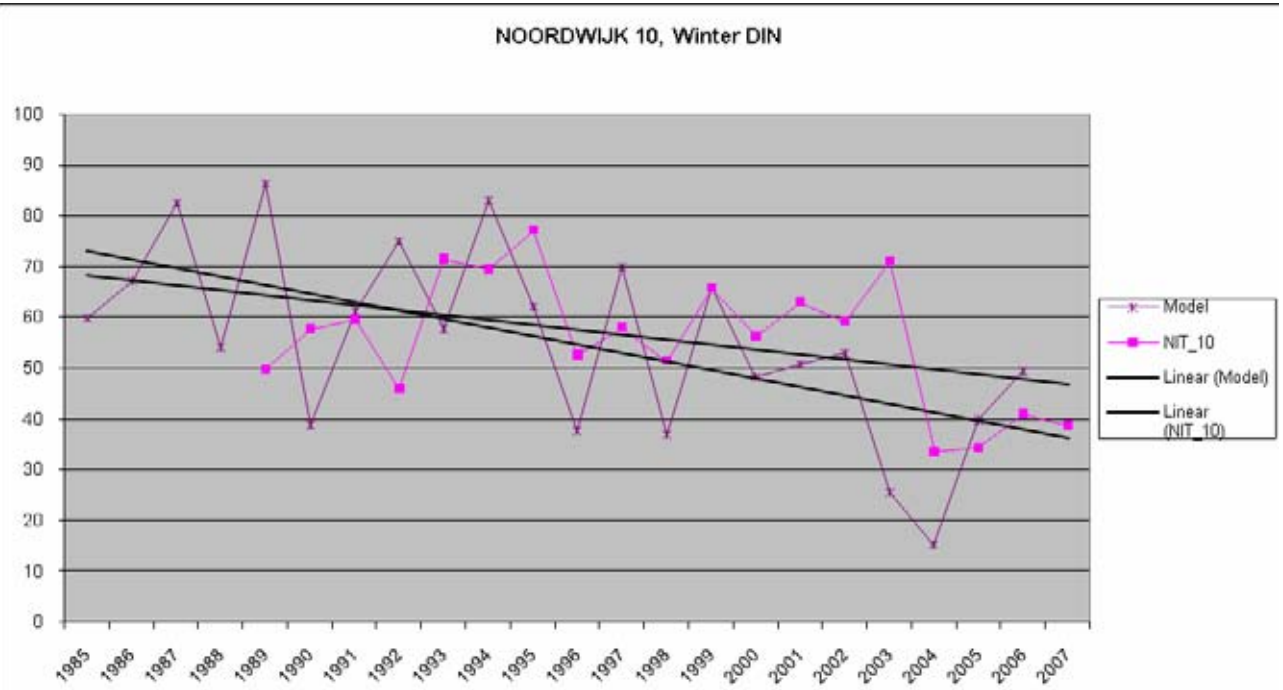


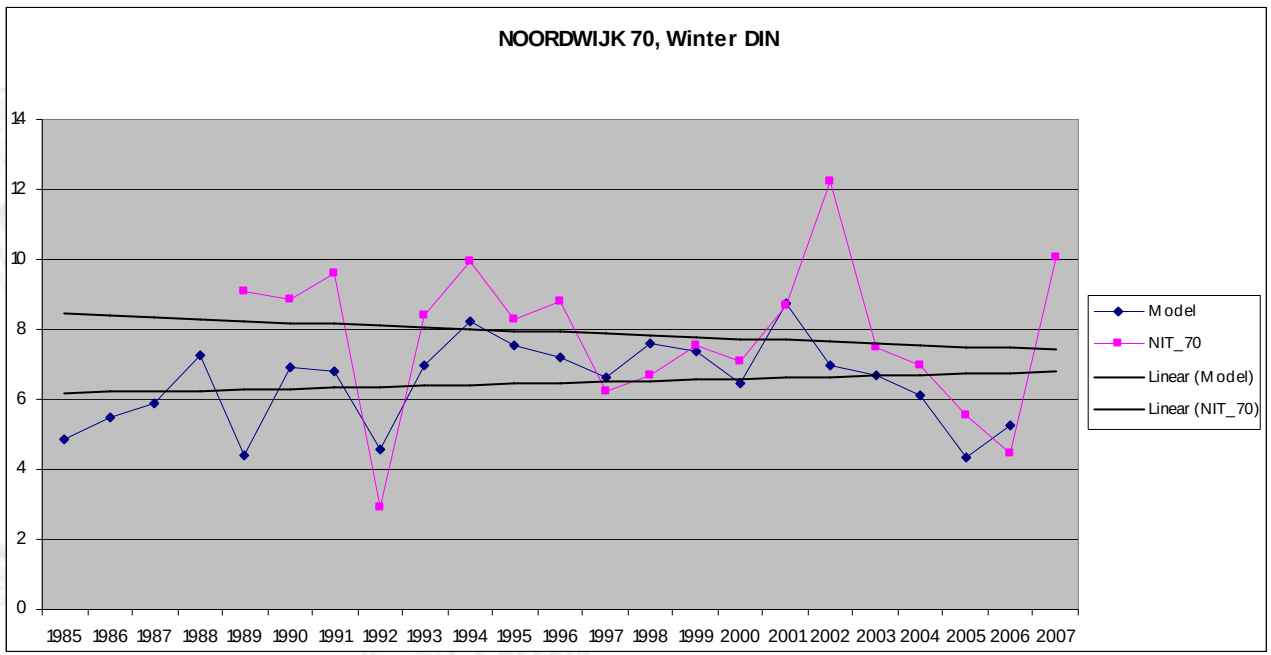


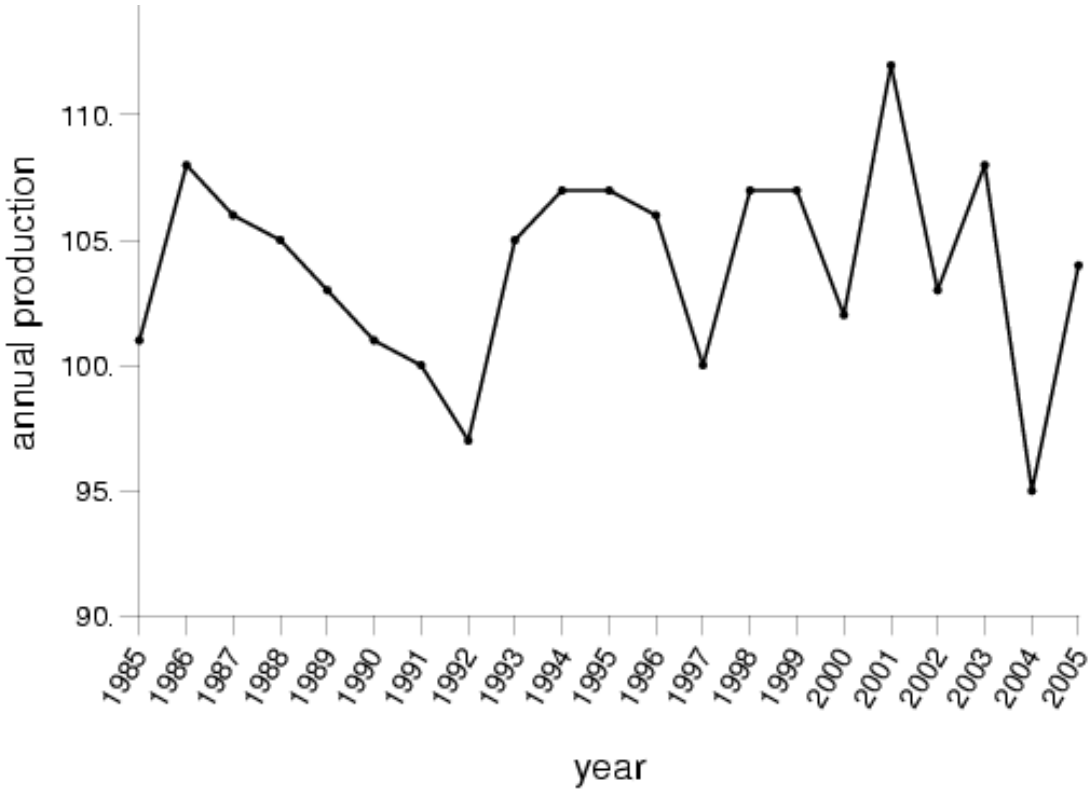


Driving force for winter inflow in north: NAO

3: Nutrient enrichment







Annual primary production related to inflow

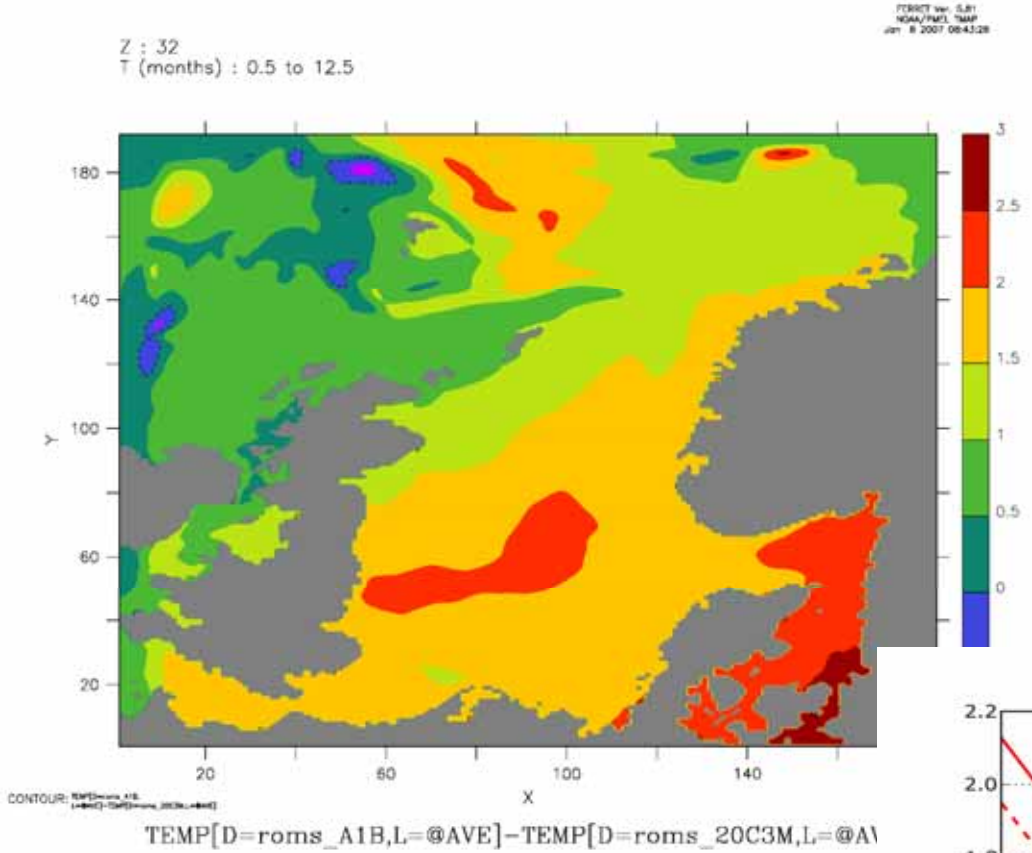
Skogen&Moll(2000), this study

Summary

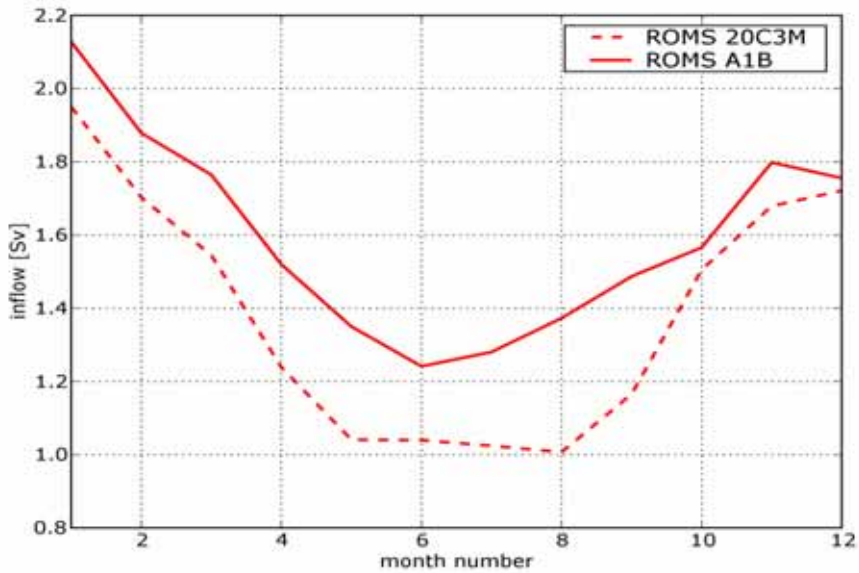
Three forcing factors affecting the North Sea ecosystem

- Temperature; I.e heat content
  - Annual mean weakly increasing
  - Large interannual variation in winter minimum & loss
  - winter oceanic heat inflow reduces winter cooling
  - winter oceanic heat inflow is dominated by northern boundary inflow
- Atmospheric forcing (NAO index)
  - strongly connected to inflow in north, less so in south
- Nutrients
  - No trend in primary production despite negative trends in nutrients

The northern boundary inflow (I.e the Atlantic Inflow) is a main player



Future changes in SST and inflow to the North Sea



Downscaled
20C3M vs. A1B-IPCC-runs
Ådlandsvik, 2008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