IMR activities in the Arctic and the Barents Sea

Arctic-ROOS meeting, 22 Nov 2016

HAVFORSKNINGSINSTITUTTET
INSTITUTE OF MARINE RESEARCH

Mission of IMR

- **Vision**

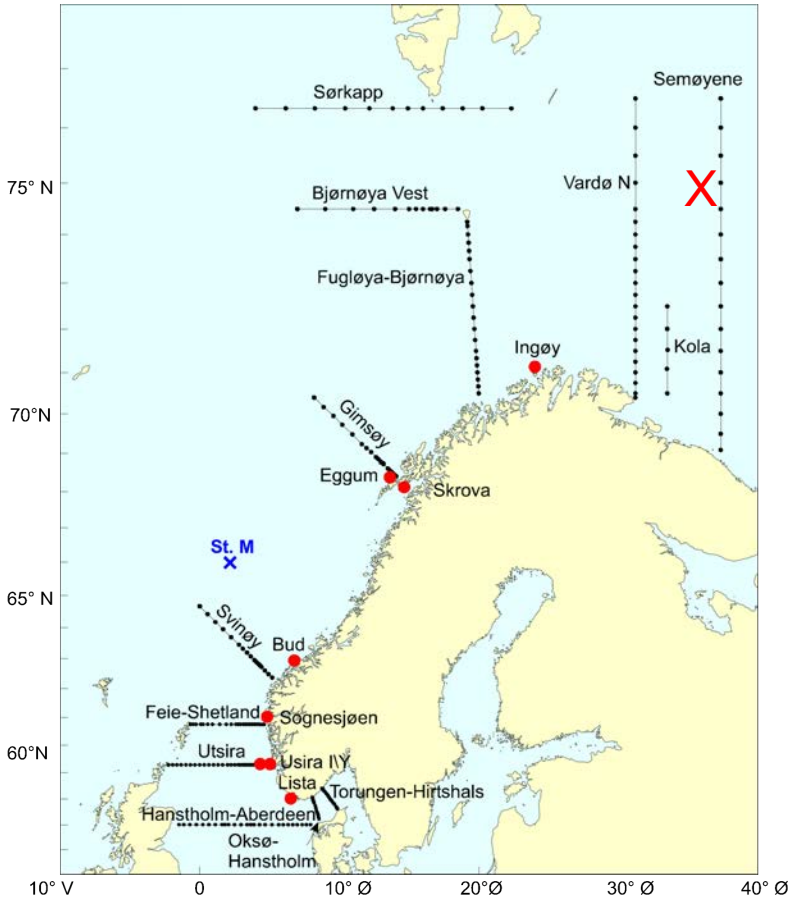
Knowledge and **advice** for rich and clean marine and coastal regions.

- **Ambition**

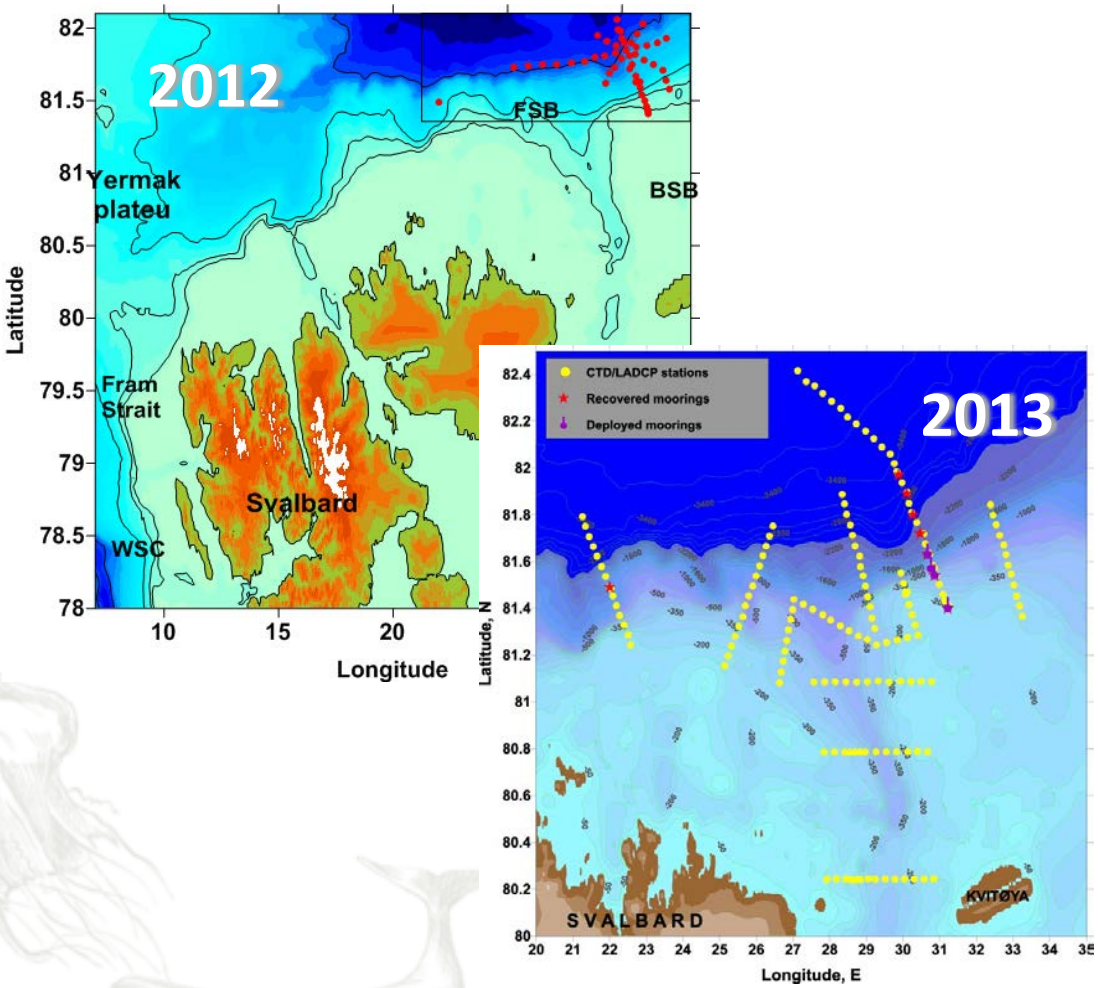
We aim to be international leaders in **marine research** and **management advice**.

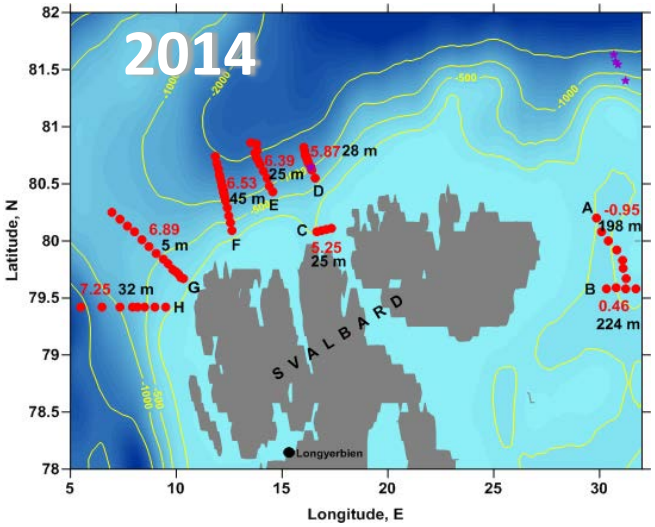
Physical Oceanography

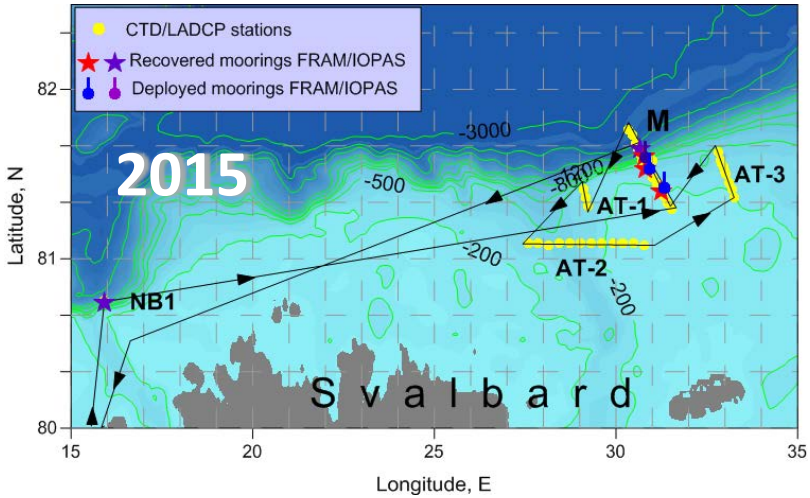
- Hydrographic monitoring (CTD stations)
  - standard sections
  - regional surveys
- Fixed coastal stations (hydrography)
- Current meter moorings
- On survey vessels (ship mounted ADCPs and termosalinograph)



Long-term variability and trends in the Atlantic Water inflow region (A-TWAIN)







UNIS

Framsenteret

Existing and new international partners

IOPAS, Poland
- two moorings 2012-present
- cruise participation every year

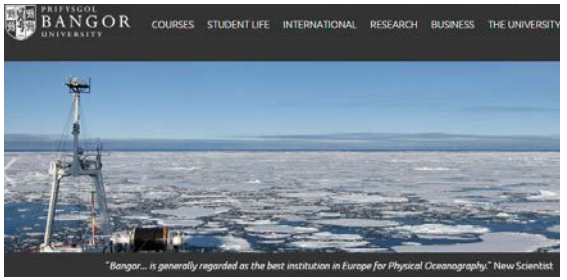
http://www.whoi.edu/warmingarctic/

WHOI, USA
- four moorings 2012-13
- cruise participation 2012+13

Planned collaboration on data analysis and possible joint cruises in the future

Scottish Association for Marine Science, Oban , Scotland

New projects & collaborations underway to team up with A-TWAIN: ArcticPrize, SIOS, Nansen Legacy, AWI



University of Wales in Bangor

UNIS

Framsenteret

AGU PUBLICATIONS

Geophysical Research Letters

RESEARCH LETTER

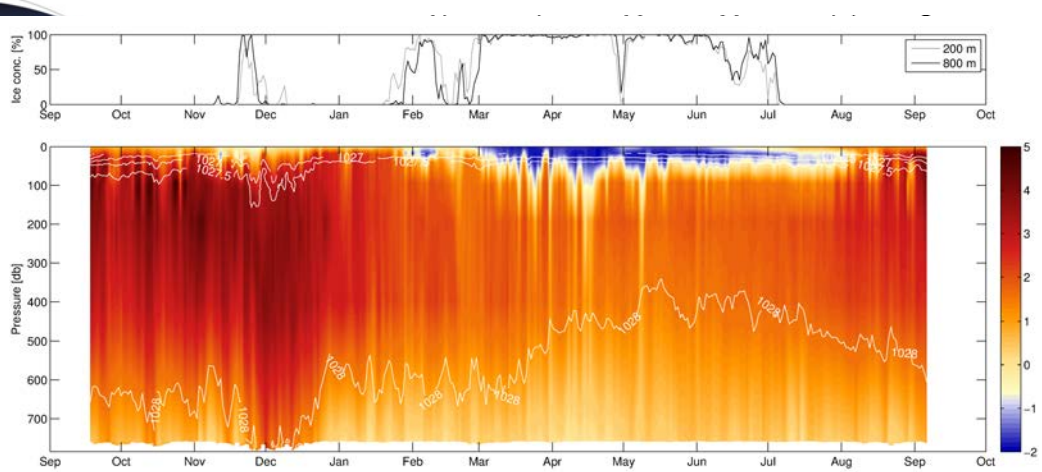
10.1002/2015GL063655

Seasonal variability and fluxes of nitrate in the surf waters over the Arctic shelf slope

Key Points:
- First year-round moored observations of nitrate in the Eastern Arctic Ocean
- Vertical nitrate fluxes are supported

Achim Randelhoff[1,2], Arild Sundfjord[2], and Marit Reigstad[1]

[1]Institute for Arctic and Marine Biology, University of Tromsø, Tromsø, Norway, [2]Norwegian Polar Ins



AGU PUBLICATIONS JGR

Journal of Geophysical Research: Oceans

RESEARCH ARTICLE

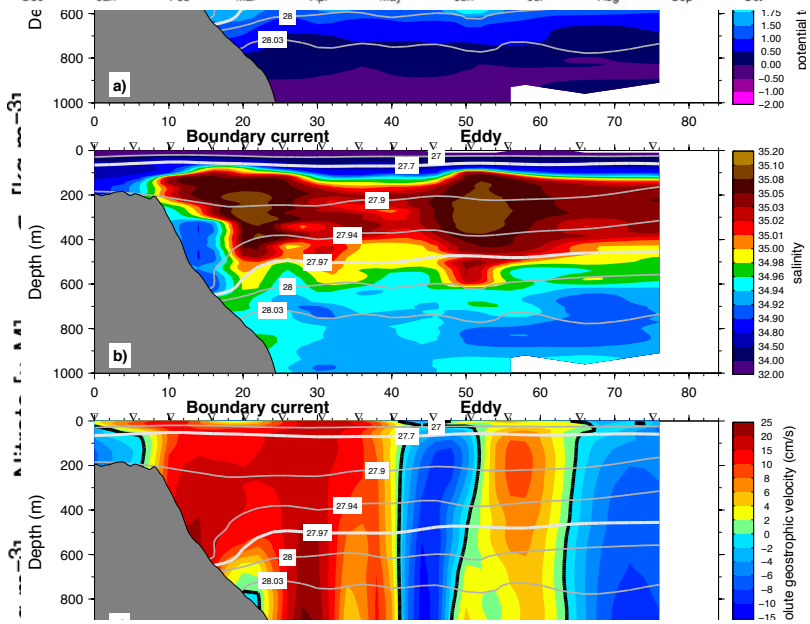
10.1002/2016JC011715

The Atlantic Water boundary current in the Nansen Basin: Transport and mechanisms of lateral exchange

Key Points:
- Data from a shipboard survey are used to investigate the Atlantic Water boundary current north of Svalbard
- The transport of Atlantic Water in the boundary current is quantified
- The roles of eddies and upwelling in lateral exchange between the boundary current and the interior

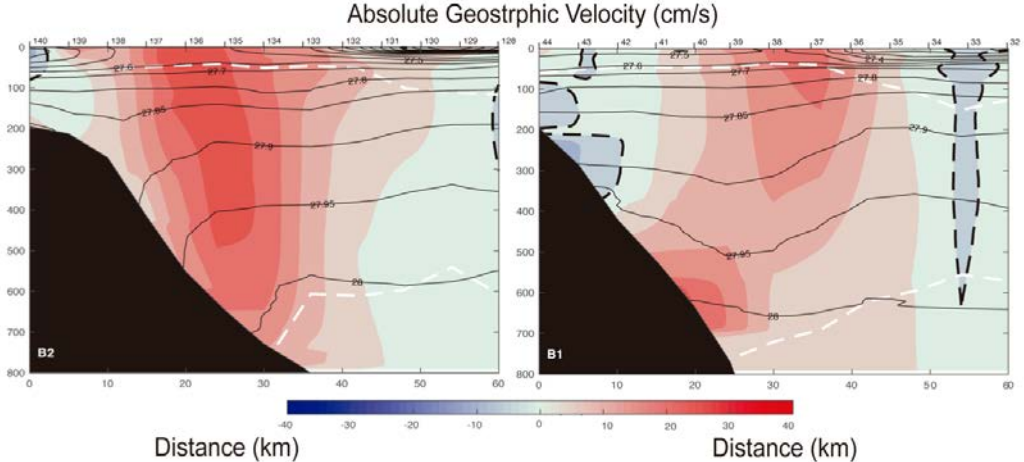
Kjetil Våge[1], Robert S. Pickart[2], Vladimir Pavlov[3], Peigen Lin[2,4], Daniel J. Torres[2], Randi Ingvaldsen[5], Arild Sundfjord[3], and Andrey Proshutinsky[2]

[1]Geophysical Institute, University of Bergen and Bjerknes Centre for Climate Research, Bergen, Norway, [2]Woods Hole Oceanographic Institution, Woods Hole, Massachusetts, USA, [3]Norwegian Polar Institute, Tromsø, Norway, [4]State Key Laboratory of Marine Environmental Science, College of Ocean and Earth Sciences, Xiamen University, Xiamen, China, [5]Institute of Marine Research, Bergen, Norway



Submitted: The Atlantic Water boundary current north of Svalbard. M. D. Pérez-Hernández et al., JGR

In prep: Oceanic influence on the sea ice cover over the Atlantic Water boundary current in the Arctic Ocean northeast of Svalbard. A. H. H. Renner et al.



future plans:

- ongoing data analysis & work on manuscripts
- mooring recovery & redeployment cruise in 2017
- site north of Svalbard = one of the focus sites in INTAROS
- contributions to SIOS, Nansen Legacy
- further collaborations with NABOS, IOPAS, WHOI, AWI, SAMS/U Bangor, ...

Long term biological measurements

Spring and autumn bloom dynamics - initiation, maximum and culmination (Chl concentration, ordinate day)

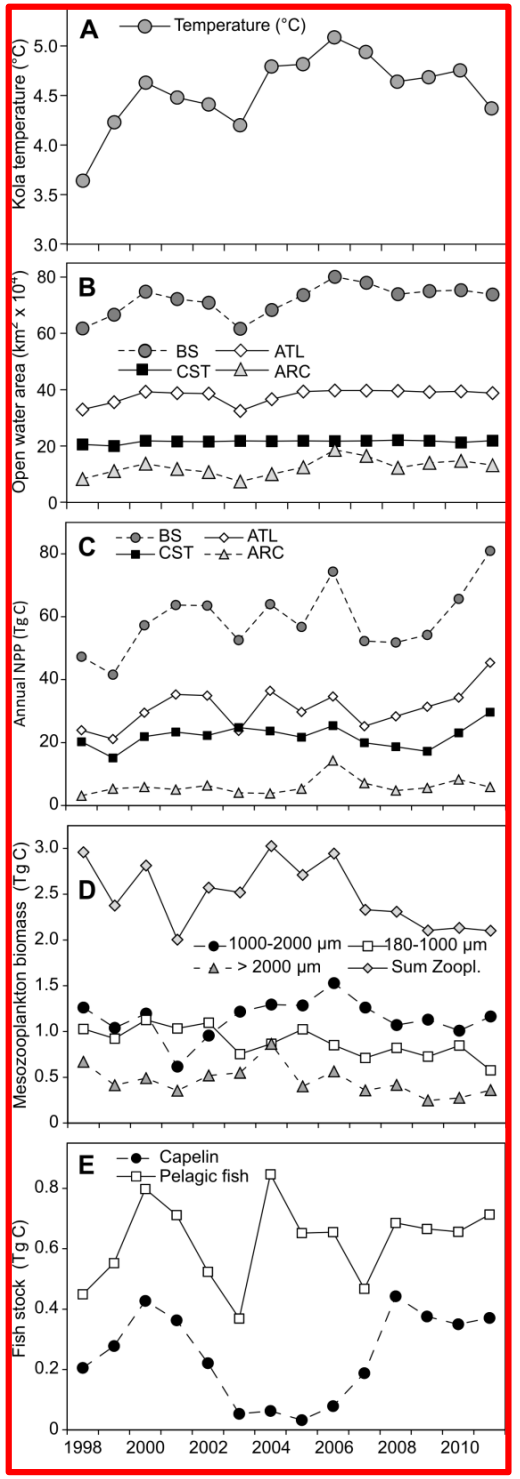
Pelagic production (phytoplankton and zooplankton) - spatial and temporal dynamics

Processes governing the lower trophic levels

How does different trophic levels respond to climate warming

Trophic transfer efficiencies

carrying capacity of the key planktivorous fish – e.g. based on net community primary production

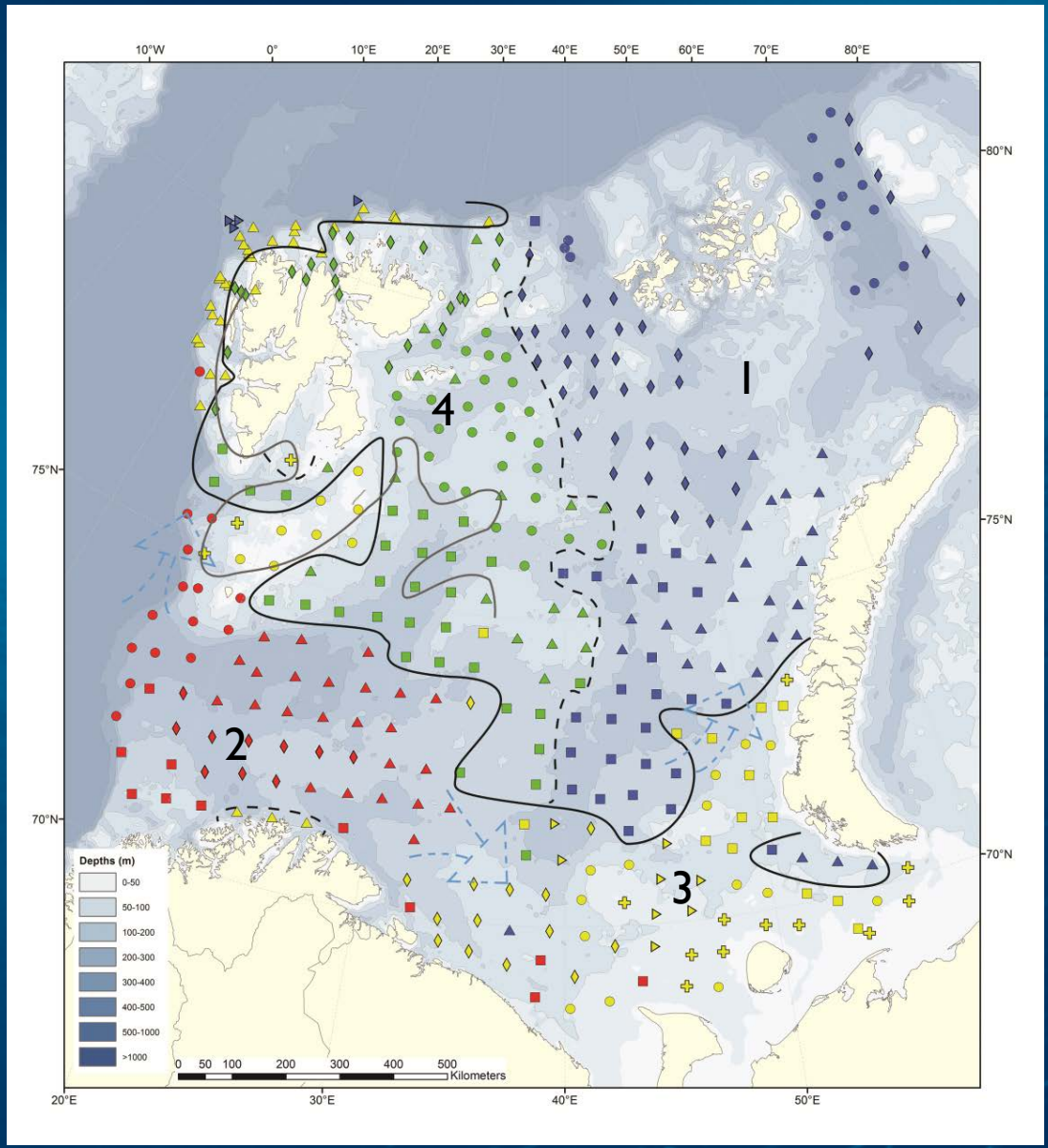


Benthos in the Barents Sea

Annual surveys idendified four regions:

1 Blue: Arctic, North East
2 Red: Boreal, South West
3 Yellow: Shallow cold banks
4 Green: Deep cold, North West

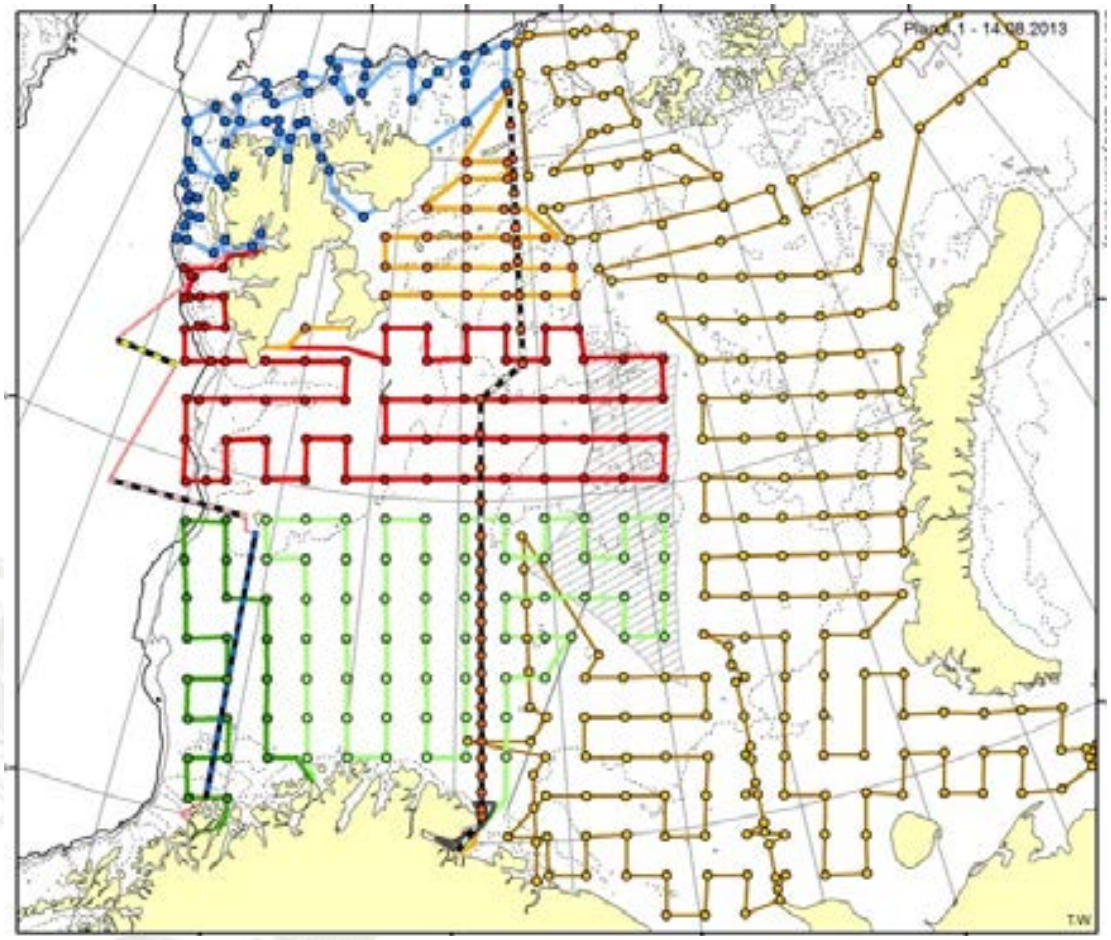
Repeated sampling shows shifts in distribution and invasive species

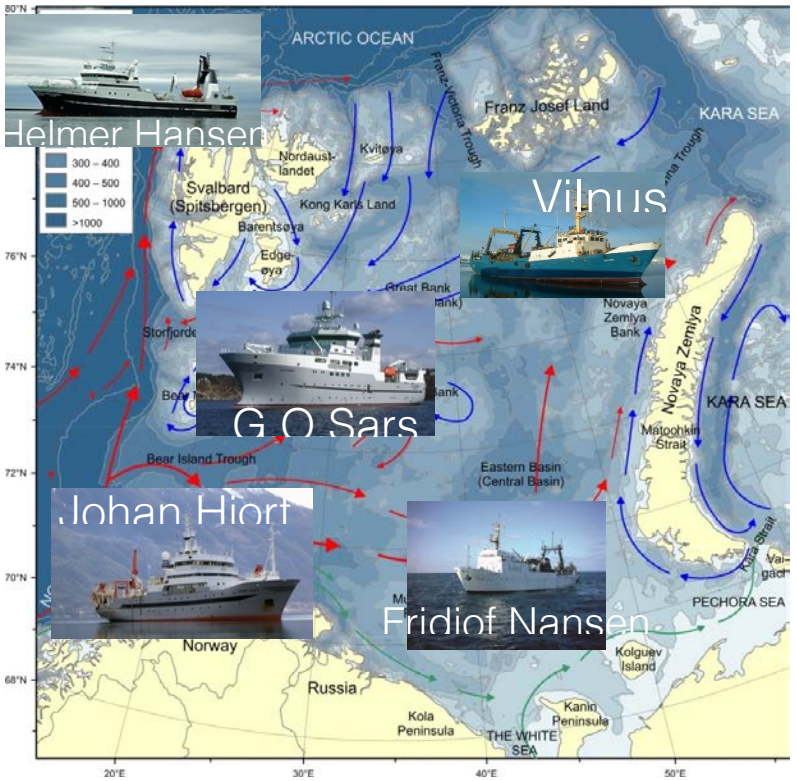


Jørgensen et al 2014. Distribution of benthic megafauna in the Barents Sea: baseline for an ecosystem approach to management. ICES Jour of Mar Science

Ecosystem survey Barents Sea

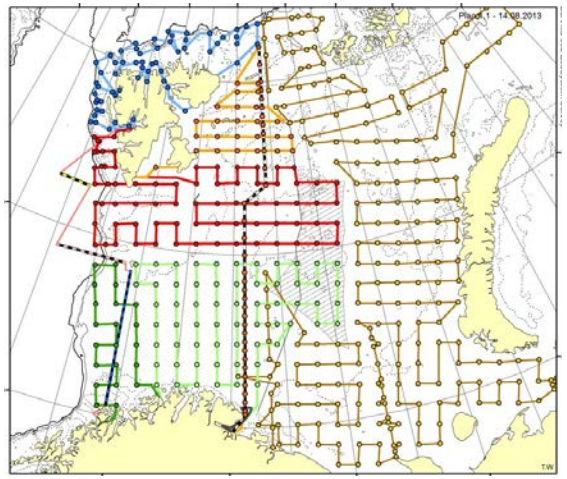
Institute of Marine Research/PINRO



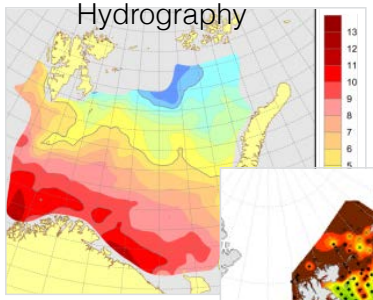


Ecosystem survey Barents Sea

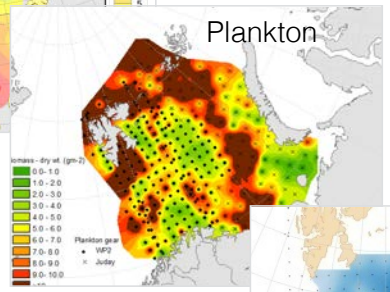
Institute of Marine Research/PINRO



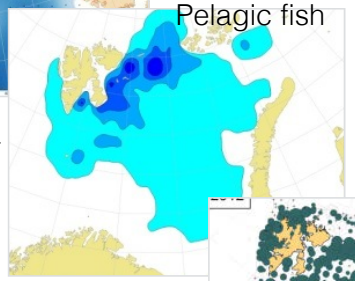
Hydrography



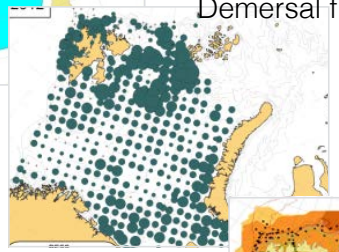
Plankton



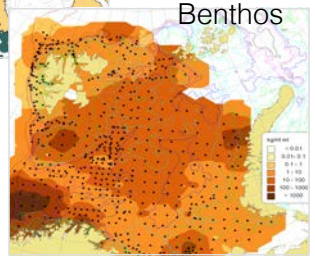
0-group fish



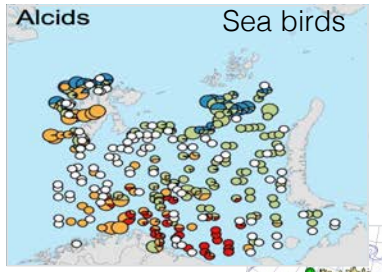
Pelagic fish



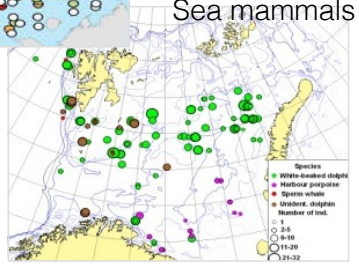
Demersal fish



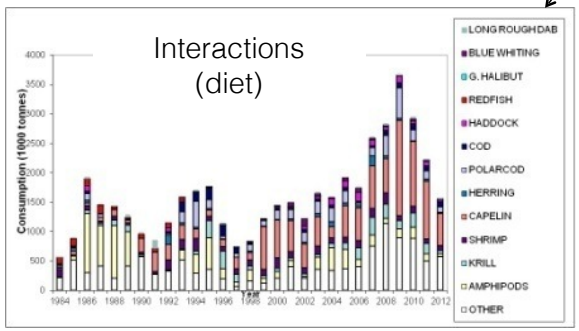
Benthos



Sea birds



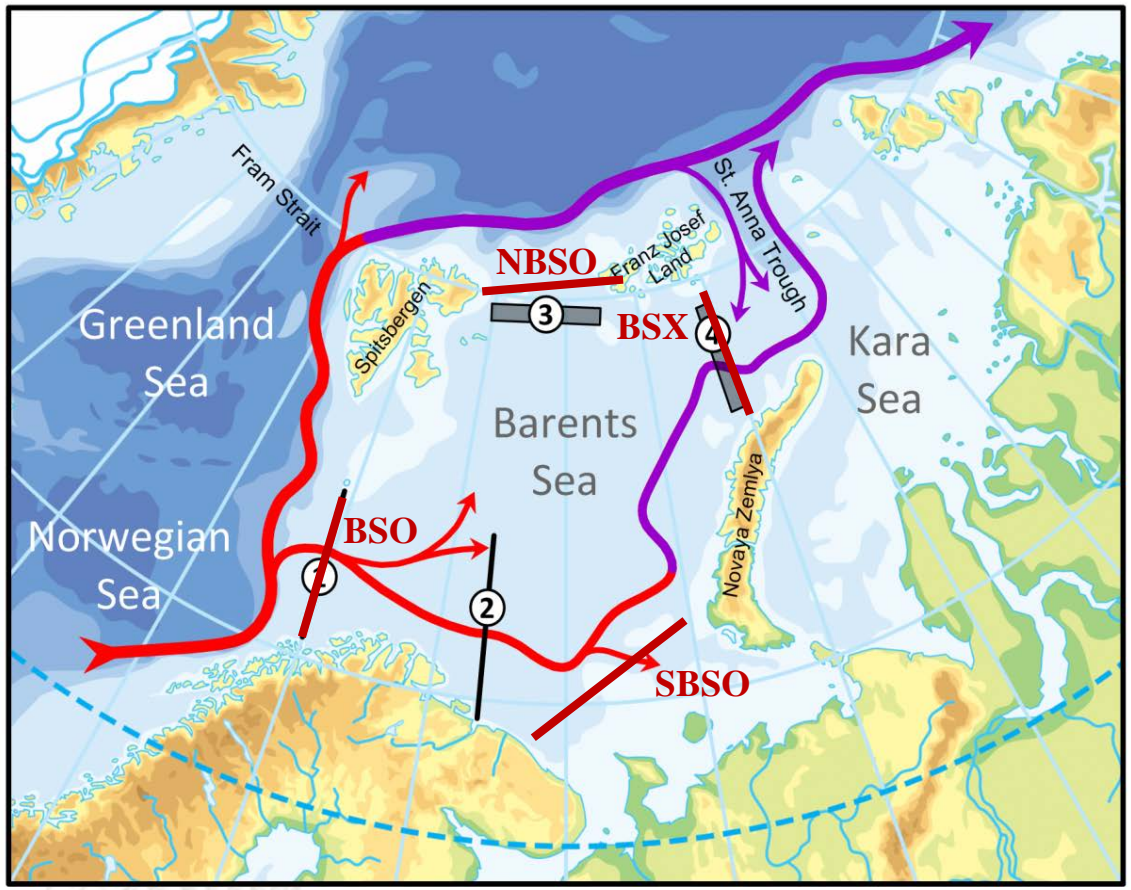
Sea mammals



Interactions
(diet)

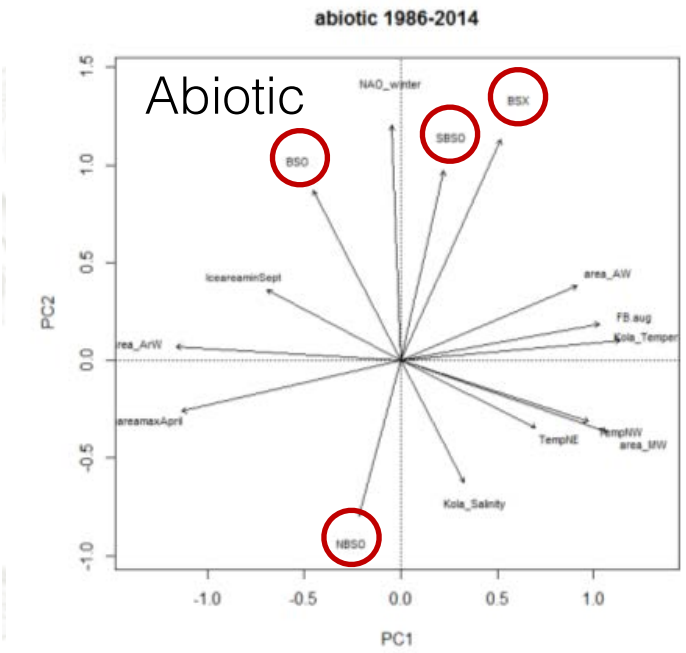
WGIBAR Integrated Assessment –
the future of ecosystem-based management

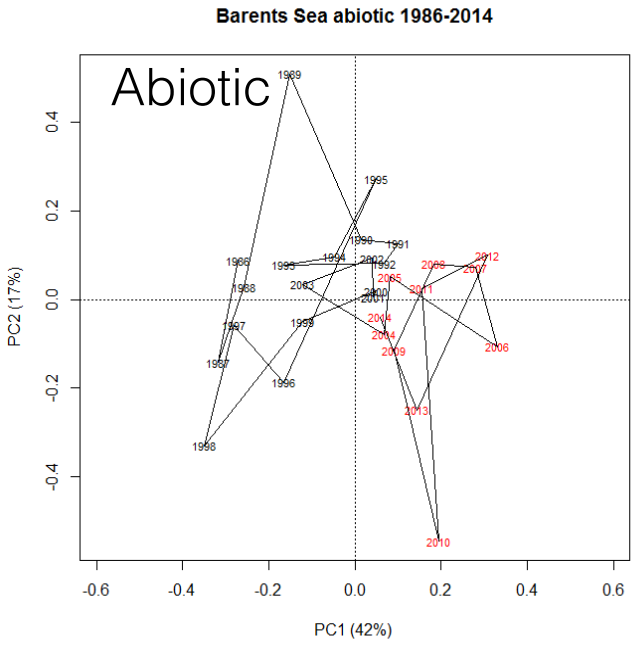
- Data from ecosystem cruise (previous slide)
- Model transport data

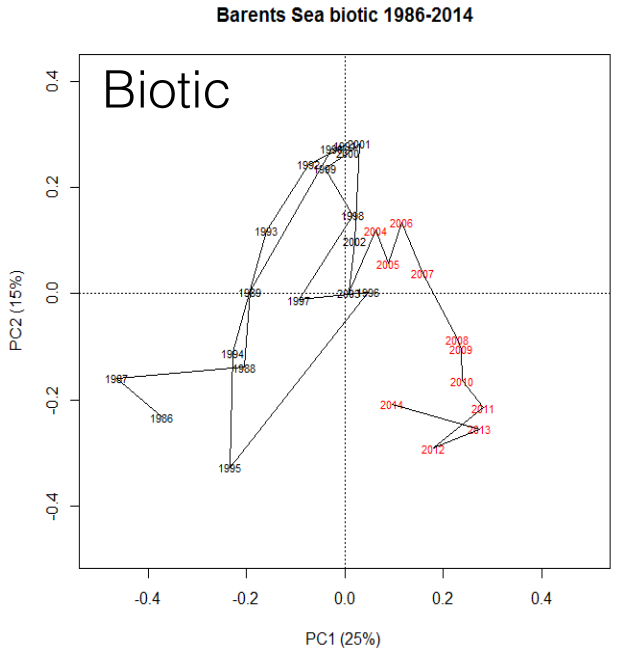


WGIBAR Integrated Assessment –
the future of ecosystem-based management

- Data from ecosystem cruise (previous slide)
- Model transport data
- Annual meeting between physicists and biologists from IMR and PINRO
- Overview of ecosystem status
- Principal Component analysis of biotic and abiotic data







WGICA - ICES/PAME Working Group on Integrated Ecosystem Assessment for the Central Arctic Ocean

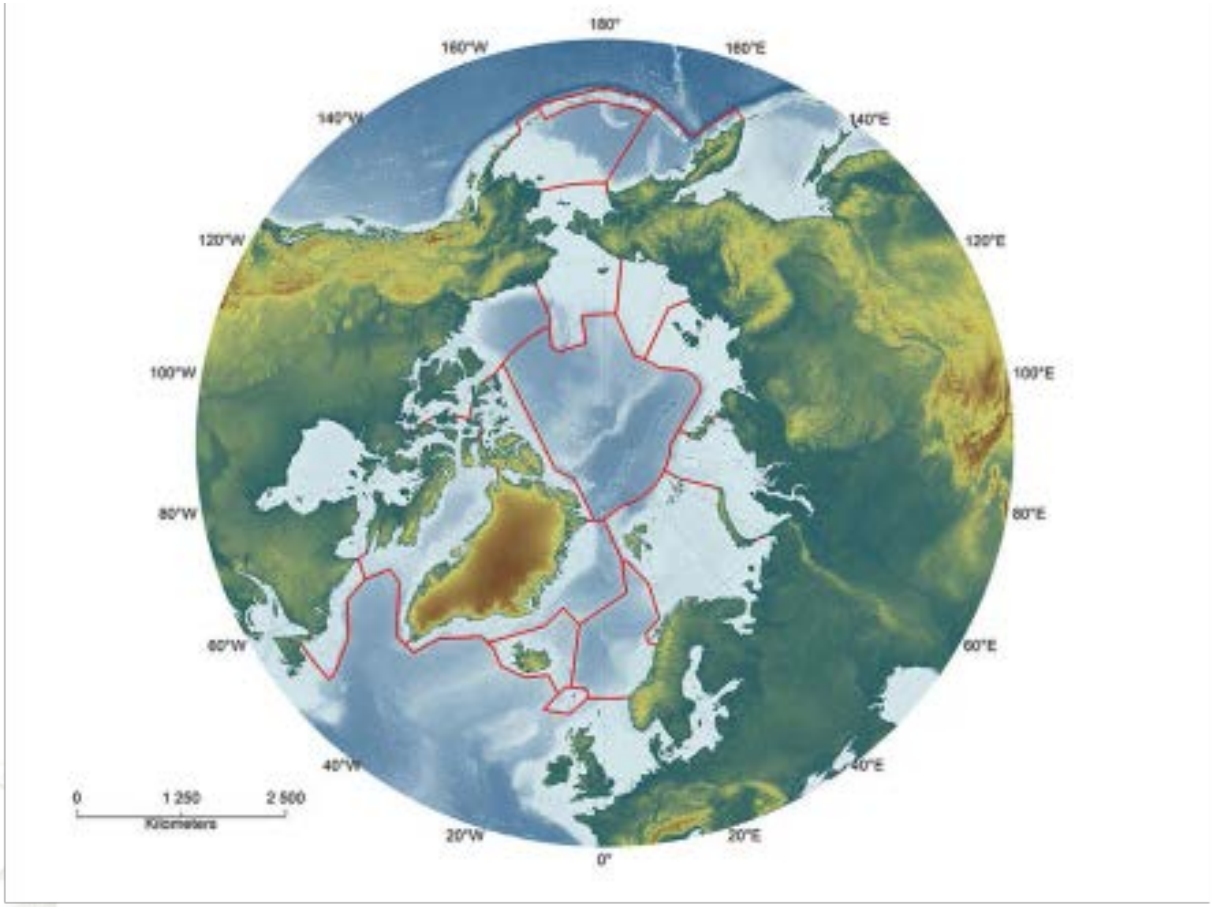
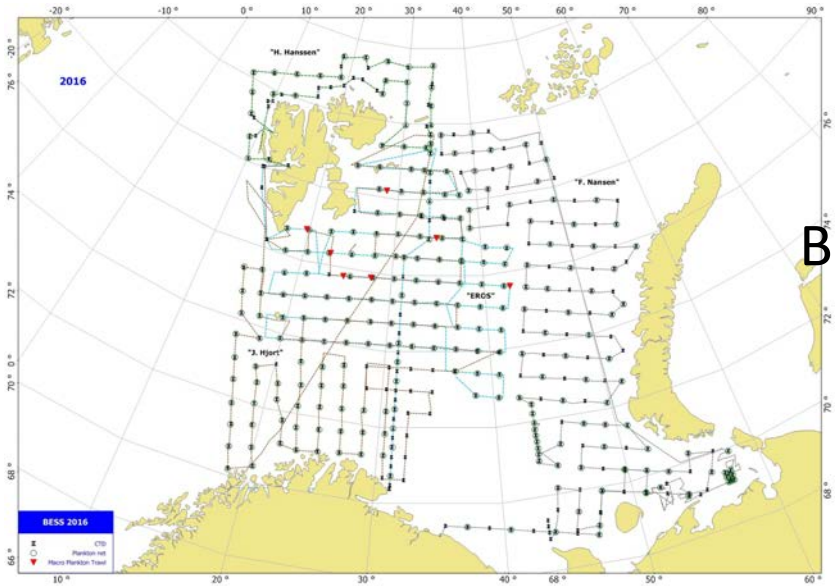


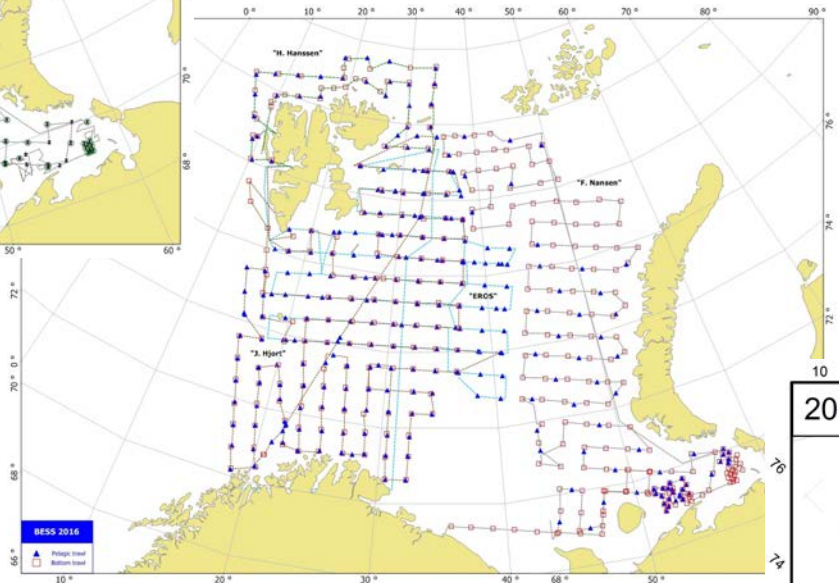
Figure 5.1. Map of 18 Large Marine Ecosystems (LME) in the Arctic as adopted by the Arctic Council

Hydrography and plankton

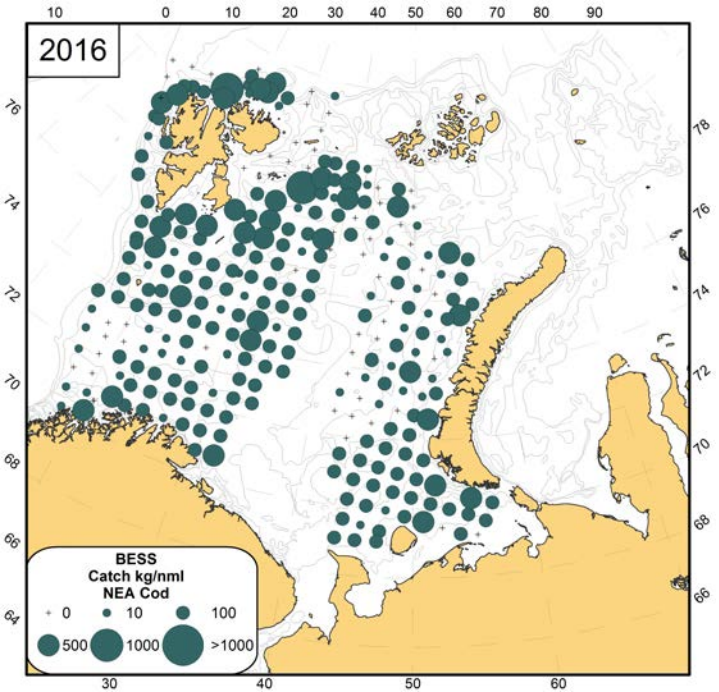
Some results from the 2016 survey



Bottom and pelagic trawl



Cod in bottom trawl



Some results from the 2016 survey

- Not optimal coverage
- Low abundance of capelin
- God recruitment of capelin
- Low recruitment of other species
- Cod still located far north
- High level of biomass in general
- No ice in survey area

Some results from the 2016 survey

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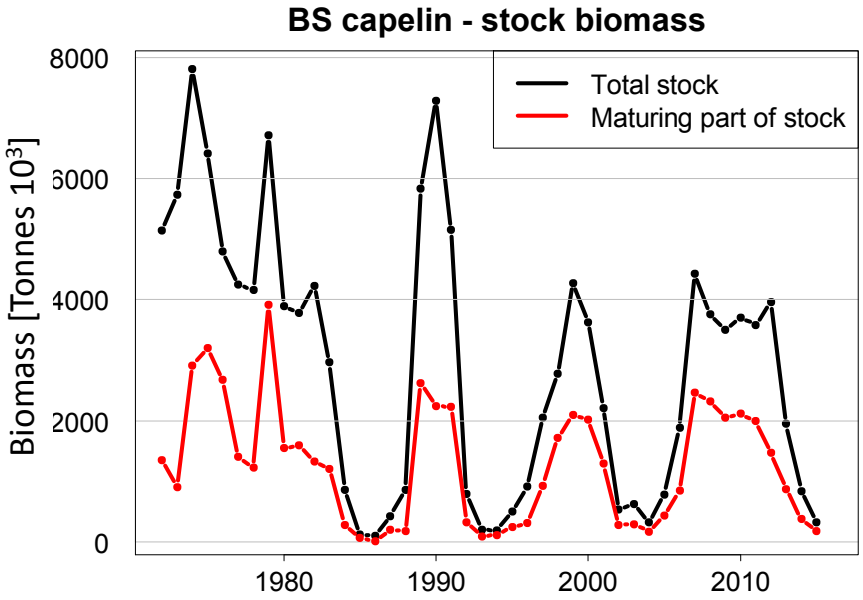
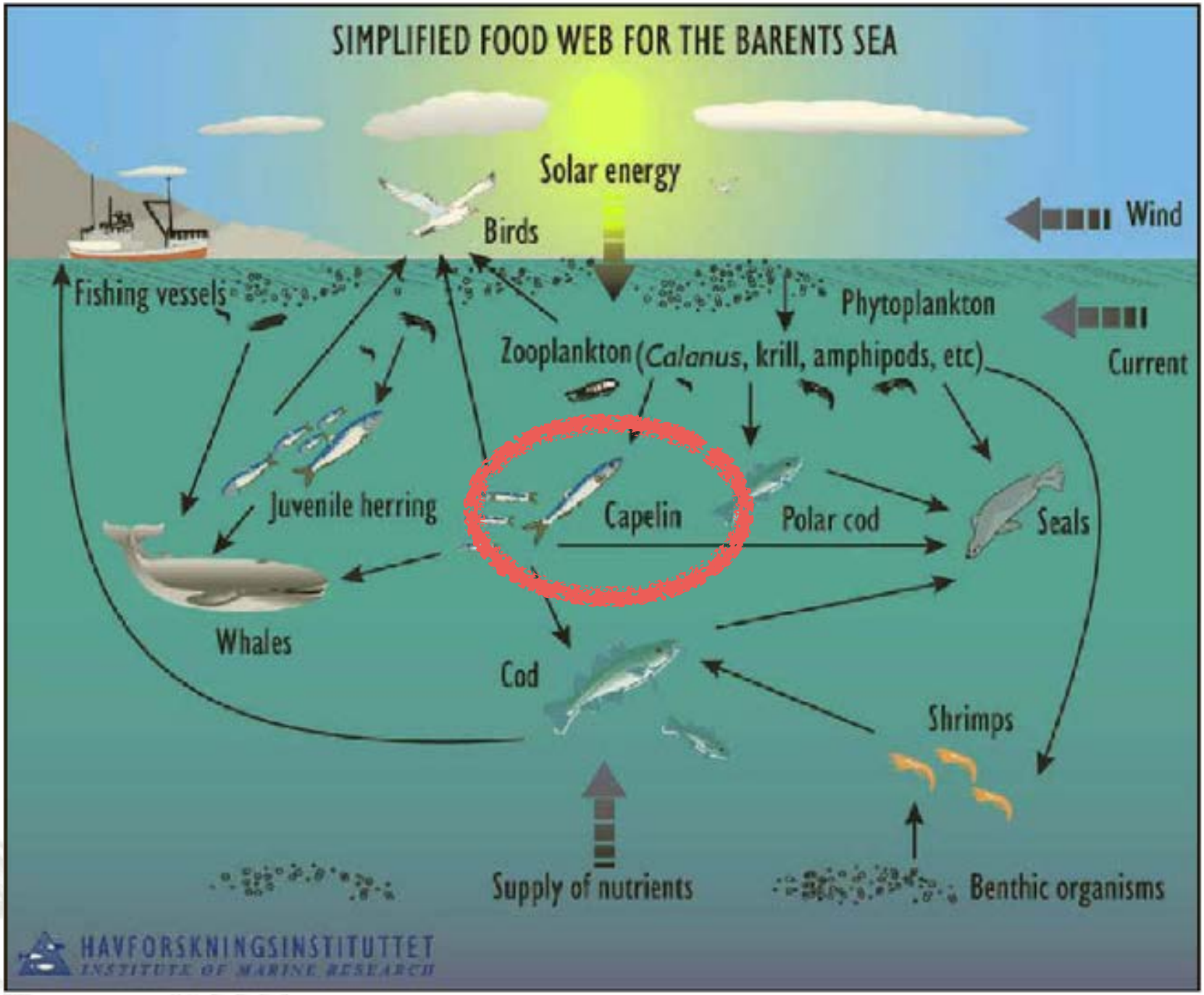
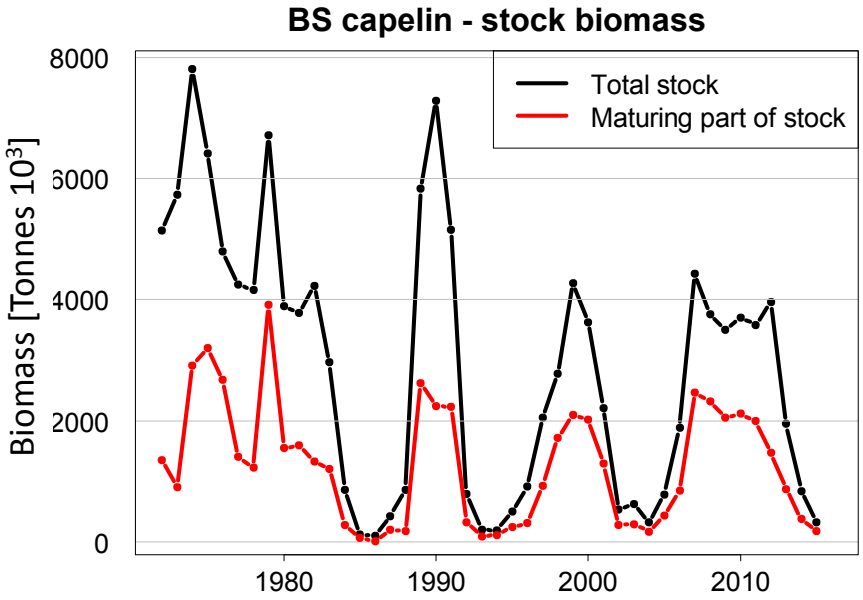
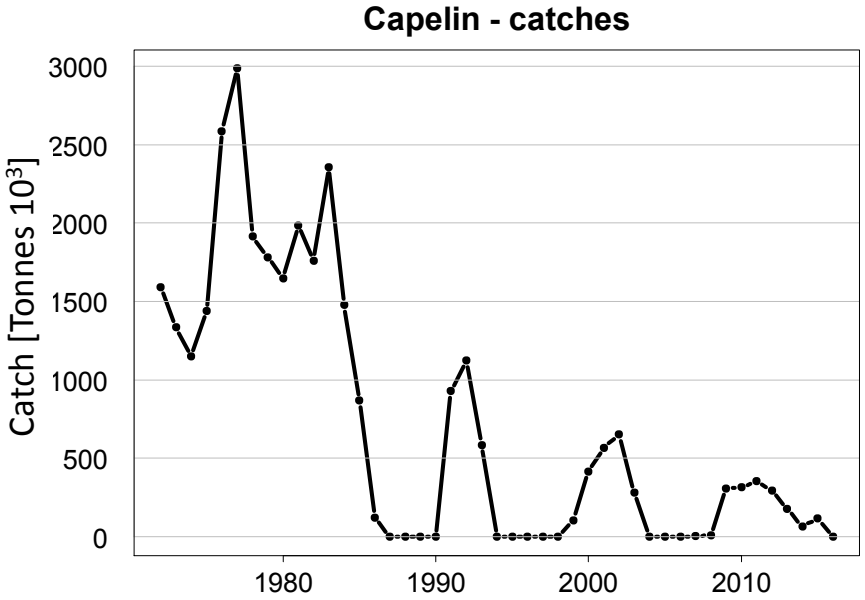
CAPELIN – STOCK DEVELOPMENT



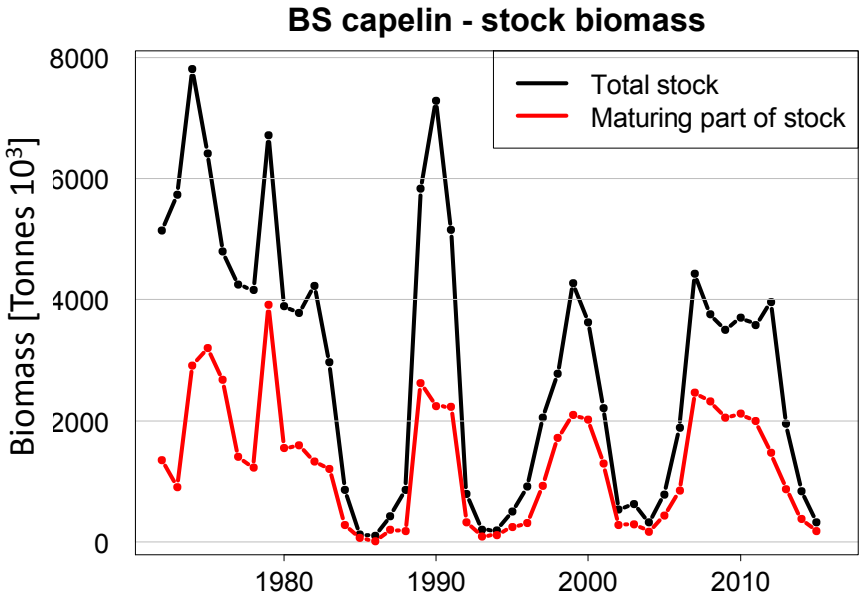

SIMPLIFIED FOOD WEB FOR THE BARENTS SEA
Solar energy
Wind
Birds
Fishing vessels
Phytoplankton
Current
Zooplankton (Calanus, krill, amphipods, etc)
Juvenile herring
Capelin
Polar cod
Seals
Whales
Cod
Shrimps
Supply of nutrients
Benthic organisms
HAVFORSKNINGSINSTITUTTET
INSTITUTE OF MARINE RESEARCH

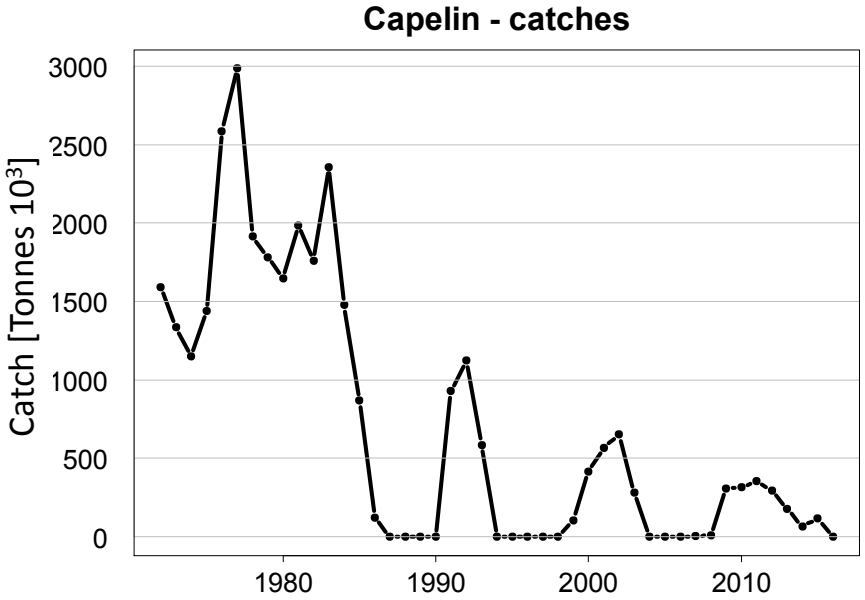
CAPELIN – STOCK DEVELOPMENT

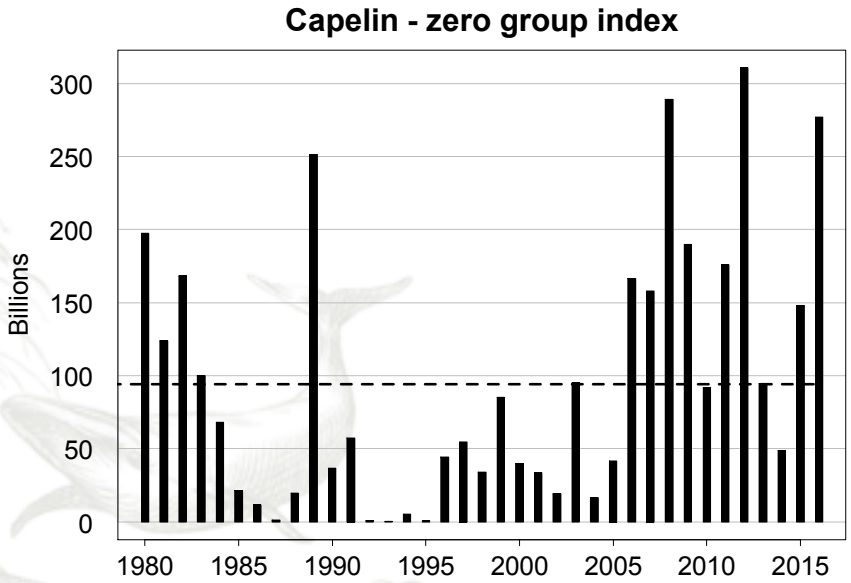




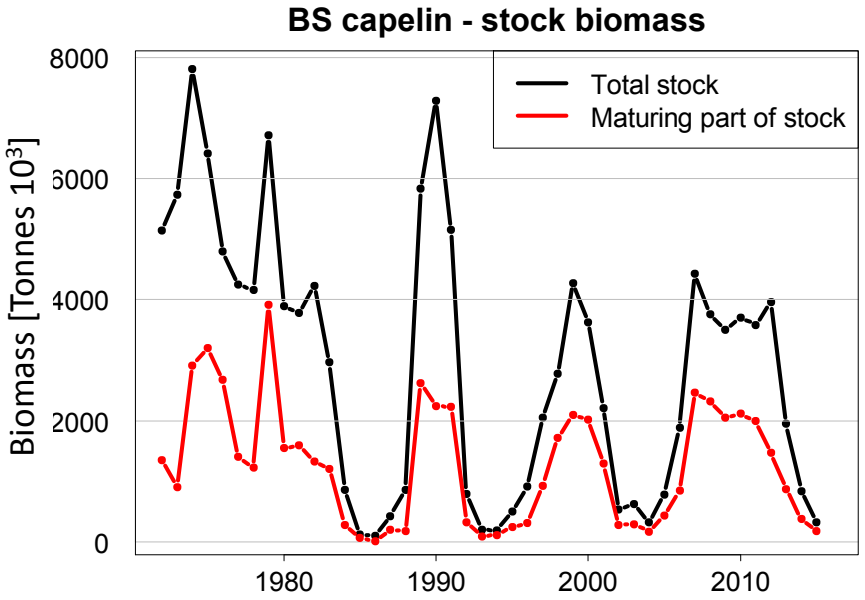
CAPELIN – STOCK DEVELOPMENT

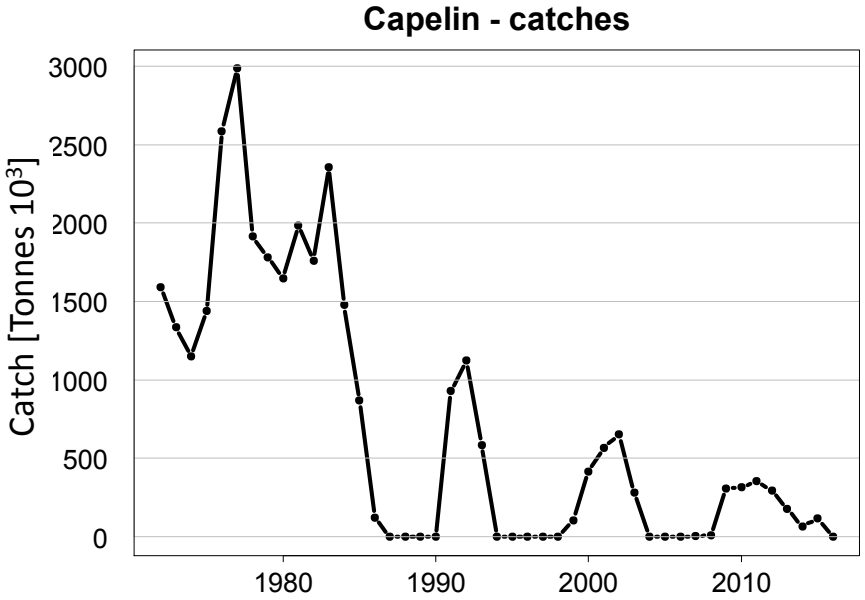


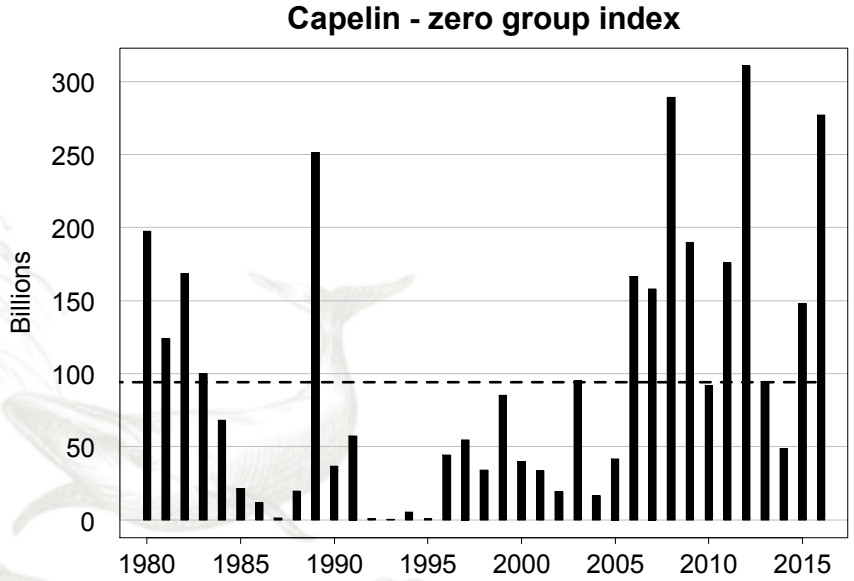


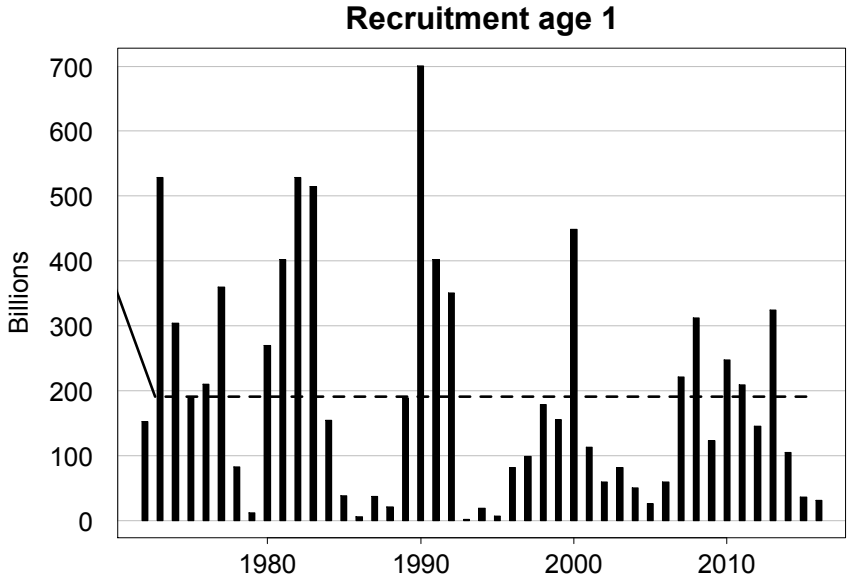


CAPELIN – STOCK DEVELOPMENT

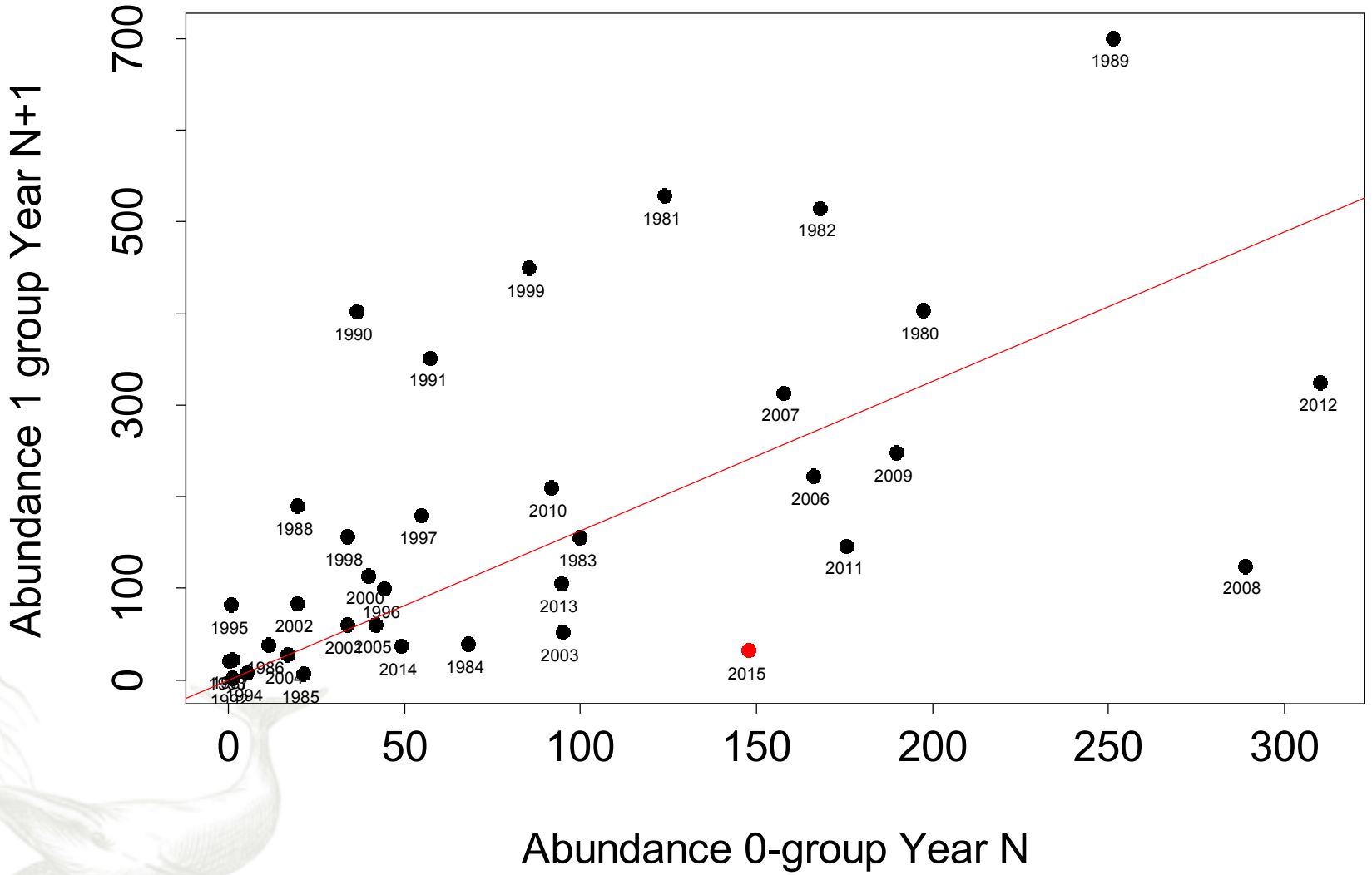




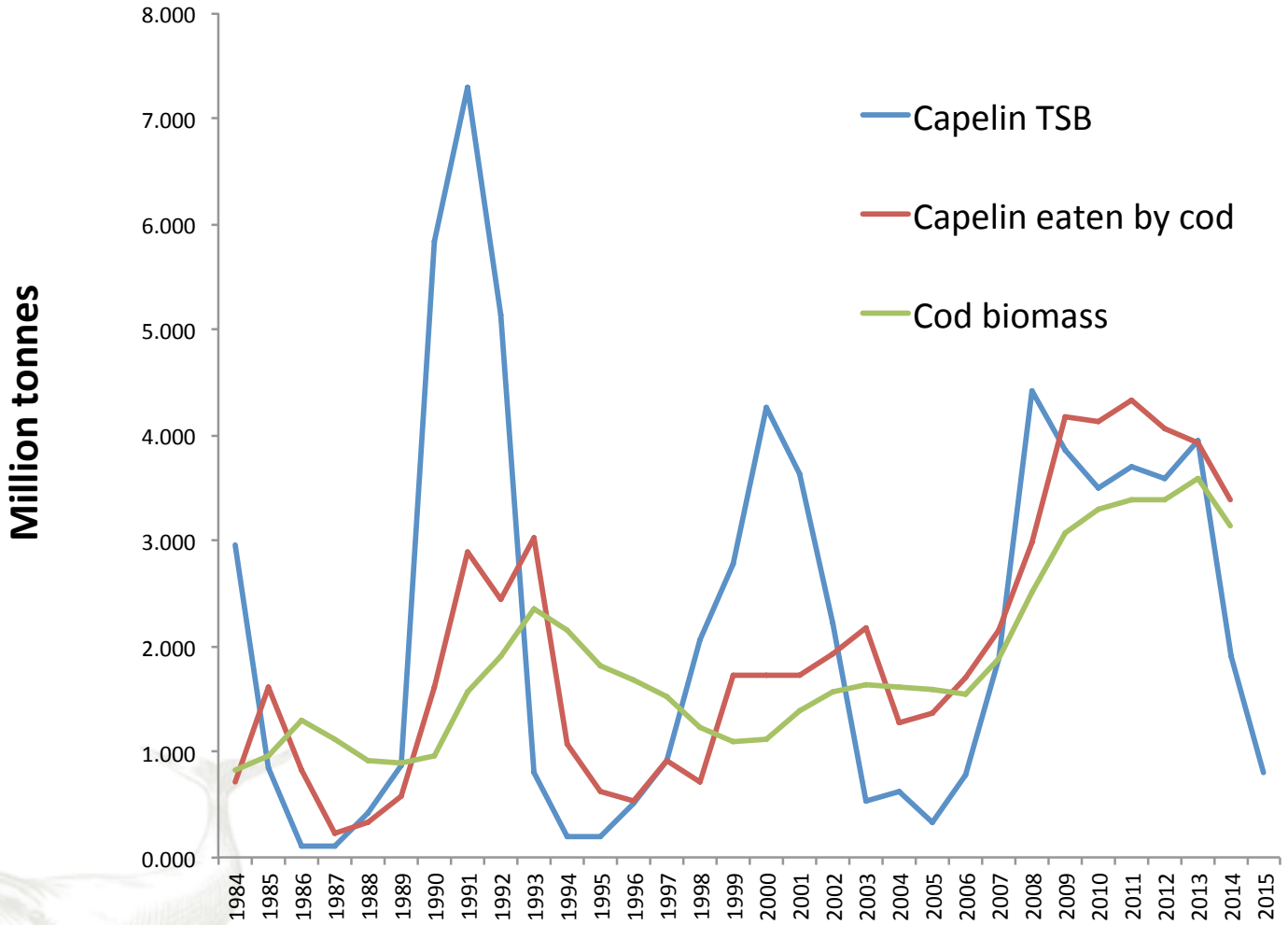




SURVIVAL FROM 0-GROUP (JUVENILES) TO 1 GROUP



Consumption of Capelin by Cod in the Barents Sea



Utviklinga av loddemengdene i Barentshavet har svinga som ein jo-jo sidan Havforskingsinstituttet starta med årlege loddetokt tidleg på 1970-talet. (Foto: Jan de Lange / Havforskingsinstituttet)

Loddekollapsen held fram for andre år på rad

KRONIKK: Det har ikkje vore loddefiske i Barentshavet i år, og det blir ikkje nokon kvote i 2017 heller. Samstundes er det nesten rekordmykje loddeyngel. Korleis heng det i hop?

Bjarte Bogstad
forskar, Havforskingsinstituttet

Harald Gjøsæter
forskar, Havforskingsinstituttet

Elena Eriksen
forskar, Havforskingsinstituttet

Georg Skaret
forskar, Havforskingsinstituttet

16.11 2016 04:00

SE OGSÅ

Strategic Initiative – The Arctic Ocean Ecosystem (SI_ARCTIC)

- 5-yr project (2014-2018) funded by the Norwegian Ministry of Trade, Industry and Fisheries (channeled through the Norwegian Research Council)

Overall obectives:

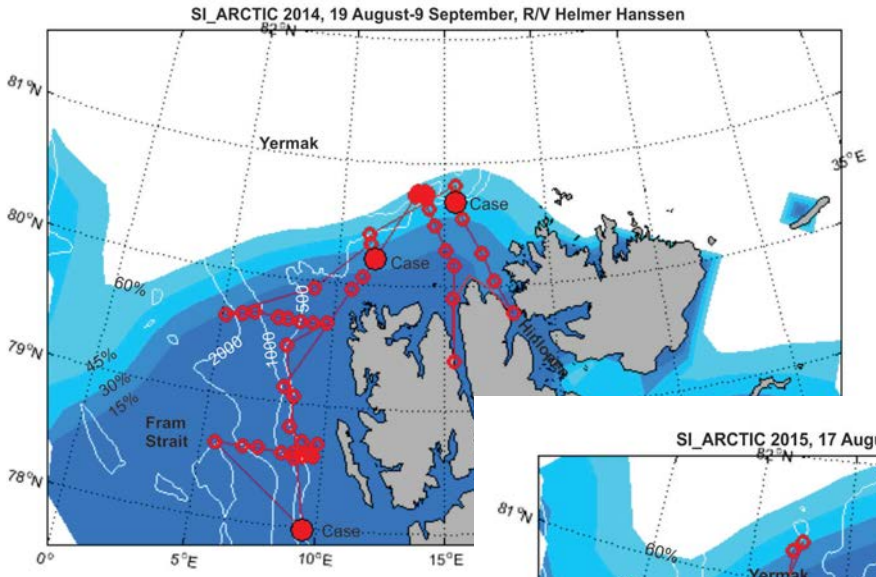
To develop a **knowledge base on the state and variability** of the present and future Arctic Ocean ecosystem.

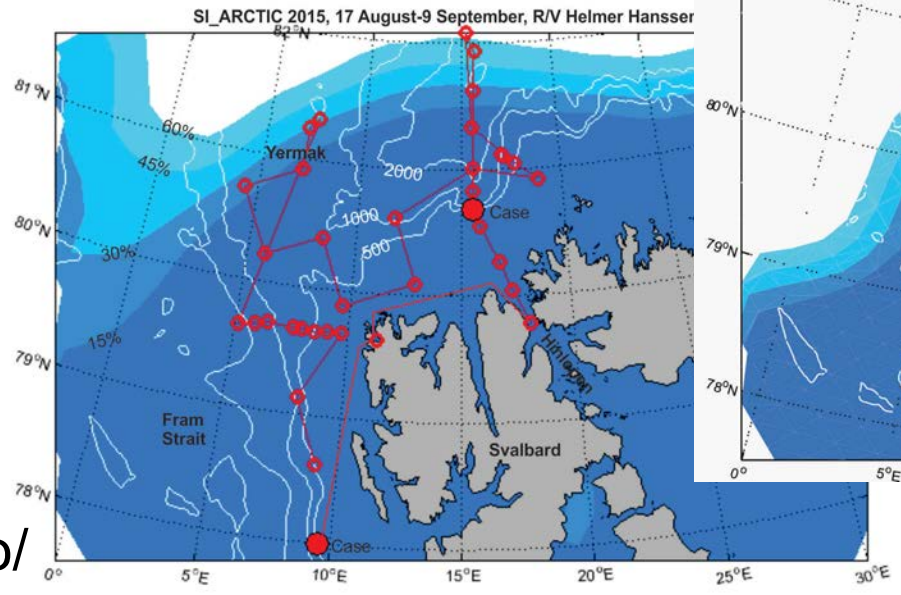
To explore potential options for providing **ecosystem-based advice** in a changing climate context.

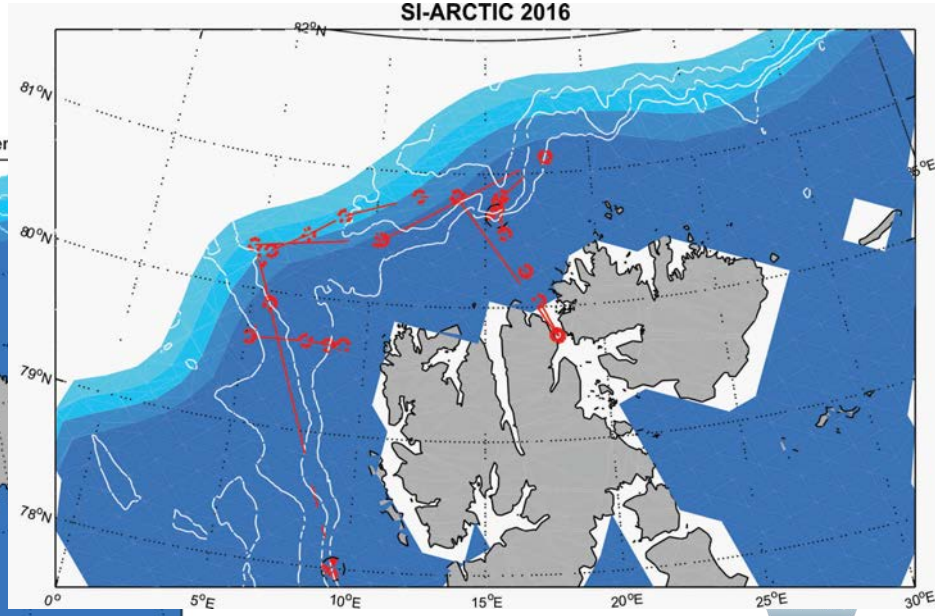
2014-2016 Surveys

- Aim of surveys: Conduct baseline studies of the marine ecosystem in the Arctic Ocean/the region north of Svalbard

Cruise track and sea ice conditions







Observations of:
- Physical and chemical oceanography
- Phyto- and zooplankton
- Fish (pelagic and demersal)
- Benthos
- Marine mammals and birds

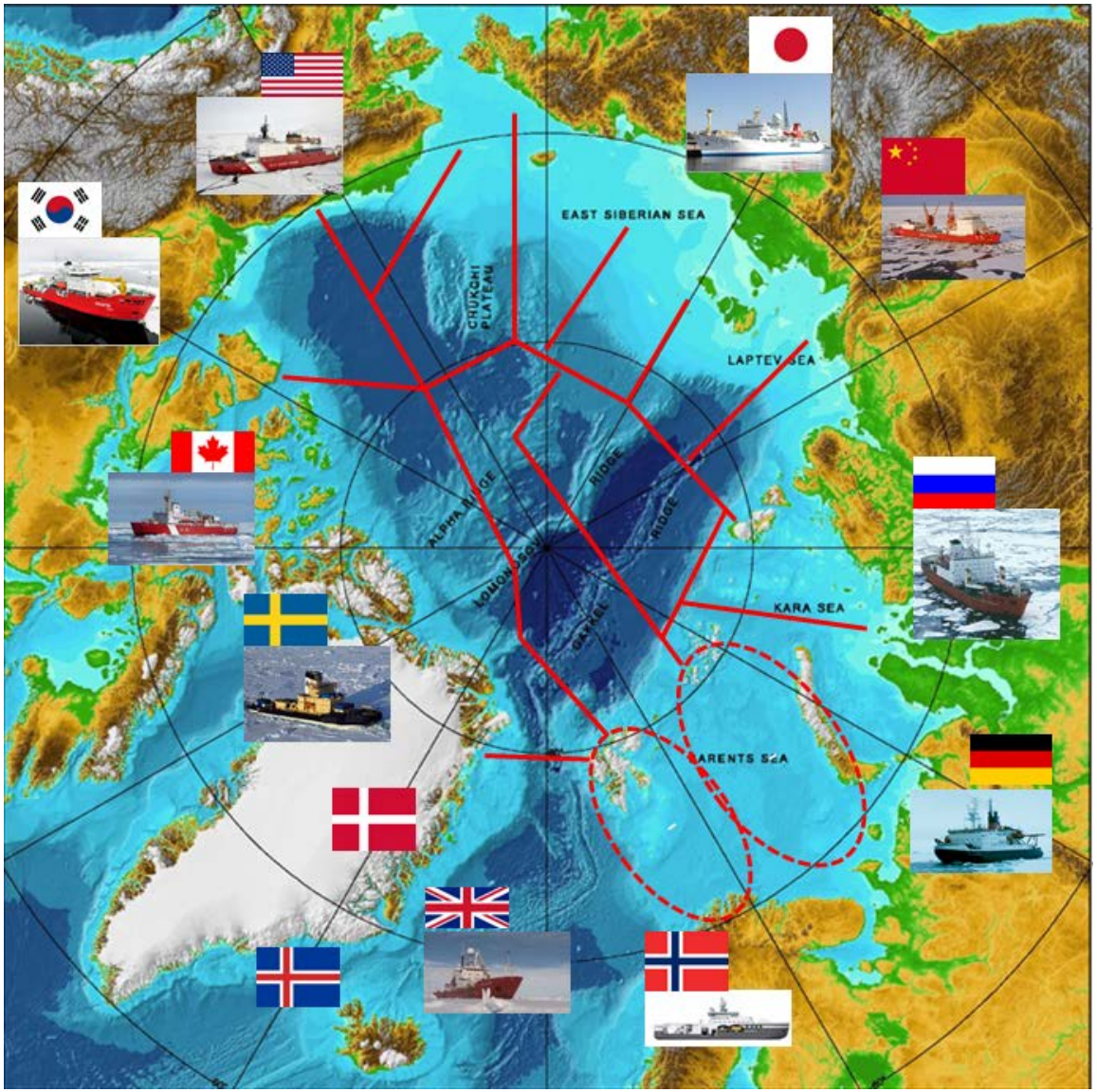
http://siarctic.imr.no/

Possible activities in the future:

Nansen Legacy
-large research program with 8 Norwegian governmental institutions involved
- focus area in the northern Barents Sea and adjacent Arctic Ocean

SI_ARCTIC

Synoptic Arctic Survey



*Disclaimer: none of the ships have been allocated or promised to the SAS

→SAS: An international, coordinated field campaign in the Arctic in 2020

→Each nation covers respective zones of interest with already planned or dedicated cruises

→Mutual sampling strategies and measurement protocols

→ Hydrography, CO_2 and biogeochemistry, ecosystems

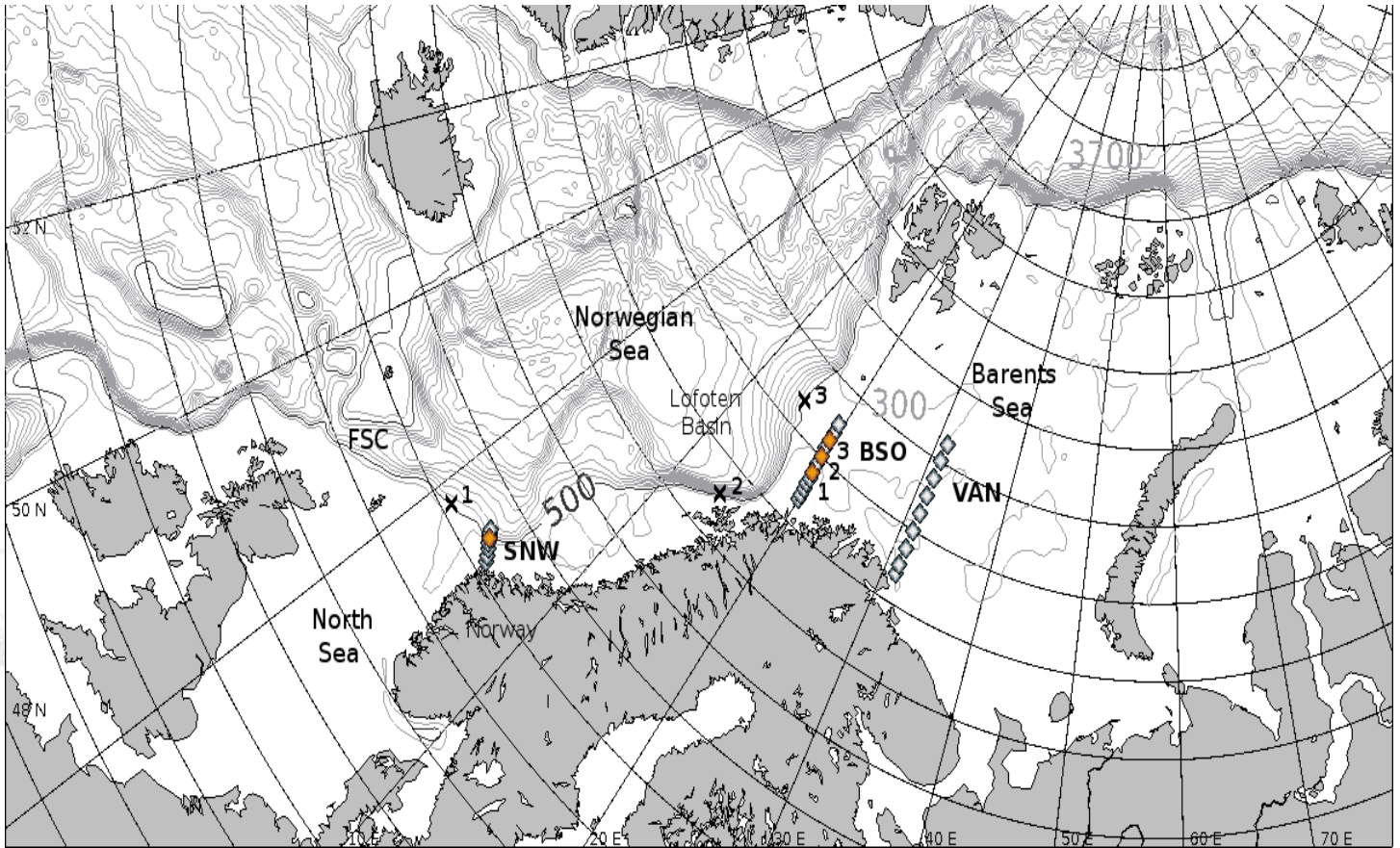
→Share data

→Makes the whole much bigger than the individual parts.

→Milestone in Arctic Observing

SVIM Nordic Sea 4km

- Nordic and Barents seas at 4 km resolution for the period 1960-2015
- «Semi-operational» - updated seasonally to annually
- Daily and monthly fields
- Well documented (Lien et al., 2013, 2014, 2016a,b) and used in risk assessment (Vikebø et al., 2014, 2015)

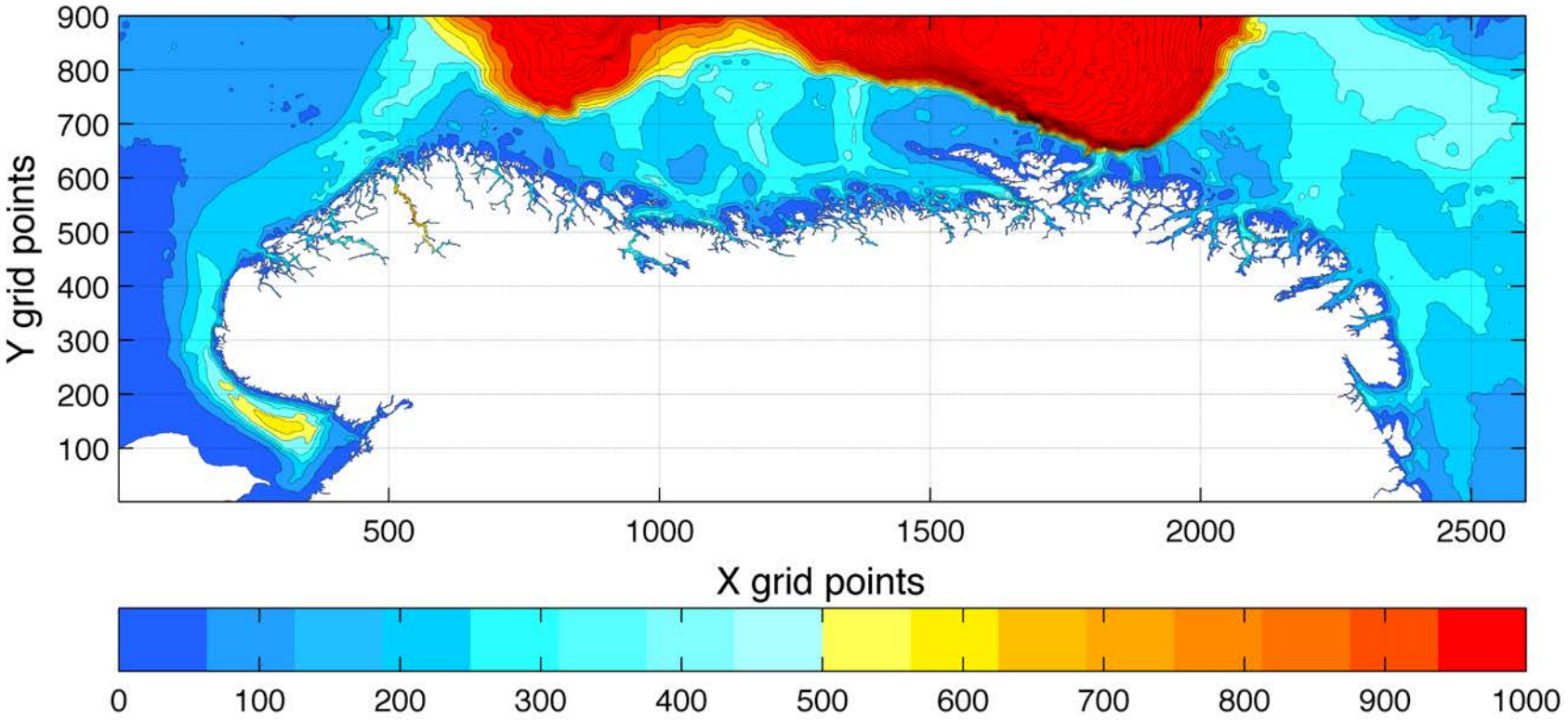


NorKyst800

- Model over entire NorKyst800-domain is now run from Jan 2005
- Uses SVIM-4km for boundary conditions & at open boundaries
- Used operationally by MET

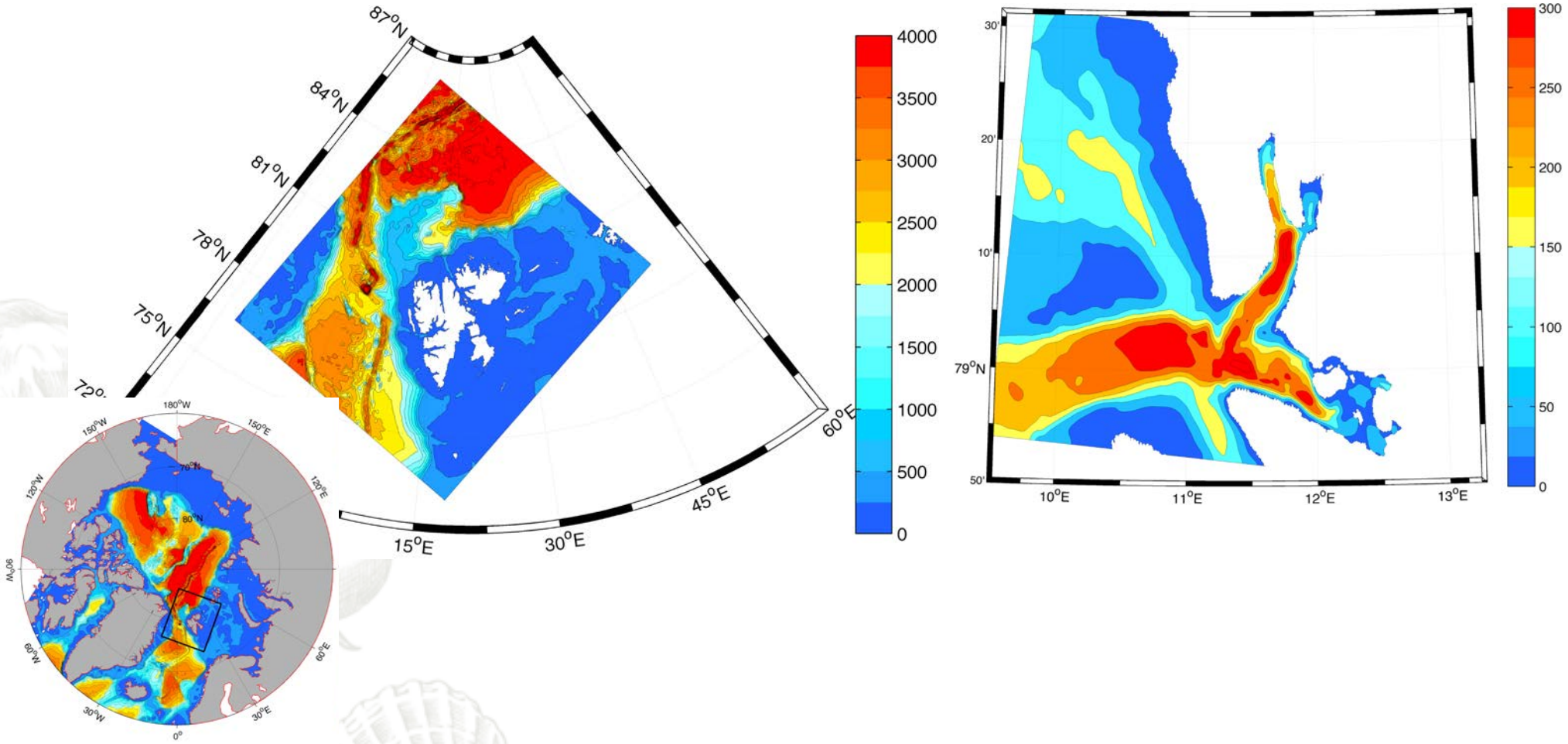
NorFjords160

- Sub domains with 160 m horizontal grid resolution
- Run for parts of the NorKyst800 domain
- Can be run for new sub domains at short notice



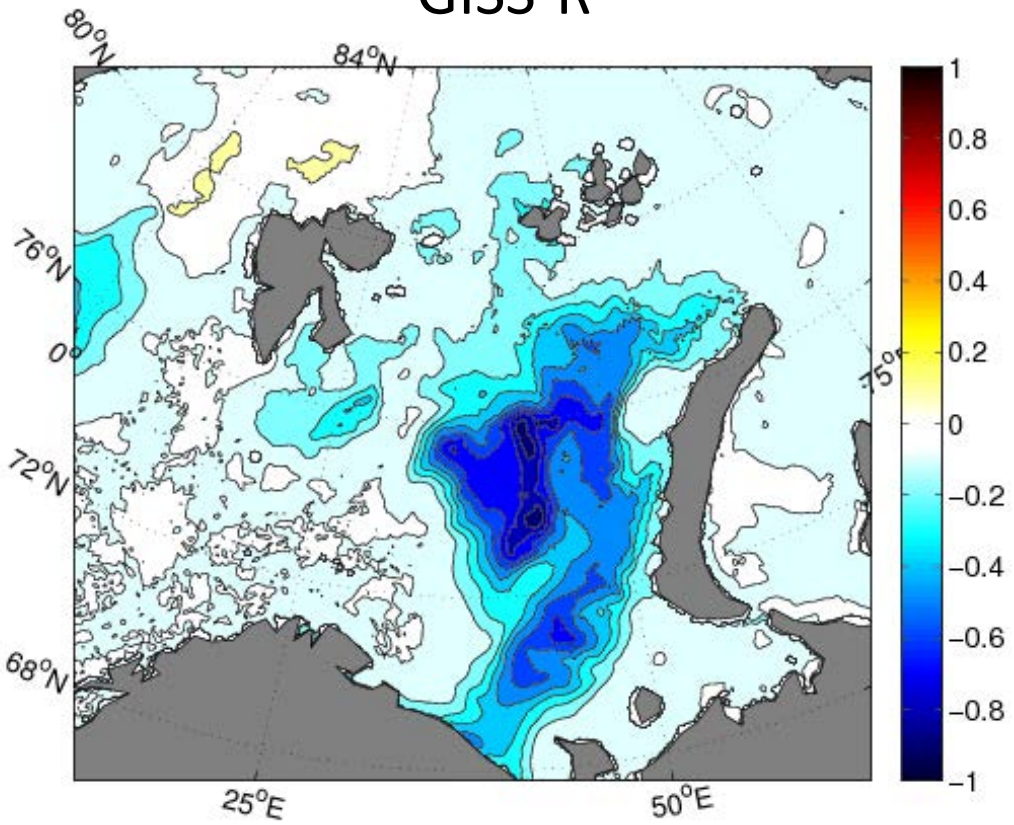
Svalbard models

- Svalbard800-model nested in Arctic-4km (Hattermann et al., 2016, GRL)
- output from different runs available
- Kongsfjorden-160m up and running as wel

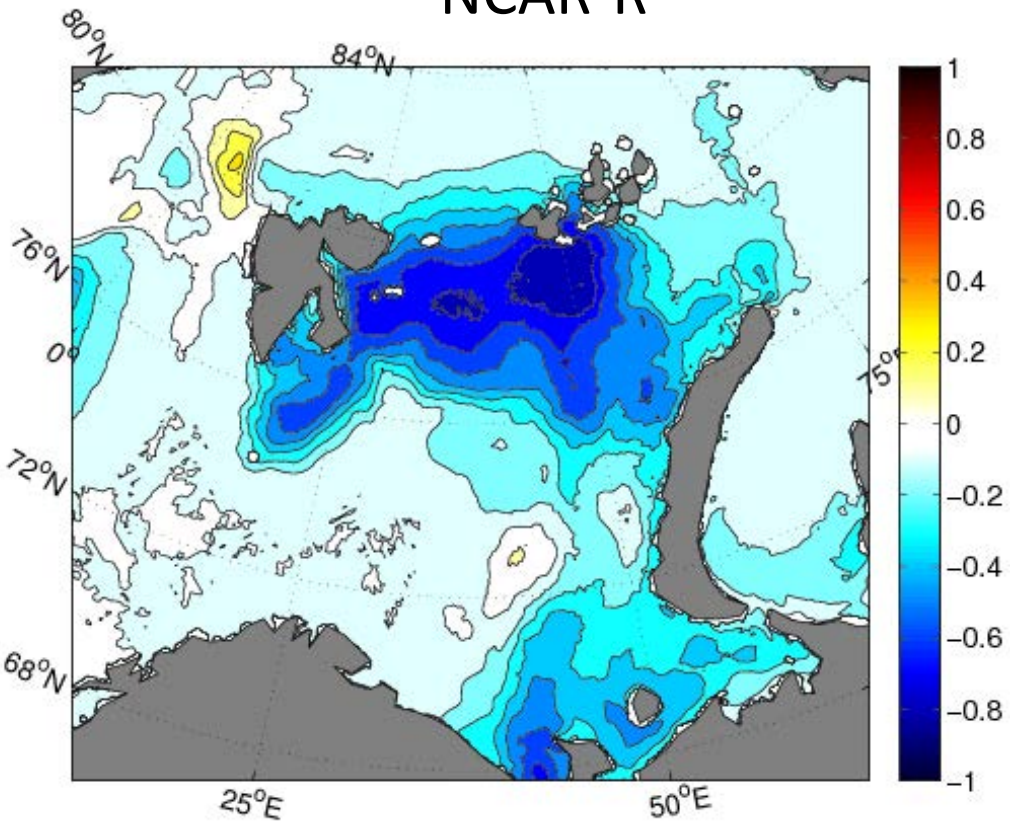


Downscaling global climate scenarios

GISS-R



NCAR-R

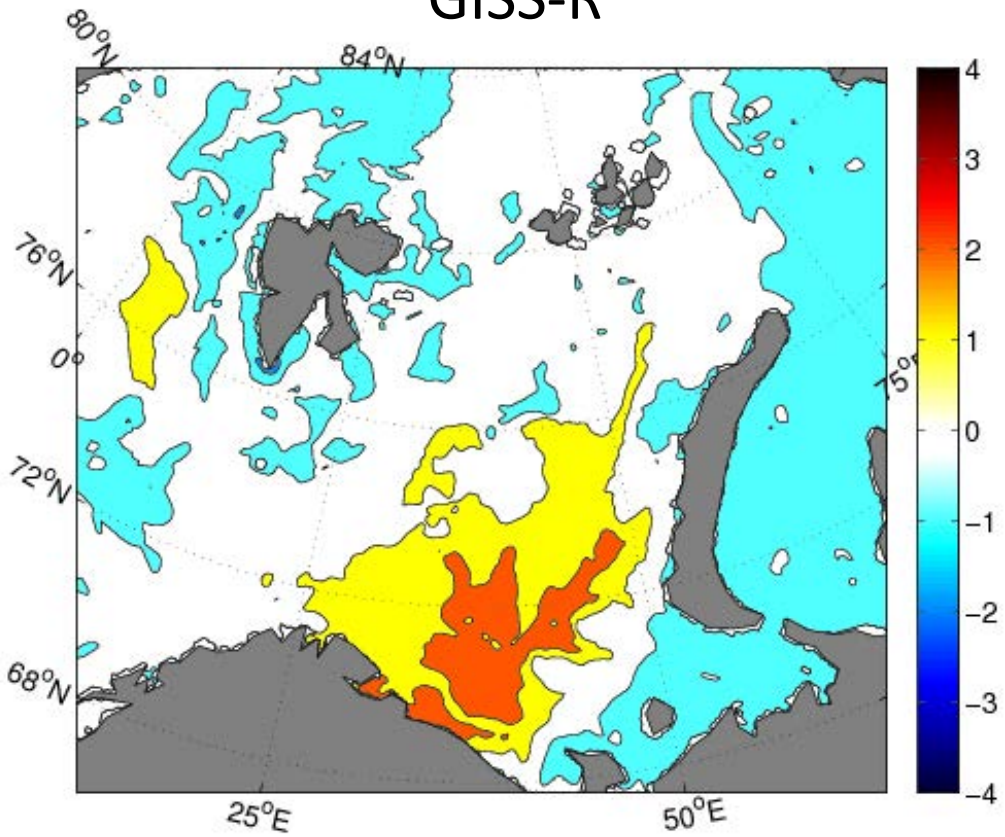


Change in ice-concentration, March (2046 – 2061) - (1981 – 1999)

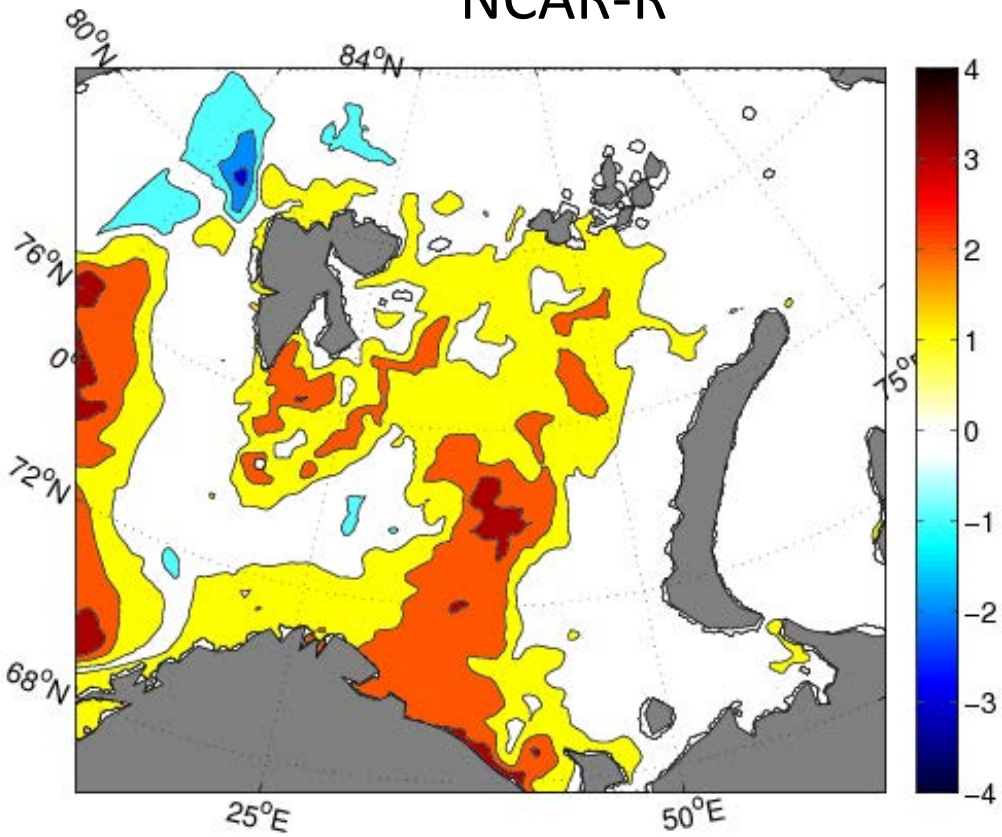
Sandø et al., 2014

Downscaling global climate scenarios

GISS-R



NCAR-R

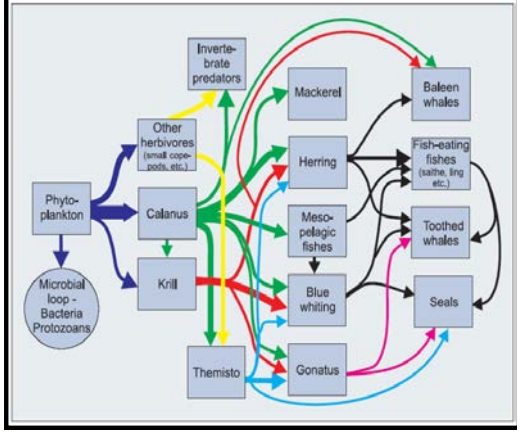


Change in sea surface temperature, March (2046 – 61) - (1981 – 99)

Sandø et al., 2014

NORWECOM.E2E

An integrated system of numerical models that describe the key elements in the Norwegian/Barents Sea / Arctic ecosystems with focus on processes of importance to harvestable stocks



Predator field

Pelagic fish IBM (Herring, blue whiting, mackerel)

Predator field

Zooplankton IBM (Calanus, Krill)

PHYTOPLANKTON MODEL

OCEAN MODEL - hindcast and scenarios

Zooplankton distribution

Phytoplankton distribution

3D field of current, temperature, turbulence