Demonstration for fisheries and environmental management Task 6.8 Greenland

Marie Maar, Eva Friis Møller, Janus Larsen, Mikael Sejr (Aarhus University, AU)

Asbjørn Christensen (Danish Technical University, DTU)

Mads H Ribergaard (Danish Meteorological Institute, DMI, subcontract)

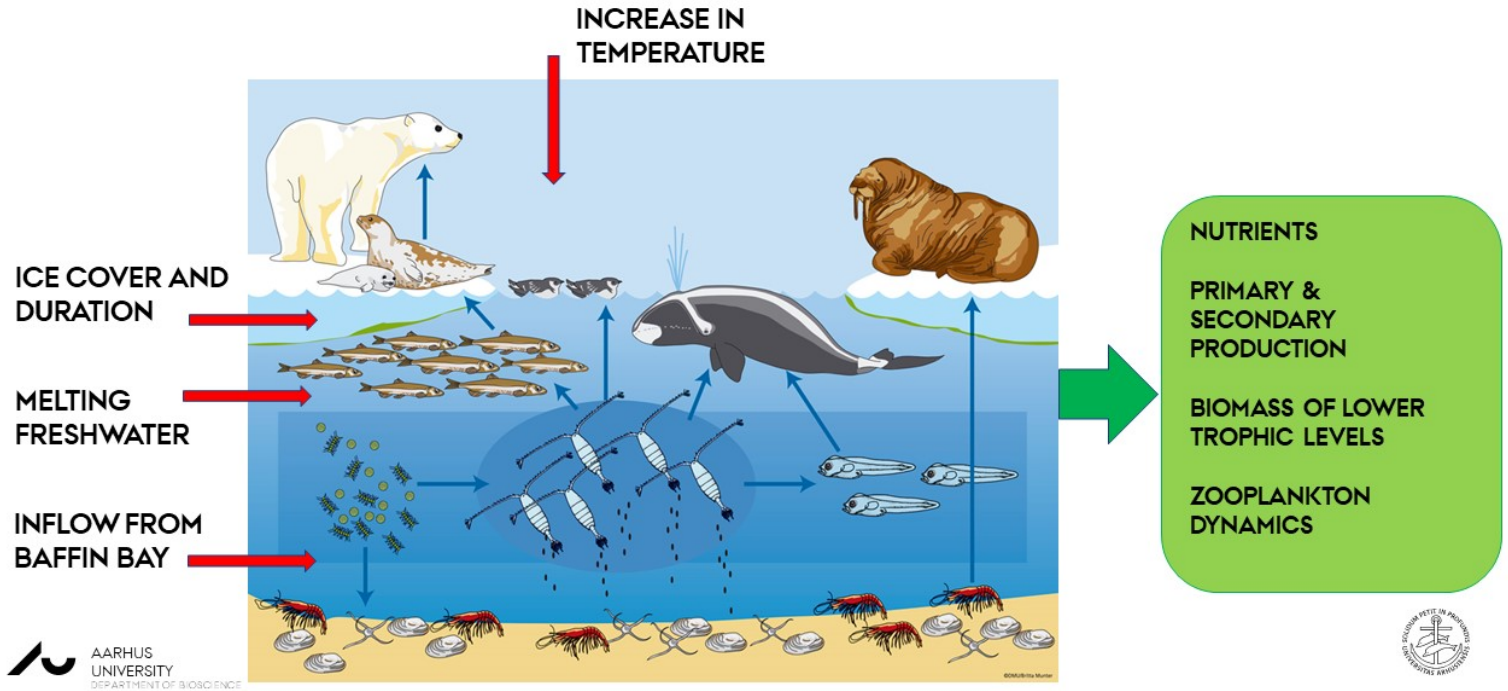
Kenneth Mankoff (Danish Geological Surveys, GEUS)

Demonstrate how an iAOS can

- **Provide environmental data to analyze changes in fish stocks**
- **Allow down-scaling from regional to coastal fine-scale models**
- **Improve and validate marine ecosystem models**
- **provide a scientific basis for better-informed decisions and better-documented processes for managers and policy-makers on local, regional and pan-arctic scales.**

INTAROS

GREENLAND CASE STUDY SCENARIOS



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GRØNLANDS NATURINSTITUT GREENLAND INSTITUTE OF NATURAL RESOURCES

GEM

GREENLAND ECOSYSTEM MONITORING

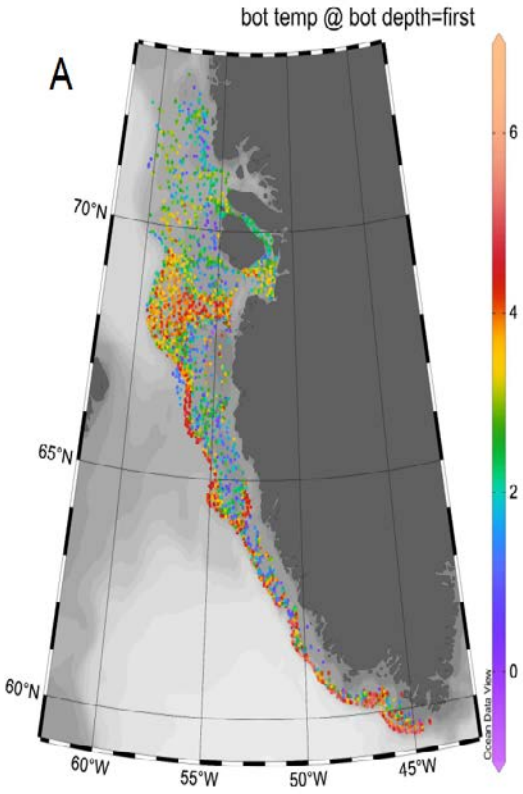
Impact of climate change on Greenland fish distributions

Aim:

- Synoptic analysis of spatial and temporal changes in distribution and biomass of 35 demersal fish species on West Greenland shelf
- Identify potential drivers of change

Major findings:

- Substantial increase in fish biomass –large contribution from species with an affinity for “warm” water, e.g. cod
- Complex dynamics in ocean temperature –some areas/depths warming, some cooling
- Reduced by-catch from commercial shrimp trawling important
- Reduced sea ice cover and increased run-off from Greenland Ice Sheet has increased light and nutrients for primary production

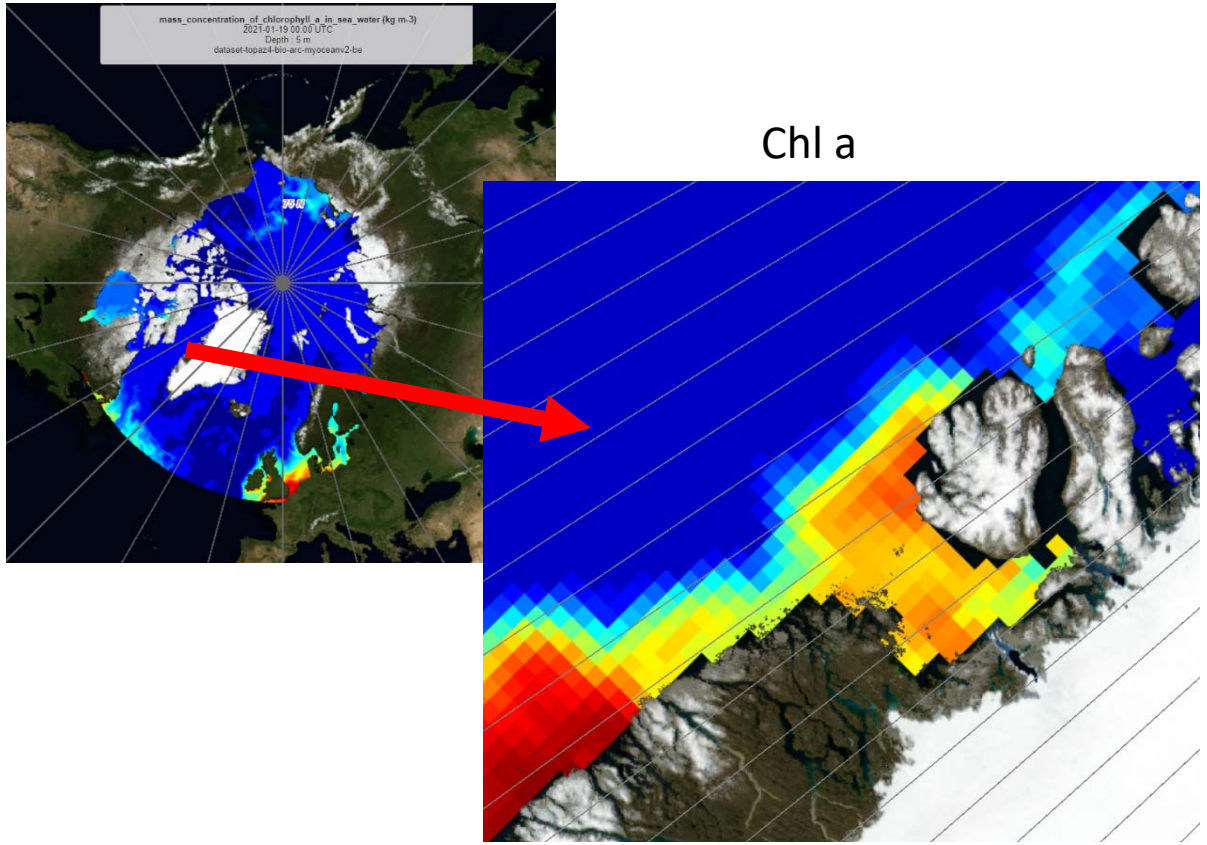


1993-2016

Copernicus large-scale eco-model (12.5 km)

Down-scaling

Local fine-scale model (>50m, av. 1.8 km)



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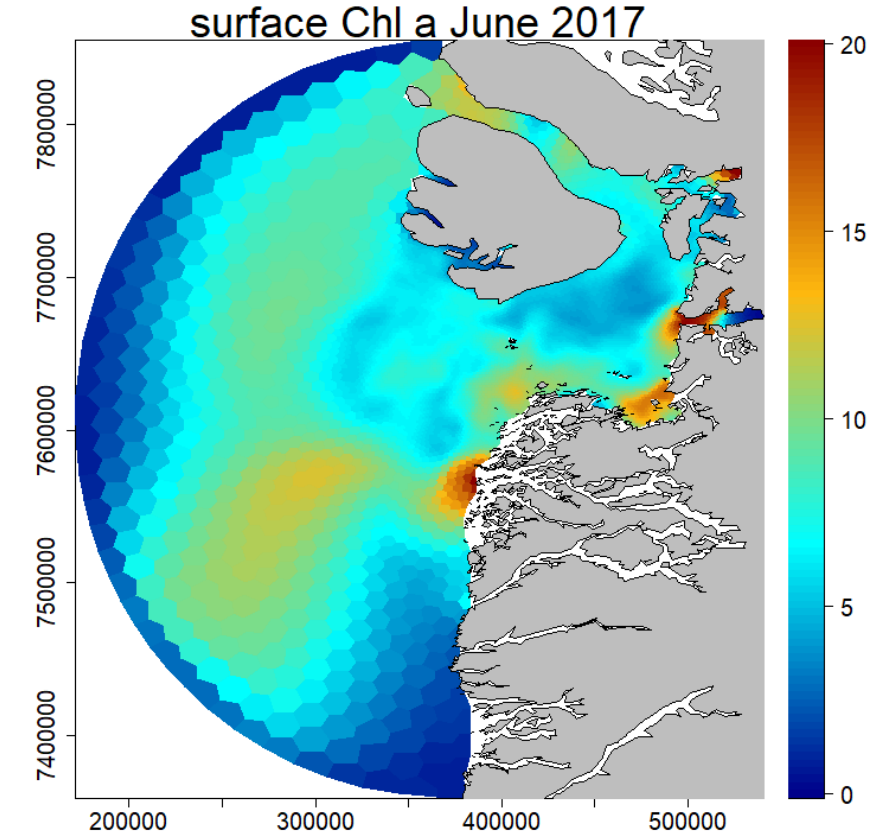
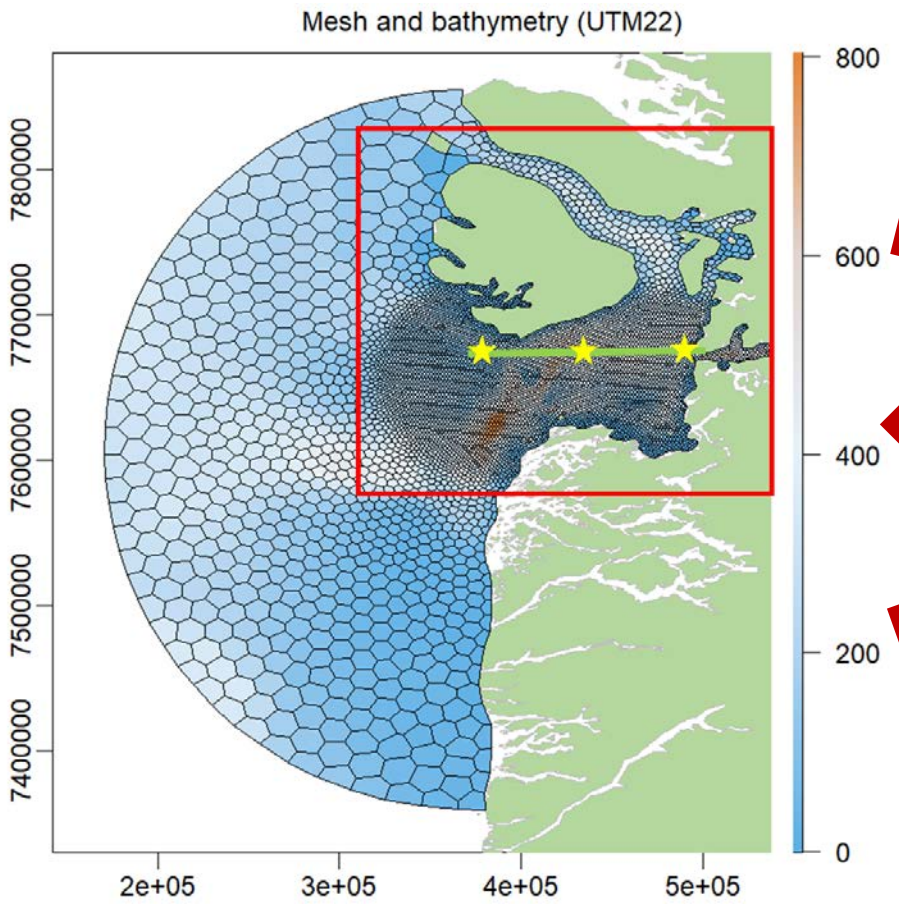


DISKO BAY ECOSYSTEM MODEL (FlexSem-ERGOM)

Sea ice model (CICE, DMI)

Large scale hydrodynamic ocean model (HYCOM, DMI)

Large scale ecosystem model (ERSEM, NIVA)



GIS discharge (PROMICE, GEUS) (WP5)

Satellite data assimilation (DTU, WP5)

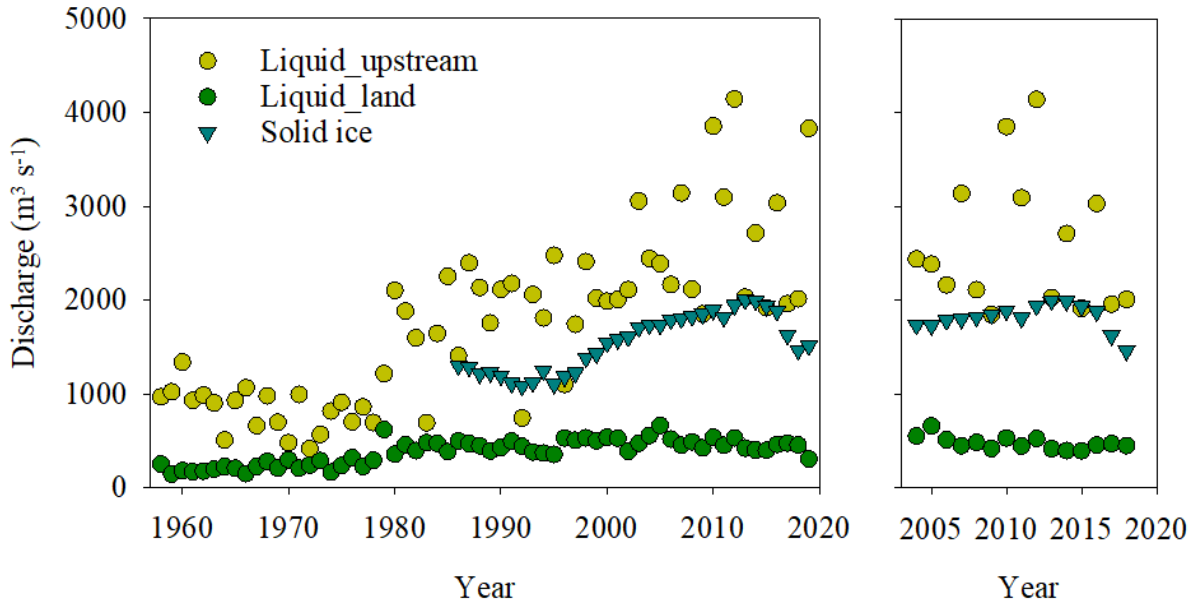
In situ data integration (Greenland monitoring program, AU)

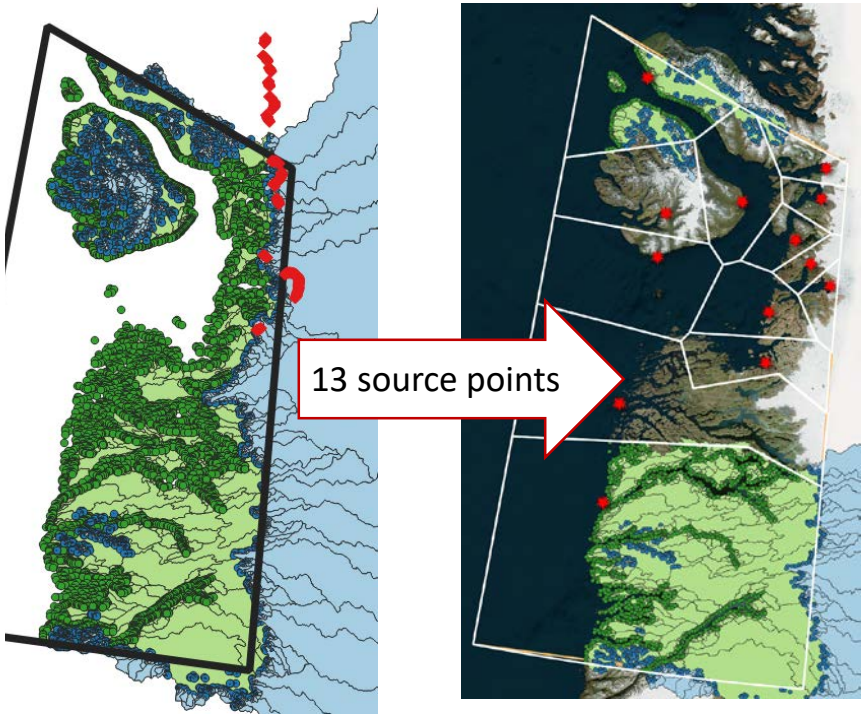
GREENLAND ICE SHEET DISCHARGE (GEUS, WP5)

- Liquid runoff obtained from two regional climate models (MAR and RACMO), divided into melt from the ice-sheet and runoff from land (Mankoff et al 2020a)

- Solid ice discharge at the ocean ice sheet interface from ice velocity and ice and bed elevation (Mankoff et al 2020b)

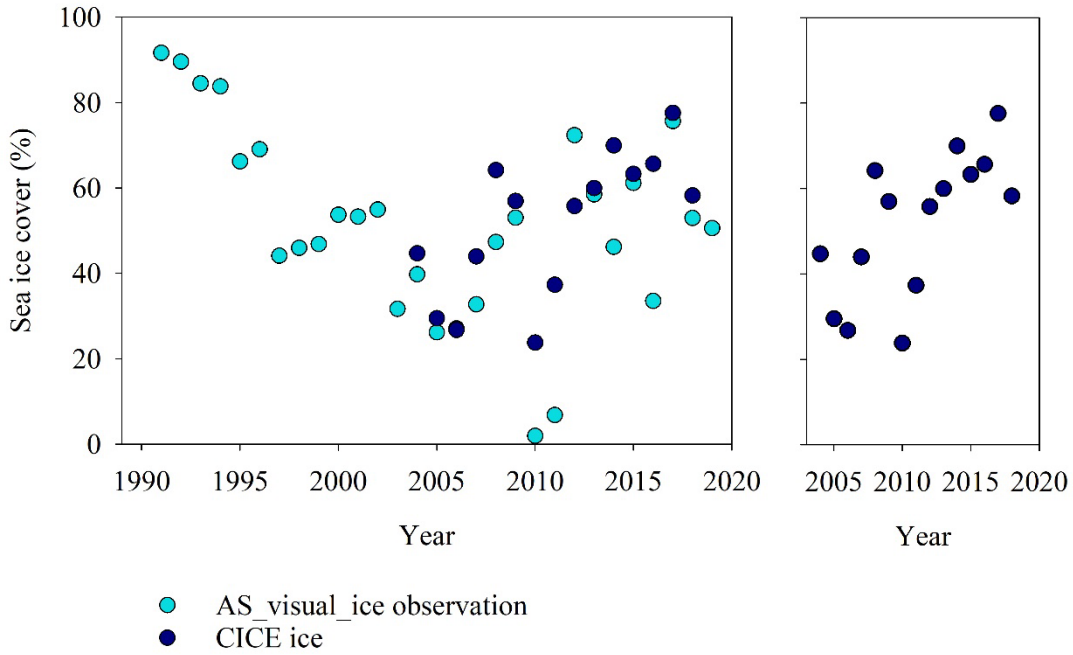
- Input to FLEXSEM models through 13 merged source points at the coast



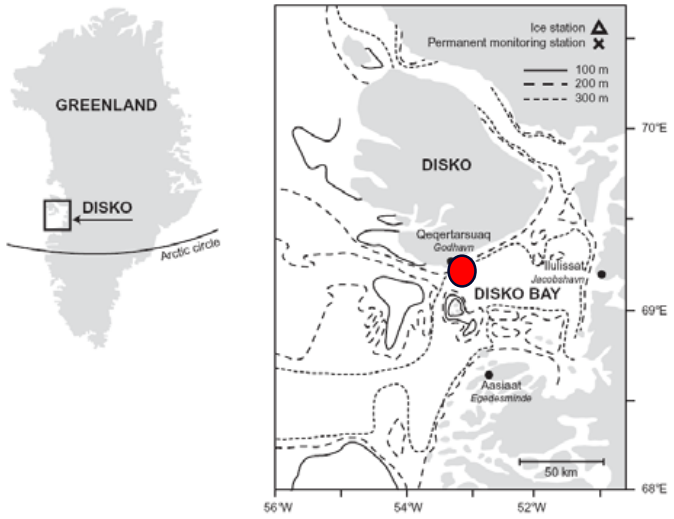


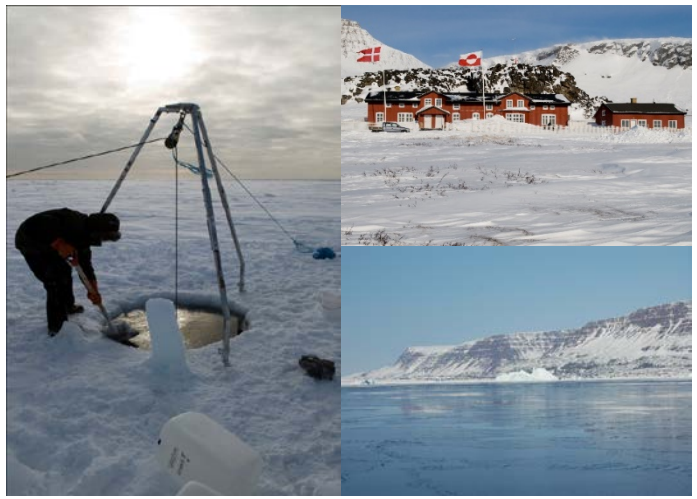
SEA ICE DATA (CICE, DMI)

- The HYCOM-CICE model system assimilates re-analyzed sea-surface temperature and sea-ice concentration from satellite (Copernicus)
- Visual inspection at the Arctic Research station at Disko Island
- Shows a decrease in sea ice cover over time, but with high year-to-year variability



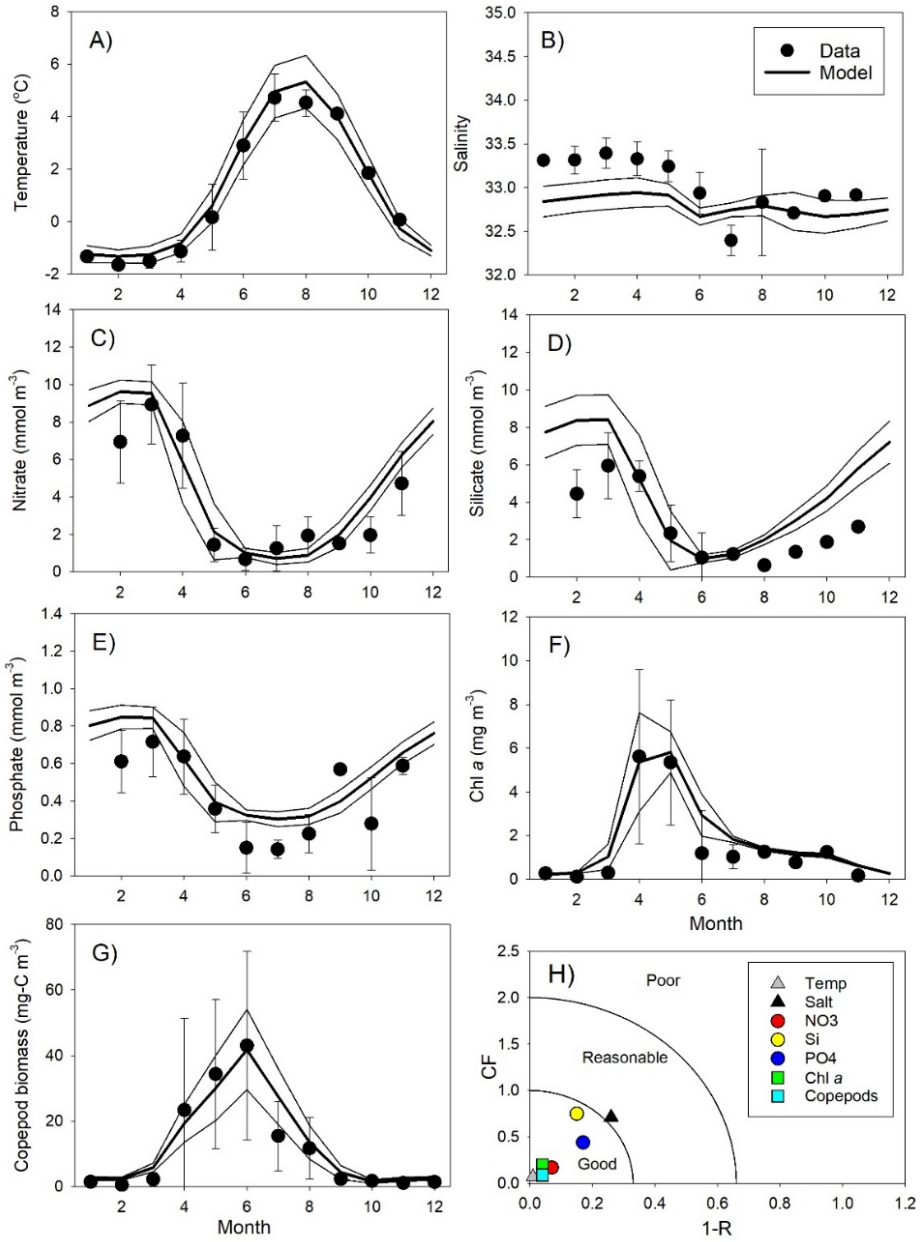
INTEGRATION OF *IN SITU* DATA





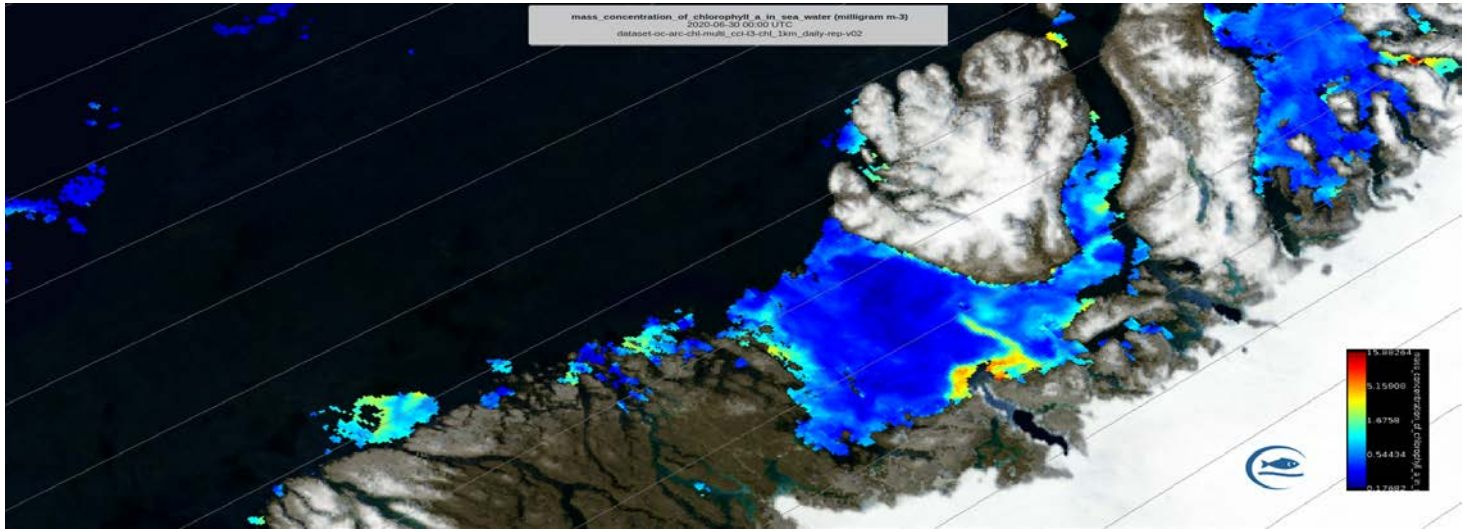
In situ data were used to calibrate and validate the FLEXSEM ecosystem model (2004-2018)

Obtained from scientific campaigns and the Greenland ecosystem monitoring programme (mainly just south of Disko Island)



Data assimilation in Flexsem (DTU/AU)

- External Data Assimilation Tool (EDAT) is implemented for data assimilation of remote sensing / in situ time series to confine residual uncertainty in Flexsem ecosystem variables
- OCEANCOLOUR_ARC_CHL_L3_REP_OBSERVATIONS_009_069-TDS at 1km resolution, which is expected to improve bloom timing that is a trigger for higher trophic levels
- Observational variance based on quality index for chlorophyll-a and provision for variable cloud coverage.

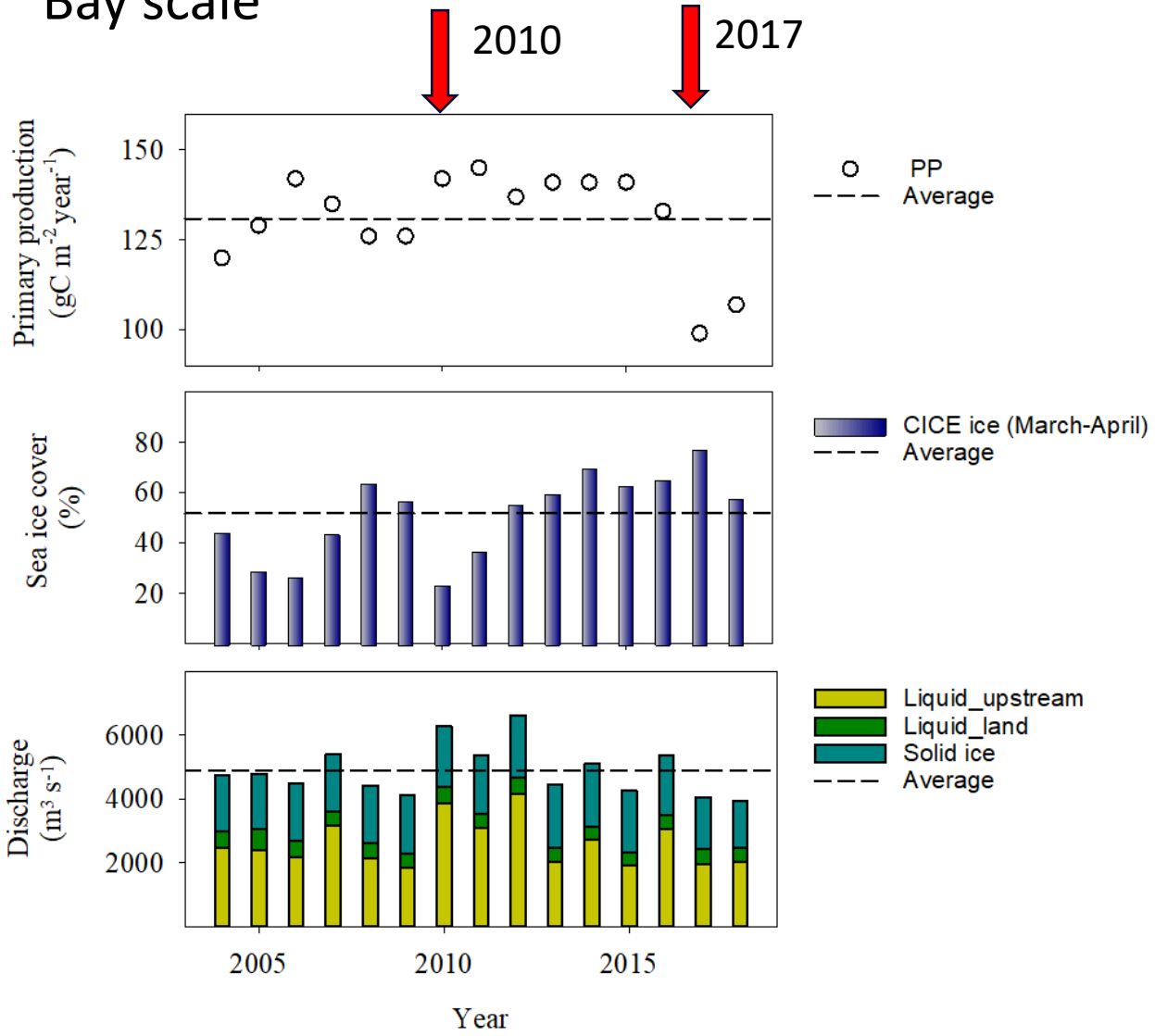


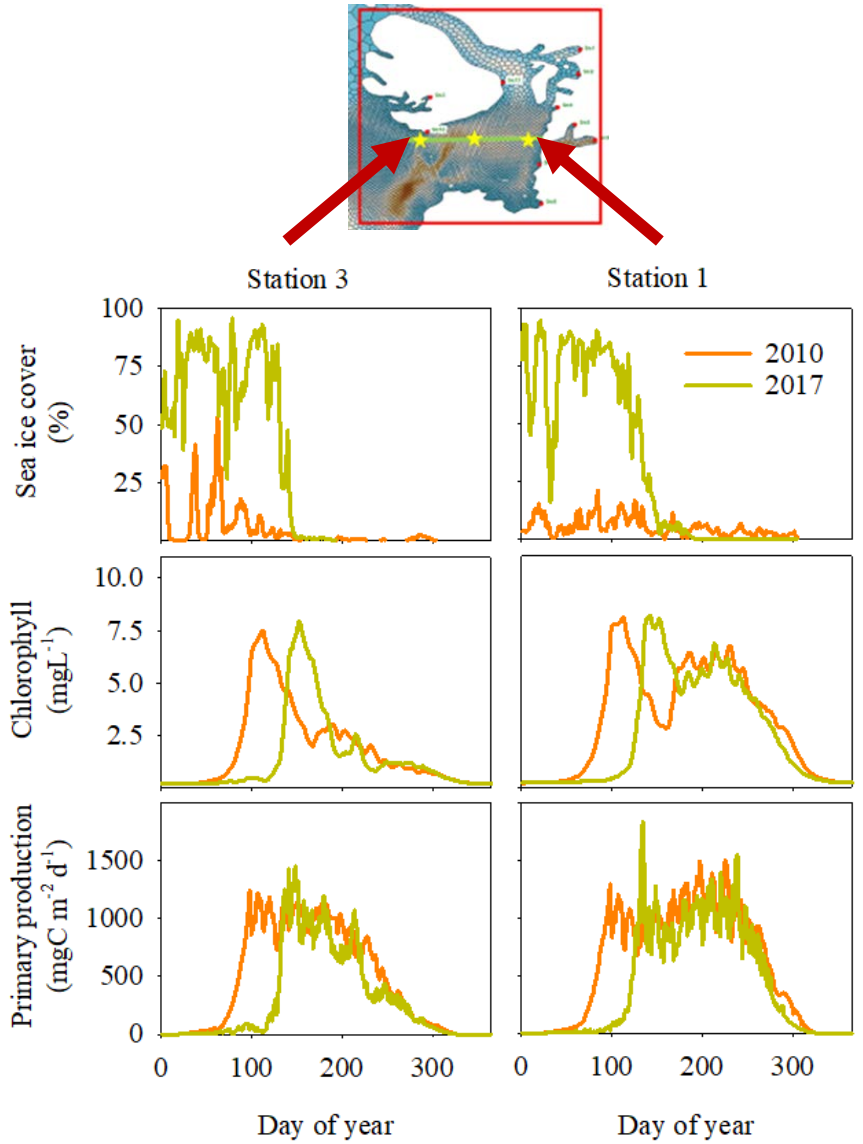
INTAROS

Contact: Asbjørn Christensen, DTU

THE IMPACT OF CHANGES IN SEA ICE COVER

Bay scale

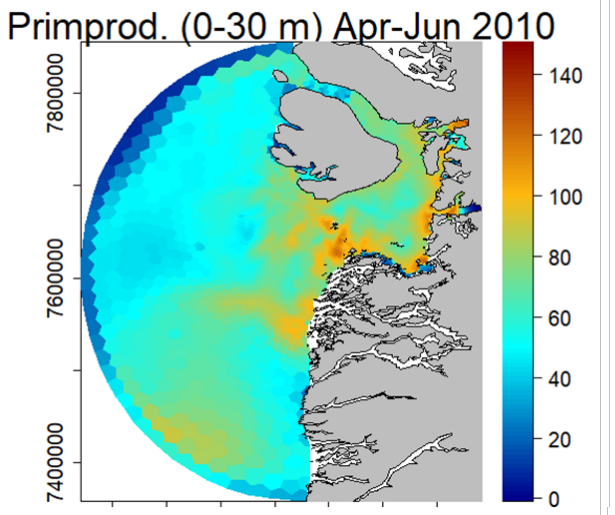


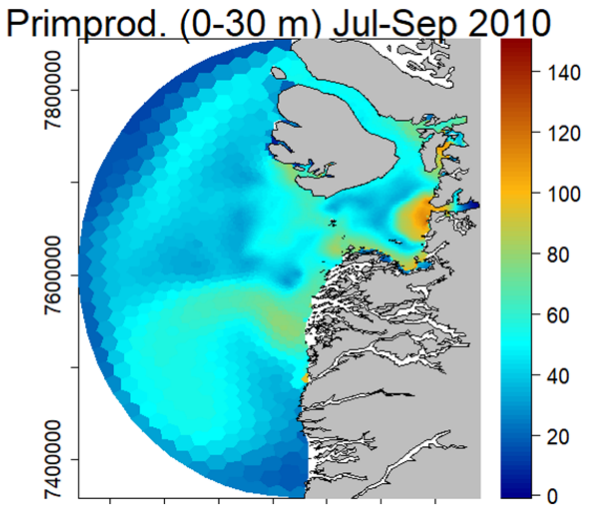


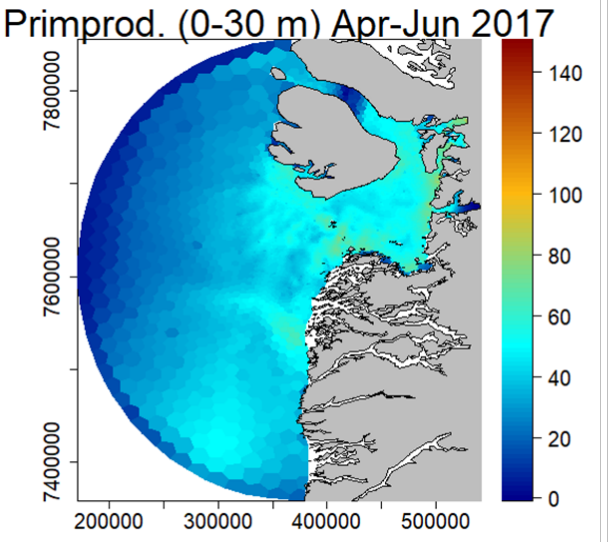
PRIMARY PRODUCTIVITY AND ICE COVER

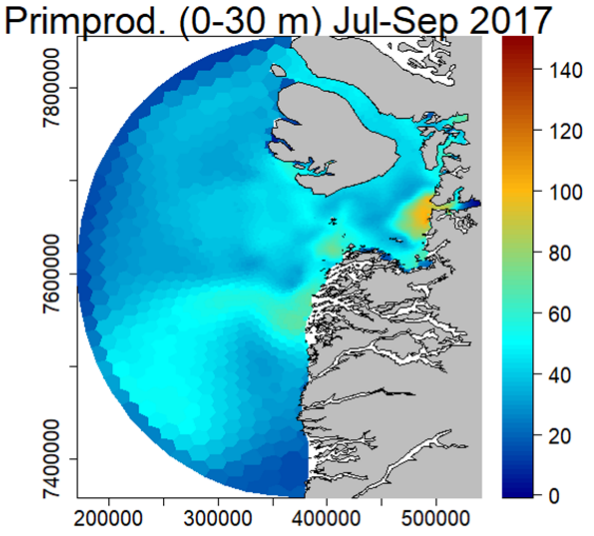
2010: Low ice cover
Primary production=
142 gC/m2/yr

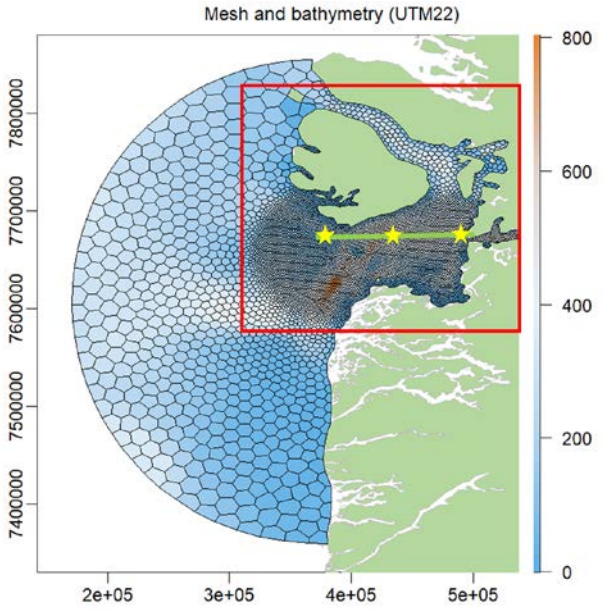
2017: High ice cover
Primary production=
100 gC/m2/yr





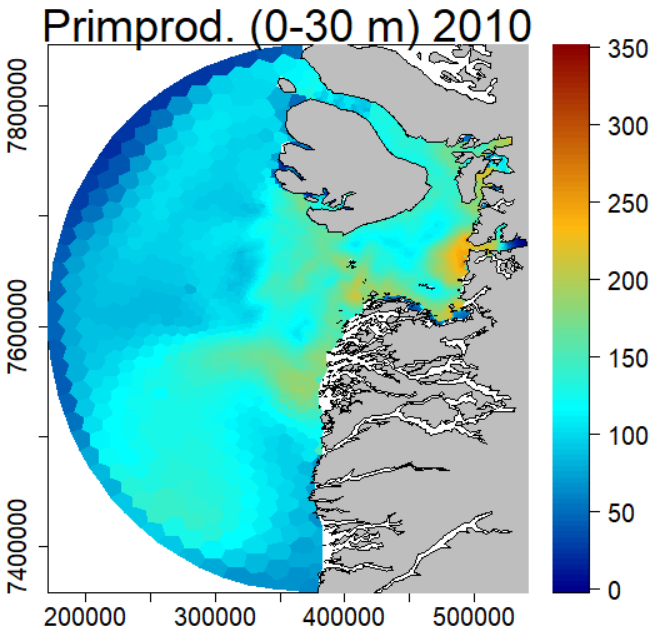






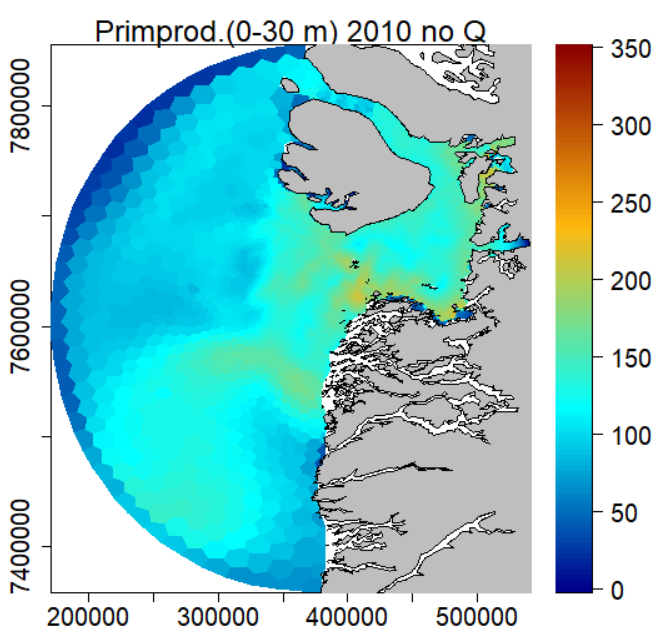
PRIMARY PRODUCTIVITY AND FRESHWATER DISCHARGE

YEAR 2010



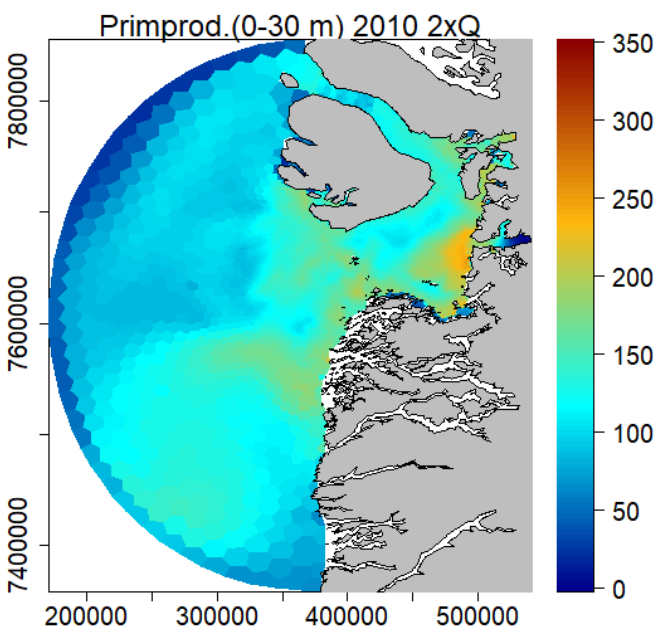
142 gC/m2/yr

No discharge



138 gC/m2/yr

High discharge (X2)



143 gC/m2/yr

Conclusion on results

- W Greenland Fish stocks; preliminary conclusion: Recovery of over-exploited fish stocks mediated by climate change
- On the bay scale, sea ice cover is the most important factor, and decreasing sea ice cover leads to higher primary production
- The freshwater discharge has a major impact on the timing and level of primary production near the source; more discharge leads to higher primary production
- In the future, less sea ice and more discharge will increase primary productivity with implications for fish stocks and fisheries and hence the local population in Disko Bay