Climate variability, climate change and the future of fisheries in the Arctic and sub-Arctic marine ecosystems

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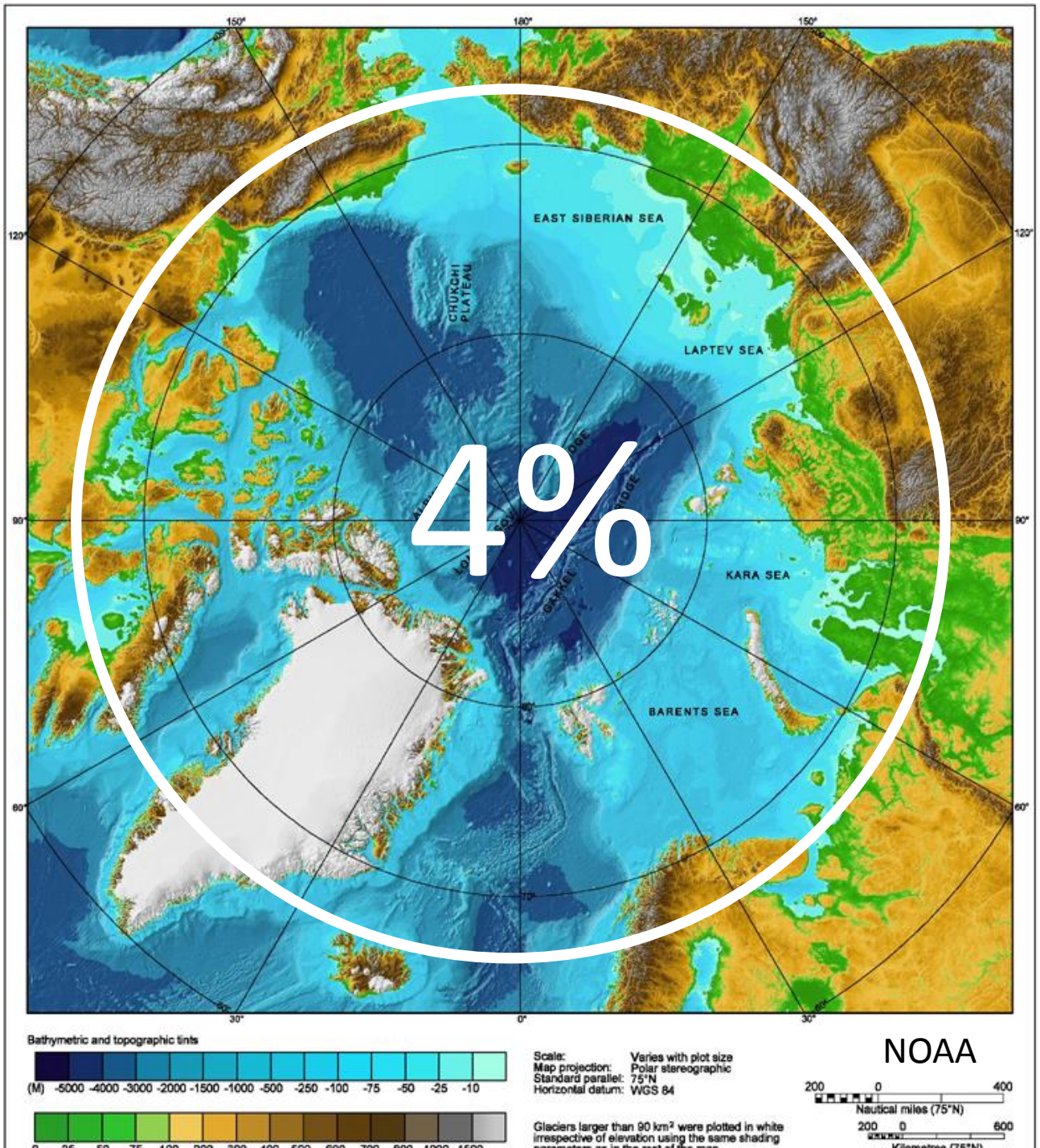
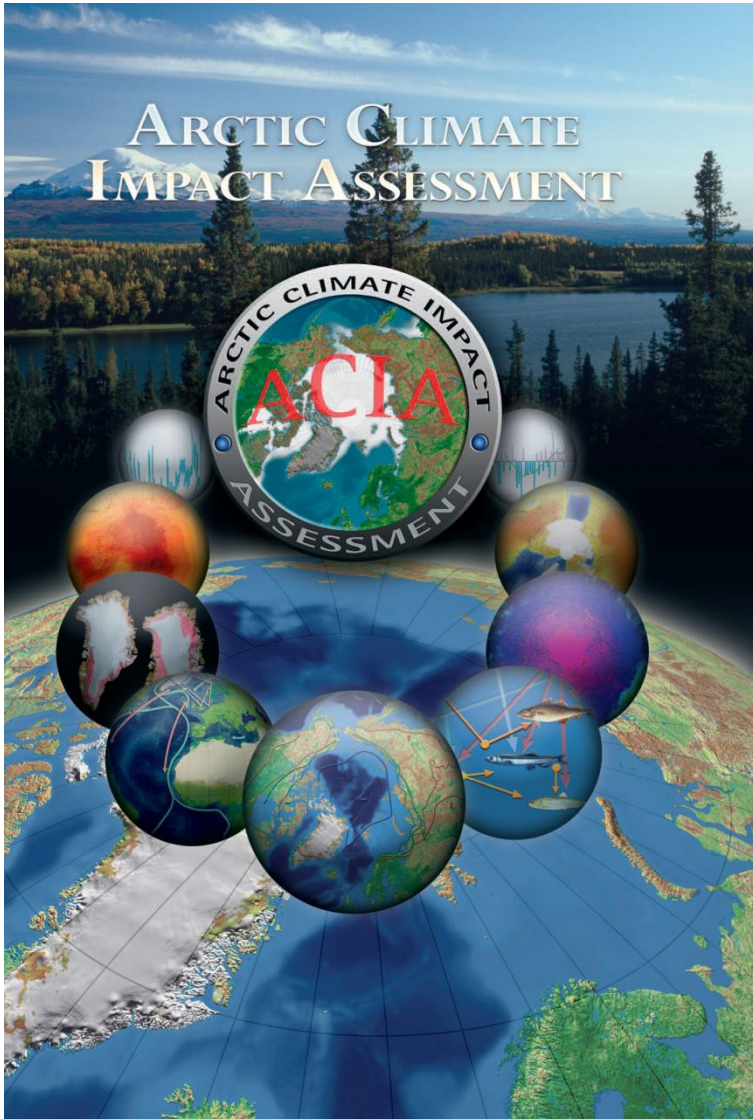

150°
180°
150°
120°
120°
90°
90°
60°
60°
30°
0°
30°
EAST SIBERIAN SEA
CHUKCHI PLATEAU
LAPTEV SEA
4%
KARA SEA
BARENTS SEA
Bathymetric and topographic tints
(M) -5000 -4000 -3000 -2000 -1500 -1000 -500 -250 -100 -75 -50 -25 -10
Scale: Varies with plot size
Map projection: Polar stereographic
Standard parallel: 75°N
Horizontal datum: WGS 84
Glaciers larger than 90 km² were plotted in white irrespective of elevation using the same shading
NOAA
200 0 400
Nautical miles (75°N)
200 0 600

Arctic Climate Impact Assessment (ACIA) report 2005

- The most comprehensive review of the status of the Arctic marine ecosystems and fisheries
- Probably a good idea to prepare a second ACIA report



ACIA report concludes with…

- The total effect of a moderate warming (1-3°C) of climate on fish stocks is likely to be of less importance than the effects of fisheries policies and their enforcement
- It is unlikely that that the impact of the climate change projected for the 21st century on arctic fisheries will have significant long-term economic or social impacts at a national level

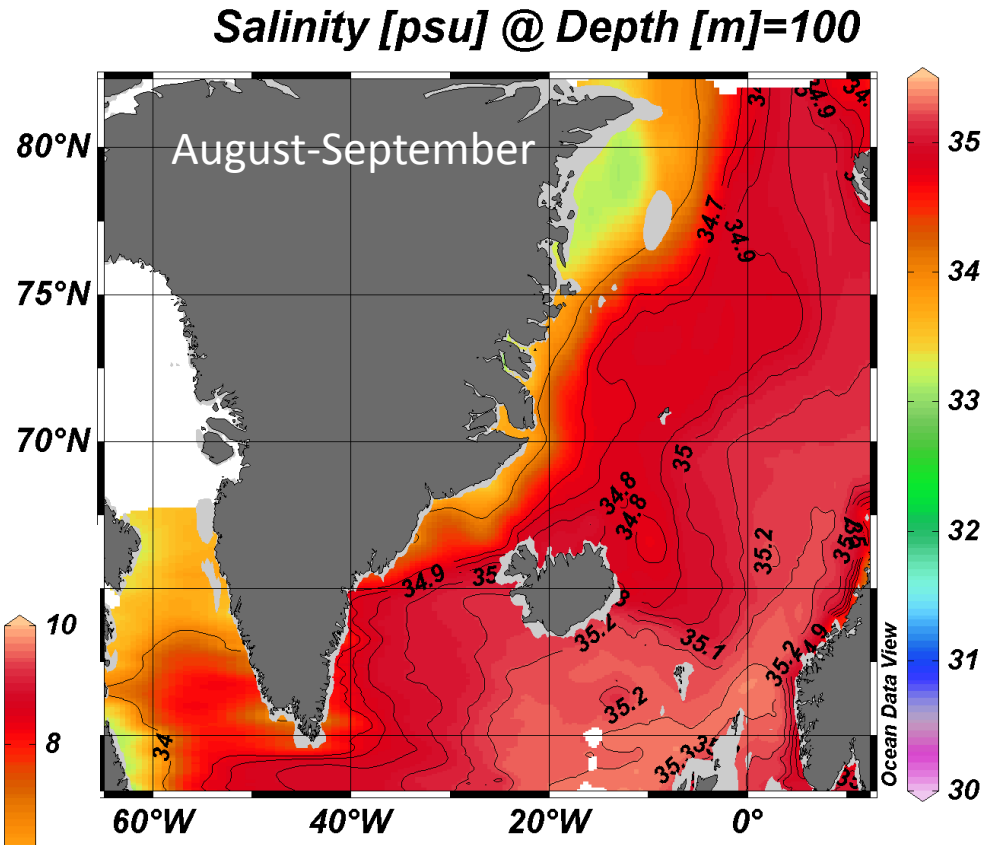
Fishing vessel activity for 2004

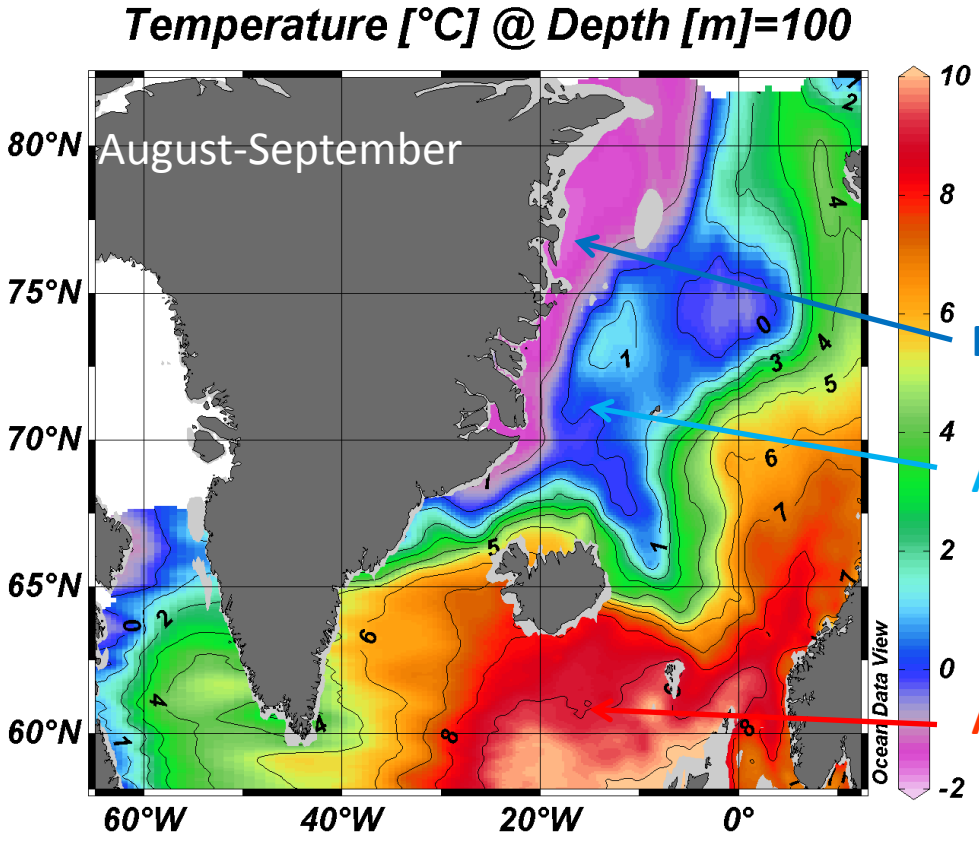
Very limited fishing activity occurs in the Arctic Ocean and the Canadian Arctic Archipelago, mostly small-scale food fisheries

Most of the fishing activity takes place in the sub-Arctic

AMSA (2009)

Temperature and salinity at 100 m depth in the Northern North Atlantic. The NISE database



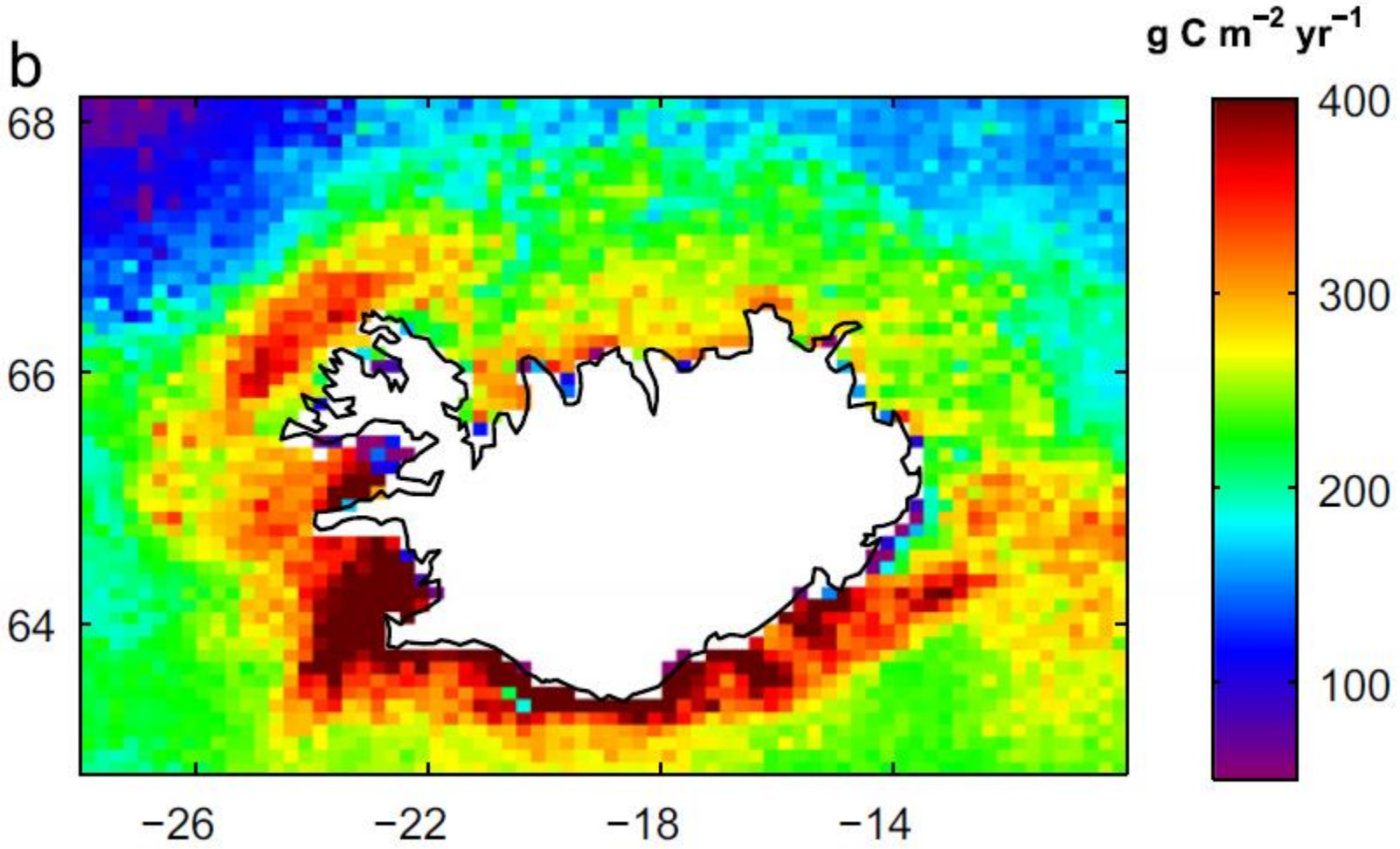


Polar Water

Arctic Water

Atlantic Water

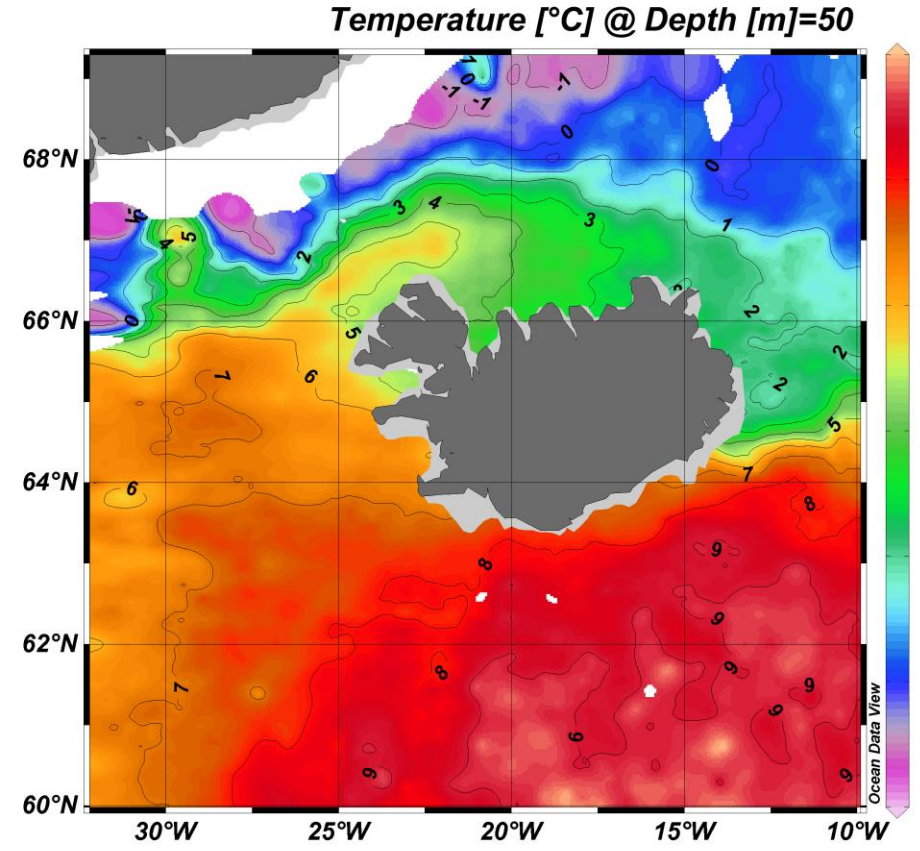
NISE database

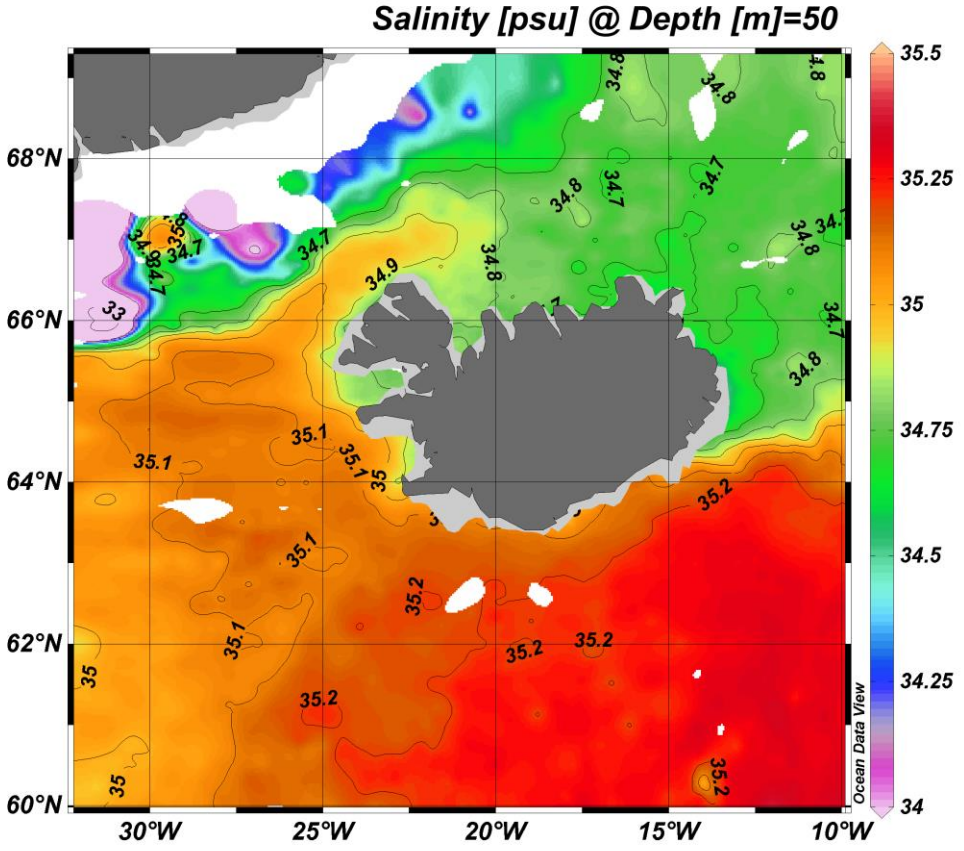


Primary production through water column for period from March to October.

From L. Zhai et al. (2012)

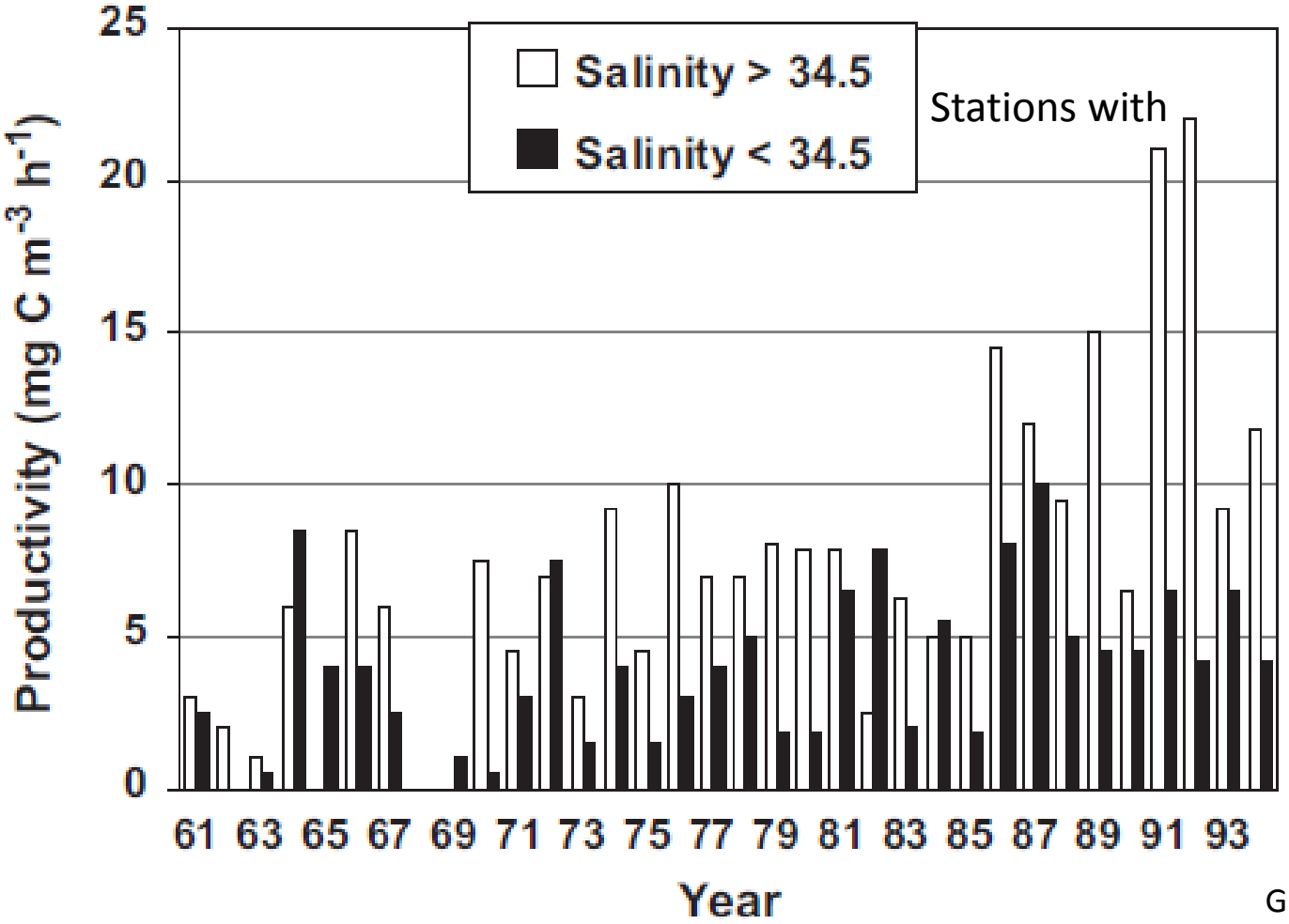
Temperature and Salinity at 50 m depth in May/June





Phytoplankton

- Stratification is important for the onset of the spring bloom
- It occurs earlier in the stratified PW than in the less stratified AW
- There is usually a second bloom in the autumn
- 2.5 times higher at high salinity stations

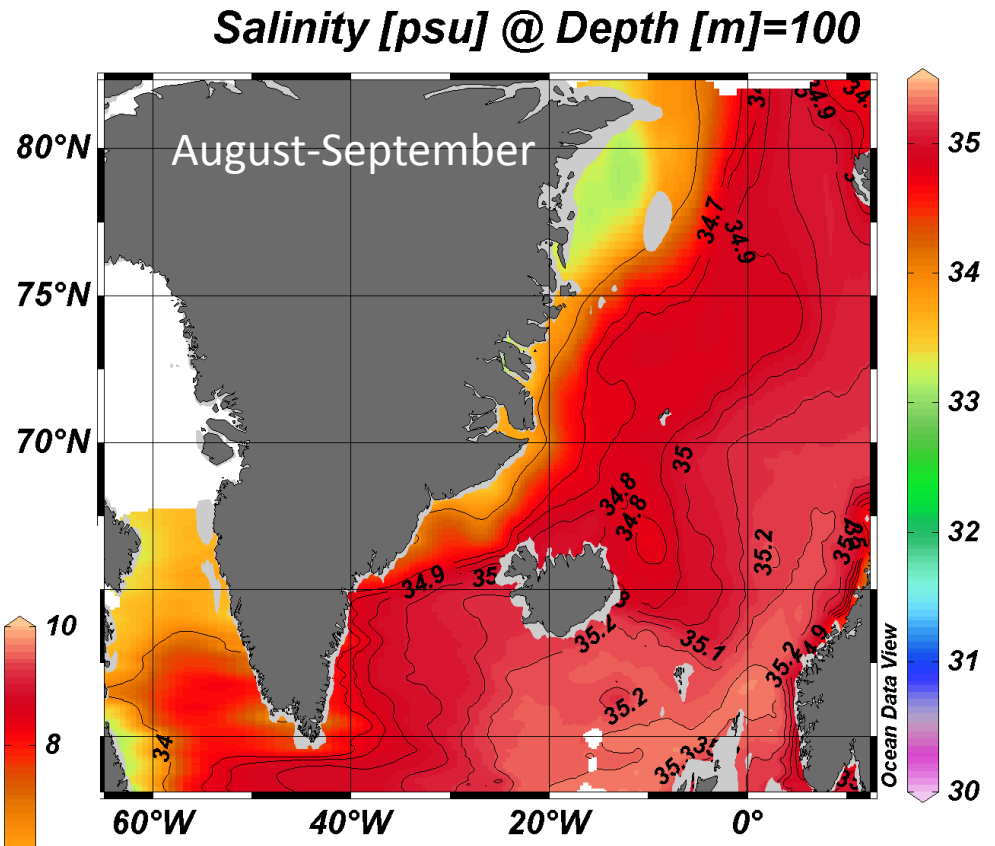


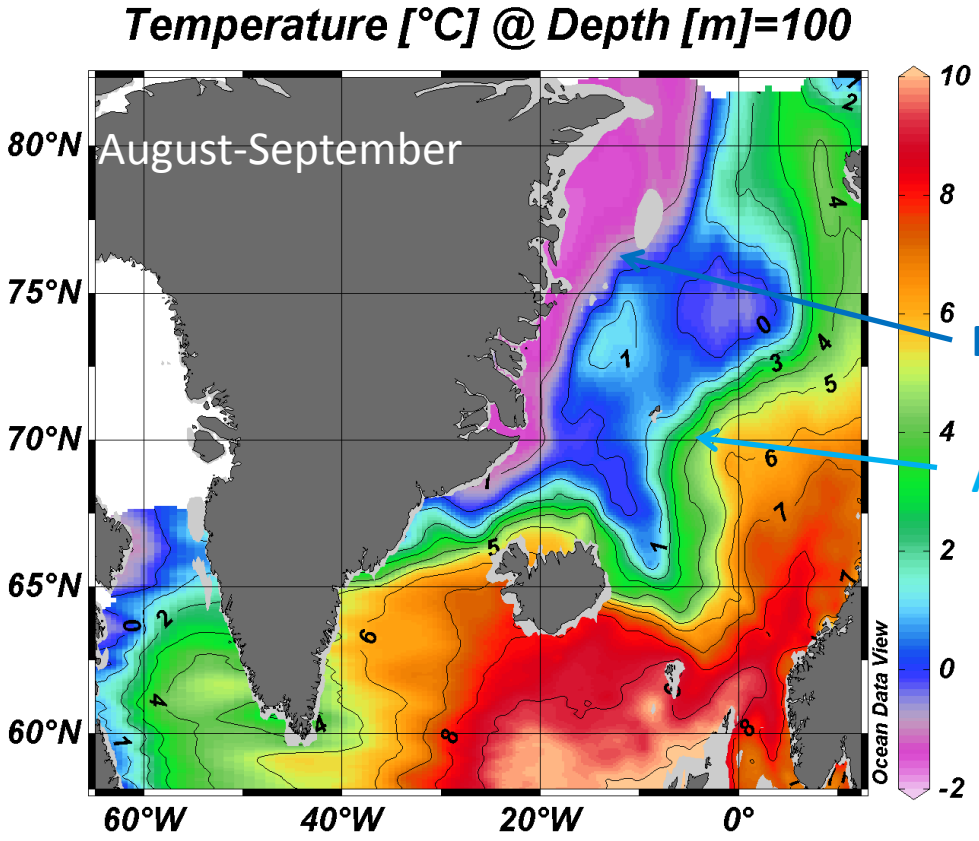
Gudmundsson (1998)

Fronts

- Fronts are boundaries between water masses
- Fronts are often bound by topography and are therefore unlikely to move long distances except if something very drastic happens, (e.g. during ice ages)
- Most commercial fish stocks are mainly found in a single water mass and are unlikely to cross fronts

Temperature and salinity at 100 m depth in the Northern North Atlantic. The NISE database



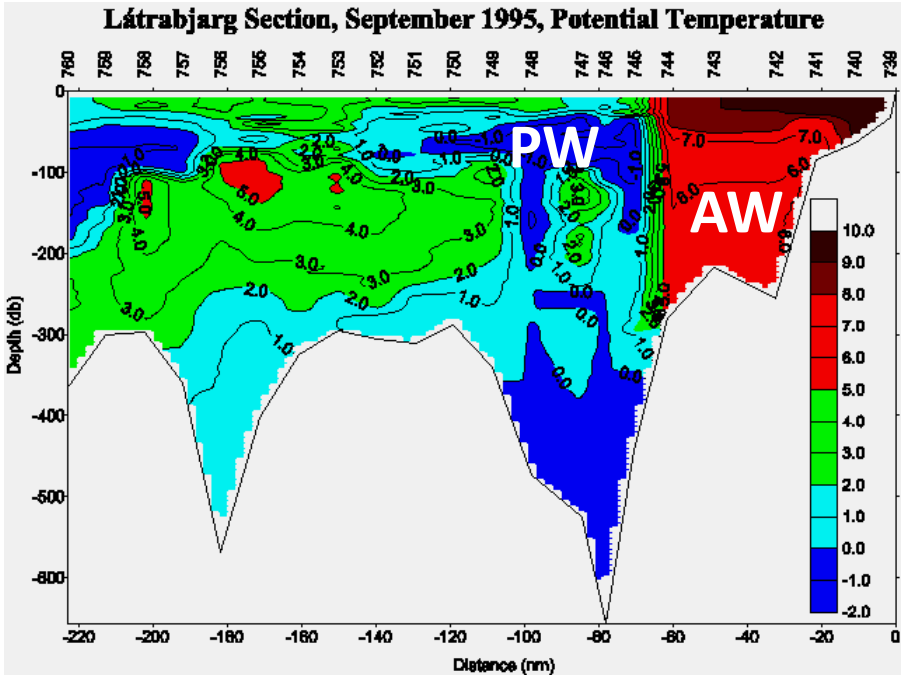


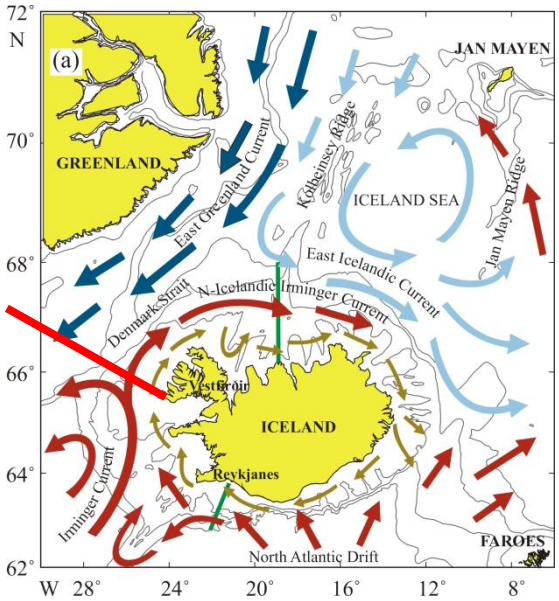
Polar front

Arctic front

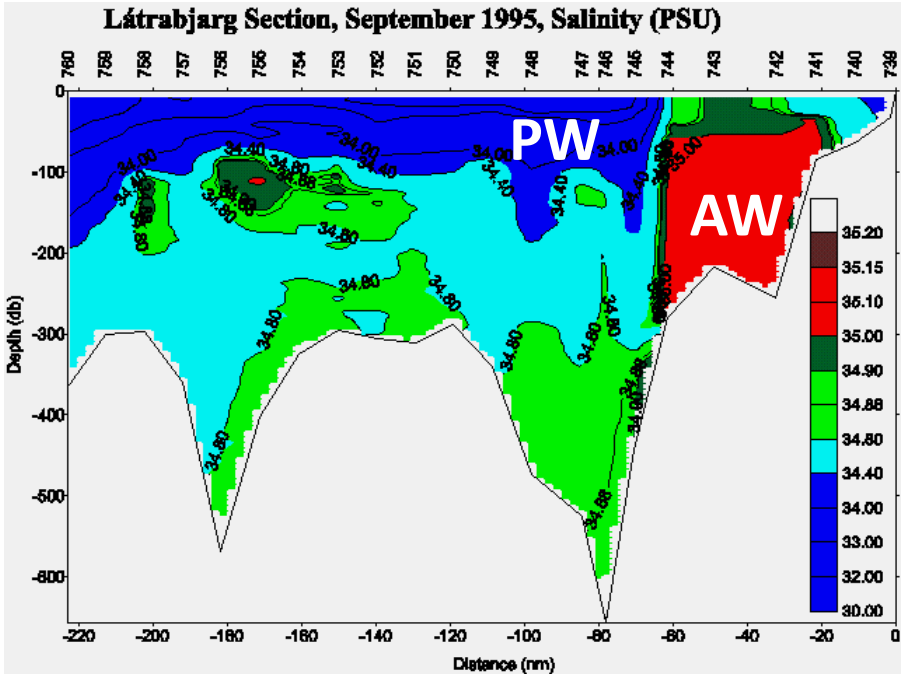
NISE database

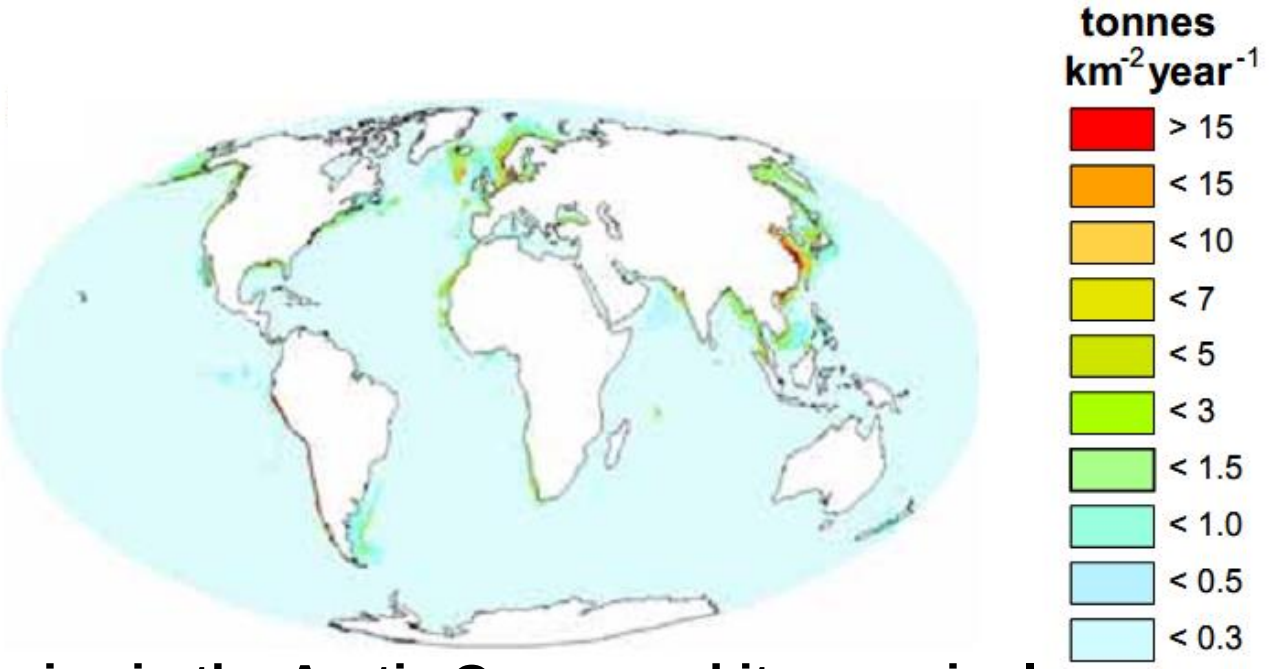
The Polar front in Denmark Strait



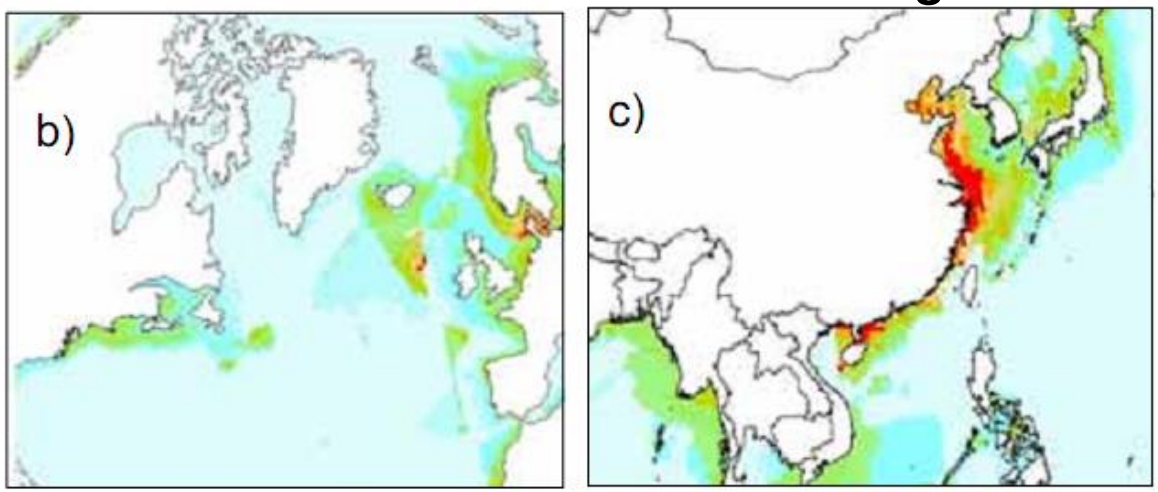


MRI





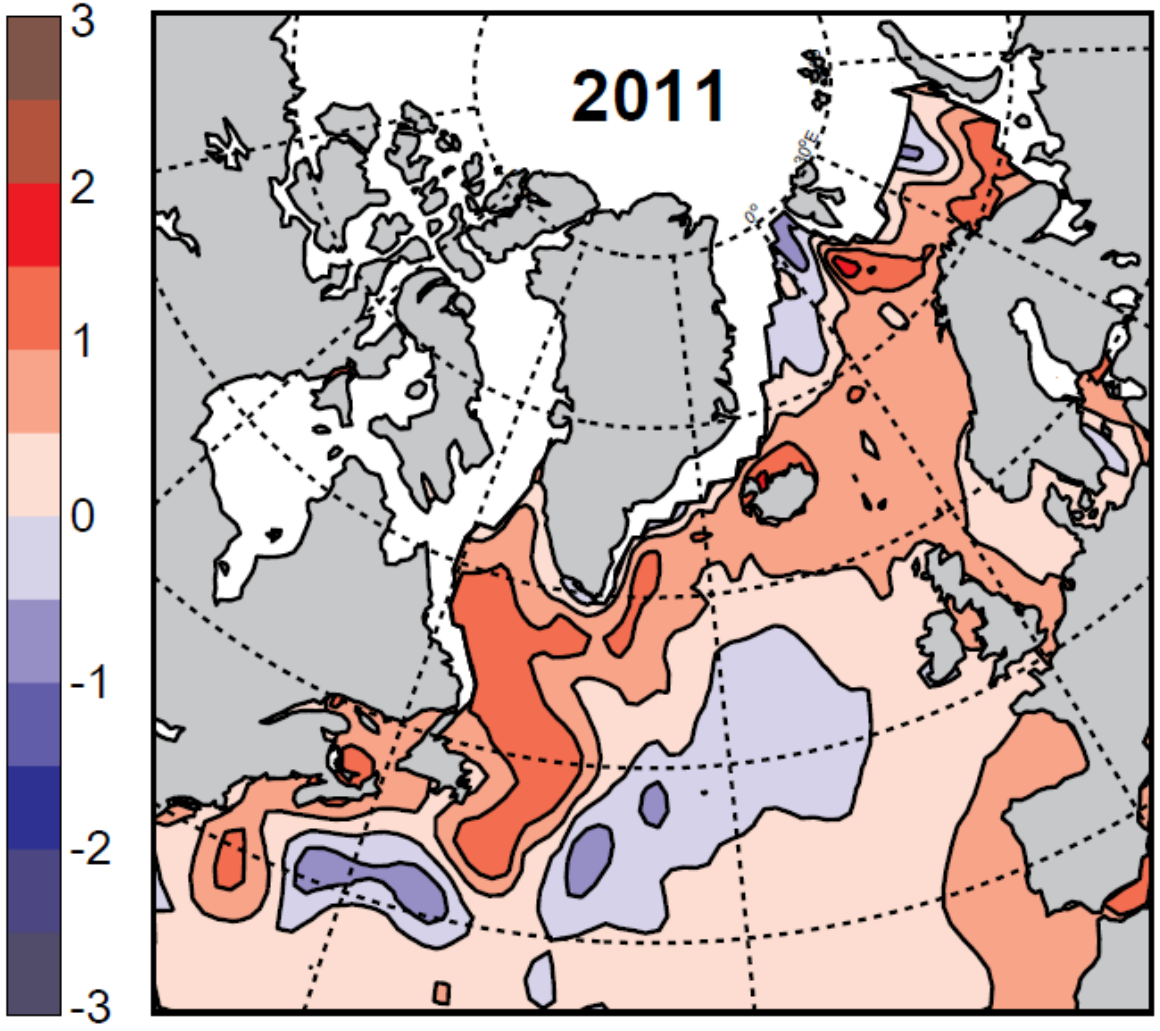
Very small fisheries in the Arctic Ocean and its marginal seas



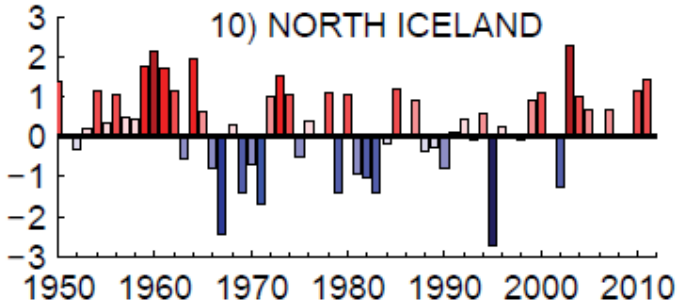
Watson (2004)

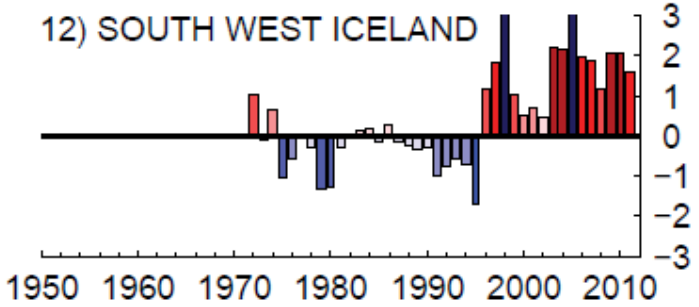
Map 2. Allocated catch rates (tonnes km^{-2} year^{-1}) for all species for 2000 based on FAO's data (a) globally, (b) for the North Atlantic, and (c) for Southeast Asia.

Upper ocean temperature anomalies in 2011 at selected locations across the North Atlantic. The anomalies are normalized with respect to the standard deviation



Time-series of normalized anomalies at two stations close to Iceland

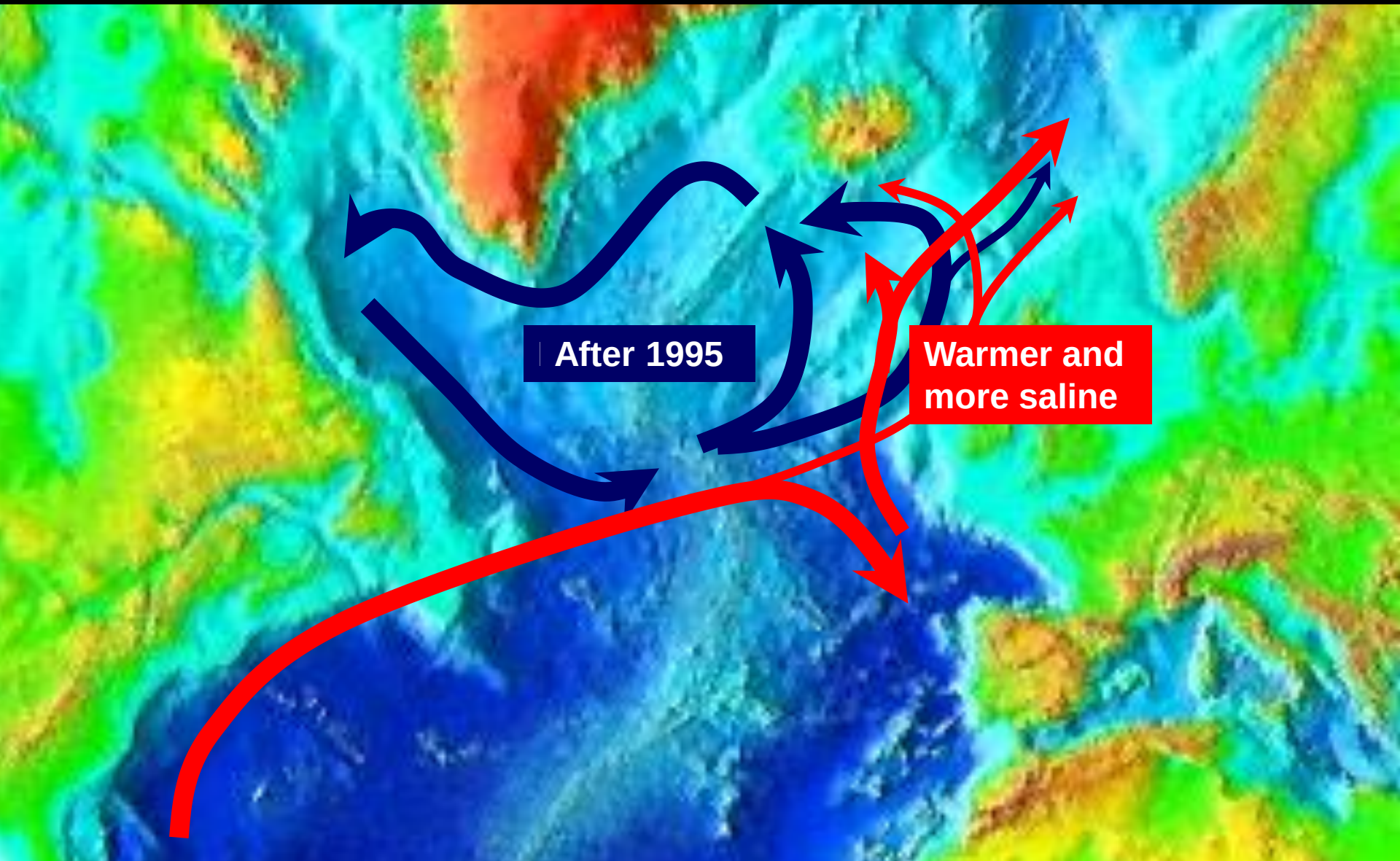




ICES (2012)

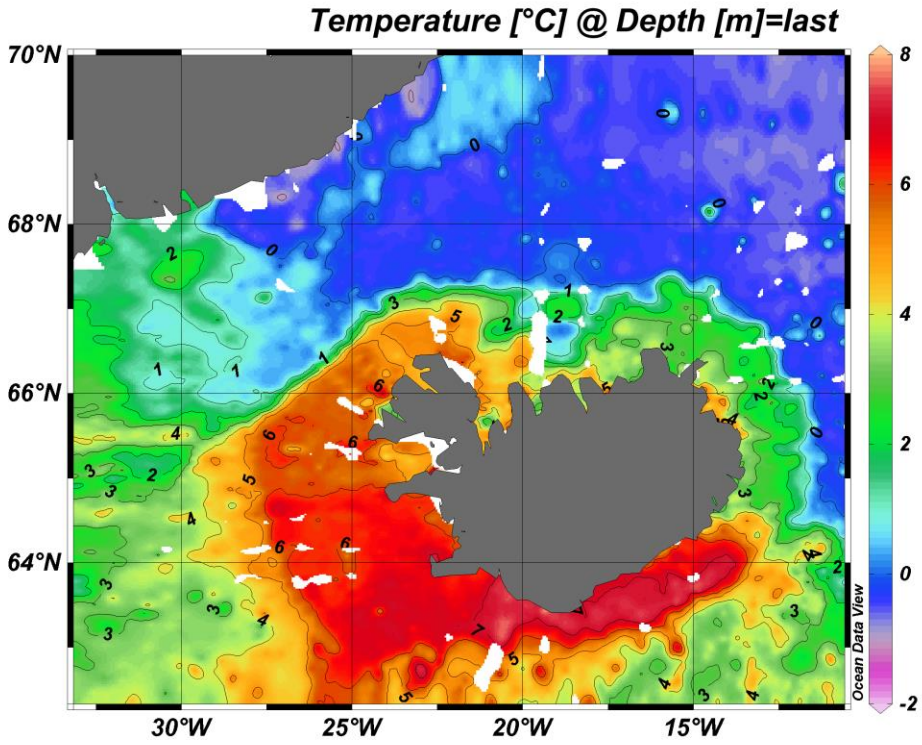
The effect of SPG shrinkage

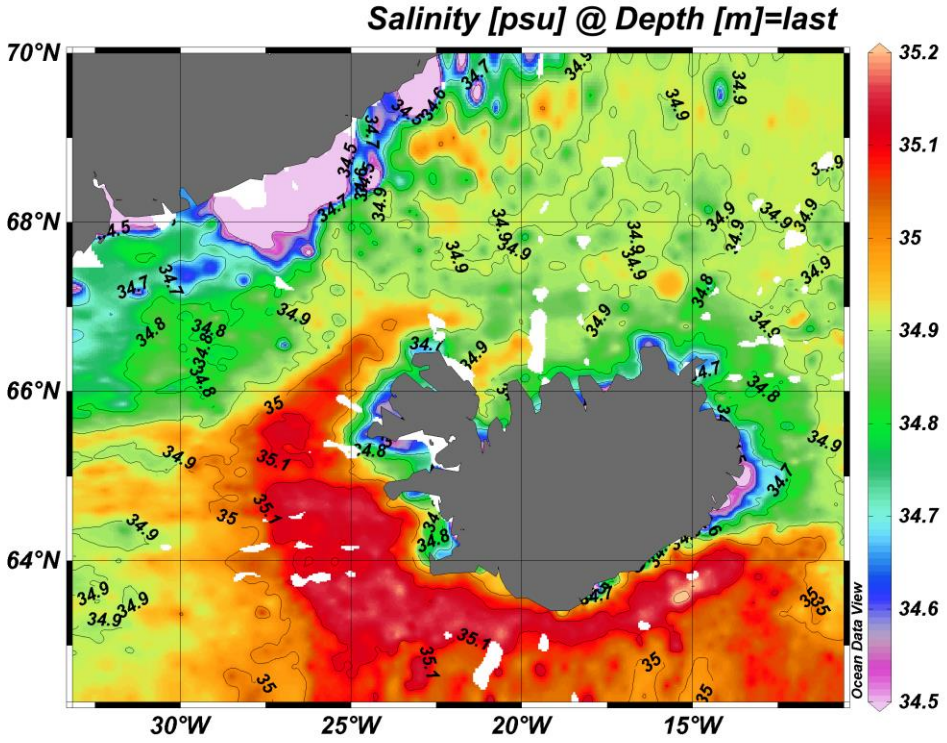
(Hakkinen & Rhines, 2004; Hátún et al., 2005)



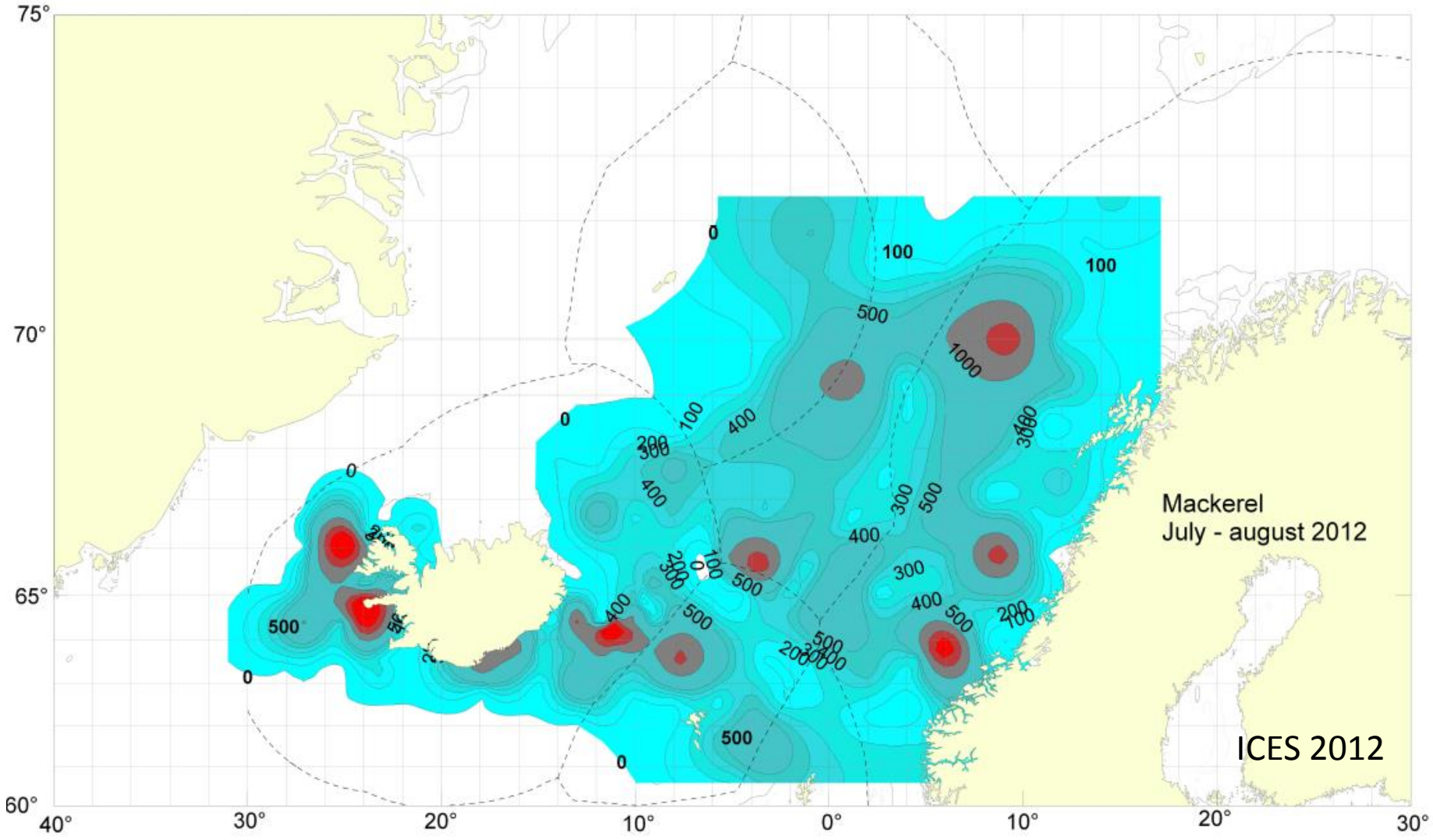
The spatial distribution of monkfish in the Icelandic Groundfish Survey 1985–2009 (after Sólmundsson et al., 2010).

Temperature and Salinity at bottom for all months





Distribution of mackerel in July-August 2012 (kg/nautical mile)



Conclusions

- We will mainly see expansion of fish stocks within a water mass and to a much lesser extent migration of fish stocks between water masses
- Monitoring is essential to document the changes occurring as an effect of climate change and research is needed to understand how the changes affect the ecosystems
- The Arctic is an area that is difficult to access and therefore we have limited information on it. However this has improved a lot during recent years especially since the International Polar Year in 2007-2008 that put the focus of the research community on the Arctic

ACIA report concludes with...

- The total effect of a moderate warming (1-3°C) of climate on fish stocks is likely to be of less importance than the effects of fisheries policies and their enforcements


Thank you for your attention