A possible barrier in the Lofoten basin

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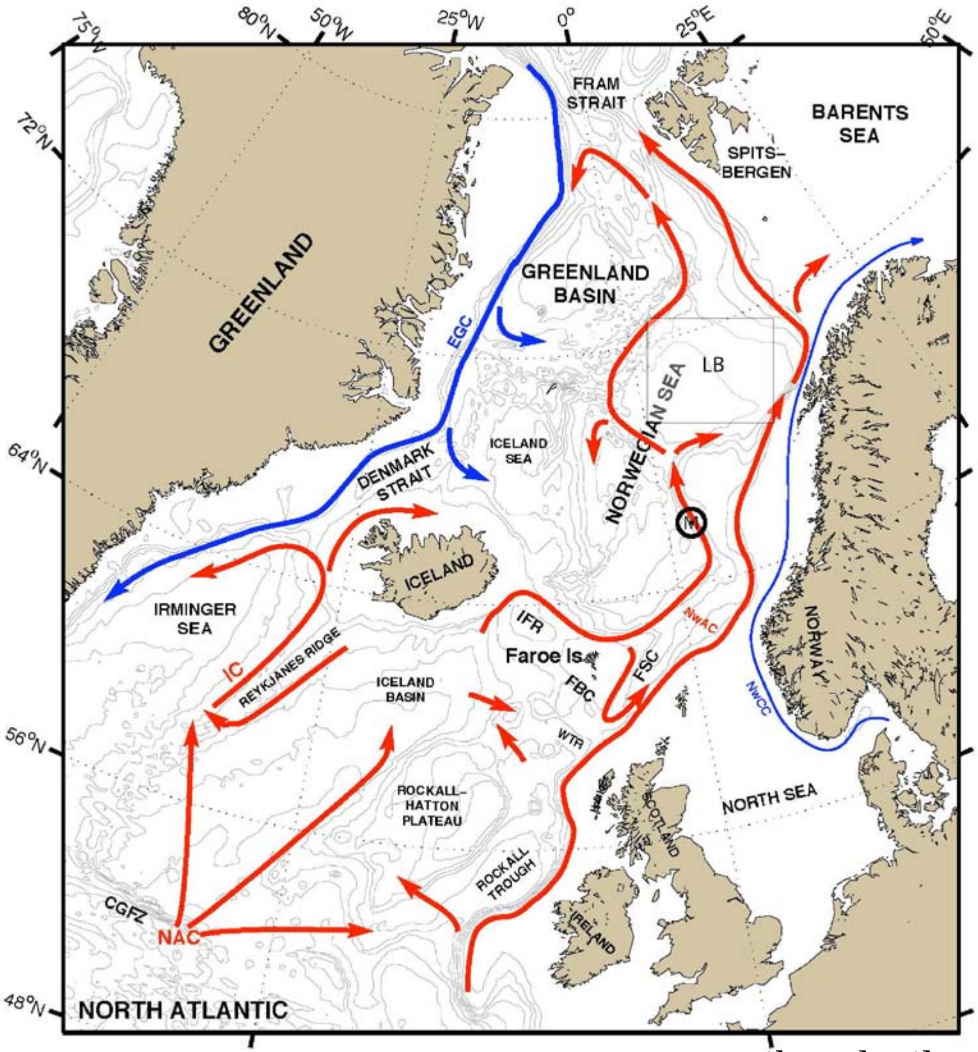
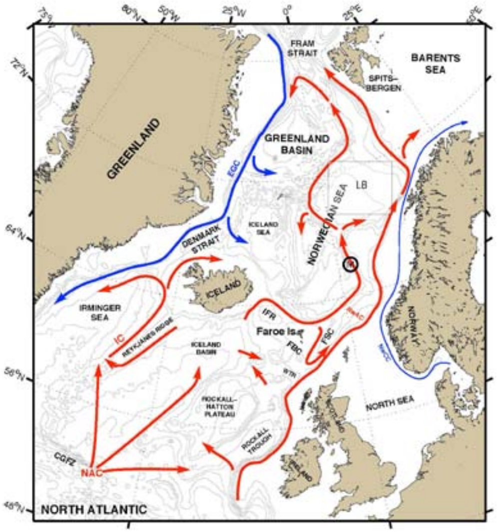
Circulation in the Nordic seas



Furevik and Nilsen, 2005

- ➢ Importance of the Lofoten basin

- The Largest heat reservoir and the region of largest eddy activity in the Nordic seas.
- Large winter heat loss.



Standard deviation of sea surface height

Data and Analysis

1. Altimeter data

High resolution weekly absolute geostrophic velocity maps ($1/3^o \times 1/3^o$) are computed from the absolute dynamic topography obtained from merged JASON/TOPEX/POSEIDON/ERS data (AVISO; http://www.aviso.oceanobs.com) using the conventional geostrophic relation;

$u = -g/f\ (\partial h/\partial y)$ and $v = g/f\ (\partial h/\partial x)$,

where, u and v are components of velocity, g is the acceleration due to gravity, f is the coriolis parameter, h is the sea surface height, while $\partial/\partial x$ and $\partial/\partial y$ are spatial derivatives in the respective ($1/3^o$) longitude and ($1/3^o$) latitude grids.

Dynamic topography is the sum of sea level anomaly (SLA) and mean dynamic topography (Rio et al., 2004).

2. Hydrography :-

NISE (Norwegian Iceland Seas Experiment) data (1948-2004), (Nilsen et al., 2008) .

3. Sea surface temperature :-

Weekly sea surface temperature is obtained from 25 km resolution Advanced Microwave Scanning Radiometer for EOS (AMSR-E) SST data (2002-2007) onboard the NASA/AQUA and are available since July 2002.

4. Chlorophyll concentration :-

Weekly and monthly Chlorophyll-a (chl-a) pigment concentration (9 km resolution) from SeaWiFS (1998-2008).

5. Evaporation :-

a.Objectively Analyzed air-sea Fluxes (OAFlux), (Yu et al., 2008)
b.Hamburg Ocean Atmosphere Parameters and Fluxes (HOAPS), (Axel et al., 2007)

OAFlux

$$\mathrm{Evp} = \mathrm{LHF}/\rho_w L_e, \qquad (2)$$

ρ_w -density of seawater

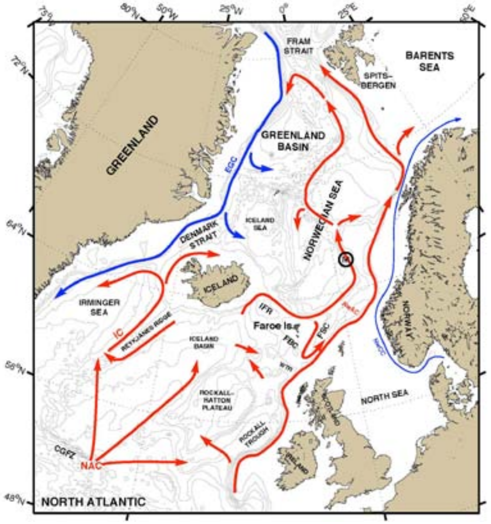
L_e is the latent heat of vaporization= $[2.501 - (0.002\,37 \times \mathrm{SST})] \times 10^6$.

The OAFlux LHF product is different from other flux products in that it is not constructed from one single data source, but rather it is determined by objectively blending the data sources from satellite and NWP model outputs while using in situ observations to assign the weights.

HOAPS

Evaporation at the sea surface is parametrized by the bulk approach. The required values of wind speed u, the saturation specific humidity at the sea surface qs, and the near-surface humidity q1 are determined from satellite measurements.

- Analysis of weekly absolute geostrophic velocity maps (1995-2008) indicate the presence of a locally developed branch of NwAC in the central Lofoten basin (LB)

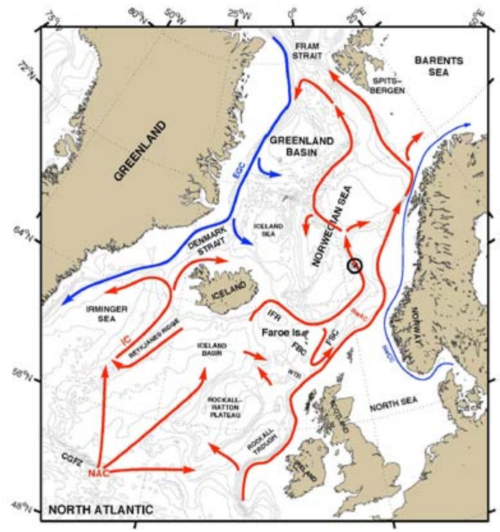


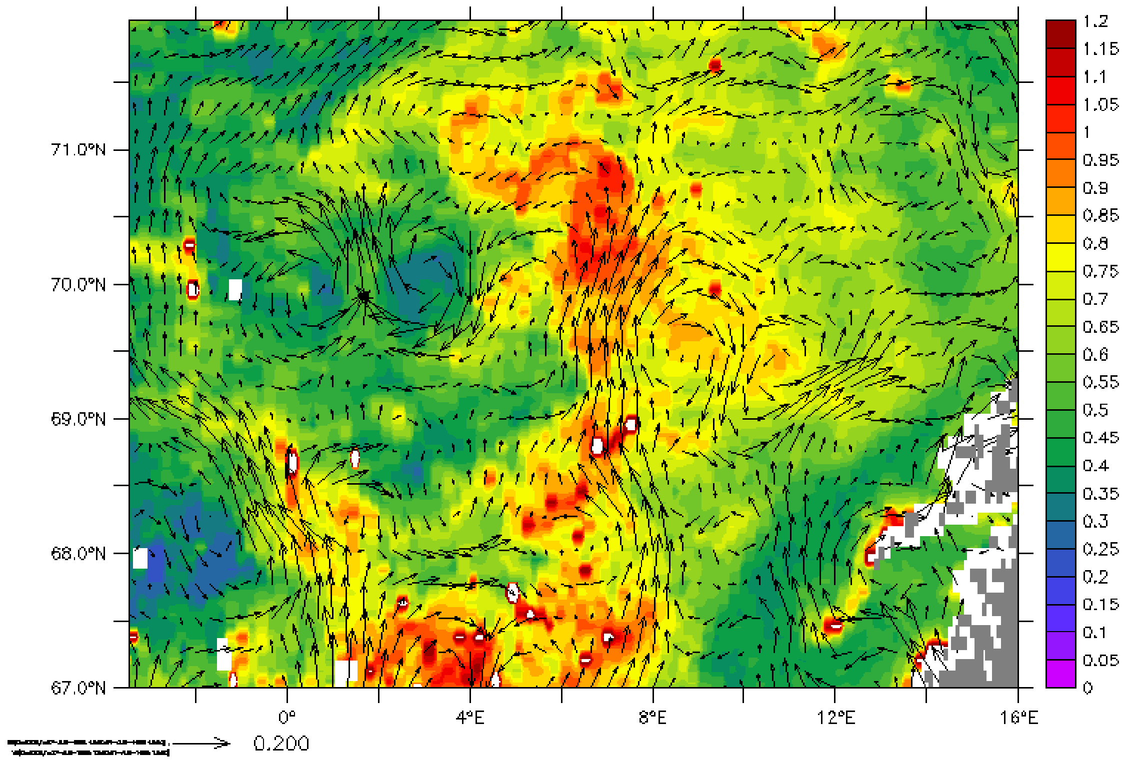
Absolute geostrophic during 9-16 June 1996

- This branch seems to be influencing the eddy activity of the LB.

- Weak meridional flows results in strong mesoscale eddies (Dubus, 1999; Spall, 2000)

Absolute geostrophic velocity superimposed on chl-a concentration (mg/m^3) during July 1998





- Advection of chlorophyll rich waters by the central branch of NwAC

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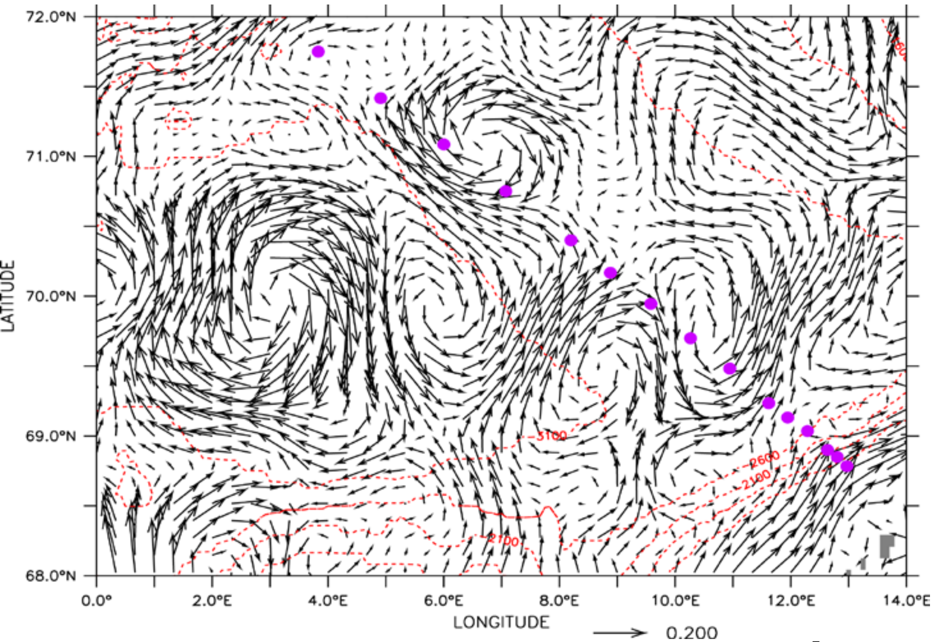
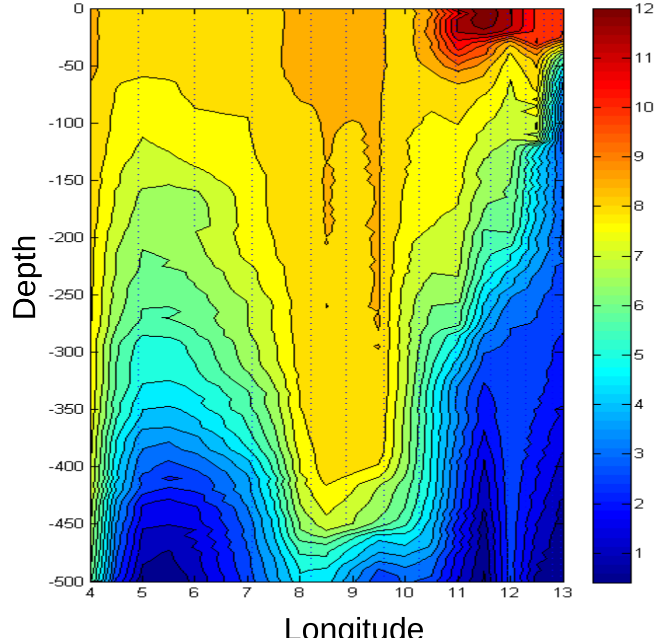
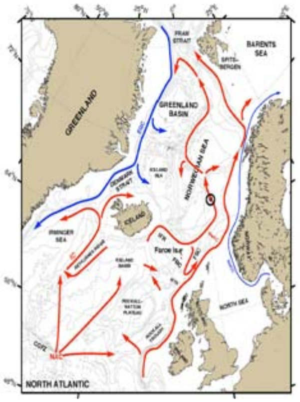
Hydrography and the central branch

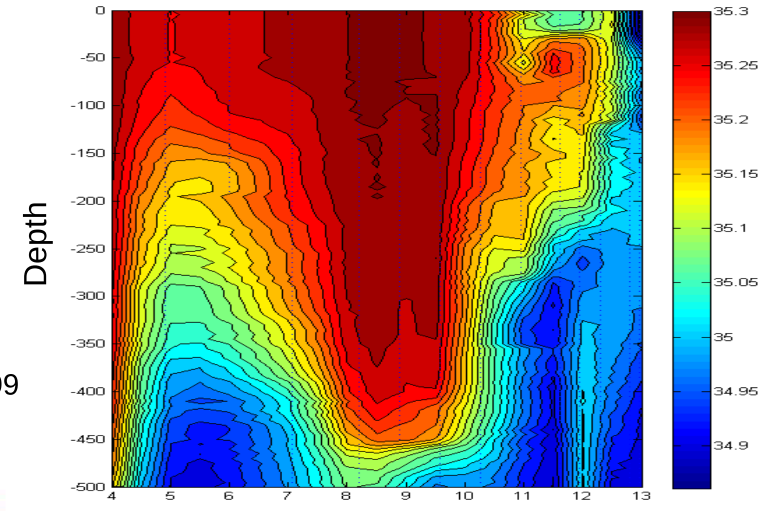


Temperature

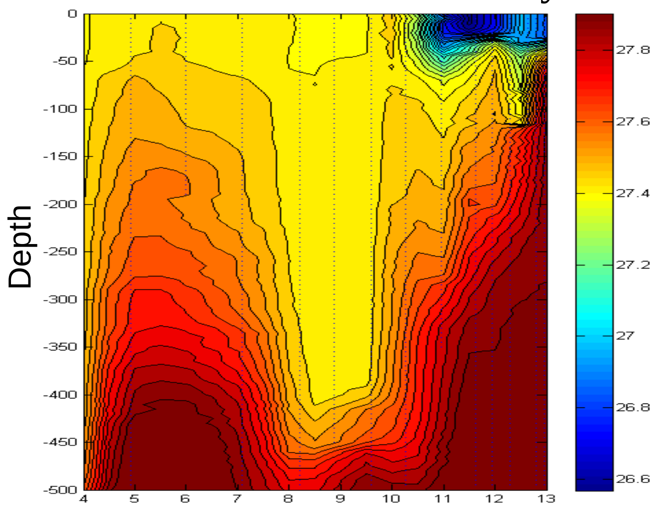




Salinity



Density



16-23 June 1999

- Warm saline waters are penetrated deep down

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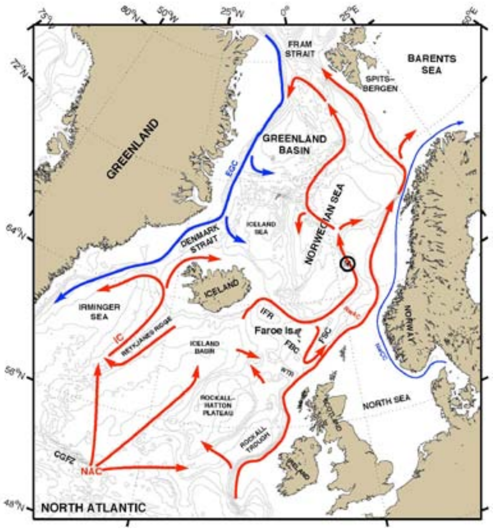
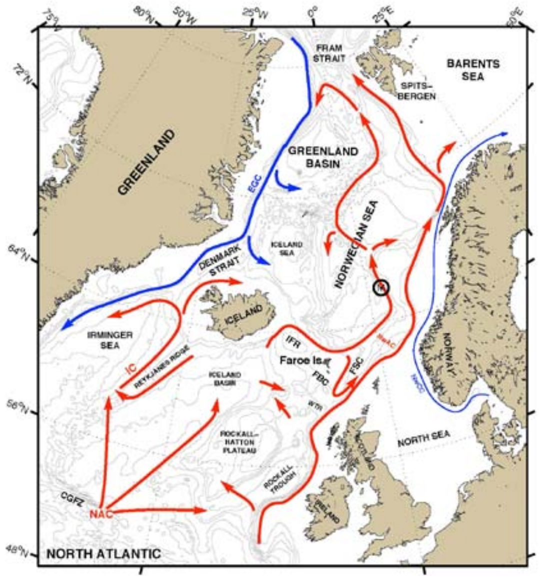
- Winter climatology of absolute geostrophic velocity (1995-2008) confirms the existence of this central branch.



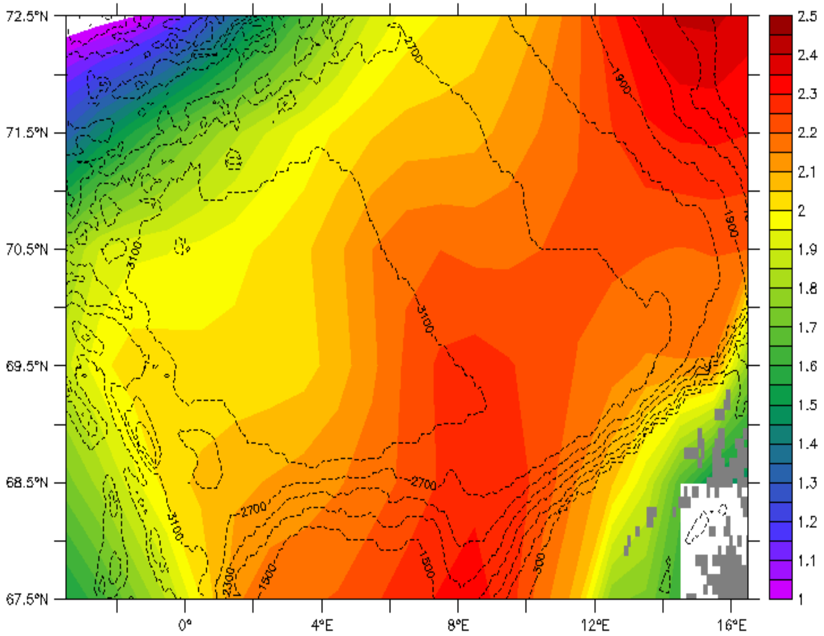
Central branch and SST



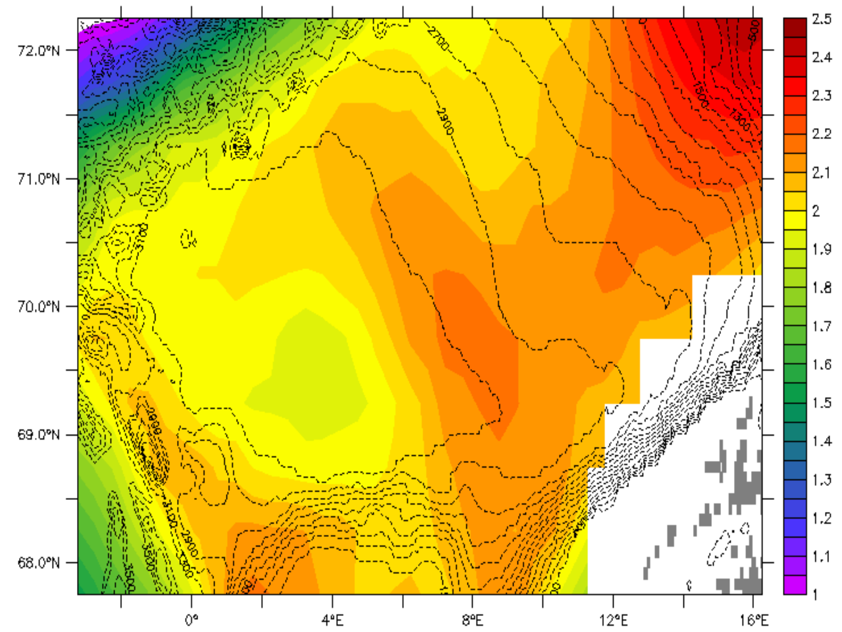
Climatology of AMSR-E SST

- Warm Atlantic waters are advected by the Central branch of NwAC

Evaporation (mm/day)– Climatology (1986-2006)

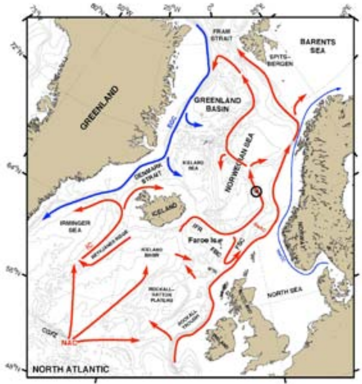


OAFlux



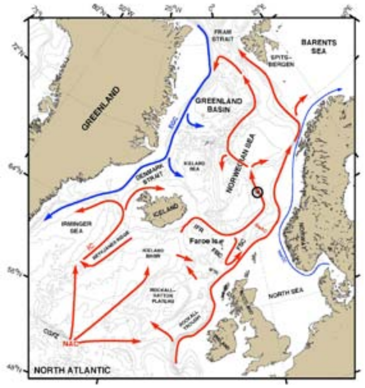
HOAPS

- ➢ Warm Atlantic waters seems to be confined within the eastern Lofoten basin



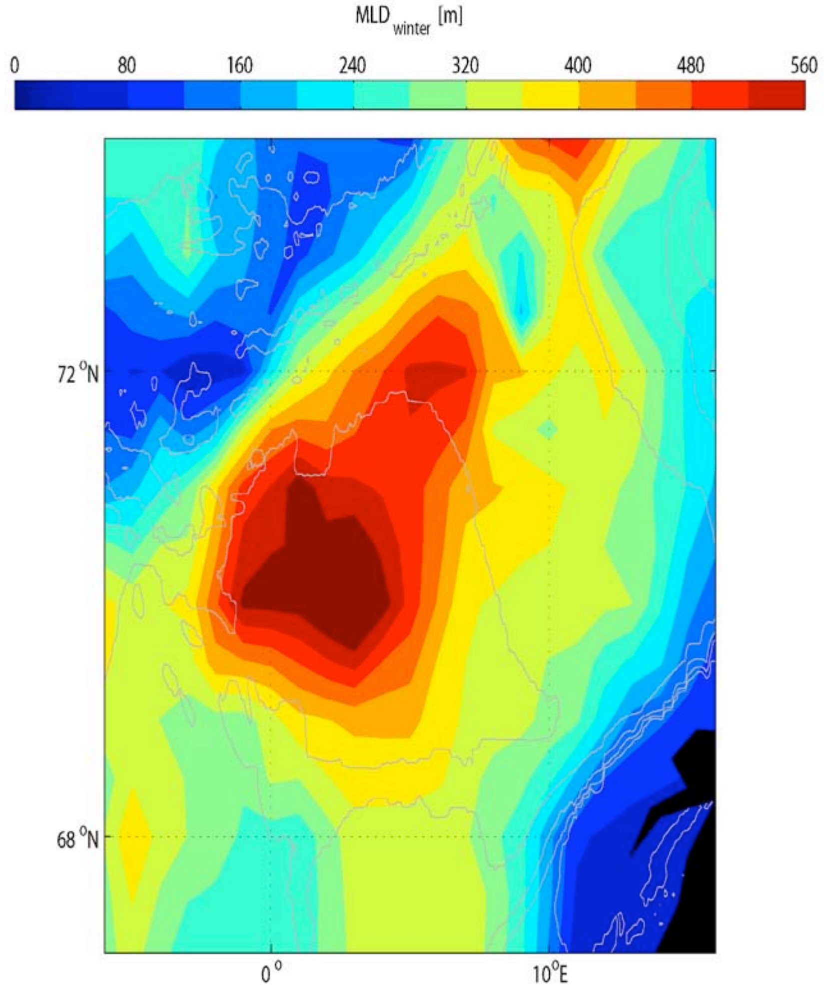
High chlorophyll waters are concentrated in the eastern Lofoten basin

Climatology (1997-2007) of chlorophyll-a concentration

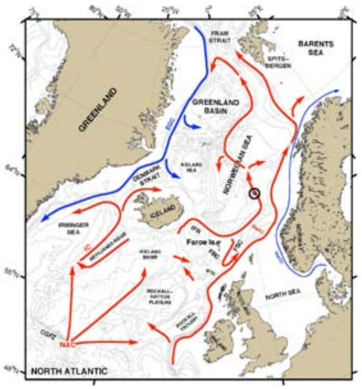


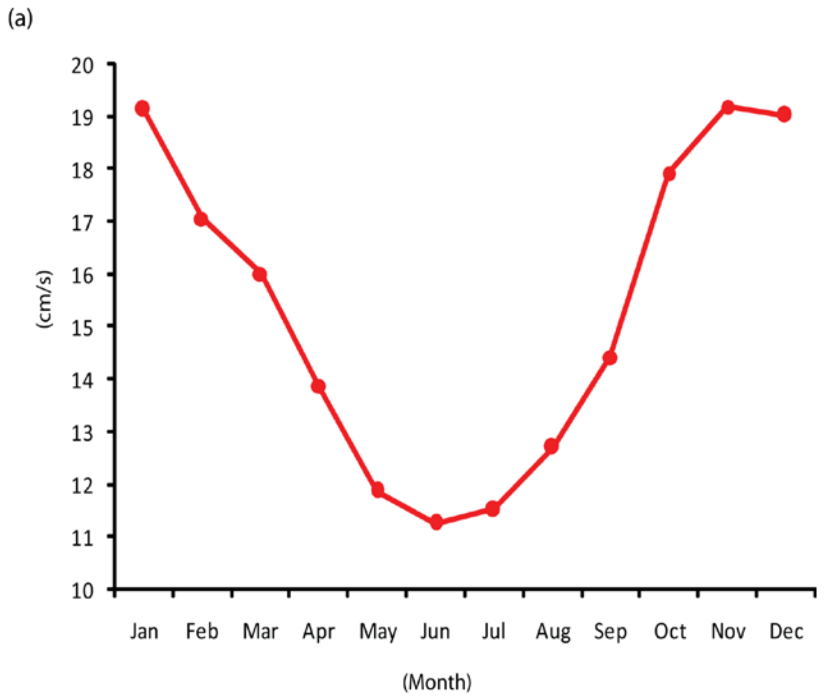
Major source of fresh water input into the eastern LB upstream of the Lofoten basin.

- The central branch divides the entire Lofoten basin into western and eastern parts.

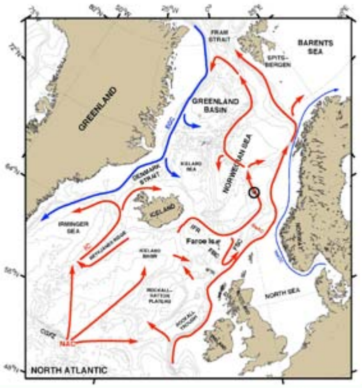


Winter Mixed Layer Depth climatology (1948-2004)





- Significant correlation **(0.41)** between NAO and velocity of coastal influx (box b2) after de-trend analysis of monthly data during winter (Dec-Mar) for 13 years (1995-2008) .



Conclusions

- The presence of the locally developed branch (central branch) of the NwAC in the central LB carrying warmer and saltier Atlantic waters which divides the entire basin into eastern and western parts is established using satellite and hydrographic datasets.

- The central branch is likely to act as a barrier to the majority of warm Atlantic waters from the slope current and fresh coastal waters from entering the western LB, which explains the decrease in the winter Mixed Layer Depth towards the east of the central branch.

- We hypothesize that the likely barrier effect of the central branch in the LB is important to the dense water formation in the western LB and thus influences the AMOC.

- The central branch of the NwAC is important to the biological productivity of the basin.

Thank You

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