

***4th Euro-Argo Science Meeting and Workshop
on the Arctic and sub-Polar North Atlantic***

National Oceanography Centre, Southampton, UK, 18 - 20 June 2013

***Transformation of the Atlantic Water
in the West Spitsbergen Current
- synoptic observations versus ARGO floats results***

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**INSTITUTE OF OCEANOLOGY
POLISH ACADEMY OF SCIENCES**





OCEANIA

GDANSK



**VEINS
ASOF-N
DAMOCLES
AWAKE
AWAKE-2
PAVE**

**ALKEKONGE
EUROARGO**



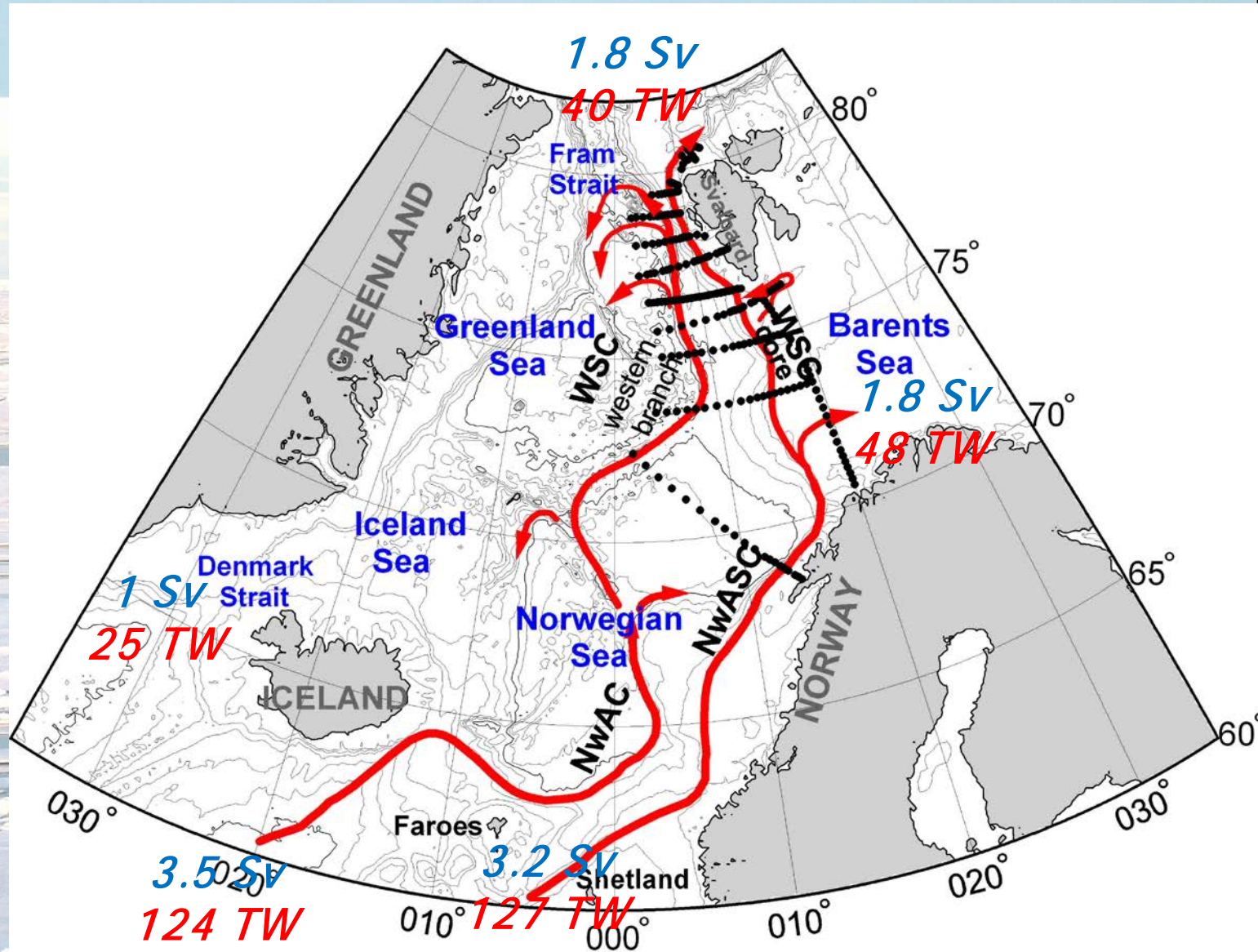
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- **10-11 sections**
- **~200 CTD profiles**
- **~200 LADCP profiles**
- **Towed CTD – high resolution section**
- **West Spitsbergen fiords investigations**



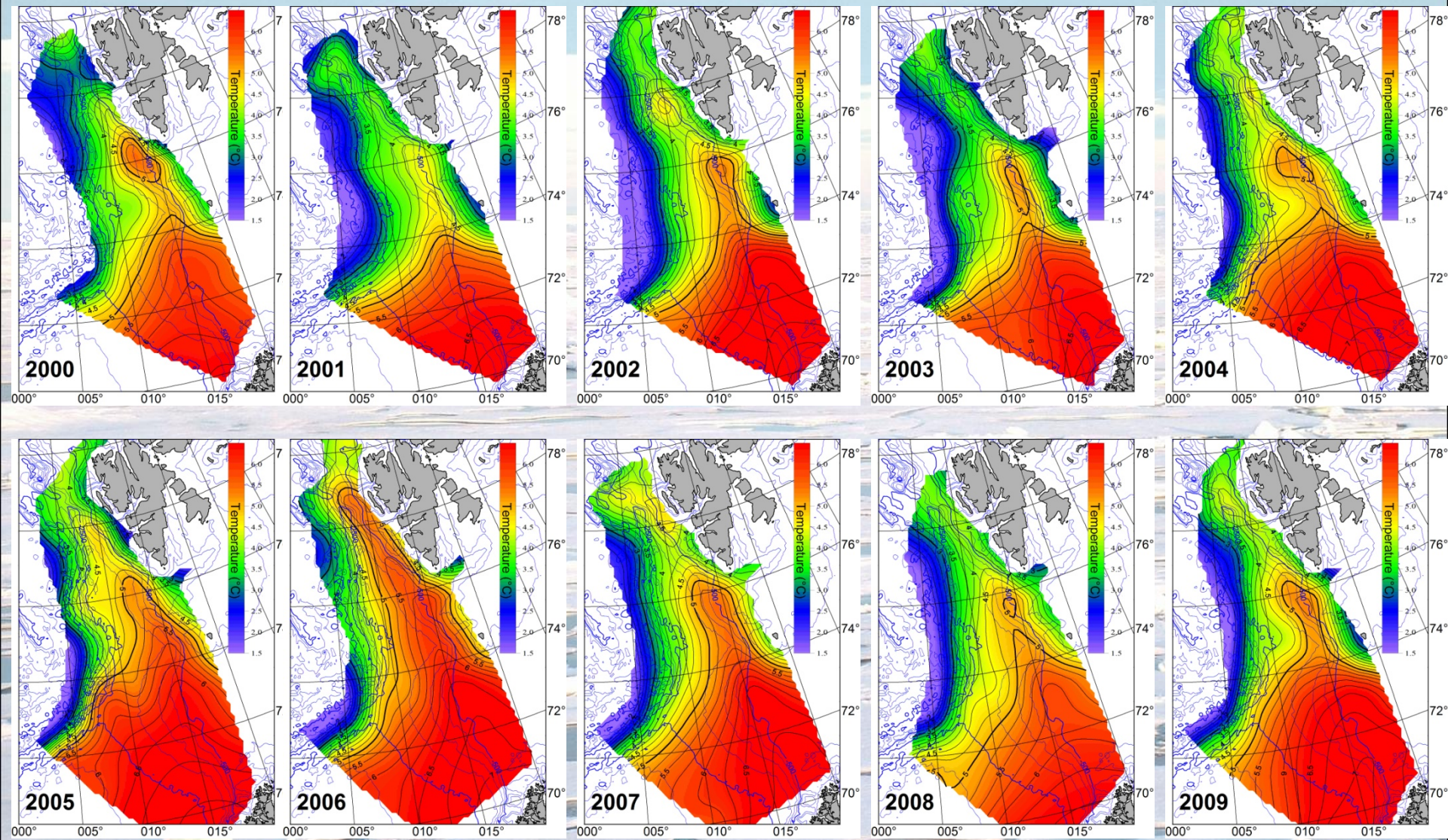
NAC North Atlantic Current
NwAC Norwegian-Atlantic Current
NwASC Norwegian Atlantic Slope Current
WSC West Spitsbergen Current



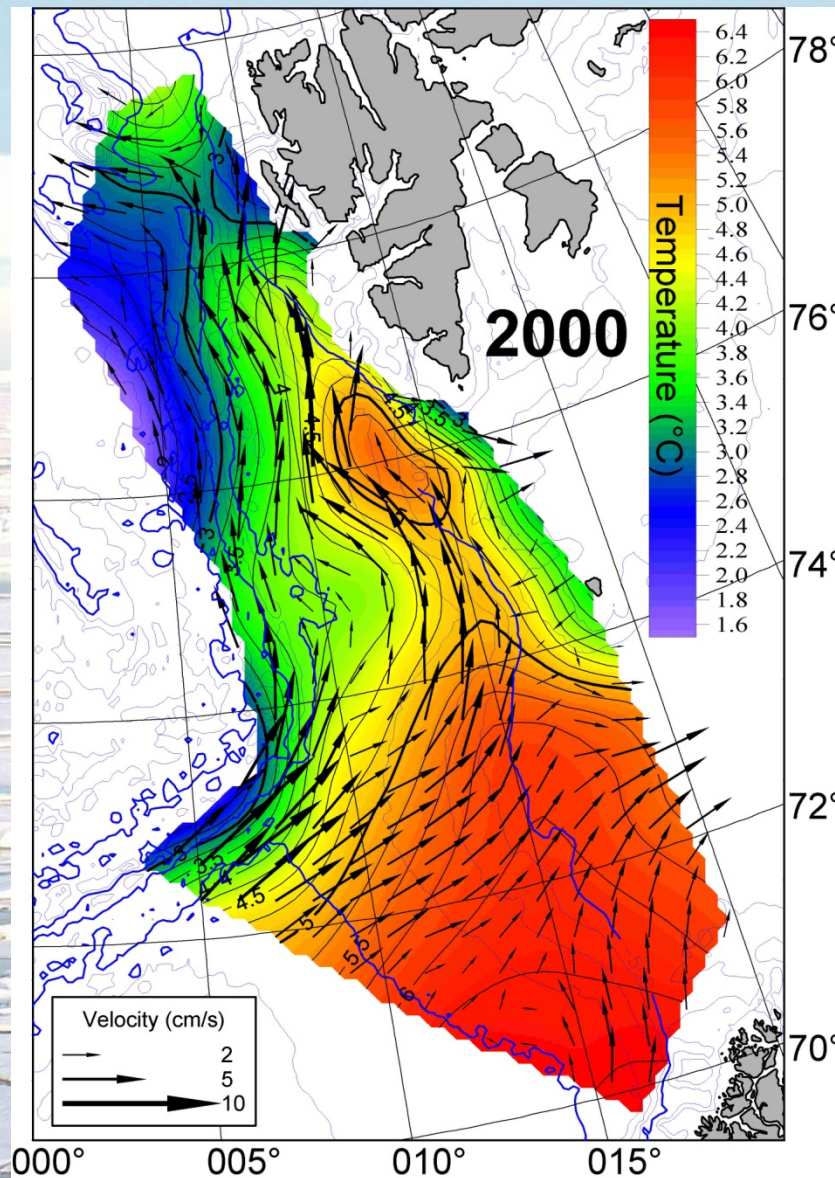
How changes of AW properties influences Arctic climate?
temporal changes (variability)
spatial changes (transformation)



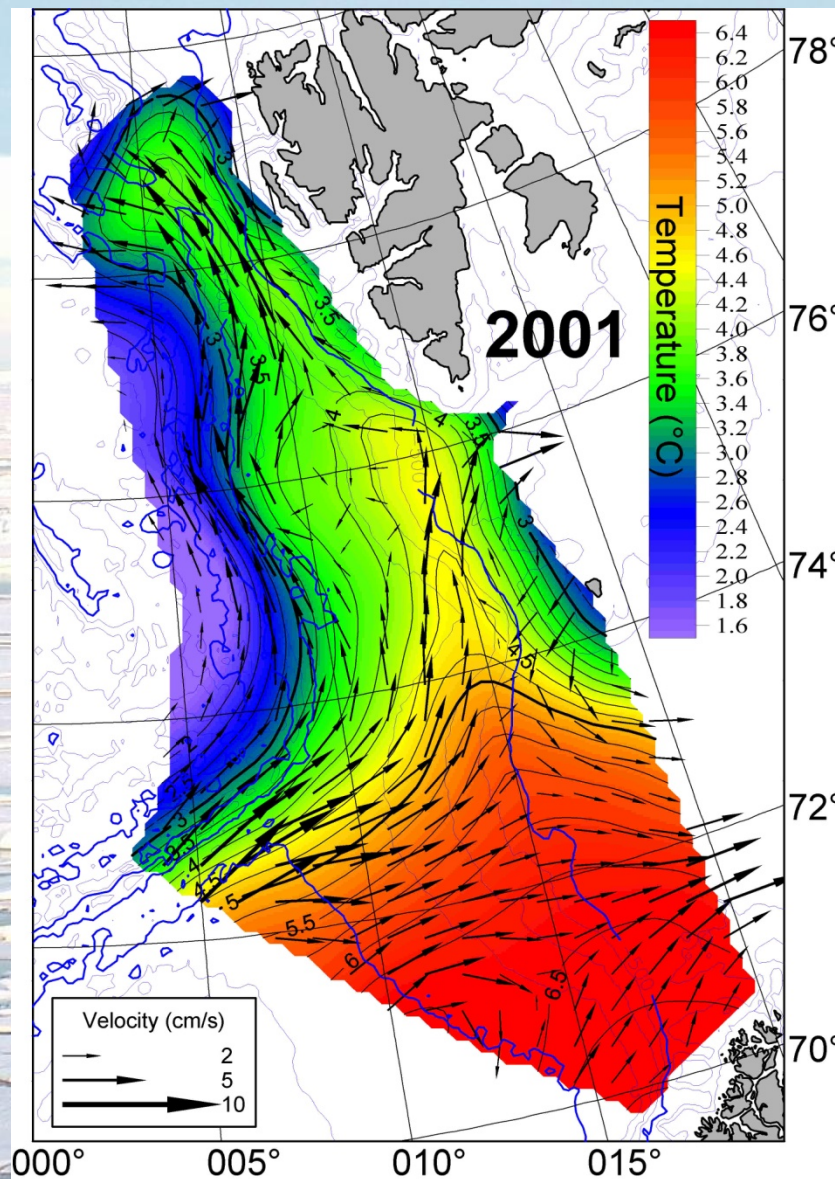
Temperature distribution at 100 dbar Summers 2000-2009



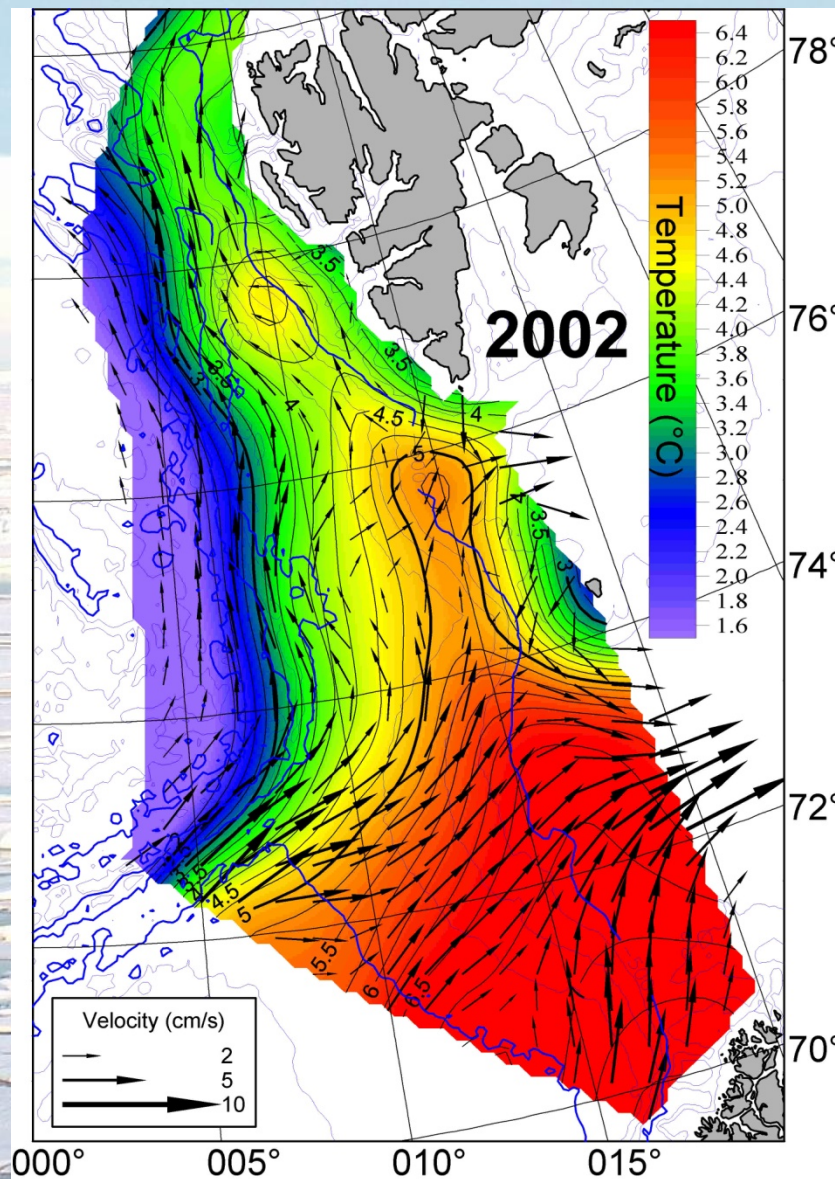
Temperature and baroclinic currents at 100 dbar



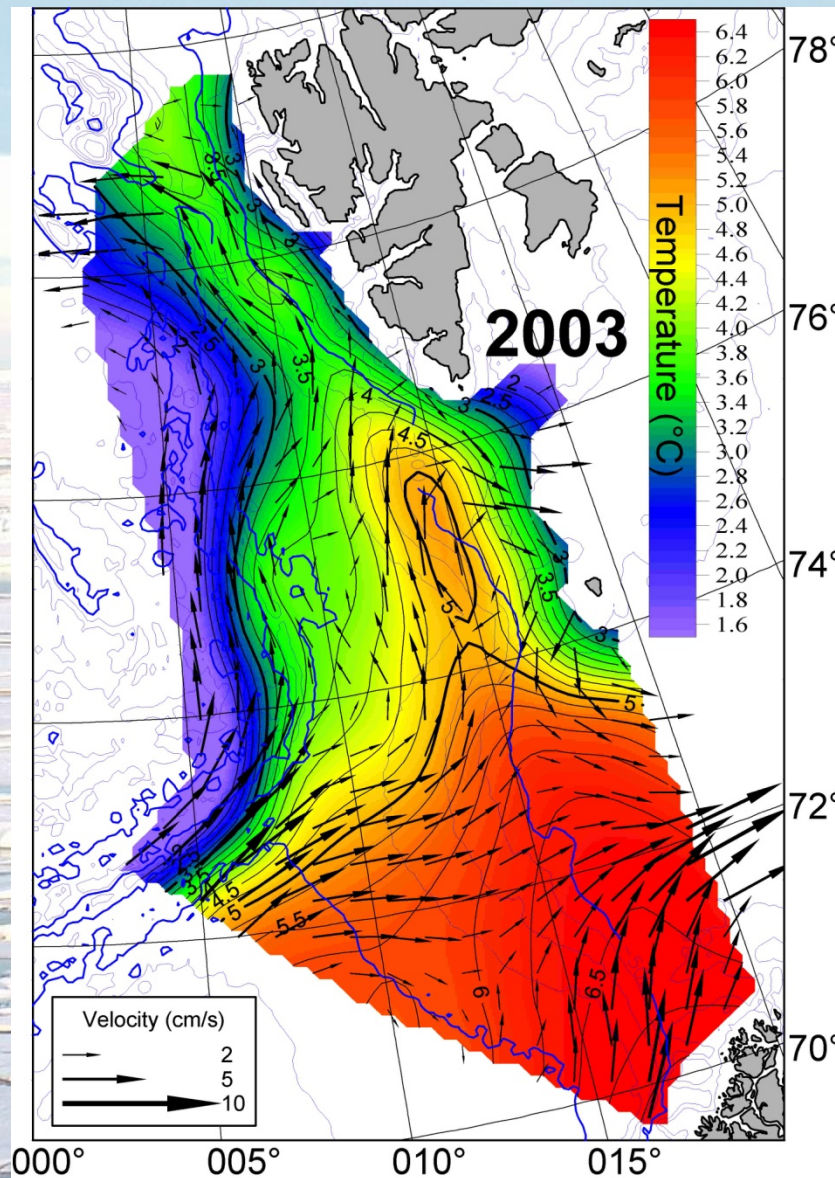
Temperature and baroclinic currents at 100 dbar



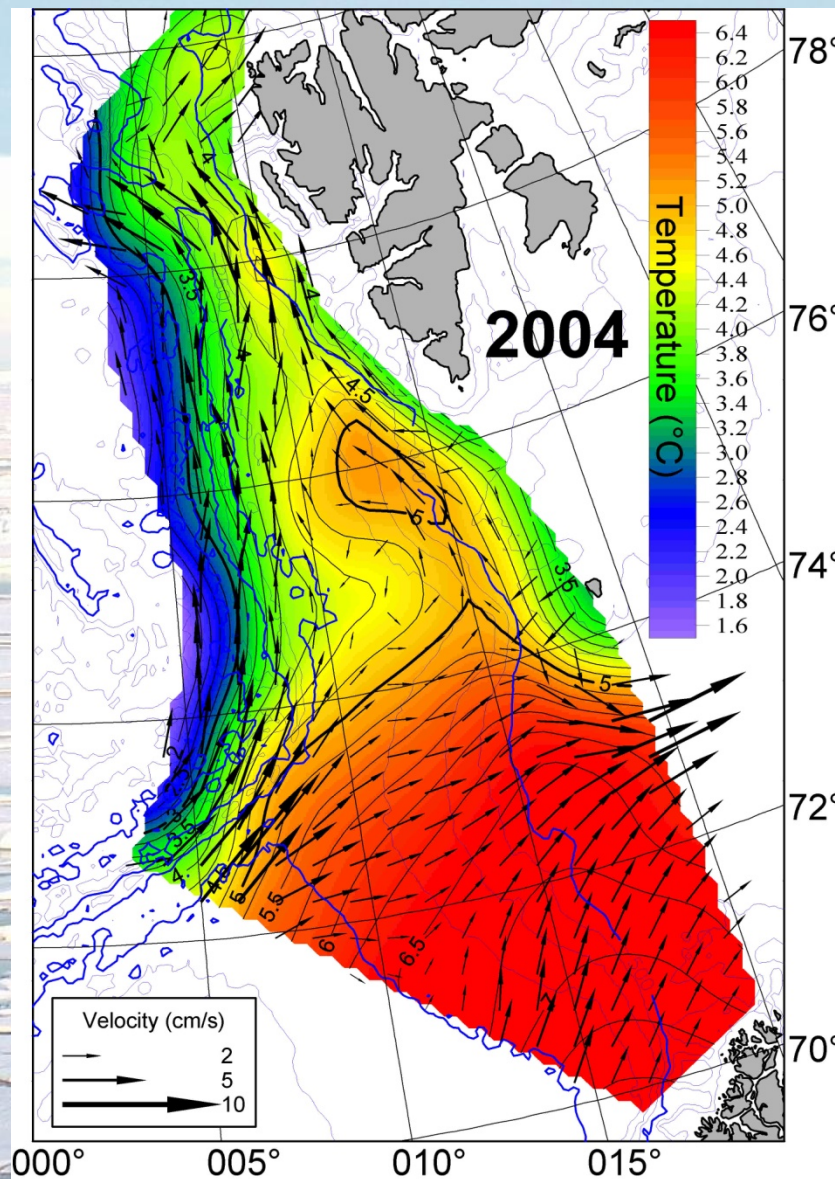
Temperature and baroclinic currents at 100 dbar



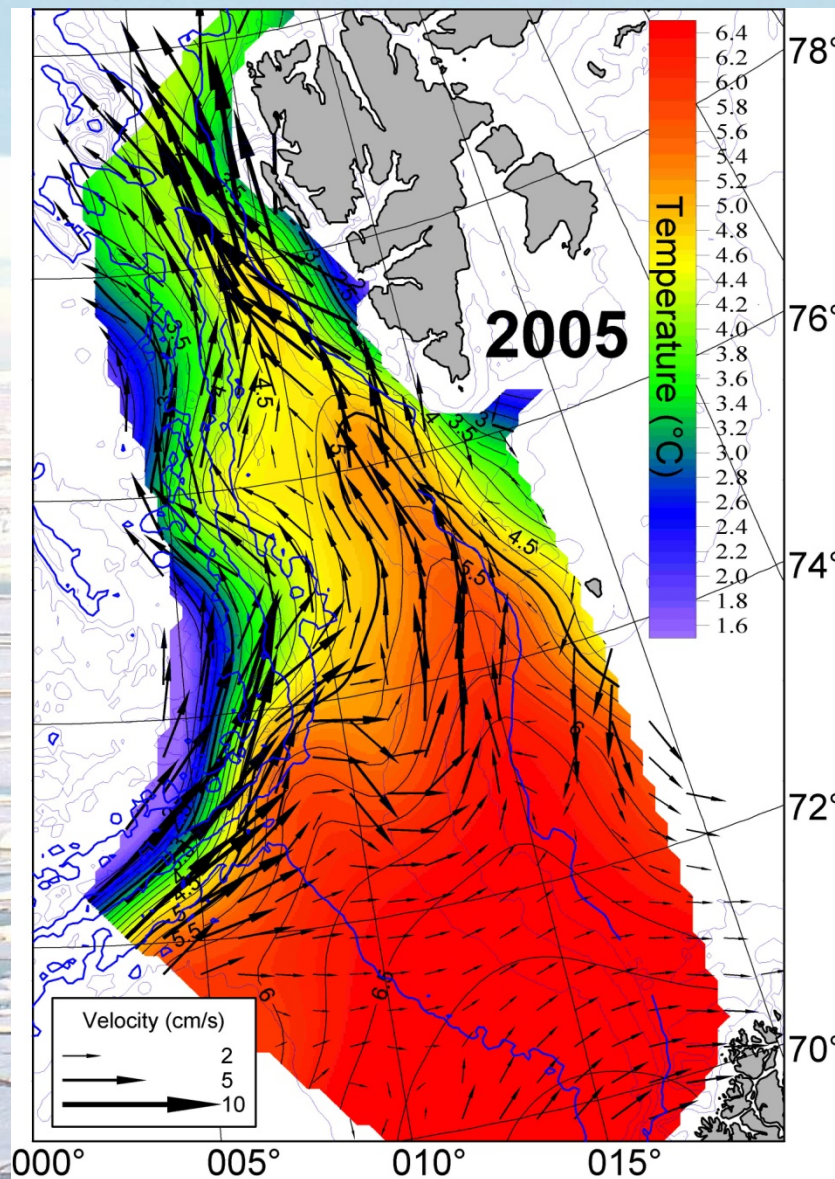
Temperature and baroclinic currents at 100 dbar



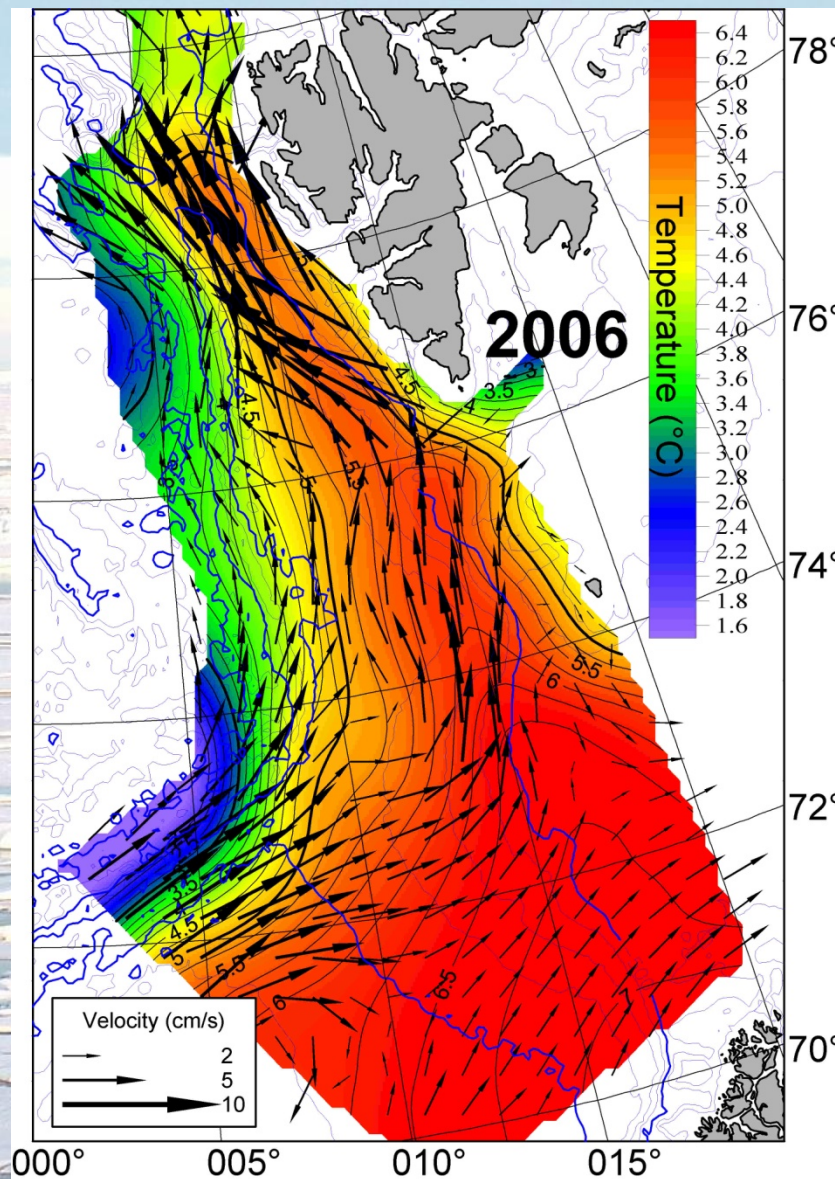
Temperature and baroclinic currents at 100 dbar



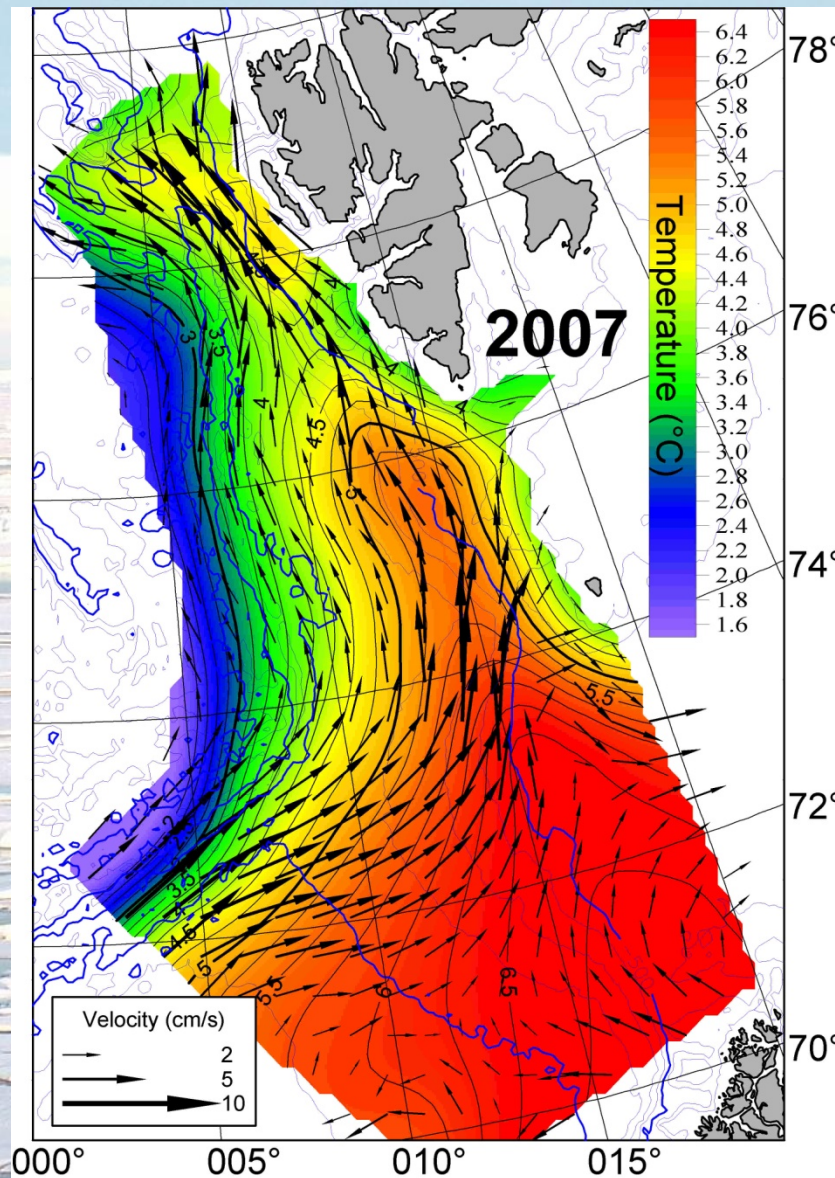
Temperature and baroclinic currents at 100 dbar



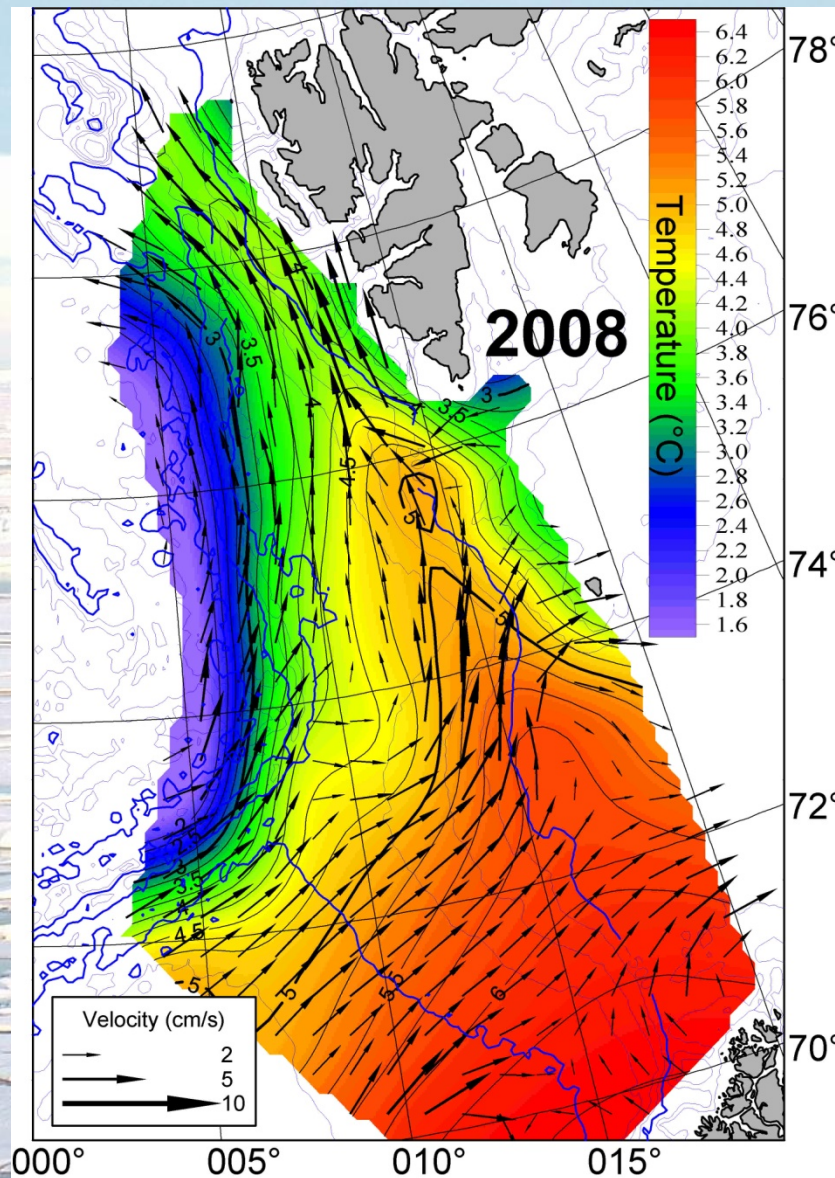
Temperature and baroclinic currents at 100 dbar



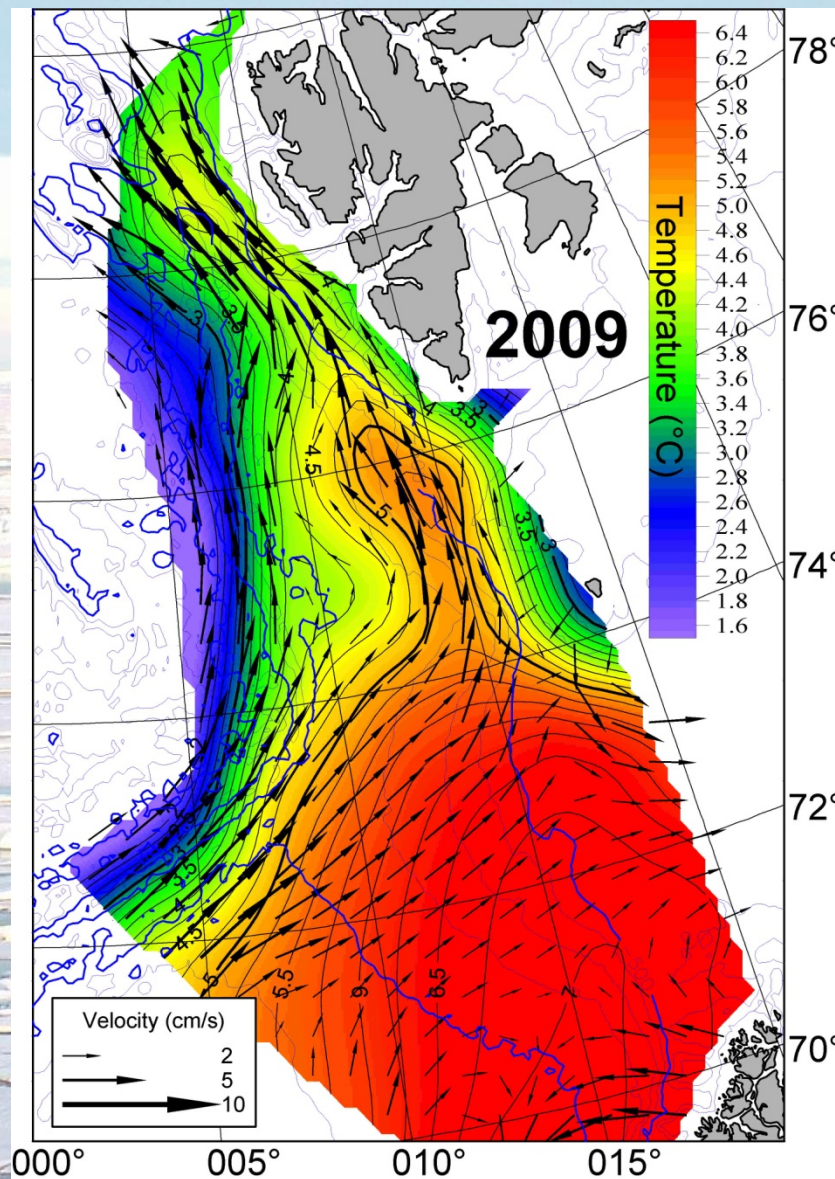
Temperature and baroclinic currents at 100 dbar



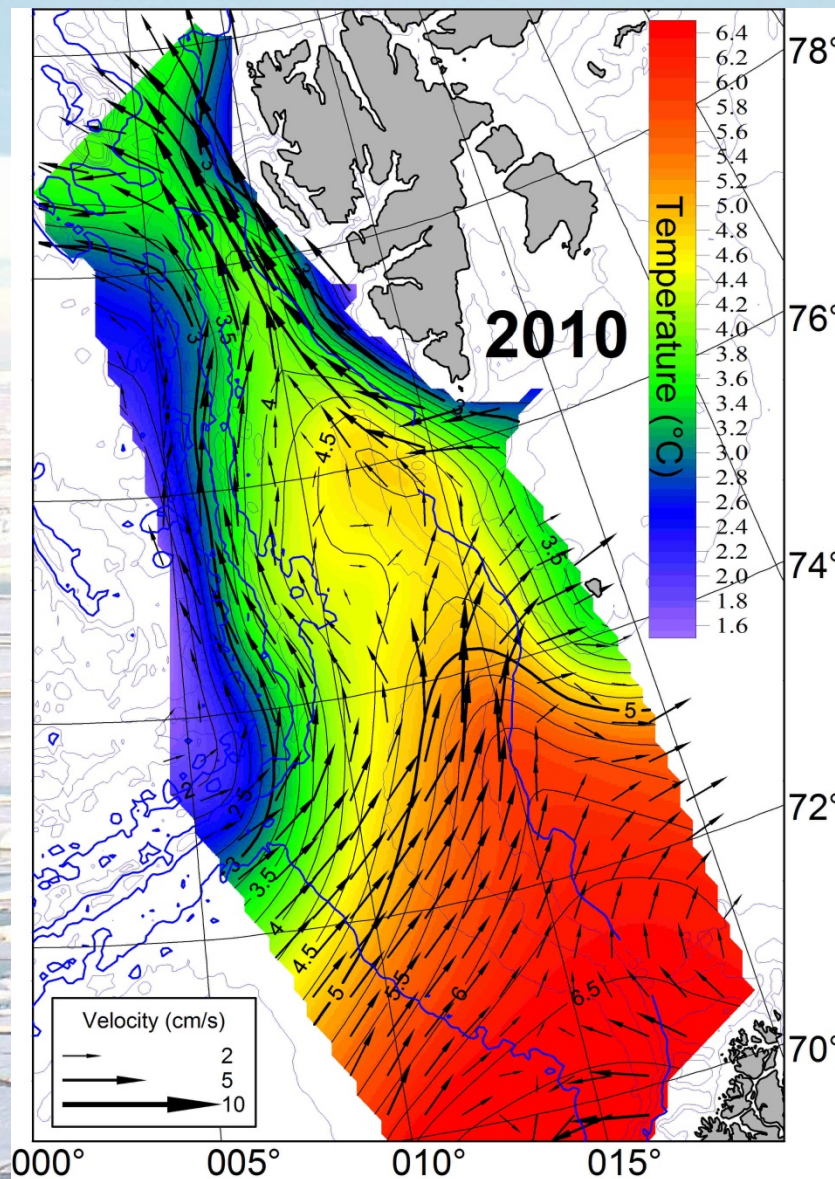
Temperature and baroclinic currents at 100 dbar



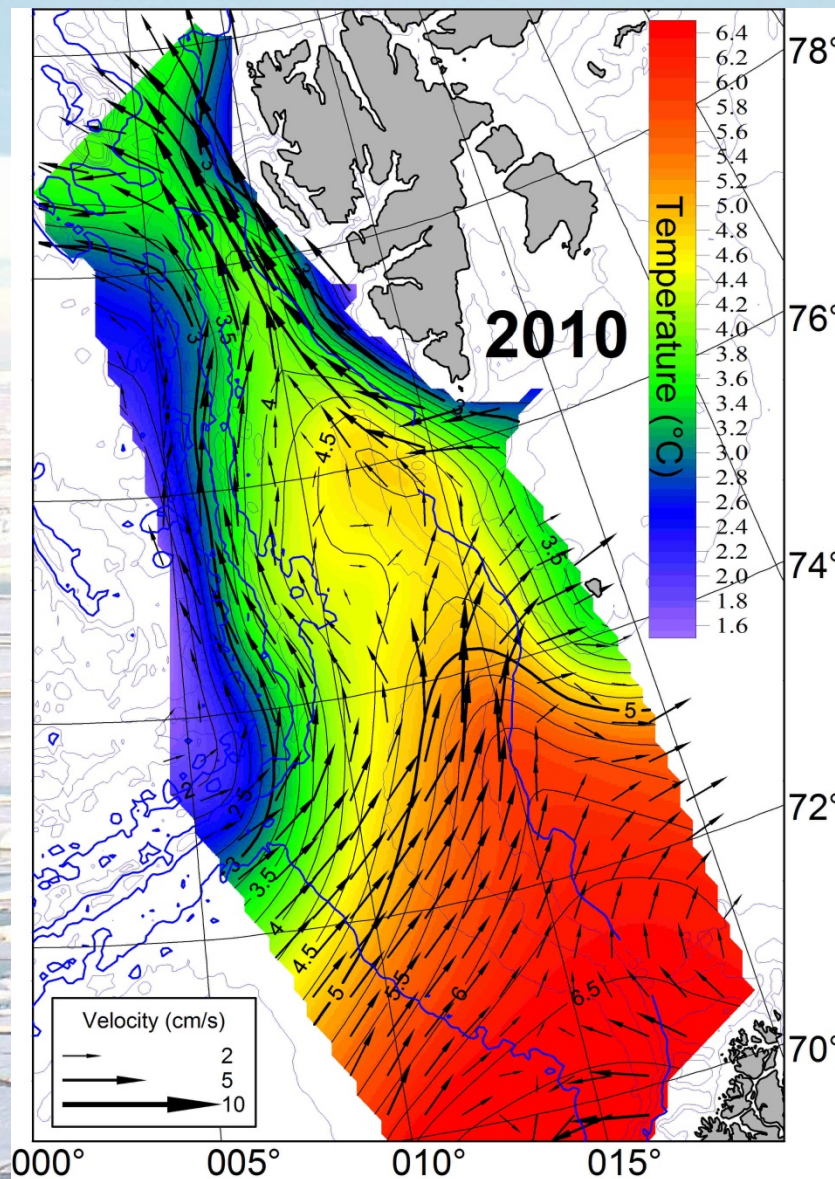
Temperature and baroclinic currents at 100 dbar



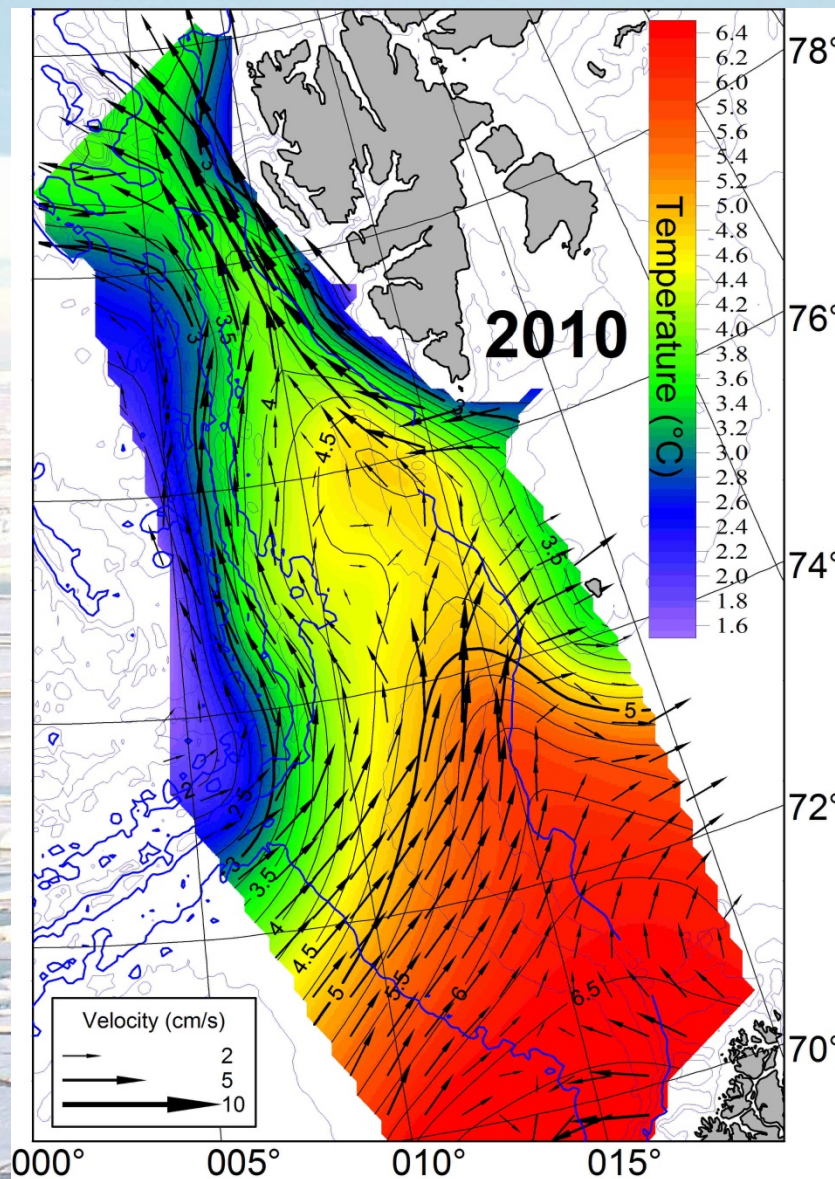
Temperature and baroclinic currents at 100 dbar



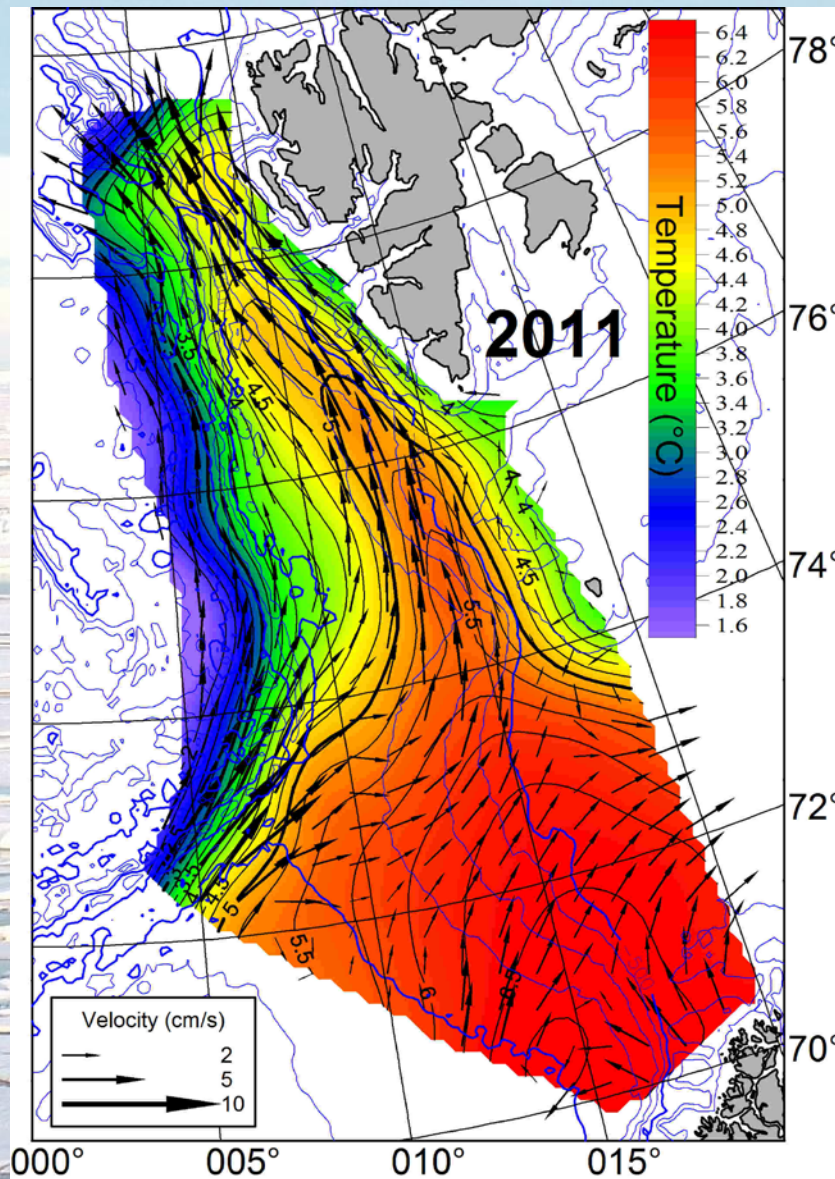
Temperature and baroclinic currents at 100 dbar



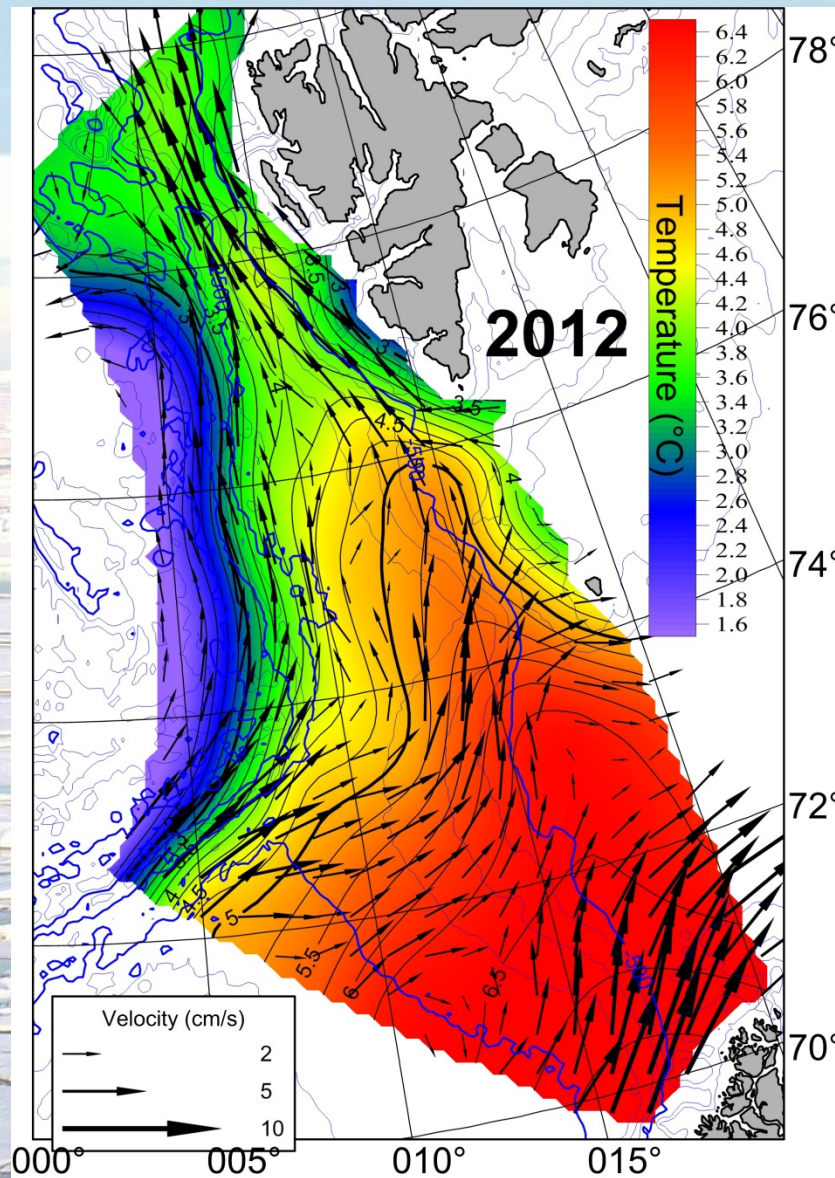
Temperature and baroclinic currents at 100 dbar



Temperature and baroclinic currents at 100 dbar

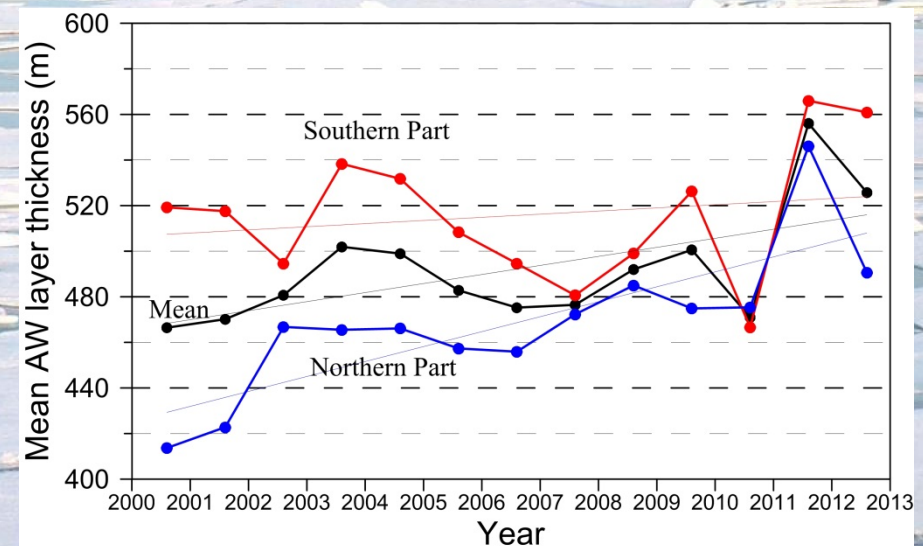
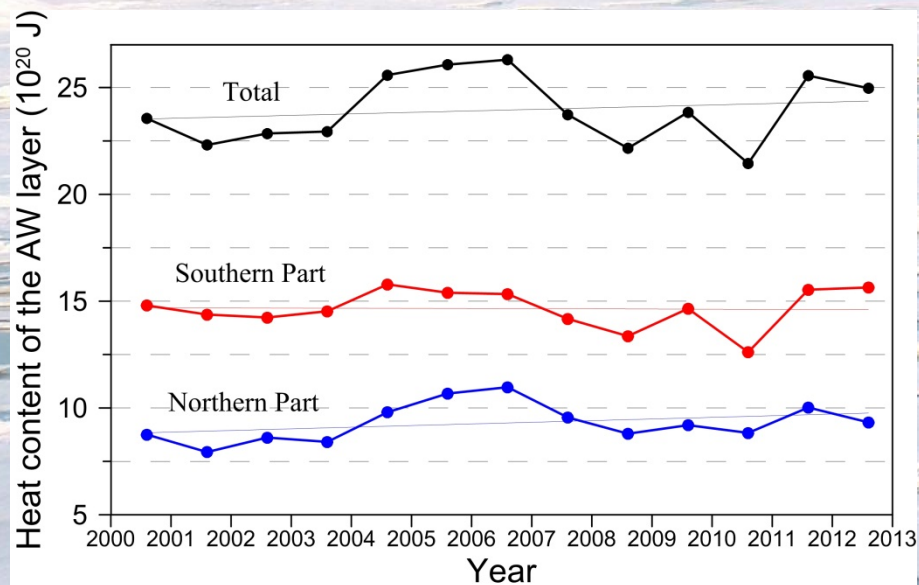
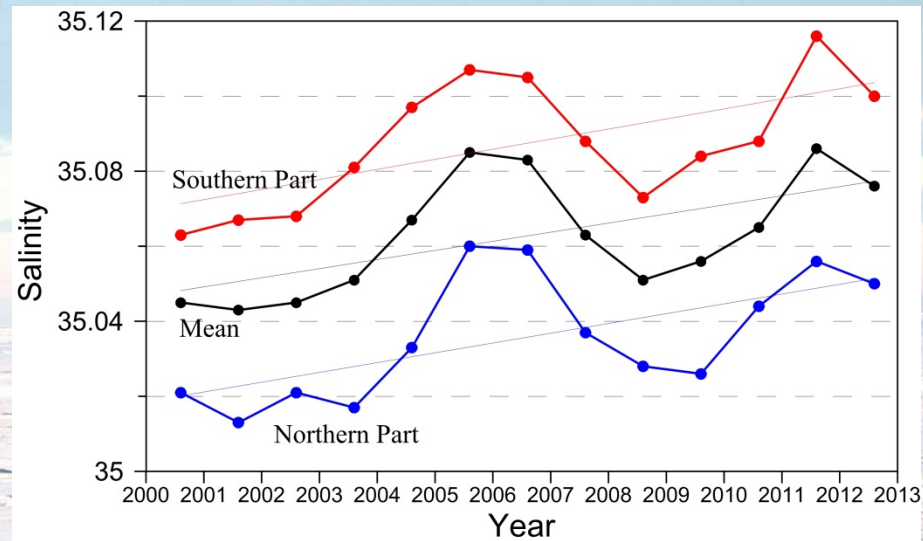
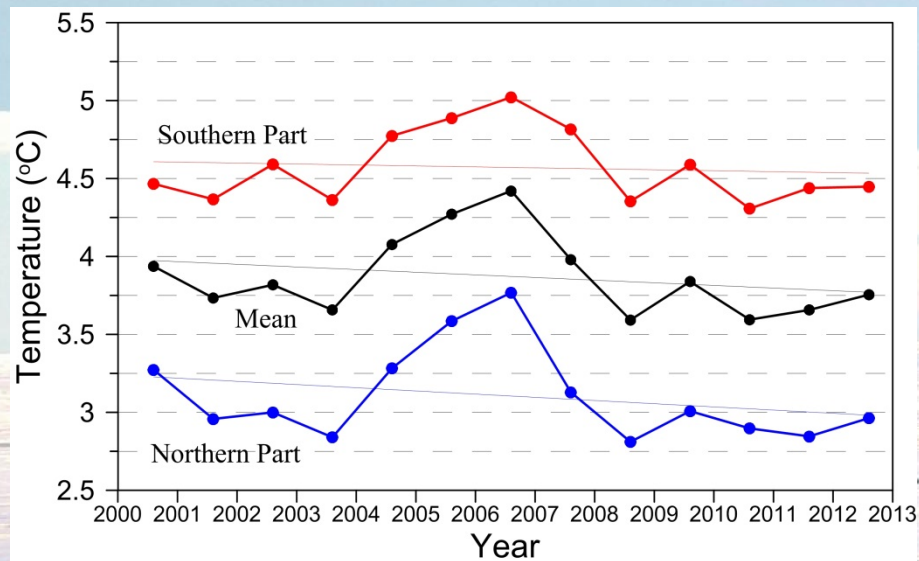


Temperature and baroclinic currents at 100 dbar

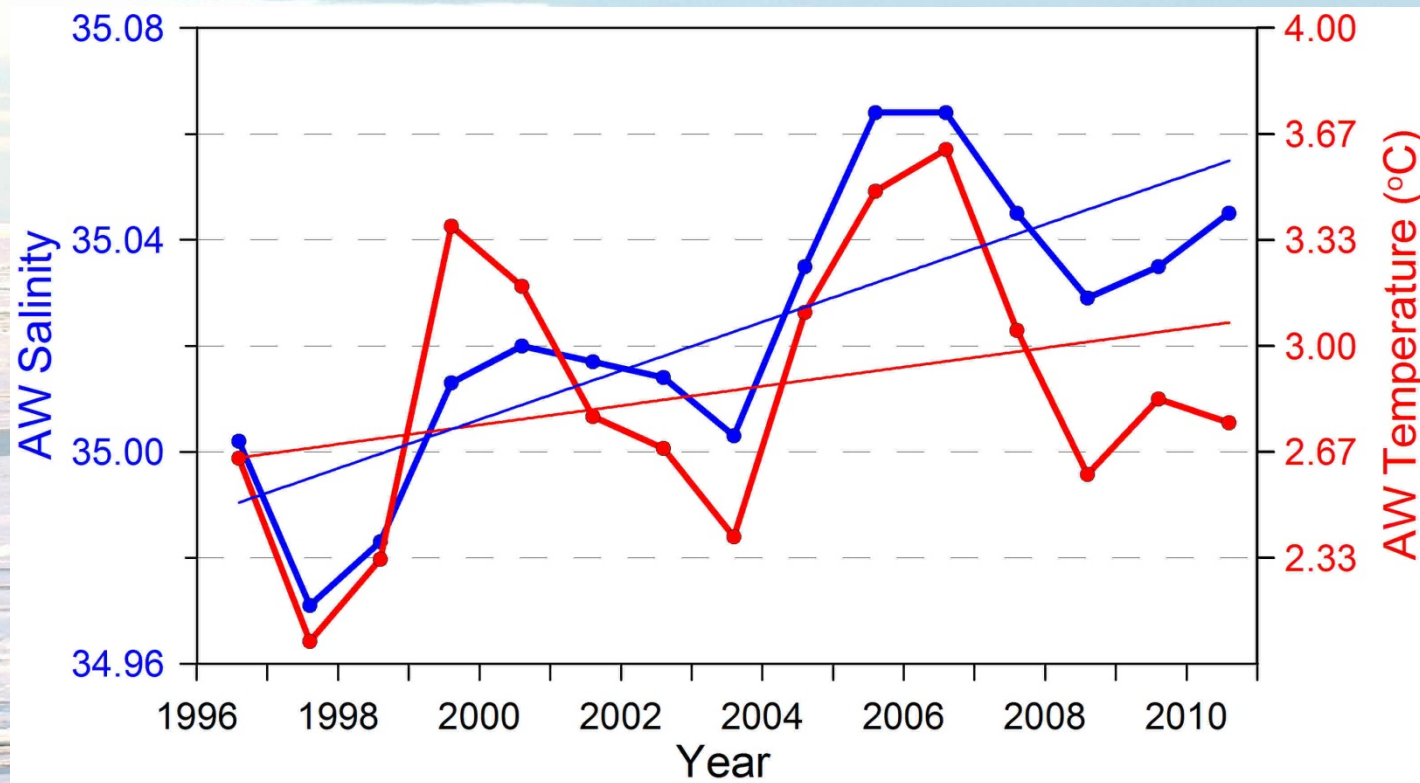


Properties of Atlantic Water ($T > 0^\circ\text{C}$, $S > 34.92$)

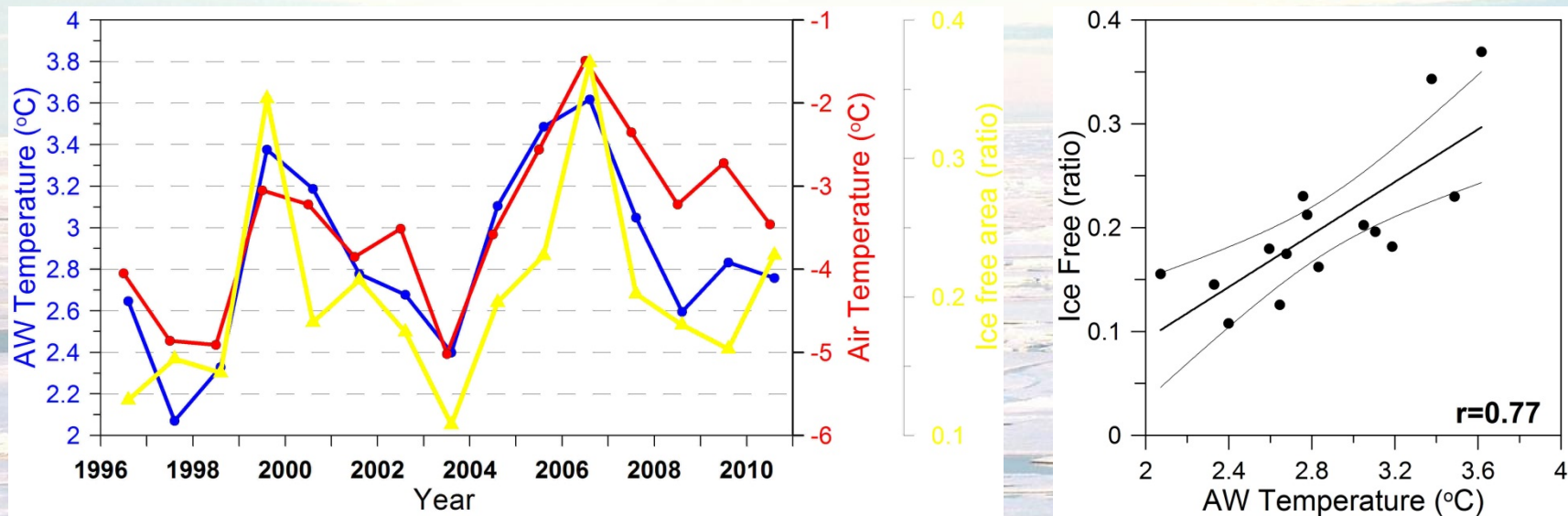
Mean (black), northern part (blue), southern part (red)



Temperature and salinity of AW at 76° 30' N parallel

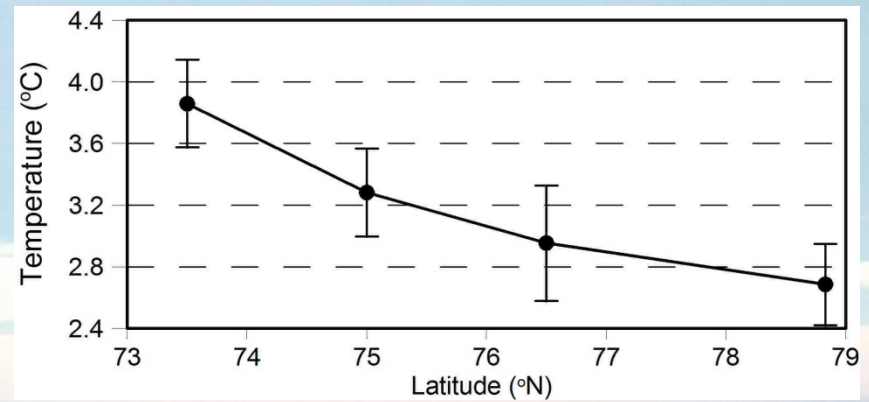
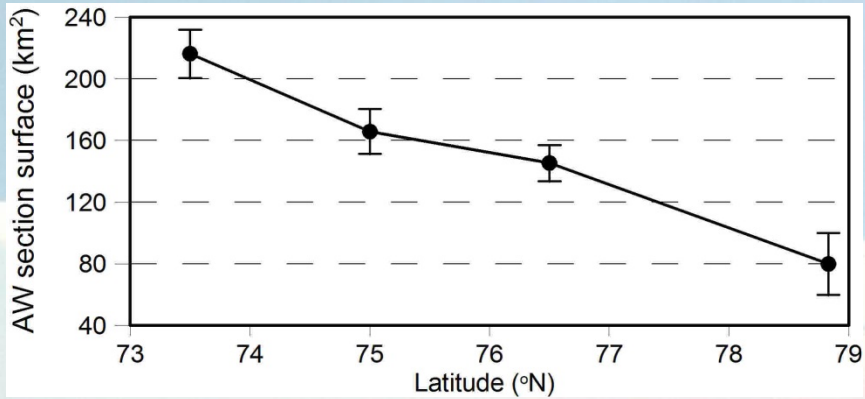


Inflow of the Atlantic Water shapes the Svalbard climate and ice conditions

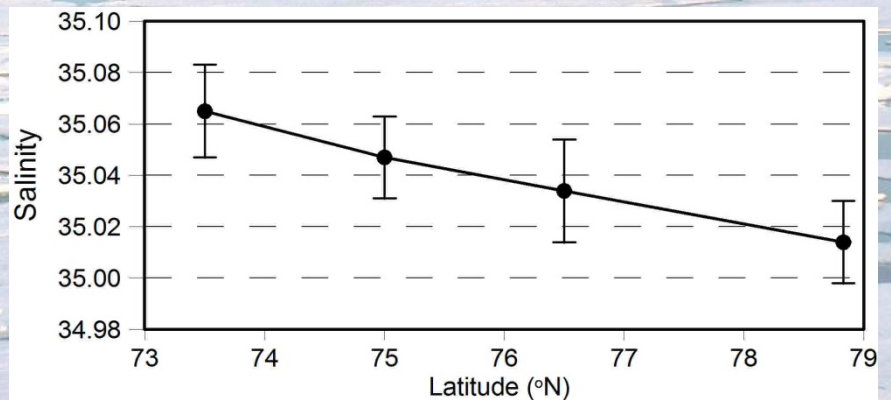
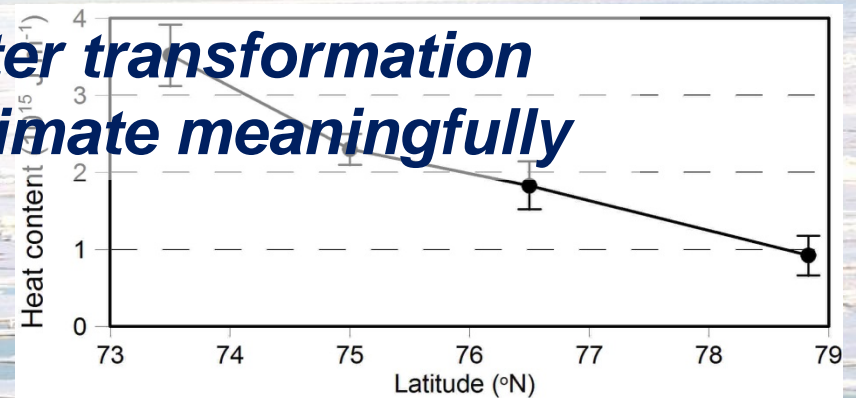
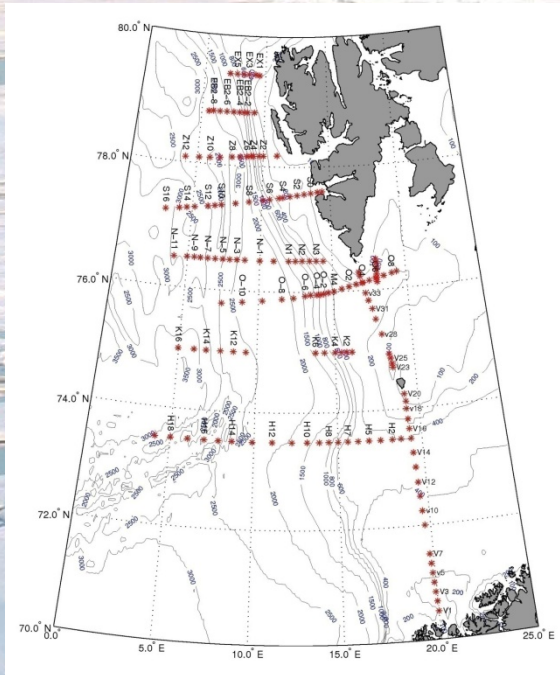


Temperature of Atlantic Water at section along the 76°90' N parallel (blue), yearly mean air temperature in Polish Polar Station in Hornsund (red), and ice free area (ratio) north of Svalbard.

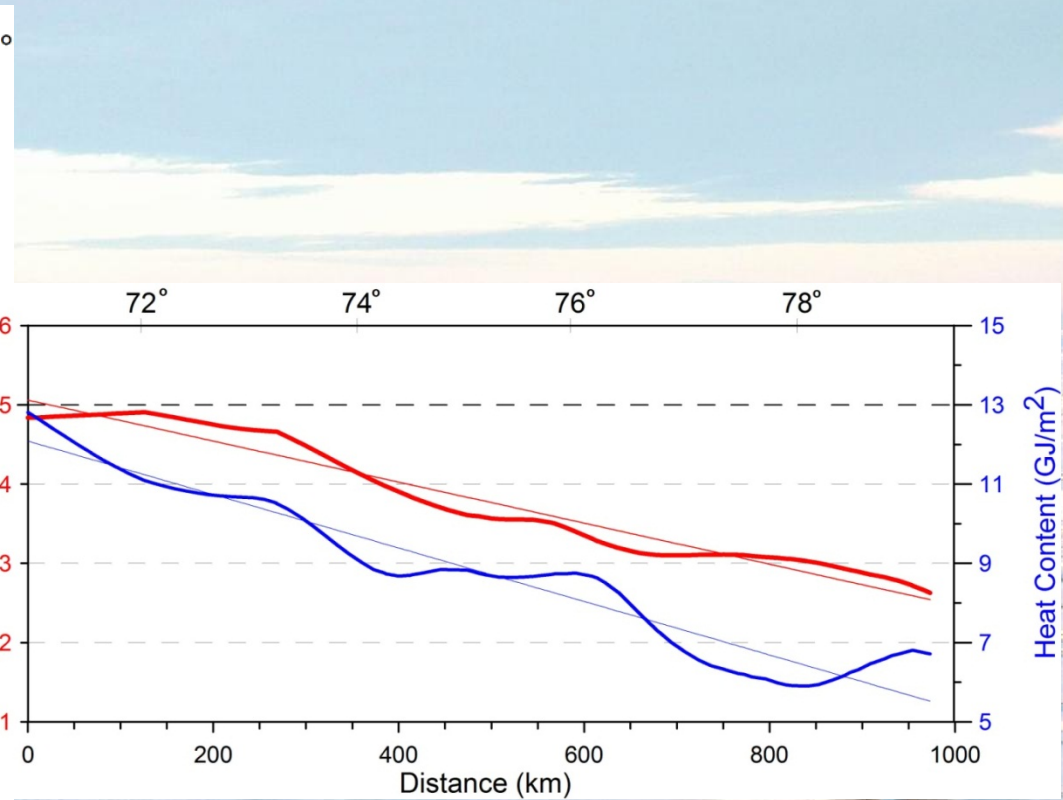
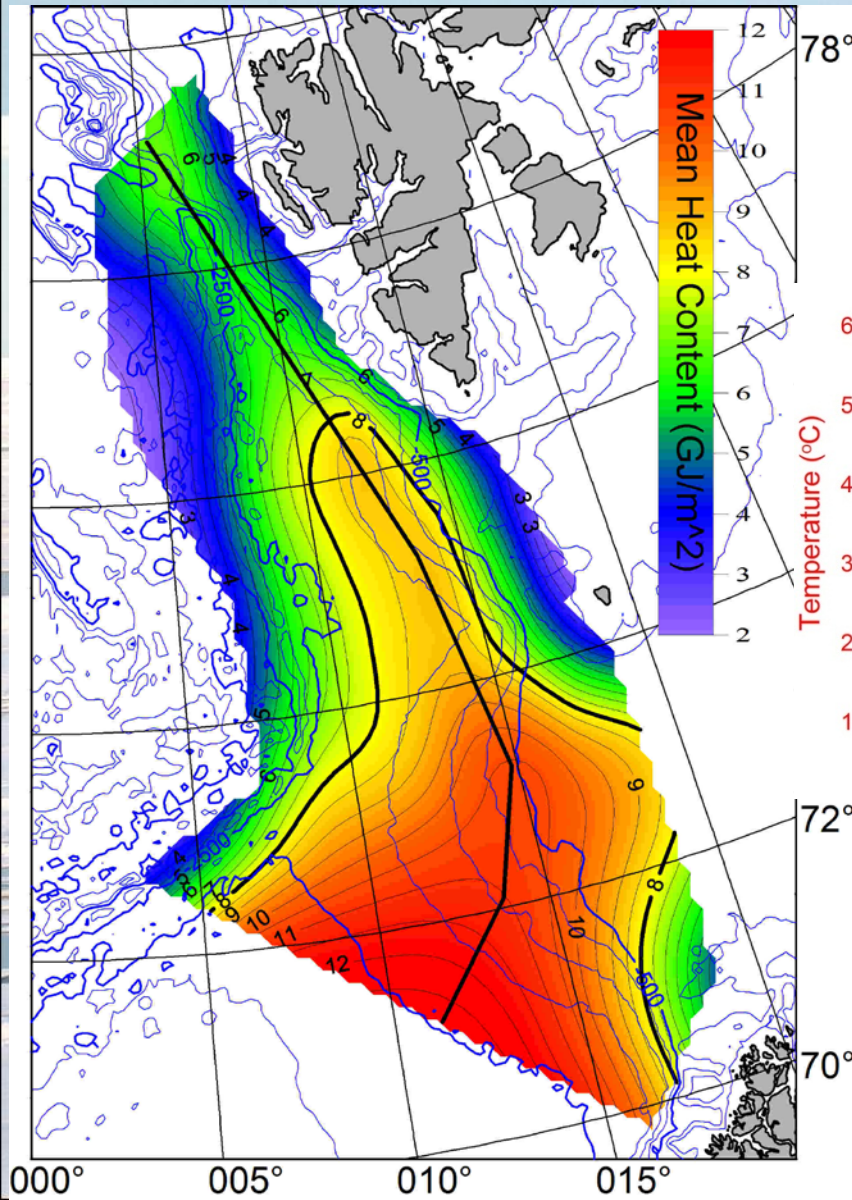
Changes of AW properties as function of latitude. Mean 2000-2010 summers



Atlantic water transformation influences climate meaningfully



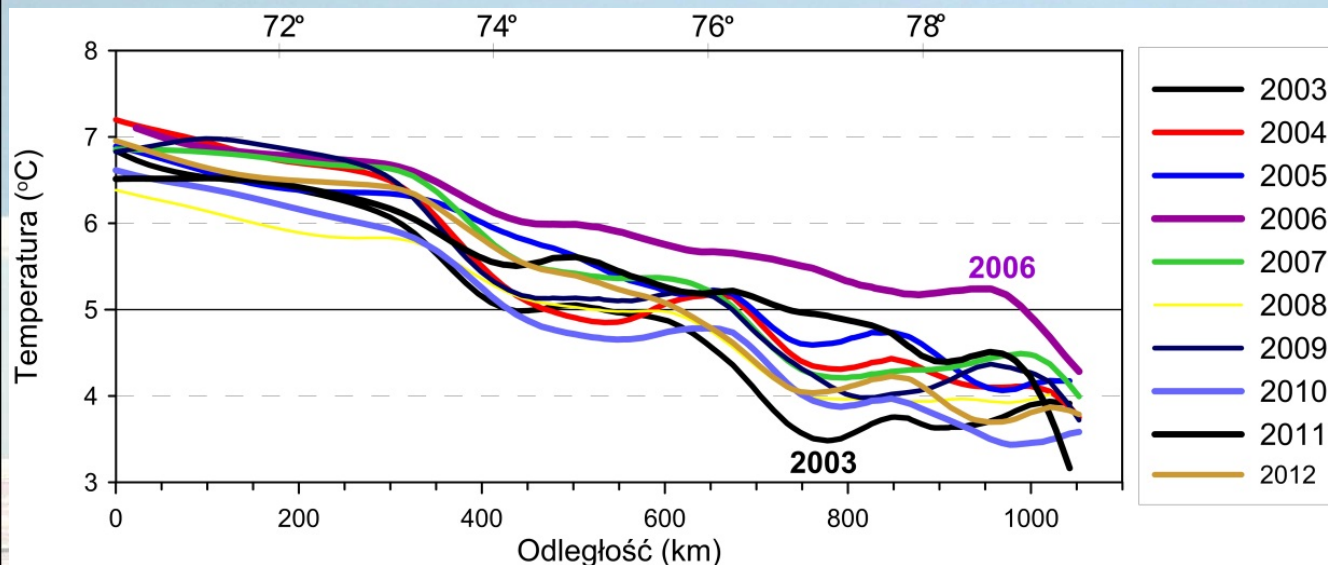
Mean (summers 2000-2009) heat content (GJ/m^2) of Atlantic water layer



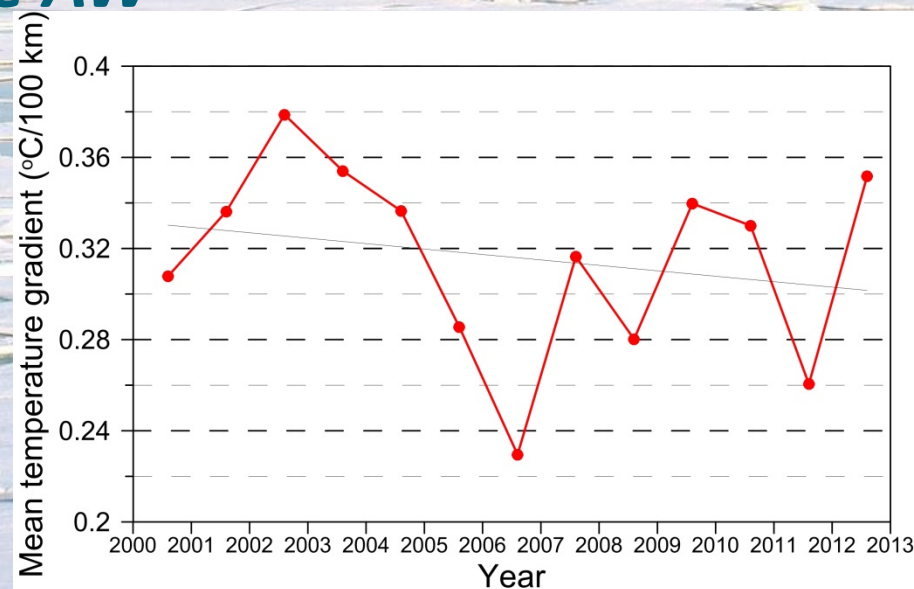
Atlantic Domain loses $\sim 4.3 \text{ GJ}$ of heat per 1 meter of northward flow

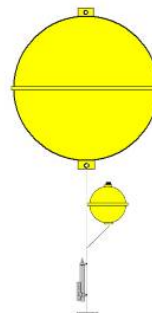
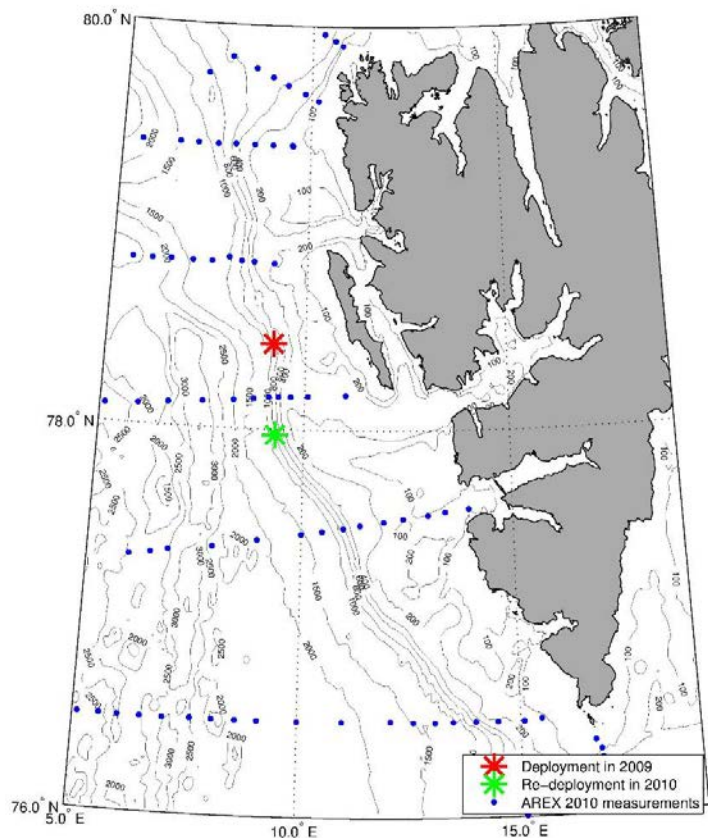


Meridional changes of the AW temperature at 100 m



Horizontal gradients of the AW temperature at 100 m





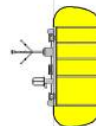
McLane steel sphere 48"

Chain 2 m

17" Benthos XT-6000 Acoustic Transponder

SBE 37-SMP S/N 4689

Stopper



McLane Moored Profiler

S/N ML11984

1/4" Nilspin line 700 m



Stopper

Chain 1.5 m

ORE 8242XS Acoustic Release Transponder S/N 31380

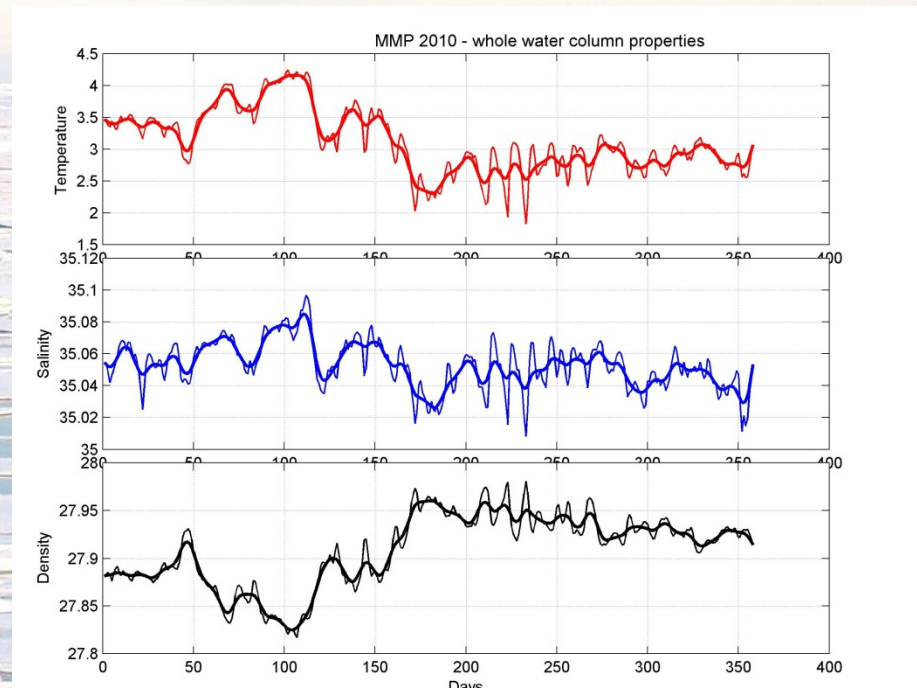
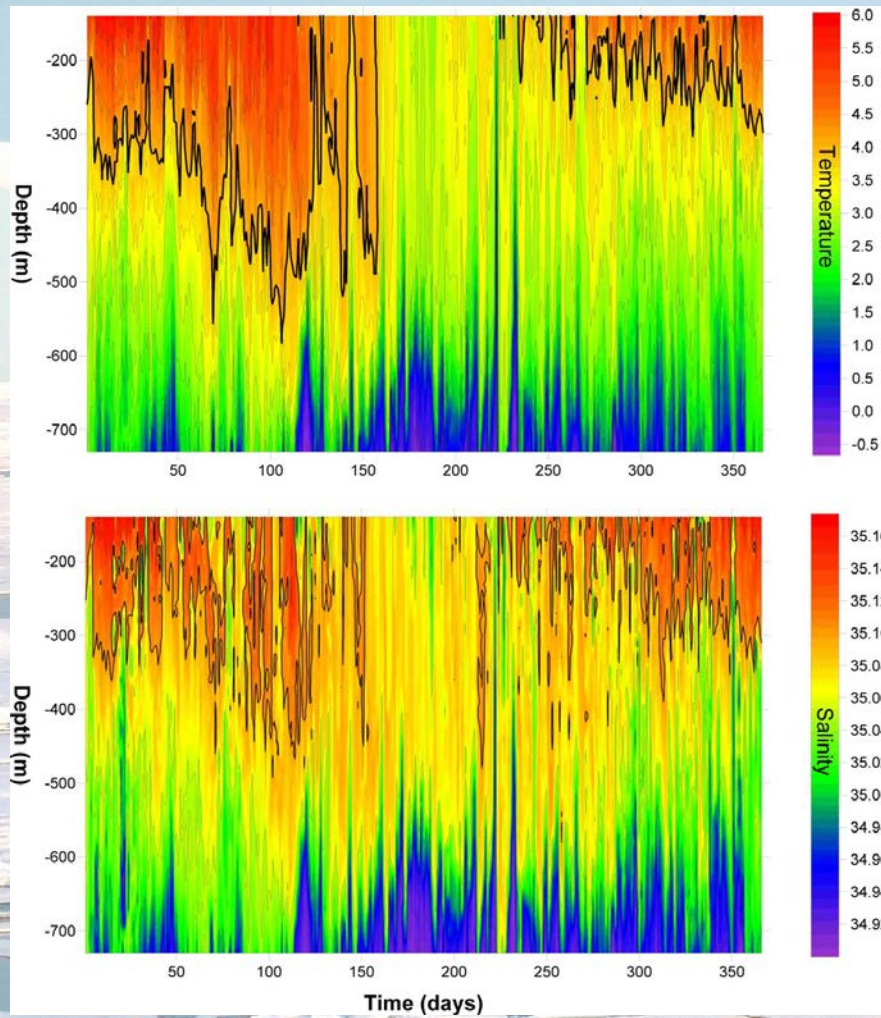
Chain 0.4 m

Anchor 1000kg

2009 deployment	September 16th, 2009 11:22 UTC
Geographical location	78° 25.808'N, 009° 11.733' E
Recovery in 2010	September 16th, 2010 01:03 UTC
Re-deployment In 2010	September 16th, 2010 15:03 UTC
New geographical location	77° 58.297' N, 009° 18.224' E

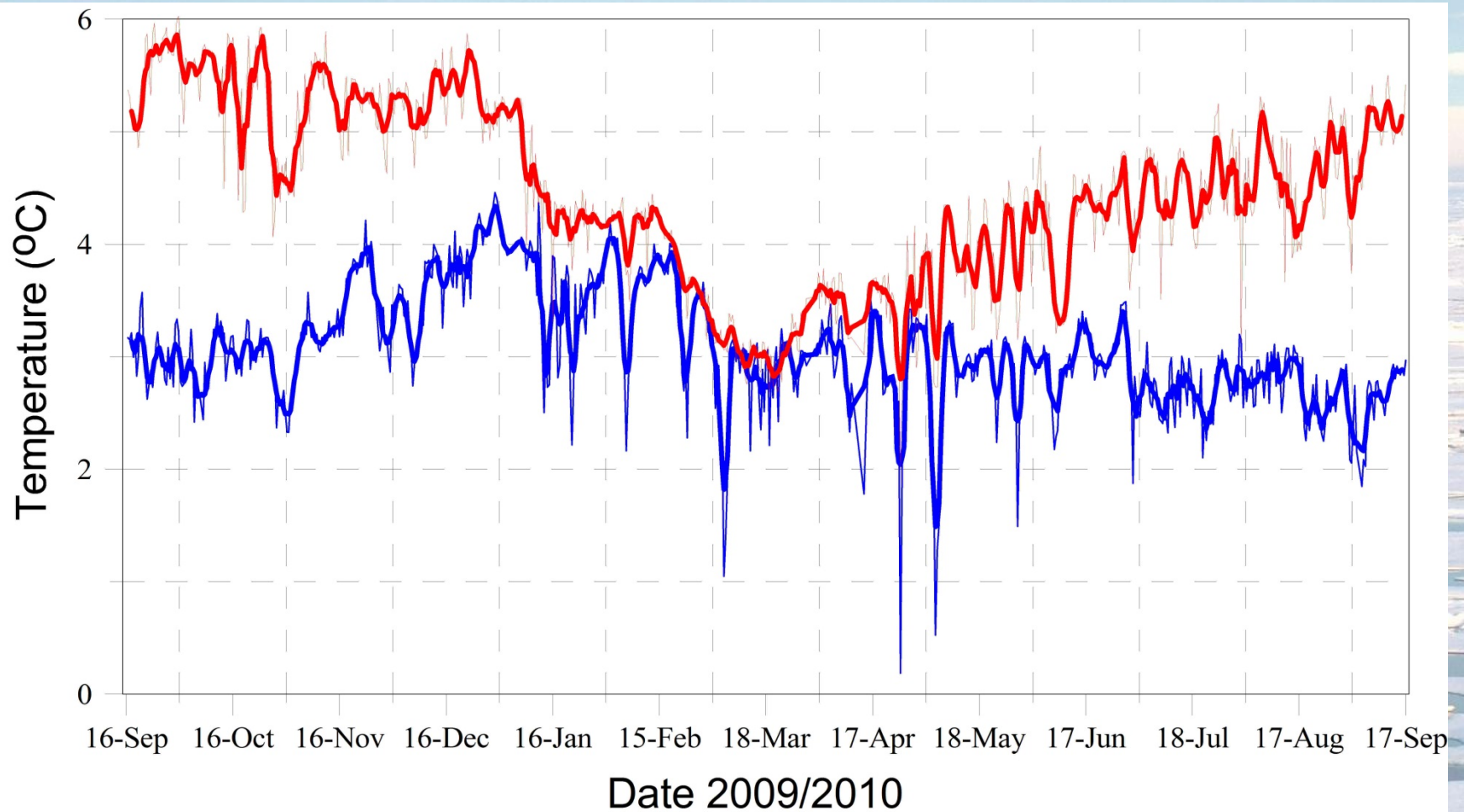


MMP results 2009-2010

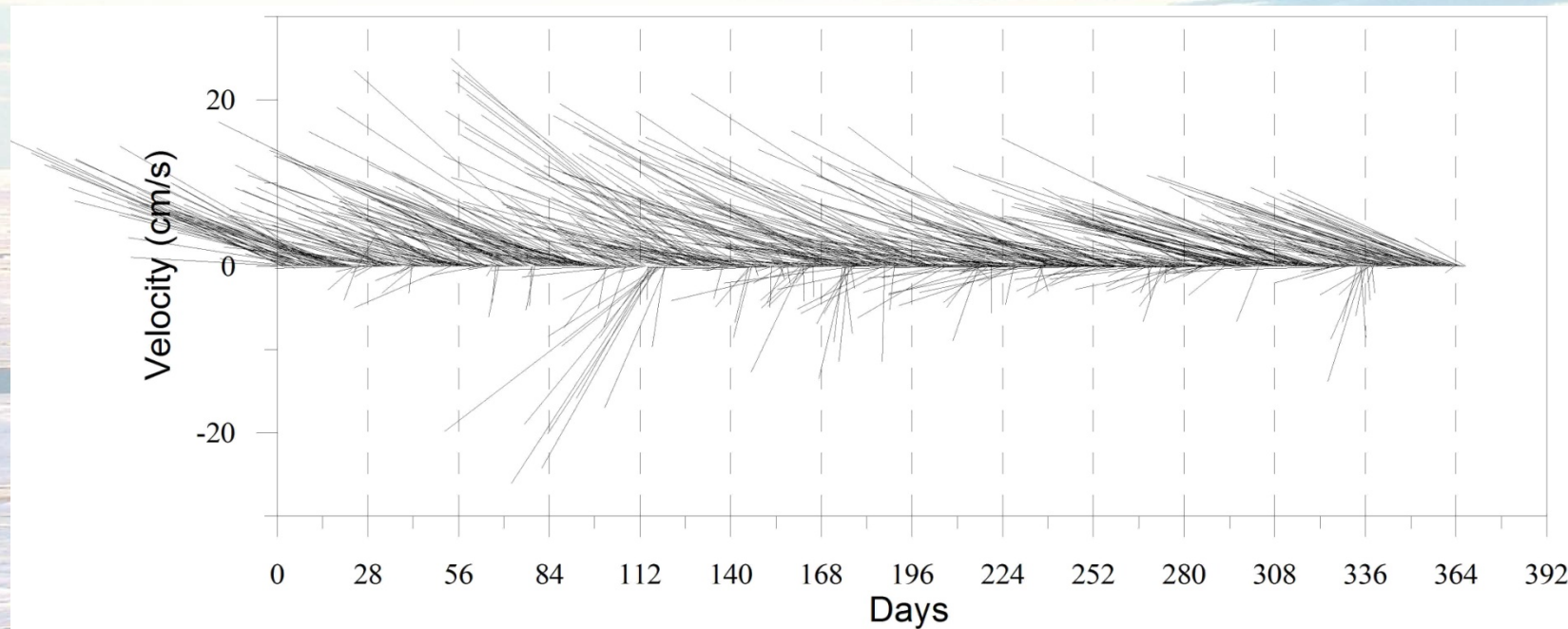


MMP wstępne wyniki

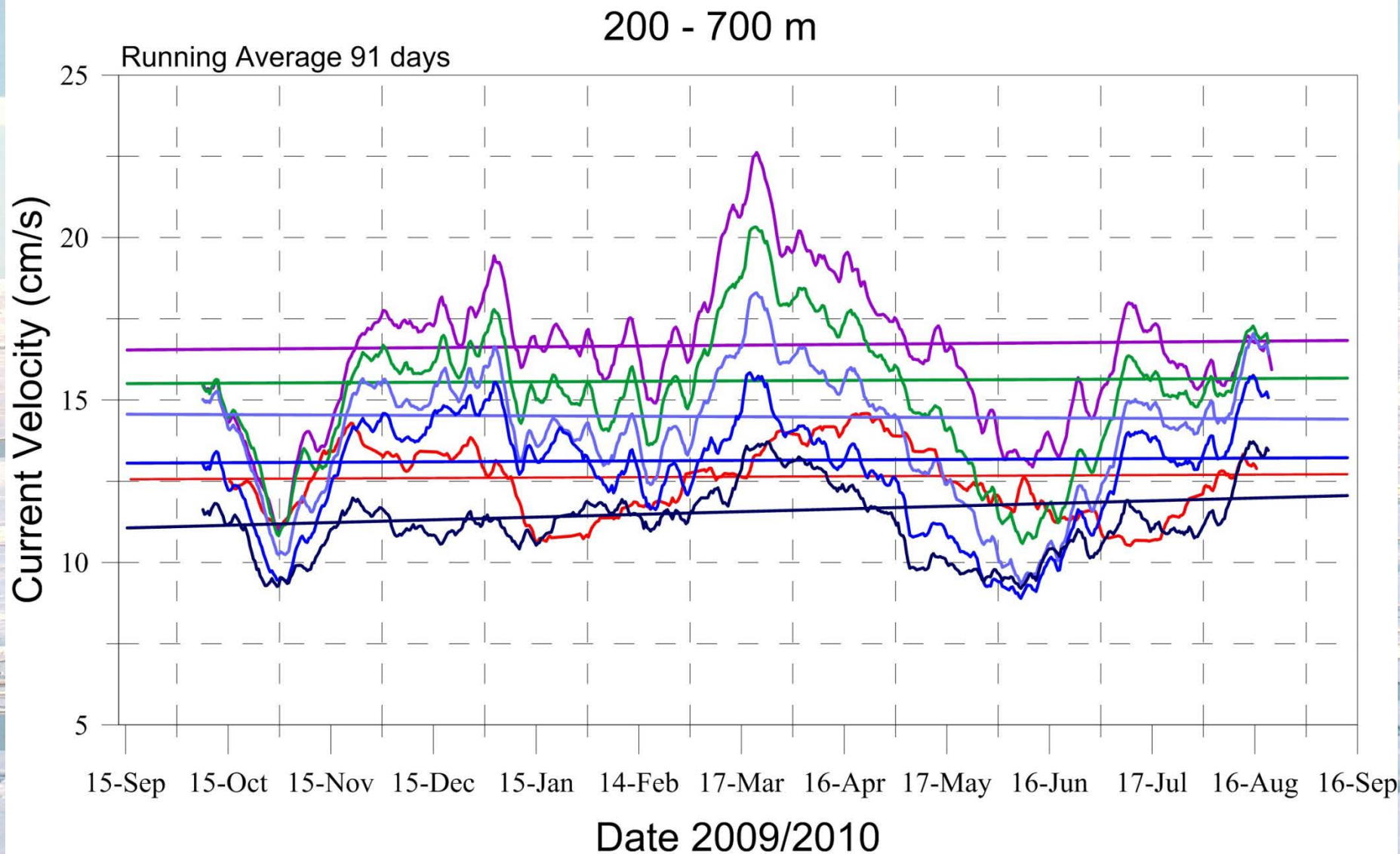
Temperatura na 150 i 500 m



MMP wstępne wyniki Prądy na 300 m



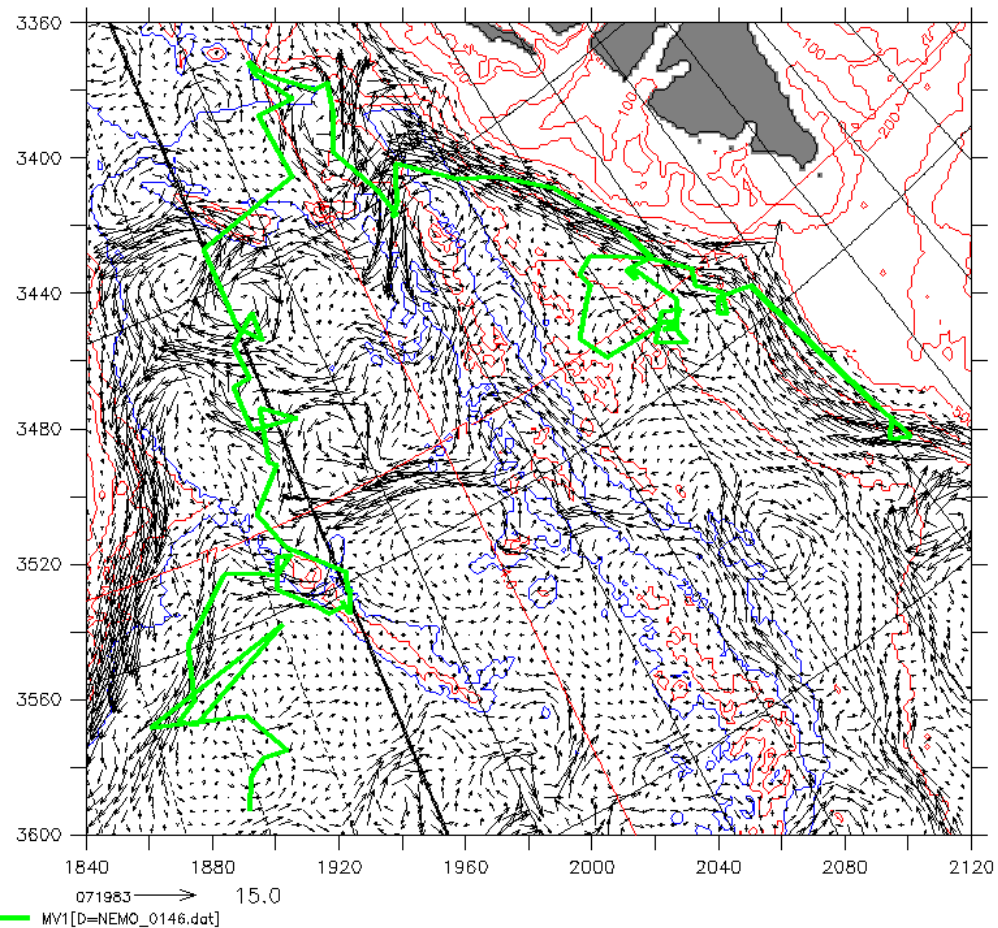
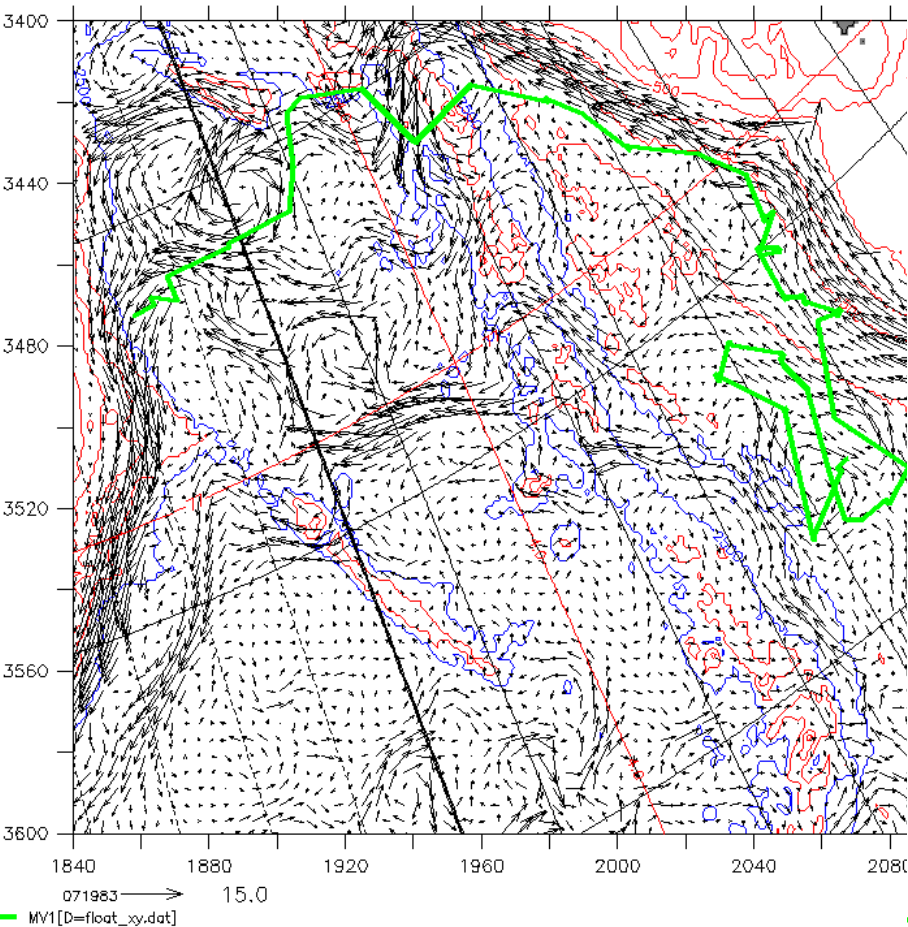
Current velocity 200 – 700 m

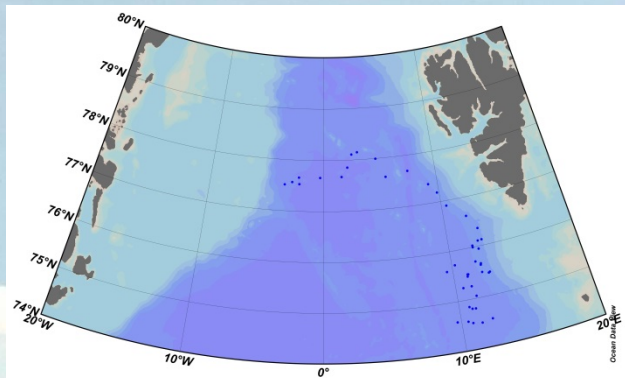


Wodowanie pływaka ARGO z „Oceanii”

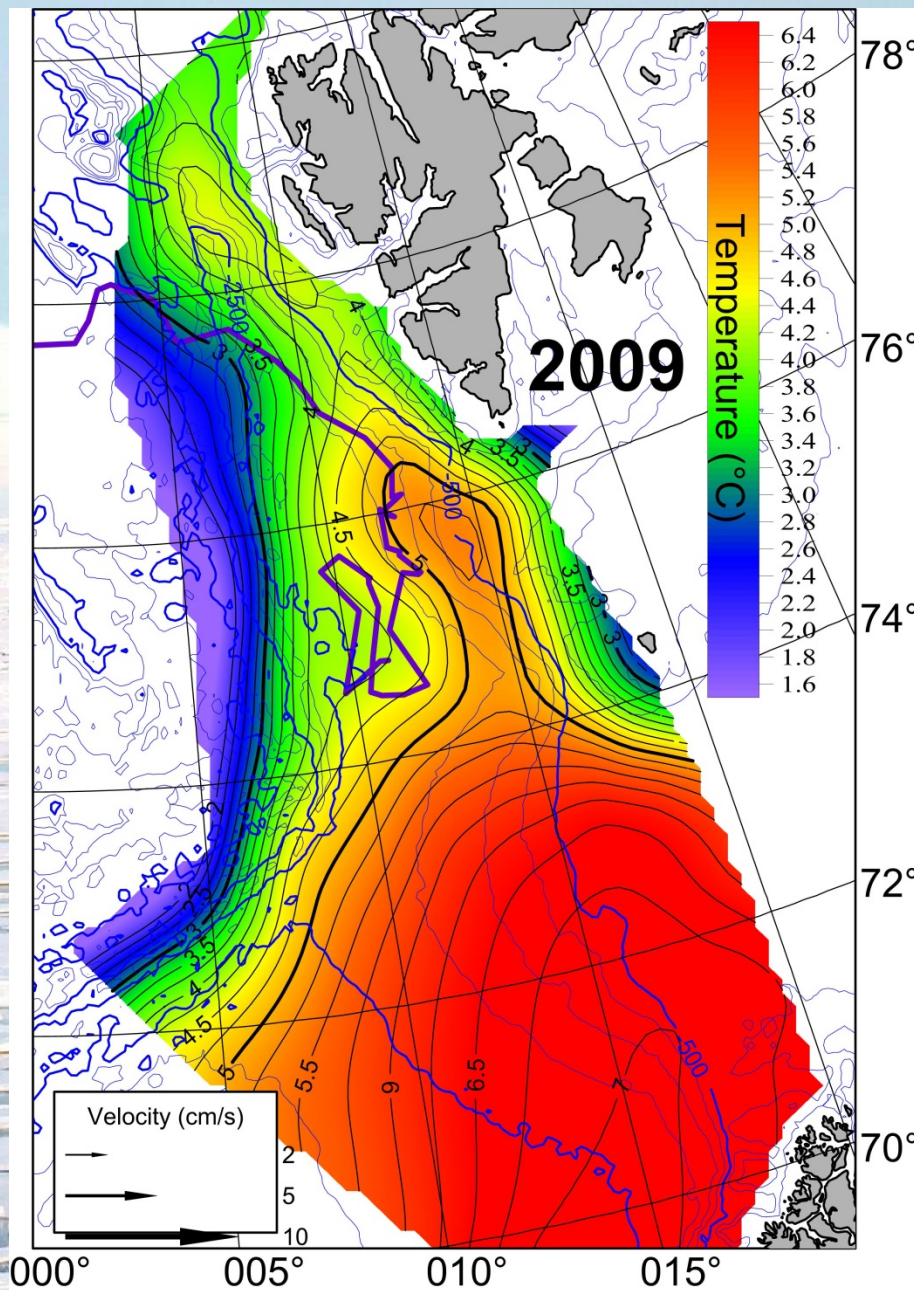


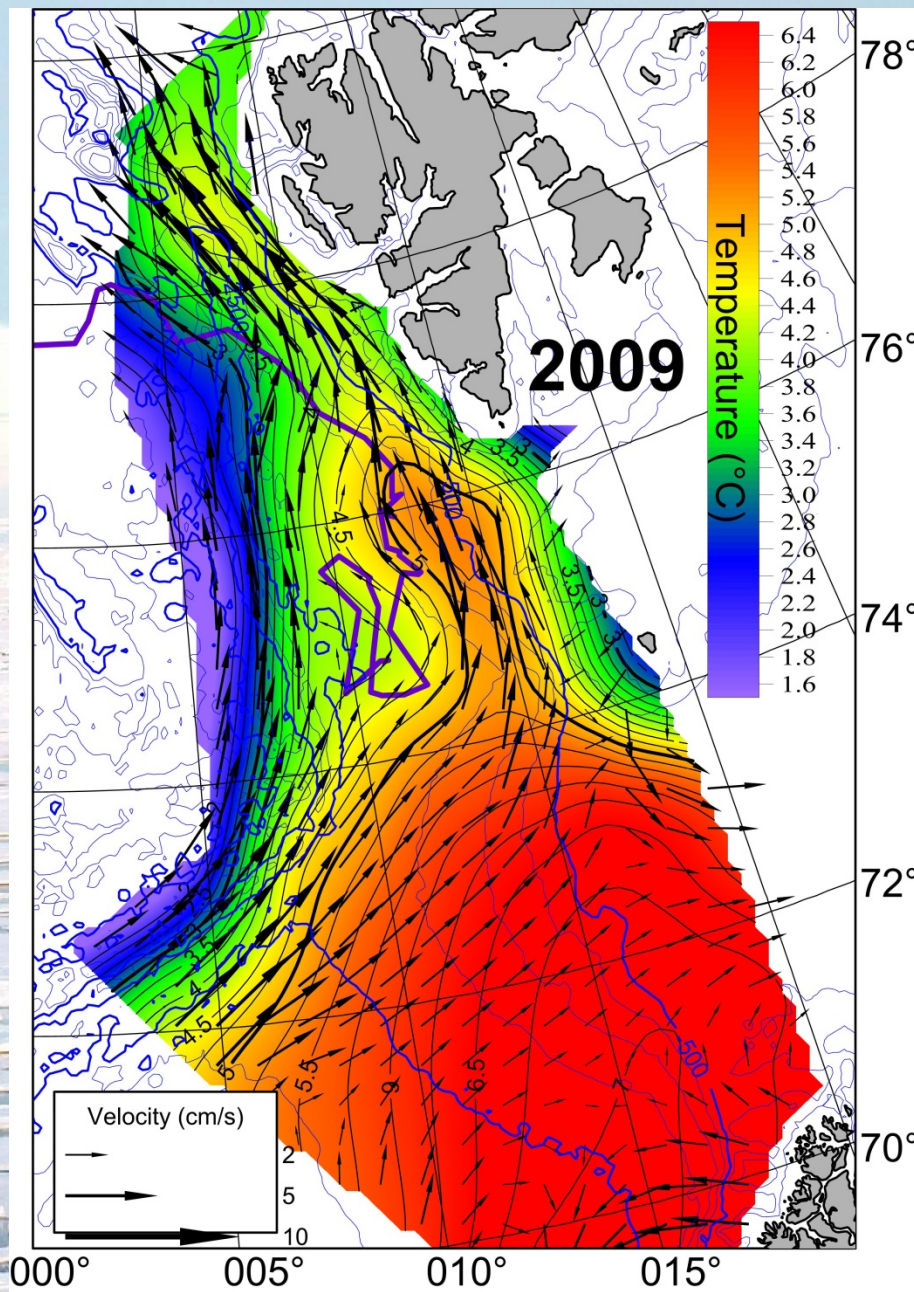
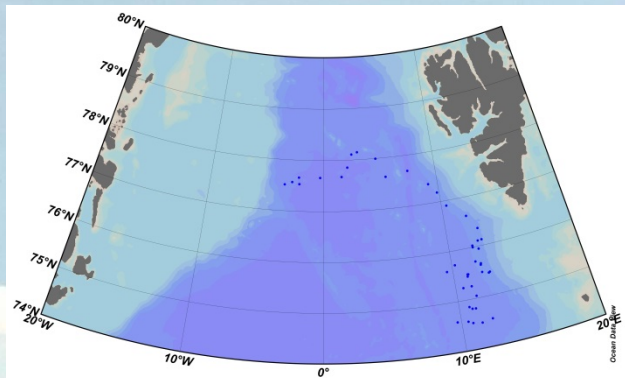
Euro-Argo project, Poland as observer in the ERIC structure. 2 floats/year

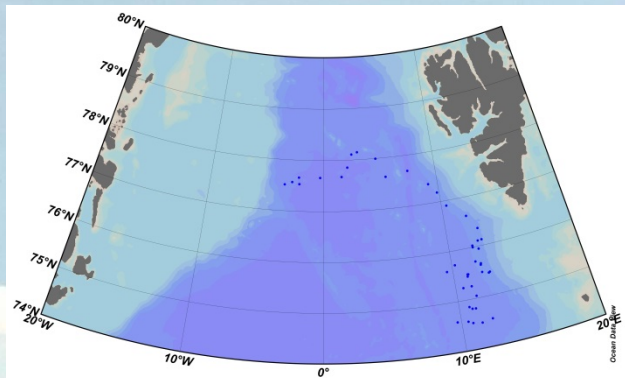




6900808
11.07.2009-11.02.2010
Parking depth 1000 m
Cycle 5 days







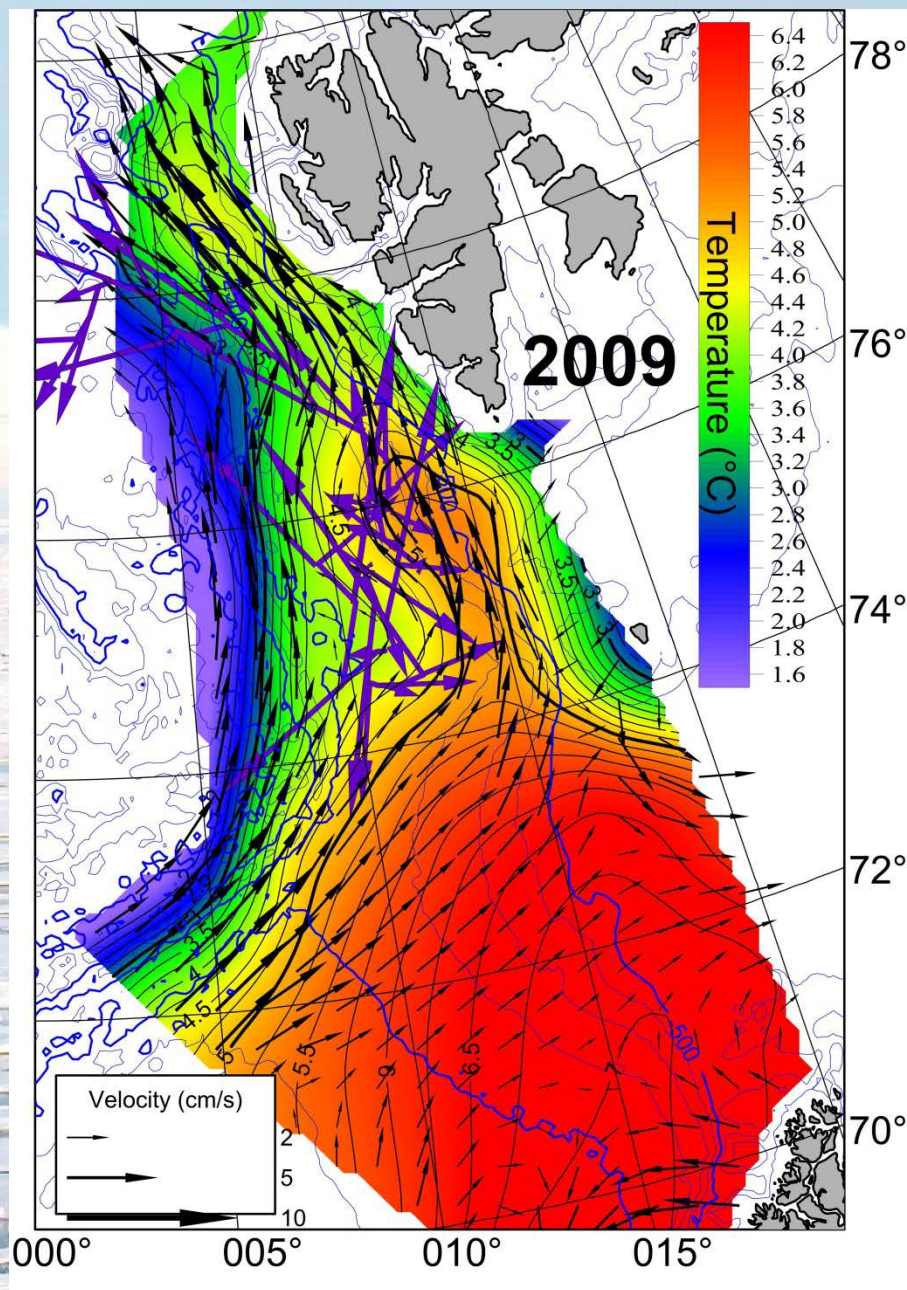
6900808

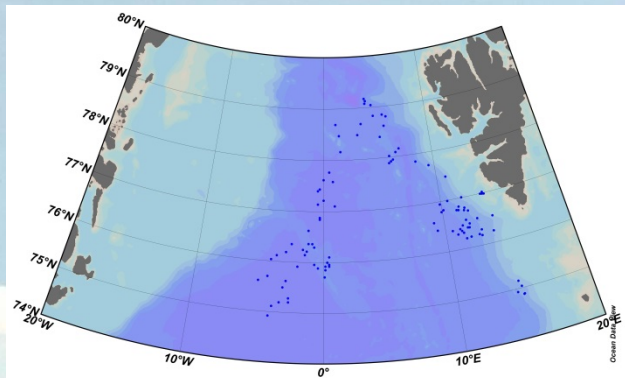
Vel_{max} 17.7 cm/s

Vel_{mean} 6.5 cm/s

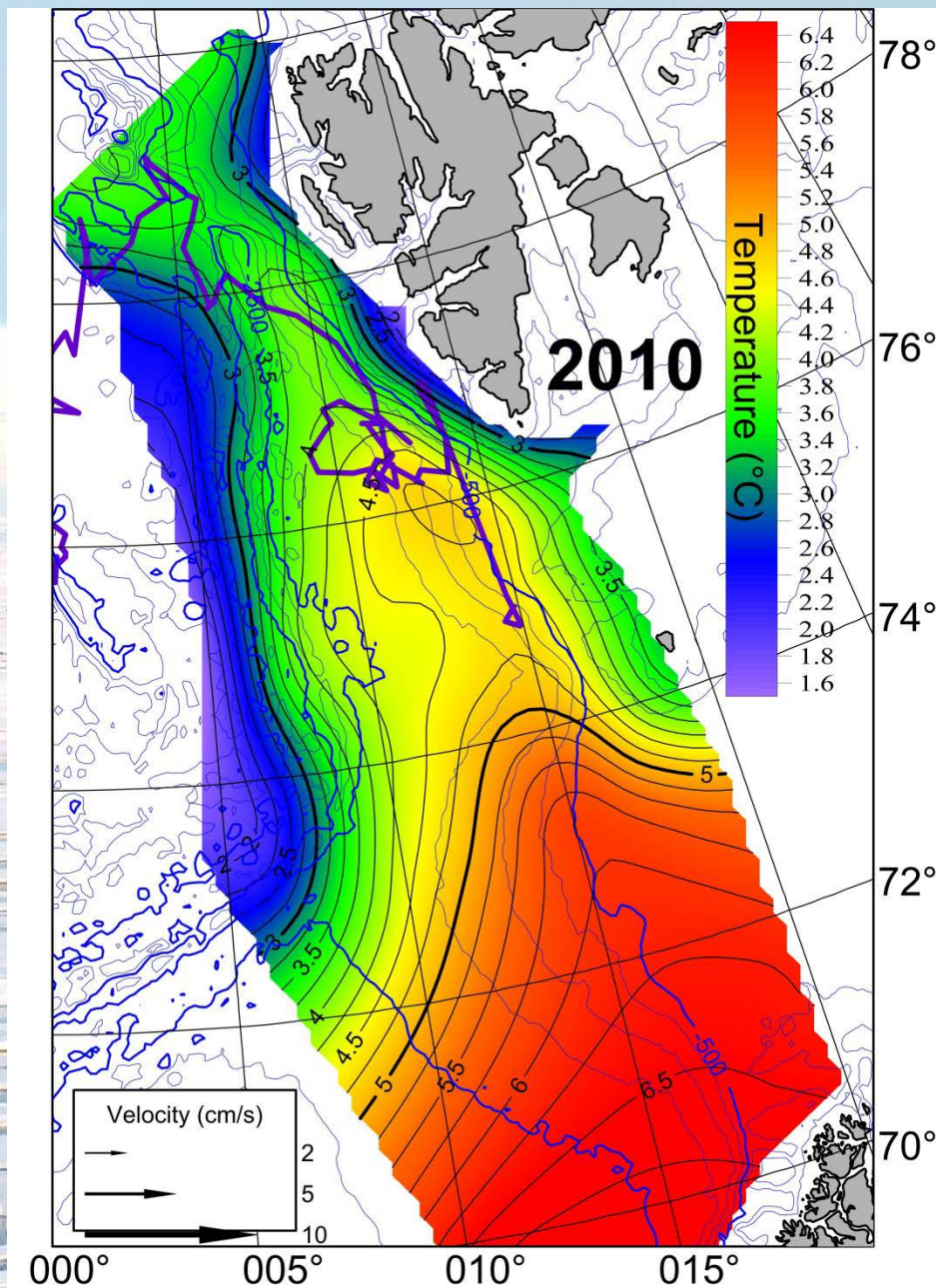
U_{mean} -1.3 cm/s

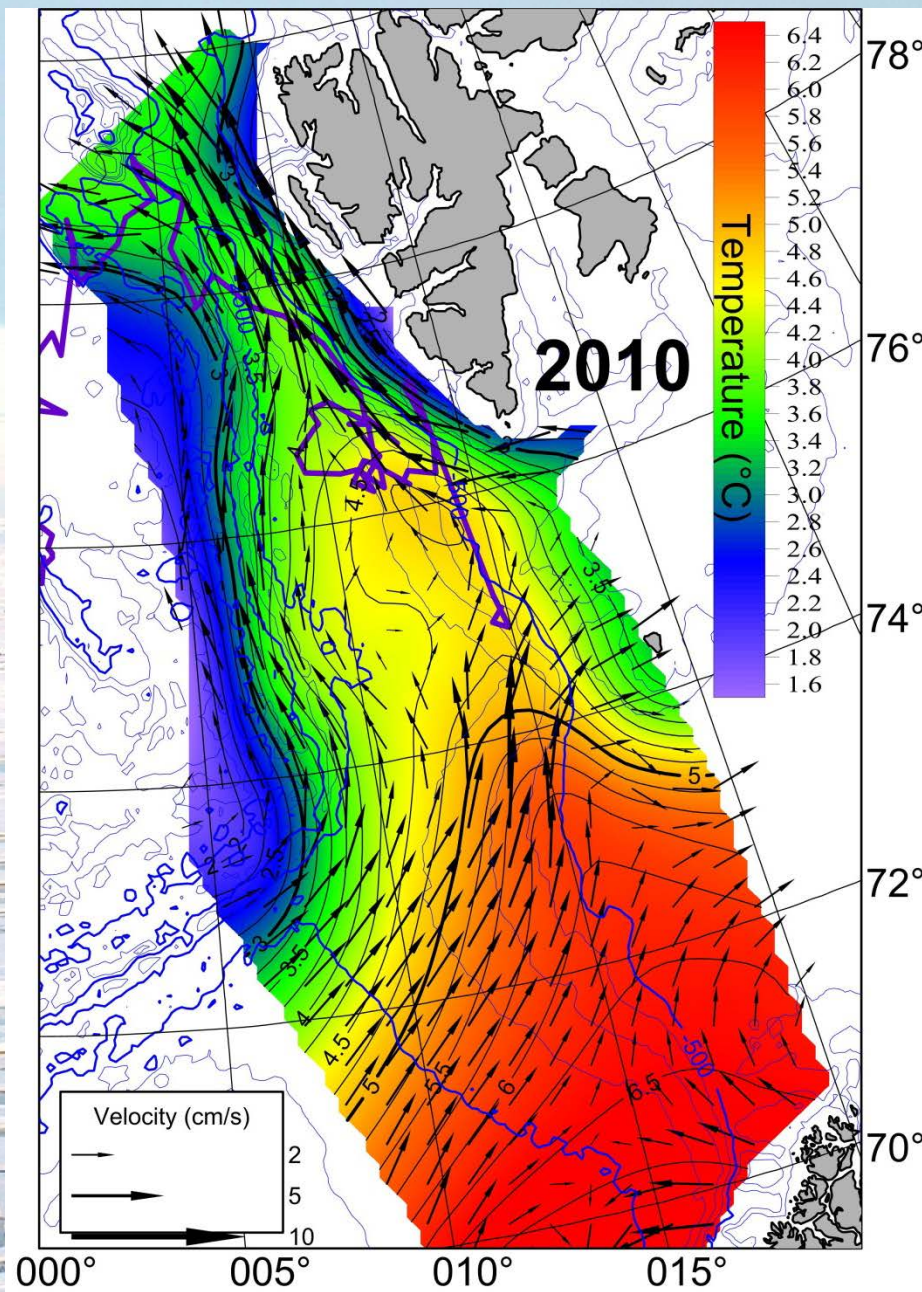
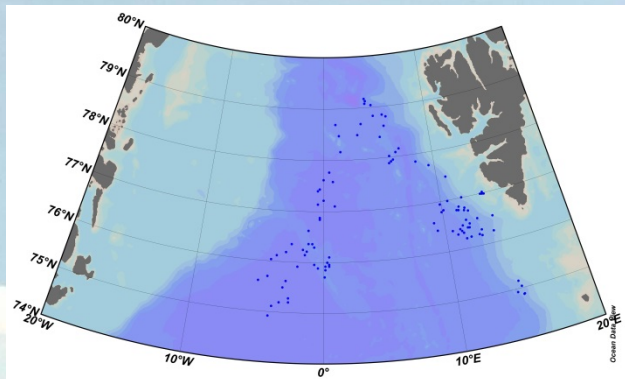
V_{mean} 2.3 cm/s

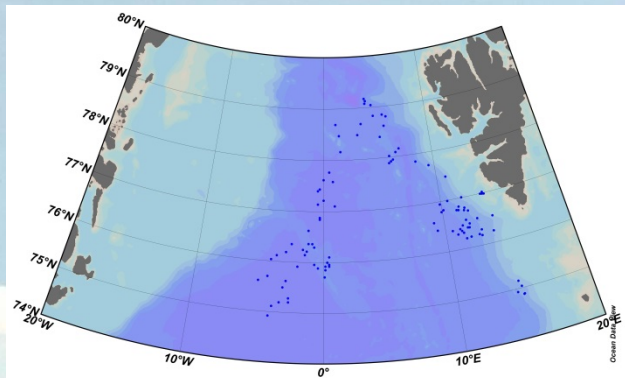




6901387
02.07.2010-28.05.2011
Parking depth 500 m
Cycle 5 days







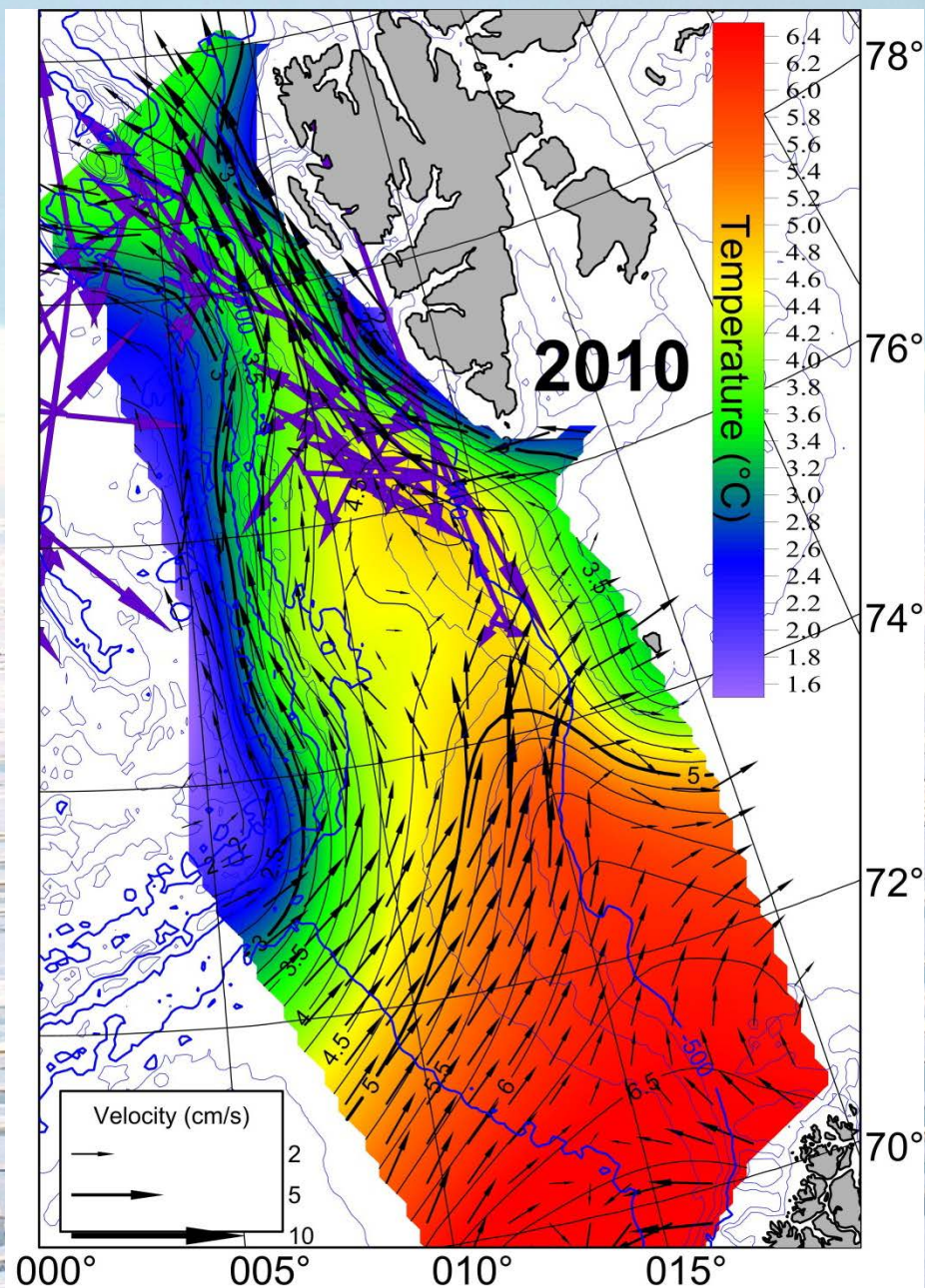
6901387

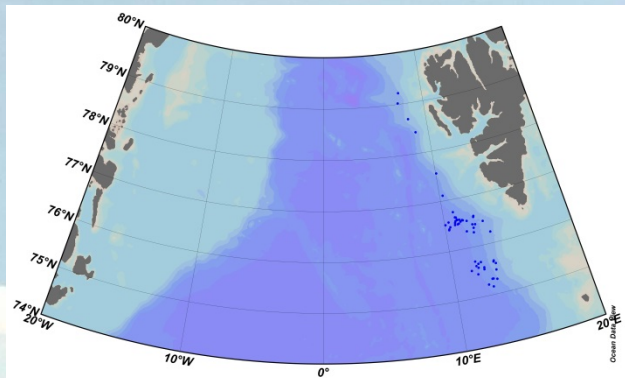
Vel_{max} 39.0 cm/s

Vel_{mean} 8.3 cm/s

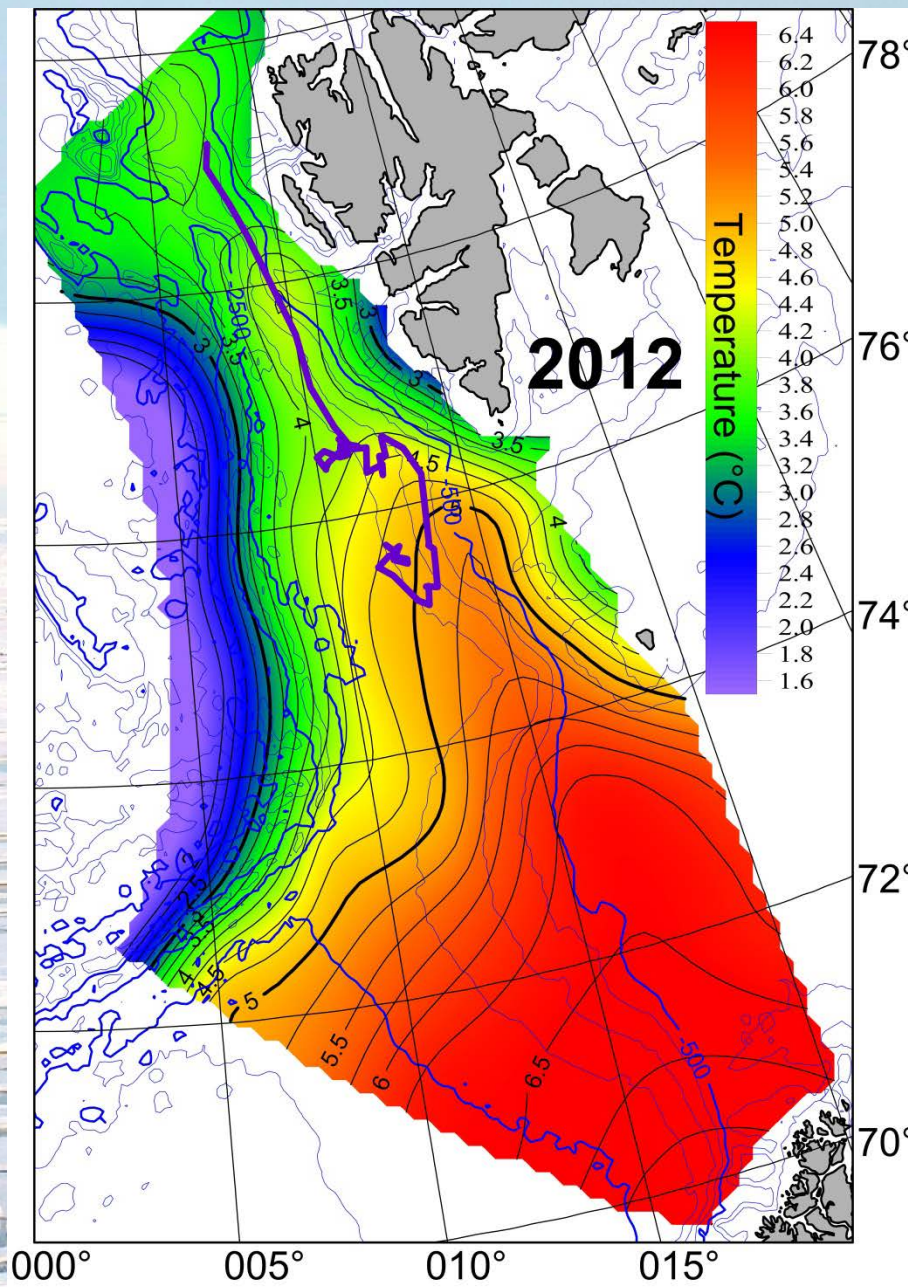
U_{mean} -1.5 cm/s

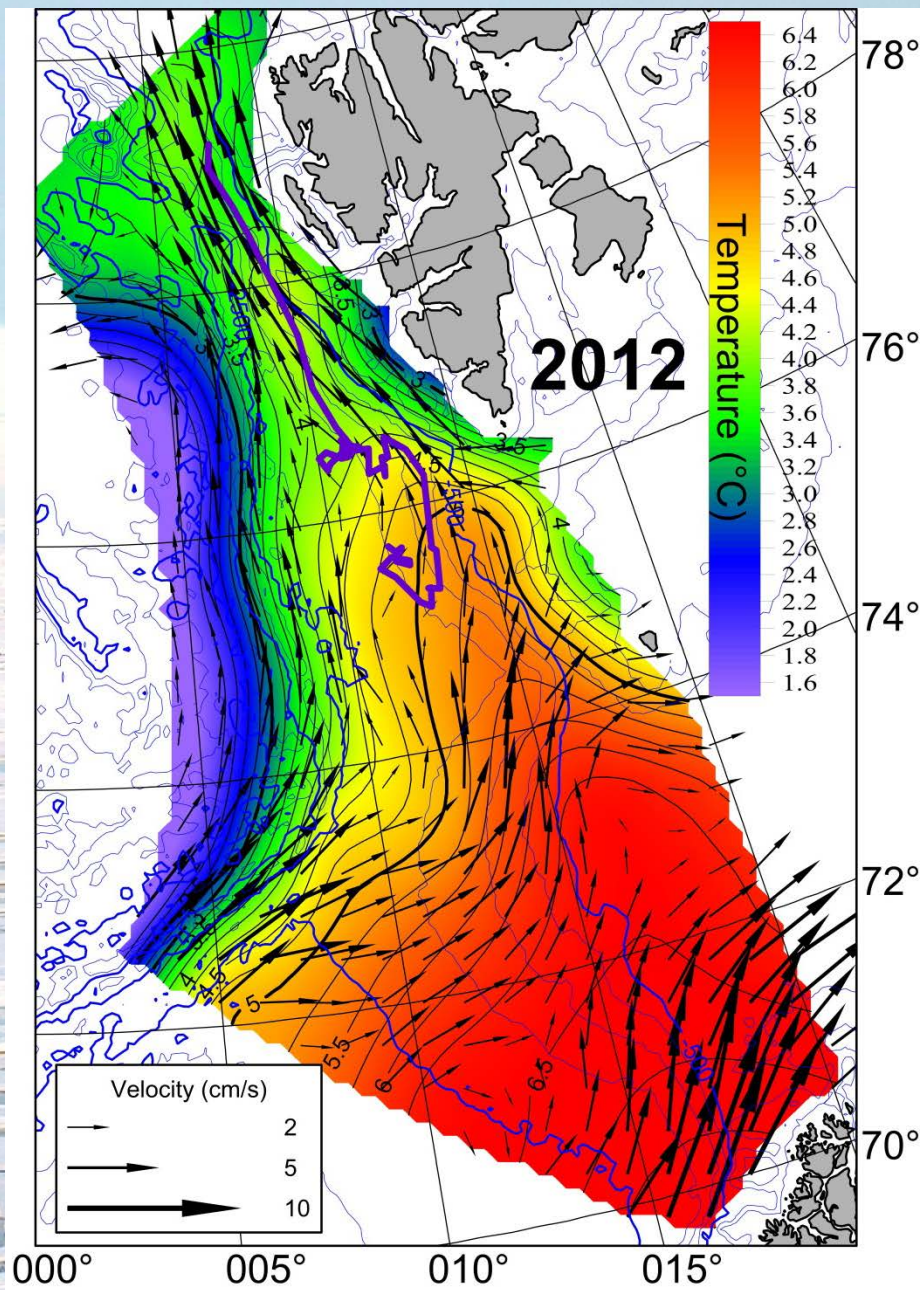
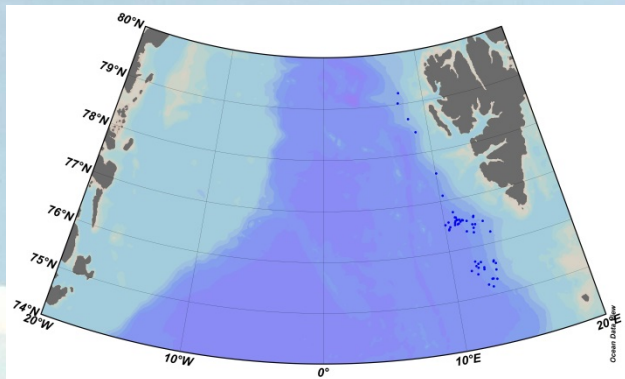
V_{mean} 2.3 cm/s

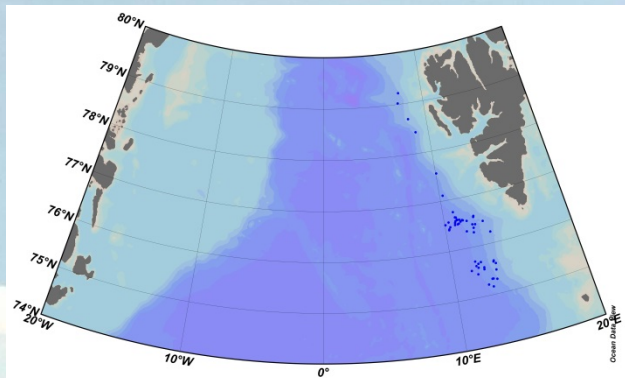




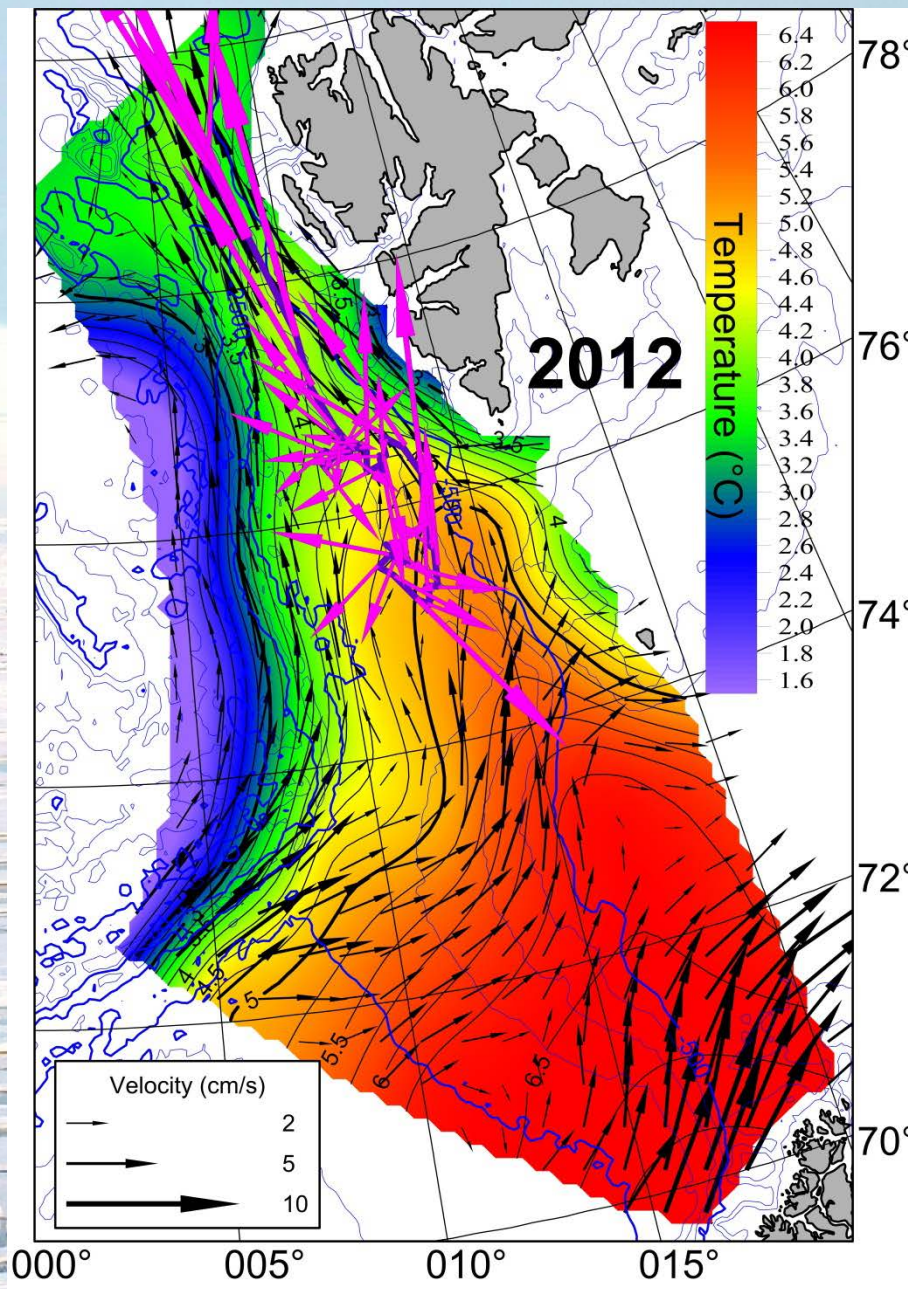
6901902
16.07.2012-11.12.2011
Parking depth 500 m
Cycle 3 days







6901902
 Vel_{max} 38.7 cm/s
 Vel_{mean} 6.1 cm/s
 U_{mean} -0.7 cm/s
 V_{mean} 2.7 cm/s



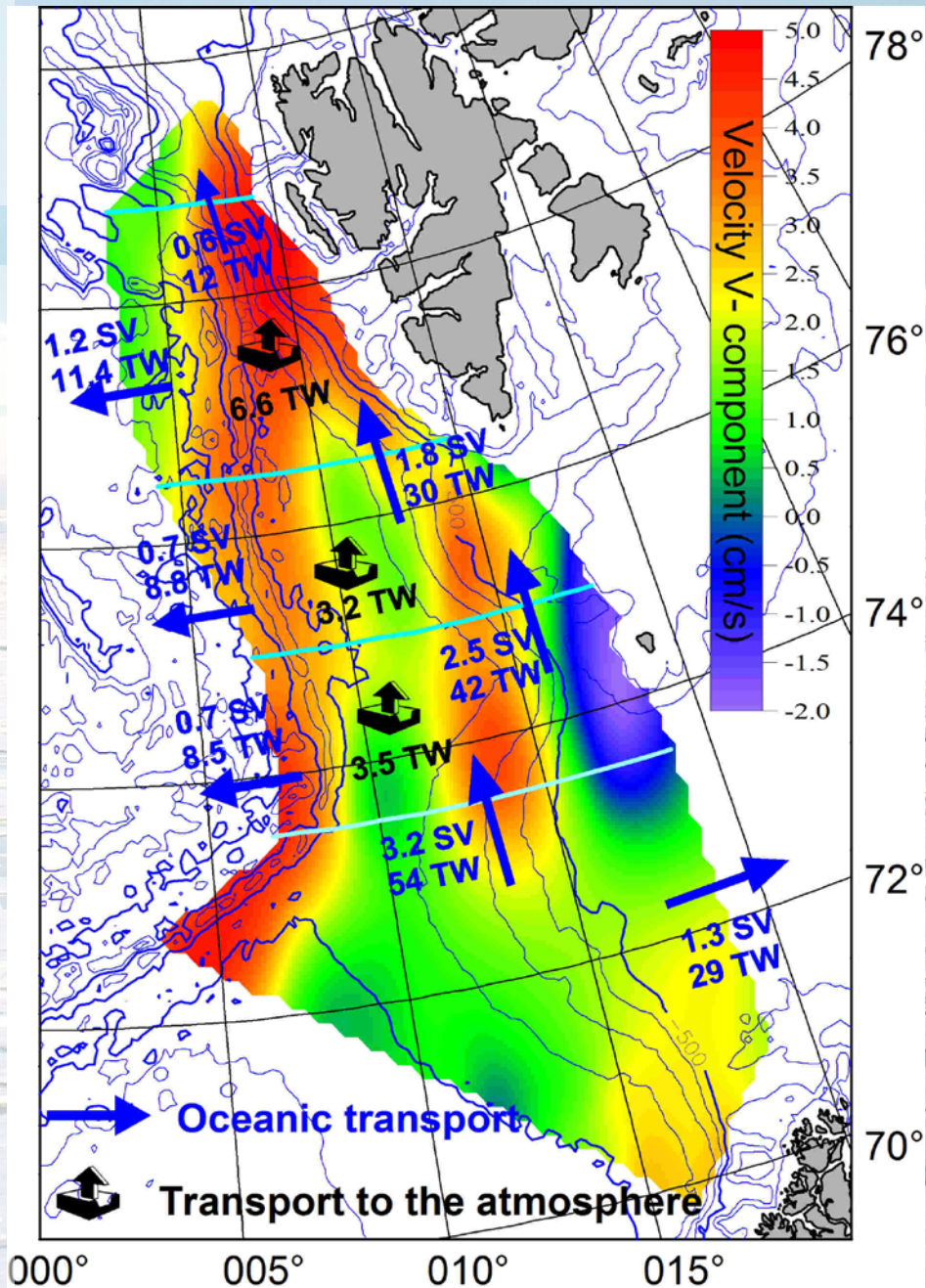
West Spitsbergen Current heat and volume divergence (geostrophic calculations)

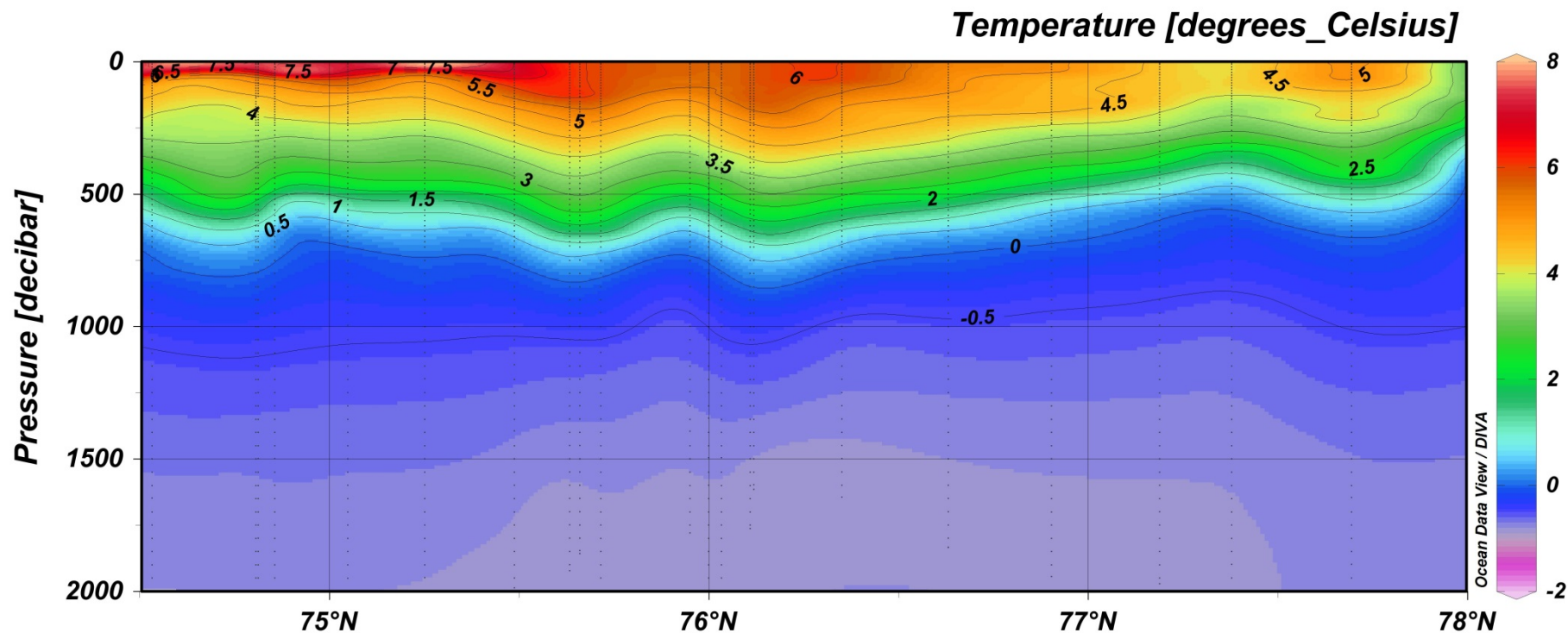
Heat flux to atmosphere:

- 68 W/m^2 in southern part
- 129 W/m^2 in northern part

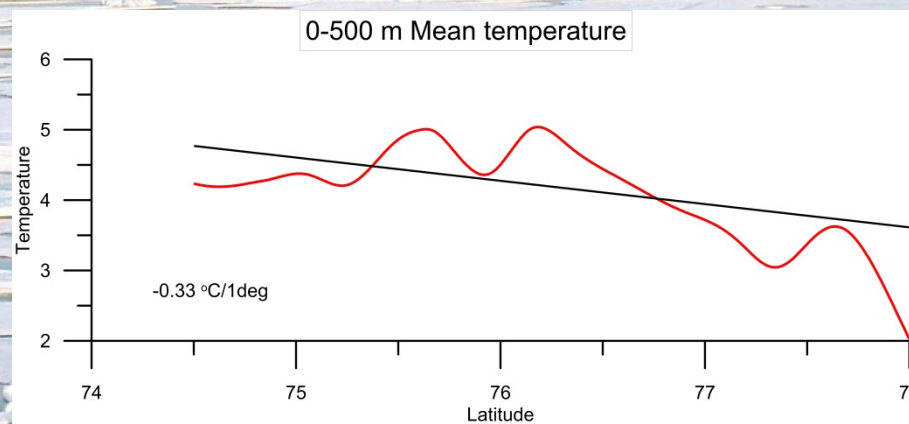
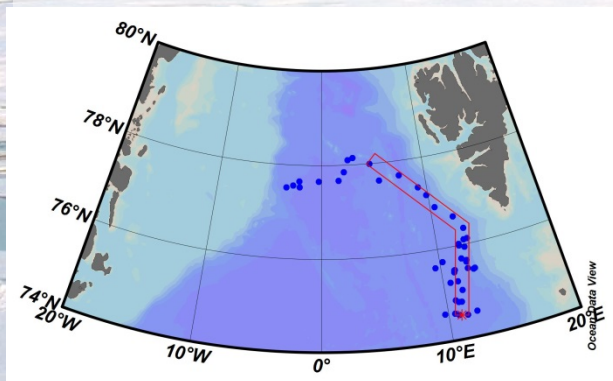
Heat transported by WSC north of $73^\circ 30'$ parallel diverges:

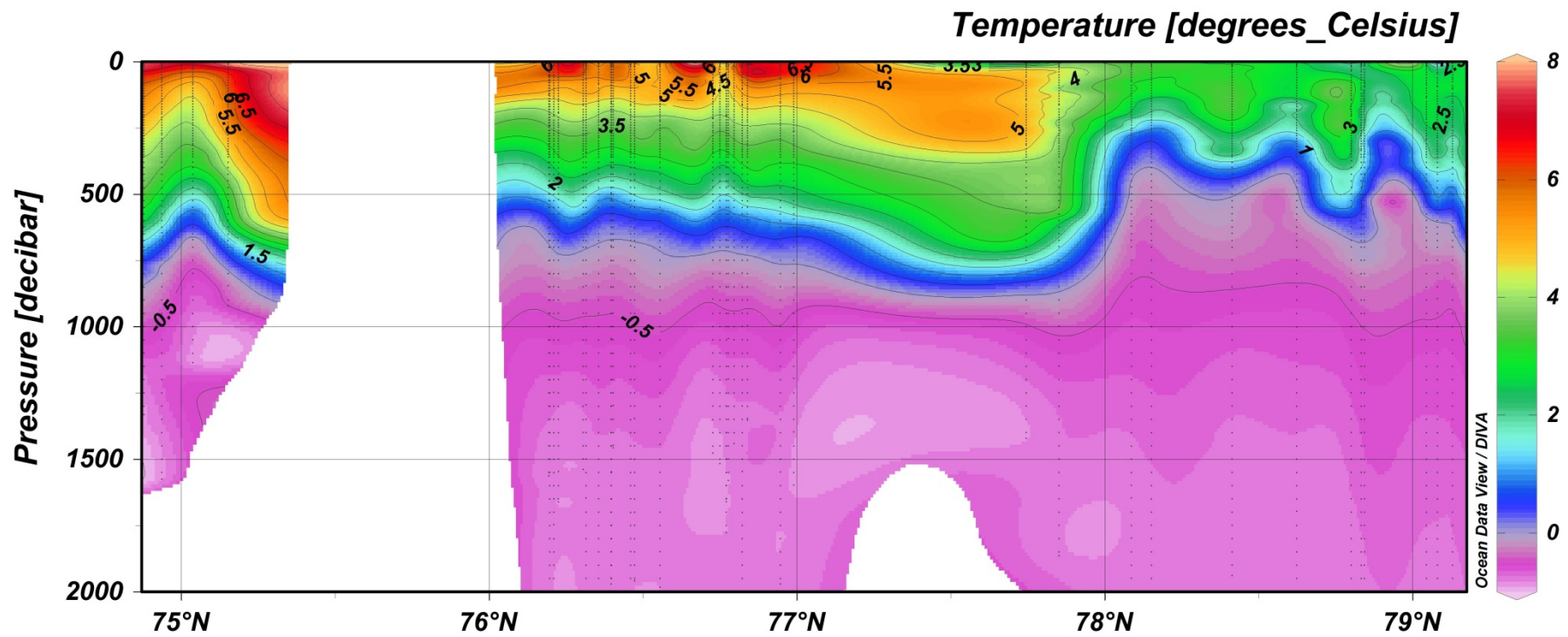
- 22% northward, to Arctic Ocean through the Fram Strait;
- 25% to the atmosphere;
- 53% westward, to the Greenland Sea.





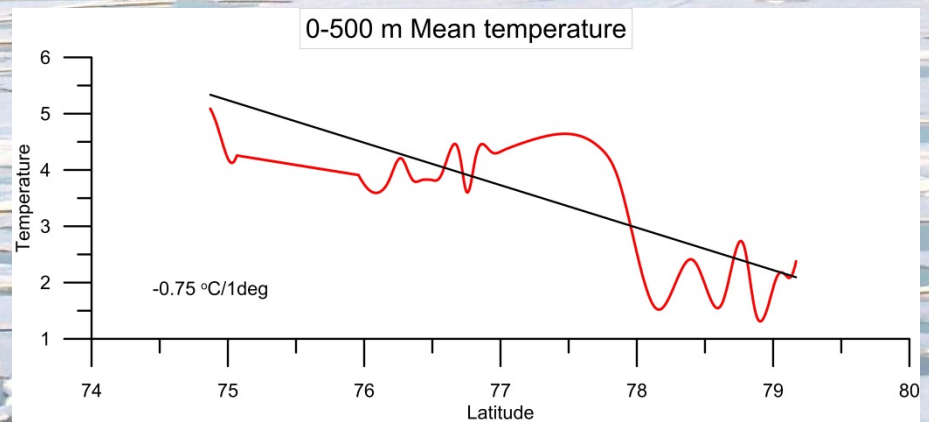
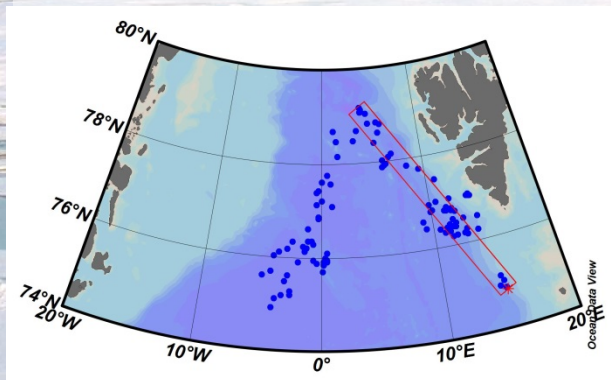
6900808
07.2009-01.2010

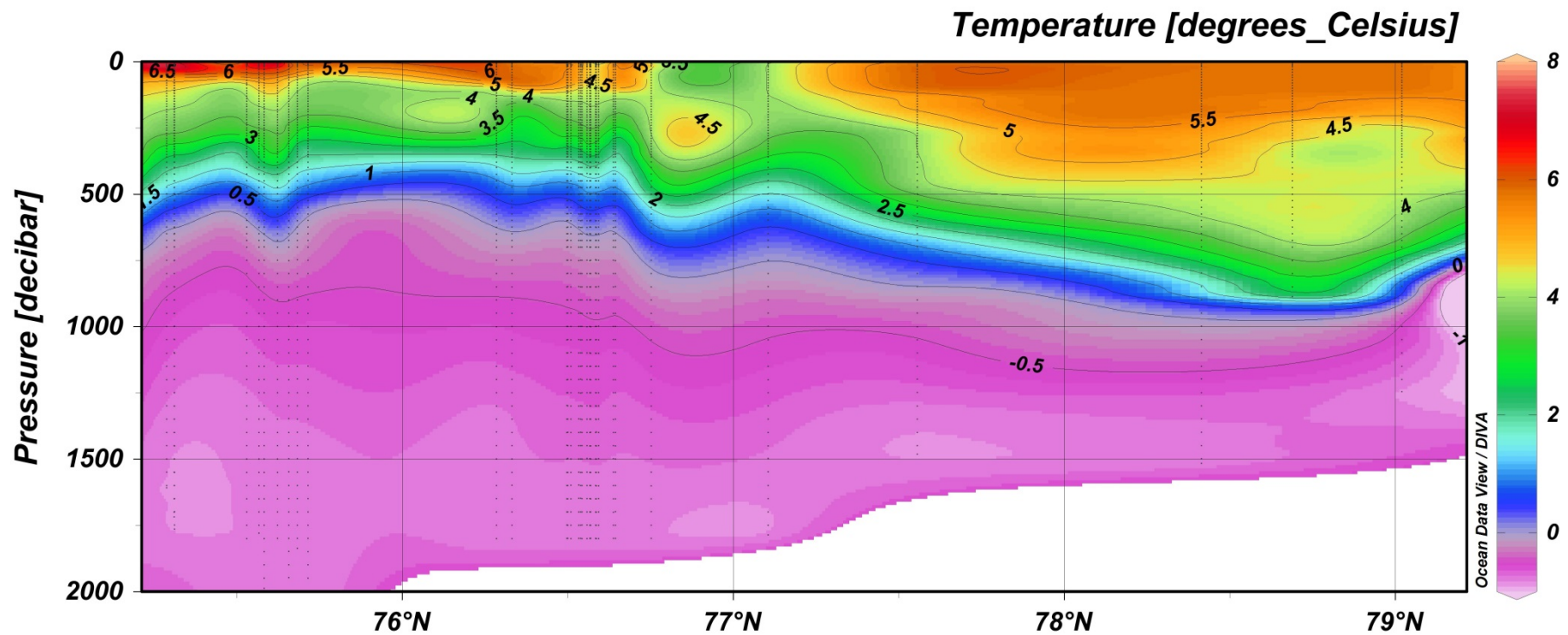




6901387

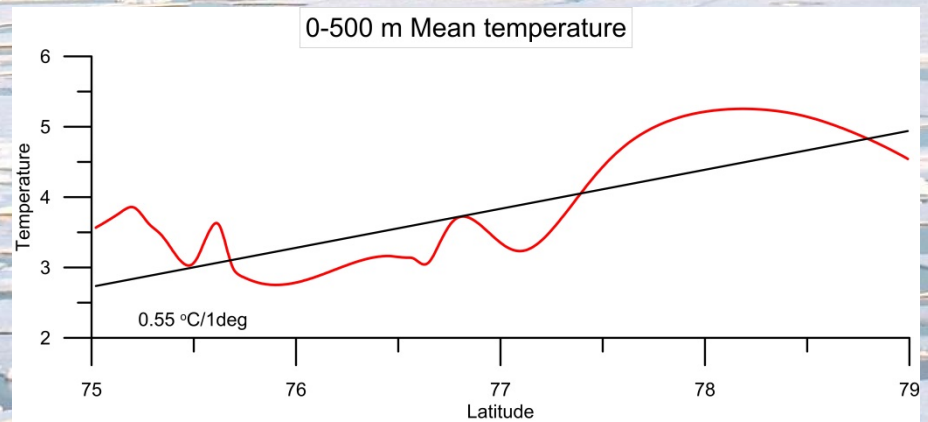
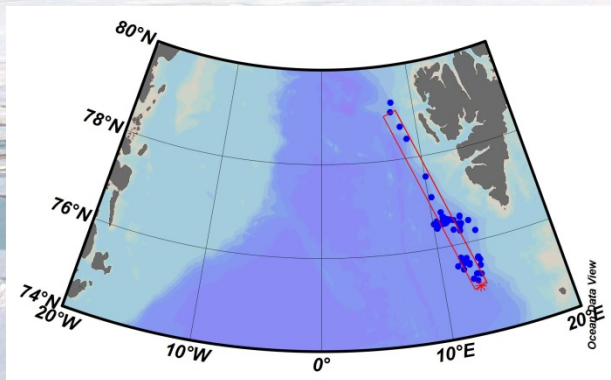
07.2010-01.2011





6901902

07.2012-12.2012



Conclusions

- *High variability of Atlantic Water (AW) properties is observed;*
- *Meaningful transformation of AW during northward flow occurs;*
- *Results from the Argo floats confirm calculations of the mean baroclinic currents and signal propagation velocity in the West Spitsbergen Current 2-3 cm/s*
- *In winter 2012-2013 the increasing of AW temperature in Fram Strait was registered by the ARGO float;*
- *Continuation of the Argo measurements in the Fram Strait and Arctic Ocean region is very important for understanding the AW transport processes*
- *Increasing of the floats deployment in the Arctic boundary current is necessary*

