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Changes of the Thermohaline Circulation of the Nordic Seas and Climate

Waldemar Walczowski, Jan Piechura
Institute of Oceanology Polish Academy of Sciences, Sopot

INSTITUTE OF OCEANOLOGY
POLISH ACADEMY OF SCIENCES

OUTLINE

Structure of the West Spitsbergen Current;

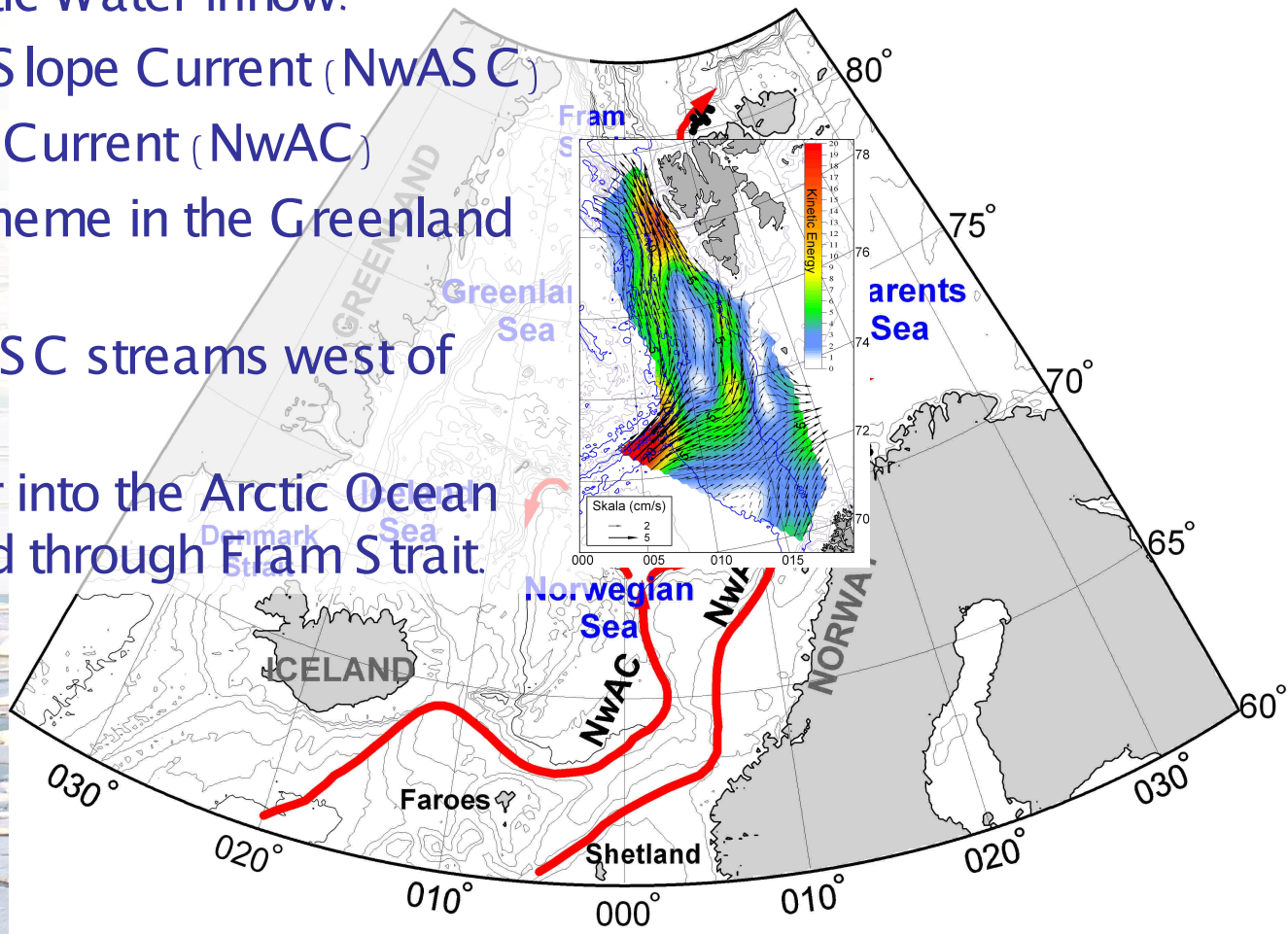
Variability of the WSC:

- Observed temporal variability of the AW properties;
- Volume and heat transports changes;
- Warming of the WSC;
- Spatial changes of the AW properties;
- Heat transport;

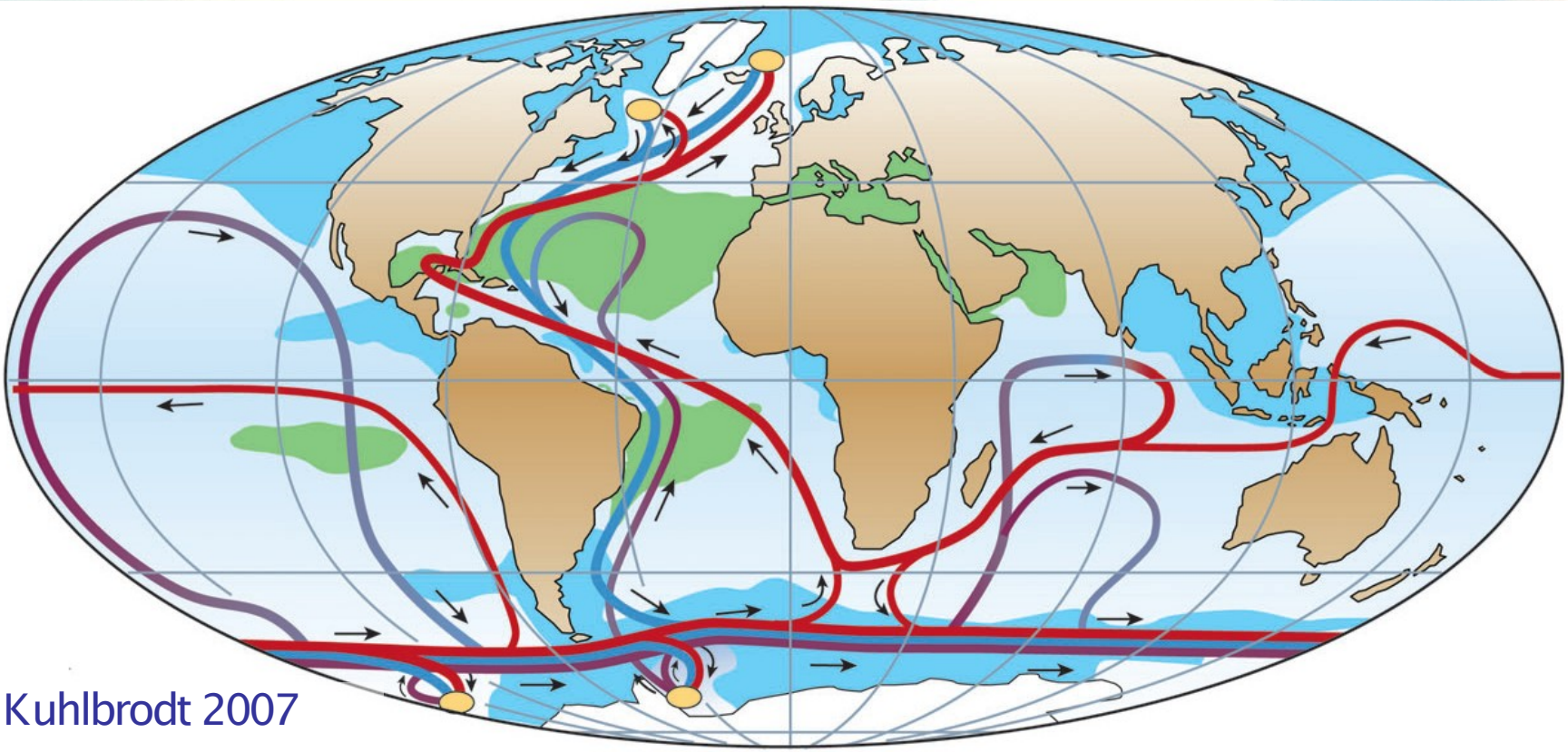
Conclusions.

STRUCTURE OF THE ATLANTIC WATER FLOW TRHOUGH THE NORDIC SEAS

- Two branches of Atlantic Water inflow:
  1. Norwegian Atlantic Slope Current (NwASC)
  2. Norwegian Atlantic Current (NwAC)
- Continuation of this scheme in the Greenland Sea
- Convergence of two WSC streams west of Spitsbergen
- Inflow of Atlantic Water into the Arctic Ocean via Barents Sea and through Fram Strait.

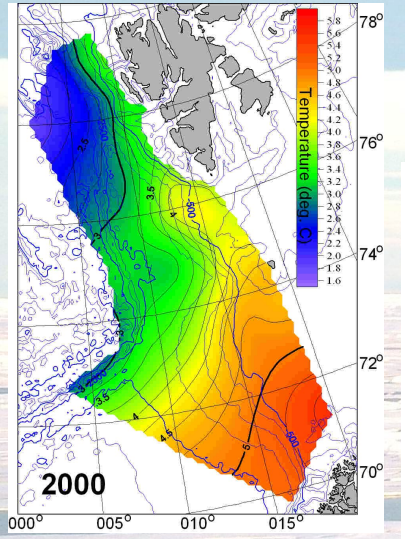


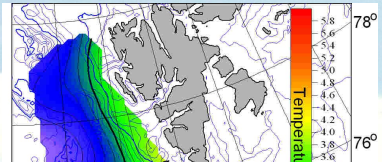
SCHEMATIC REPRESENTATION OF THE GLOBAL THERMOHALINE CIRCULATION

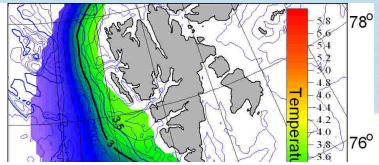


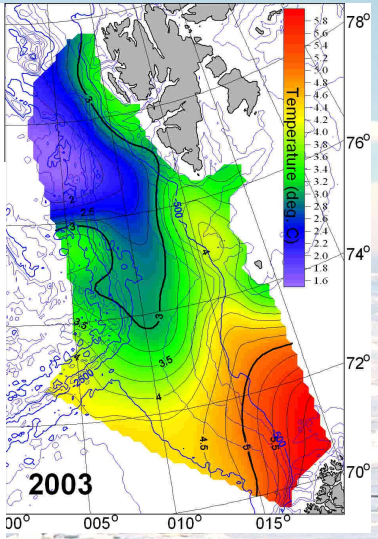
Kuhlbrodt 2007

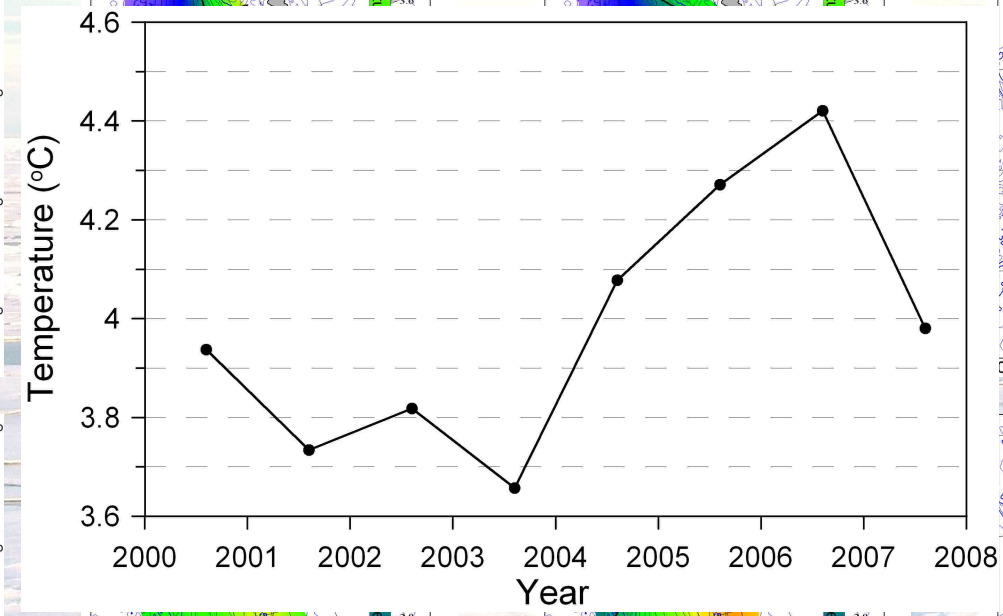
OBSERVED TEMPORAL (SUMMER-TO-SUNNMER) CHANGES of ATLANTIC WATER COLUMN TEMPERATURE

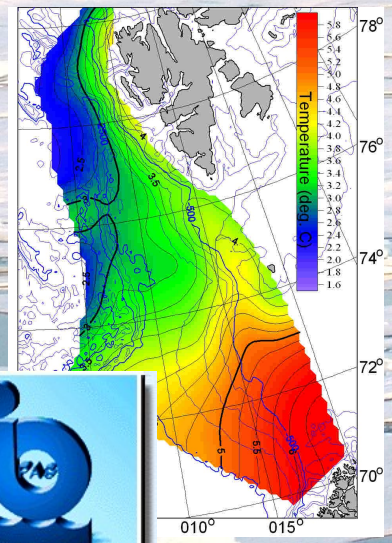


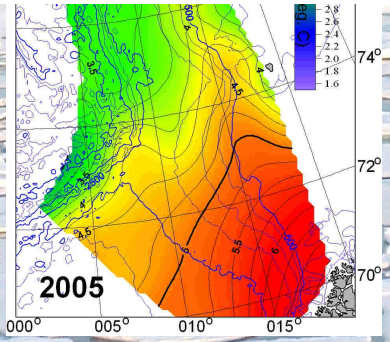


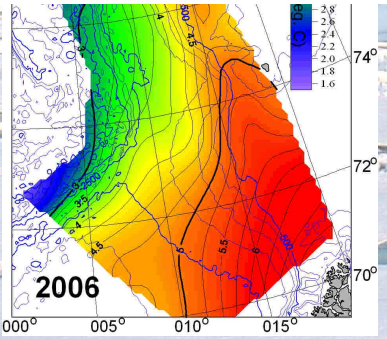


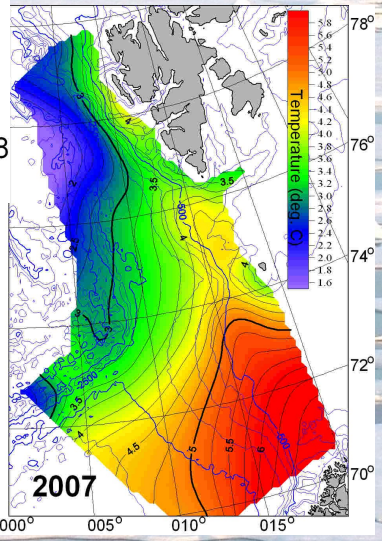




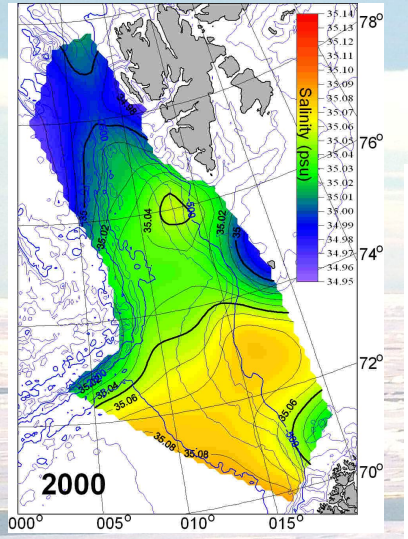


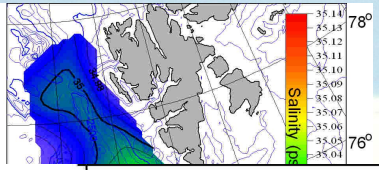


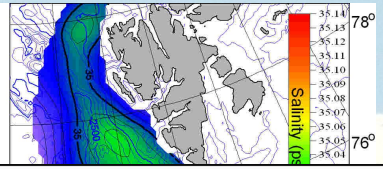


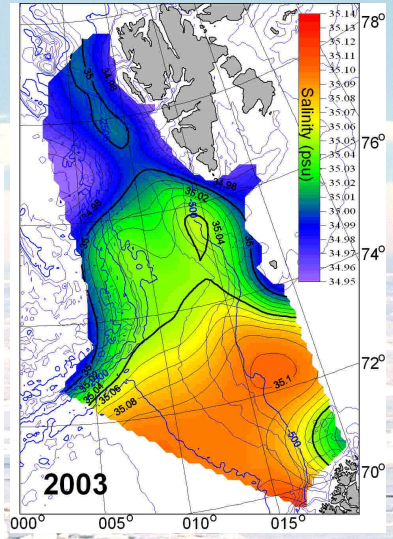


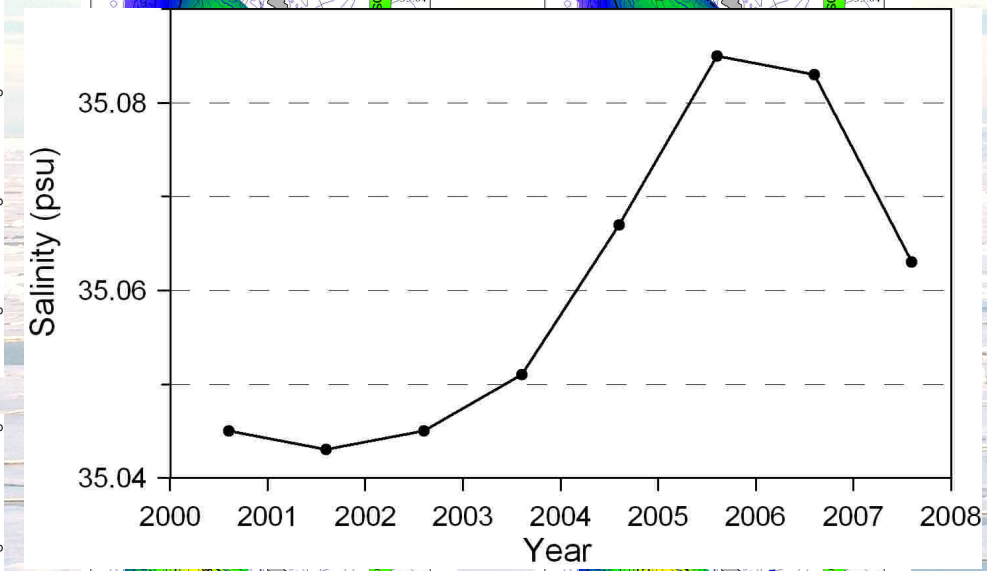
OBSERVED TEMPORAL (SUMMER-TO-SUNNMER) CHANGES AW COLUMN SALINITY

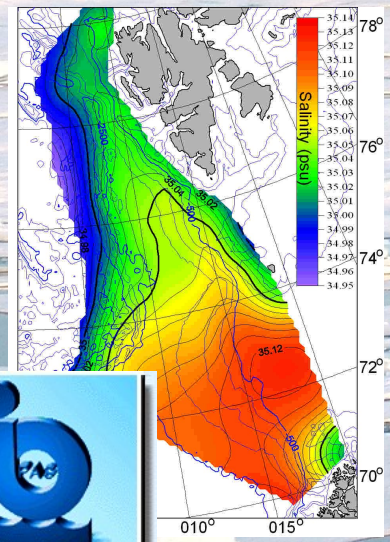


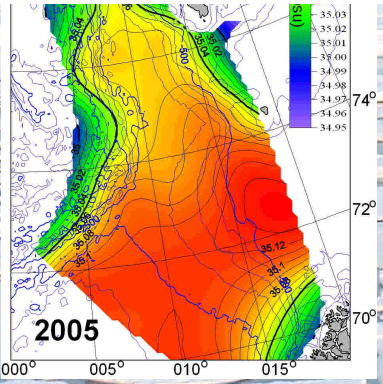


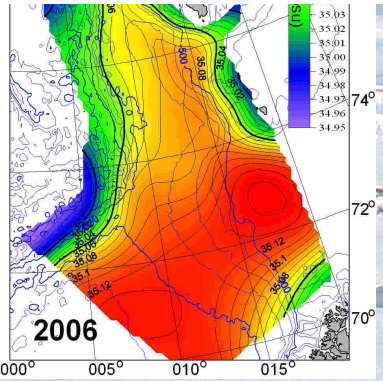


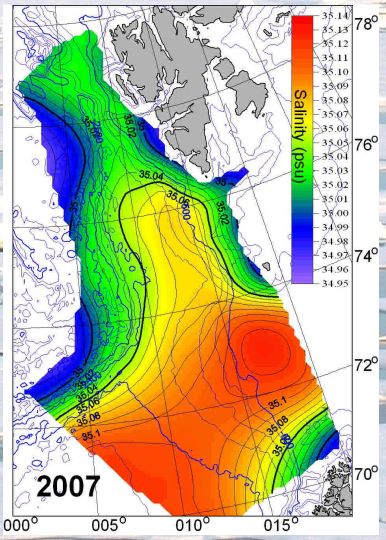




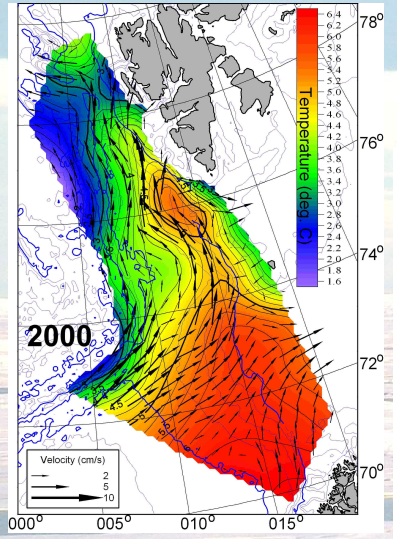


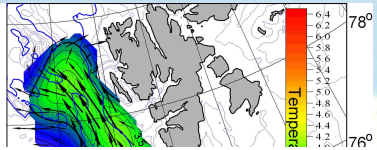


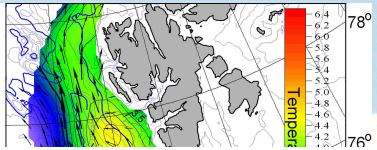


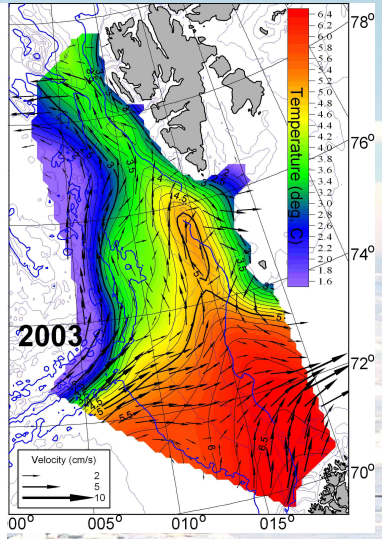


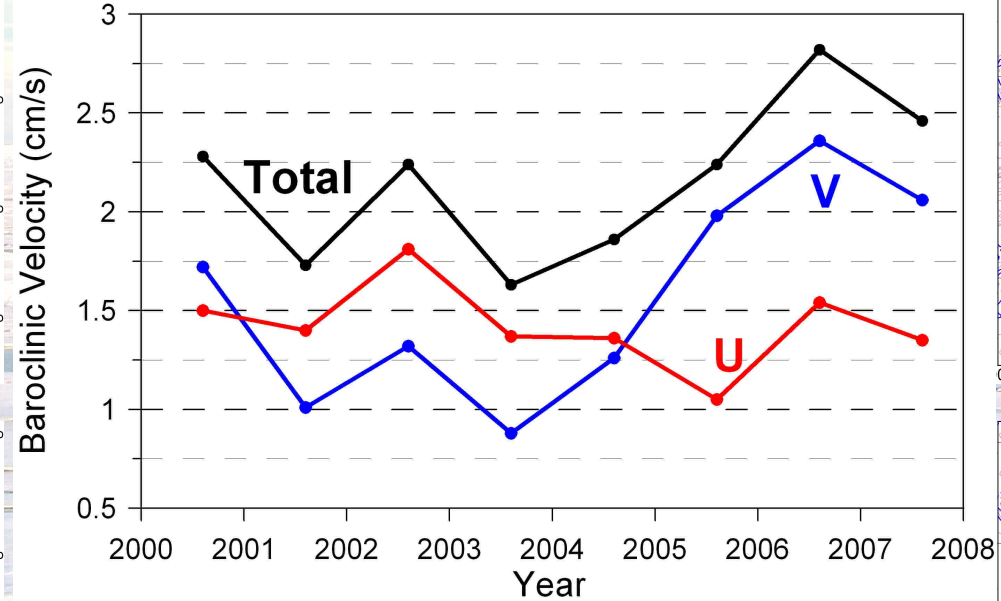
CHANGES of TEMPERATURE AND BAROCLINIC CURRENTS AT 100 dbar

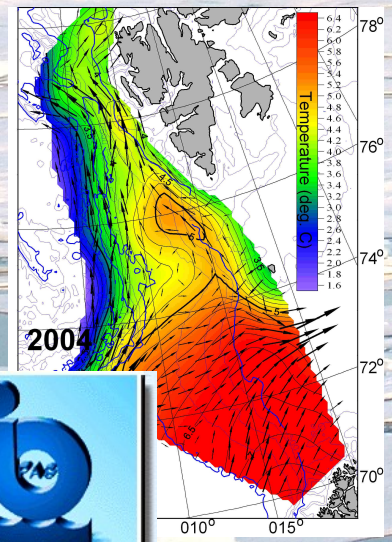


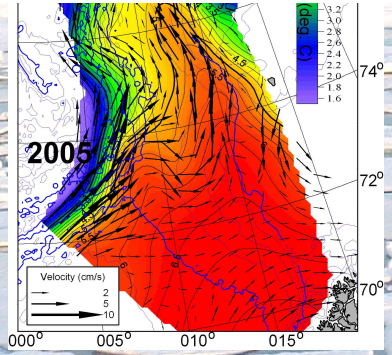


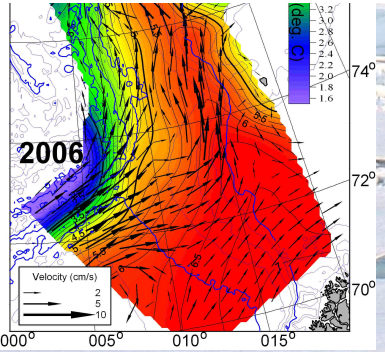


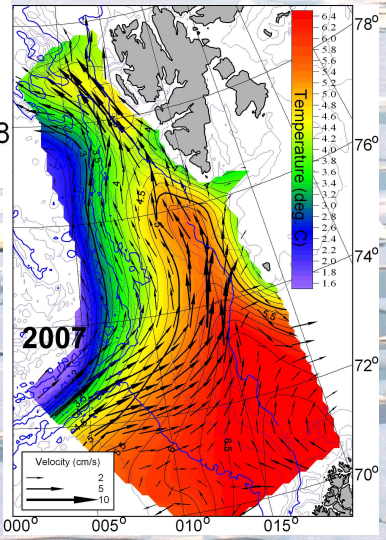




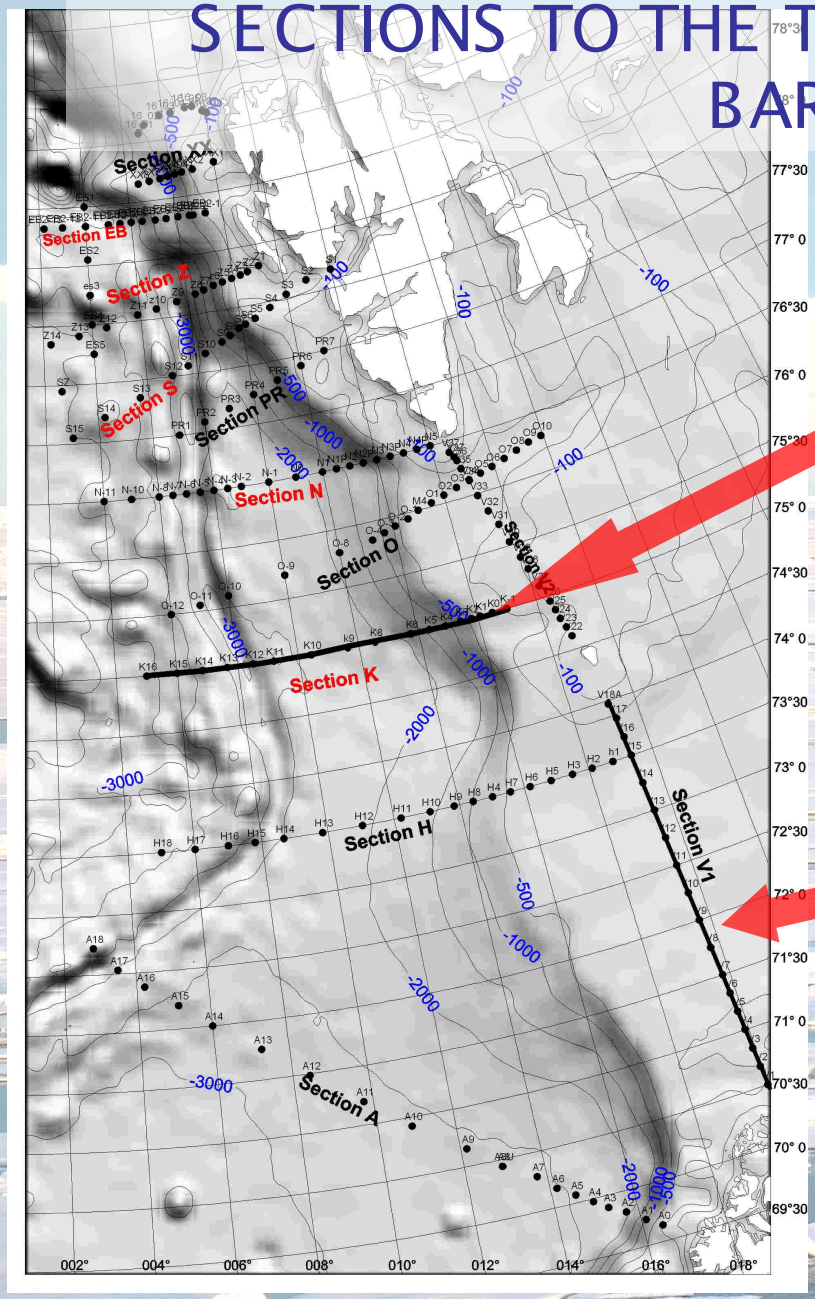


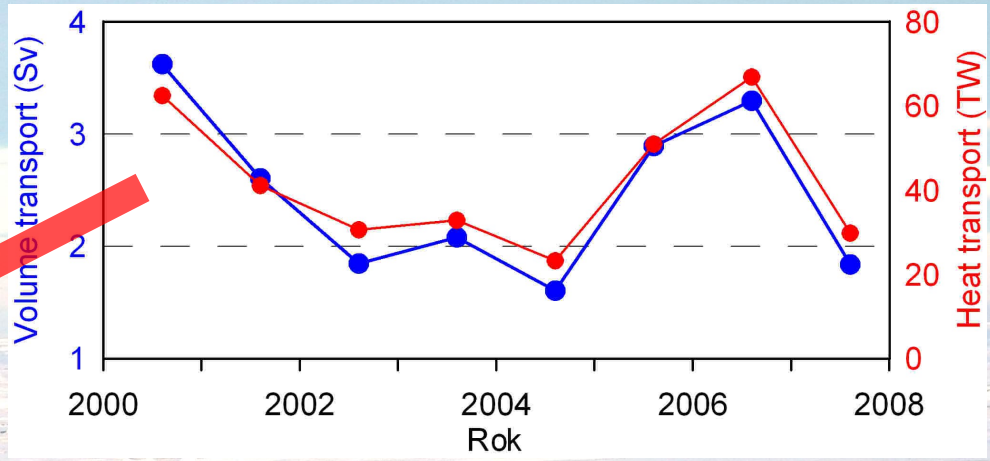


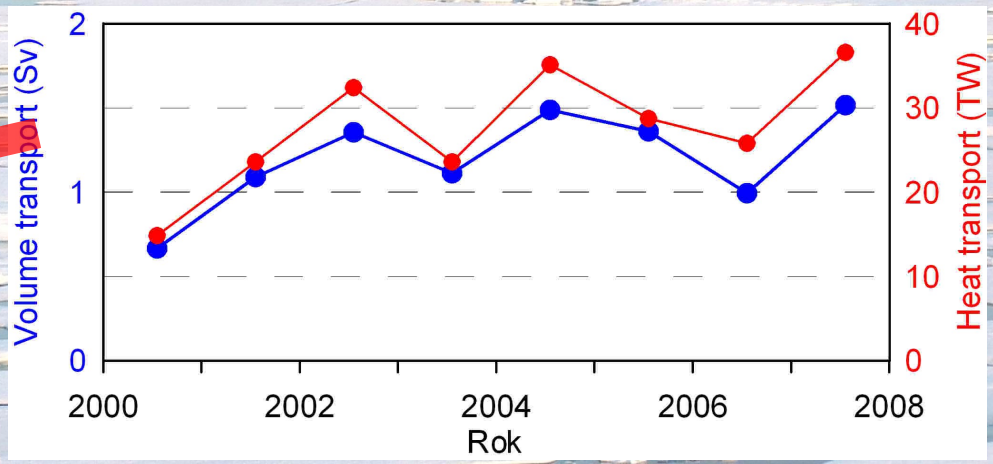




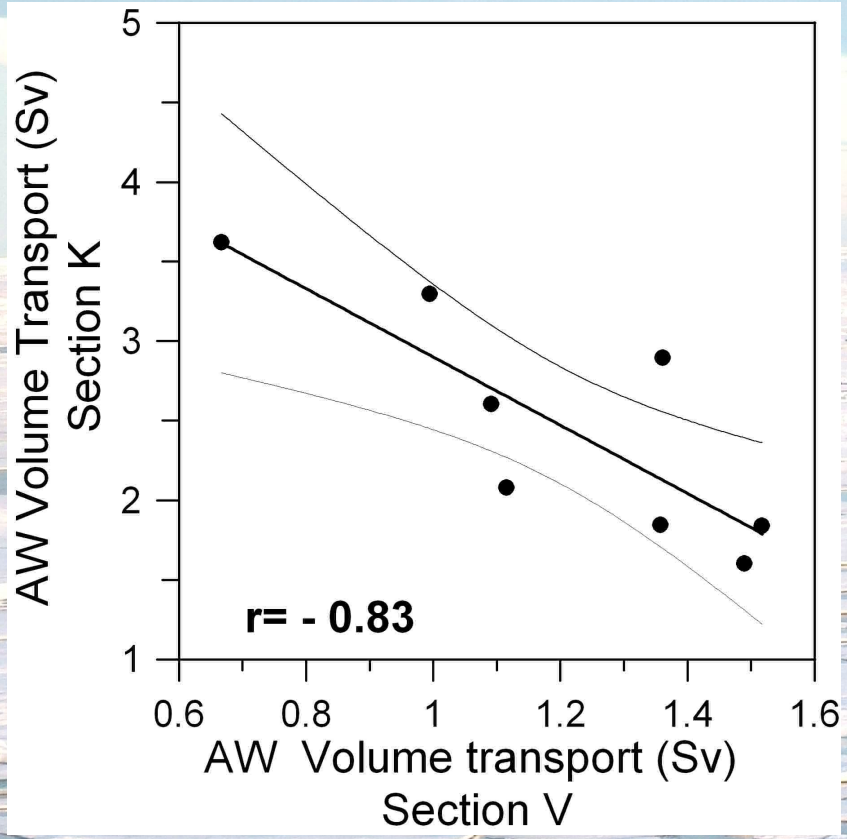
VOLUME AND HEAT TRANSPORT THROUGH SECTIONS TO THE TO THE ARCTIC OCEAN AND BARENTS SEA

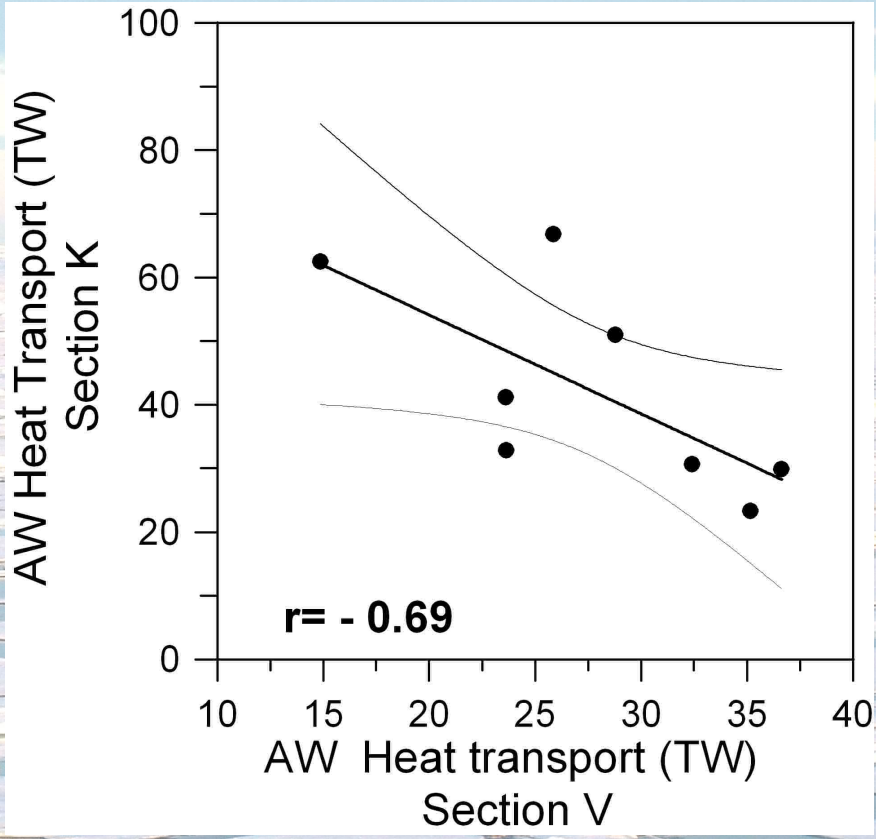






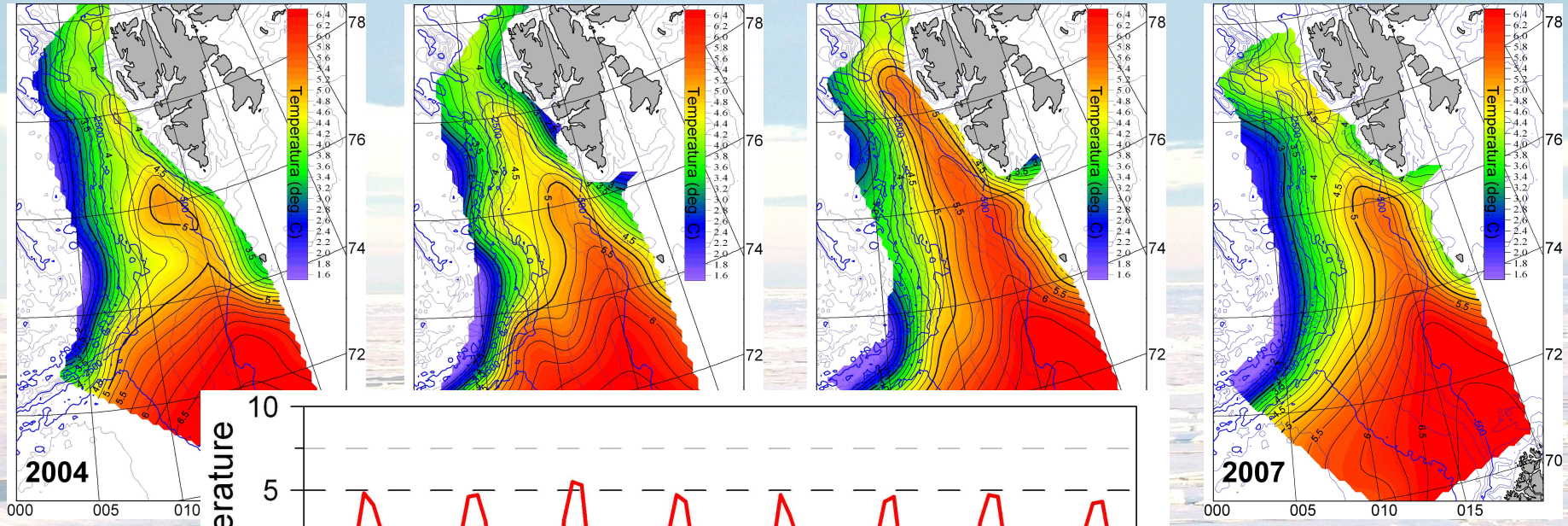
CORRELATIONS BETWEEN EASTWARD AND NORTHWARD VOLUME AND HEAT TRANSPORTS

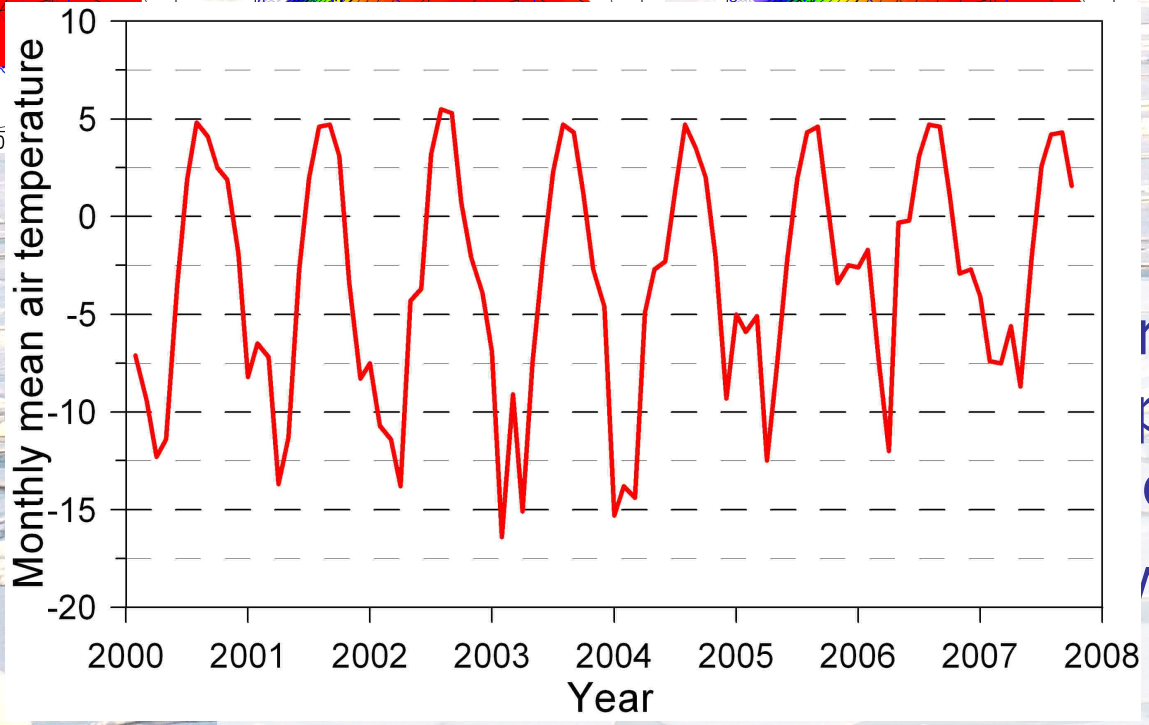




Confidence levels 95% marked

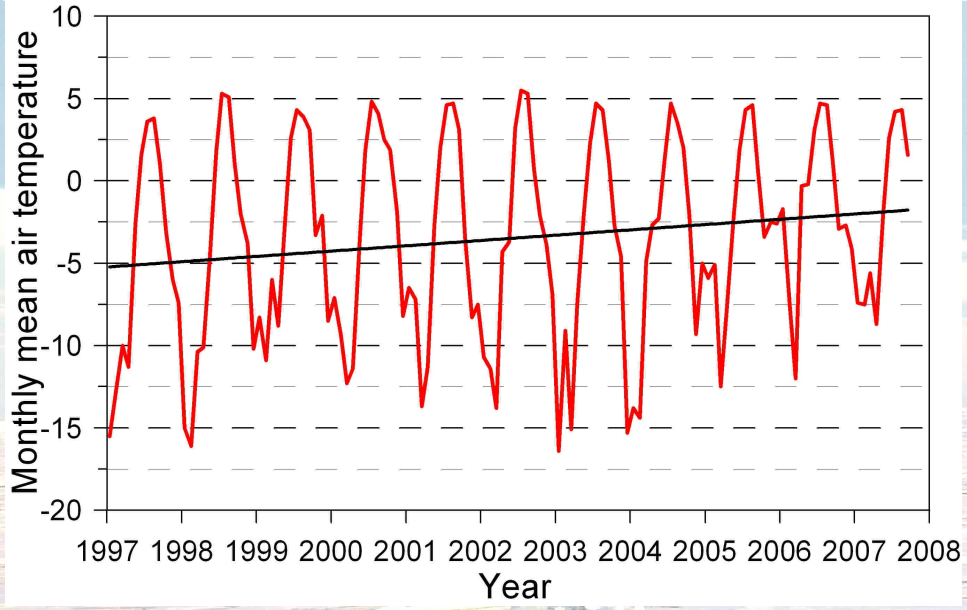
CHANGES OF TEMPERATURE AT 100 dbar.

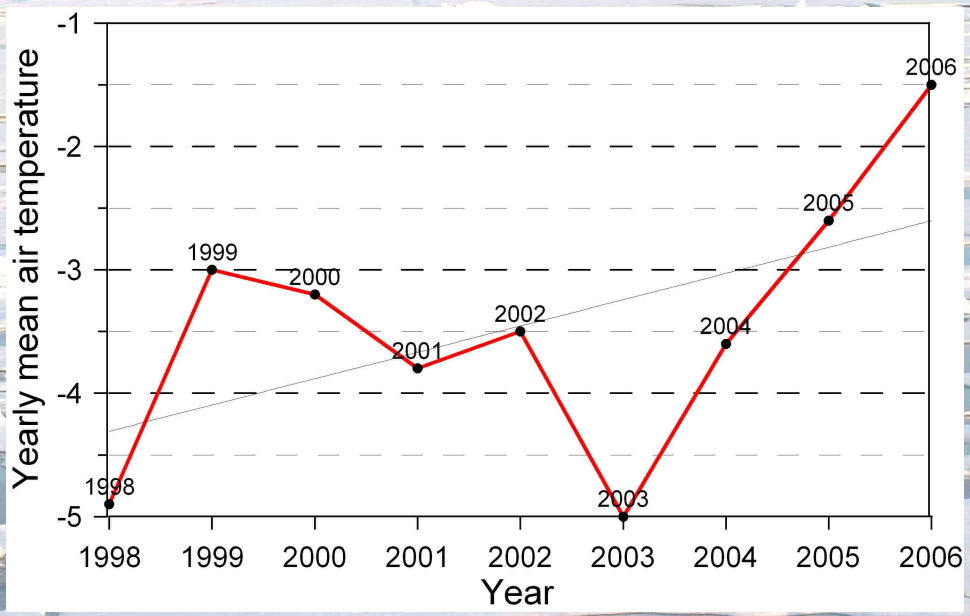




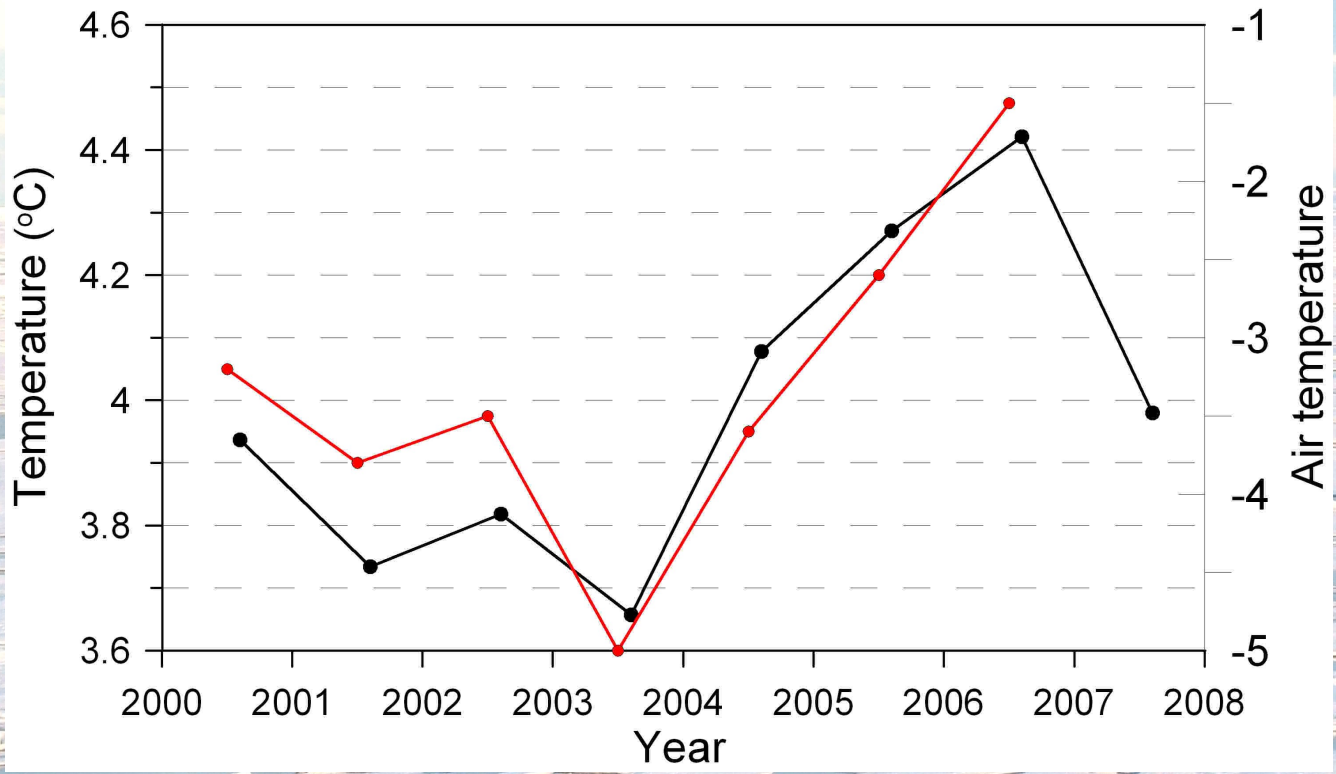
nsion of 5°C
perature and
creasing;
warm tongue;

CHANGES OF AIR TEMPERATURE IN HORNSUND.



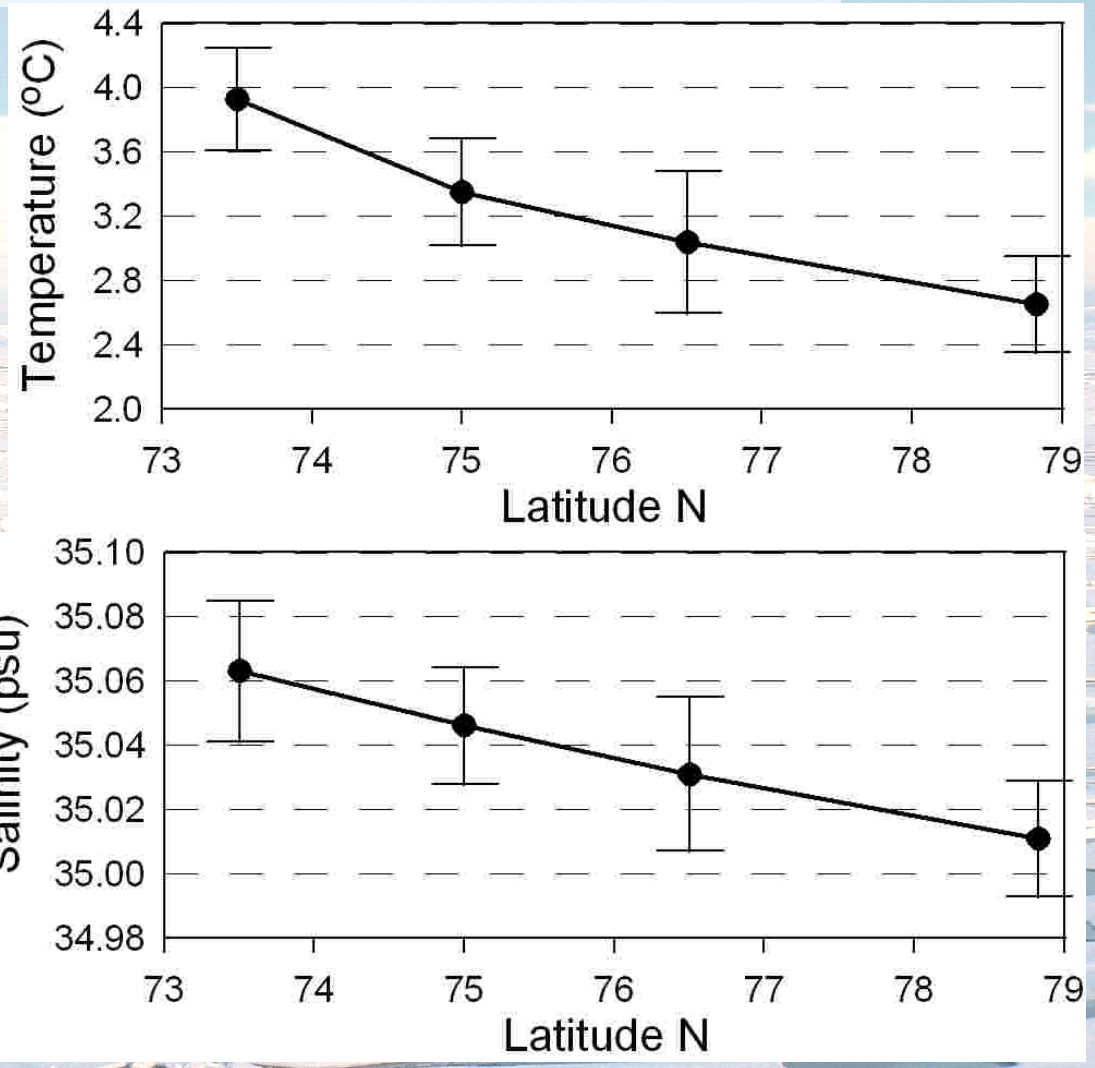


CHANGES OF ATLANTIC WATER TEMPERATURE AND YEARLY MEAN AIR TEMPERATURE IN HORNSUND.

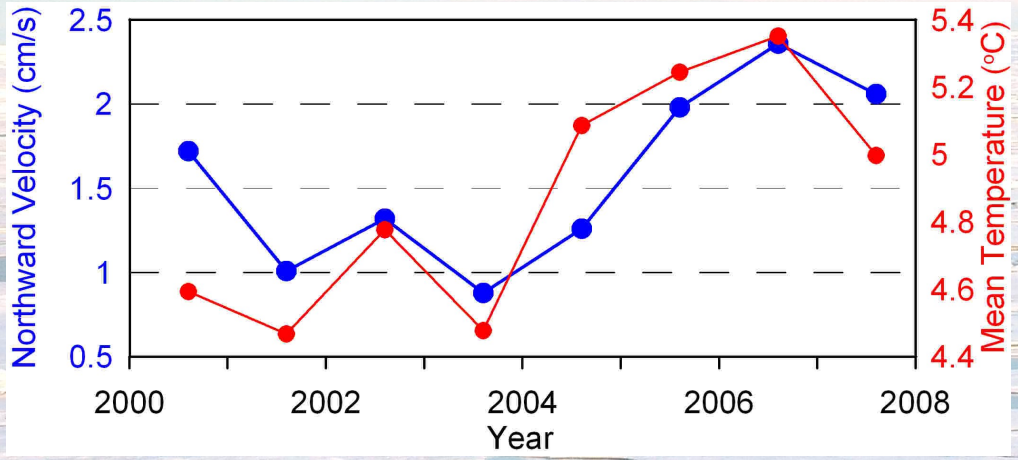


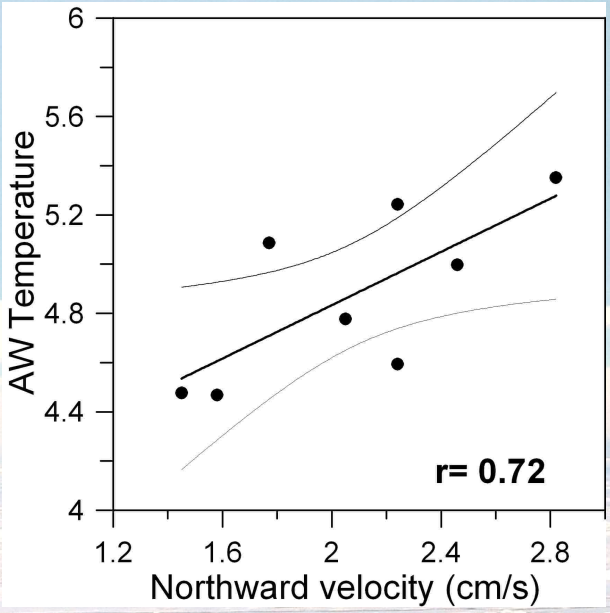
ZONAL CHANGES OF THE AW PROPERTIES
(mean summers 2000-2006)

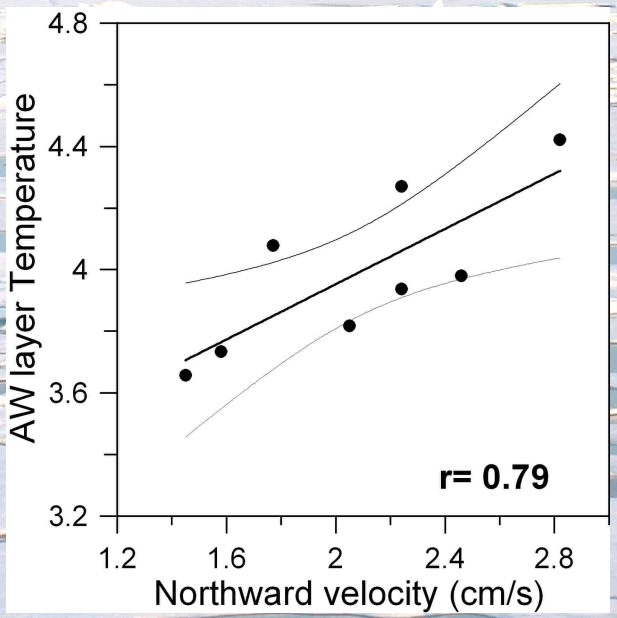
Meridional AW properties changes due to ocean – atmosphere heat exchange and lateral mixing



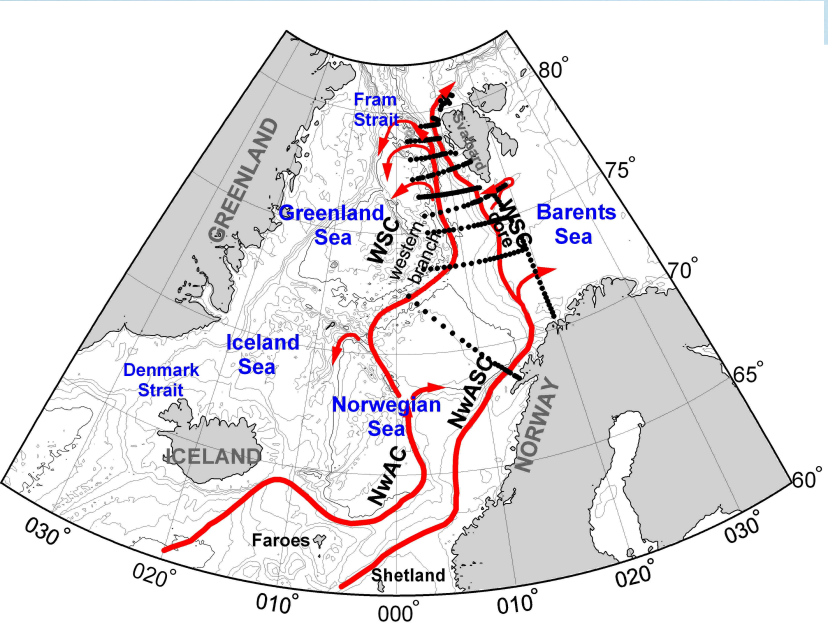
Northward baroclinic velocity and AW temperature at 100 dbar

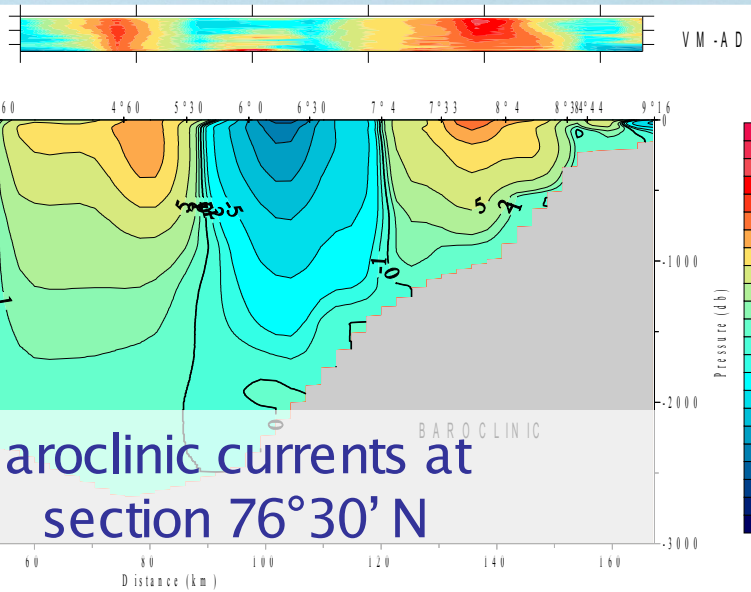




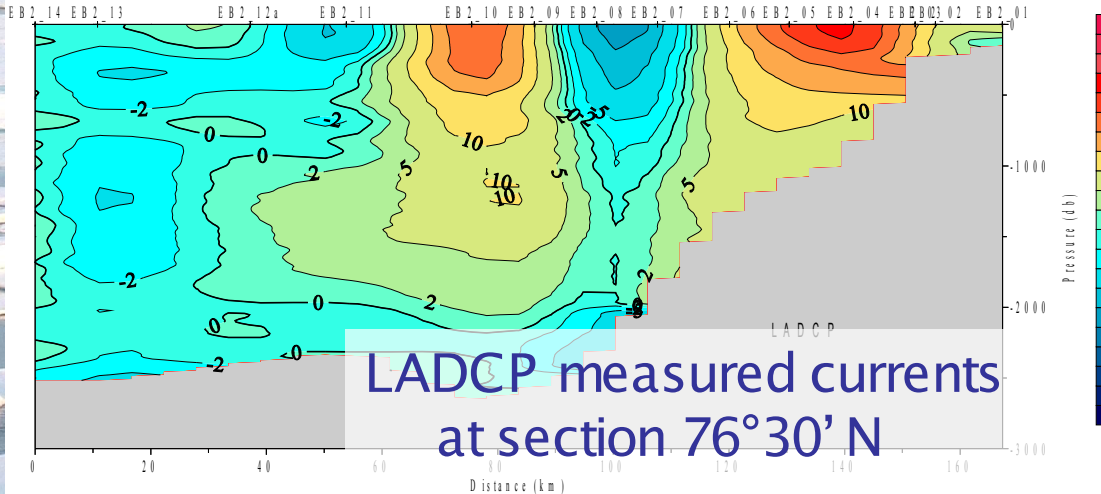


STRUCTURE OF THE ATLANTIC WATER FLOW TRHOUGH THE NORDIC SEAS



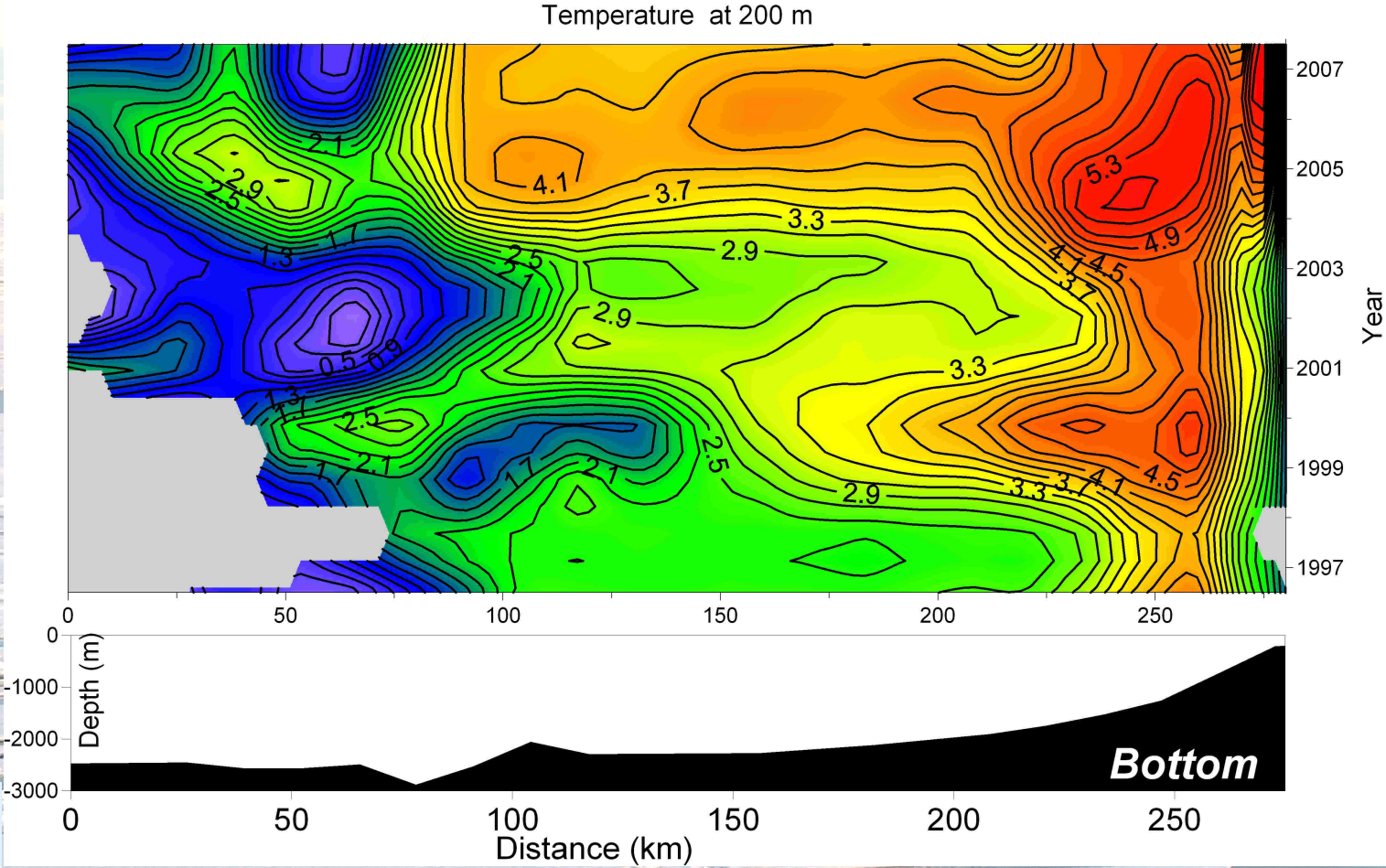


Baroclinic currents at section 76°30' N

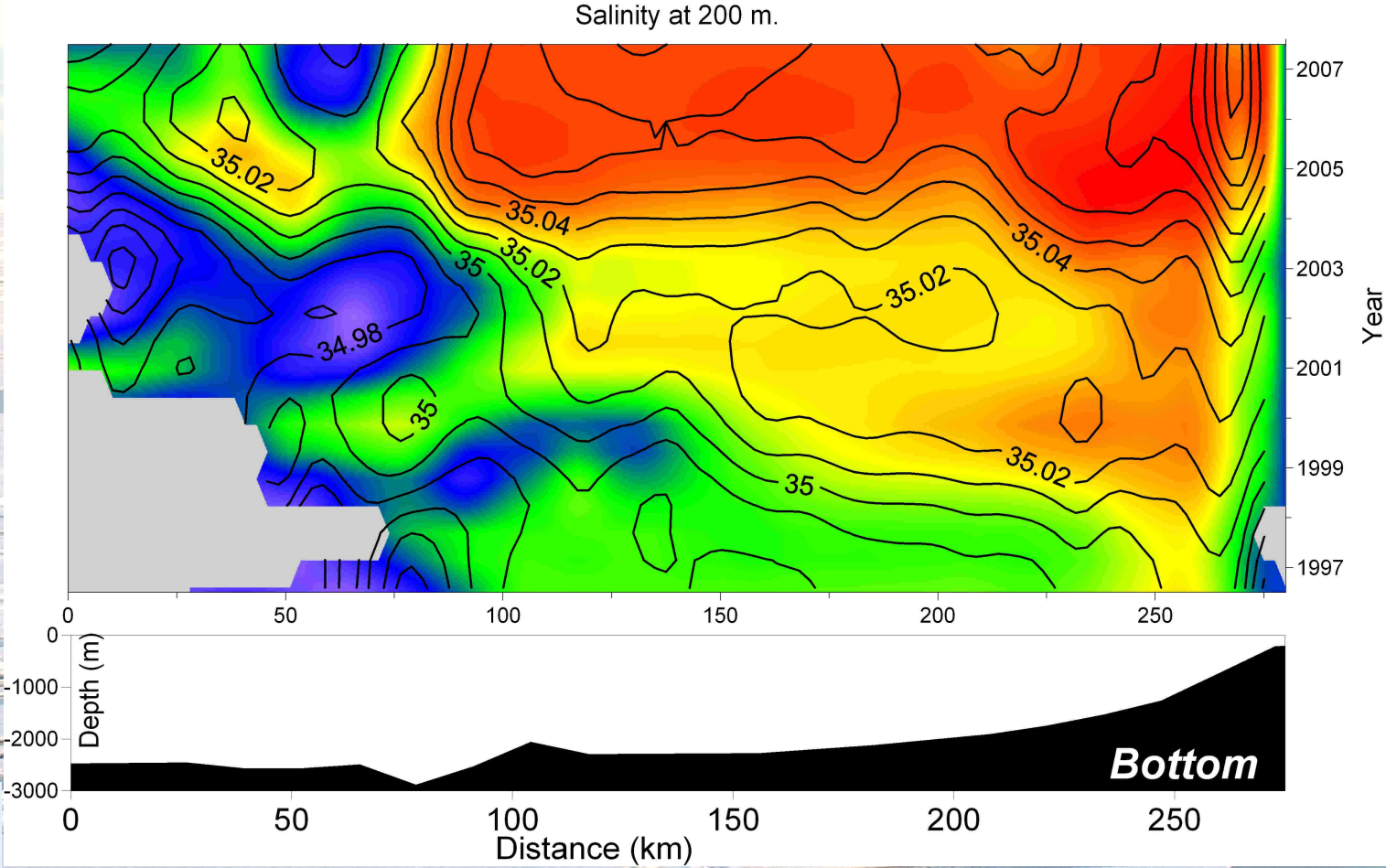


LADCP measured currents at section 76°30' N

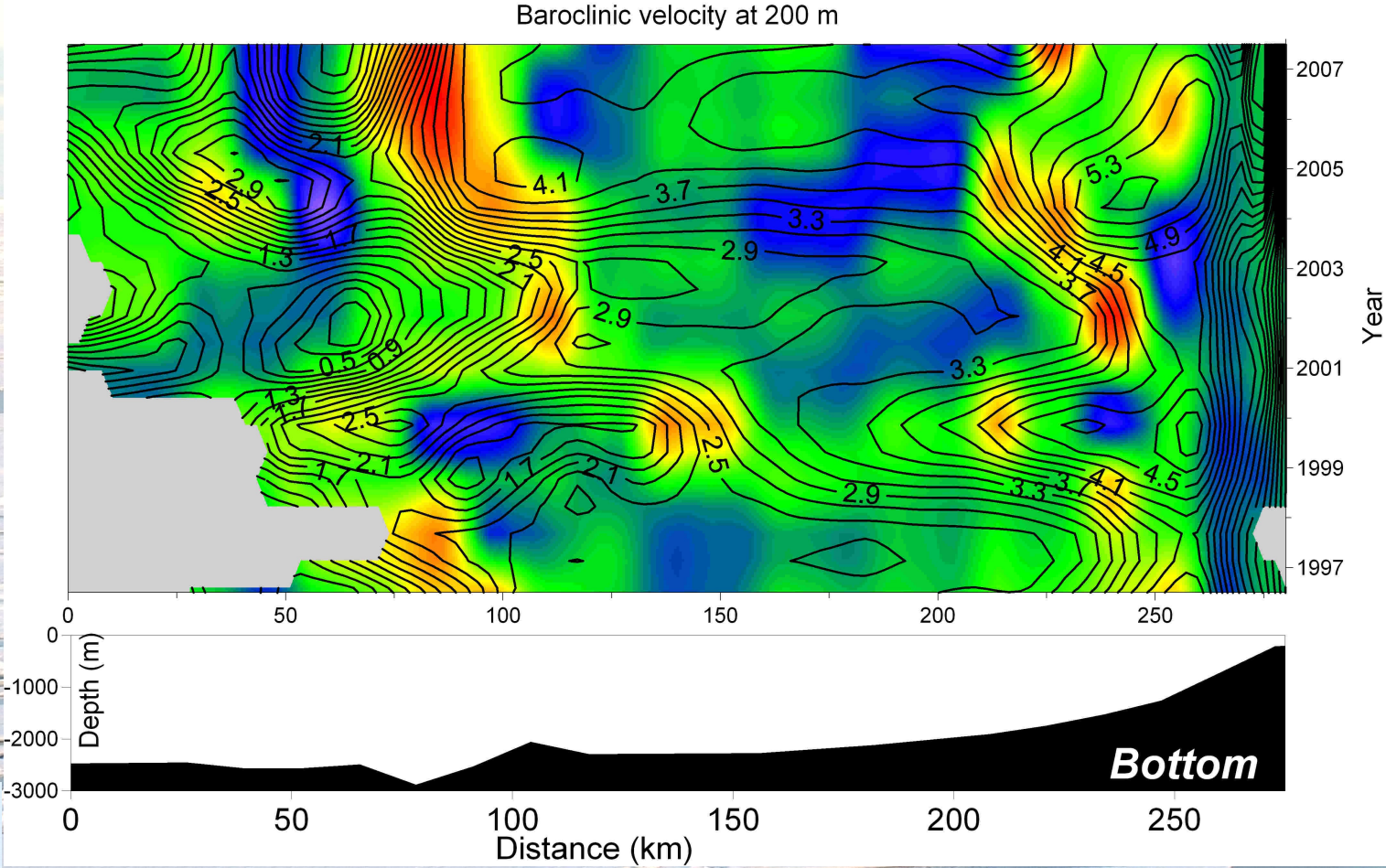
Section along 76º30' parallel, between 04ºE –15ºE. Hovmoeller plot of the temperature at 200 m 1996–2007.



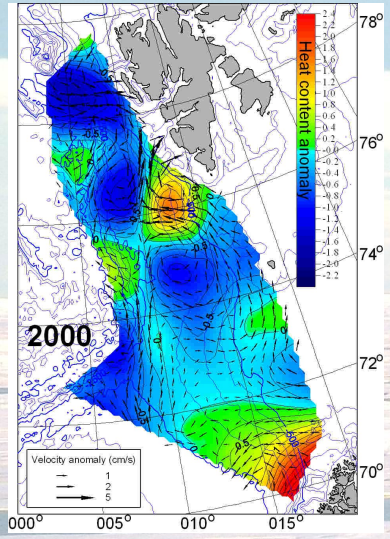
Section along 76º30' parallel, between 04ºE –15ºE. Hovmoeller plot of the salinity at 200 m 1996–2007.

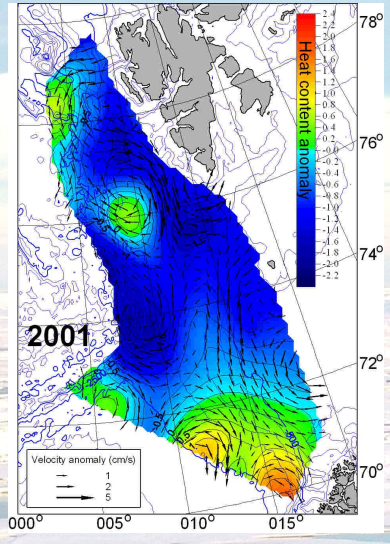


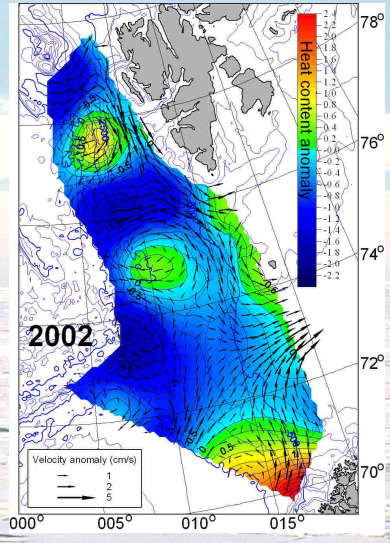
Section along 76°30' parallel, between 04°E –15°E. Hovmoeller plot of the baroclinic velocity at 200 m 1996–2007.

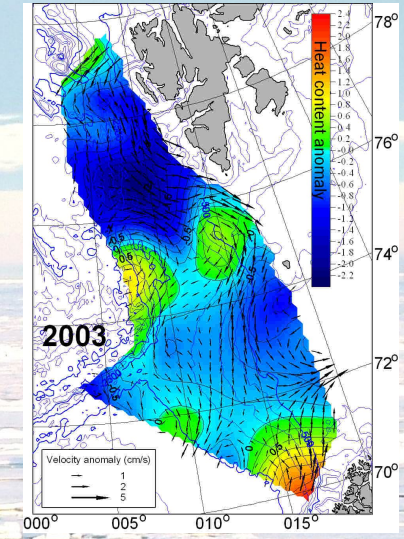


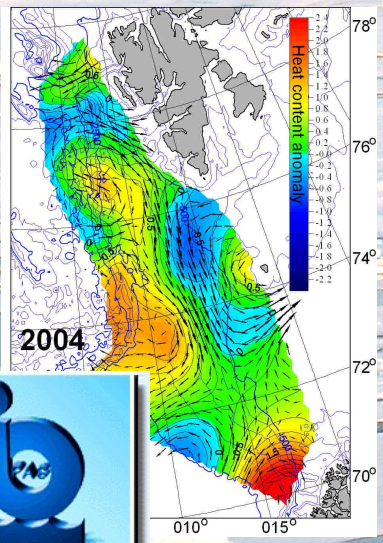
Summers 2000–2007 mean
Atlantic Water layer heat content anomalies and baroclinic currents anomalies

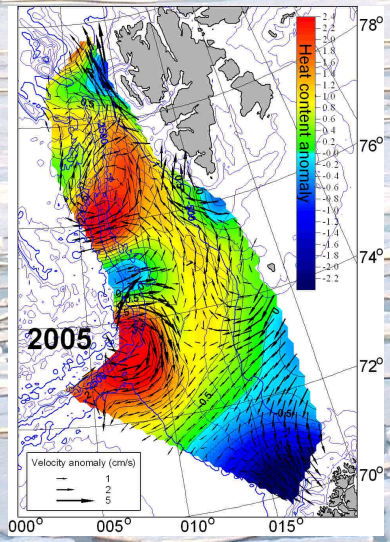


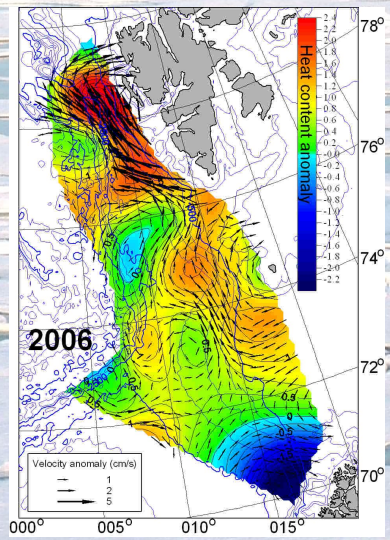


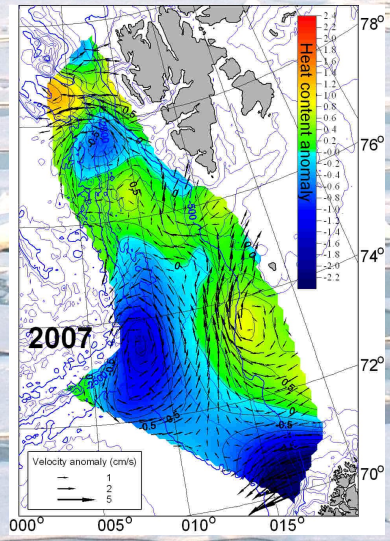






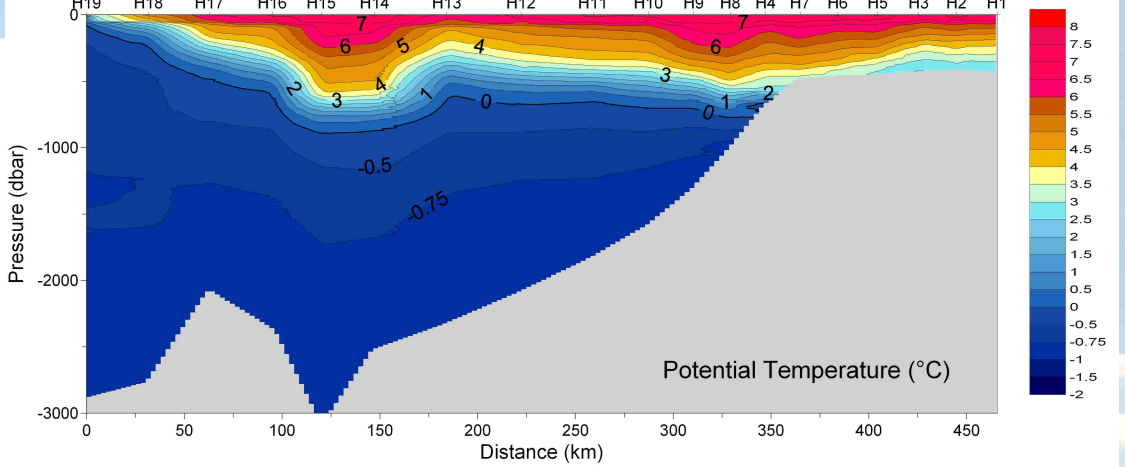


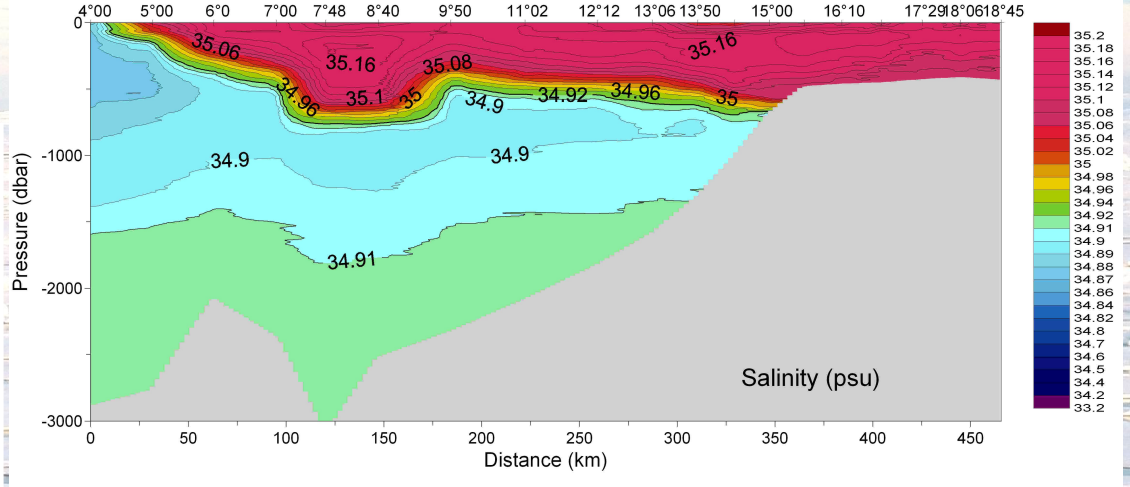


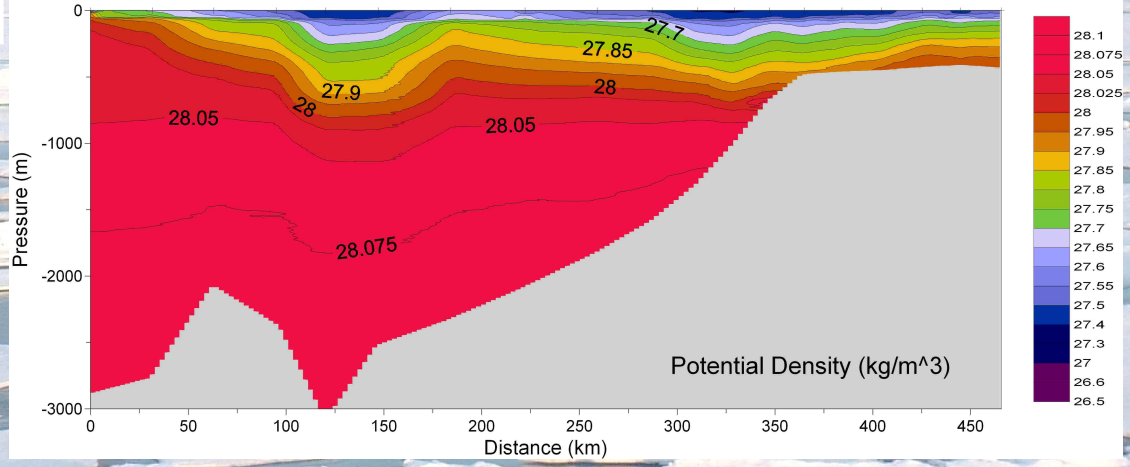


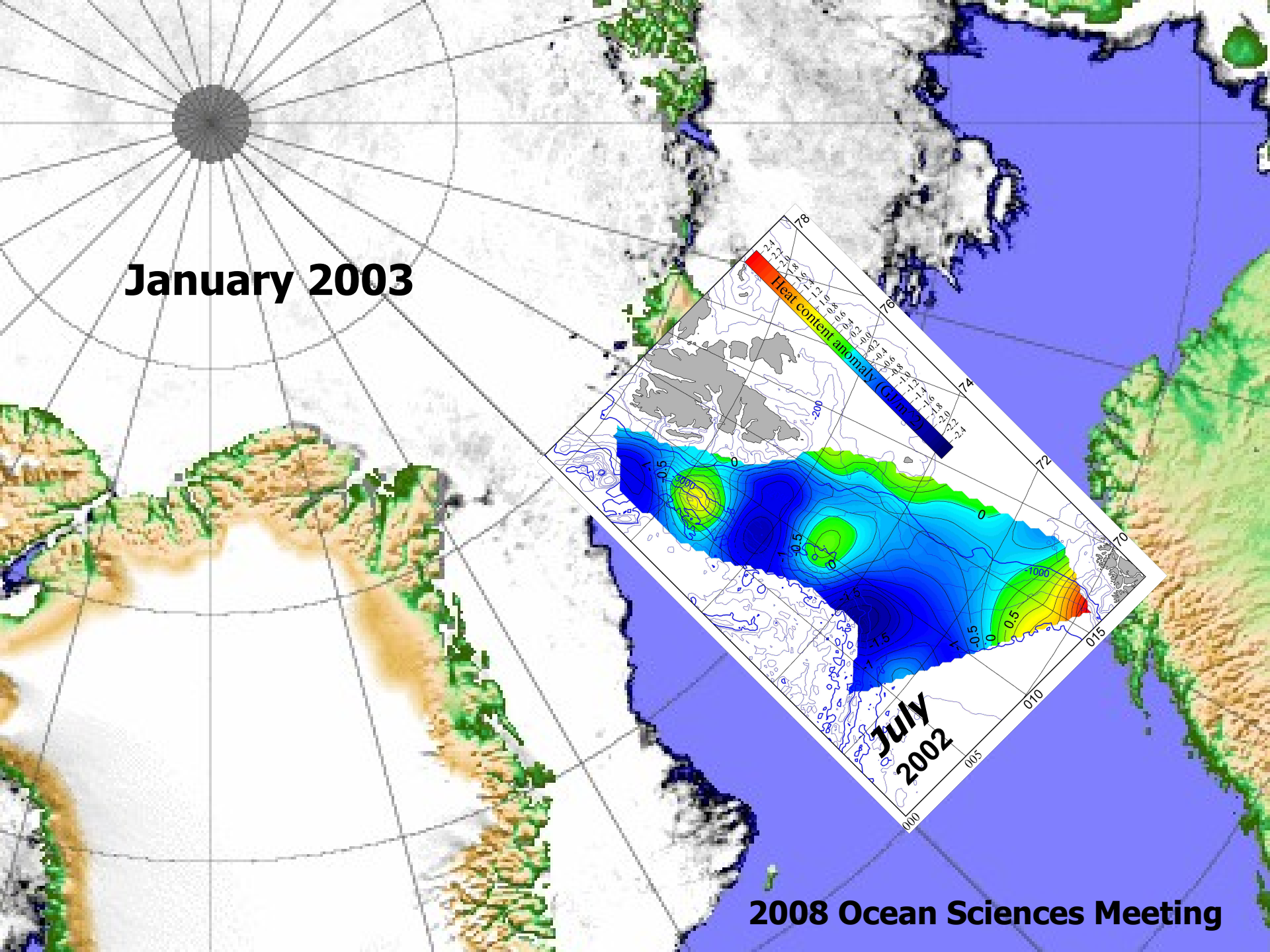
Summer 2005 Section along the 73°30' parallel

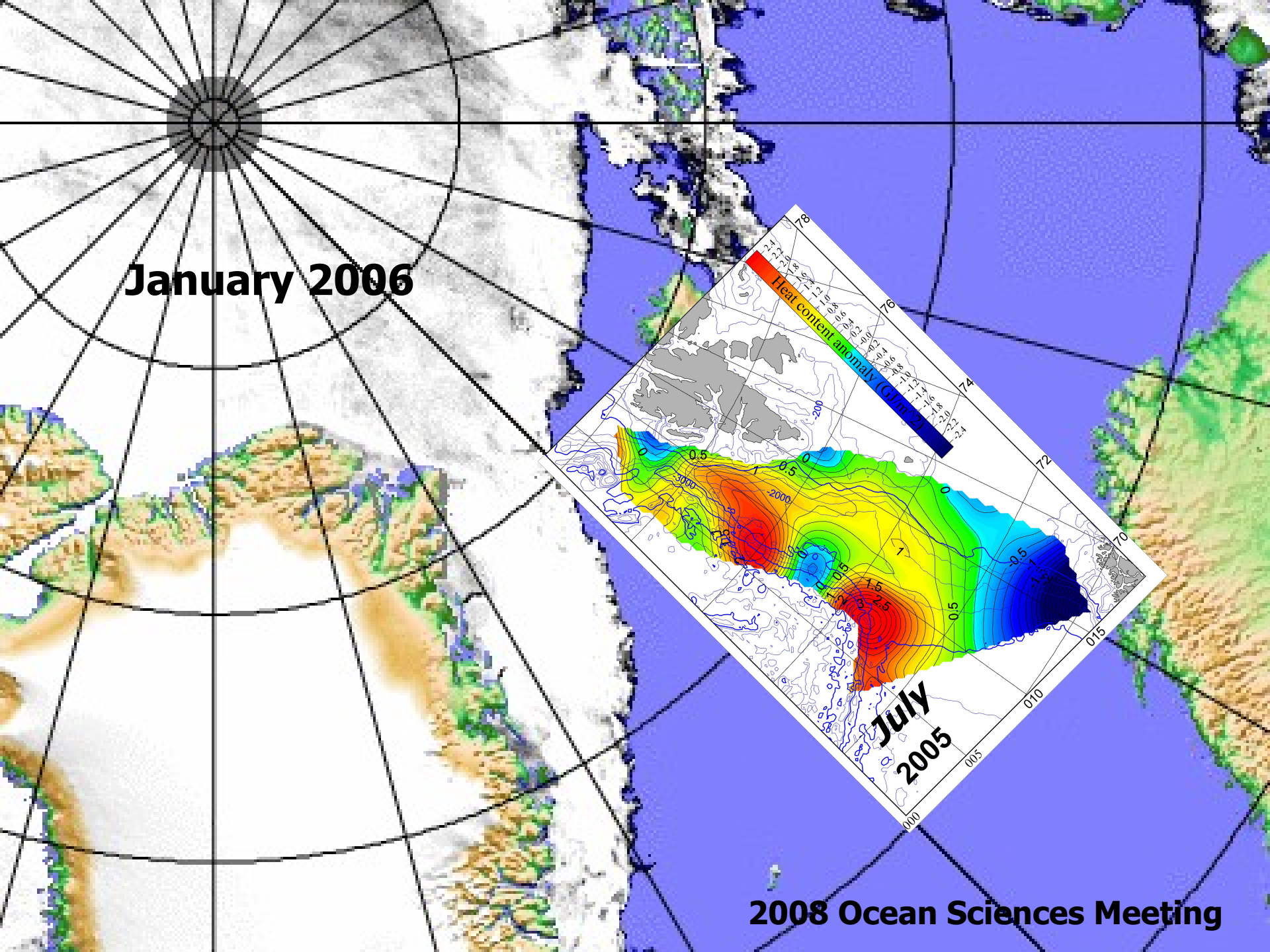
- Large (min 170 km diameter) anticyclonic eddy in the western branch of WSC
- Lowering of the AW layer min 250 m.








January 2003
Heat content anomaly (GJ/m^2)
July
2002
2008 Ocean Sciences Meeting


January 2006
Heat content anomaly (GJ/m^2)
July
2005
2008 Ocean Sciences Meeting

CONCLUSIONS

- Complex WSC structure ;
- Convergence of the WSC streams west of Spitsbergen, in the Fram Strait vicinity
- High temporal AW variability;
- Rapid warming of the WSC in 2004–2006 period;
- Cooling of the WSC in 2007;
- Advective nature of the observed warming;
- Negative correlations between northward and eastward volume and heat transports;
- Intensification of the western branch activity during warming;
- Important role of the huge baroclinic eddies in northward heat transport;
- Coincidence of the winter sea ice extend north of Svalbard with in the previous summer Atlantic Water temperature
- The end of the warming trend ?


Thank You