Changes of the Thermohaline Circulation of the Nordic Seas and Climate

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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 THROUGH 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-SUMMER) CHANGES of ATLANTIC WATER COLUMN TEMPERATURE
OBSERVED TEMPORAL (SUMMER-TO-SUMMER) CHANGES
AW COLUMN SALINITY
CHANGES of TEMPERATURE AND BAROCLINIC CURRENTS AT 100 dbar
VOLUME AND HEAT TRANSPORT THROUGH SECTIONS TO THE ARCTIC OCEAN AND BARENTS SEA
CORRELATIONS BETWEEN EASTWARD AND NORTHWARD VOLUME AND HEAT TRANSPORTS

Confidence levels 95% marked
2004 – 2006 Northward expansion of 5°C isoline mostly due to AW temperature and northward currents velocity increasing;

2007 Regression of the AW warm tongue;

The end of warming trend?
CHANGES OF AIR TEMPERATURE IN HORNUND.
CHANGES OF ATLANTIC WATER TEMPERATURE AND YEARLY MEAN AIR TEMPERATURE IN HORSUND.
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 THROUGH 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 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

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 the previous summer Atlantic Water temperature;
• The end of the warming trend?
Thank You