



Predicting the Climate of Europe: the THOR project

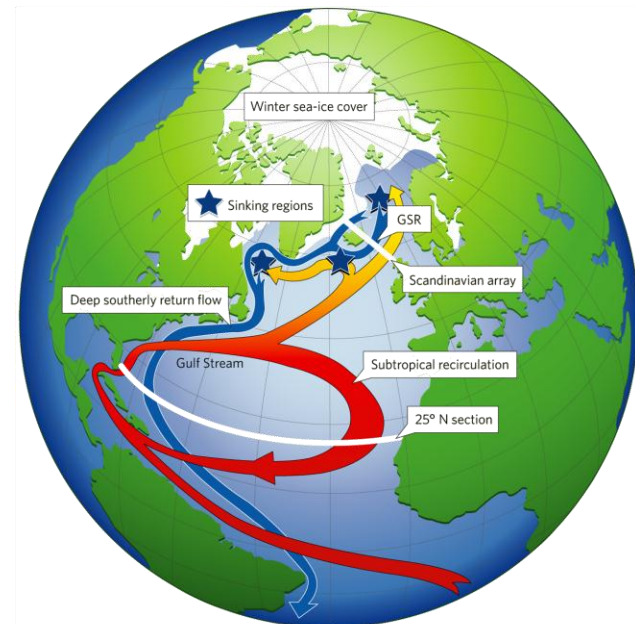
Laurent Mortier – University of Paris
for **Detlef Quadfasel (co-ordinator)** - University of Hamburg





THOR Goals

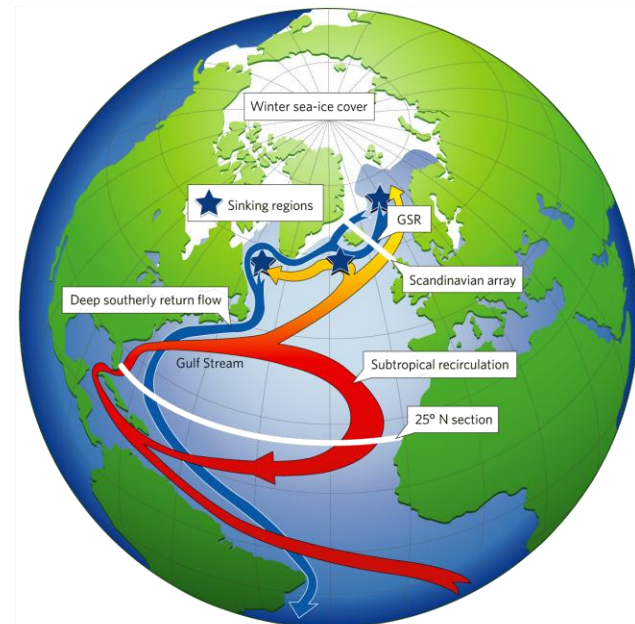
- Identify induced climate impacts of changes of the oceanic Thermohaline Circulation (THC) and the probability of extreme climate events
- Develop and operate an optimal ocean observing system for the North Atlantic component of the THC
- Assess the stability of the THC to increased freshwater run-off from the Greenland ice sheets for various global warming scenarios
- Forecast the Atlantic THC and its variability until 2025





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THOR: Thermohaline Overturning – at Risk?

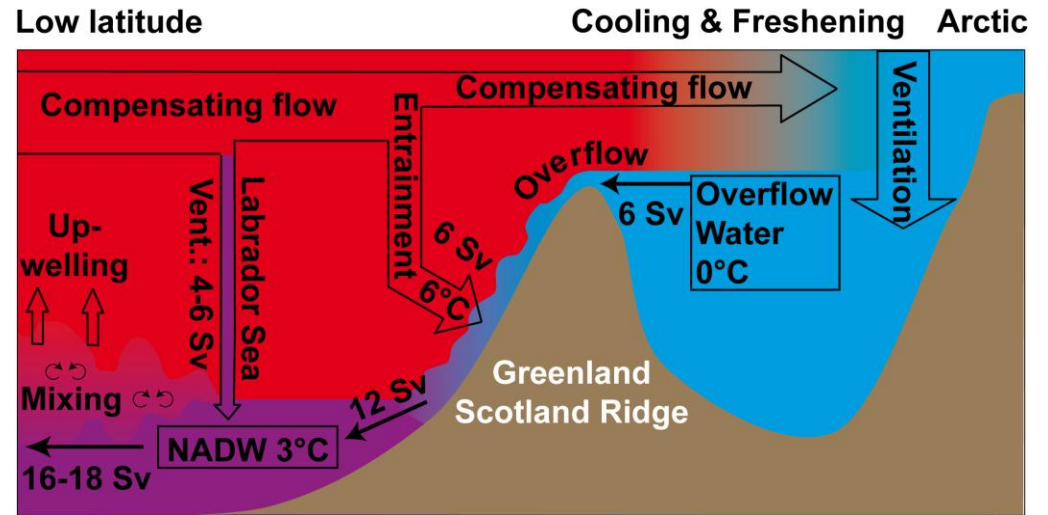
Facts and Figures

- **A FP7 Collaborative Project**
- **Research focus:** Stability of the ThermoHaline Circulation
- **Duration:** 4 years, December 2008 – November 2012
- **Number:** 20 participating institutions from 9 European countries
- **5 Core Themes**, around 60 Researchers
- **Project cost:** 12.95 million Euro
- **EU Funding:** 9.27 million Euro

Contact and data requests: THOR.EU@zmaw.de <http://www.eu-thor.eu/>



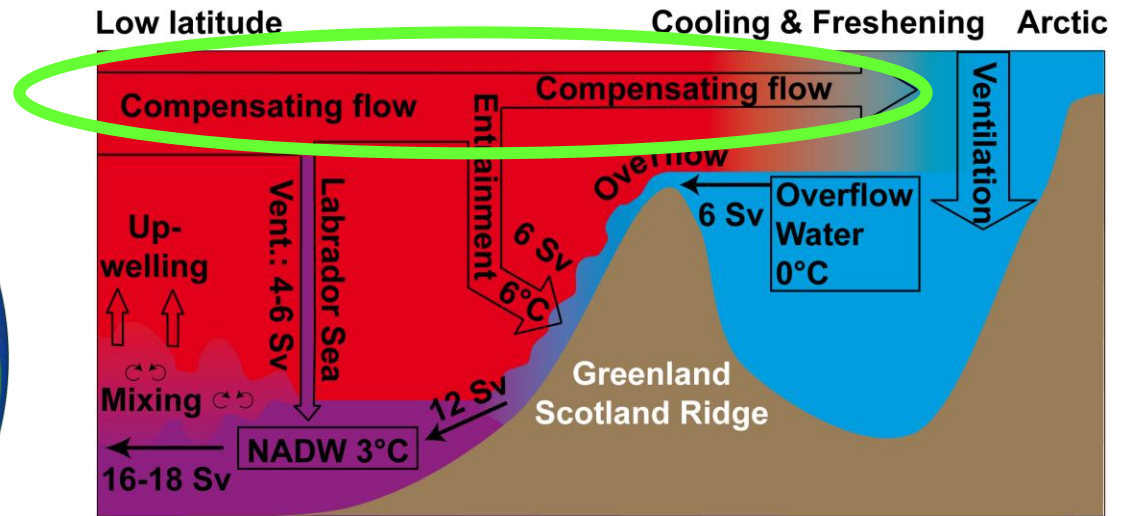
Atlantic Meridional Overturning Circulation



*Sinking at high latitudes
 Mixing in the interior
 Southern Ocean upwelling*



Atlantic Meridional Overturning Circulation

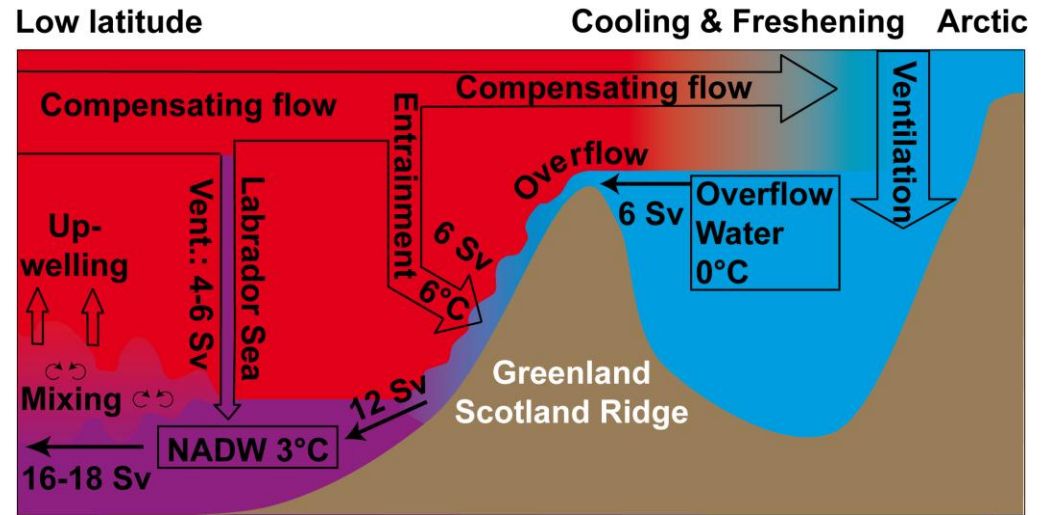


*Sinking at high latitudes
Mixing in the interior
Southern Ocean upwelling*

The compensating flow of warm water bring heat to northern Europe and keeps the eastern Nordic Seas free of ice.



Atlantic Meridional Overturning Circulation



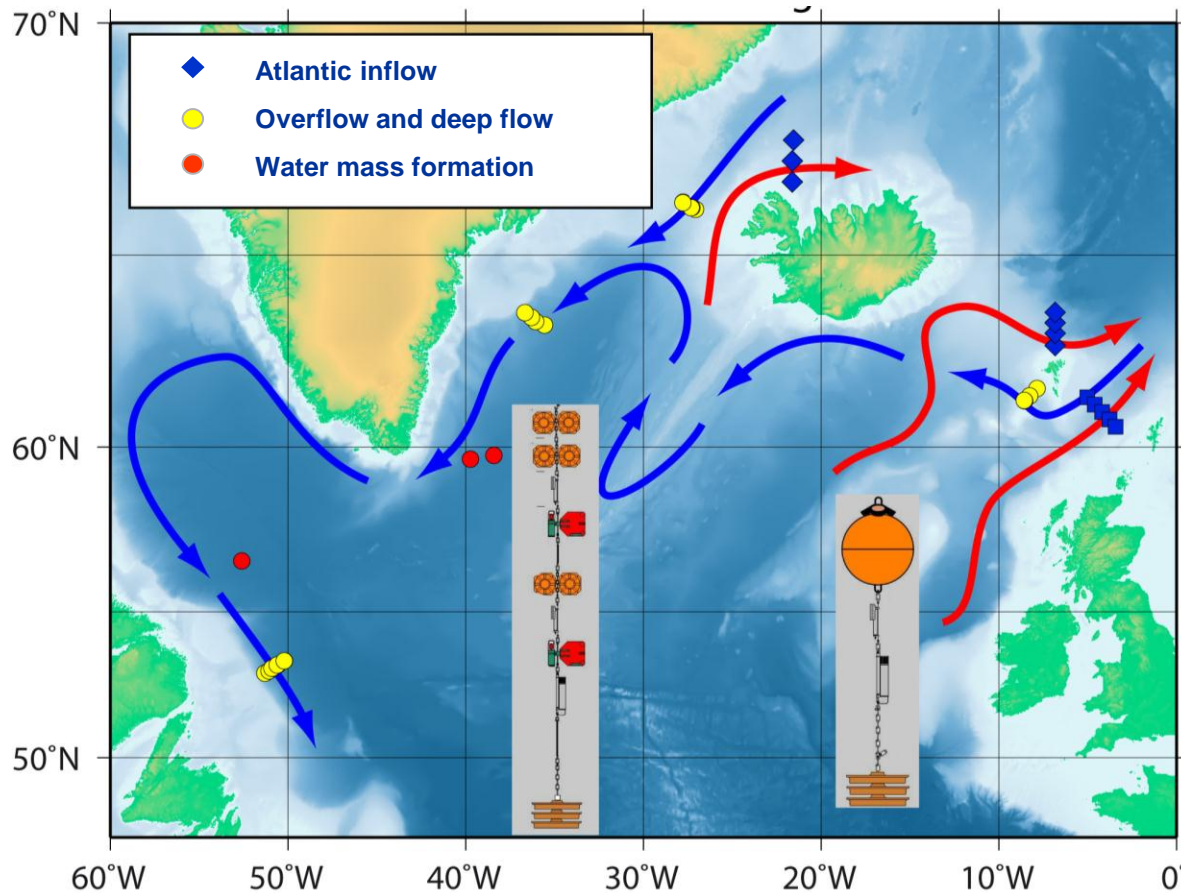
*Sinking at high latitudes
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Climate predictions show a weakening by about 30 % until 2100 radiative forcing - Greenhouse effect, freshwater forcing

On decadal time scales ocean circulation and memory plays the important role



The THOR AMOC Observing System



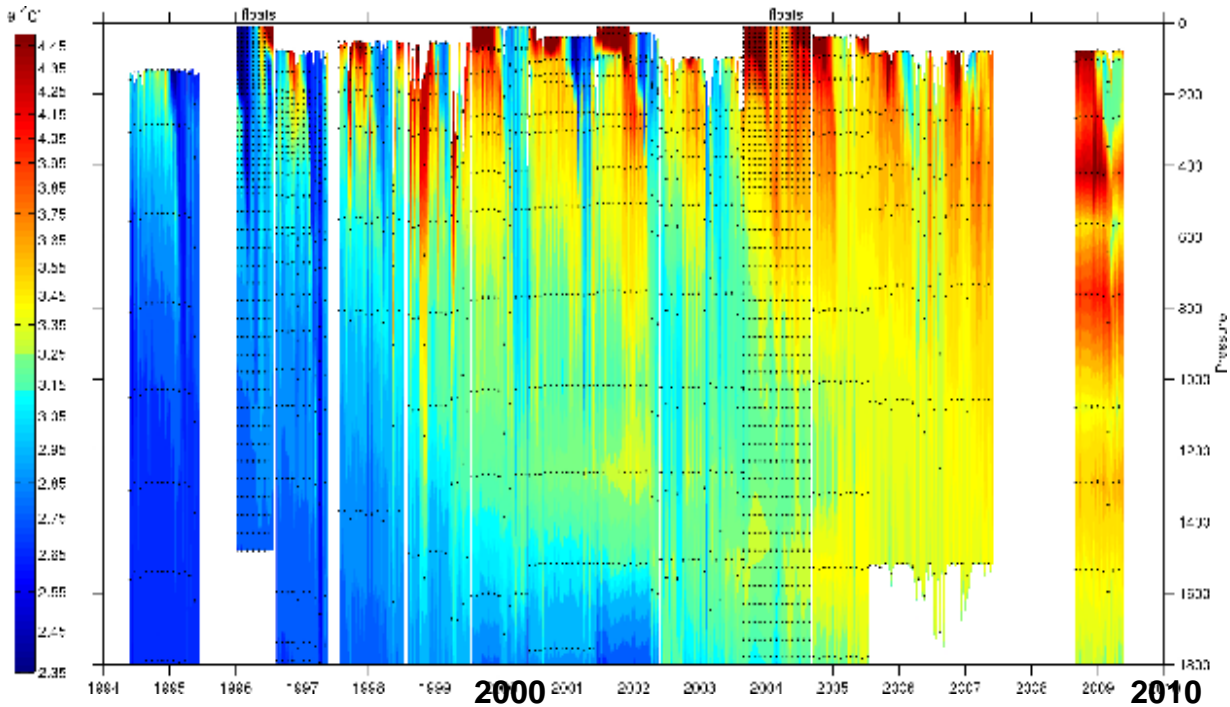
self-sustained moorings
ship-surveys
autonomous floats (ARGO)
satellite remote sensing

flux measurements
quantification of water mass formation
process-oriented experiments (mixing)



Water mass formation - transformation

Through winter time convection the Labrador Sea contributes about one-third to the deep AMOC branch



The Labrador Sea shows an overall warming since 1994

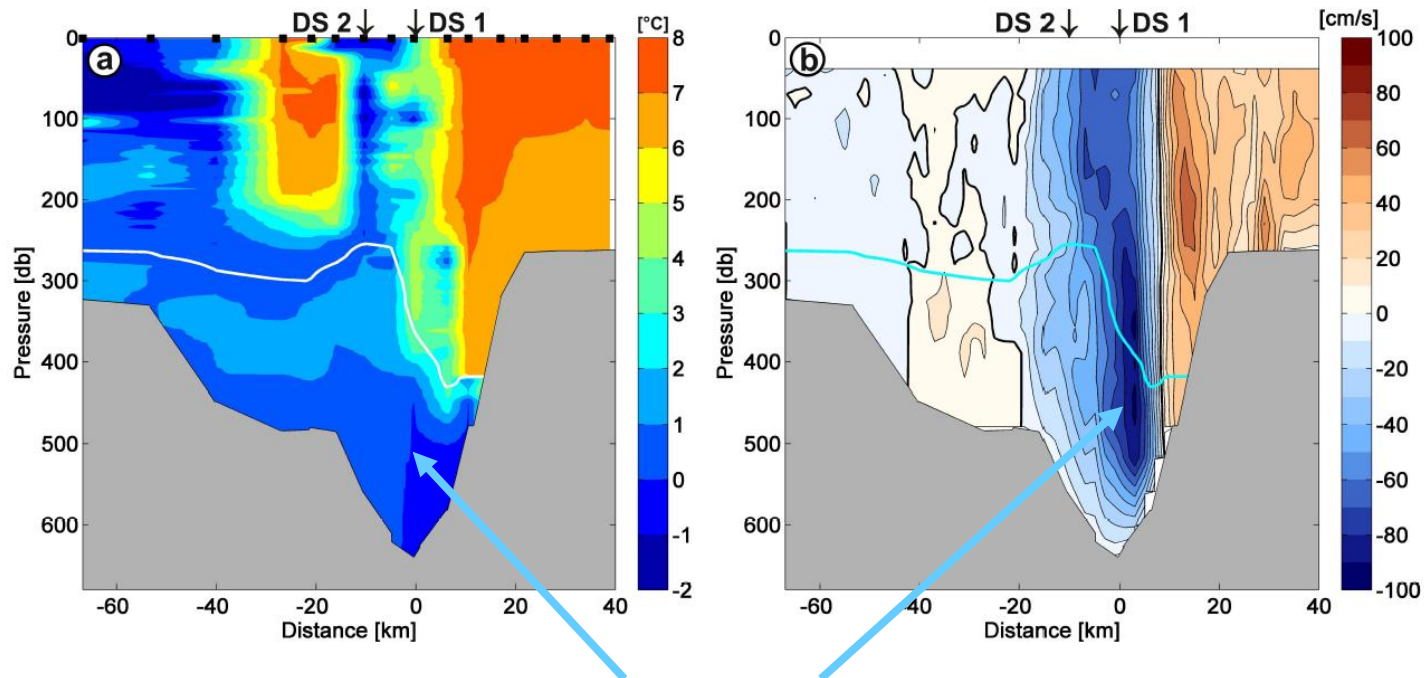




Deep-water volume fluxes in Denmark Strait

Synoptic section across Denmark Strait (July 2010)

Temperature and currents

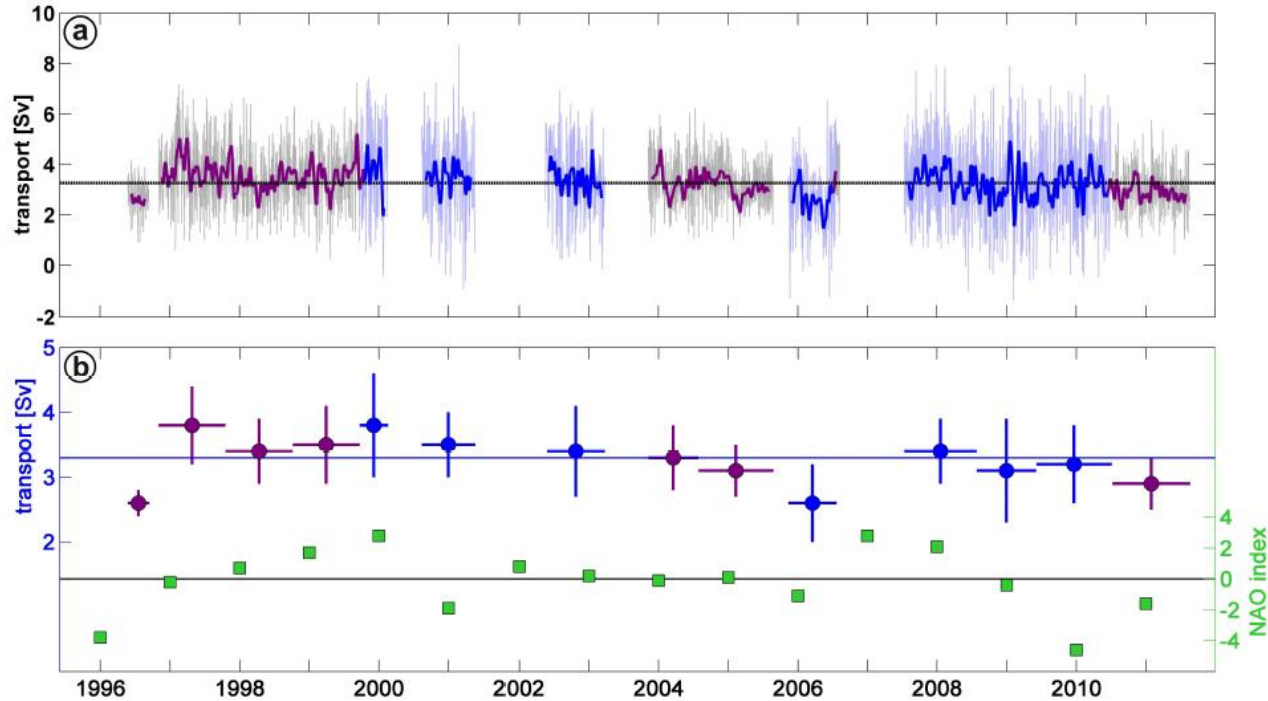


Cold and dense overflows of Nordic Deep waters

DS – current meter mooring locations



Deep-water volume fluxes in Denmark Strait



Daily & 20 day transports in $10^6 \text{ m}^3/\text{s}$

Annual mean transports in $10^6 \text{ m}^3/\text{s}$

NAO Index

The cold and dense overflows of Nordic Deep waters across the Greenland-Scotland Ridge have been very stable during 1996 - 2011



Some results

The North Atlantic has experienced a strong warming over the past decades

The circulation - in contrast - is very stable

A good knowledge of the state of the North Atlantic is a pre-requisite for reliable climate forecasts on decadal time scales.

With a different focus the observational work of THOR will be continued in NACLIM



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