THOR: long term observations of MOC variability in the North Atlantic

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Motivation

The variability of deep water fluxes in the North Atlantic is a subject of considerable interest due to its implications on the climate of western Europe, and more generally to its repercussions on global ocean circulation and climate patterns. The dense waters that fill the North Atlantic basin flow over the sills between Greenland and Scotland that separate it from the formation regions to the north. This flow follows a complex path where mixing, entrainment, deep winter convection in the Labrador Sea and recirculation in the subpolar North Atlantic are present to varying extent, affecting the fluxes and characteristics of the water masses involved in the Atlantic Meridional Overturning Circulation (AMOC). As consequence of this complexity, an assessment of the AMOC variability requires an integrated effort, involving field measurements at several key locations.

THOR

The THOR project ("Thermohaline Overturning – at Risk?") addresses the need for an integrated approach to the study of AMOC variability in the North Atlantic. Financed by the European Union under Framework Programme 7, it counts with the collaboration of 20 institutions of research and higher education in 9 European countries. The project crucially depends on a set of time series of flux observations at key locations (see Fig. 1), which it seeks to extend and enhance. The direct observations are complemented by numerical modelling studies to assess the uncertainty and predictability associated with observations, and palaeoclimate studies to provide an improved understanding of the potential climate impacts of observed variability. Additionally, the project includes efforts to develop the use of near-realtime data from moored instruments, allowing data recovery between servicings of the mooring, as is usually done. THOR is sub-divided into five core themes:

CT1: Quantifying and modelling the thermohaline circulation (THC) variability using palaeoclimate observations and simulations;
CT2: Assessing sources of uncertainty in ocean analyses and forecasts;
CT3: Observations of the North Atlantic THC;
CT4: Predictability of the THC;
CT5: Technological Advancements for Improved near-realtime data transmission and Coupled Ocean-Atmosphere Data Assimilation.

Observational programme

Under the THOR project, coordination between existing observational programmes of the collaborating institutions will be improved. Flux time series from moored current meters (mechanical and acoustic) measuring both the inflow of Atlantic source waters and the outflow of dense waters from the subpolar North Atlantic will be integrated to present a detailed overview of the meridional overturning in the region. Historical time series will be continued, and

complemented with data from newly deployed instruments. Most moorings provide in addition time series of temperature, salinity and pressure, with varying resolution of the water column. The data from moored instruments are complemented with hydrographic data obtained during the cruises done to service the moorings, namely CTD, ADCP and LADCP data.

Figure 1 shows an overview of the regions that will be monitored during THOR:

1) Atlantic inflow and overflows at the Faroe-Shetland Channel and Wyville Thomson Ridge (T. Sherwin, SAMS)
2) Iceland-Faroe Ridge inflow and Faroe Bank channel overflow (B. Hansen, FFL);
3) Atlantic inflow at Hornbanki (S. Jónsson, MRI);
4) Denmark Strait overflow and entrainment and East Greenland Current at Denmark Strait and downstream at Angmagssalik (D. Quadfasel, IFM Hamburg; S. Dye, CEFAS);
5) recirculation in the Irminger Sea (H. van Aken, NIOZ);
6) dense waters in the Central Irminger Sea (J. Karstensen and J. Fischer, IFM-GEOMAR);
7) convection in the central Labrador Sea (J. Fischer, IFM-GEOMAR);
8) Labrador Sea outflow at 53°N (J. Fischer, IFM-GEOMAR);
9) fluxes of AMOC components at 26°N.

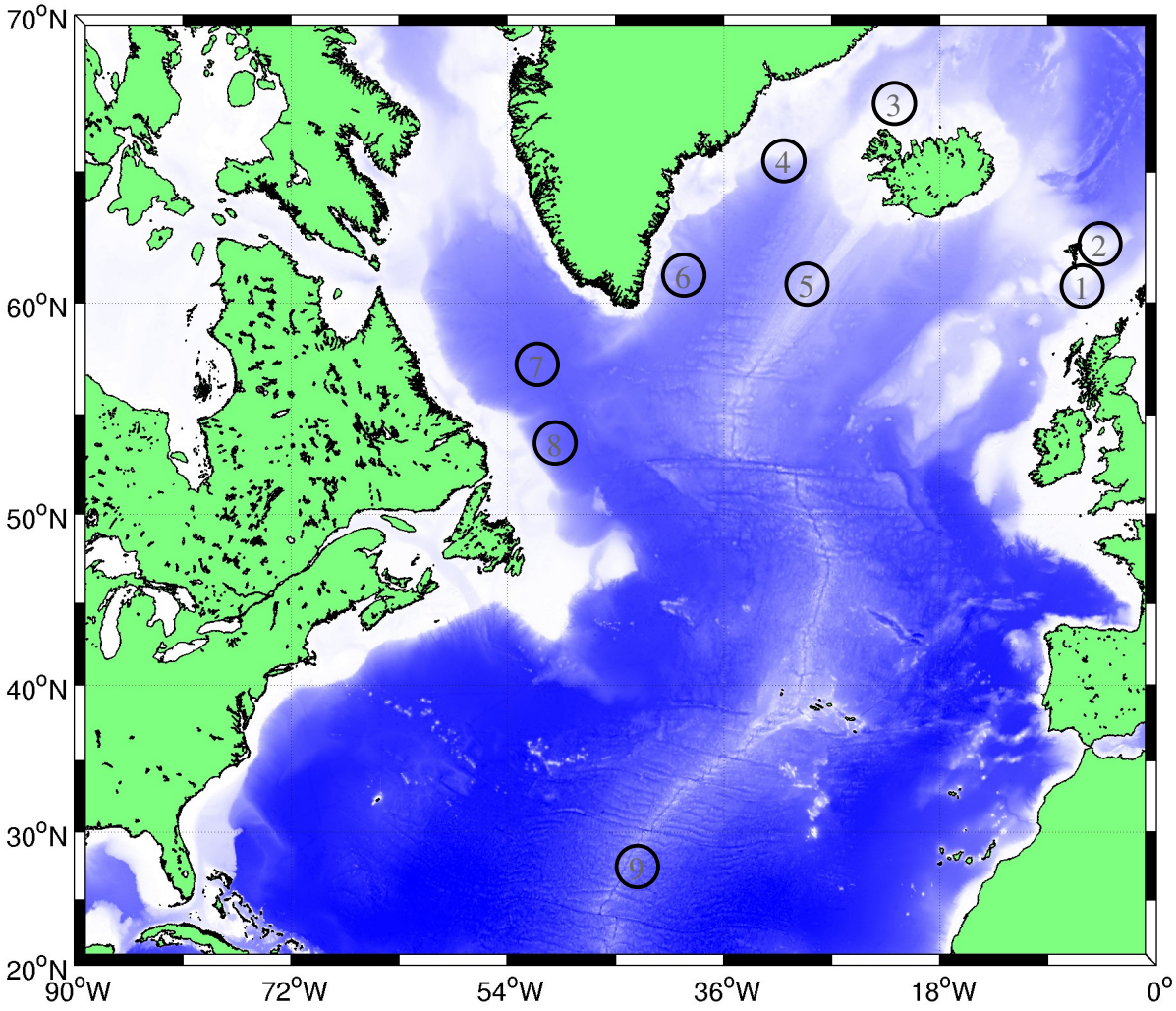

Fig. 1: key regions for AMOC variability for which fluxes will be monitored by THOR collaborators (see text for details).