

Annual Summary of THOR 2010



THOR has just reached the half-time of the project and following is a brief report on the achievements obtained so far. The major task of THOR is to integrate model simulations, observations, as well as process and paleo-studies to facilitate an overall assessment of the dynamics, stability and variability of the Thermohaline Circulation and to predict its development for the next decades.

THOR is running on schedule and most (>95%) of the planned work has been done. So far, we have completed 14 deliverables on time and 2 are slightly behind schedule. In all, 15 publications in peer-reviewed journals have appeared or are in press, another 13 manuscripts have been submitted for publication. At the beginning of THOR each core project has focused on its own individual tasks, but now cooperation between the core themes has begun and the first results of this cross-fertilization have emerged.

The modeling groups of **Core Theme 1** have provided long (>1000 years) integrations of coupled ocean-atmosphere general circulation models and analyzed THC variability on decadal to centennial time scales. Here the focus is on the overflows from the Arctic Mediterranean and on the sub-polar-gyre characteristics. CT1 also compared the Atlantic Multidecadal Oscillation (AMO) and Atlantic Meridional Overturning Circulation (AMOC), quantified the impact of AMOC variations on the atmosphere. It also turned out that external forcing (e.g. volcano eruptions) impact strongly on the THC variability. The paleo sediment cores have been dated and show similar statistics in variability as the model runs. These data are accessible on the THOR exchange data server in Kiel.

The **Core Theme 2** (with focus on assessing the uncertainty in ocean analyses and forecasts on time scales of decades) coordinated model experiments across a range of model systems have been completed. Despite their different spatial resolution they show excellent agreement with the flux estimates provided by the observational groups. The Earth System Model (ESM) and the Ice Sheet Model (ISM), developed outside THOR, are now also available (with a delay of one year) and are being coupled for the investigation of the additional Greenlandic fresh water releases to the ocean in a warming world. This work will be done during the next 12 months.

In **Core Theme 3**, the direct ocean observations in the sub-polar and subtropical North Atlantic continued. More than 20 scientific cruises were carried out and more than 30

monitoring moorings are in the water. THOR thus expanded the long term observation of heat and volume fluxes, as well as that of ocean properties and water mass formation through key sections and at key sites in the North Atlantic, between 62° N to 26.5°N. Estimates of the volume fluxes across the Greenland-Scotland Ridge and at the exit of the Labrador Sea showed continued and remarkable stable conditions. The collected observation data (both up-to-date and historical) are available on the THOR server to the THOR scientific community – and the Commission.

Core Theme 4 works on the prediction of the AMOC and associated climate state at decadal time scales. It separates forced (anthropogenic) components from natural variations. The team has determined optimum perturbations for most coupled models, finalized decadal hindcasts – which is not only a contribution for THOR, but also to CMIP5 of IPCC AR5.

Core Theme 5 improves observational and modeling techniques. Two systems have been developed for real time data transmission, in other words, to access mooring data without recovery of the moorings. The Bergen system was deployed in Faroe Bank Channel and the Kiel system in Eckernförder Bay and Schwentine in 2010. After some preliminary problems both systems work successfully and the Kiel system will be deployed in the Labrador Sea this year. A new coupled ocean-atmosphere model – also named as “THOR” – that allows the assimilation of both oceanic and atmospheric observational data was successfully developed and implemented in this core theme by coupling the MIT ocean circulation model with the PLASIM atmospheric model.

Core theme 6 - administration: our first interim reports on scientific achievements and financial administration were approved by the Commission within 105 days after the 1st reporting period. Auditing by the company Lubbock Fine (commissioned by the EU) will take place in late January / beginning of February 2011. The second financial transaction has been distributed to all partners in December 2010. On October 1st, 2010, an end-user workshop was held at the University of Hamburg. 35 participants from the scientific community in the field of climate and marine research, the boundary organizations such as European and Federal Environmental Agencies, the instrumental manufacturers, other small and medium size enterprises, the general publics as well as the THOR group have joined the workshop.