

Unique monitoring system for the Atlantic circulation proves its worth

An international team of scientists have for the first time been able to continuously monitor the daily variations in the strength of the Atlantic's circulation. Results from the first year of observations were published in two papers in *Science* magazine on 17 August 2007. The Atlantic circulation is largely responsible for Europe's warm climate, and its likelihood of ever 'switching off' has been debated for years.

The researchers have established a unique system of observational instruments that will help to provide early detection of change in the Atlantic Meridional Overturning Circulation (MOC). The system will help scientists to verify simulations of the MOC from climate models, and to produce more realistic climate change predictions, which are essential for the development of adaptation plans.

Prof. Jochem Marotzke, Director at the Max Planck Institute for Meteorology (MPI-M) in Hamburg, who moved there in 2003 from the National Oceanography Centre Southampton (NOCS), UK, initiated the research project and was, until his move to MPI-M, the project's Principal Investigator.

The research was carried out in close collaboration with colleagues from the NOCS, from Germany (the Max Planck Institute for Meteorology in Hamburg), and the United States (the Rosenstiel School of Marine and Atmospheric Science and the US Atlantic Oceanographic and Meteorological Laboratory, AOML, in Miami.)

In March 2004, the scientists deployed an instrument array across the Atlantic at 26°N from the Saharan coast of Africa to the Bahamas. Since then, the instruments have provided a continuous record of the temperature, salinity and density of the ocean. In combination with current measurements of the Gulf Stream in the Straits of Florida (provided by scientists from AOML) and satellite measurements of the wind-driven flow across 26°N, the MOC has been calculated on a daily basis.

The publications in *Science* show that the remarkable instrument array is working effectively and is bringing in some surprising results. The full range of variability measured in the Atlantic MOC is large. It can range from as little as 4 Sverdrups to as much as 35 Sverdrups. (A Sverdrup is a measure of ocean flow, with one Sverdrup equivalent to one million tonnes of water a second.) The year-long average of the MOC calculates at around 19 Sverdrups, in agreement with earlier estimates.

Prof. Marotzke explains, "There is no indication of an MOC slowdown. And the large fluctuations explain why previously it was diagnosed that a slowdown had already happened. By chance, measurements were taken at a time when the MOC happened to be quite weak."

With the instrument array it is feasible to monitor the annual average MOC to a resolution of about 1.5 Sverdrups, or about 8 percent of the mean value. This would be sufficient to detect any large, abrupt changes in the circulation, critical to planning for future climate change.

Original publications

The two papers appeared in *Science* (Vol. 317, issue 5840) on 17 August 2007.

-- "Observed Flow Compensation Associated with the MOC at 26.5°N in the Atlantic"

Torsten Kanzow, Stuart A. Cunningham, Darren Rayner, Joël J.-M. Hirschi, William E. Johns, Molly O. Baringer, Harry L. Bryden, Lisa M. Beal, Christopher S. Meinen, Jochem Marotzke

-- “Temporal Variability of the Atlantic Meridional Overturning Circulation at 26.5°N”

Stuart A. Cunningham, Torsten Kanzow, Darren Rayner, Molly O. Baringer, William E. Johns, Jochem Marotzke, Hannah R. Longworth, Elizabeth M. Grant, Joël J-M. Hirschi, Lisa M. Beal, Christopher S. Meinen and Harry L. Bryden

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