Meridional Coherence and Divergence of the Atlantic Meridional Overturning Circulation (AMOC)

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The AMOC is responsible for the meridional transport of heat on climate-relevant timescales. Numerical model studies suggest that the AMOC varies on broad range of periods: wind forcing dominates local and intraseasonal variability; buoyancy forcing is important at longer periods and sets - at least - the mean strength of a meridionally coherent AMOC. We shall present contemporaneous observations targeting AMOC fluctuations for the period 2000 to 2010. Three continuous data sets from 16N, 26N and 40N are available.

Continuous mooring-based density observations of the deep southward transport of North Atlantic Deep Water in the western basin are available since the year 2000 at 16N in the framework of the MOVE experiment (operated by SIO, USA). From 2006 the western basin transports are extended to the eastern basin using data from the TENATSO mooring near Cape Verde. This enables us to compute NADW transports integrated across almost the entire zonal width of the Atlantic at 16N. From 2004 the RAPID / MOCHA (NOC, UK / RSMAS & AOML, USA), a purposefully designed monitoring array, has been monitoring the strength of the AMOC (both the northward transport of warm water and cold NADW return flow) at 26N To put the decade-long observations at 16N and 26N into a long-term perspective, we construct a 146 year-long index of changes of the AMOC near 40N based on tide gauge records along the US east coast, which go back in time with interruptions to the year 1856.

We present evidence of the occurrence of coherent changes of the AMOC between 16N and 26N, suggesting that AMOC anomalies with meridional scales larger than 1000 km are observed. We find evidence of periods of pronounced divergence in NADW transports between 16 N and 26N. Isolating different transport contributions of the AMOC signal at both latitudes, we trace the origin of coherent and divergent events.

Extremely low AMOC values (observation period 2004 to 2010) were observed at 26N in the winter of 2009/10, associated with the extreme negative state of the North Atlantic Oscillation. The tide-gauge AMOC index at 40N, (since 1868) also has its lowest value at this time. This might indicate that occurrences of low-AMOC events like the winter 2009/10 anomaly are extremely rare.

First results from this work have been presented at the EGU General Assembly in April 2012 (www.egu2012.eu); this is a follow-up to the EGU presentation.