Geophysical Research Abstracts
Vol. 14, EGU2012-4967-1, 2012
EGU General Assembly 2012

Observed and simulated seasonal variability of the AMOC at 26°N and 41°N

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Timeseries of the Atlantic Meridional Overturning (AMOC) have recently become available, but so far no meridional coherence has been documented in these timeseries. Here, we analyze the 26°N RAPID and the 41°N ARGO-based AMOC observations (Cunningham et al., 2007; Willis, 2010) for meridional coherence at seasonal timescales. We use monthly values smoothed by a three month running mean for both timeseries. At present, the 26°N RAPID array is available for five years (04/04 – 06/09) and the 41°N data are available for eight years (01/02 – 09/10).
With no obvious relation between the two latitudes, the AMOC and Ekman transport timeseries are dominated by the annual cycle at 26°N and 41°N. However, after subtracting the Ekman transport from the AMOC, we find an inverse seasonal phasing between AMOC–Ekman at 26°N and 41°N. The mean annual cycle of AMOC–Ekman shows a maximum in October and a minimum in March at 26°N, but a maximum in April and a minimum in December at 41°N. We also find this inversely seasonal cycle in the Sverdrup transports calculated from the zonal integral of the wind stress curl using the NCEP reanalysis at both latitudes.
We compare our results to a simulation with the high resolution NCEP-forced ocean simulation from the STORM project. We analyze the period that overlaps with the AMOC observations (01/02–12/10). The horizontal resolution of the model is about 10km, and the daily model output is smoothed to three month running means. In the STORM run, we also find inversely phased seasonal cycles in the Sverdrup transports between 26°N and 41°N, and no obvious relation between the Ekman transports. However, for AMOC–Ekman, we find a positive correlation of the 26°N and 41°N timeseries, with the mean seasonal cycles having a maximum in October and a minimum in March and April at both latitudes.
A direct comparison shows that the Ekman and Sverdrup transport agree between the model and the observations both at 26°N and at 41°N. For the total AMOC at 26°N, model and observations agree well, whereas for the total AMOC at 41°N, the observational mean seasonal cycle has its maximum in April and the model mean seasonal cycle shows a maximum in October. While further studies are required, our preliminary results suggest a meridionally coherent seasonal cycle in the AMOC, and in turn (potentially) meridionally coherent AMOC variability even at seasonal timescales.