Sources and Impacts of Variability of the Meridional Property Transports in the Atlantic Ocean

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The goal of this study is to explain the causes of interannual to decadal anomalies of meridional heat and freshwater transport in the Atlantic Basin using analysis of both observations and model output. Satellite observations of sea level, sea surface height, mass, and *in situ* based estimates of heat storage and observationally constrained surface fluxes, as well as output from both ocean only and coupled climate models, are all used in the analyses. In addition, we are examining the impact of changes in transport and storage of heat in the ocean on the atmosphere.

Recent results

An analysis of the contributions to North Atlantic sea level variability by graduate student Jinting Zhang along with Thompson and Kelly showed that on seasonal timescales, local heating explains most of the sea level signal north of 18°N while Rossby waves are important closer to the equator. In contrast, at interannual to decadal times scales, the topographic Sverdrup balance explains the signal near Greenland and Rossby waves as important between 30 and 50°N. A paper on this work will be submitted soon.

An analysis of a set of coupled model experiments, with and without perturbing the temperature in the deep subpolar gyre, shows that a positive AMOC/meridional heat transport (MHT) anomaly propagates meridionally with an advection speed consistent with the meridional flow of the deep limb of AMOC. This heat anomaly leads to heat convergence (warming) in the subpolar gyre and divergence (cooling) in the Gulf Stream region and suggests predictability of mid-latitude AMOC from temperatures upstream in the subpolar gyre. Jinting Zhang and Rong Zhang will soon submit a paper on this work.

The analysis of Kelly et al. (2014) has been extended to Atlantic heat and freshwater budgets by assimilating thermosteric and halosteric sea level, equivalent water thickness (from GRACE), and sea level anomalies. A sensitivity study using three different heat flux fields was also performed.

A lagged-correlation analysis between interannual sea surface height (SSH, as a proxy for upper ocean heat content) and surface turbulent heat flux (OAFLUX, Objectively Analyzed Air-sea Flux), and SST with OAFLUX is performed to investigate whether stored heat in the ocean below the surface layer can feedback to the atmosphere. The results show that while SST is dominantly forced by variability in the atmosphere except for in the western subtropical gyre, heat content (SSH) variability in the ocean is driven by heat transport convergences both in the separated Gulf Stream and the North Atlantic Current. In addition, the analysis suggests that the atmosphere upstream generates the heat that is released by the Gulf Stream and North Atlantic current. We are also investigating the relationship between the heat released in the Gulf Stream with the RAPID/MOCHA estimates of AMOC and MHT. A manuscript is in preparation on this work.

Bibliography

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