Variability and Forcing Mechanisms of the Atlantic Meridional Overturning Circulation

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LONG-TERM GOALS

To understand processes associated with intra-seasonal to decadal variability of the Atlantic Meridional Overturning Circulation (AMOC) and the relation to surface forcing.

OBJECTIVES

(1) To analyze the consistency and fidelity of existing global ocean data assimilation (ODA) products for their estimates of AMOC state and the associated meridional transports of heat and freshwater, (2) to anatomize AMOC variability by decomposing it into different components that are associated with different dynamics and observations, and (3) to examine the meridional coherence and connectivity of the AMOC.

APPROACH AND WORK PLAN

To achieve the objectives, we will (1) analyze the consistency among available ODA products and compare them with the RAPID observations, (2) decompose AMOC variability inferred from ODA products into various dynamical components and examine their relations to different forcing and observations; (3) examine the meridional coherence and connectivity of the AMOC using ODA products.

WORK COMPLETED

We have compared the mean and variability of the AMOC strength between estimates derived from three different ECCO ocean state estimation products (ECCO-JPL, ECCO2, and G-ECCO) and that obtained from the RAPID-MOCHA data for the period of 2004-2007. We also compare the correlation and regression coefficient of meridional volume transport (MVT) to meridional heat transport (MHT) between the ECCO products and RAPID data and auxiliary measurements. We use the ECCO products to evaluate the most suitable latitudes to infer MHT from MVT. The PI has been serving as the chair of a task team of the US AMOC Program to study variability and mechanisms of AMOC. The PI also took a major responsibility to organize and convene the 2010 Annual Meeting of the US AMOC Science Team, Miami, FL, June 7-9, 2010.

RESULTS

Encouraging agreement is found between the ECCO products and the RAPID data in terms of MVT in the upper 1000 m at 26N (the latitude of the RAPID observations). The reasonable consistency between the ECCO products and RAPID observation encourage us to use the ECCO products to examine other science questions related to the AMOC. One of the major issues regarding AMOC observation is the ability to infer meridional heat transport (MHT) from meridional volume transport (MVT). The RAPID array was designed to measure the AMOC's MVT, but not MHT. Recently, an observation-based estimate of MHT was derived based on the RAPID array and auxiliary data. Since the ECCO products are able to reproduce the MVT-MHT relation at 26N, we use the ECCO product to investigate the latitudes at which one can use MVT variability to infer MHT variability effectively. We found that the subtropical gyre (e.g., near the RAPID array latitude) is a reasonable location. The latitude of 15N and 35N has the largest regression coefficient between MVT and MHT. These are regions where the meridional overturning circulation carries most of the MHT. At other latitudes, the horizontal gyre circulation has a substantial contribution to the variability of the MHT.