TIME SERIES OF TRANSPORT VARIABILITY AND SPREADING PATHS OF THE NORTH ATLANTIC SUBPOLAR GYRE

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The Subpolar Gyre of the North Atlantic Ocean is one of the key regions for the earth´s climate system. Warm and saline waters of the North Atlantic Current (NAC) are transferred into the subpolar and polar regions, and subsequently returned as the deep and cold limb of the Atlantic Meridional Overturning Circulation (AMOC). Model simulations hint to a relation between deep water formation, the strength of the Subpolar Gyre and the intensity of the AMOC. To measure the variability of the NAC and thus the strength of the Subpolar Gyre, an array of four inverted echo sounders with bottom pressure sensors (PIES) was deployed along the Mid Atlantic Ridge between 47°40'N and 52°30'N in August 2006. The location of the PIES allows the separation of the main NAC spreading paths through the fracture zones (Charlie-Gibbs, Faraday and Maxwell). The PIES were deployed on intersection points of orbiting altimeter satellites, allowing a comparison between the two independent data sets. The two year long time series from the PIES were retrieved 2008 by acoustic telemetry, while the array remained at the seafloor to complete its scheduled 5-year deployment period. The retrieval in August 2009 failed due to propulsion damages on the research vessel.

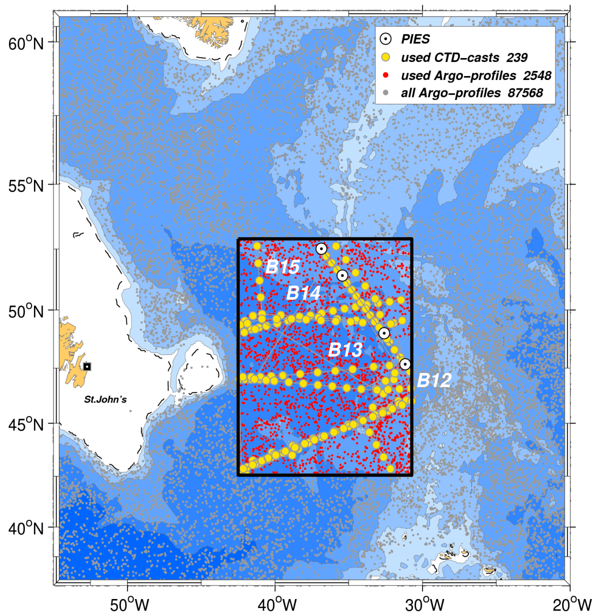

Figure 1: Map showing the PIES positions and the used CTD and Argo profiles

To remove the temporal drift from the bottom pressure time series, an exponential-linear function is fitted and subtracted from the respective time series [1]. As the reference level, a depth of 3400 dbar (the deepest common depth of all PIES) was chosen, and the detrended horizontal bottom pressure differences are used to estimate the geostrophic velocity fluctuations at the reference level.

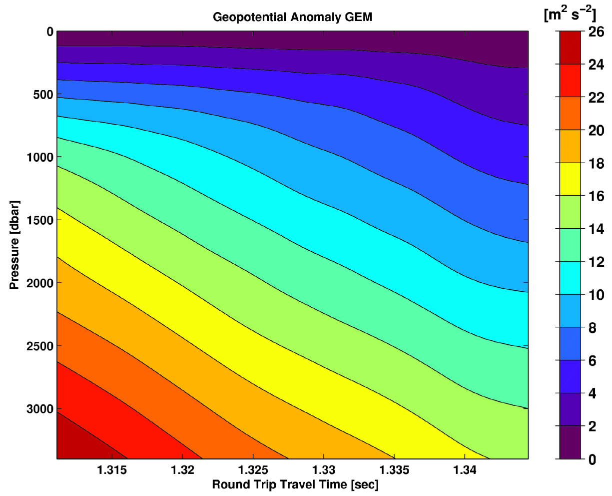

Figure 2: Gravest Empirical Mode for the geopotential anomaly

The travel time measurements of the PIES are combined with hydrographic data from profiling Argo floats and ship measurements to calculate time series of hydrographic properties and the baroclinic contribution to the transport variability.

Hydrographic data of the area of interest are used to produce this transfer function, the so called Gravest Empirical Mode (GEM) [2], which is a single dominant mode. The profiles used in this project are 239 CTD- and 2548 Argo-profiles, taken between January 2000 and August 2009 (Fig. 1). For these profiles the round trip travel times (RT) are calculated at a reverence depth of 1000 dbar. This depth is chosen, because 97.5 % of the available profiles reach a depth of 1000 dbar or more. The linear correlation of RT calculated for the same profiles at 1000 dbar and 3400 dbar is used to convert the RT times series from the different PIES to the chosen reference depth of the transfer function. As an example, the GEM for the geopotential anomaly is shown in Fig. 2.

All observations are then sorted according to their calculated RT. To smooth the data on a regular grid, horizontal cubic smoothing splines are applied every 25 dbar separately for every pressure level, with a horizontal resolution of 0.1 ms. The Argo profiles span a wider range of RT than the CTD profiles. The areas where there are no CTD data are linearly extrapolated for every pressure level. To remove artificial noise, vertical cubic smoothing splines with knots at every 50 dbar are applied separately at every interpolated time step, The next step is then to apply the different GEMs to reproduce the different time series of temperature, salinity, density and GPA for all of the four PIES. The GPA times series are then used to calculate the geostrophic velocities between two of the four PIES relative to 3400 dbar.

The poster will present the combined geostrophic transport fluctuations, separated for the NAC, the Labrador Sea Water, and the deeper water masses. The horizontal meandering of the NAC will also be discussed.

References:

1. Watts, D.R. & Kontoyiannis, H. (1990). Deep-Ocean Bottom Pressure Measurement - Drift Removal and Performance. *Journal of Atmospheric and Oceanic Technology*, **7**, 296-306

2. Meinen, C.S. & Watts, D.R. (1998). Calibrating Inverted Echo Sounders Equipped with Pressure Sensors. *Journal of Atmospheric and Oceanic Technology,* **15**, 1339-1345