The South Atlantic is an important pathway for the inter-basin exchanges of heat and freshwater with strong influence on the global meridional overturning stability and variability. Along the 34°S parallel, a quarterly, high density expendable bathythermograph (XBT) transect (AX18) samples the temperature structure in the upper ocean. The AX18 transect has been shown to be a useful component of a meridional overturning monitoring system of the region. However, a feasible, cost-effective design for an XBT-based system has not yet been developed. Here we use a high-resolution ocean reanalysis to simulate an XBT-based observational system across the South Atlantic. The sensitivities of the meridional heat transport, meridional overturning circulation, and geostrophic velocities to key observational and methodological assumptions are studied. Key assumptions taken into account are the horizontal and temporal sampling of the transect and the level of reference for geostrophic velocities. In addition, the sensitivity of the meridional transports to XBT measurement errors, such as historical fall-rate equation biases and temperature accuracy, are estimated. With the current sampling strategy, the largest errors in the meridional overturning and heat transport are the estimation of the barotropic velocities, and the western boundary sampling. An approach for estimating barotropic velocities using altimetry data is presented.

**Model**

In the present study we use data from the global HYCOM/NCOA assimilative product (Chassignet et al., 2009) to simulate XBT measurements along 34°S. This model includes a Mercator grid with an average of 1/12° horizontal spacing and 32 vertical layers, forced by the 3-hourly and 0.5° output from the NOGAPS model. Assimilated data include satellite sea height anomaly, in-situ SST and vertical temperature/salinity profiles from XBTs, Argo floats, and moored buoys.

**Reference velocity choice**

Vertical shear component is insensitive to the choice of reference velocity. The barotropic component, on the other hand, needs at least climatological velocity values at eastern and western boundaries to represent its strength. A weaker barotropic mode produces a stronger MOC reconstruction.

**Altimetry to estimate barotropic velocity**

A possible way to improve the estimation of the barotropic velocities is using altimetry and hydrography together. The residual between SSH and dynamic height referenced to a certain level gives the non-steric component: the barotropic SSH. Optimal reference values are around 800 to 1000m.

**Impact of historical XBT biases**

The XBT biases represent between 3-6% of the CONTROL (randomly resampled 2008 to 2013) geostrophic MOC/MHT variability assuming the manufacturer’s accuracy distributions.

**AMOC and MHT reconstructions**

The MOC/MHT reconstructions are decomposed into vertical shear, barotropic and Ekman components. The eddy variability account for most of the residual (reconstruction - model). The seasonal cycle shows Ekman and geostrophic components in phase. Vertical shear has weak seasonal cycle because of strong zonal density compensation.

**Time/Space sampling**

Temporal sampling: The precision to represent the seasonal cycle in the AX18 transect depends on the number of samples/year and the number of years sampled. Thus far, the AX18 transect is in the region close to the most uncertain values in the parameter space (star).

Spatial sampling: The western boundary is the most sensitive to spacing, and the interior the least. Current sampling (25km boundary/50 km interior) is close to optimal.

**References**
