Temporal variability of the South Atlantic Meridional Overturning Circulation between 20°S and 35°S

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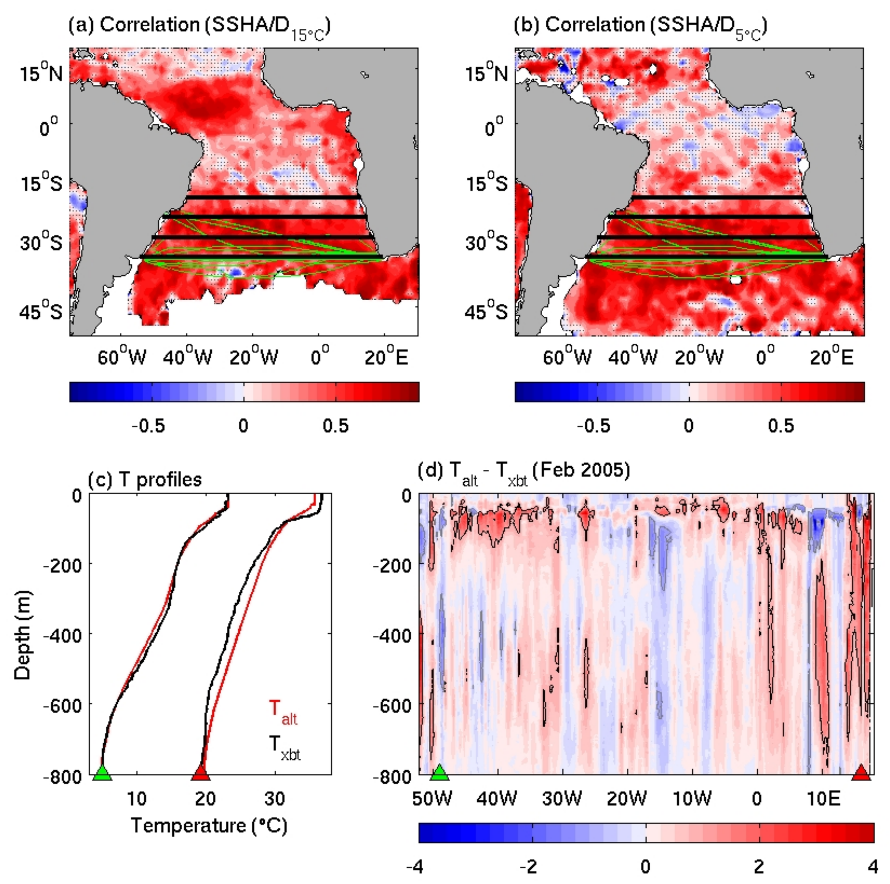
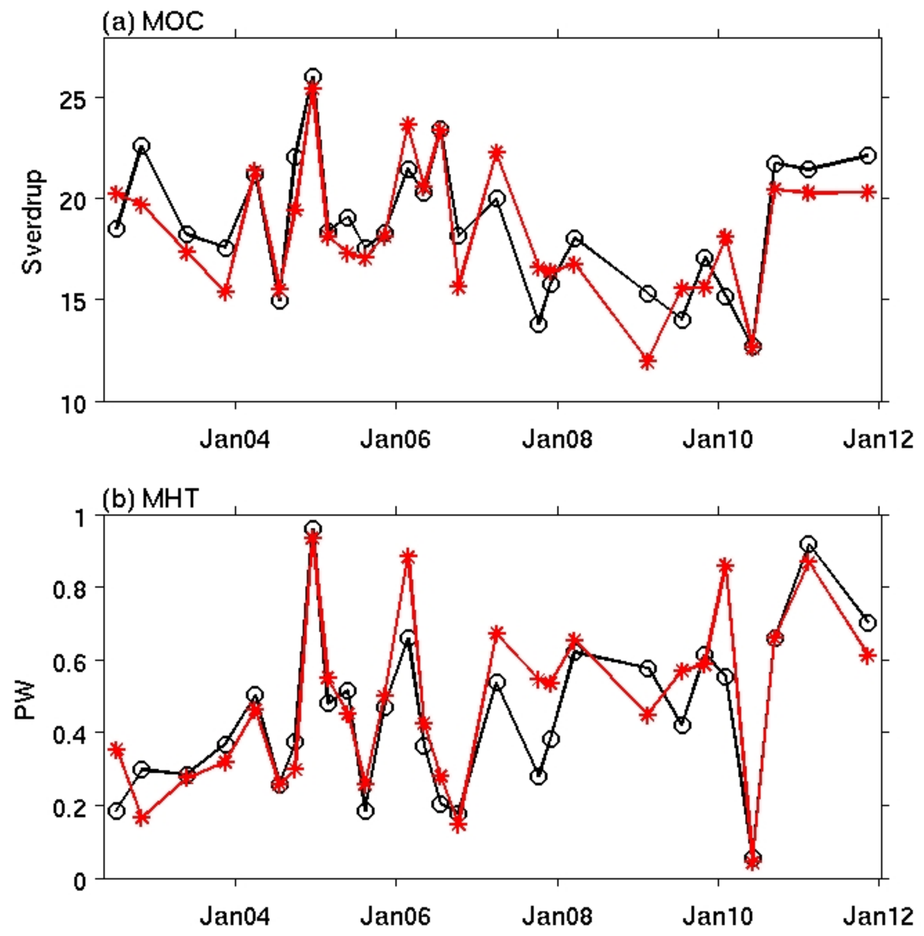
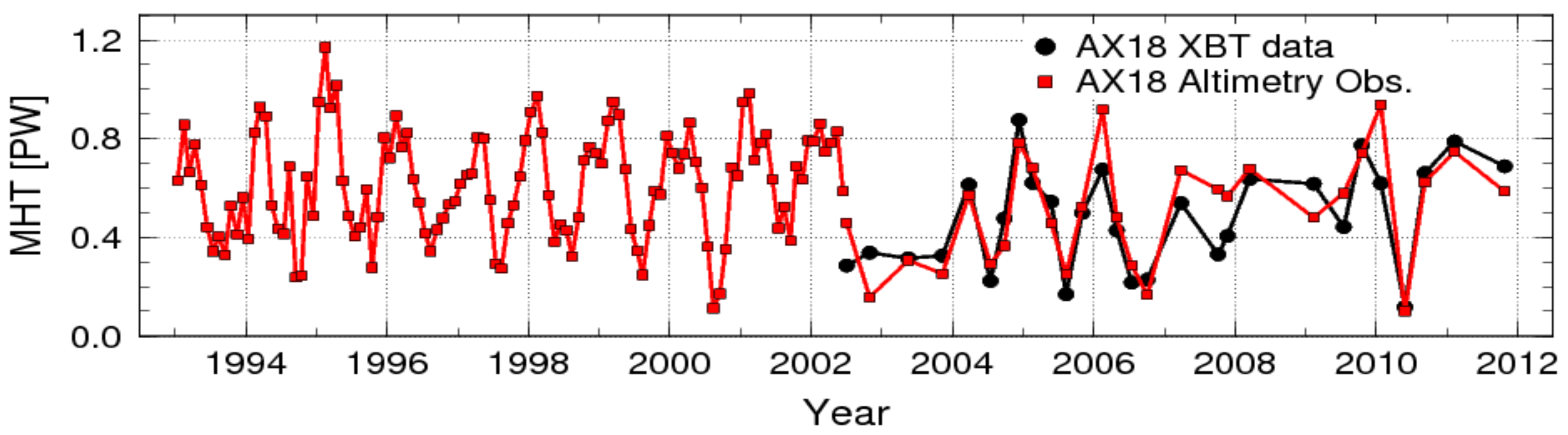
Satellite altimetry measurements are used to investigate the spatial and temporal variability of the Meridional Overturning Circulation (MOC) and Meridional Heat Transport (MHT) in the South Atlantic. Altimetry-derived synthetic temperature and salinity profiles between 20°S and 34.5°S are used to estimate the MOC/MHT, which compare well with estimates obtained from XBT measurements. Consistent with studies from XBT/Argo data results, the geostrophic contribution to the MOC exhibits strong annual cycles, and plays an equal role than the Ekman component in the AMOC seasonal variation. The strongest variations on seasonal and interannual time scales in our study region are found at 34.5°S. The dominance of the geostrophic and Ekman components on the interannual variations in the MOC and MHT varies with time and latitudes, with the geostrophic component being dominant during 1993-2006 and the Ekman component dominant between 2006-2011 at 34.5°S.



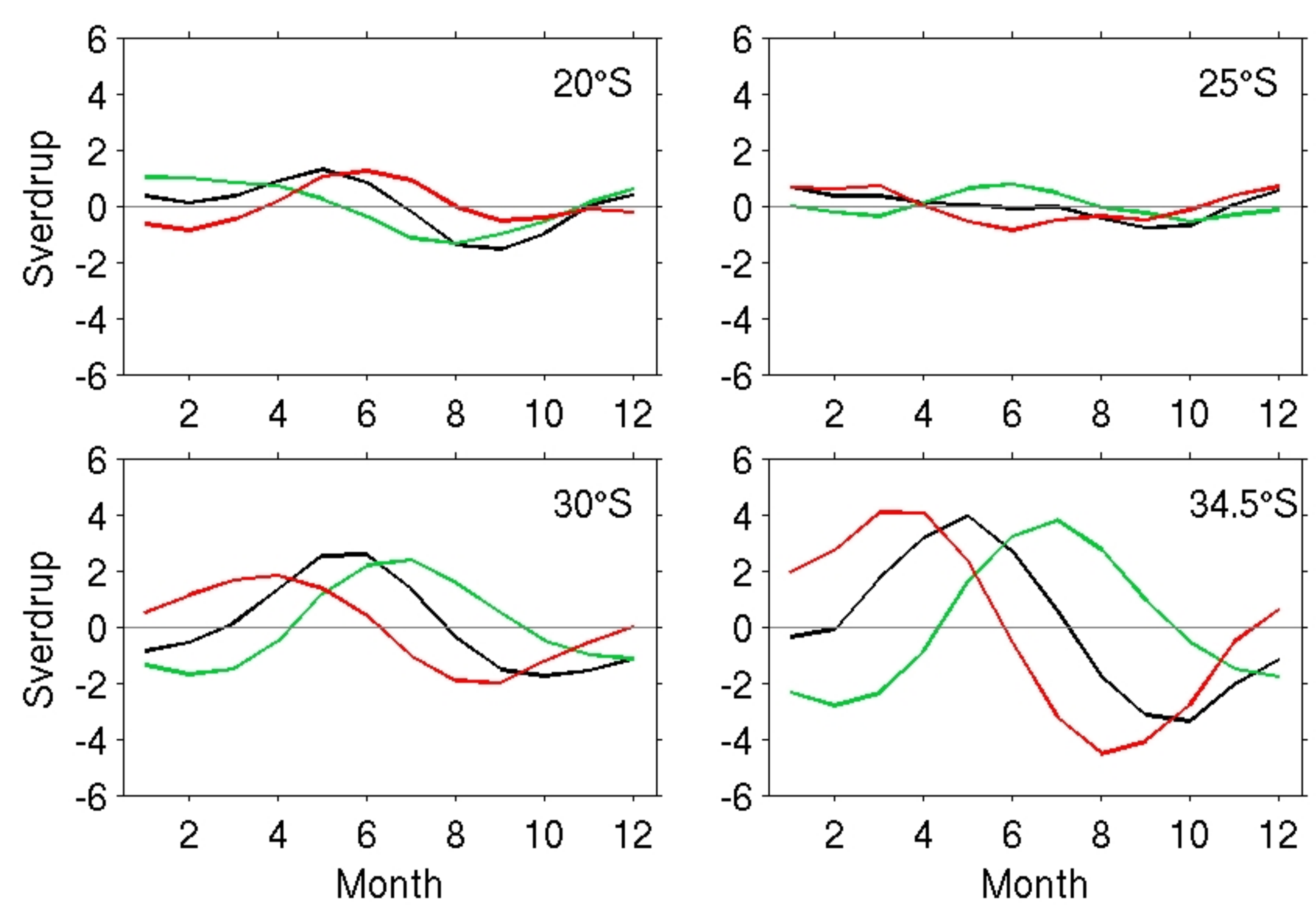
Correlations between sea surface height anomaly (SSHA) and isothermal depths for (a) 15°C and (b) 5°C. Green lines show the AX18 XBT transect locations. Dotted areas indicate where the correlations are insignificant. (c) Examples of the temperature profiles close to the boundaries and (d) temperature differences between altimeter-derived and observed from XBTs for the February 2005 transect along 34.5°S. The corresponding locations for the profiles in (c) are indicated by triangles in (d). Note that the profiles close to the eastern boundary (red triangles) in (c) are shifted by 15°C in order to separate the two examples. Units for (c) and (d) are degree Celsius (°C).



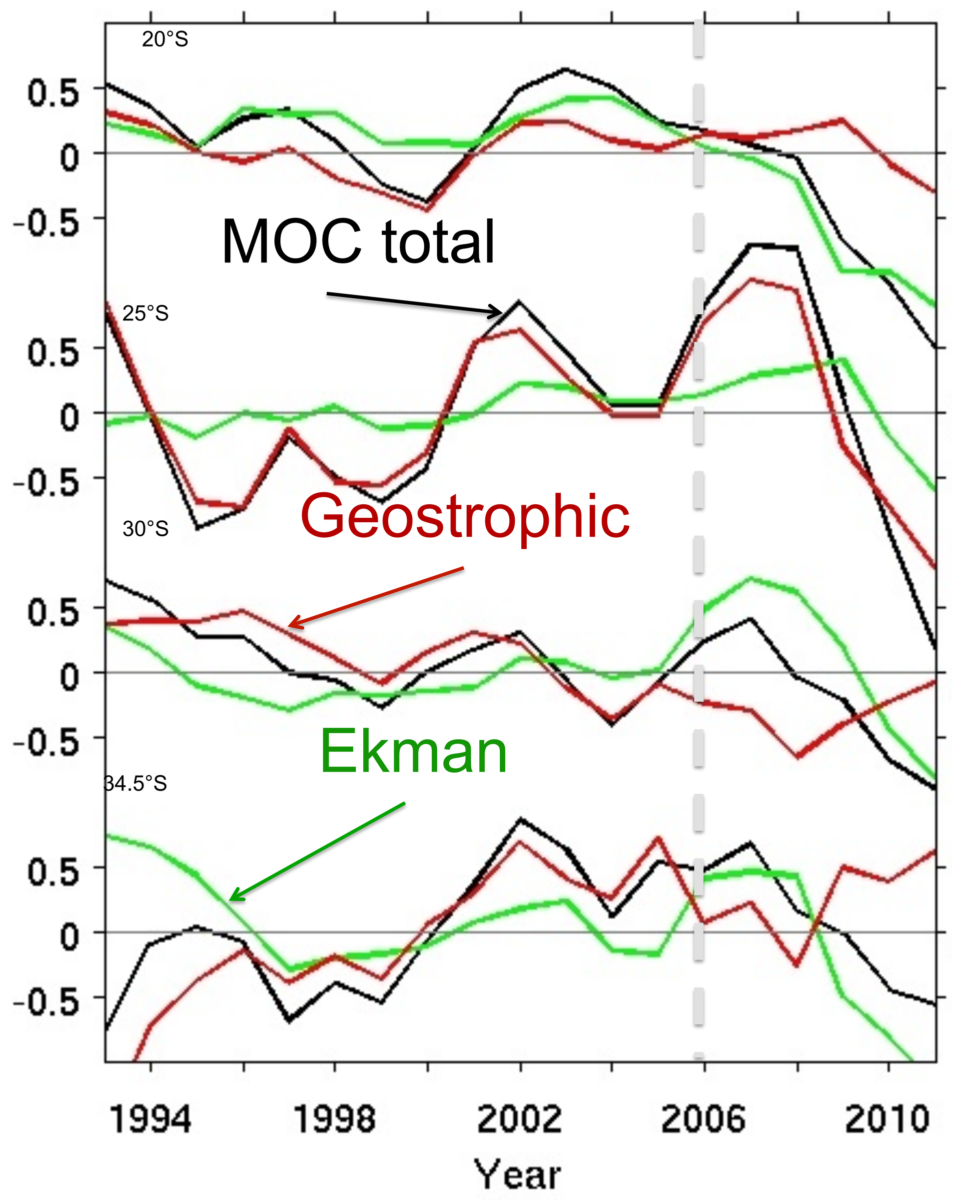
Comparison of the (a) MOC and (b) MHT along AX18 XBT transects estimated from the XBT measurements (black line) and the synthetic T/S profiles from altimeter SSH measurements (red line).



Time series of the MHT along 34.5S obtained from XBT observations (black) and altimetry observations (red). Altimetry allows to extend the time series back in time since 1993.



Seasonal variations of the MOC (black) and contributions from the geostrophic (red) and Ekman (green) components estimated from the synthetic T/S profiles at 20°S, 25°S, 30°S, and 34.5°S, respectively. The time-mean values for the total MOC and each component have been removed.



Interannual variations of the MOC (black) and contributions from the geostrophic (red) and Ekman (green) components at 20°S, 25°S, 30°S, and 34.5°S, respectively.

Key Results

Different leading contributors at different times:

- Largely dominated by **geostrophic** component **before 2006**.
- Largely dominated by **Ekman** component **after 2006** (except at 25°S, both are equal).
- At 34.5°S, long period variability with **high values** in mid 2000-2008 and **low values** in 1993-2000 2008-present.
- Next: Examine if models reproduce this variability

Historical hydrographic data are from the World Ocean Atlas 2013 (http://www.nodc.noaa.gov/OC5/woa13/). Altimeter SSH data are available at http://www.aviso.altimetry.fr/en/data/data-access.html. The velocity at 1000 m depth from Argo floats ire from http://apdrc.soest.hawaii.edu/projects/Argo/data/trjctry/. This work was supported by NASA Grant and NOAA Grant NA10OAR4310206, and also by the NOAA Atlantic Oceanographic and Meteorological Laboratory (AOML). This research was carried out in part under the auspices of the Cooperative Institute of Marine and Atmospheric Studies of the University of Miami and NOAA, cooperative agreement NA10OAR4320143.