Equatorial Atlantic Ocean dynamics in a coupled ocean-atmosphere model simulation

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Introduction

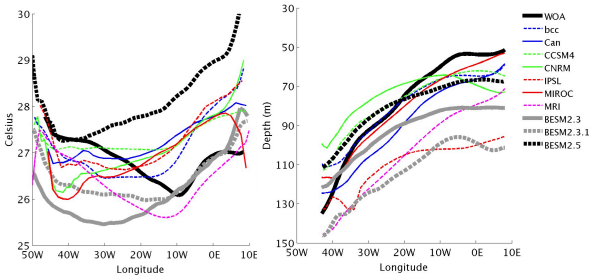
The Brazilian earth system model (BESM) is a cooperative effort of many Brazilian institutions. The first stable version, BESM2.3, was documented in Nobre et al. (2013).

Bottino and Nobre (2015) investigated some biases in BESM2.3. The revision of the cloud cover scheme and other related parameterizations in the atmospheric component resulted in an improved version of the code, BESM2.3.1.

In Giarolla et al. (2015), the ocean temperatures and zonal currents at the equatorial Atlantic, simulated by BESM2.3.1, were compared to the ones obtained by BESM2.3 and other seven CMIP5 models.

This work refers to Giarolla et al. (2015) but also includes in the comparisons the most recent BESM version, BESM2.5. Analyses are based in the last 30 years of 100-yr long simulations.

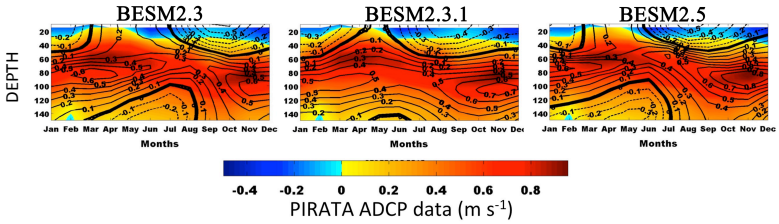
Results: (1) SST and thermocline slope along the Equatorial Atlantic for CMIP5 models.



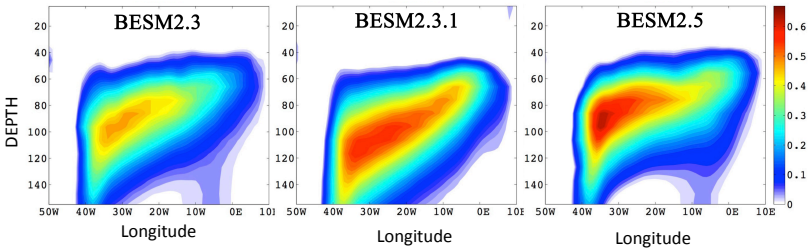
- Results vary substantially among the models.
- Seven of those models, including BESM2.5, have the warm bias in the eastern equatorial Atlantic.
- BESM2.3 and BESM2.3.1 have a warm bias only at the easternmost region.
- BESM2.3.1 thermocline about 50–60 m deeper than the observed climatology, also deeper than BESM2.3.
- However, BESM2.3.1 better represents the "shape" of the climatological thermocline slope. BESM2.5 thermocline is shallower than other BESM versions.

Results: (2) Atlantic EUC

ZONAL VELOCITIES at 0N 23W

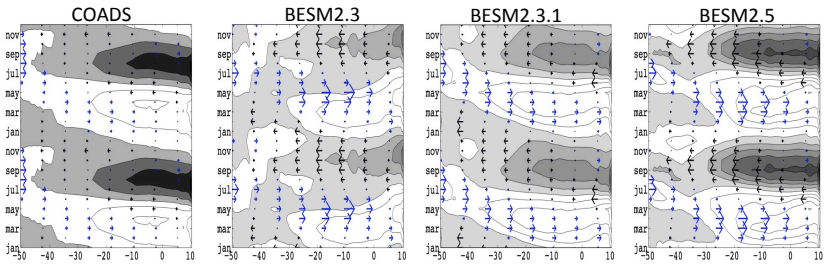


ZONAL VELOCITIES along the EQUATORIAL ATLANTIC



- At 0°N, 23°W, all BESM experiments do not precisely represent the surfacing of the EUC, which is observed to occur between mid-March to April, related to the weakening of the local surface winds.
- However, BESM2.5 presents the best simulation of the EUC core depth and seasonal variation.
- Regarding the mean EUC core along the Equator, according to Johns et al. (2013), BESM2.3 has a good EUC core depth but it is weaker than observations. BESM2.3.1 EUC is stronger but deeper.
- BESM2.5 generates the most realistic EUC, both in magnitude and depth

Results: (3) Atlantic aSST and ataux seasonal variability



- Observed and simulated SST and zonal wind stress anomalies at the Equatorial Atlantic (5ºS-5ºN)
- SST seasonal cycle along the equator better represented in versions BESM2.3.1 and BESM2.5

Conclusions

- The changes in the latest BESM versions improved the atmospheric circulation over the tropical Atlantic, e.g., leading to a better representation of the zonal wind stress distribution along the Equator.
- The improved atmospheric circulation allowed a better representation of the cold tongue over the equatorial Atlantic.
- Improvements were also noticed in subsurface features, such as the thermocline slope and seasonal variations of the EUC.
- Persistent biases, e.g., in the equatorial Atlantic SST, are still present, and currently being investigated.

Acknowledgements

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