The Atlantic Equatorial Thermocline as simulated by the Brazilian Earth System Model: known biases and possible causes

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As a result of a coordinated effort of several institutions in Brazil, the Brazilian Earth System Model has been developed to help the investigation of global climate changes, its effects and impacts on society. The first version of this model, here named Brazilian Earth System Model - Ocean-Atmosphere version 2.3 (BESM-OA2.3), followed the criteria for participation in the Coupled Models Intercomparison Project 5 (CMIP5) protocol, simulating the behavior of the coupled ocean-atmosphere system on decadal time scales under varying green house gases concentrations in the atmosphere. Extended runs with over 2,000 years of ensemble members showed many coherent results, such as the response of the model to increasing atmospheric CO2 concentrations in a consistent manner. In spite of that, the model still has biases and discrepancies when compared to observations, some of them also detected in other global coupled ocean-atmosphere models. As an example of known bias, the thermocline along the Atlantic equator flattens after the second year of simulation. In other words, it anomalously deepens at the eastern region near the African coast after some months. This issue is observed in all CMIP5-based experiments made with the BESM-OA2.3. However, a newer version of the BESM-OA, with updated microphysics parameterizations and the Integrated Biosphere Simulator (IBIS) included, has shown promising results, i.e., the thermocline tends to maintain its inclination in the second year better than the first version of BESM-OA. In this work we discuss the possible causes of the thermocline flattening comparing simulations of both model versions. We don't have conclusive explanations since the study is still in progress, but some results indicate that the seasonal eastward shift of the zonal wind reversion (represented as the zero zonal wind line) at the Atlantic equator, in April-May, is better represented in the newest version of the model. With more realistic winds at the equator, the mean Equatorial Undercurrent core at 23o W, averaged after the first year, does not become shallower as in the previous version of the model, causing the thermocline to keep its slope after the first year of simulation.

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