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Importance of diapycnal mixing for simulating the eastern equatorial Atlantic ocean

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Generally, oceanic models forced by surface fluxes without any correction or data assimilation, fail to reconstruct the eastern equatorial Atlantic Cold Tongue. In these models, the cold tongue is displaced too far to the west and the intensity of its cooling is underestimated. Some models do not represent it at all. It results in too warm surface temperatures in comparison with observations; consequently the oceanic circulation is modified and in coupled models, the atmospheric circulation is affected as well.

This misrepresentation is exacerbated by the very shallow mixed-layer depths present in the eastern equatorial Atlantic (less than 20 m throughout most of the year with maximum of 30 to 40 m in boreal autumn). Thus any errors in surface heat or fresh water fluxes, or errors of flux representations at the base of the mixed-layer can significantly impact mixed-layer properties and enhance biases compared to observations. Among other factors, radiation, winds, cloud representation, humidity, or flux parameterizations are commonly pointed out.

Sensitivity tests performed with various oceanic models during the formation of the Atlantic cold tongue suggest that diapycnal mixing is very important for simulating the turbulent vertical mixing inside the stratified thermocline and this mixing can significantly affect mixed-layer temperatures and salinities. These tests support the idea that model errors in the eastern tropical Atlantic are not only due to atmospheric forcing, but are also due to insufficient mixing at the base of the (very shallow) mixed-layer depths. Turbulence in-situ data collected during the AMMA/EGEE campaigns in 2005 and 2006 corroborate this study.