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Barrier layers and tropical Atlantic SST biases in coupled GCM's

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In the ocean the vertical stratification in salinity is sometimes much stronger than in temperature. In that case a barrier layer develops, which is defined as the layer in between the base of the isothermal surface layer and the base of the mixed layer. This layer forms a barrier to entrainment of cold subsurface water into the mixed layer. The dynamics of barrier layers is complex and consequently difficult to model. Biases in rainfall/evaporation, river discharge, ocean currents, etc., affect the salinity stratification, and hence the formation of barrier layers in models. This may contribute to biases in SST. We have explored the contribution from biases in barrier layers to tropical Atlantic SST biases in coupled GCM's. In reality, the strong barrier and the associated temperature inversion below the mixed layer tend to form in the western tropical Atlantic during boreal fall and winter, contributing to the maintenance of warm sea surface temperatures. Many coupled models underestimate this contribution, which may be an important factor in the cold SST bias in the region. In contrast, all models investigated show an erroneous barrier layer in the eastern equatorial Atlantic in boreal summer, where a strong warm SST bias exists. The warm SST bias prevents the ITCZ from migrating towards the north, causing too much rainfall and surface freshening over the eastern equatorial Atlantic, which in turn tends to maintain the erroneous presence of barrier layers. An important implication of our study is that model SST biases in the tropical Atlantic can be significantly improved by reducing the biases in salinity stratification.