

An evaluation of the performance of CMIP6 models in the tropical Atlantic: mean state, variability, and remote impacts

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General circulation models of the Coupled Model Intercomparison Project Phase 6 (CMIP6) are examined with respect to their ability to simulate the mean state and variability of the tropical Atlantic, as well as its linkage to the tropical Pacific. While, on average, mean state biases have improved little relative to the previous intercomparison (CMIP5), there are now a few models with very small biases. In particular the equatorial Atlantic warm SST and westerly wind biases are mostly eliminated in these models. Furthermore, interannual variability in the equatorial and subtropical Atlantic is quite realistic in a number of CMIP6 models, which suggests that they should be useful tools for understanding and predicting variability patterns. The evolution of equatorial Atlantic biases follows the same pattern as in previous model generations, with westerly wind biases during boreal spring preceding warm sea-surface temperature (SST) biases in the east during boreal summer. A substantial portion of the westerly wind bias exists already in atmosphere-only simulations forced with observed SST, suggesting an atmospheric origin. While variability is relatively realistic in many models, SSTs seem less responsive to wind forcing than observed, both on the equator and in the subtropics, possibly due to an excessively deep mixed layer originating in the oceanic component. Thus models with realistic SST amplitude tend to have excessive wind amplitude. The models with the smallest mean state biases all have relatively high resolution but there are also a few low-resolution models that perform similarly well, indicating that resolution is not the only way toward reducing tropical Atlantic biases. The results also show a relatively weak link between mean state biases and the quality of the simulated variability. The linkage to the tropical Pacific shows a wide range of behaviors across models, indicating the need for further model improvement.

Keywords: CMIP6, tropical Atlantic, interannual variability