

Model under-representation of decadal Pacific trade wind trends and its link to tropical Atlantic bias

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The strengthening of the Pacific trade winds in recent decades has been unmatched in the observational record stretching back to the early twentieth century. The wind strengthening has been connected with numerous climate-related phenomena, including accelerated sea-level rise in the western Pacific, alterations to Indo-Pacific ocean currents, increased ocean heat uptake, and a slow-down in the rate of global-mean surface warming. Here we show that models in the Coupled Model Intercomparison Project phase 5 (CMIP5) underestimate the observed range of decadal trends in the Pacific trade winds, despite capturing the range in decadal sea surface temperature (SST) variability reasonably well. Analysis of observational data suggests that tropical Atlantic dynamics contributes considerably to the Pacific trade wind trends, but the Atlantic feedback in coupled models is muted. Since atmosphere-only simulations forced by observed SST fields are capable of recovering the time-variation and magnitude of the trade wind trends, we relate the under-representation in coupled models to tropical Atlantic SST biases.

In a follow-up study with targeted model experiments, it is shown that the recent Atlantic warming trend combined with the typical climate model bias leads to a substantially underestimated Pacific Ocean wind and surface temperature response. The underestimation largely stems from a reduction and eastward shift of the atmospheric heating response to the tropical Atlantic warming trend. These results suggest that the recent Pacific trends and model decadal variability may be better captured by models with improved mean-state climatologies.

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