

A stronger Walker circulation and colder eastern equatorial Pacific in the early 21st century: a transient forced response to global warming versus natural variability

Alexey Fedorov and Ulla Heede

Since the 1990s the Pacific Walker circulation shows a strong multi-decadal strengthening, which is opposite to future model projections. Whether this trend, evident in a wide range of indices especially before the 2015 El Niño, reflects the coupled ocean-atmosphere response to global warming or the negative phase of the Pacific Decadal Oscillation (PDO) is under debate. Understanding this trend is critical if we are to trust future climate projections for the tropical Pacific. Here we demonstrate that SST trends during 1980-2020 include an externally forced warming pattern, which closely resembles the transient ocean thermostat (OT)-like response to global warming emerging in a subset of CMIP6 models. This pattern shows warming in the western Pacific and tropical Indian ocean but cooling in the central and eastern equatorial Pacific. The resultant anomalous SST gradient contributes to the observed Walker circulation strengthening. Overall, CMIP6 historical simulations underestimate this transient pattern, which explains in part the models' inability to replicate the recent Walker cell strengthening. Eventually, this ocean thermostat-like response will give way to the eastern equatorial Pacific (EP) warming pattern and a weaker Walker circulation, but the magnitude and the time of emergence of this pattern crucially depend on the competition between the OT and EP effects.