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TITLE: Role of Pacific trade winds in driving ocean temperatures during the recent slowdown and projections under a wind trend reversal

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ABSTRACT:

Interannual to decadal variability in the Pacific Ocean is a prominent feature of Earth's climate system, with global teleconnections. Recent studies have identified Pacific decadal variability as a major driver of periods of rapid and slower global mean surface air temperature change. Here, we use an eddy-permitting global ocean model to investigate the role of the observed 1992–2011 trade wind intensification and concurrent trends in surface atmospheric variables over the Pacific associated with the negative phase of the Interdecadal Pacific Oscillation (IPO) in driving ocean circulation and heat content changes. We find a strengthening of the Equatorial Undercurrent (EUC) in response to strengthened winds, which brings cooler water to the surface of the eastern Pacific and an increase in the Pacific shallow overturning cells (PSOC), which in turn drives additional heat into the subsurface western Pacific. The wind acceleration also results in an increase in the strength and subsequent heat transport of the Indonesian throughflow (ITF), which transports some of the additional heat from the western Pacific into the Indian Ocean. The circulation changes result in warming of the subsurface western Pacific, cooling of the upper eastern Pacific Ocean and warming of the subsurface Indian Ocean, with an overall increase in Indo-Pacific heat content. Further experiments impose a symmetric reversal of the atmospheric state to examine how the ocean would behave if the winds (and other atmospheric variables) were to revert to their initial state. This mimics a return to the neutral phase of the IPO, characterised by a weakening of the Pacific trade winds. In response we find a slowdown of the EUC and the PSOC, which results in a return to climatological SST conditions in the western and eastern Pacific. The ITF also slows towards its original strength. However, the subsurface temperature, heat content and ITF responses are not symmetric due to an overall increase in the surface heat flux into the ocean associated with the cooler surface of the Pacific. There may also be irreversible heat transport across the thermocline via diapycnal mixing, further contributing to this asymmetry. The net result of the experiment is that the Indo-Pacific subsurface ocean is warmer than it was in its initial state.

SOURCE: Climate dynamics

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