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Role of observed Pacific trade wind trends in the recent hiatus and future projections

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Over the period 2001-2013 a slowdown (or 'hiatus') in global surface temperature has been observed. Recent studies have identified Pacific decadal variability as a major driver of hiatus and accelerated warming periods. Here we use an eddy-permitting global ocean model to investigate the role of the observed 1992-2011 trade wind intensification and associated atmospheric surface changes related with a strong negative phase of the Interdecadal Pacific Oscillation (IPO) in driving ocean circulation and heat content changes.

We find a strengthening of the Pacific shallow overturning cells and Equatorial Undercurrent (EUC) in response to strengthened winds, which brings cooler water to the surface of the eastern Pacific and transports additional heat into the subsurface western Pacific. The intensified winds also increase the volume and heat transport of the Indonesian Throughflow, moving some of the additional heat from the western Pacific into the Indian Ocean. The net result is a warmer subsurface western Pacific, a cooler upper eastern Pacific and a warmer subsurface Indian Ocean, with an overall increase in Indo-Pacific heat content.

Extended experiments with a symmetric reversal of the atmospheric state examine how the ocean would respond if the winds (and other associated atmospheric variables) were to revert to their initial state. We find a slowdown of the EUC and Pacific shallow overturning cells, resulting in a return to climatological SST conditions in the western and eastern Pacific. The ITF also slows toward its original strength. However, the temperature, heat content and ITF responses are not entirely symmetric due to an overall increase in the surface heat flux into the ocean associated with the cooler surface of the Pacific and irreversible heat transfer from the Pacific into the Indian Ocean via the ITF. There is also irreversible heat transport across the thermocline via diapycnal mixing, further contributing to this asymmetry. Consequently, after the atmosphere has returned to its initial state we find an Indo-Pacific subsurface ocean is warmer than it was at the start of the combined experiments.