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The impact of Atlantic ocean circulation on El Nino-Southern Oscillation (ENSO) variability

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A coupled ocean-atmosphere general circulation model is used to investigate the modulation of ENSO variability due to a weakened Atlantic thermohaline circulation (THC). THC weakening induced by "water hosing" of the North Atlantic leads to a well-known SST dipole and a southward shift of the Intertropical Convergence Zone in the tropical Atlantic. Through atmospheric teleconnections and local coupled air-sea feedbacks, a meridionally asymmetric mean state change is generated in the eastern equatorial Pacific, corresponding to a weakened annual cycle, and westerly anomalies develop over the central Pacific. The westerly anomalies are associated with anomalous warming of SST, causing an eastward extension of the west Pacific warm pool particularly in August-February. These and other changes in the mean state lead in turn to an eastward shift of the zonal wind anomalies associated with El Nino events, and a significant increase in ENSO variability. The mechanism identified may help to explain links between the Atlantic Ocean and ENSO activity suggested by paleoclimate records. In addition, we have shown with further experiments that variations during the twentieth century of the Atlantic Multidecadal Oscillation (AMO), which are thought to be related to the THC, may also have influenced ENSO activity. The AMO negative phase, characterized by an anomalously cold North Atlantic and warm South Atlantic, was associated with strong ENSO variability while its positive phase was associated with weak ENSO variability. This relationship is also reproduced qualitatively in idealized regional coupled experiments where Atlantic SSTs were prescribed. This study suggests that fluctuations of the THC can mediate not only mean climate globally but also modulate interannual climate variability. The results suggest a non-local mechanism for changes in ENSO statistics and provide an alternative view to understanding the multidecadal variability of ENSO activity during the twentieth century