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Phase locking of equatorial Atlantic variability through the seasonal migration of the ITCZ

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The equatorial Atlantic is marked by significant interannual variability in sea-surface temperature (SST) that is phase-locked to late boreal spring and early summer. The role of the atmosphere in this phase locking is examined using observations, reanalysis data, and model output. The results show that equatorial zonal surface wind anomalies, which are a main driver of warm and cold events, typically start decreasing in May, one month before the peak of SST anomalies. This behavior is closely associated with the seasonal northward migration of the intertropical convergence zone (ITCZ) in early summer. The north-equatorial position of the Atlantic ITCZ contributes to the decay of wind anomalies in three ways: 1) Horizontal advection associated with the cross-equatorial flow damps anomalies on the equator. This is because wind anomalies are small south of the equator. 2) The absence of deep convection leads to changes in vertical momentum transport that reduce the equatorial surface wind anomalies. 3) The cross-equatorial flow is associated with increased total wind speed. This enhances surface drag and deposits more momentum into the ocean.
A similar mechanism applies to the equatorial Pacific and Indian Oceans but there the ITCZ is more diffuse and its seasonal migration is less abrupt, leading to less pronounced phase locking.
Further analysis and model experiments suggest that the Atlantic phase locking mechanism may have far-reaching consequences because it makes equatorial Atlantic variability susceptible to subtropical influences and climate change.