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 June, despite SST and sea-level pressure gradient anomalies being at their peak during this month. This counterintuitive behavior is explained by 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 winds transports air masses of comparatively low zonal momentum anomalies from the southeast toward 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, which increases surface drag and deposit of momentum into the ocean.
Previous studies have shown that convection enhances the surface wind response to SST anomalies. The present study indicates that convection also amplifies the surface zonal wind response to sea-level pressure gradients in the western equatorial Atlantic, where SST anomalies are small. This introduces a new element into coupled air-sea interaction of the tropical Atlantic.

Keywords: equatorial Atlantic, phase locking, ITCZ

