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How ITCZ latitude influences equatorial Atlantic interannual variability

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Monthly mean deep convection over the tropical Atlantic is typically organized in a zonally oriented band known as the Atlantic intertropical convergence zone (ITCZ). Climatologically, the Atlantic ITCZ is farthest away from the equator in September at 8ºN and closest in April when it is located right on the equator. In the climatological sense, therefore, the ITCZ is never found south of the equator. ITCZ latitude, however, is subject to considerable interannual variability and thus there are actually many instances when the ITCZ does move south of the equator, particularly during boreal spring (MAM). Our analysis shows that such fluctuations in ITCZ latitude are closely linked to the strength of the equatorial surface winds. The surface winds in turn are a critical factor for the zonal mode of sea-surface temperature (SST) variability, often referred to as Atlantic Niño. Based on monthly mean surface winds and ITCZ latitude from the ERA-Interim reanalysis we find that equatorial easterlies weaken approximately linearly with latitude in the range 5ºN to 2ºS. Thus the easterlies are weakest when the ITCZ is located south of the equator. Such south-equatorial ITCZ excursions in MAM appear to be an important factor in the onset phase of Atlantic Niños, which peak in boreal summer (JJA). This is evidenced by a composite analysis of both observations and ERA-Interim reanalysis.

General circulation models (GCMs) participating in the Coupled Model Intercomparison Project phase 5 (CMIP5) typically place the MAM ITCZ south of the equator far more often than observed. Consistently, the model climatology suffers from weaker than observed easterlies on the equator, and warmer than observed SSTs in the eastern equatorial Atlantic, reminiscent of the positive phase of the zonal mode. Despite their substantial mean state biases some models reproduce the observed phasing of Atlantic Niños, with southward ITCZ shift and weakening of the equatorial easterlies in MAM preceding the SST warming in JJA.

Using both observations and CMIP5 models we further investigate the large-scale conditions that favor south-equatorial ITCZ excursions. Among other we reexamine the hypothesis that convection over tropical South America and Africa influences the Atlantic ITCZ latitude.