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Atlantic tropical cyclones (TC) and their associated severe storm surge and coastal flooding cause loss of human lives and damage to properties. It is well known that the seasonal activity of Atlantic TC is largely modulated by tropical Pacific and Atlantic sea surface temperature anomalies (SSTAs) associated with El Niño-Southern Oscillation (ENSO) and Atlantic meridional mode (AMM). However, ENSO is typically in a developing phase during the peak season of Atlantic hurricane (August–October), and AMM usually develops in boreal spring and often dissipates before August. In the tropical Atlantic, the leading mode of SST variability in boreal summer and fall is Atlantic Niño/Niña, characterized by warm/cold SSTAs in the eastern equatorial Atlantic that often persist through the Atlantic hurricane peak season. Nevertheless, the relationship between Atlantic Niño/Niña and Atlantic TC activity has not yet been explored. This is the first systematic study of the physical and statistical links between Atlantic Niño/Niña and Atlantic TC. Our analysis of observational and reanalysis datasets during 1948-2019, together with model experiments, shows that Atlantic Niño strengthens the Atlantic intertropical convergence zone, increasing rainfall over the west African sub-Sahel region and African easterly waves. Additionally, the enhanced atmospheric convection produces low-level westerly wind anomalies over the tropical North Atlantic, which in turn increase low-level relative vorticity and decrease vertical wind shear over the Atlantic TC main development region (MDR). These atmospheric conditions over the MDR are favorable for increasing Atlantic TC activity. Further analysis shows that the tendency for La Niña to enhance Atlantic TC activity is amplified during Atlantic Niña and weakened during Atlantic Niño. Conversely, unfavorable conditions for Atlantic TC activity during El Niño are amplified during Atlantic Niña, but suppressed during Atlantic Niño. This study suggests that Atlantic Niño/Niña may aid to improve the current seasonal prediction skill of Atlantic TC activity.
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