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Ph.D. Dissertation Announcement

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SCHOOL OF OCEAN AND EARTH SCIENCE AND TECHNOLOGY

Inter-basin teleconnection between the tropical Pacific and tropical Atlantic

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You are invited to a Zoom meeting.
When: April 7, 2021 at 9:00AM HST

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Abstract:

In this dissertation, the inter-basin teleconnection between the tropical Pacific and the tropical Atlantic is investigated through observational analyses and numerical simulations. In the first part, the impact of the El Niño-Southern Oscillation (ENSO) on tropical North Atlantic (TNA) sea surface temperature anomaly (SSTA) is discussed. During El Niño decaying spring, the TNA region displays a significant warm SSTA, which is mainly caused by trade wind-induced surface latent heat flux anomaly. ENSO can generate anomalous southwesterlies over the TNA region through an extratropical pathway (via the Pacific - North American pattern) and a tropical pathway (remote Gill response with suppressed tropical Atlantic rainfall). Both a partial regression analysis and numerical simulations indicate that the extratropical (tropical) pathway contributes to approximately 60% (40%) of the observed wind anomaly in TNA.

In the second part, the relationship between the ENSO and equatorial Atlantic (EA) variability is explored. While boreal summer EA SSTA has an insignificant correlation with the preceding ENSO, it exists a robust simultaneous negative correlation with the Pacific SSTA (Niño3.4 index). A further analysis shows that both the El Niño and La Niña events in boreal winter precede a warm EA event. The physical cause of the asymmetric ENSO impacts is explored. It is found that El Niño impact is primarily through the preconditioning of the Atlantic SSTA during El Niño developing fall and mature winter, whereas the La Niña impact is mainly via the remote teleconnection pattern during boreal spring and summer after the peak of the La Niña. The season-dependent feature is attributed to distinctive phase evolution characteristics between El Niño and La Niña.

In the third part, how the tropical Atlantic SSTA variability affects subsequent ENSO evolution is investigated. It is shown that the TNA (EA) forcing tends to generate a CP-type (EP-type) ENSO event due to the relative longitudinal location of the TNA and EA SSTA forcing. While a basin-wide warming pattern in the Atlantic exerts a robust influence on the Pacific, a meridional dipole pattern cannot. By comparing four different forcing experiments (TNA, EA, basin warming and dipole pattern), we demonstrated the essential role of the Kelvin wave response and the associated monsoon-ocean interaction over the northern Indian Ocean (NIO) and Maritime Continent (MC) in connecting the Atlantic SSTA forcing and zonal wind anomalies and thus ENSO over the equatorial Pacific. When the Atlantic-induced Kelvin wave process is absent, the zonal wind anomaly generated by the Rossby wave process only remained in the off-equatorial Pacific region, which hardly affects the subsequent ENSO evolution. Further sensitivity experiments show that the TNA/EA forcing is not strong enough to alter the sign of a pre-existing ENSO, but can modulate the amplitude of the ENSO events.