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The Madden-Julian Oscillation (MJO) is known as the dominant mode of intraseasonal variability in the tropics, characterized a region of enhanced convective activities that propagate from the Indian Ocean (IO) to the Western Pacific(WP). However, our understanding of its fundamental role in the atmosphere, and explanation for why it exists is still limited. Taking this into consideration, this study examined how the MJO propagation speed and the intensity of their events were modulated by the background environment and sought for an intrinsic relationship of the MJO with the background atmospheric states.

To build on our recent finding of MJO enhancement with background zonal sea surface temperature (SST) gradient, we examined how MJO propagation speed was influenced by the background SST. We constructed a tracking method of MJO convection and calculated the propagation speed of each event. We investigated how the characteristics of the MJO and the background SST states that they occur in varied depending on their propagation speed. The analysis revealed that the slower events were associated with a condition of low-frequency SST (> 60 days) distribution with a positive zonal gradient from the IO to WP. In contrast, high-frequency SST (20 –60 days) distributions associated with the MJO events were much the same between the fast and the slow groups with little zonal SST gradient across IO to WP. Furthermore, the extension of the analysis to rest of the events revealed that the relationship between zonal SST gradient and propagation speed was not a tendency restricted to the fastest and the slowest groups, but is an overall relationship that is displayed by all of the events. Taking note that the presence of zonal SST gradient in the low-frequency range has the potential to enhance large-scale zonal circulation, the component of the zonal wind associated with the background circulation was also analyzed. The analysis showed that there is a tendency for MJO to propagate slower when the background large-scale zonal circulation was stronger, implying that slower MJOs are embedded in enhanced large-scale zonal circulation.

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