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Tropical Cyclone Interactions with Madden-Julian Oscillation Convection in the Indian Ocean

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The Madden-Julian Oscillation (MJO) can create favorable conditions for tropical cyclone (TC) genesis in the Indian Ocean, but past work has not thoroughly investigated how TCs *after* genesis may influence MJO convection development. This work utilizes long-term composite analysis to broadly establish the relationship between Indian Ocean TCs and each MJO phase over the Indian basin, and then seeks to isolate direct impacts of the TCs on MJO convection coverage and intensity.

We first examine Indian Ocean TC interactions with MJO convection using daily-mean ERA5 reanalysis and TRMM precipitation products from 1998-2018 for TC and non-TC days per MJO phase, excluding 3 days before and after Best-Track TC lifespans to reduce contamination of non-TC composites. Preliminary analysis suggests that TC periods are associated with stronger MJOs, with an anomalously stronger MJO large-scale circulation and associated subsidence over the equatorial Indian Ocean. We find higher CAPE and increased TRMM rainfall during convectively-active MJO phases over the eastern Indian Ocean when TCs are present, but increased dry-air advection, greater CIN, and decreased TRMM rainfall over the western Indian Ocean during the same phases. These findings allude to suppression of MJO convection development during TC periods in the western MJO convective envelope, with coincident enhancement of MJO convection in the eastern MJO convective envelope. While these broad conclusions are consistent during non-convectively-active MJO phases, changing MJO strength during TC periods for convectively-active MJO phases limit our ability to quantify TC impacts on MJO convection using only composite analysis.

To better quantify TC influences, we next isolate direct TC impacts on MJO convection using metrics for the TC range of influence, likelihood of interaction with MJO convection, and strength of TC-MJO convection interactions. Since a TC's influence likely extends beyond the 34-kt wind radii provided by Best-Track, we determine an “outer wind radius” by integrating a radial wind model outward from each TC eye to ~5 m/s. We next quantify the overlapping area between each TC outer wind radius and the coincident MJO convection by using the MJO precipitation boundary determined from a large-scale precipitation tracking dataset, with the size of the overlapping area providing the likelihood of interaction. For time periods when TC outer wind radii and MJO convection overlap, we compare the convection coverage and intensity observed by TRMM

between MJO convection sectors with and without TC wind overlap. The strength of a TC-MJO convection interaction is finally quantified by comparing the convection coverage and intensity between these sectors. With climatological statistics on the likelihood and strength of TC-MJO interactions, future MJO prediction and Maritime Continent rainfall forecasts could be adjusted according to the presence or absence of Indian Ocean TCs.