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The impact of diurnal precipitation over Sumatra Island, Indonesia, on synoptic disturbances and its relation to the Madden-Julian Oscillation

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The impact of diurnal precipitation over Sumatra Island, the Indonesian Maritime Continent (MC), on synoptic disturbances over the eastern Indian Ocean is examined using high-resolution rainfall data from the Global Satellite Mapping of Precipitation project and the Japanese 55-year Reanalysis data during the rainy season from September to April for the period 2000–2014. When the diurnal cycle is strong, the high precipitation area observed over Sumatra in the afternoon migrates offshore during nighttime and reaches 500 km off the coast on average. The strong diurnal events are followed by the development of synoptic disturbances over the eastern Indian Ocean for several days, and apparent twin synoptic disturbances straddling the equator develop only when the convective center of the Madden–Julian Oscillation (MJO) lies over the Indian Ocean (MJO-IO). Without the MJO, the synoptic disturbances develop mainly south of the equator. The differences in the locations and behaviors of active synoptic disturbances are related to the strength of mean horizontal winds in the lower troposphere. During the MJO-IO, the intensification of mean northeasterly winds in the northern hemisphere blowing into the organized MJO convection in addition to mean southeasterly winds in the southern hemisphere facilitate the formation of the twin disturbances. These results suggest that seed disturbances arising from the diurnal offshore migration of precipitation from Sumatra develop differently depending on the mean states over the eastern Indian Ocean. Furthermore, it is shown that the MJO events with the strong diurnal cycle tend to have longer duration and continuing eastward propagation of active convection across the MC, whereas the convective activities of the other MJO events weaken considerably over the MC and develop again over the western Pacific. These results suggest that the strong diurnal cycle over Sumatra facilitates the smooth eastward propagation of the intraseasonal convection across the MC.