

MJO Effects on the Formation and Subseasonal Predictability of Record-breaking Northeast Asian Heatwave in the Summer of 2018

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In the summer of 2018, Northeast Asia experienced a heatwave event that broke the existing high-temperature records in several locations in Japan, the Korean Peninsula and northeastern China. At the same time, an unusually strong Madden-Julian Oscillation (MJO) was observed to stay over the western Pacific warm pool. Based on reanalysis diagnosis, numerical experiments and assessments of real-time forecast data from two subseasonal-to-seasonal (S2S) models, we discovered the importance of the western Pacific MJO in the generation of this heatwave event, as well as its predictability at the subseasonal timescale.

During the prolonged heat extreme period (11 July to 14 August), a high pressure anomaly with variability at the intraseasonal (30–90 days) timescale appeared over Northeast Asia, causing persistent adiabatic heating and clear skies in this region. As shown in the composites of MJO-related convection and circulation anomalies, the occurrence of this 30–90-day high anomaly over Northeast Asia was linked with an anomalous wave train induced by tropical heating associated with the western tropical Pacific MJO. The impact of the MJO on the heatwave was further confirmed by sensitivity experiments with a coupled GCM. As the western Pacific MJO-related components were removed by nudging prognostic variables over the tropics towards their annual cycle and longer timescales (>90 days) in the coupled GCM, the anomalous wave train along the East Asian coast disappeared and the surface air temperature in Northeast Asia reduced. The MJO over the western Pacific warm pool also influenced the predictability of the extratropical heatwave. Our assessments of two S2S models' real-time forecasts suggest that the extremity of this Northeast Asian heatwave can be better predicted 1–4 weeks in advance if the enhancement of MJO convections over the western Pacific warm pool is predicted well.

Keywords: Madden-Julian Oscillation, Heatwave, Mechanism, Predictability