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# Evaluating Asian Monsoon Northward Propagation Mechanisms in the ERA-interim Reanalysis and SP-CCSM

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Equatorial tropical convection is dominated by the eastward-propagating Madden-Julian Oscillation (MJO). During boreal summer months, MJO convection also acquires a northward component to its propagation, which results in the intraseasonal "active" and "break" periods of the Asian monsoon. Northward propagation (NP) may results from air-sea coupling and/or from the interaction of convection, particularly that associated with equatorial Rossby (ER) waves, and environmental easterly shear that develops as low-level winds shift from northeasterly to southwesterly during the summer months. Several studies have proposed specific mechanisms for NP, but no consensus exists as to which mechanisms are dominant, or even present, in observations.

This study evaluates the presence and impact of NP mechanisms on the Asian monsoon as observed in the ERA-Interim reanalysis and in the super-paramaterized CCSM (SP-CCSM). We evaluate the following mechanisms: 1) surface temperature destabilization, 2) SST gradient-induced boundary layer convergence, 3) the easterly shear mechanism of Jiang et al. (2004), 4) boundary layer moisture advection, and 5) tropospheric vorticity advection. Comparison of the relative impacts of these myriad mechanisms is accomplished by computing an index of each mechanism, and regressing normalized indices onto ISO-filtered OLR anomalies at several lead/lag times. Indices with high regression coefficients are considered to be important to NP.

We conclude that many mechanisms contribute to NP in the Asian monsoon, but are dominated by boundary layer moisture advection and the easterly shear mechanism. Air-sea coupling effects are secondary to atmospheric dynamic mechanisms. The distribution and relative contribution of mechanisms in SP-CCSM is remarkably similar to those in the reanalysis, and emphasize the need for both realistic basic states of wind and moisture, as well as robust tropical equatorial waves.