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Tropical Variations Associated with the Madden and Julian Oscillation

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Two new diagnostic methods are used to better understand the interactions in the Tropics associated with the Madden and Julian Oscillation (MJO). The first, Composite Singular Value Decomposition (CSVD), is used to analyze at various time lags the space–time relationships between Outgoing Longwave Radiation (OLR), low-level specific humidity and divergence, and surface evaporation in an Equatorial band for the period 1981–2000. These data are filtered at each point using a 20–100-day Lanczos filter capturing well the MJO periodicities. The two dominant CSVDs describe an eastward-propagating quasi-wavenumber-1 system in all of the analyzed variables. The dominant low-level divergence, moisture, and latent heat flux variations lead those of OLR by approximately 10 days. The low-level convergence and positive moisture anomalies develop near and to the east of the ensuing convective perturbations; positive latent heat flux variations generally occur farther to the east. Near the centers of convection the low-level moisture increases at the same time that the 1000-hPa flow is becoming slightly more divergent. This implies that the moisture preconditioning of convective events is not driven totally by moisture convergence.

The second method is Centered Composite Analysis (CComp), which composites data after identifying the dates and central locations of key events. The elements of the composite means are centered on these central locations removing much of the spatial fuzziness, which is inherent in traditional Composite Analysis. The results, based on MJO filtered OLR for the reference data and reanalysis products for the composites, show highly significant composites of unfiltered data for not only zero lag, but also lags back to 20 days before the target events. These composites identify propagating patterns of surface pressure, upper and lower troposphere zonal winds, surface temperature, and 850 hPa specific humidity. The propagation characteristics of important

features, especially surface pressure, differ substantially for MJO convective anomalies centered over the Indian or Western Pacific Oceans. This suggests that distinctly different mechanisms may be dominant in these two regions, and that many earlier analyses may be mixing properties of the two.