Impacts of Madden Julian Oscillations on Temperature and Precipitation in North America during ENSO-Neutral and Weak ENSO Winters

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An extended Empirical Orthogonal Function (EEOF) analysis is applied to the pentad velocity potential at 200-hPa for ENSO-neutral and weak ENSO winters (November-April) during 1979-2000. The first EEOF is composed of ten time-lagged patterns that describe the eastward propagation of the MJO with a timescale of roughly 45 days. Ten MJO indices are obtained by regressing the filtered (25-87 days) pentad data onto the ten patterns of the first EEOF. By keying on the convectively active phase of the ten MJO indices, ten composites of the major MJO events are constructed for various fields, including surface air temperature and precipitation.

Significant MJO-related influences on surface air temperature and precipitation in North America are found. When the convectively active phase of the MJO is located near 120oE, a negative Pacific-North American (PNA) pattern develops and persists for 2-3 pentads. During the negative PNA phase, the Pacific North West (PNW) often experiences wetter-than-normal conditions, and California experiences dryer-than-normal conditions. At the same time, the eastern U.S. experiences warmer-than-normal conditions and the western Canada experiences cooler-than-normal conditions. As the enhanced convection shifts eastward towards the dateline, the polar branch of the Pacific jet stream weakens and the subtropical branch of the jet stream strengthens. A plume of moisture is transported northeastward towards the west coast of the U.S., producing wetter-than-normal conditions in California and dryer-than-normal conditions in PNW. At the same time, the western Canada experiences warmer-than-normal conditions. As the enhanced convection reappears in the western Indian Ocean, a ridge of high pressure develops in the eastern North Pacific and a trough of low pressure develops along the west coast of the U.S., producing cooler-than-normal conditions there.

The MJO indices discussed here are used for real-time monitoring purposes at the Climate Prediction Center
(http://www.cpc.ncep.noaa.gov/products/precip/CWlink/daily_mjo_index/mjo_index.html).
During the winter of 2001-2002, this monitoring capability greatly improved our understanding of relationships between the MJO and prominent teleconnection patterns, such as the Pacific-North American pattern, which we also monitor. In the near future, we plan to use a Markov approach to make empirical forecasts of the MJO and its associated impacts.