

Modulations of the East Asian Winter Monsoon by the Western Pacific (WP) Pattern: Its Dynamics and Remote Influence from the Tropics

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The Western Pacific (WP) pattern, originally identified in monthly anomalies by Wallace and Gutzler (1981), is characterized by north-south dipolar anomalies in pressure over the Far East and western North Pacific. Though sometimes referred to as the North Pacific Oscillation (Linkin and Nigam 2008), well-defined signature of the WP pattern can be extracted by statistically removing the dominant variability associated with the PNA pattern (Tanaka et al. 2016). The dipolar anomalies in baroclinic structure with their phase lines tilting southwestward with height can convert available potential energy (APE) from the climatological-mean field, in which the East Asian winter monsoon is embedded. The APE conversion is more efficient than the net feedback forcing by sub-weekly transient eddies and sufficient for maintaining the monthly WP pattern against dissipative processes. The WP pattern may thus be regarded as a preferred mode of variability that modulates the East Asian winter monsoon and associated planetary waves. As their distinctive characteristics, blocking anomalies associated with the WP pattern augment monsoonal cold air outbreaks toward Korea/Japan and act to strengthen the stratospheric polar vortex. The probability density distribution (PDF) of the WP pattern can be altered by any external forcing, including teleconnection from the tropical variability. Enhanced (reduced) convective activity over the South China Sea during a La Niña (El Niño) event is known to increase the likelihood of the blocking phase of the WP pattern, offering the basis for seasonal prediction for winter climate over East Asia. Our latest study has revealed, however, that convective activity around the Maritime Continent in boreal winter, especially the Australian summer monsoon, is uncorrelated with tropical SST variability, which can therefore lower the potential predictability of the East Asian winter climate. The insensitivity of the Australian summer monsoon to SST anomalies arises from the climatological seasonality of the surface winds and subsurface oceanic condition over the tropical southeastern Indian Ocean.

Key words: winter monsoon, teleconnection, tropical variability blocking, predictability

References

- Linkin, M.E., and S. Nigam, 2008: *J. Climate*, **21**, 1979-1997.
Tanaka, S., and Coauthors, 2016: *J. Climate*, **29**, 6597-6616.
Wallace, J.M., and D.S. Gutzler, 1981: *Mon. Wea. Rev.*, **109**, 784-812.