



## **Regime-dependent nonstationary relationship between the East Asian winter monsoon and North Pacific Oscillation**

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The East Asian winter monsoon (EAWM) and the North Pacific Oscillation (NPO) constitute two outstanding surface atmospheric circulation patterns affecting the winter sea surface temperature (SST) variability in the north-west Pacific Ocean. By analyzing data over a total of 48 winter seasons (1965-2012), our analyses show that the indices of the above atmospheric circulation patterns underwent an abrupt regime shift around 1988, from a strong winter monsoon regime before 1988 to a weaker monsoon regime afterward. The 11-year running correlation indicates that the EAWM and NPO were tightly connected to each other during the last two thirds of the strong monsoon regime (1973-1987; SM-HC epoch) but nearly completely disconnected during the first two thirds of the weak monsoon regime (1988-2002; WM-LC epoch). This regime-dependent nonstationary relationship between the EAWM and NPO is related to a tight (insignificant) statistical connection in sea level pressure variations between the Siberian high (SH) and NPO centers of action during the SM-HC (WM-LC) epoch. This is also associated with the pronounced decadal weakening of the SH system over the entire Eurasian continent after the 1988 regime shift as well as the concomitant, positive NPO/WP-like dipole change in surface and upper-level circulation patterns over the North Pacific. It is also shown that the EAWM and NPO are consistently well linked to the upper-level blocking events, Ural and Kamchatka blockings, which determine predominantly the variability of the SH and west Pacific teleconnection pattern (WP), respectively. The regime-dependent changes in atmospheric surface circulation affect differently the northwest Pacific SST. During the SM-HC epoch when the EAWM and NPO were strongly connected to each other, a very similar spatial pattern of SST anomalies was projected by these circulation modes, while a quite dissimilar and weakened pattern was observed during the WM-LC epoch when the EAWM and NPO were practically independent. In particular, the EAWM impact on SST during the latter epoch shrank remarkably into a limited area in the East China Sea, making a clear distinction from the NPO impact.