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Origin of seasonal predictability for summer climate over the Northwestern Pacific

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Summer climate in the Northwestern Pacific (NWP) displays large year-to-year variability, affecting densely populated Southeast and East Asia by impacting precipitation, temperature and tropical cyclones. The Pacific-Japan (PJ) teleconnection pattern provides a crucial link from the tropics of high predictability to East Asia. Using coupled climate model experiments, we show that the PJ pattern is the atmospheric manifestation of an air-sea coupled mode spanning the Indo-NWP warm pool. In this coupled mode, the PJ pattern forces the Indian Ocean (IO) via a westward propagating atmospheric Rossby wave. In response, IO sea surface temperature (SST) feeds back and reinforces the PJ pattern via a tropospheric Kelvin wave. Ocean coupling increases both the amplitude and temporal persistence of the PJ pattern. Cross-correlation of ocean-atmospheric anomalies confirms the coupled nature of this PJIO mode. El Nino-Southern Oscillation (ENSO) is a major external driver of the PJIO mode, leaving the last echoes of ENSO in the IO-NWP in the form of this mode. We further demonstrate that the PJIO mode is indeed highly predictable, giving hopes for skillful seasonal forecast over the densely populated region.

Keywords: air-sea coupled mode, climate variability, East Asian summer monsoon, El Nino-Southern Oscillation