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Effect of the tropical Pacific and Indian Ocean warming since the late 1970s on wintertime Northern Hemispheric atmospheric circulation and East Asian climate interdecadal changes

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Observation reveals that the tropical Pacific-Indian Ocean (TPIO) has experienced a pronounced interdecadal warming since the end of 1970s. Meanwhile, the wintertime midlatitude Northern Hemispheric atmospheric circulation and East Asian climate have also undergone substantial interdecadal changes. The effect of the TPIO warming on these interdecadal changes are identified by a suite of AMIP-type atmospheric general circulation model experiments in which the model is integrated from September 1948 to December 1999 with prescribed historical, observed realistic sea surface temperature (SST) in a specific region and climatological SST elsewhere. Results show that the TPIO warming reproduces quite well the observed Northern Hemispheric wintertime interdecadal changes, suggesting that these interdecadal changes primarily originate from the TPIO warming. However, each sub-region of TPIO has its own distinct contribution. Comparatively, the tropical central-eastern Pacific (TCEP) and tropical western Pacific (TWP) warming makes dominant contributions to the observed positive-phase PNA-like interdecadal anomaly over the North Pacific sector, while the tropical Indian Ocean (TIO) warming tends to cancel these contributions. Meanwhile, the TIO and TWP warming makes dominant contributions to the observed positive NAO-like interdecadal anomaly over the North Atlantic sector as well as the interdecadal anomalies over the Eurasian sector, although the TWP warming's contribution is relatively small. These remote responses are directly attributed to the TPIO warming-induced tropical convection, rainfall and diabatic heating increases, in which the TIO warming has the most significant effect. Moreover, the TPIO warming excites a Gill-type pattern anomaly over the tropical western Pacific, with a low-level anticyclonic circulation anomaly over the Philippine Sea. Of three sub-regions, the TIO warming dominates such a pattern, although the TWP warming tends to cancel this effect. The anticyclonic circulation anomaly intensifies the southwesterly flow that transfers more moisture from the Bay of Bengal to East Asia and considerably increases the winter precipitation over the southern East Asia. This is strongly supported by the observational fact that there has been a significant interdecadal increase of winter precipitation over the southern China since the end of 1970s.