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Winter-to-Winter Recurrence (WWR) of Air-Sea System in the Northern Hemisphere

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Sea surface temperature anomalies (SSTA) persistence has strong seasonal dependence in the mid-latitude ocean, showing a tendency to recur from one winter to the next without persisting through the intervening summer. Previous studies have speculated such seasonal dependence of persistence is closely tied to the oceanic reemergence mechanism associated with seasonal variation of oceanic mixed layer depth. It is known that, in the extratropics, atmosphere tends to drive ocean especially in winter. However, winter-to-winter recurrence (WWR) of atmospheric circulation and its influence on the WWR of SSTA remains unclear. The spatiotemporal characteristics of WWR of air-sea system in the Northern Hemisphere are comprehensively studied through lag correlation analysis. Our results show that. WWR is a seasonal evolutional characteristic of the whole air-sea system in the North Atlantic (North Pacific). The WWR displays a strong interannual variability and does not occur every year. During WWR years, atmospheric circulation anomalies exhibit the WWR phenomenon. Atmospheric forcing as well as the oceanic reemergence mechanism can act synergistically to create SSTA in the following winter with the same sign. During non-WWR years, winter atmospheric circulation anomalies do not recur in the following winter, and the following winter has opposing atmospheric forcing on SSTA. Although the oceanic reemergence mechanism is likely still operating, the anomalous heating supplied by the oceanic reemergence mechanism is smaller than that coming through the atmospheric forcing.