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Feedbacks of Sea Surface Temperature to Wintertime Storm Tracks in the North Atlantic

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Storm tracks, characterized by the intense activities of synoptic-scale transient eddies in the midlatitudes aloft, play a critical role in the climate system. Previous studies have revealed the importance of oceanic fronts associated with strong sea surface temperature (SST) gradients on the climatological structure of storm tracks. The coupling relationship between storm-track and SST anomalies, however, has not been clearly identified in observation.
Here, the lagged maximum covariance analysis (MCA) is performed on winter storm-track anomalies, represented by the meridional heat flux by synoptic-scale (2-8 days) transient eddies, and SST anomalies in the North Atlantic, which both are derived from the reanalysis datasets spanning the 20th century. The analysis shows significant seasonal and interannual coupling between storm-track and SST variations. On seasonal time scales, it is found that SST anomalies in the preceding early winter (November-December), which are expected to change the lower-tropospheric baroclinicity, can significantly influence storm tracks in early spring (March); that is, an intensification and slight northward shift of storm tracks in response to a midlatitude SST dipole, with cold pole centered to the southeast of Newfoundland and warm pole in the western subtropical Atlantic. This storm-track response pattern is similar to the storm-track forcing pattern in early spring, which resembles the dominant mode of storm tracks. On interannual time scales, it is found that the wintertime (January-to-March) storm-track and SST anomalies are mutually reinforced, manifesting as a zonal-dipole-like pattern in storm-track anomalies (with dominant negative anomalies in the downstream) coupled with a midlatitude SST monopole (with warm anomalies centered to the south and east of Newfoundland).