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Divergent Responses of Extratropical Atmospheric Circulation to Interhemispheric Dipolar SST Forcing over the Two Hemispheres in Boreal Winter

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Global sea surface temperature (SST) evolution exhibits an anti-phase variation between the two hemispheres that is referred to as the SST inter-hemispheric dipole (SSTID) mode. The impacts of the SSTID on extratropical atmospheric circulation in boreal winter are explored by both regression analysis and SST-forced numerical simulations. The responses of extratropical circulation to SSTID thermal forcing bear an equivalent barotropic structure. For the Southern Hemisphere (SH), positive SSTID events lead to a meridional dipolar perturbation in sea level pressure (SLP), similar in pattern to the positive Southern Annular Mode (SAM). While SSTID forced SLP anomalies over the Northern Hemisphere (NH) do not exhibit a zonally symmetric pattern as is the case over the SH, however, they still show signs of a meridional dipole opposite to the SH over the oceans. Divergent circulation responses to SSTID forcing between the two hemispheres are suggested to be associated with contrasting storm track variations. Positive SSTID events weaken oceanic fronts in both the North Atlantic and North Pacific, and thus lead to the decline of NH storm track activity by decreasing atmospheric baroclinicity. In the SH, positive SSTID events correspond to the enhancement of SH transients by intensifying Antarctic polar frontal zone. Additionally, local baroclinic energy conversions are diagnosed to explain the SSTID-related storm track variations over both hemispheres. Finally, an investigation of transient eddy feedback indicates that the SSTID mode modulates extratropical atmospheric circulation, primarily by regulating storm tracks and changing the corresponding eddy feedback.