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Influence of a midlatitude oceanic frontal zone on the formation of a storm-track and eddy-driven jet and their dominant variability

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Influences of a midlatitude SST frontal zone on the formation of a storm-track and eddy-driven jet and their dominant "annular" variability are assessed in idealized "aqua-planet" experiments using an atmospheric general circulation model. In one experiment with a midlatitude frontal SST gradient as observed in the South Indian Ocean, transient eddy activity in each of the hemispheres is organized into a deep storm track along the SST front, accompanying an eddy-driven polar-front jet (PFJ) with strong surface westerlies. Their dominant variability has a structure similar to the annular mode observed in the Southern Hemisphere. In another experiment, elimination of the midlatitude frontal SST gradient yields marked weakening in the storm-track activity and annular-mode signal in addition to an equatorward shift of westerly wind anomalies in step with a shift of the joint mean axis of the PFJ and storm track in the summer hemisphere. In the winter hemisphere, the elimination of the frontal SST gradient leads to a marked reduction in the variance of midlatitude zonal-mean westerlies, while the dominant mode of variability represents subtropical jet (STJ) variability under the weakened eddy feedback onto the westerly wind anomalies. Additional experiments performed with changing the latitude of the frontal SST gradient reveals rather high sensitivity of the mean low-level axes of PFJ and storm track, indicating the anchoring effect of a midlatitude oceanic front on the storm track and eddy-driven jet through effective restoration of near-surface baroclinicity via cross-frontal differential heat supply from the ocean.