Observations show that the major storm-tracks and associated precipitation bands tend to form along the major oceanic frontal zones (OFZs) where warm and cold currents are confluent to maintain tight meridional sea-surface temperature (SST) gradient. Storm-track formation requires recurrent development of atmospheric disturbances, which becomes possible if the surface baroclinicity is restored effectively against the relaxing effect by their heat transport. The restoration is particularly effective in OFZs via cross-frontal differential heat supply from the ocean, which may be called “oceanic baroclinic adjustment”, as confirmed by recent modeling studies (Nakamura et al. 2008; Nonaka et al. 2009; Taguchi et al. 2009; Sampe et al. 2010). In the presence of a mid-latitude OFZ, enhanced storm-track activity maintains a polar-front jet (PFJ) with strong surface westerlies, whose axial migrations are manifested as the annular mode. In fact, an eddy-driven PFJ and its annular variability are well simulated as observed in the Southern Hemisphere in a particular “aqua-planet” AGCM experiment where frontal SST gradient as observed in the South Indian Ocean is prescribed as the lower-boundary condition. In another experiment where the frontal SST gradient is artificially removed, the reduction in storm-track activity weakens the PFJ and its annular variability, adding serious distortion to the structure of the annular mode, including its vertical connectivity with stratospheric anomalies in the model winter hemisphere.