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A mechanism for decadal variability in intensity of the Kuroshio Extension Current in an eddy-resolving OGCM

Masami Nonaka[†]; Bunmei Taguchi; Hisashi Nakamura; Hideharu Sasaki
[†] Japan Agency for Marine Earth Science and Technology, Japan
Leading author: nona@jamstec.go.jp

The present study investigates decadal variations in the Kuroshio Extension Current (KEC) speed and its mechanism based on a sixty-year-long hindcast integration of an eddy-resolving ocean general circulation model. The analysis on the KEC-axis coordinate shows that intensified KEC is primarily dominated in the upper about 700-m layer with about two degrees latitude in width, and associated with westward current anomalies to the north and south of the KEC axis. Also, intensified KEC is accompanied by high (low) potential vorticity (PV) anomalies to the north (south) of its axis. Horizontal distribution of the upper layer PV shows that when KEC is intensified, higher PV appears around Izu Ridge, and then it is advected downstream to the north of KEC, causing the high PV anomalies. Correlation between the KEC intensity and SSHAs to the south of KEC, the latter of which is associated with westward propagation of wind-driven Rossby waves, suggests that the former are originally caused by atmospheric variations, consistent with the previous studies. The associated variations in KEC in the upper-most stream region around Izu Ridge can induce the aforementioned PV anomalies and their downstream advection, forming frontal-scale, i.e., small meridional-scale anomalies in the PV and zonal velocity fields. These suggest that through these processes broad-scale wind variations can be converted into the frontal-scale oceanic variations. Impacts of KEC variations on surface oceanic variables are also examined. In association with intensification (northward shift) of KEC, SST tends to warm on the KEC axis and to the south (north) of it. Further, KEC tends to accompany shallower mixed layer (ML) than the surrounding regions in the mean, and the meridional shift and the intensification of the KEC are associated with the shift of the shallow ML and with shallower ML in the upstream region, respectively.