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Mechanisms of northward movement of sub-monthly-scale disturbances over the Bay of Bengal

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Using vorticity budget analysis, we discuss mechanisms of northward movement of sub-monthly-scale disturbances over the Bay of Bengal (10◦N-20◦N, 80◦E-100◦E) during the boreal summer (May-September). The ECMWF 40 Years Re-Analysis data are used to analyze the years 1979-99.

The disturbances are characterized by the relative vorticity and upward velocity anomalies which are horizontally close to each other. The disturbances move west-northwestward, and the averaged northward speed is estimated at 0.9◦ latitude par day.

Because the relative vorticity anomaly exhibits equivalent barotropic structure up to the 200-hPa level, budget of the relative vorticity integrated from the surface to the 100-hPa level is calculated. The following two terms mainly contribute to the northward movement: advection of the disturbances by the environmental meridional flow and tilting of the environmental horizontal vorticity vector by the vertical velocity anomaly.

We define an index which quantitatively represents term's strength to force the disturbances move northward. The index reveals that the former advection effect and the latter tilting effect are the primary and secondary contributors to the northward movement, respectively.

The former advection effect turns out to contribute mainly in the lower troposphere. This fact reflects the advection by the environmental low-level southerly, which is one of the features of the summer monsoonal flow over the Bay of Bengal. On the other hand, the latter tilting effect proves to contribute mainly in the middle troposphere, because the environmental easterly vertical shear, which means vorticity vector pointing south, has its maximum at the middle troposphere.

Keywords: intraseasonal phenomenon; northward movement; vorticity budget analysis; tilting effect.