The effect of the external forcing on the long-term variability of travelling eddy in the South China Sea

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Using a daily global eddy-resolving (0.1°) model product called STORM that covers a period of 1950–2010, we explore the role of external forcing for the eddy variability in the South China Sea (SCS). The frequency and pattern of eddy occurrence in the simulation is broadly consistent with satellite-based (AVISO) data.

On average, annually, 28 anticyclonic travelling eddy (AE) tracks and 54 cyclonic travelling eddy (CE) tracks with long travel lengths were identified in the discrete sea surface height anomaly fields of STORM. EOFs of the spatial fields of eddy diameter (ED), eddy intensity (EI), and eddy number (EN) show almost white eigenvalue spectra, when calculated on the model's 0.1-degree grid, but when the data are coarsened to grids with 1-degree and 2-degree grid spacing, meaningful structures emerge.

The monthly ED, EI, and EN exhibit annual cycles, which are, however, not very stable. The variabilities of annual means of ED, EI, and EN are large at interannual time scales, are small at interdecadal sales, and exhibit hardly a trend. The sizes and intensities of eddies in the SCS are hardly connected to the ENSO-variability in the tropical Pacific.

Most external drivers affect the eddy activities indirectly and pass its effect on the eddy activities through the background flow. Furthermore, the instability of the background flow provides the primary energy source for eddy formation and eddy growth, by inducing the energy conversion from available potential energy to kinetic energy. We use a canonical correlation analysis (CCA) to investigate the effect of three components of the instability (i.e. barotropic instability, current shear and temperature stratification) on the travelling eddy variability (indicated by the EI, the ED, the EN of the peak points, the travel distance of the eddy track, the eddy lifetime and the percentage of intense eddy points). The CCA results exhibit up to 39% variability of eddy activities in the SCS could be traced by the background flow.

The limited impact of the large-scale background flows, the white noise in the spatial distribution of eddy properties, and weak correlation with El Niño, point to a massive presence of internal variability (which is opposed to variability provoked by large-scale drivers). We suggest that to a large extent, the variability of eddy activity isgoverned by internal variability.