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

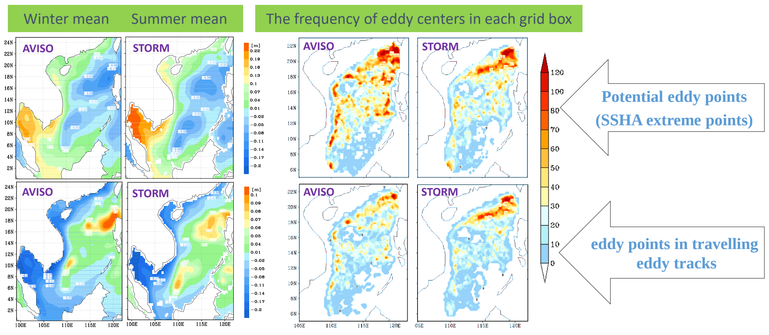
Meng Zhang[1,2] Hans von Storch[1]

1. Institute for Coastal Research, Helmholtz-Zentrum Geesthacht Centre for Materials and Coastal Research, Max-Planck-Str. 1,21502 Geesthacht, Germany
2. State Key Laboratory of Tropical Oceanography, South China Sea Institute of Oceanology, Chinese Academy of Sciences, Guangzhou, China

- ✓ **On average, annually, 28 anticyclonic travelling eddy (AE) tracks and 54 cyclonic eddy (CE) tracks with long travel lengths were derived from the discrete SSHA fields of "STORM" simulation. 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 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 the canonical correlation analysis (CCA) to investigate the effect of three components of the instability (i.e. barotropic instability, current shear and potential density 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 may be governed by its internal variability.**

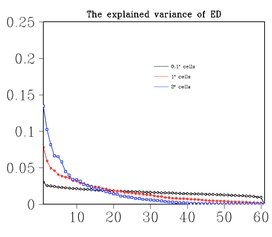
The "STORM" simulation:

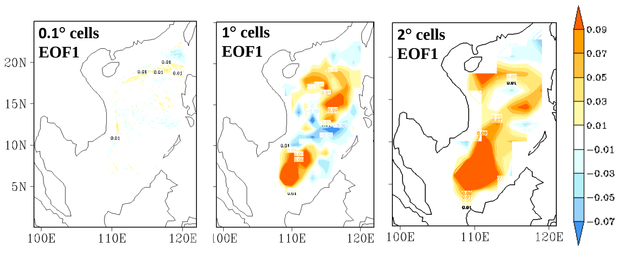
- MPI-OM model, forced by NCEP1
- Tripolar Arakawa-C grid
- Covering 1948-2010
- Number of hor. grid points: 3602 x 2394
- Grid distance: approx. 10km.



- STORM can well reproduce the ocean circulation in the SCS.
- AVISO has problems of underestimation of eddy occurrence (Amores et al., 2018), and has significant uncertainties (Taburet et al., 2018).
- A large number of potential eddy points in the AVISO data may be noise.

No dominant pattern is shown in eddy properties at 0.1° cells.





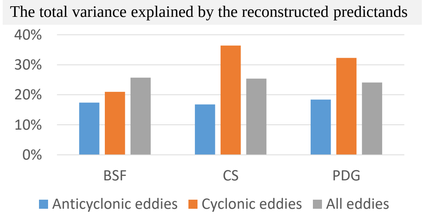
Predictors:

- Barotropic mass stream function (BSF);
- Current shear (CS);
- Density stratification (the gradient of potential density; PDG).

CCA

Predictands:

- Peak eddy intensity;
- Peak eddy diameter;
- Peak eddy number;
- Track length;
- Life time;
- Percentage of intense events.



Canonical correlation analysis (CCA) is applied in two vectors to searching for their strongest joint patterns of variations.

Reference

- von Storch J.-S. et al., 2012. An estimate of the Lorenz energy cycle for the world ocean based on the 1/ 10° STORM/NCEP simulation. J. Phys. Oceanogr. 42 (12), 2185-2205, http://dx.doi.org/10.1175/JPO-D-12-079.1
- Zhang M., von Storch H., Chen X., Wang D., and Li D., 2019. Temporal and spatial statistics of travelling eddy variability in the South China Sea. Ocean Dynamics.