Long-term trends and variability of eddy activities in the South China Sea

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1. Overview

- **The long-term variability of eddy activities in the South China Sea (SCS) is still not documented.**
- **This study presents the variability in different temporal scales and the spatial distribution of the eddies in the SCS.**

2. Data and methodology

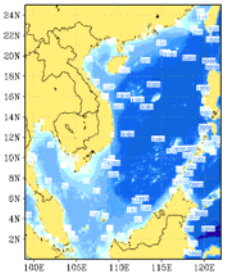

Fig. 1: Tophography of the SCS

STORM global simulation (MPI-OM , J. von Storch et al., 2012):

- Tripolar curvilinear Arakawa-C grid;
- Forced by 6-hourly NCEP1;
- Time period: 1950-2010; daily data;
- Horizontal grid resolution: about10 km;

Identification of eddies

- Footprints in SSHA (sea surface height anomalies)
- Along one eddy track, each SSHA extremum (eddy center) with relative intensity (RI) over 3mm and the strongest extremum (RI_{max}) over 6mm;
- Size over 5 pixels;
- Travel length longer than 100km;
- 90% of lifespan in deep water (deeper than 200m).

3. Evaluation of the model dataset

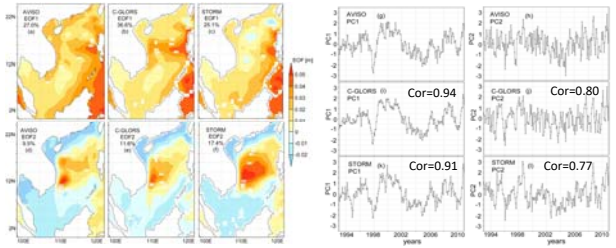

Fig.2 The first two EOFs [m] of 1993-2010 (the joint period) deseasonalized and detrended monthly SSHA from AVISO, CGLORS and STORM

- STORM simulation reproduces the SCS ocean dynamics reliably, comparable with the C-GLORS reanalysis data. More details can be found in Zhang and H. von Storch (2017).

4. Statistics and variability of eddies in the SCS

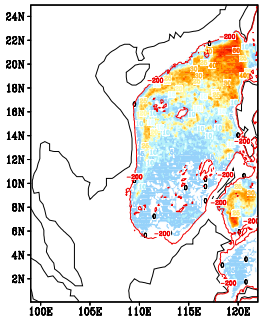

Fig. 3: Frequency of eddy occurrence

- In the SCS, eddies occur most frequently near Luzon Strait and Vietnam coast.
- A total of 1871 anti-cyclonic eddy (AE) tracks and 4219 cyclonic eddy (CE) tracks have been detected from STORM daily data.
- More CEs occurs in the SCS than AEs.

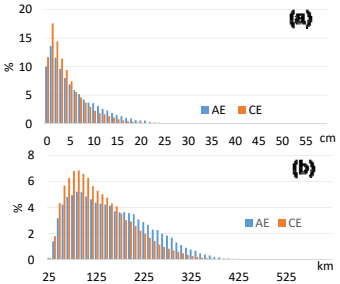

Fig.4: Distribution of eddy intensity (a) and eddy diameter (b)

- The maximum eddy intensity (EI) is less than 40 cm, and the maximum eddy diameter (ED) is over 500 km.
- Compared with CEs, AEs have a higher percentage of eddies with an intensity over 6 cm and diameter over 175 km.

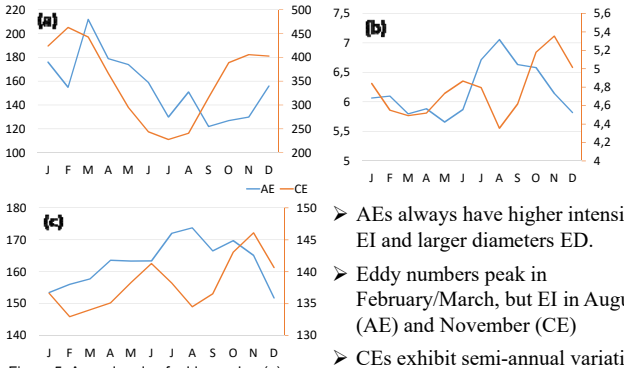

Figure 5: Annual cycle of eddy number (a), mean EI (b; cm) and mean ED (c; km).

- AEs always have higher intensities EI and larger diameters ED.
- Eddy numbers peak in February/March, but EI in August (AE) and November (CE)
- CEs exhibit semi-annual variation.

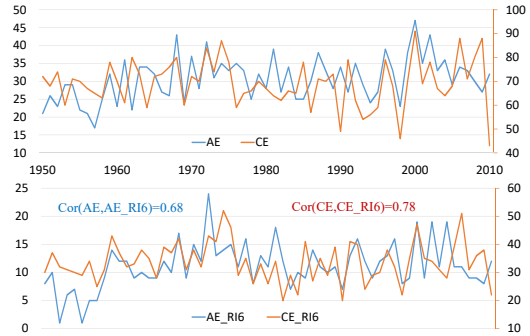

Fig. 6: Sensitivity to differently chosen thresholds: Annual eddy number based on RI = 3 / 6mm and on Ri_{max} = 6 /10mm (top/bottom)

- Inter-annual variability dominates the annual eddy genesis.
- Different sets of parameters do not change the pattern of interannual variability.

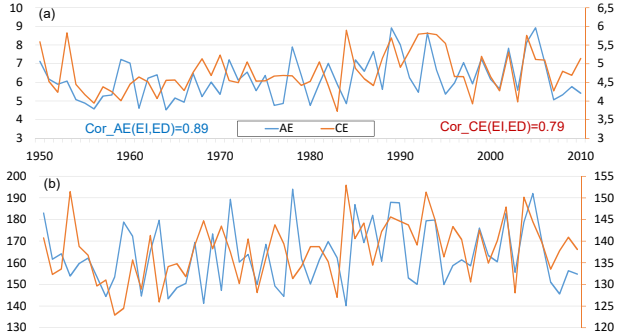

Fig.7: ime series of annual mean EI (a; unit: cm) and ED (b; unit: km);

- The annual series also presents predominant interannual variability.
- ED and EI are strongly correlated, in terms of both AEs and CEs.

5. Summary

- Cyclonic eddies (CEs) are much more active in the SCS than anticyclonic eddies (Aes). General, AEs are more intense and larger in size.
- Strong interannual variability dominates in the series of annual mean eddy number, intensity (EI) and size (ED).
- Eddy statistics exhibit annual variations; CEs have a semi-annual variations.
- EI and ED are highly correlated, for CEs and AEs

References

- 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., 2017. Toward downscaling oceanic hydrodynamics - suitability of a high-resolution OGCM for describing regional ocean variability in the South China Sea. *Oceanologia.* 59 (2), 166-176, DOI 10.1016/j.oceano.2017.01.001