Statistical Characteristics and Three-Dimensional Properties of Mesoscale Eddies in the Bay of Bengal from Satellite Altimetry and Argo float data

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◆ Abstract

Mesoscale eddies are rotating coherent structures of ocean currents, which generally refer to ocean signals with spatial scales from tens to hundreds of kilometers and time scales from days to months. Eddy properties in the Bay of Bengal are studied from satellite altimetry data using a sea level anomaly (SLA)-based eddy identification. Based on Argo profile data and climatology data, the eddy synthesis method was used to construct three-dimensional properties of the eddy in this area. The temperature and salt structure of eddies show that the cyclones tend to raise the mean thermocline, while anticyclones suppress the thermocline in the Bay of Bengal.

◆ Data & Eddy Identification

Altimetry data ：daily SLA fields with spatial resolution of 0.25° .

Argo float data: total 3,048 temperature and salinity profiles, the temperature anomaly θ' and salinity anomaly S' were computed by removing climatologic profiles.

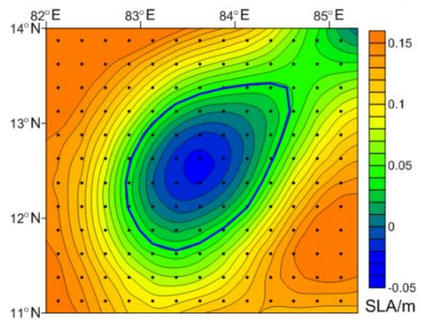

Fig. 1. An identification case of a cyclonic eddy based on gridded SLA data. The black dots represent 0.25° grid points of SLA data, the blue thick line represents the boundary of the eddy.

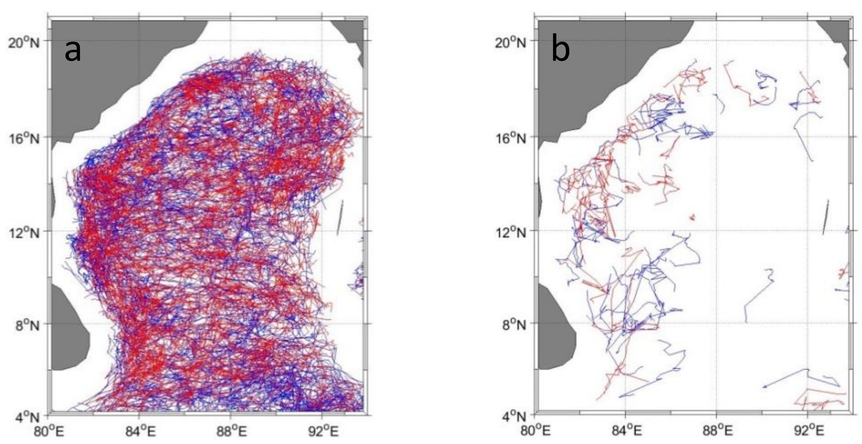

Fig. 2. The westward (a) and eastward (b) propagation trajectories of the 524 cyclonic (blue lines) and 467 anticyclonic (red lines) eddies.

◆ Eddy Characteristics

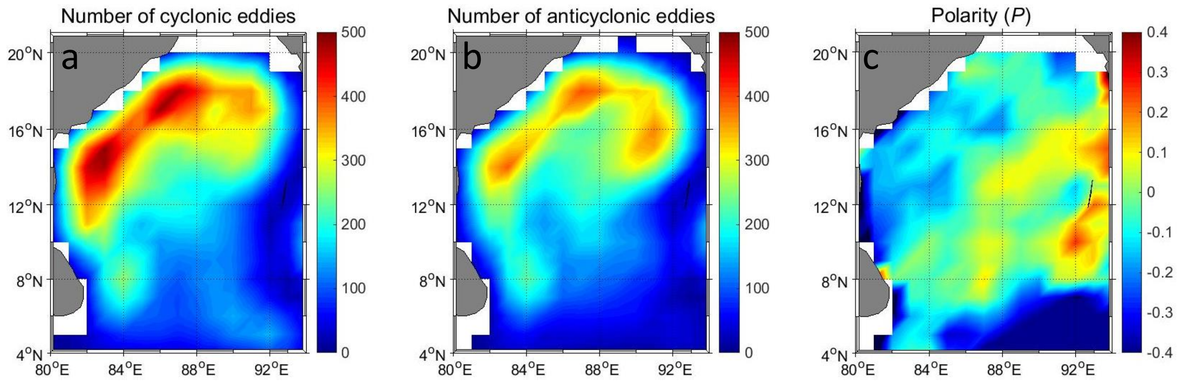

Fig. 3. Census statistics for numbers of cyclonic (a) and anticyclonic (b) eddies, and their polarity (c) for each 1° ×1° region (smoothed using a 3° ×3° window). Eddy polarity P indicates that a region prefers anticyclonic (P>0) or cyclonic (P<0).

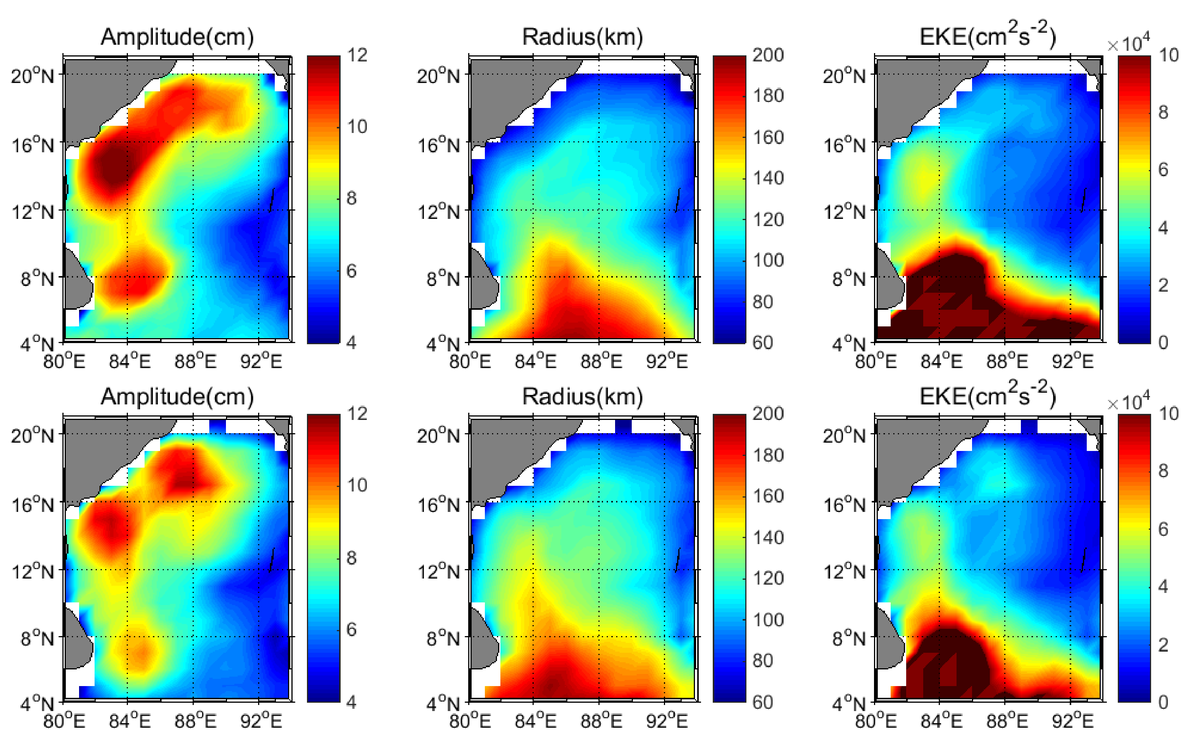

Fig. 4. The mean amplitude, radius and EKE of cyclonic (top) and anticyclonic (bottom) eddies for each 1° ×1° region (smoothed using a 3° ×3° window).

◆ Temperature and Salinity Structures

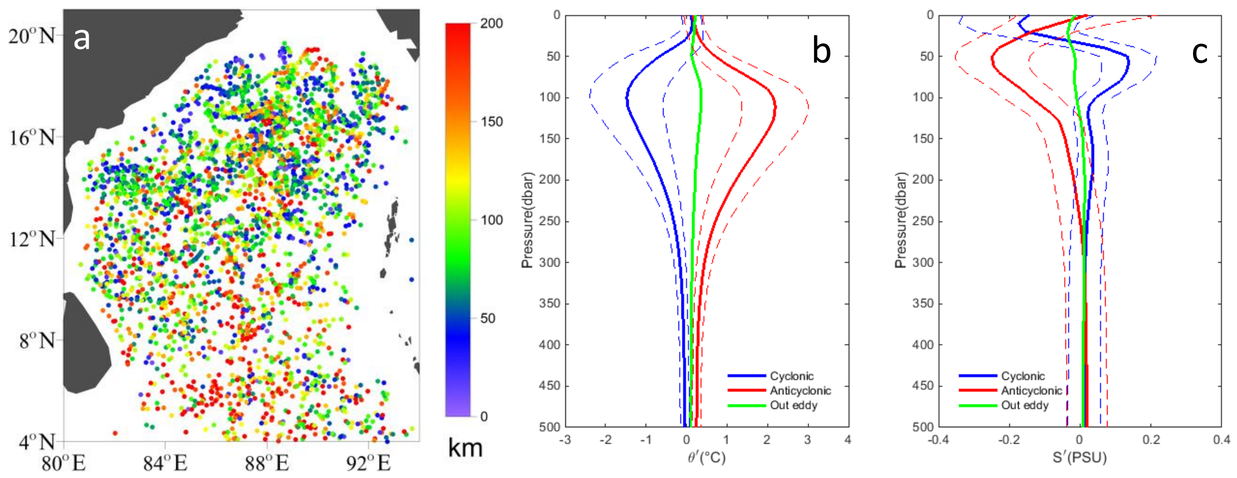

Fig. 5. Spatiotemporal distribution (a) of 3,048 Argo profiles inside eddies, the color means the distance from the center of the matched eddies; mean temperature anomaly θ' profiles (b) and salinity anomaly S' profiles (c) inside cyclonic and anticyclonic eddies as a function of depth. The dashed curves indicate one standard deviation value range. The green curves are the mean diagrams based on Argo profiles outside eddies. The temperature and salinity structures differ significantly for these two types of eddies.

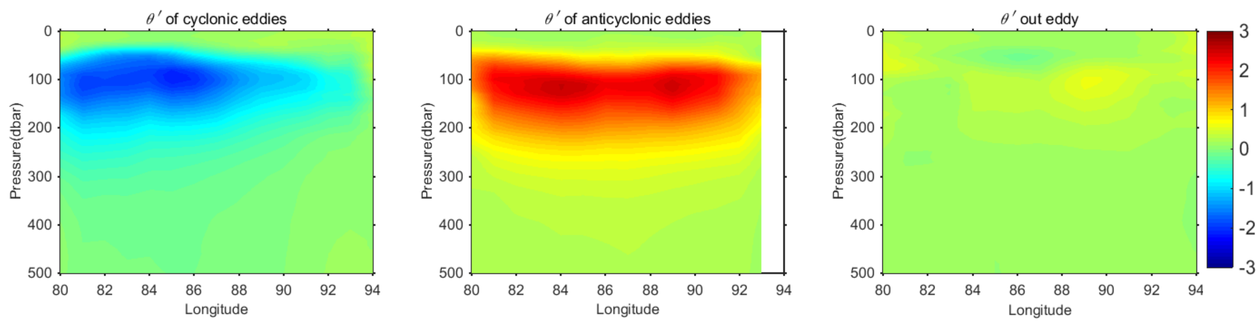

Fig. 6. The potential temperature anomaly θ' (° C) of cyclonic , anticyclonic eddies and outside eddies at different longitudes. The most striking feature is the westward strengthening of cyclonic eddy signals in both anomaly magnitude and effecting depth. The θ' of anticyclones have large value at central and western of the Bay of Bengal which make its westward strengthening obscure.

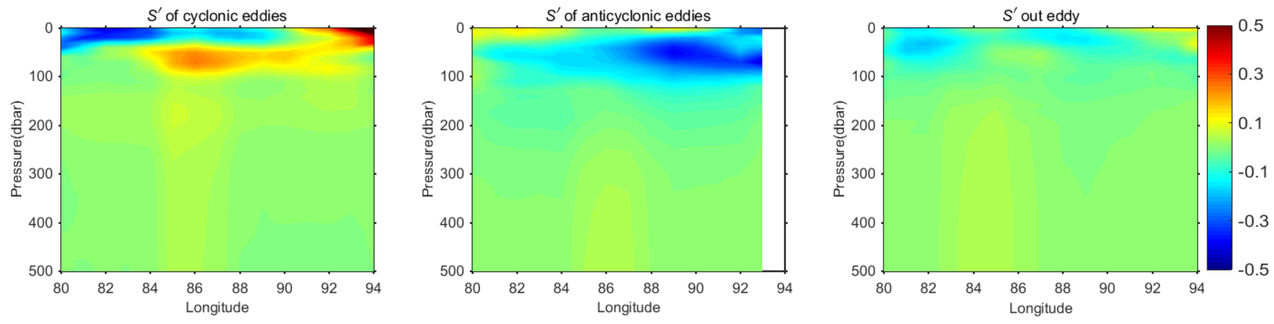

Fig. 7. The salinity anomaly S' (psu) of cyclonic, anticyclonic eddies and outside eddies at different longitudes. The anticyclonic eddies tend to induce maximum negative salinity anomaly in the subsurface, while cyclonic eddies prefer to induce maximum positive salinity anomaly. A negative perturbation of salinity anomaly at the surface is observed for cyclonic eddies in the western Bay of Bengal and S' becomes positive below 30 dbar depth.

◆ Conclusions

- The mesoscale eddies occur primarily in the western Bay of Bengal and the large-amplitude eddies mainly occur in the western boundary current and eastern of Sri Lanka.
- A maximum θ' of cyclonic eddies is nearly -1.5 ° C at about 100 dbar depth, while the anticyclonic eddies show maximum θ' of nearly +2 ° C at 120 dbar.
- A maximum S' of +0.15 psu is observed for the cyclonic eddies at about 50-80 dbar. For anticyclonic eddies, the maximum anomaly S' is -0.25 psu at about 50 dbar.
- The cyclones tend to raise the mean thermocline, while anticyclones suppress the thermocline in the Bay of Bengal.

◆ Acknowledgements

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◆ Major references

Chaigneau, A., Le Texier, M., Eldin, G., Grados, C., & Pizarro, O. (2011). Vertical structure of mesoscale eddies in the eastern South Pacific Ocean: A composite analysis from altimetry and Argo profiling floats. Journal of Geophysical Research: Oceans, 116(C11).