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Global pattern of annual cycle of mesoscale sea level anomaly

Nikolai Maximenko and Jan Hafner

International Pacific Research Center, School of Ocean and Earth Science and Technology, University of Hawaii

contact: maximenk@hawaii.edu

Analysis of historical data of mesoscale sea level anomaly (MSLA) reveals robust global pattern of its annual cycle (Figure 1). Outside of the tropics, the annual signal is initiated at the eastern boundaries of all oceans and propagates westward consistently with the dynamics of Rossby waves. Locations of approximately 20% of documented mesoscale eddies (both cyclonic and anticyclonic; Chelton et al, 2011) are in phase with the annual signal (Figure 2). This suggests that, contrary to the stochastic turbulent concept, formation and propagation of eddies may be anchored to the pattern of basin-wide Rossby waves along with beta-plumes (Figure 3) and striations (Figure 4) suggested in previous reports. Our study extends seasonal formation of mesoscale eddies exemplified in regional studies (e.g., Hasson et al, 2018) to the global scale.

Our findings will help to better understand the dynamic of mesoscale eddies and relation of their statistics to large-scale, time-mean, or low-frequency ocean phenomena and to improve predictions of seasonal variability of sea level, both globally and locally (e.g., Calafat et al., 2018).









Figure 2. Counts of cyclonic (left) and anticyclonic (right) mesoscale eddies (data of Chelton et al, 2011) in the northern (top) and southern (bottom) subtropics sorted according to the phase of annual cycle of mesoscale SLA shown in Figure 1 (top).

Figure 1. Month of maximum SLA (top) and range of SLA (bottom) in daily climatology, high-pass filtered with 5-degrees longitude-latitude filter.





Figure 4. (meridionally) Propagating striations in spatially high-pass filtered anomaly of zonal geostrophic velocity. (Melnichenko et al., 2011 OSTST meeting)

References

Calafat, F. M., T. Wahl, F. Lindsten, J. Williams, and E. Frajka-Williams (2018), Coherent modulation of the sea-level annual cycle in the United States by Atlantic Rossby waves, Nature Communications, 9:2571, DOI: 10.1038/s41467-018-04898-y.

Chelton, D. B., M. G. Schlax, and R. M. Samelson, 2011: Global observations of nonlinear mesoscale eddies, *Prog. Oceanogr.*, 91, 167-216.

Hasson, A., J. T. Farrar, J. Boutin, F. Bingman, and T. Lee, 2018: Intraseasonal variability of surface salinity in the eastern tropical Pacific associated with mesoscale eddies, JGR-Oceans, doi: 10.1029/2018JC014175









