MPO776 - Mesoscale Oceanography

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Paper Review: Chelton, D. B., M. G. Schlax, R. M. Samelson, and R. A. de Szoeke (2007), Global observations of large oceanic eddies, Geophys. Res. Lett., 34, L15606, doi:10.1029/2007GL030812

Dear editor, bellow you will find my Chelton et al. manuscript review. This document is organized in eight topics: (1) Paper's overview, (2) Importance, (3) Methodology, (4) Originality, (5) Results summary, (6) Implications, (7) Critics, and (8) My recommendation.

(1) The manuscript presents an assessment of general characteristics (i. e., distribution, diameter, propagation, surface height amplitude, nonlinearity) of large mesoscale eddies (diameter≥100 km, lifetime≥4 weeks) in the global ocean, and how much of the altimetry-derived Sea Surface Height (SSH) signal variability is explained by such eddies. In order to achieve their goal, the authors have used a SSH dataset obtained from a blend of different altimetric products, and performed a well established eddy-tracking procedure. Then the results are explained based on what is known about linear Rossby waves and extratropical eddies theories.

(2) As well mentioned by the authors in paragraphs [2] (Introduction) and [19] (Discussion) most of the ocean kinetic energy is in mesoscale features, and eddies are extremely important for understanding the distribution of tracers, energy, and ocean biology. Therefore, by accounting how much of the mesoscale activity is due to nonlinear eddies and how they propagate we can better understand such distributions and its variability, perform better assessment of numerical models behaviors, and improve parameterizations schemes.

(3) The results were obtained by studying eddies defined as closed contours of the Okubo-Weiss parameter on SSH fields anomalies. The authors built the 10-year time series (Oct. 1992 - August 2002) of global SSH fields by merging the products from TOPEX/Poseidon and ERS-1/ERS-2 altimeters. Then the anomalies were computed by removing the 1993-1999 mean at each grid point.

(4) Although coherent features tracking in the global oceans were performed in several studies, it is the first time that someone apply it in order to characterize general aspects of the large scale eddies from global SSH observations with such high spatial resolution. Therefore this work is original.

(5) The authors showed that most of the identified large mesoscale eddies in the dataset are non-linear eddies, with SSH amplitudes of 5-25 cm and diameters of approximately 100-200 km, and no preferential polarity (i. e., number of anticyclones are similar to cyclones). Moreover in eddy-rich areas (e. g., Gulf Stream and Kuroshio extensions, Brazil-Malvinas confluence, Antarctic Circumpolar Current) they account for more than 50% of the dataset variance. It is important to mention that due to the nature of the tracking procedure, areas where the relative SSH amplitudes are not large enough its hard to account how much of the variance can be explained by the eddies (i. e., at eddy-poor areas).

Additionally, the non-linear long-lived eddies (lifetimes≥12 weeks) analysis showed that they present quasi-westward propagation with small deflection pole and equatorward. Approximately 58% (60%) of the cyclonic (anticyclonic) eddies tend deviate poleward (equatoward). These "phase" speeds are consistent with non-dispersive baroclinic Rossby waves at each latitude band.

(6) This study may have a significant impact in future research. Although it presents important quantitative information about oceanic eddies throughout the world oceans, the most striking impact would

be in the altimetric data interpretation. This research shows that not all westward propagating signals with velocities consistent with linear Rossby waves are waves. In fact the north-south deflection of those signals can be explained by the presence of non-linear long-lived eddies.

(7) In my opinion, this manuscript was well written and consists of striking original results in physical oceanography. Additionally the authors are aware of their methodologies restrictions and achieved their goals successfully. However, there are few topics and key details that are missing that could improve the manuscript. I separated my comments in two general topics with some specific questions.

1. **Missing details and minor doubts:**
    - In paragraph [4] (Data Processing) the authors describe how they defined the SSH anomaly fields. If I understood well they have SSH fields between Oct. 1992 and August 2002, however the anomalies were computed by removing the 1993-1999 temporal average. I wonder why the author did not choose to use an average of the entire time series, or an average using the entire years (e. g., 1993-2001).
    - One of the most interesting results is how much of the SSH variance is explained by the eddies. Additionally, the authors mention in the Discussion section (see paragraph [18]) that the computation of the explained variance is subjective without explaining how they did it. I believe it is important to clarify that, even though it is subjective.
    - In the Propagation Direction and Speeds section, the authors studied the eddies with lifetime grater than 12 weeks. I do not understand why they did not use shorter lifetimes to improve the statistics by studying more eddies. I would like to see how their analysis would change.
2. **Eddy tracking method:**
    - Although the Okubo-Weiss parameter method is well established and wide used by the scientific community for detecting eddies, it is known that there are other methods that can generate good (even better) results depending on the dataset and the eddies characteristics. The manuscript does not compare or mention any other method (e. g., geometric or wavelets) that could be used with the same purpose. We know that such methods can yield very different quantitative results, however if the main characteristics of the eddies are robust they must be captured by other methods. Therefore it would be a good idea to perform a comparison between them, or at least mention that what kind of results are expected from different methods.

(8) Finally, based on the observations above I recommend accept this article. It fulfills the GRL's expectations and characteristics, being adequate for publication. I also think that the authors should consider clarify (add) some of my doubts (observations) pointed out in (7), future readers (especially non-experts in the field) might have the same issues.