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Interactive comment on "Impact of vertical and horizontal advection on nutrient distribution in the South East Pacific" *by* B. Barceló-Llull et al.

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The authors describe the analysis of vertical velocities inferred by the solution to the QG Omega equation based on a combined analysis of satellite altimetry and in situ temperature and depth profiles (Argo and climatology). The analysis compares the advection of a passive tracer with and without the estimated vertical velocities. The results are inferred through the lens of the effects of mesoscale vertical velocities on nutrient distribution. The paper is well written and presents another interesting analysis from this group of the importance of mesoscale vertical velocities. It is my opinion that the paper is acceptable as is, however, in it's current format, it fall short of being of much importance to the community as a whole. The following suggestions are aimed at helping to expand the reach of the paper by suggesting further analysis and

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simulations. In my opinion, the main shortcoming of the research described in this manuscript is the short (30-day) integration time of the simulations. With only 1 month of data, it does not seem like much could really be said about the effect of mesoscale processes on nutrient distribution. For example, the average lifespan of eddies in this region exceeds 1 month (see Chelton et al., 2011a and 2011b). Furthermore, with such a short integration time, is it not a surprise that the initial and final "nitrate" are so similar (I use quotations here because the advected field is passive, which nitrate is not)? I would have run out the simulation for 300 days (at minimum) instead of running 10 ensembles, as the authors did. What exactly was the purpose of the ensemble runs anyways? I see that they report the RMS values of the "nitrate" concentration between the two experiments, but with the 10 ensembles, they should be able to provide some sort of estimates of the confidence interval of these values. This is the only reason that I can see for running the ensembles. I would suggest, that if the authors are interested in mesoscale differences in the nitrate distribution as a result of the inclusion of mesoscale vertical velocities, why not look at particular eddies or meanders? This could simply be done from a few case studies, or from composite analysis. A prior, the patterns of the vertical advection of nitrate in eddies is not clear. The experiment run for this project would be a great way to describe this. A few comments: In the ARMOR3D product, is the dynamic height constrained to match observed SSH? If not, maybe this would be a good idea? Page 2259, Line 21: Argo, not ARGO. Page 2260, Line 5: "..in the oligotrophic gyres mesoscale processes promote vertical advection of nutrients into the euphotic layer, thereby stimulating primary production." Please provide a reference for this statement.

Page 2260, Line 7: The present work is focused on the same area analyzed by Chelton et al.(2011a), the offshore South East Pacific (SEP, white box in Fig. 1), where nutrient input by mesoscale vertical exchange is considered to play a lead role in primary production." Please provide a reference for this statement. Also note type of analyzed. There are numerous instances of this type. Page 2265, Line 4: With regards to the upwelling and downwelling along meanders, not that this was shown by a

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number of people long before Pollard and Regier, 1992. For example, look at: (Woods, 1988; Bower, 1991; Flierl and Davis, 1993; Olson et al., 1994; Spall and Richards, 2000; Lima et al., 2002), which are all included at the end of this review. Bower, A.S., 1991. A simple kinematic mechanism for mixing fluid parcels across a meandering jet. Journal of Physical Oceanography 21 (1), 173-180. Flierl, G.R., Davis, C.S., 1993. Biological effects of Gulf Stream meandering. Journal of Marine Research 51 (3), 529-560. Lima, I.D., Olson, D.B., Doney, S.C., 2002. Biological response to frontal dynamics and mesoscale variability in oligotrophic environments: Biological production and community structure. Journal of Geophysical Research: Oceans 107 (C8), 25-21-25-21. Olson, D.B., Hitchcock, G., Mariano, A., Ashjian, C., Peng, G., Nero, R., Podesta, G., 1994. Life on the edge: marine life and fronts. Oceanography 7 (2), 52-60. Spall, S., Richards, K., 2000. A numerical model of mesoscale frontal instabilities and plankton dynamicsâĂŤI. Model formulation and initial experiments. Deep Sea Research Part I: Oceanographic Research Papers 47 (7), 1261-1301. Woods, J.D., 1988. Mesoscale upwelling and primary production. In: Rothschild, B.J. (Ed.), Toward a Theory on Biological-Physical Interactions in the World Ocean. D. Reidel, Dordrecht, pp. 7-23.

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