Ocean Science
Discussions

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# Interactive comment on "El Niño, La Niña, and the global sea level budget" by Christopher G. Piecuch and Katherine J. Quinn

**Anonymous Referee #2**

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The paper discusses the steric and barystatic contributions to the global mean sea level record from satellite altimetry during ENSO events. While previous studies have mainly focused on barystatic contributions, this study focuses primarily on the steric contribution to La Nina and El Nino events in sea level. The paper is well written and structured and presents some interesting ideas.

Similar to reviewer #1, I mainly have a few general questions for the authors:

1) Correlation/regression analysis: Given the complex nature of the response to ENSO particularly in barystatic sea level, I wonder if a correlation analysis directly provides conclusive results. As for example Llovel et al., 2010, Fasullo et al., 2012 elude to, the response of the barystatic sea level to ENSO events is related to the complex response of the water cycle, which includes where evaporation/precipitation is generated, what

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the specific wind patterns are like, what is the setup of the hydrologic basin etc. Hence, the response in the mass part of sea level may be tied to regional variability in the extent of ENSO events as well as their strength. This makes it difficult to only use correlation and regression to quantify the response. However, for the steric part the response may be a bit more straightforward as it is mainly a warming/cooling signal of the upper ocean as this study partly also suggest. In general – as reviewer #1 also mentions – a correlation analysis can easily be misleading if one of the components is not well determined (be it by length of record or definition of indices etc.). Nevertheless, it is very interesting to see the impacts on the different layers in various ocean basins (e.g. Fig. 3, line 142ff) and think it would be great to see more details on this aspect of the study. In particular, it may be interesting to see how spatial patterns of the warming/cooling signals compare – in particular, between the different ARGO products and also compared to altimetry minus GRACE (e.g. total warming vs. layer structure).

2) Data products: Two ARGO products are being used for this study. Given the spread between data products and the focus of this paper being the steric contribution, it would be interesting to see a more detailed comparison between the two products used (or even add a third). So far, the differences in the products have mainly been evaluated to determine the error bar for the estimates but it may be worthwhile to look into the spatial distribution and spread for specific ENSO events in more detail.

3) Additional data: To add statistical significance to the steric analysis, I am wondering if the inclusion of ECCO output might be useful. The longer time series could support the correlation and regression analysis as well as basic comparisons of depths of the warming/cooing signals in the different ocean basins.

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