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Interactive comment on "A Mechanistic Analysis of Tropical Pacific Dynamic Sea Level in GFDL-OM4 under OMIP-I and OMIP-II Forcings" *by* Chia-Wei Hsu et al.

Anonymous Referee #2

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Review on manuscript (#gmd-2020-374) "A Mechanistic analysis of tropical Pacific dynamic sea level in GFDL-OM4 under OMIP-I and OMIP-II forcings" by Hsu, Yin, Griffies and Dussin

This manuscript examined sea level simulation in the tropical Pacific by the GFDL-OM4 ocean model driven by two different atmospheric products: CORE and JRA55-do. Long-term mean, linear trends, seasonal and interannual variability are discussed in detail, in particular focusing on the differences between model results and observations, and between two model experiments. It's found that the JRA55-do tends to give improved simulation, closer to observations than CORE.

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Discussion paper

Generally speaking, the manuscript was written fairly well and easy to follow. Detailed comments are as follows.

General Comments

1. My major comment/concern after reading through this quite lengthy manuscript is that I feel it may be more appropriate for other journals than GMD – a journal focusing on model development. But I have to say it's my personal feeling based on my understanding of GMD versus other journals, and it's really up to the editor to decide.

If the authors agree on this, I suggest the authors can reduce some parts (which don't really show new results), and tighten up the storyline. I guess it would be a better paper.

2. Wind stress and wind stress curl are heavily discussed throughout this paper, which is fine. However, the coarse-resolution (4x4 deg) WASwind product is used, and differences between JRA55-do and CORE are defined as "biases". I feel it could be problematic. For example, some features in the wind stress curl map (Fig. 11b) may be "artificial", reflecting the 4x4 grid. I think there should be some better-quality wind products, e.g., based on satellite Scatterometer observations?

detailed comments

Line 23 (L23), this sentence is confusing and thus needs to be changed. Sea level variability is not only associated with ocean temperature (heat content), but can also due to halosteric component (ocean salinity) and mass component.

L31, OMIP-I and II are not defined before. I feel they should be introduced here with a couple of sentences. What are main differences and similarities between them? It may help to state your motivation more clearly. Some material from the 2nd paragraph of Section 2.1 (L63-69) can be moved here.

L96-97, steric sea level rise is not only due to ocean warming, but also ocean freshening (decreasing salinity).

L105, change “which relates” to “which mainly relates”, since salinity can also play a role, in addition to ocean temperature (or equivalently thermocline depth change).

L115 “sea level variations” should be more appropriate here than “sea level changes”

L152-153, This statement is reasonable, but you used a coarse-resolution (4x4) wind product (WASwind) as your observational reference, could it affect your derivation of “biases” as shown in Fig. 4 and discussions about wind stress curl in the following sections?

L225-229, one important aspect from Fig. 8, not discussed here, is that this sea level trend map (east-west contrast) mainly results from decadal variability rather than represents the long-term trend, as discussed by Bromirski et al. (2011), Zhang and Church (2012), and Hamlington et al. (2014).

L247, by calculating the degrees of freedom in this way, you treat each monthly data point independent from each other, which is not true. You need to calculate “effective” degrees of freedom by considering the autocorrelation of the time series.

Fig. 11, for the left three panels (i.e., a, c, e), it would be ideally to plot the corresponding vector (e.g., JRA55-do bias wind stress vector), rather than the same mean wind stress vector. By doing so, you would also show the meridional wind stress information, which help to understand wind stress curl plots on the right.

L261: you may want to give information of the “five-year mean”, over which period?

L288-291, as commented above (L225-229), deriving trends over short periods can be influenced by interannual to decadal variability.

L307, this 0.3 m/s doesn’t make sense to me, shouldn’t it be around 0.9 m/s (it takes about 6 months for 1st baroclinic Rossby waves to travel across the tropical Pacific basin, which gives a speed of about 0.9 m/s). A simple check of Fig. 16 doesn’t support 0.3 m/s.

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Discussion paper

L376, is it possible to use Johnson et al. (2002) as an observational reference and overplot it in Fig. 19c?

L423, the range for the third stage (Jan-June Year 2) overlaps with the 2nd Stage (Aug Year 1 to Jan Year 2).

L435-437, there are already some studies on the meridional asymmetry, e.g., by McGregor et al. (2012).

L467-468, by designing this regression between DSL and wind stress curl at each grid point, are you implying that sea level responds to mainly local Ekman pumping and wave propagation can be neglected (using the simplified 1st baroclinic Rossby wave model as an example).

References:

Bromirski, P. D., A. J. Miller, R. E. Flick, and G. Auad, 2011: Dynamical suppression of sea level rise along the Pacific Coast of North America: Indications for imminent acceleration, J. Geophys. Res., 116, C07005, doi:10.1029/2010JC006759.

Hamlington, B. D., M.W. Strassburg, R. R. Leben, W. Han and R. S. Nerem and K.-Y. Kim, 2014: Uncovering an anthropogenic sea-level rise signal in the Pacific, Nature Climate Change, 4, 782–785, doi:10.1038/NCLIMATE2307.

McGregor, S., , A. Timmermann, , S. Schneider, , M. F. Stuecker, , and M. H. England, 2012: The effect of the South Pacific convergence zone on the termination of El Niño events and the meridional asymmetry of ENSO. J. Climate, 25, 5566–5586, doi:10.1175/JCLI-D-11-00332.1.

Zhang, X. and J. A. Church, 2012: Sea level trends, interannual and decadal variability in the Pacific Ocean, Geophys. Res. Lett., 39, L21701, doi:10.1029/2012GL053240.

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