Ocean Science Discussions

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Comment on os-2021-5

Anonymous Referee #2

Referee comment on "On the low western Pacific sea levels observed prior to strong East Pacific El Niños" by David J. Webb, Ocean Sci. Discuss.,
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This manuscript offers description of a series of forced ocean model results in which different ocean initial conditions and applied wind forcing, representative of 1981 and 1982, are paired to help explain why the model ocean developed lower sea surface height in 1982 than 1981 over the northwestern tropical Pacific region of interest; approximately 6N, 140E-170E. The motivation for this question was provided by a previous paper by the author, which hypothesized that increased transport of warm water by the North Equatorial Counter Current (NECC) was the main cause of the 1982-83 El Nino event. The present manuscript is focused on the question of what causes the modeled NECC change in 1982. It reaches the conclusion that local wind forcing caused the countercurrent to increase in 1982 compared to 1981.

Evaluation of wind variability components and ocean processes responsible for large El Nino events such as that of 1982-83 remains relevant to ENSO and climate science. The hypothesis that the NECC might play a role in El Nino development is not new (as stated in this manuscript), nor is the finding, in the forced ocean model experiment context, that the annual wind stress applied to the tropical Pacific mainly determines that year's El Nino-related oceanic development. The pairing of the two in the previous paper Webb (2018) does not represent a widely held belief. In that sense, the context for the present paper can be considered somewhat novel. However, the present paper is focused on explaining modeled NECC variability.

It is difficult to say that the conclusions reached here have been adequately supported.

There is no observational evidence offered in this manuscript to validate the model that is used in the experiments presented. Model validation is instead attempted by comparing one set of model results to another. This is an insufficient method for evaluating the capability of the model to simulate the observed behavior that is ultimately in question. The degree to which the forced model can accurately hindcast the observed space-time variability of SST, SSH, and surface currents in 1981 and 1982, along with northwest Pacific isopycnal depth (as in Fig. 25), is fundamental to the conclusions reached in this manuscript. These aspects have not been adequately evaluated but should be.

The role of observational uncertainty has not been but also should be considered in this context. Previously, for example, Harrison et al. (1990) reported on forced ocean model hindcasts of the 1982-83 El Nino event and found that the answers to questions like those being asked presently, for example, concerning the relative importance of local and remote wind forcing to anomalous currents and SST, depended very much on which wind data set was used to force the model. The present manuscript appears to report results based on only one wind data set, which is not described in the text. Given the previous Harrison et al. demonstration of the importance/limitations of observational wind uncertainty in this context, the impact of this wind uncertainty needs to be examined before the reliability of the results presented can be understood.

Notwithstanding the issues raised in the comments above, more precise description of the experiment results would improve their presentation (and facilitate comparison to observations). This manuscript relies mainly on visual inspection of snapshot-maps and time-longitude plots of SST, SSH and currents to support its conclusions about the relative importance of different ocean initial conditions and components of wind variability for causing changes in NECC-related SSH. I suggest defining metrics that quantify the salient model experiment results in relation to the control-hindcast to thereby offer a more streamlined and precise presentation of results.

I suggest that "Westerly Wind Events" be removed from the title. This manuscript does not identify or directly discuss westerly wind events. Something like "On the development of low North Equatorial Pacific sea level pressure during 1982-1983" would be more appropriate.

The last paragraph of the abstract attempts to describe the relationship between westerly wind events, the Madden Julian Oscillation, North Equatorial Counter Current (NECC) and the observed development of the 1982-83 El Nino event based on the NECC-related model experiments presented herein. However, what is presented herein does not sufficiently support conclusions about these relationships because three of these four phenomena (wind events, MJO, observed El Nino development) are not substantially addressed by the results presented in the manuscript. The abstract should be modified to better reflect what has and has not been done here.

Many of the model comparison figures, for example Figs. 3&4, 5&6 etc. can be combined to the benefit of the reader's ability to make the intended visual comparison. Reducing the total number of figures may also improve the presentation; 24 is perhaps an over-abundance of figures for the scope of this paper.

There has been considerable progress made in understanding El Nino development since Wyrtki (1973, 1974) offered hypotheses about the role of enhanced NECC. This manuscript would benefit from taking into account what has been learned and described in many of the relevant publications since then.

Specific comments.

line 52 stated -> started

Line 53 "depend primarily ON the wind field..."

Line 76 "global topography THAT has previously..."

Line 96. Suggest "all the high" -> "higher" or be more specific about which frequencies are muted by the 5 day averaging.

Figure 1 caption: Hoffmuller diagram OF the sea level...

Also, would be better to match Y-axis labels of (a) and (b)

Line 110. Better to quantify "reasonably small drop"

Line 113. Beginning of this line should read "Figs. 3 to 6"

Paragraph beginning Line 117 and associated Figures. The key, near-equatorial features are difficult to see with latitudes +/- 30 and surface current vectors shown. The author may wish to consider reducing the Y-axis range to facilitate visual inspection of the most

import model results.

Figure 13. Caption and text refers to "top" and "bottom" panels although the Figure 13 panels (a) and (b) are side-by-side.

Figure 16's top/bottom description in text and caption does not match its left/right layout.

Line 183. Western Pacific cold pool?

Line 214. an region -> a region

Paragraph beginning on Line 252. Integration smooths any field regardless of whether its variability is characterized by a "long term systematic change", or a more event-like abundance of, for example, equatorial westerly anomalies. Results therefore may not imply what the text claims they do.

Line 300. The observed variability of coupled tropical Pacific system does not support a one-to-one correspondence between equatorial ocean current variability and the observed variables most closely related to deep atmospheric convection activity, such as is implied here. The statement about convection should be sufficiently supported or withdrawn.

Reference:

Harrison, D.E., B.S. Giese, and E.S. Sarachik (1990): Mechanisms of SST change in the equatorial waveguide during the 1982–83 ENSO. J. Climate, 3(2), 173–188.