Geosci. Model Dev. Discuss.,
https://doi.org/10.5194/gmd-2019-243-AC1, 2020
© Author(s) 2020. This work is distributed under
the Creative Commons Attribution 4.0 License.

Geoscientific Model Development Discussions

Interactive comment on "Mitigation of Model Bias Influences on Wave Data Assimilation with Multiple Assimilation Systems Using WaveWatch III v5.16 and SWAN v41.20" *by* Jiangyu Li and Shaoqing Zhang

Jiangyu Li and Shaoqing Zhang

jiangyu_li@qq.com

Received and published: 7 January 2020

In general:

The comments and suggestions from Reviewer #1 are excellent, which are very helpful for us to compare the influence of error sources more clearly. In the revision, we have added: (1) section 3.4 to quantify the comparison of the wind forcing error and model error in time and space, (2) clearer description about how to get SWH (significant wave height) bias and bias correction.

Printer-friendly version

Discussion paper

The following is the point-by-point reply to address the comments and suggestions of Reviewer #1.

This study investigates the challenge of model bias on wave model data assimilation. It applies a set of twin-model experiments to quantify the different error sources in wave model: initial, boundary, and model error. Based that It provide a simple statistical approach to reduce the impact of model bias and improve the assimilation results. The topic is interesting and important for wave data assimilation, well fit for GMD. The experiments are well designed and manuscript is in good shape. Here I only have few points to further polish this work. Therefore, I suggest miner revision for current version.

RE: Thanks for reviewer's encouragement.

1 There are three error sources: initial/boundary/model-bias. You have identify them in your biased/unbiased twin experiment. It turns out both boundary and model-bias are important. In my pointer of view, both error sources could lead to SWH biases/uncertainties for assimilation/simulation. It would be great to separate them and quantify the improvement percentage by your data assimilation from your biased/unbiased twin experiments. The SWH bias and its decrease percentage may give your hind on mitigation the assimilation bias for the real observation. Similar separation should apply to real observation assimilation cases. In your figure 5, mainly represent the SWH bias. You can recalculate figure 6 (RMSE) after remove the bias in figure 5, which represent the uncertainties related to boundary/model bias. When you apply average to reduce the assimilation error of SWH. You only reduces the uncertainty part but not the bias part. You have to direct remove the bias from the reanalysis.

RE: Thanks for your thoughtful advice. We have added the quantitative comparison between boundary and model bias, please see lines 443-449 for their performances in the twin experiments. In the experiments of real-data assimilation, we also have replotted the Fig. 6 (Fig. 9 in the revised version) after removing the model bias shown

CC BY

in Fig. 5 (Fig. 6 in the revision). The reviewer is right, as a try, the first method of bias correction is used to reduce the uncertainty part from the reanalysis and the second method is used to reduce the bias part.

2 In your real observation assimilation, the boundary and model-bias are both included. You may compare spatial pattern and the decreasing percentage of SWH bias with those your biased/unbiased twin experiments to speculate which source (boundary/model-bias) has stronger impact in certain area..

RE: Thanks for your excellent suggestion. In the twin experiments, we have compared the spatial pattern of errors caused by wind forcing and model bias, please see lines 458-476 and Fig. 5.

3 You only applied one kind of wind forcing for different models and then use them to do the bias correction. Since the bias also come from the boundary forcing. I encourage you using two kinds of wind forcing to further investigate the bias/uncertainty generated by the boundary forcing.

RE: Thank you for your helpful comment. In the real experiment, it's very difficult to distinguish the error sources. Then, as an understanding, we have tested the influences of these two error sources in the twin experiments. Next, we use a better wind forcing from ERA-Interim reanalysis in this manuscript to drive wave models and conduct bias correction in the real experiments. It is more reasonable and indicative to use bias correction mitigating hybrid errors and finally improve the quality of data assimilation results in the case of assimilating real observations.

4 it is unclear how do you get the SWH bias for bias correction, what is the spatial pattern. I thought it should refer to the figure 5, but I did not find those in the manuscript.

RE: Thanks for your kind reminder. More detailed description about how to get SWH bias has added in the revision, please see lines 556-561 and Fig. 6.

5 Model description in page 4. This part need be more condensed with appropriate

CC BY

reference. Readers would appreciate more on the differences among those models, instead of the comparison to their own previous version. You may highlight the advantage or disadvantage among three modes.

RE: Thanks for your good advice. We simplified the description of this section, please see lines 112-119.

Interactive comment on Geosci. Model Dev. Discuss., https://doi.org/10.5194/gmd-2019-243, 2019.

CC BY

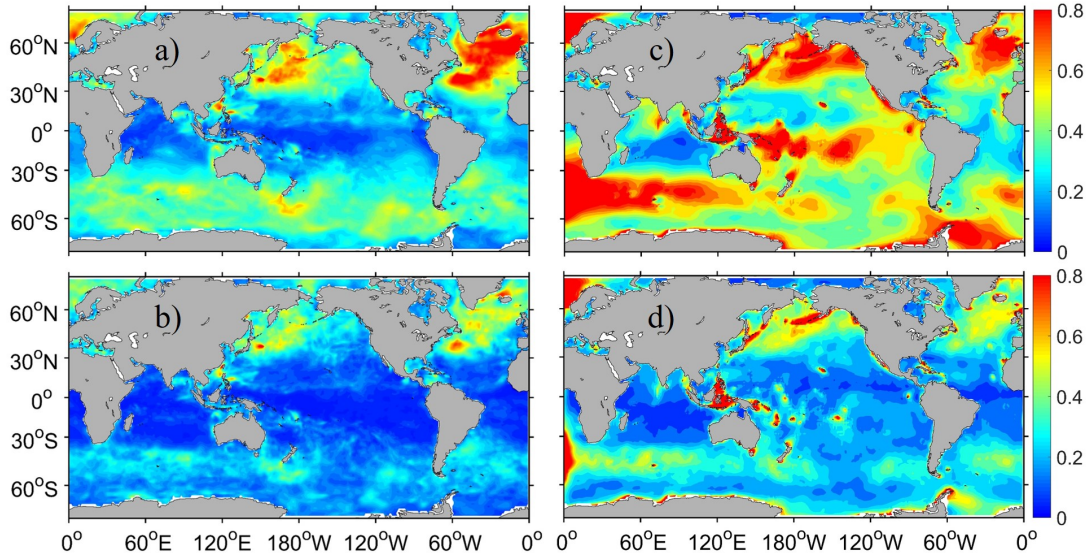

Fig. 1. figure5

Printer-friendly version

Discussion paper

CC BY

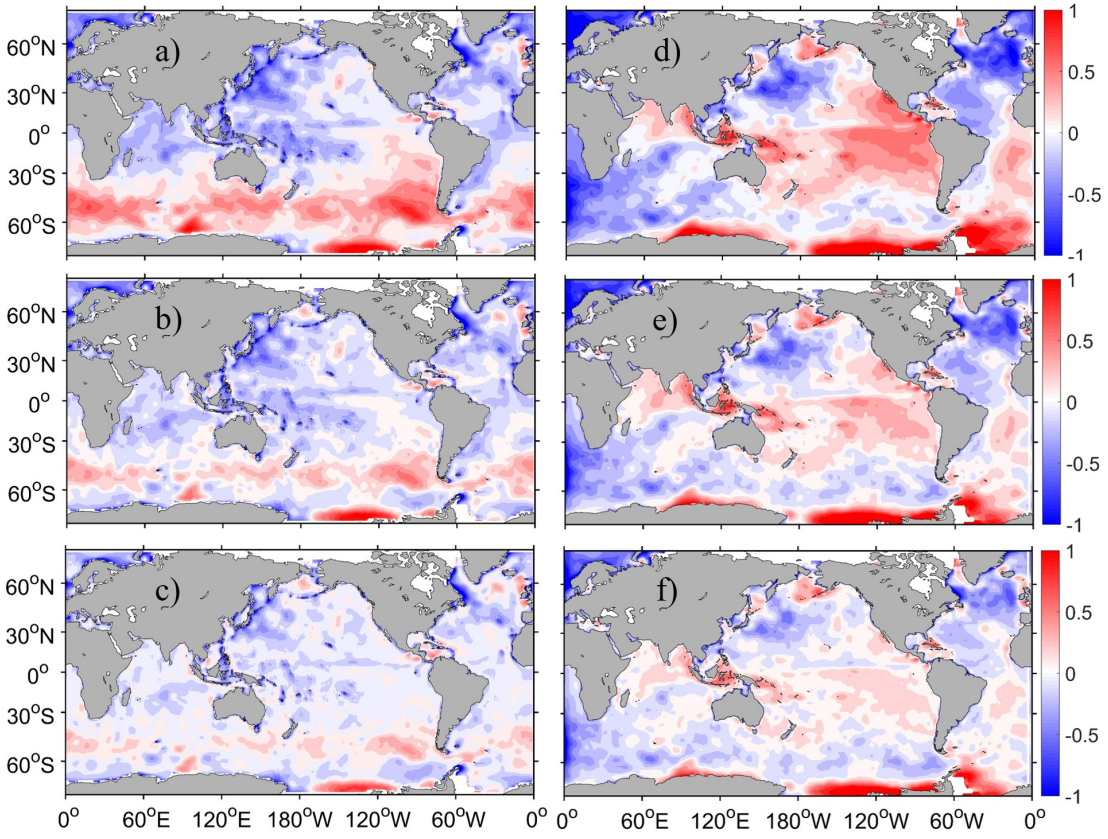

Fig. 2. figure6

Printer-friendly version

Discussion paper

CC BY

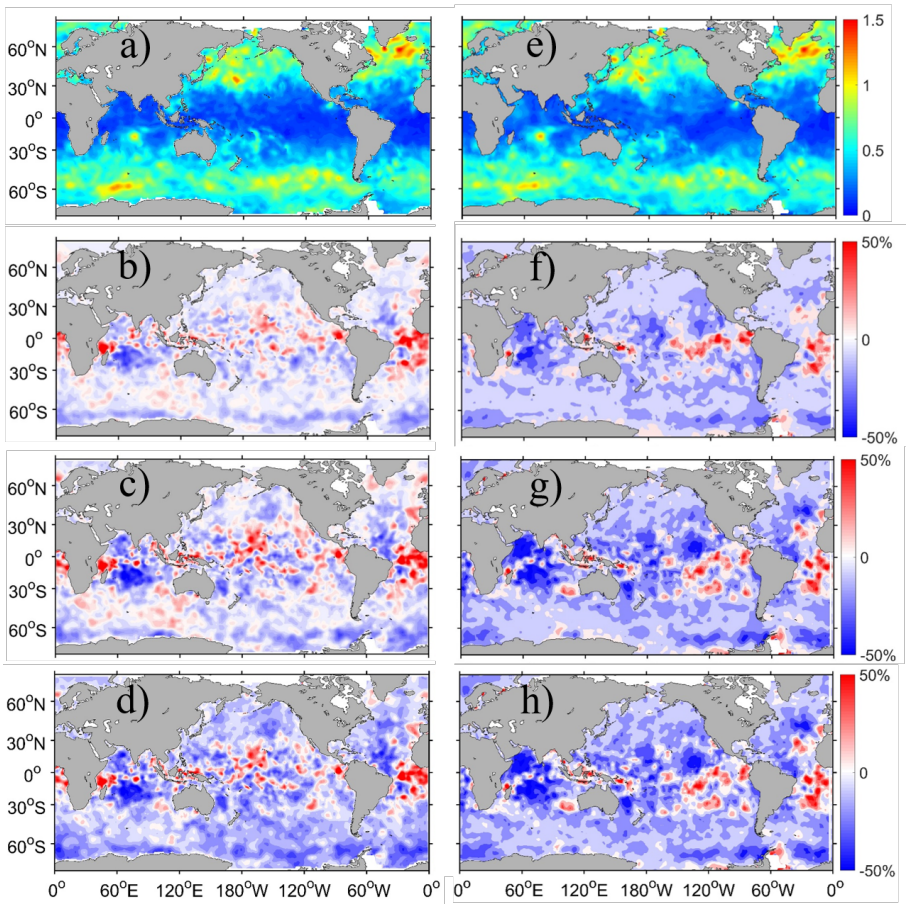

Fig. 3. figure9

Printer-friendly version

Discussion paper

CC BY