

# ***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***

## **Anonymous Referee #2**

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This paper describes the effect of OI data assimilation on ocean wave simulations, including bias correction. The work is mainly done through running a series of twin experiments. The paper contains scientifically interesting results, clear writing and good quality of figures. There is a potential to use the system to produce a global wave reanalysis (ensemble) product. There are some questions and comments, which are described as following.

In Model configurations: the resolution of wind forcing could cause misleading. For example, 0.125x0.125deg is not the resolution of ERA-Interim itself (in which the model

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resolution is much coarser), but is the resolution of gridded reanalysis data. Please clarify.

AVISO data: along-track data are used in wave simulation and gridded data are used for validation. What will be the possible effect due to difference of these data? Are there any observation-related errors/uncertainties that would influence the validation results? Also, the validation data are not independent to those assimilated. Do author consider using wave buoy data for validation in the future?

Following above comment, now some latest observation data contain wave direction information (i.e. peak wave direction, 2D spectra). These obs can be used to assimilate model wave spectra, which will have more advantages than assimilating SWH only. This might be worth mentioning somewhere in the paper.

L190: why did authors choose  $\text{Sigma}_M=0.6\text{m}$  and  $\text{sigma}_O=0.25\text{m}$ ? Are the same model and observations as used in (Qi and Fan, 2013)? Is sigma varying with time, space and models? There ought to be some assumptions before using these parameters.

In equation 3,  $\text{sigma}_i/\text{sigma}_k * r_{i,k}$  is for SWH (or wave spectra?) correlation and statistics. I just wonder whether wave covariances will have the same structure as wave error covariances as equation 3 is supposed to be for error covariance. In a storm the high-sea state may have a few hundred km long, but this doesn't necessarily mean the error is propagating in a few hundred km distance. I don't have a solution for this question. But it needs some assumptions on equation 3, with clarifications of potential drawbacks, before using it.

2.3 section step 4: ocean waves have two components, i.e. windsea waves and swells. The wind should (only) be corrected based on the analysed windsea waves, while analysed swells that are not directly forced by local wind have no impact on wind correction. This concept is described in Lionello et al 1995. Mostly wave models can output wind-sea and swell SWH. Why did not authors use the windsea SWH (rather than use total

SWH) to correct wind forcing? Using analysed total SWH to correct wind, wind could be overly corrected for example when it is a swell dominant event at the DA time.

Fig2: not very clear what b and c are for in these snapshots. SWH difference between what? Which is for increment? Please clarify.

Fig3,4: are these statistics for global mean or any regions? In Fig4, what are the correlation coefficients for (spatial correlations)? Same for other figures.

Fig4 shows wind correction does not clearly improve SWH simulation when assimilating J2. What about assimilating all satellite tracks i.e. J2+J3+SA? Does wind correction have a stronger effect?

Section 4.1 and Fig7: results show that wind correction only improves wave simulation by certain degrees. 1) Does the wind correction scheme used here have an impact? Can authors show (or suggest) any difference when using the scheme of Lionello et al 1995 (see above comment); 2) How about the spatial distribution of Fig7 red lines? 3) Are there more improvements seen in windsea waves than in swells? (you can simply partition wind sea waves and swell waves from total SWH). I assume wind correction will have a stronger impact in windsea wave simulations at high latitudes with strong wind.

Section 4.2: Please describe a bit more how the bias is produced and removed in these simulations. It is not very clear to me. How was 'bias correction of model control run' implemented?

Was bias correction in this paper like the offline-type bias correction? If we can have a long-term historic run, to produce the climatology of wave bias, and then use it as an offline bias correction term before online DA term (simply like some DA procedures in European systems), will this produce similar results as produced in Fig 10? This offline term can potentially be used in forecast as well. One normally won't expect that DA can efficiently correct the long-term and persistent bias, but expects DA is

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more powerful for correcting the instantons/short-term/flow-dependent errors. It is not simple to have an immediate answer for this question, but it will be useful to have a discussion somewhere in the paper.

Line 61: to produce=> for producing L337: inaccurate

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