

Interactive comment on “An atmosphere-wave regional coupled model: improving predictions of wave heights and surface winds in the Southern North Sea” by Kathrin Wahle et al.

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The subject of this manuscript is the 2-way coupling of atmospheric and wave models in the German Bight. Atmospheric forcing is supplied to the wave models, and the wave model sends back the surface roughness to the atmospheric model. The results of 2-way coupling are compared to 1-way coupling for a 3-month period that includes one of the most severe storms, named Xaver, in the last decades.

The subject is highly relevant and the technique promises a sizeable improvement of wave forecasts in especially shallow areas with complex topography. And the authors indeed show an overall improvement of wave forecasts and also in particular for the Xaver storm.

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It is, however, sometimes difficult to get to the message the authors try to convey. One of the reasons are the many errors in the English language, especially incorrect or missing articles, inconsistency between singular and plural, inconsistency in tenses, and missing commas. The manuscript should therefore be carefully checked and corrected.

Chapter 3, on results, is very fragmented and lacks a clear wrap-up and conclusion at the end. Moreover, especially Section 3.1 is very long and deals with a number of more or less separate items. It would help to put these in separate subsections.

Sometimes the conclusions are contradictory to what the figures or tables suggest.

Comments in more detail:

1. Introduction

The reference Lionello (2003) is not in the references list. But the remark about what it states seems very odd here. The formulation suggests that the 2003 paper already describes the current work.

Towards the end, Staneva et al. (2016) is referenced. I would say that the subject of this paper has more relevance to the present paper than just the fact that wave heights are overestimated or the description of the used models. I would expect a discussion on coupling just waves and the atmosphere and including also circulation. And in the end you will probably want to couple all three together.

2.4 Integration Period and Data Availability

At the end, you refer to Figure 1b for the wave rider buoys, but they are in Figure 1c.

3.1 Validation of models

As in the final paper the tables will be close to the text, you might consider leaving out the values themselves here. It would make the text more easily readable.

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Line 221: "due to the reasons explained above" is not clear which reasons you are aiming at.

Line 230: Change "It is well known that..." into "Passaro et al. (2014) established that...".

Line 240: "... wave heights are in good agreement." I do not agree. In the calm case, both models underestimate the wave height by approximately 1 m over a large part of the track.

Line 242: "... however,[!] the reduced wave height...". Change "however" into "although". Differences between the models are much smaller than the difference with the observations.

Line 246: The peak of the storm, at least the highest wave heights, are at the edge of the domain of the wave model. Any differences with observations will therefore strongly be influenced by the boundary conditions. And, actually, Figure 3b does not show a maximum, just an increasing wave height towards the North.

The comparison of these two tracks is a very useful illustration. You must have looked at the other tracks as well. Without giving any details here, it would be relevant to say something of the general picture that emerges from that. Does it agree with these two examples, or are there also other features there?

More or less the same remark on the comparison with the wave buoys. You show Helgoland and Westerland, but you should at least mention whether the results for Fino and Elbe are similar.

Line 280: As the results for both wave models are different in shallow water, what does that mean for the 2-way coupling? Should you not get the sea surface roughness from the model that includes wave breaking?

Line 289: "were provided by the DWD" is a remark that should be in Section 2.4.

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Line 296: "Even though differences ... decrease ..." That is not what I see. Differences in biases in Table 2 are not really different between 50 and 100 m and the difference in standard deviation is even larger.

Line 303: The word "either" gives a choice between two possibilities. So it is not correct where you want to combine 4 things.

Line 307: It would help to give RMSE also in Table 3, if you refer to that instead of the standard deviation.

3.2 Impact

The first paragraph suggests that in 1-way coupling the coupling to the waves is too strong. If you would decrease this coupling, e.g. by a smaller Charnock constant, would that not give similar results for the waves? Then, what is the added value of the 2-way coupling?

You claim that the argument you infer from Figure 5 for wind speed differences is supported by the effect on wind stress (Figure 6). But the wind stress has a rather straightforward relation to the wind speed, so this is really the same argument. Just the fact that the wind stress is more that quadratic in the wind speed makes the effect only seem stronger.

Line 332: "... which tends to fill the low" is not what Janssen and Viterbo (1996) claim. They claim that the disturbance will grow less, what is not the same.

Line 336: "... indicates a shift of the pressure low minimum". That should be easily seen directly in the pressure fields. Why then an indirect argument?

Line 340: "such effects". What effects?

Figures:

The use of figures with several subfigures is not always an advantage. Some of the graphs, especially time series in Figures 3, 4 and 8 are already small and will be

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smaller even and more difficult to read in a printed version. The authors might want to split some apart.

Figure 1: The explanation is not logical: first 1c and then 1b.

Figure 1b: I am not sure if a figure with all of the tracks is useful. They are not at the same time, and it is rather obvious that the pattern would look like that.

Figure 1c: The name Westerland is unreadable.

Figure 2: Units are missing on the wind speed scale.

Figure 3: The subfigures are not really similar enough to combine all of them. 3c and 3d could be taken together, but the way in which they are presented now suggests that 3a belongs to 3c and 3b to 3d.

As 3c and 3d are mentioned first in the text, they should be before 3a and 3b.

It would be useful to limit the area of Figure 3a to the same area as Figure 3b. Now a comparison is difficult.

It would help to indicate the buoys in 3a and 3b.

The color yellow in 3c and 3d is hardly visible.

Figure 5: The use of "bias" and "rmse" in this figure is confusing, as these terms are mostly used to indicate the difference with observations. Suggestion: "average difference" and "RMS difference". Also in Figure 6.

The figure might be explained more clearly. Either in the subscript, or in the text.

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