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Interactive comment on "Surface drifters in the German Bight: Model validation considering windage and Stokes drift" *by* Ulrich Callies et al.

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Received and published: 25 June 2017

1 Summary

The manuscript describes an experiment with surface drifters and model simulations in the German Bight. The goal is to assess the realism of the BSHmod and TRIM models. The authors compare six observed surface drifters (tracked for about 30-40 days) with simulated drifters using the two models. They find discrepancies between observations and models and discuss what could have caused them.

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2 Overall comments

The manuscript is very well written with only a few misspellings and somewhat confusing sentences. While it is good that the authors give a detailed account of the drifter experiments, the main text makes a lot of references to maps in the supplementary material, which is split into multiple files and pages. I would recommend adding an extra plot or two in the main text where some results can be shown so that the reader does not have to go back and forth between the paper and supplementary material so often.

I recommend this paper be accepted for publication after dealing with a few minor comments.

3 Specific comments

Parameters for including wind effects
How did the authors chose the parameters in Section 2.2.3? Did the authors try a few different values and tune the fields to match observations in this study, or was the tuning done in another study? If the parameters were tuned in another study, please cite that study and add a comment on how well it worked. If the parameters were tuned for the data in this study, the observations and models are not really independent and a validation can not be made. In the Discussion, the authors hint that no tuning was made. What was the motivation for choosing these values?

Page 1: Line 21: "Lagrangian transport simulations also provide . . . "
Line 22: remove "for instance"

Page 2: Line 3: "...as many of the input ..."
Line 9: "However, the Eulerian surface currents ..."
Line 10: "In cases of necessity, drifter simulations ..."
Line 12: "...5 m deep top layer. Therefore, even for an ideal ..." Line 13: "...of hydrodynamic currents." Line 14: "...1m deep layer". Line 24-25: I found this sentence a bit confusing. "Although provided with ...for instance.". Do the authors mean that the wave model is forced with the same atm forcing as the ocean model, and the Stokes fields are added "offline", i.e. after the ocean model and wave model fields have been integrated and stored? In that case, why not write something like "Stokes drift is calculated from the wave model using the same wind forcing as used in the ocean model."

Page 3: Line 32-34: I found this sentence unclear. "After simulations ...25 h length." I understand drifters are split into 25 h segments, but what is meant by "different model setups explored the range of possible effects"? How were the setups different, and what were the effects?

Page 4: Line 11: "of the drifter"

Page 6: Line 8: "Eulerian model currents can usually not fully reproduce observed currents"
Line 17: How was α chosen? See comment above.
Line 18: remove "a" and change "parts" to "part".
Line 21: "...when model currents used do ..."
Line 22: How was 0.6% chosen? See comment above.
Line 23: "(1m deep top layer)"

Page 7

Line 10: I think Fig 4 is defined before Fig 3? Line 12: "A principal component analysis (PCA) was performed on the residual currents, focusing on the inner German . . . "

Page 8
Line 9: "a few days"
Line 12-15: I found the two sentences really hard to read. "For each . . . existing observations." The time bar does not really show anything that has to do with the release of simulated drifters. I think the first sentence should be something like "The time bars show the durations of the surface drifters and different colours indicate subjectively identified drift regimes." The second sentence I think means that the time bars start at midnight, while simulations start at 13:00. Why not start the time bar at 13:00?
Line 29: ". . . of about 20 km from drifter 8".

Page 11
Line 7: "extreme drift speeds". It is hard to judge whether the drift speeds are extreme by just looking at maps. Could the authors include a time series plot of drift velocities instead, or a probability density function for speeds? Fig. 10 and 11 show this, so I would recommend moving that plot this section and perhaps include more drifters in it.
Line 9: "moderate drift velocities". Again, hard to judge just by looking at maps.
Line 20: How were these parameter values chosen? See comment above.

Page 12:
Line 2: Somewhere here it might be good to remind the reader about how TRIM and BSHmod are different.

Page 16
Line 2-4: "Although . . . Eulerian currents." It is an important statement that adding

wind effect gives the correct direction for drifter 7. It would be good with a plot or at least some numbers in the text where the the drift is shown for observations, TRIM, BSHmod and BSHmod+W (only TRIM and BSHmod+W shown in Fig 7).

Page 17
Line 28: "An exception is drifter 9 . . . "

Page 18
Line 5: ". . . drifter 9 does not."
Line 16: "Although wind speeds can be relatively strong (not shown), strengths of 25 h . . . "
Line 20-22: "Note, however . . . locations.". I could not understand what is meant here.
Line 23: ". . . caused by the fast west-northwest movement of drifter 8, not shared by drifters 5 and 6 (SM3)."
Line 26: "A four-day period . . . "
Line 32: "A particularly fast movement of drifter 8 is observed on days 34 and 35. On day 35, drifter 8 also drifts more westward than drifter 5 and 6."

Page 19:
Line 13: "Southwesterly winds cause a transition towards a strengthened . . . "
Line 30: "Currents in TRIM representative of a surface layer of 1m depth had drift velocities similar to those observed (Fig 9)."

Page 20:
Fig 9: Why is BSHmod not shown in Fig a, or why are current speeds not shown in Fig b? It would be good to see what effect adding the wind effect actually has, i.e. what are the relative magnitudes of Eulerian currents and added wind effects? Also,

the authors should consider showing probability distributions of errors in displacement and angles in order to condense the information. Does the error in angle have a zero mean or are the errors predominant in one direction? Does one model have smaller errors than the other?

Page 21
Line 9: what does "currents will generally not parallel winds" mean?
Line 15: "... may be one of the reasons why simulated trajectories resemble each other ..."
Line 19-20: "Both TRIM and BSHcmod are unable to reproduce the specific ..."
Line 24: "... they start with small initial separations $O(1-10\text{m})$.
Line 29: "However, this separation might have been triggered ..."
Line 34: "could imply accelerated spatial separation". Why? How? I would rather say "and relative dispersion measured using drifters of different types may not reflect the diffusivity of the flow."

Page 22
Line 4: "The subsequent separation rate of about 3 km per day ..."
Line 7: "... modelling was undertaken to ..."
Line 19: Somewhere here I think a discussion is warranted about the differences in wind forcing in TRIM and BSHcmod. What is the temporal and spatial resolution of the wind data? Do they capture variations on the same spatial and temporal scales?
Line 20: Again, how were the parameters for your wind effects chosen. See comment above.

Page 24
Line 1-4: Here the authors touch upon how the wind parameters were chosen, but it is not clear. Was the Stokes drift parameter chosen so that Stokes drift would be of

similar magnitudes as windage effects?

Page 25:

Line 1: "Fig 10 also shows magnitudes . . ."

Line 4-5: "Variations of maximum drift speeds indicates that movements along different branches of . . ."

Line 14: "Fig 10(a), magnitudes of drift velocities were smoothed using a 25 h moving average of hourly data"

Line 31-32: "Note that . . . wave effects." I think the authors mean they add Stokes and wind effects offline, i.e. after the Eulerian currents have been stored. Why not write "Note that the Stokes drift and windage was calculated offline and added to the Eulerian currents after the model had been integrated and the fields stored."

Page 26

Line 2: What bulk formulas were used to include wind forcing in the TRIM and BSHcmod models? Same or different? Could the choice of bulk formula impact the results?

Line 9: "Two crucial and outstanding questions are a) are the drifters' behaviours representative of surface . . ."

Page 27

Line 1: "To fully disentangle . . . "

Line 11: "Possible reasons for the deviant behaviours of drifters 8 and 9 can only be speculated. "

Page 28:

Line 3: Could power spectra of kinetic energy show how important the sub-grid scale

motions are?

Line 8: "... wind speeds in this case. "

Line 19-23: This bit is hard to understand. I think it needs some rewriting. The sentence "Keeping in mind ... Stokes drift" should probably be split into two sentences. Also "Accordingly ... marine currents" should probably be split as well.

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Interactive comment on Ocean Sci. Discuss., https://doi.org/10.5194/os-2017-40, 2017.