

Interactive comment on “Ice and AIS: ship speed data and sea ice forecasts in the Baltic Sea” by U. Löptien and L. Axell

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We thank reviewer 2 (R2) for his time, effort and encouraging comments.

- R2: 1. How well does HIROMB perform in the study area? For example, are forecasts of convergence/divergence, drift speed and ridge density realistic?

- A: We will add a model evaluation based on satellite observations in the revised manuscript.

- R2: 2. What is the rationale for determining which variables to include as fixed effects versus random effects? Ice drift, convergence and angle are only included as fixed effects, why?

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- A: We aim to keep the number of estimated parameters as low as possible. Each additional factor included into the mixed effects would increase the degrees of freedom enormously and when including everything we would tend to overfit the data. We thus included the variables which showed the largest spread in ship speeds with decreasing median (according to the preceding data analysis). We will add this information to the revised manuscript.

- R2: 3. In the discussion of Figure 3, I don't understand the references to non-linear relationships. Figure 3b looks similar to 2a-c?

- A: The non-linearity becomes more visible when using another partitioning of the velocity classes. At the moment the class-width are, in contrast to the sub-plots in Figure 2, non-equal which might be confusing. We will exchange the respective Figure and adapt the description.

- R2: 4. I had a hard time following the discussion of Table 1 (page 3819). For example, where does it show that the strongest factor affecting ship speed is slow drift speeds with ice drift from the side of the ship? In general, I had a hard time linking most statements to the data shown in Table 1.

- A: Thanks. We will change the description of the Table and refer explicitly to the respective numbers.

- R2: 5. The variables in Figure 2 are tested for correlation, why isn't this done for the mixed effect variables and is there an implication to the validity of the model if two of the random components (ridges and level ice thickness) are highly correlated?

- A: True. High correlations do not impact the validity of the statistical model and the predictive skill is not affected. However, the correlations are of interest since the impact of correlated variables can not be fully separated and the significance of one of the respective variables might be masked; i.e. we can not fully distinguish to what extent ice thickness compared to ridge density causes a median speed drop. We will make

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this point more clear in the revised manuscript.

Concerning the correlations of the factors in Fig.3: We will provide these for the underlying continuous variables.

Minor comments:

- R2: 1. The model is developed using data from only one year, 2011, are there any caveats applying it to other years?

- A: There are no caveats we can think of. Our choice of 2011 for this pilot study was a pragmatic one (our momentary data access was limited).

- R2: 2. In the discussion of Figure 2, I see the general decreases in the median and first quartiles but why are there general increases in the upper bound and extremes?

- A: We assume, as mentioned in line 74ff, that the ships aim to keep a relatively high speed whenever possible. When the ice conditions get severe, small ships will experience large speed drops while big ships with a strong engine are less affected. We expect, that this factor leads to an increased spread in ship speeds under severe ice conditions. This hypothesis is supported by the fact that the random intercepts are correlated with the random slopes (line 280ff). We will add a discussion of this issue.

- R2: 3. Figure 3c represents a known situation where ships tend to get stuck. What about convergence and high ice concentrations? Are there other combinations of sea ice variables that lead to besetting in this region?

- A: Convergence in combination with high ice concentrations did not turn out to be a significant factor. This might well be related to problems with the representation of convergences. We will add a related discussion based on satellite-derived ice velocities. Concerning "...other combinations...": We tested several other interactions between explanatory variables but could not score any remarkable improvement of the statistical fit (according to the Akaike information criterion (AIC)). We will discuss this in the revised manuscript.

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- R2: 4. In general for Figures 2 and 3, how many observations are in each category? A difference in means test could be used to test the statistical significance of the difference in means between each category.

- A: True - we will add the information about the amount of observations per category.

- R2: Page 3814 Line 8: typo "was developed in the 90th " Line 23: change to "regularly passed by ships" Line 24-25: awkward wording, maybe something like::: "The region consists of relatively narrow passages with little space to circumnavigate problematic areas"

- A: Thanks

- R2: Page 3815 Line 6: how many observations were excluded compared to the ~14,000 included in the analysis

- A: The original table (without ice breakers) contained 16407 observations (which we will mention in the revised manuscript).

- R2: Page 3818 Line 20::: Change to "Fitting statistical models:::"

- A: Thanks

- R2: Page 3819 Line 1: How did you test the statistical significance? Was this significance test applied to all of the categories/variables in figure 2 and 3?

- A: We apologize. We used a t-test when fitting the statistical model, while the preceding data analysis is purely heuristic. We will add this information to the revised manuscript.

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