Thank you very much for your comments. Below you will find our responses where the reviewer's comments are in *italics* followed by our responses in blue.

Reviewer #2

General Comments:

Based on the oil transport equation in marginal ice zones (MIZs), the authors proposed a generalized transport equation for estimating the transport velocity in the MIZ by primarily introducing a leeway coefficient in the ice (i.e., α_i) into the former equation. The transport velocity u, by design, then is a weighted mean of the ice and water velocities, either of which has been corrected by the respective leeway coefficient (i.e., α_i and α_w). Using the field observations from 4 drifters, the authors further determined the optimal leeway coefficients ($\alpha_w = 0.03$ and $\alpha_i = 0.02e^{-i\pi/6}$) which would minimize the MAE between the observations and the results predicted by the model. I found the manuscript is very interesting and the general leeway model suggested here could be very useful for future operations in the Arctic. I therefore suggest to accept the "manuscript once it goes through a minor revision. Please see my specific comments below.

Thank you for the excellent comments on the manuscript. We will address your specific comments individually below.

Specific Comments:

L112: "as well as for wave models (Rogers et al., 2016)" to "... (Masson and Leblond, 1989; Rogers et al. 2016; Liu et al. 2020)"

Masson, D., & Leblond, P. (1989). Spectral evolution of wind-generated surface gravity waves in a dispersed ice field. Journal of Fluid Mechanics, 202, 43-81. doi:10.1017/S0022112089001096

Liu, Q., Rogers, W. E., Babanin, A., Li, J., & Guan, C. (2020). Spectral Modeling of Ice-Induced Wave Decay, Journal of Physical Oceanography, 50(6), 1583-1604.

Added the additional references

L117: "... calculate their solutions " to "... calculate their source terms or source functions?"

This has been changed to emphasize the source terms are weighted by ice concentration, but only one solution for the wave action equation is calculated in the MIZ.

L147-151: This paragraph does not read well. If I understood correctly, both the CAPS and TOPAZ simulations were forced by the CAPS winds. But line 148 presents that "TOPAZ is forced by ECMWF IFS ...". Please revise here for clarity.

Yes, we can see how this is confusing. We have clarified in the text that only the CAPS winds are used in the leeway analysis.

L193: "... at a fixed value of α_w" to "... α_w (0.03)" L200: "... at a fixed value of α_i" to "... α_i ($0.02e^{-i\pi/6}$)"

Thanks. The sentence has been reworded for clarity.

P12, Fig. 5 caption: "for each of the four drifters" to "... drifters with the constant $\alpha_i = 0.02e^{-i\pi/6}$"

Corrected to similar format as Fig. 4 caption.

Fig. 2 uses the unit "m/s" for all the velocities. Figs. 4 and 5, however, adopt "km/day". I am a bit confused why two different units are used for velocities in these figures. Furthermore, to better understand how large the errors are, it may be better to also include the relative error (i.e., in %) in Tables 1 and 2.

This is a good point (to clarify we know you meant Fig. 3). We show drifter velocities and model velocities in m/s as this is a typical choice for instantaneous values from these sources. We also output the errors in km/day as we are interested in the errors on the time scale of days plus km/day is a typical unit for ice drift. But you bring up a good point and we feel it could be useful to have both scales, which we have now added to Fig. 3.

Tables 1 and 2 show the mean average error, so what you are suggesting is to show the mean relative error (or more commonly the mean absolute percentage error [MAPE])? This is an entirely different metric and would not simply be another column in Tables 1 and 2,

$$\text{MAPE} = 100\left|\frac{\mathbf{u}_o - \mathbf{u}_m}{\mathbf{u}_o}\right|,$$

where $\mathbf{u}_o$ is the velocity of the object and $\mathbf{u}_m$ is the velocity of the model. This will create singularities when $\mathbf{u}_o$ is close to 0 (for example drifter 14438 around Sep-22). Also, we feel the units are easy to relate with the time-dependent analysis presented in Figs 6 and 7 and Table 3.

We calculated the MAPE and included the figures here. The MAPE is larger for the drifter with the smaller velocities (14432) as expected while the MAE is only slightly larger. We feel this new metric is not well suited for this study and opt to not include it.

L206: "Lagrangian ... n), which is a ..." - delete "which is"

Corrected.

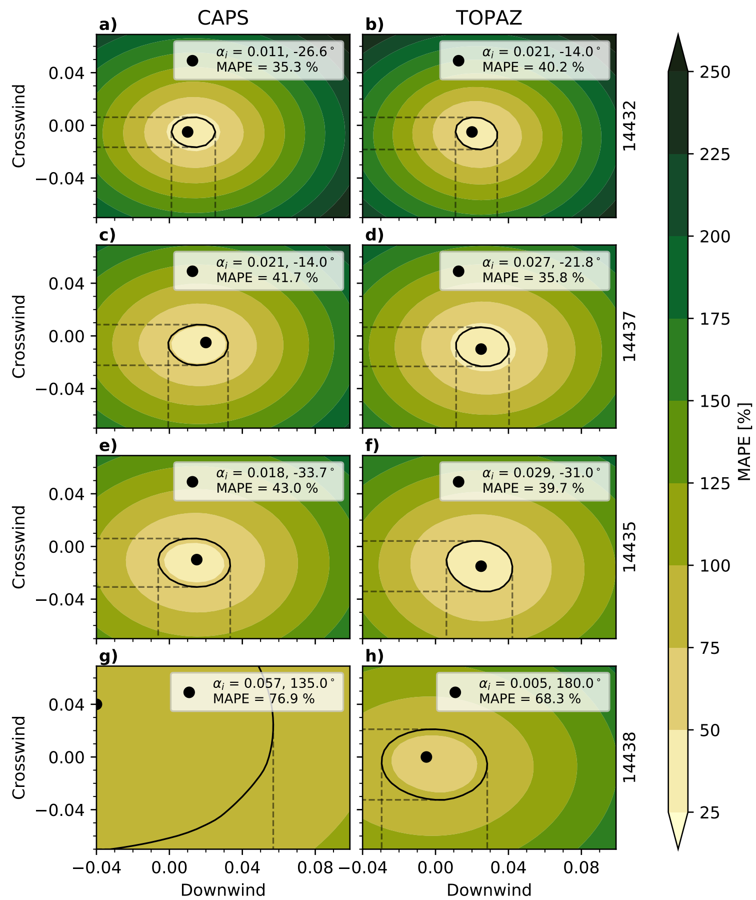

Figure R1: Filled contours of MAPE (in %) between observed drift velocities and (3) for the along and cross-wind components of α_i with $\alpha_w = 0.03$. The left column uses the CAPS forcing and the right column uses TOPAZ forcing. The black dot shows the location of the MAE minimum and the black contour line shows the MAE value within 10% of the minimum. Each row is for an individual drifter in order from high ice concentration at the top to low ice concentration at the bottom. Sensitivity to to the choice of α_i is much greater in the high ice concentration than the low.

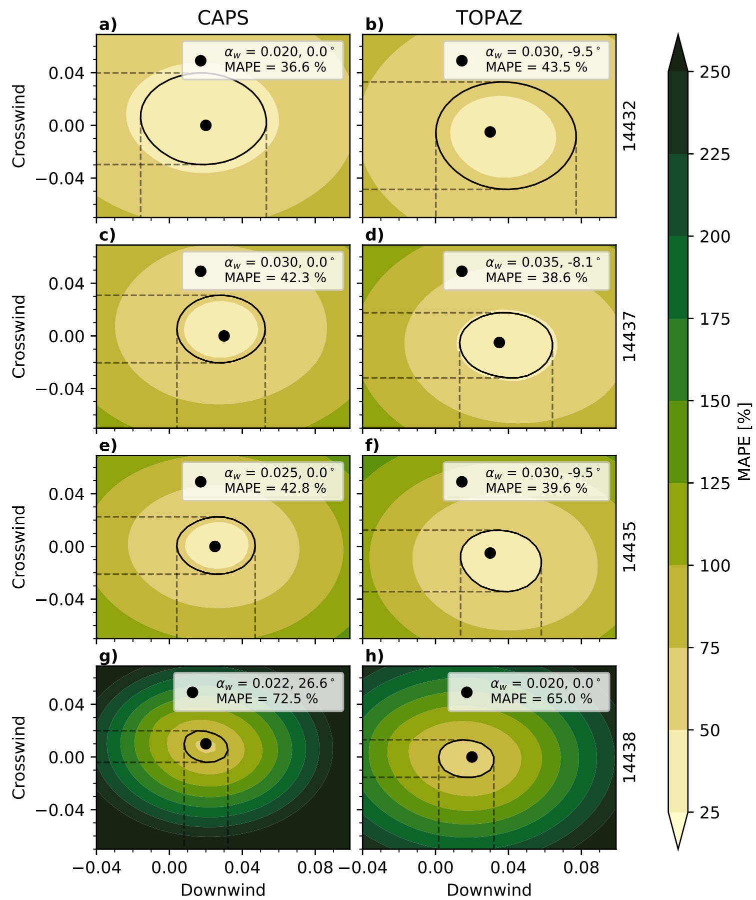

Figure R2: Filled contours of MAPE (in %) between observed drift velocities and (3) for the along and cross-wind components of α_i with $\alpha_w = 0.03$. The left column uses the CAPS forcing and the right column uses TOPAZ forcing. The black dot shows the location of the MAE minimum and the black contour line shows the MAE value within 10% of the minimum. Each row is for an individual drifter in order from high ice concentration at the top to low ice concentration at the bottom. Sensitivity to to the choice of α_i is much greater in the high ice concentration than the low.