We thank the referee for good comments and suggestions regarding our manuscript. Regarding suggestions for improving the writing and grammar, as well as figures and figure captions, we will implement them as suggested and will therefore not comment on all of these here. For more major questions and comments, we have tried to answer them one by one below.

Introduction:

L.18–21: could do with a few additional references

Good point. We will include a few additional references in the revised manuscript, both on the topic of vertical mixing and on lateral transport by non-linear dynamics (see also reply to comment below on bringing the work into a general research context in the Conclusions).

L 50-65: It would be nice to have a diagram to illustrate this process. You could move Figure 9 to the intro and refer to it here as it greatly adds to the intuitive understanding of the process.

L 68-83: Again, it would be nice to have the diagram for this in the intro.

This is an interesting suggestion. We will consider moving the two diagrams to the intro to help illustrating the two transport processes better. It may add some difficulties since these figures, especially Fig. 9, introduce some parameters that may not need to be introduced at this early stage. But we will give it a try.

Methods:

L 118: Why do you use TPXO7.2? The latest version is 9 and is available as a higher resolution dataset. This is likely to affect your results. By how much do open boundary forcing values differ between the two datasets?

The actual model run was conducted a few years back, but we got delayed in analyzing the data and writing this paper. This is why an older version of TPXO has been used. However, we believe that the validation against previous studies as well as observations is the most important check regarding model performance. We take the favorable comparisons shown in Figure 5 as indication that this model is adequate for investigating what are, first and foremost, *qualitative* aspects of the tidal dynamics and transport in the region.

Model validation:

It would be nice to see some numerical values so that the reader can assess the performance of the model in absolute terms. Could you add a table with the amplitudes, phases, and amplitude and phase errors for each station for M2 and K1? You could also report mean errors for each constituent analysed.

We will include such a table as part of the model validation.

Tidally driven transport:

L.177: Why do you show results only for 3 and 4.5 hours? It would be good to see the process through the tidal cycle at e.g. hourly intervals.

We agree that a higher temporal resolution would be useful in these figures. However, we chose to show only 3 and 4.5 hours after the two slack tides due to space constraints. Essentially, including many more time-steps will make each subfigure smaller and harder for the reader to interpret. The main purpose of these figures is to show that dipoles form, propagate away from the strait, and partly escape the return flow.

But, as said, we agree with your point. So, we will try to add a few more time-steps without compromising the quality of the figures.

Rectified tidal transports:

L.335: I'm not sure this sentence fully makes sense? Which mechanism dominates and is responsible for the net flux or how does each process contribute?

We agree with you here and will modify the text here in the revised manuscript. The main message that we will try to get across is that tidal pumping is the dominating mechanism causing net fluxes out of Vestfjorden in general. But south of Røst the net flux is mainly due to tracer advection by the rectified tidal currents (not tidal pumping). A possible modified text (also including the sentence above):

"Figure 12 also shows the time-mean tracer field, revealing that the circulation cells advect low-concentration waters into Vestfjorden northeast of the island groups and high-concentration waters out of the fjord on the southwest sides. So even though much of the net tracer transport south of Lofotodden is due the tidal pumping mechanism investigated above, there is also a contribution driven by anticyclonic mean flows around the islands here. This mechanism appears to be particularly important south of Røst where, it should be noted, there can be no formation of self-propagating dipoles."

L343: How will your choice of linear bottom friction impact your results? Is this the same bottom friction used in the tide model? It may be an issue if they are not consistent?

The numerical model uses quadratic bottom friction. But in our discussion of theory, we have used linear bottom friction in order to arrive at closed-form analytical expressions (eqns. 12 and 13). We will comment on this in a revised manuscript.

As for comparison between simplified theory and numerical results (with regards to the response to the spring-neap cycle), we primarily seek an order-of-magnitude agreement since the theoretical expression is obviously simplified. The reviewer's comments nevertheless led us to improve on our previous guestimate for an effective linear drag coefficient. Essentially, we can set $R = C_d*|u|$, where C_d is the model's quadratic drag coefficient and $|u|$ is an expected magnitude of current strength.

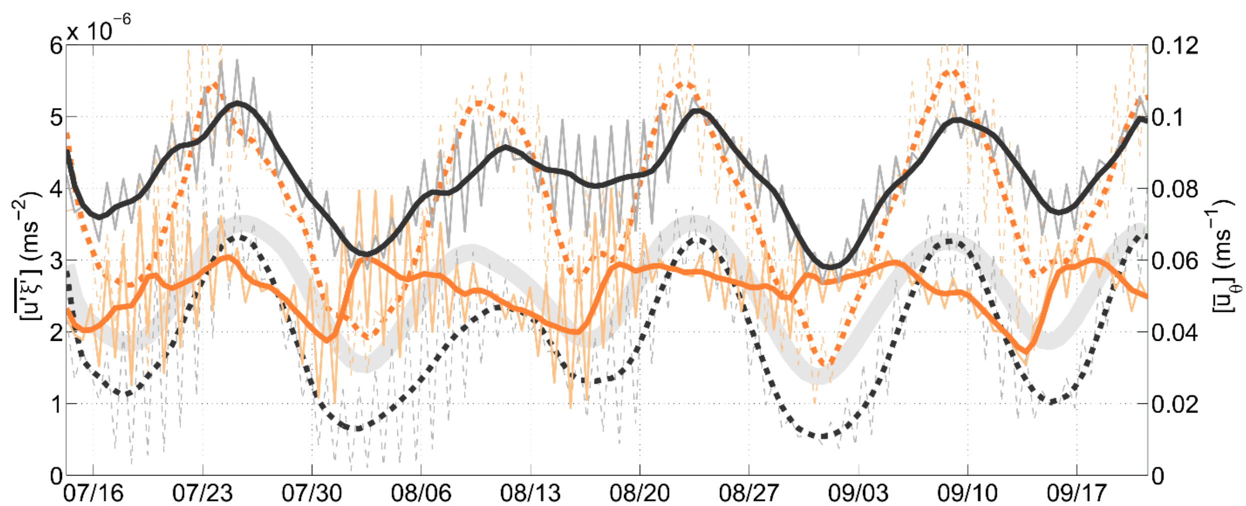
As outlined in the text, we investigated 5 and 9 closed depth contours around Mosken-Værøy and around Røst, respectively. Updating these calculations, now using the model's actual drag coefficient ($C_d = 0.0025$) and mean values for current strength $|u|$ (0.29 and 0.23 m/s for Mosken/Værøy and Røst, respectively), we found effective linear friction coefficients to be $R = 8.6 \cdot 10^{-4}\, m/s$ and $R = 5.7 \cdot 10^{-4}\, m/s$, for Mosken/Værøy and Røst, respectively. These are mean value for all the closed depth contours around each of the island groups. Using these updated values in our expression for phase lag,

$$\phi = tan^{-1}\left(\frac{\omega_{msf}H}{R}\right),$$

we obtain an updated mean phase-lag of the response to the spring-neap cycle of 0.6 days (0.24 rad/s) and 0.9 days (0.39rad/s), for Mosken-Værøy and for Røst, respectively. We will update the text with these new estimates.

L375: How does the choice of filter impact the curves? It would be nice to see 1 tidal cycle values as well.

The purpose of the low-pass filter is to make the figure cleaner by removing higher frequency variations (e.g. diurnal). But it's possible to add these with thinner lines. Attached here is a sample figure where fast variations have been added. We will consider using this in the revised manuscript.



L440: I'm not sure I understand how you define the topographic length scale

L445: Where do you define L_B and what is it? How does it differ from L?

We see that we have forgotten to define the topographic length scale in the manuscript and thank the referee for pointing this out for us. We will fix this in the revised manuscript. But for now: L_B is the topographic length scale, defined as follows:

$$L_B = \frac{H_0}{\alpha}, L_B = \frac{H_0}{\Delta H}$$

where H_0 is a mean depth and $\alpha = \Delta H$ is the slope of the bottom topography. L_B is thus used to characterize bathymetric feature, which will cause water to move vertically over a ridge or a bump etc. at the sea floor bottom. L on the other hand is the horizontal distance the water column has moved within some time dictated by a given dynamical process. In our case here, $L = L_T$, where L_T is half a tidal cycle.

Summary and conclusion:

L.492: 'But not all straits are created equal' – reword to something more specific.

This was a play on words originating from the American Declaration of Independence. We may reword this general transitional sentence, but the specifics are given in the two sentences that complete that paragraph.

General: Given that your introduction talks about cod quite a lot, the reader feels a little let down in the conclusions. How important are these tidal processes for the dispersal of the Arctic cod?

This is a good point. Since we only investigate purely tidally-driven flows in this manuscript, we cannot say much about the contribution relative to other processes that impact the drift of cod eggs out of Vestfjorden (winds, background currents, freshwater run off etc.). We already point towards our more complete 3D follow-up study, where such a comparison will be done, at the very end of the Conclusions section. But we will downplay the cod-eggs discussion in the introduction somewhat, to not promise more than we can keep.

How do the observed processes compare to other regions in the world and different observations? It would be nice to see this work be put into context of other previous work in this section.

This is a useful suggestion. We will put the work a bit more into context of previous work in the revised manuscript. Below are a few examples of studies that are relevant upon a discussion in the manuscript, in which we will elaborate a bit more in the revised manuscript..

Tidal pumping, particularly in relation to tidal flushing and estuaries have been widely studied, and the formation of dipole vortices are observed many places where prominent tidal currents exit narrow straits (e.g. Aransas Pass: Whilden et al, 2014; Messina Strait: Cucco et al, 2016, Great Barrier Reef: Delandmeter, 2017). Delandmeter et al (2017) investigate dipoles formation and interaction between a line of islands which are separated by 1-2 km, which is comparable geometry to Moskstraumen and Nordlandsflaget. While the authors do not estimate the net transports through the straits, both observed and modeled behavior is qualitatively similar to what we find in southern Lofoten.

Regarding tidal rectification, George's bank is the most widely studied. Here, current meter and drifter observations have been interpreted in light of both modelling and theoretical studies (Loder, 1980; Limeburger & Beardsley, 1996; Chen et al, 2001). The residual currents encircling the bank—in a clockwise fashion—is of similar strength as the flow we model around Røst and Mosken/Værøy, with mean Eularian speeds in the range of 0.2-0.3 m/s. By calculating the average topographic length scale and comparing it to the cross-isobath length scale of the mean current from values provided in table 1 in Loder (1980), we find that on the northwestern side and northern side $L_T/L_B \simeq 1$, equivalent to what we find for the islands of southern Lofoten. The Norfolk sandbanks are another famous example where tidally-induced circulation patterns are observed, but past studies (Huthnance, 1973; Howart & Huthnance, 1984) do not provide estimates of L_T/L_B ratios for this region.

Chen, C., Beardsley, R. and Franks, P.J., 2001. A 3-D prognostic numerical model study of the Georges Bank ecosystem. Part I: physical model. *Deep Sea Research Part II: Topical Studies in Oceanography*, *48*(1-3), pp.419-456.

Cucco, A., Quattrocchi, G., Olita, A., Fazioli, L., Ribotti, A., Sinerchia, M., Tedesco, C. and Sorgente, R., 2016. Hydrodynamic modelling of coastal seas: the role of tidal dynamics in the Messina Strait, Western Mediterranean Sea. *Natural Hazards and Earth System Sciences*, *16*(7), pp.1553-1569.

Delandmeter, P., Lambrechts, J., Marmorino, G.O., Legat, V., Wolanski, E., Remacle, J.F., Chen, W. and Deleersnijder, E., 2017. Submesoscale tidal eddies in the wake of coral islands and reefs: satellite data and numerical modelling. *Ocean Dynamics*, *67*(7), pp.897-913.

Howarth, M.J. and Huthnance, J.M., 1984. Tidal and residual currents around a Norfolk sandbank. *Estuarine, Coastal and Shelf Science*, *19*(1), pp.105-117.

Huthnance, J.M., 1973. Tidal current asymmetries over the Norfolk Sandbanks. *Estuarine and Coastal Marine Science*, *1*(1), pp.89-99.

Limeburner, R. and Beardsley, R.C., 1996. Near-surface recirculation over Georges Bank. *Deep Sea Research Part II: Topical Studies in Oceanography*, *43*(7-8), pp.1547-1574.

Loder, J.W., 1980. Topographic rectification of tidal currents on the sides of Georges Bank. *Journal of Physical Oceanography*, *10*(9), pp.1399-1416.

Whilden, K.A., Socolofsky, S.A., Chang, K.A. and Irish, J.L., 2014. Using surface drifter observations to measure tidal vortices and relative diffusion at Aransas Pass, Texas. *Environmental Fluid Mechanics*, *14*(5), pp.1147-1172.

Figures:

Here we will only shortly comment on the direct questions. Suggestions of technical improvements and rephrasing figure captions will be implemented in the revised manuscript.

Figure 2: It would be nice to have more information with this figure: e.g. (a) how do the two figures differ? (I guess it's the phase of the tide); (b) the velocity front is identified – why is this relevant and what does it mean for this study?

The purpose of this figure is to show that formation dipoles and tidal jet are actually observed in Moskstraumen, and not only a result of numerical modelling. We will reformulate to bring this point up in the text and also add some more info in the caption.

Figure 4: how about plotting observed values on top as shaded circles on top of the model results? Also, plot against latitude and longitude rather than distance.

The suggestion of plotting observed values on top of the model results is a good idea. However, the observations are in general located near land, inside straits, where gradients are large. We are therefore weary that adding shaded circles may make the figure messy and potentially hide the overall structure of the tides. But we will consider if we can include validation here in a good way. However, we will fix these figures to plot against latitude and longitude instead of distance.

Figure 7: Could you take your panels a bit further south? At 10.5 hours you are missing part of the incoming waters

Yes, we will experiment with this. Note, however, that at 10.5 hours the current is southward. So extending the panels further south will include more of the outflowing water rather than incoming water (3 and 4.5 hours contain northward-directed flow).

Figure 9: Panel b: Why is A_e in the sink region? Should it not be in the jet? It would be nice to illustrate all of the length scales on this plot (as far as possible)

A_e is in the jet (the black two-headed arrow). But we see that the location of the label is poorly placed. We will fix this in the revised manuscript and also include an arrow showing the sink radius.

Figure 13: What do you mean by 'sets of closed contours'? Could you show these on a map?

The "sets of closed contours' should have been phrased as "sets of 5-9 closed depth contours encircling the island groups". We will include a map similar to the one in Figure 17 for the readers to see the locations of these contours.

Minor comments:

Thanks. All these suggestions will be implemented.