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Interactive comment on "Winter sea ice export from the Laptev Sea preconditions the local summer sea ice cover" *by* Polona Itkin and Thomas Krumpen

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Concerning the comment of reviewer #2: Lack of novelty/originality We strongly disagree: Although the paper builds up upon previous work of Krumpen et al. (2013), it certainly covers new aspects and provide new insights into a mechanism that has not received much attention. The presented results indicate that this mechanism may be the most important one controlling summer ice retreat along the North East passage (NEP). In the following, we highlight the scientific value and new findings that go beyond previous study. However, we agree that this findings should be made clearer in the manuscript.

In Krumpen et al. (2013) the statistical connection between late winter export and

summer ice extent was discovered for the first time. However, the preconditioning effect is not a focus of the paper and by that time, the investigation was limited to sea ice motion and concentration data, completely neglecting sea ice thickness as such. In this manuscript, we were able to deepen the understanding of the linkage between winter ice dynamics and summer ice extent and highlight the importance for seasonal forecasts, by means of a sensitivity study using a numerical model and in-situ ice thickness observations:

First important question we address is weather numerical models are capable of resolving the described process. A correct representation of the preconditioning effect will enable models to predict sea ice anomalies along the NEP and beyond. Our results show that the applied regional model captured the preconditioning effect of late winter dynamics on summer ice extent quite well, although existing GCMs have difficulties in predicting sea ice extent in marginal ice zones, in particular the Laptev Sea. This finding is indeed novel and of high interest to the model community. The need for these kind of studies was just discussed on the Sea Ice Prediction Workshop 2017, in Bremerhaven. Our sensitivity study also shows that besides the preconditioning there are other mechanisms that become important after winter and contribute towards the actual summer sea ice situation. Combined with the publication of Steele and Ermold (2015) and Maslanik (2000), our manuscript provides, for the first time, a complete picture of processes controlling summer ice extent on the Laptev Sea shelf: The preconditioning effect of winter ice dynamics (this manuscript), cyclones bringing anomalous warm air masses to the Laptev Sea during summer months (Maslanik), and winds that force ice floes/edge back into warm waters cause melting (Steele and Ermold).

Apart from complementing the current understanding of ice retreat in summer, our model simulation also provides insight into long-term changes of sea ice volume export that is currently not available from observations or satellite data. The simulated trend of sea ice volume export for the period from 1992 till 2014 is positive, but not significant. This indicates that the observed acceleration of the sea ice drift and associated

increase in area export out of the Laptev Sea may not be compensated by the thinning effect of enhanced offshore advection. Hence, we expect that an increased volume export from the Laptev Sea into the Transpolar Drift has far reaching consequences for the entire Arctic sea ice mass balance.

In this manuscript, we can also show that winter ice dynamics not only precondition pack ice extent in summer, but also influence fast ice decay. Up to know, the shortening of the fast ice season was very much associated to changing temperatures, delay in freeze-up and earlier onset of river break-up. Here we discover ice advection as another (so far unknown) mechanism that speeds up fast ice break-up, and as such, contributes to the increasing coastal erosion, warming of permafrost, etc. This aspect is another new finding, adding to the existing knowledge.

Last but not least, the thinning effect of ice advenction on Russian pack ice was never investigated with in-situ data. In this manuscript we present for the first time thickness observations showing the thinning effect of two different winters of different export strength. From our perspective, the in-situ data alone is very unique and worth of publishing.

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