Dear Julienne,

thanks for your feedback and the deadline extension. It was very much appreciated. Below you find answers for your comments.

Let us know if there is something missing or unclear.

Best regards

Thomas

C1: I thank the authors for revisions in response to the reviewers' concerns. I have a few remaining issues however before accepting the paper for publication. One there are several typos in the paper, i.e. Hollands, 2010 should be Holland et al., 2010, that need to be corrected. A careful proofread will reveal these instances (without line #s it's impossible for me to detail each one).

A1: We carefully proofread the manuscript and did a couple of corrections. Changes we made are highlighted in the document.

C2: The Vavrus et al. 2012 reference for future loss of sea ice seems a bit strange as that is based on only one model that doesn't capture the Beaufort Sea High, which certainly will impact on the evolution of the sea ice cover. Why not reference studies that show results from several or all CMIP5 models and thereby better isolate the forced component from the internal variability? Several references exist, also as a function of different emission scenarios. Stroeve and Notz, 2015 is a review paper on the models performance and future projections that may be of additional interest and deals with the interannual/forced change issue.

A2: We agree. The suggested paper may be indeed a better reference. We now refer to Stroeve and Notz, 2015.

C3: Since you are blending the NSIDC ice motion data set with CERSAT, why not show a comparison for the months you have both to assess if there will be a potential bias in blending the two data sets? As a side note a reprocessed ice motion data set will be released soon by NSIDC that hopes to solve some of the known problems, but that will be too late for this study.

A3: The intention of using CERSAT motion information for 3/4 of the year is its better performance on the shelf seas, where most of the Fram Strait sea ice is coming from. The good performance was shown earlier by Rozman et al. 2011 and Krumpen et al. 2013.

When bridging the missing summer month with NSIDC data, we may indeed introduce a potential bias. This bias is however small: When running the tracking routine solely with NSIDC data starting at positions located in Fram Strait, the pathways of sea ice are only slightly different a run that includes CERSAT data during winter month (see additional Figure provided). Hence, we do not expect the source area and the length of pathways to change significantly when doing the blending.

A bias assessment is however difficult, since differences of drift vectors are not spatially uniform, but covariant with ice concentration and thickness. Sumata et al. (2014) investigated differences among products through an intercomparison of four low-resolution remotely sensed ice-drift products: NSIDCv2, KIMURA, OSISAF and CERSAT. The intercomparison has however shown that in high ice-concentration areas (like the Transpolar Drift and Laptev Sea during winter month, compare Fig. 5e in Sumata et al. 2014), the differences are small which gives us additional confidence in the bridging approach.

Therefore we believe that an investigation of a potential bias that may arise from blending two data sets is beyond the scope of the study. In particular, since the only aim of the tracking approach is to assess source areas and pathways to ensure a comparability of observations. However we added a sentence about the expected differences between products and refer to Sumata et al. 2014.

Thanks for the information about the planned reprocessing of NSIDCv2 data. I will certainly have a closer look at it. Note that OSISAF announced an operational low resolution summer sea ice motion product too.
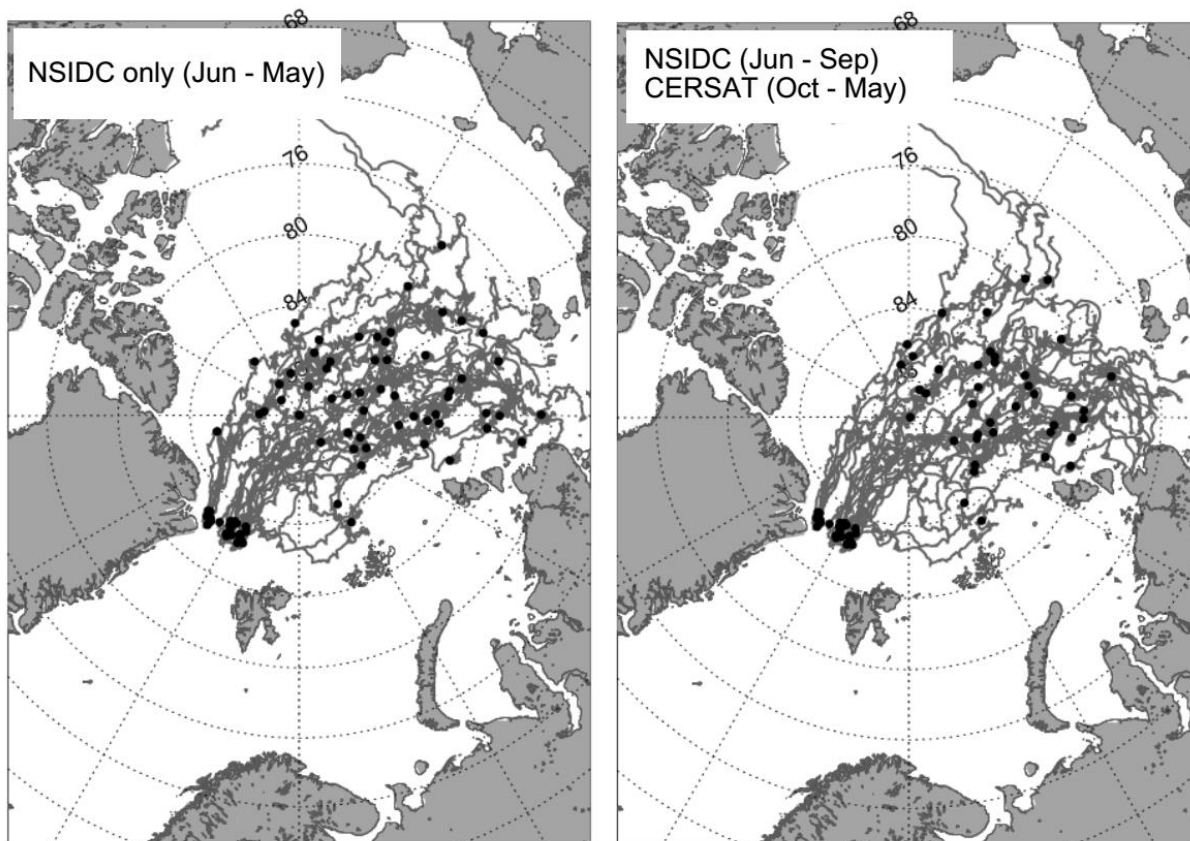
Fig.: Backtracking based on positions located in Fram Strait during summer for the period between 2013 and 2004. The left panel shows trajectories computed from NSIDC motion information only. The right panel is based on a combination of CERSAT (winter) and NSIDC (summer) motion data.

C4: a strong caution is needed for making concrete assessments of the ice age changes. Unfortunately, the ice age product stores the highest age of an ice parcel as the age of the ice of that pixel. For example, a pixel may consist of 90% first-year ice and 10% 5 year old ice for example, yet be labeled as 5 year old ice. It's a real limitation of the current ice age product. I would mention that in your paper as there may be real changes in ice age that you are missing that could explain the thickness decreases.

A4: I wasn't aware of this limitation. We now mention in the product description that the age information provided for each grid cell is the age of the oldest tracer parcel that exists in the grid cell. We also adapted the description of Fig. 3 that compares Fram Strait ice age with age of ice covered by EM-measurements.

Despite the limitations of the Maslanik ice age product, we are still confident that the decrease in modal ice thickness cannot be explained by a shift in age composition towards younger ice, since the length of drift trajectories provided in Fig. 2 are the same for 2010, 2011 and 2012 (now mentioned in the text).

A5: Good point. We looked at ERA-Interim data and differences in heat flux between northern and southern most location and found it to be much lower than for NCEP. The difference is 2.5 Wm-2 only. This would point to a greater ocean impact on ice melt. Given the large differences in SW/LW flux estimates among products and the uncertainty of our transit time estimate, we cant separate between ocean and atmospheric contribution without additional observations.

In the manuscript we shortened discussion about transit time and mention differences among radiative fluxes obtained from ERA-Iterim and NCEP. We conclude that an exact quantification of atmospheric and oceanographic contribution remains elusive.

A6: We agree. Seasonal variability may at least partly be expected. The annual mean speed of the sea ice in the Fram Strait is in the range 8-14 cm/s (Smedsrud et al.), and the East Greenland Current (EGC) carries about 4.6 cm/s (Widdel et al. 2003) to 5.0 cm/s (Smedsrud et al 2011) of this speed. However, two recent studies suggest that 5.0 cm/s is too low for the mean and that the EGC is stronger during winter and is responding to the larger scale wind forcing in the Nordic Seas. De Steur et al. (2014) analyzed mooring data along 79° N between 1997 and 2009, and found that surface currents were below 5 cm/s during summer and above 10 cm/s during winter. Also Daniault et al (2011) found faster flow in January and slower flow in July for the years 1992—2009 based on altimetry in the EGC further south.

In the manuscript we shortened the discussion of transit time estimates, since uncertainties of low resolution drift products are high and differences in radiative fluxes large (compare answer to comment 5).

With respect to uncertainties of sea ice concentration data during summer melt: In summer and at the ice edge, the accuracy of sea ice concentration algorithms is lower than during winter due to presence of melt ponds, wind roughened open water areas, more atmospheric

humidity, etc. Ivanova et al. 2014 reported differences in sea ice concentration among eleven algorithms of up to 8 % in summer (September, with 12 % in the Canadian Archipelago area). Assuming the deviation among algorithm to be a valid measure for the potential bias associated to NDISC Bootstrap algorithm, results in an additional uncertainty of +-4% for the area flux estimates in summer. This is stated in the manuscript now.

References:

Daniault, N., Mercier, H., and Lherminier, P.: The 1992–2009 transport variability of the East Greenland-Irminger Current at 60 N, Geophys. Res. Lett., 38, 2011. TS2 7

de Steur, L., Hansen, E., Mauritzen, C., Beszczynska-Möller, A., and Fahrbach, E.: Impact of recirculation on the East Greenland current in Fram Strait: results from moored current meter measurements between 1997 and 2009, Deep-Sea Res. Pt. I, 92, 26–40, 2014. 18

Smedsrud, L. H., Sirevaag, A., Kloster, K., Sorteberg, A., and Sandven, S.: Recent wind driven high sea ice area export in the Fram Strait contributes to Arctic sea ice decline, The Cryosphere, 5, 821–829, doi:10.5194/tc-5-821-2011, 2011.

Ivanova, N., Johannessen, O.M., Pedersen, L.T., Tonboe, R.T., Retrieval of Arctic Sea Ice Parameters by Satellite Passive Microwave Sensors: A Comparison of Eleven Sea Ice Concentration Algorithms, IEEE Trans. Geosci. Remote Sensing, Issue Date: 7233 - 7246, 10.1109/TGRS.2014.2310136, 2014

C7: On page 18, seems you need a separate conclusions section as you move from summer volume fluxes directly into conclusions. Finally, I do not agree with the last statements. These data are of limited use for model evaluation (at least for GCMs). This is because you cannot expect the models to be in phase with the natural variability that impacts on the short time-period you have. Much longer records are needed that sample both internal and forced changes. Thus, I would be very careful in stating this.

A7: It seems that there went something wrong. The new manuscript comes with a conclusion section and line numbers. About the last statement: We agree. It has been removed.