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# *Interactive comment on* "Recent summer sea ice thickness surveys in the Fram Strait and associated volume fluxes" *by* T. Krumpen et al.

**Anonymous Referee #1**

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General Comments:

The authors present summer observations of sea ice thickness in the Fram Strait from GEM and AEM surveys (between 2001 and 2012). They arrived at three conclusions from their analysis: 1) the data set supports evidence of thinning of Arctic sea ice; 2) the along strait thinning/melt seems associated with the recirculating branch of the West Spitsbergen Current; 3) the data could be used to estimate ice volume flux during the summer.

The evidence for thinning is fairly clear and the data set supports the thinning seen in the Arctic from other data sets (submarine, satellites, etc.)– their results add to the evidence, which is an important contribution though some the attributions of changes in thickness are rather speculative.



I think the along strait thinning statements are weaker (see comments below). The authors seem to like the attribution to bottom melt associated with ocean heat flux. Why is surface melt not considered here – especially in August? (also see my comment below re: ice speed).

Yes, the data could be used to estimate volume flux. So, my question is: what is quality of the estimate? It is quite easy to calculate flux with motion and thickness but it is another thing to say something about quality. And, yes, it is difficult but I think that it is important, even with warts and all, to attempt to justify the estimates or perhaps a range of estimates.

I recommend revisions prior to publication. My detailed comments are below.

Detailed Comments:

Page:Line number

5175:25 "The underestimation of peak pressure ridge thickness is a result of footprint smoothing, an effect that is mass-conserving for mean thickness values on kilometer scale." Why? Or, provide a reference?

5176:13: "... Note that before calculating mean and modal thickness from the pdf's, ice thinner than 0.15m was excluded from the analysis, as we categorize this thickness category as open water bin due to the 10 cm noise of the EM sensor..." Is this thresholding really necessary if the noise was normally distributed?

5176:18 Why 25 km? How many samples in 25 km?

5176:22 I don't quite buy the assumption that the snow biases are negligible – especially in July and early August. And, it depends on where you are along the strait – certainly not true in the northern bits. Are there field records from the Polarstern cruises that you can turn to for support of your statement?

5177:1 Too bad, it would have been interesting to see whether the effects of the Atlantic

inflow are observable. In any case, the width of that varies interannually.

Section 2.2.2 To be complete – just state the motion uncertainty for each product.

Section 2.2.3 The trajectories are rather coarse, so it is highly unlikely that one is tracking a “specific” floe – more like an “assemblage” floes.

5179:31 So, U and V are zonal and meridional ice motion?

5180:12: I assume any mention of age is ‘age’ from the NSIDC dataset?

Figure 3 Caption: How is ice age determined from EM measurements? Do you mean age of the ice covered by the EM measurements?

Figure 4 Caption: It is really ice plus whatever residual snow that is on the ice, isn’t it? Should really re-iterate that snow depth is assumed to be zero in the caption. Also, the legend of the figure should be in a box. Otherwise, they look like data on the plot. It would also help to refer the reader to the locations in Fig. 1.

Figure 5 and 6. It would be useful to plot, along with the mean, the standard deviation of the thickness estimates.

5184:1 80 days (between 81 to 79N) translate into less than 2 km/day or $\sim$ 2 cm/s. It seems slow given the current moves faster than several cm/s. In fact, you should be able to find the surface current in other publications (perhaps a citation is in order).

5184:2 You’re assuming all that ocean heat goes to melting the ice? How about surface melt? Is there no surface melt in the Fram Strait?

5185:9 It is difficult separate, in general, age and melt in this case. So, this is rather speculative.

5187:7 Are there no drifting buoys in the area for the entire period?

5187:24 The question is: what are the uncertainties of the SAR estimates and the NSIDC estimates of ice motion. Saying that it is difficult because of different method-



ology and different latitudes is a cop out. Why are the NSIDC-based sea ice motion estimates unrealistically low before 1995? Please provide a reference.

5188:20 I would dispute the use of the word “extensive”.

5189:6 Could you see in the data any localization of the thinner ice due to melt? Otherwise this is rather speculative.

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Interactive comment on The Cryosphere Discuss., 9, 5171, 2015.