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Interactive comment on "Waveform analysis of airborne synthetic aperture radar altimeter over Arctic sea ice" *by* M. Zygmuntowska et al.

Anonymous Referee #2

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General Comments: This is a well written, concise paper contributing to our knowledge about analysing radar altimeter data for the purpose of sea ice thickness retrieval in the Arctic. It aims for a method to discriminate between two different sea ice types: first-year and multiyear ice by means of differences in the waveforms recorded by an airborne synthetic aperture radar altimeter. I feel that the paper could benefit from pointing a bit more towards the achievements and the role the results could play for future sea ice thickness retrieval in the Arctic. It would have been nice to see some numbers in the abstract. The same kind of applies to the conclusions.

Specific Comments & questions:

P1217, L1: I would speak of 5-weeks periods if I wouldn't in general rather speak of 33-day periods. In general, in the part here you give different levels of information for the

different sensors: You talk about large-scale coverage for ICESat but don't give spatial resolution; you talk about limited coverage for ERS1/2 and Envisat and a relatively coarse resolution; you even give a footprint size for Cryosat. My suggestion would be that you provide the same level of information for all the 4 main sensors we are talking about here. If you don't want to write it in the text then you might want to use a table. The CryoSat part for sure requires citation of the paper by Laxon et al., 2013, Geophys. Res. Lett.

P1217,L23-L25: I am bit concerned about the "only .... whereas" combination in this sentence. It misleads a bit into the direction that you are going to improve the retrieval into the direction of a better open water - sea ice discrimination which is actually not the case.

P1218, first paragraph: It would help the understanding of the paper if you could illustrate the statements of this paragraph with a figure.

P1219: The long paragraph on this page would surely benefit from such structuring. One way to do this could be to use a table into which you put the technical details of the ASIRAS instrument. You provide an along-track but no across-track resolution. I guess the spatial resolution is altitude independent? From Line 14 onwards you talk about supporting independent data of the same measurement campaigns. I can imagine that this can be stated a bit more clear in a separate paragraph. Line 17: Is "aircraft validation" the right term to use here? Line 19: The EM-bird measures the total ice+snow thickness. Line 21: a precise –> an excellent

P1220: Here you refer to Figure 3. Are these theoretical values or are these results from the ASIRAS measurements? Neither PP nor TeS are indicated in Figure 3. Would it be possible to mark them there as well?

P1221: L1-L8: I wonder whether it wouldn't make sense to give a few more details since at least to me it is not clear why the KS test is sensitive to differences in location and shape of the distribution function.

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P1222: L10/11: How valid is this assumption that the parameters are conditionally independent?

P1222, L8: "e.g." Are these all parameters you have used? Maybe you can be more specific and give a table about which parameters you use in total and then direct the reader to a subset of these.

P1222, L9: I would add that you look for multiyear ice and first-year ice when you talk about the ice types.

P1222, L17 ... Did you tell the reader how many single waveforms are used for the mean ones? How did you select at this stage what is first-year or multiyear ice? Did you use the classifiers?

P1223, Description and interpretation of Figure 5: I guess this section would benefit from starting with a more general description of what the figure shows before you step into the details. Maybe you then discuss the parameters in the order they appear in the figure? I would find it important to stress also, that using, e.g. PP one can perfectly well distinguish between multiyear ice and leads.

P1224, L1-2: Where can we see this statement? In Table 2? I guess so. Would you mind to tell which significance test you used and how you end up at the at this statement? How reasonable is it to average of a cumulative distribution which has long tails like the LeW for multiyear ice.

P1229, L7-9: I suggest to mention that this paper is about airborne radar altimeter data and not just about "signals". I would specify the sea ice types.

P1235, caption Table 1: Were these Wide Swath Mode SAR images?

P1237: Does the multiyear ice - first-year ice discrimination have to be separate from the lead - ice discrimination? What happens if we want to classify all three surface types at once.

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P1238: Figure 1: The annotation is cut at the left edge. The legend could be smaller. In the caption there is a typo: cases –> Cases

P1239: Figure 2: Is there a chance to know the size and location of the camera images? There is a typo in the caption: from the 1 May –> from May 1.

L1240: Figure 3: Are LeW and TeW placed arbitrarily? Are these theoretical values or measured data? Please indicate so in the caption.

L1241: Figure 4, captions: The waveform –> The waveforms ... andn type –> types. What is a "power waveform"?

Technical Corrections: P1217, L24: betwenn –> between P1219, L1: until the 8 May –> until May 8 P1221, L20: Röhrs and Kaleschke: Please check this reference. As far as I remember there was a correction published in which the author number increased to 4. P1222, L12: classification –> classifications P1226, L25: He –> They P1226, L26: This is Laxon 1994b, correct? P1227, L10: that as close –> that close P1227, L21: You might also want to mention the paper of Willat et al. in Annals of Glaciology 52(57) from 2011. P1228, L4/5: Two times Kwok et al., 1992 cited. P1228, L10: I wonder whether Polyakov et al., 2011 is a relevant citation in this context.

Interactive comment on The Cryosphere Discuss., 7, 1215, 2013.