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Interactive comment on “A spurious jump in the satellite record: is Antarctic sea ice really expanding?” by I. Eisenman et al.

I. Eisenman et al.

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We thank reviewer John Walsh for these insightful comments, which we have addressed as follows in the revised manuscript (reviewer comments in italics):

This is an important paper, especially in view of the increased attention being given to the contrast between trends of Arctic and Antarctic sea ice extent. The paper places a host of past studies of Antarctic sea ice trends into a common framework, as the authors are able to reproduce earlier published trends using the v1 dataset and they reproduce more recent published results using the v2 dataset. A notable caveat of the paper is that it does not resolve the key question: Which version of the dataset is erroneous? If the present paper can stimulate the data-processing group at NASA (or elsewhere) to answer this question, then that will more than justify publication.

While the analysis of the data seems to have been done rigorously, I have several minor suggestions for improvement. First, the v2 trend for the earlier period (1979-2004) is clearly larger than the v1 trend for the same period. The latter is statistically insignificant, as noted by the IPCC AR4 and others. But is the v2 trend for this period statistically significant? A clear statement about statistical significance of the v2 trend for 1971-2004 would indicate whether the IPCC AR4's statement about statistical significance is at stake.

The v2 trend for 1979-2005 is indeed statistically significant (using the time period and significance measure adopted in the IPCC AR4) . This is summarized in the new Table S1 of the revised manuscript.

Related to the preceding comment is the following question: If the v2-v1 “offset” (readily apparent in 1991 in Fig. 2) is removed from the v2 time series, is the trend for 1979-2012 still statistically significant? Again, the impact on the conclusion about statistical significance should be clearly stated. My hunch in looking at Fig. 1A (and Fig. S1 in the supplementary material) is that the trend for 1979-2012 will be statistically significant, with or without the previously undocumented change in the processing.

In the revised manuscript, we have added discussion of the V2 time series with the V2-V1 offset removed, which we call “Bootstrap Version 1B”. The 1979-2012 trend in V1B is indeed statistically significant, although it is considerably smaller than the trend in V2. We have included this in the new Table S1 of the revised manuscript. We have also made related revisions, including changing the title – see our response to Grant Foster.

There is some confusion, at least in my mind, about the origin/awareness of this problem in the dataset. The paper repeatedly refers to a “previously undocumented change”, yet we are told that “the algorithm was adjusted by Comiso and Nishio (2008)”. How, if at all, is this adjustment related to the change in processing that introduced (or remedied) an error? Some clarification would help.

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In the Discussion paper, we mentioned that Comiso and Nishio (2008) discuss an update to the Bootstrap dataset for consistency between SSM/I and AMSR-E. In their Fig. 15a, they give the trend in the “original SMMR and SSM/I data”. We found that this matches the trend we compute using Version 2. In the Discussion paper (p. 278), we took this to imply that the change we focus on predates the documented update of Comiso and Nishio (2008).

We have further considered this point in light of this comment and other comments that we received outside the online Discussion. In general, updates to the Bootstrap dataset do not appear to all be numbered using a systematic version control, and there is some ambiguity in Comiso and Nishio (2008) regarding exactly what changes are being made to the dataset and what is referred to by the “original” dataset.

For this reason, in the revised manuscript we simply acknowledge the ambiguity in Bootstrap dataset version control, and we refer to the “undocumented effect of a change” rather than “the effect of an undocumented change”.

There is also some confusion about “ice extent” vs. “ice area” (an issue that never seems to go away). Page 275, line 25, defines ice extent as “the total area of pixels with ice concentration above 15%”. That sounds like ice area per the definitions at NSIDC’s website (<http://nsidc.org/arcticseaicenews/faq/>), which presents the nice analogy to swiss cheese “Extent would be a measure of the edges of the slice and all of the space inside it. Area would be the measure of where there is cheese only, not including the holes”. I raise this point because the Supplementary Material contains plots for both ice extent and ice area (Fig. S5).

We have attempted to clarify the definition, replacing the text quoted in this comment (defining ice extent) with “the sum of the surface area of all grid cells that have an ice concentration above 15%”. We have also revised how the definitions of the two quantities are worded in the Supplement (Section S2.2).

Page 280 (lines 4-6) says that the spatial structure of the difference between the two

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Bootstrap versions appears to be consistent with an error in the calibration across a sensor change. Since the only support for this statement is in the Supplementary Material (Fig. S9), the text on p. 280 should be more specific, e.g., by adding something like "...because the difference is essentially invariant with longitude".

We have adopted this suggestion, adding that the difference is "relatively spatially uniform, which is consistent with an error in the calibration across a sensor change".

Finally, I note that the issue of trends in Antarctic sea ice appears to extend well beyond the Bootstrap algorithm and changes in processing. See David Schneider's more comprehensive summary on his AGU poster, <http://fallmeeting.agu.org/2012/eposters/eposter/c41b-0555/> and at the Climate-DataGuide website, <http://climatedataguide.ucar.edu/seoice>. Even when the error identified in the present paper gets sorted out, I suspect we will not have heard the final word on Antarctic sea ice trends.

We agree with this comment, and we are optimistic about progress on this front in the near future.

Interactive comment on The Cryosphere Discuss., 8, 273, 2014.

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