

Interactive comment on “A record of Antarctic sea ice extent in the Southern Indian Ocean for the past 300 yr and its relationship with global mean temperature” by C. Xiao et al.

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(1) A central argument in this manuscript feels almost circular. The authors argue that MS- is a proxy of SIE primarily because the two correlate during the period of overlap. The correlation isn't very strong ($R^2=0.16$), and one can see in Fig. 3a that the SIE increases slightly during the much of the overlap period whereas the MS proxy implies an ice cover decrease. Then the authors compare with an estimate of global temperature and say the temperature and SIE are normally in phase except during the past couple decades when SIE increases despite warming. But didn't the MS- proxy actually show a sea ice decrease during this period (Fig. 3a)? So the MS

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proxy appears to vary in phase with temperature throughout the record, whereas the instrumental SIE varies out of phase with temperature. It's a little hard to accept that something unprecedented happened near the start of the instrumental record when no change is indicated in the proxy record, i.e., hard to believe that ice and temperature really varied in phase during the pre-instrumental record when the trend doesn't agree between proxy and instrumental records during the period of overlap.

Reply: Now $r^2=0.25$ when use updated sea ice data. We do not completely understand what the reviewer means by "... Fig. 3a that the SIE increases slightly during the much of the overlap period whereas the MS proxy implies an ice cover decrease.". It is necessary to compare the SIE record with the annual MS- record (thin blue line), NOT the 20-year smoothed MS record (purple line). [The SIE record we use is only 22 years long!]. This year-to-year comparison is what is shown in the inset correlation plot, and by r^2 .

(2). It would be useful if the authors would discuss, even briefly, how the accuracy of this proxy compares with other sea ice extent proxies (e.g., Wolff et al., 2006, Nature 440:491-496; the two Abram et al. papers referenced in the manuscript). This would basically be extending the discussion in Sec. 4 to compare the accuracy of different proxies rather than just comparing how a proxy for a somewhat different region compares with this proxy. Being somewhat unfamiliar with this literature, a correlation with observations of just $R^2=0.16$ does not sound very good to me, but it would be interesting to hear how it stacks up against other sea ice cover proxies.

Reply: We mention the possibility of a stacked SIE curve by integrating proxy data from different Antarctic sectors.

(3) It would be useful to say a little more about the observational data. Which NSIDC record was used for 1996-2000, Bootstrap or NASA Team? Why was the JIC record chosen rather than the NSIDC record for the earlier period (1973-1996), and would the results change much if the NSIDC record was instead used throughout? How reliable

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is the pre-SMMR JIC data (1973-1978), and what is it based on? Also, did the authors use gridded sea ice concentrations, apply a 15% threshold as is often done for sea ice extent, and then average only over 70-100E? Or did they follow a different procedure to get observed SIE? It would be useful to have this specified.

Reply: We now use the NSIDC sea ice data set. Thus the instrumental data of sea ice is uniform throughout the whole paper. The derivation of this data set is described in the paper.

(4) I found it a little bit confusing that the term "sea ice extent" was used for the ice coverage in 70-100E, rather than for the entire hemisphere as in the more common usage of the term. This was exacerbated by the acronym "SIE" apparently being used sometimes for total SH sea ice cover (page 3612 lines 15 and 20-21) and other times for sea ice cover in the 70-100E sector. This comment could be addressed simply by using "SIE" only to refer to the sea ice cover in the 70-100E sector and adding a few words to this effect the first time the term is defined (the hemispheric ice extent could, for example, just be called "sea ice cover").

Reply: OK we use regional SIE so that to avoid misunderstanding.

(5) The use of NH temperature records to estimate global temperature swings seems problematic to me. The manuscript mentions (page 3615 line 15) that "current average trends are quiet similar between the hemispheres", but I'd expect greenhouse-induced global warming trends to be more hemispherically uniform than natural variability.

Reply: We add the continent-averaged temperature from PAGES 2K data, which is integrated ice core data. The curve also displays a roughly inverse relationship with MS-, although in recent decades the PAGES data show wide-spread warming in Antarctica, which is not widely accepted.

(6) Presumably the yellow SIE curve in Fig. 3a is for the sector 70-100E. It'd be nice if this were indicated in the figure caption.

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Reply: Accepted and done, now it is actually 62-92E when we use updated satellite data.

(7) A very minor suggestion, but I think Fig. 1 would be more clear if a couple lines of constant latitude & longitude were included

Reply: Accepted and we redrew Figure 1, as shown below.

Interactive comment on The Cryosphere Discuss., 7, 3611, 2013.

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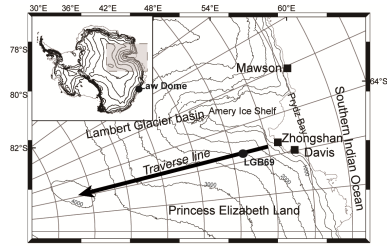


Figure1. Location of LGB69, Princess Elizabeth Land, East Antarctica

Fig. 1.

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