The Cryosphere Discuss., 7, C2304–C2308, 2013
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The Cryosphere Discussions
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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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Received and published: 5 November 2013

ïijĹ1ïijĽI would like to see some more on the calibration of MS-. The authors are eager to investigate the relationship between SIE and northern hemisphere temperature however, the MS- record only explains ∼16 of the variance in SIE (lower than has been reported at other sites). I think that the paper would benefit from some additional work to demonstrate the mechanism by which MS- from the sub-sector 70-80 E is transported to the ice core site. There is a reference to previous work, that low pressure systems in the Indian Ocean provides precipitation to this region, but perhaps this could be expanded upon in this paper. Potentially by adding the major transport

route to the map or correlate the MS- record with wind fields from reanalysis data. Alternatively have the authors looked at the back-trajectories? The correlations with SIE are relatively weak but the interpretation would be strengthened if the transport route could be demonstrated. Reply: In the revised paper we now use the NSIDC SIE data, and find the sector 62-92E is highest correlated , explaining 25% of the variance. Taking a 10-year period as an example, 1991-1999, we investigated the air mass sources of LGB69 by calculating backward trajectories, using the NOAA HYSPLIT model. We calculate the clustered mean backward trajectories for December (the time of strongest melting of sea ice and release of DMS) averaged for 1991-1999, it indicates 46% of air parcels come from the 60-90ïĆřE sector of the Southern Indian Ocean (SIO) while 54% come from inland, probably via katabatic wind (Fig 2a). To understand the moisture origins during the austral winter, we also calculated the clustered mean backward trajectories for July to October, a season during which the sea ice margins is relatively stationary and only small emissions of DMS (Fig 2b). The origins can be divided into three major sources: 43% from the SIO north of the sampling site, 40% from a more western sector of SIO, and 17% from a more eastern sector.

(2) My other concern is the use of northern hemisphere temperature reconstructions. I do appreciate that southern hemisphere records are sparse but a lot of the interpretation is based on very limited data. For example a major finding of the record is the SIE retreat during the “little ice age” however the temperature reconstruction during this period is derived from just four European stations. In the absence of SH reconstructions could you try using the ice core isotope records? Reply: It is hard to find a standard Southern Hemisphere (S.H.) temperature curve. Previous studies on centennial to millennial scale temperature changes indicate some similarities between the two spheres. Since data over the North Hemisphere is much more plentiful, we use N.H. temperature data for the global context. Most isotopic records from individual ice core (including LGB69) or certain regional ice cores in Antarctica only carry LOCAL climate signals. Using these data will go beyond our initial motivation, i.e., the relationship of sea ice change with global temperature. Nevertheless, we do agree with you that

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the relationships between MS – data and continent-averaged temperature changes in Antarctica should be investigated. Here we retrieved Antarctica-averaged temperature from PAGES 2K data set (from 11 ice core isotopes) for this comparison (see revised Figure 4b). It also shows a general relation as “high temperature versus less sea ice”, although existing a small lag of the S.H. to N.H. temperatures.

(3) The correlations between MS- and the SAM are weak. Again I think further investigation of the transport of MS- to the site might help explain the statement that “changes associated with SAM directly influence MS- deposition” Reply: There are multiple sources of air masses to LGB69 as shown in Figure 2a, b, including some even deriving from the inland ice sheet. Hence SAM is only one of the possible mechanisms influencing the MSA proxy.

(4) Technical corrections: Abstract- “high-resolution records” currently infers multiple records were used. Please make the figures larger. The legends need to be clearer on the figures and/or included in the captions Reply: We do mean a high resolution ice core record, not multiple records.

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

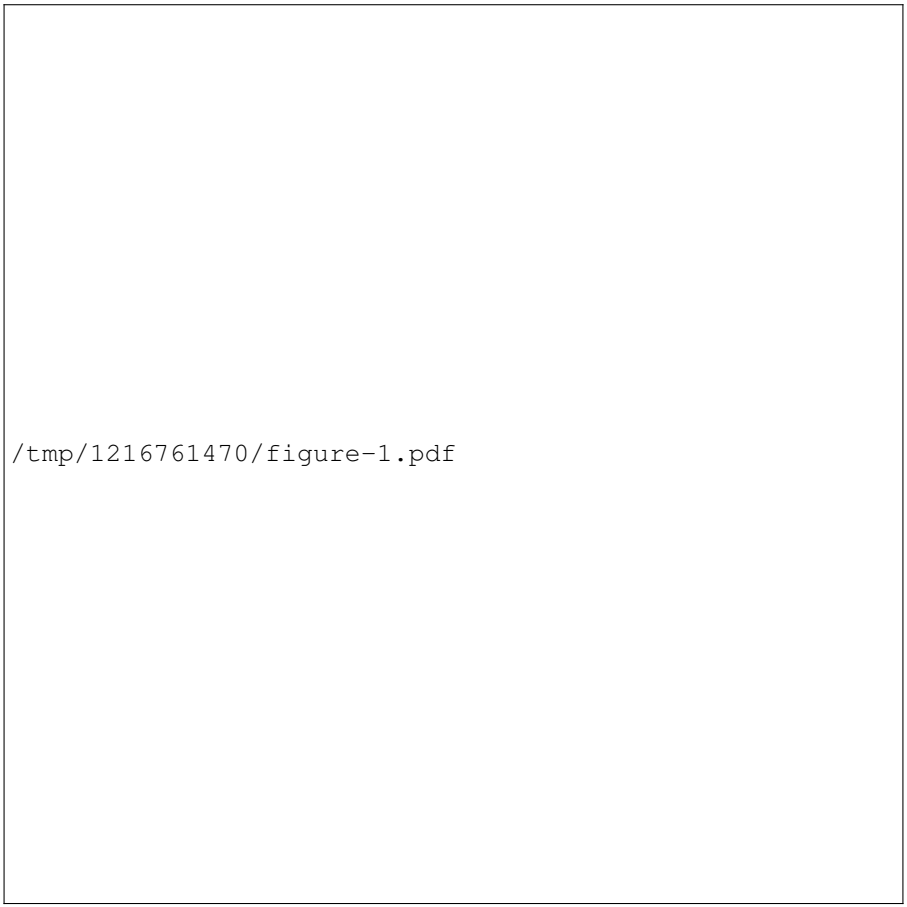

Fig. 1.

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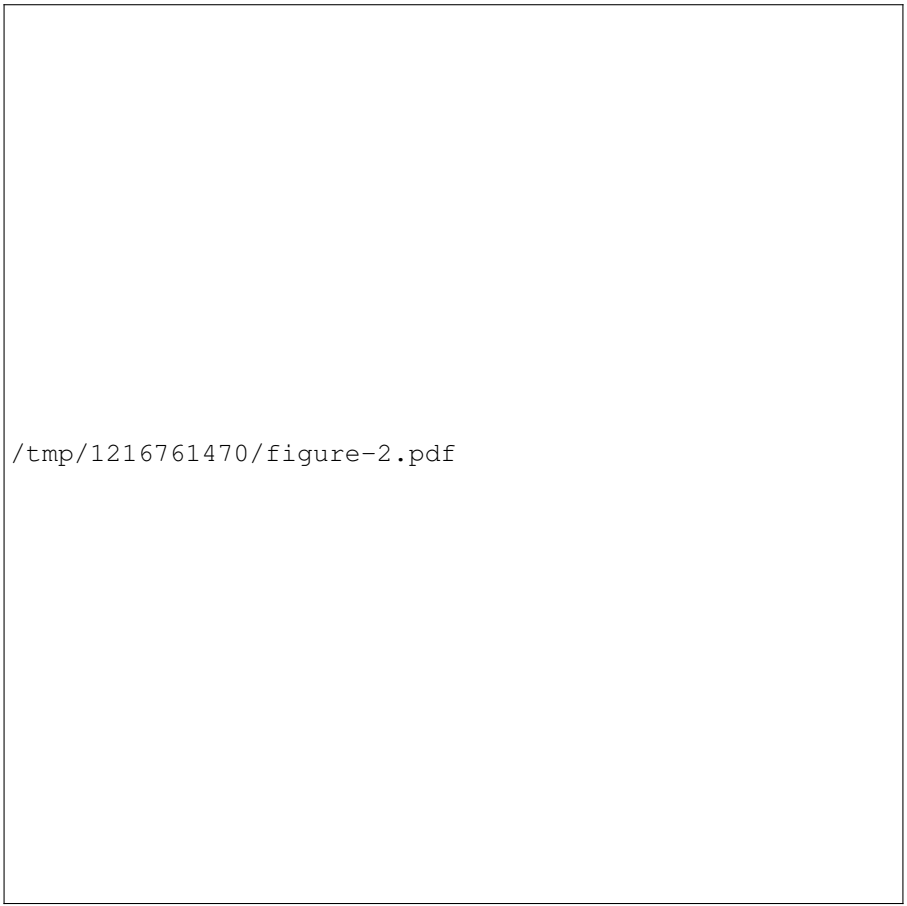

Fig. 2.

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