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Discussions

EGU

Interactive comment on "Tropical forcing of increased Southern Ocean climate variability revealed by a 140-year subantarctic temperate reconstruction" *by* Chris S. M. Turney et al.

Anonymous Referee #3

Review of Turney et al., Tropical forcing of increased Southern Ocean climate variability revealed by a 140-year subantarctic temperature reconstruction

I have reviewed a previous version of this paper before for another journal. I am pleased that the authors have addressed many of my previous concerns, including taking up my suggestion to link temperatures at the subantarctic Islands to local sea surface temperatures, as well as to tropical climate variability.

The temperature reconstruction is valuable and good work, adding to understanding of climate vaiability in this data sparse region, and deserves to be published, as does the discussion of the increased variability and influencing factors on climate variability in this region. However the structure of the paper needs to be clearer, there is much

analysis in the discussion, and the phrasing and interpretation of results in some places needs to be clearer and reflect what can be drawn from the results in all places. Also, the figures are not always numbered in the order of discussion in the text, which also hinders following of the discussion. Also, the relative influence of local vs tropical SSTs should be considered more fully.

I therefore recommend publication subject to major revisions. I apologise that this review is late.

1. Make sure that all figures, both in the main text and supplementary information, are numbered in order of discussion in the text, this is not done for all figures.

2. Section 3.1. Modern climate changes. Figure 1c shows well the coupling between atmospheric and oceanic temperatures at Macquarie Island over the annual cycle. Similarly Figure 5C shows, as well as the influence of SSTs in the Nino 3 region, strong correlations with local SSTs. Given this close coupling, the influence of this strong coupling on interannual temperature variability on Macquarie Island (MI) and Campbell Island (CI) needs to be explored further in the paper, and consideration of the relative proportions of temperature variance explained by local vs remote SSTs is needed. You should therefore include the timeseries of MODIS and HadISST temperatures for gridboxes/pixels closest to the islands in Figure 1. I would like to see this for both MI and CI. You could add the CI plots to the supplementary info, although additional panels in Figure 1 would also work. In Table 1, please include correlations with local SSTs (Modis and HadISST). I realise the MODIS correlations will be for a shorter period, but I think this analysis would still add to the paper. This analysis will allow quantification of the relative influence of local versus remote SSTs. I realise that SSTs in these two regions may not be completely independent, so perhaps also include a column correlating NINO 1+2/3 and SSTs local to MI/CI too.

I would also like to see (perhaps as a panel in Figure 9), the tree ring reconstructions with HadISST SSTs for the MI/CI region.

3. The penguin and seal analysis is not convincing and I recommend either removing this from the paper, or toning this section down. Although I am not an expert in links between penguin populations and climate, I am not convinced that the coincidence of the decline with an increase in climate variability does prove a causal linkage.

Additionally, from reading one of the sources cited (Morrison et al. 2015), these authors state that although there has been an overall long-term decline, Rockhopper Penguin numbers on Campbell Island have recovered/stabilised over the period 1996-2012 (a fact not explicitly mentioned in the text, rather hinted at by stating that 94% of the decline had occurred by the mid 1980s). Morrison et al. state 'the recent decline occurred during the period 1984–1996 and was followed by overall population growth 1996–2012, concurrent with lower SSTs and an increased abundance of a key prey species'. This would seem to fit with the SST changes discussed in Point 1 above, rather than to temperature variability.

4. Clarity of phrasing.

- First sentence of the paper. Figures 1 and S1 do not show ice sheet dynamics.

- Line 68. 'Late twentieth century Southern Ocean climate' – I assume you mean climate over the Southern Ocean region, not the climate of the ocean itself.

- Line 63, make it clear what 'This' is referring to.

- Page 2 line 75. 'ENSO is associated with spatially different temperature and wind trends across mid to high latitudes (Figure S3). Figure S3 shows the regression of Nino 3 and 3.4 on SST and wind - therefore you mean the signal/influence, not the trend.

- Section 2.2. line 150, comparison of AAE temperatures to those on the islands. Firstly, make it clear in the text that it's temperature measurements. You state that 'this analysis illustrates the trend through time rather than interpreting specific comparisons'. I do not understand what you mean by this, please rephrase.

- Line 291. You state 'a long-term trend towards increasing temperatures from the 1960s that reached a maximum during the late 1980's. I wouldn't call a 20 year trend a long-term trend, and temperatures reach a maximum in the late 1980s, not the trend. It would also help the reader if you mark 1912-15 on Figure 3. You then state that the late 1980s were warmer compared to 1912-1915, indicating some kind of linear behaviour – but what Figure 3 shows to me is lots of variability, and there are periods since 1912-15 that are cooler, and others that are warmer. Please rephrase this more carefully and clearly.

- Line 481, 'contemporary equatorial Pacific temperatures may now be a permanent feature across the mid to high latitudes' – do you mean the influence of contemporary equatorial Pacific temperatures. This sentence currently doesn't make sense.

- Caption of Fig S7, you state that there is no sustained change in wind direction since the expedition. I do not think that this can be concluded from this plot. Please rephrase (our just delete). See point 6 below.

Discussion

5. An overall comment to the discussion section is that I suggest having sub-headings in this section, to guide the reader, as well as addressing the issue of order of figure numbering, as currently this section is a little difficult to follow. You may wish to consider instead of having separate results and discussion sections, restricting to having an overall 'Results and Discussion' section (as there is a lot of analysis in the results section), but with clear subheadings that lead the reader through the analysis.

6. Line 377. You state there's no long term trend in solar radiation – it appears from Figure S8 that there has been a shift towards greater sunshine hours since the mid-1960s. This needs exploring/explaining. Also in this paragraph, you state that there has been 'a long term intensification' of winds. Please remove the phrase 'long-term intensification'. What can be concluded from Figure 5D is that winds since 1950 are stronger than those during 1912-1915, and that the 1981-2010 winds are stronger

than the 1951-1980. This could be evidence of a long-term intensification, but given the strong interannual variability in this region, there does need to be the caveat that the 1912-1915 winds are a snapshot of winds in a region with strong variability.

Also in this paragraph, Line 380/discussion of Figure S1. It needs to be shown on Figure S1 which trends are significant, perhaps marking these with a different colour arrow. Also, marking of MI and CI on this plot would be useful.

7. Line 394. You state that you 'observe a Rossby wave train', and online 396, that 'We find that post-1979 warmer temperatures in the Nino 3 region leads to deep convection.... Forcing an atmospheric wave train'. The discussion in this paragraph needs to be rephrased to reflect the fact that these are relationships based on statistical analysis, through which mechanisms can be inferred, but not proven. You do this well in the two following paragraphs.

8. Line 427. Analysis of LOVECLIM output and comparison with HadISST. Are these data fully independent? – or are any of the same data assimilated into LOVECLIM that are used in HadISST?

Minor points

Figure captions. Figure 1 is titled 'Twentieth century climate trends in the Southern Hemisphere. Panel A shows trends but panels B and C do not. Please retitle this figure. The units for panel A need to be clearer, is it trend per year, or over the entire period? (this point is valid for all plots showing trends).

Figure 3. Extend the x-axis on Figure 3. This is arguably the most important figure in the paper – so make it clearer to see.

Define CE on first use, and you have two different CE's, so you need to distinguish between them.

Line 93, change 'role (if any)' to 'potential role'

Line 129, data from Macquarie Island 'were'

Line 260. Change 'describe' to 'show'