

## **General comments**

This paper presents the first fjord-based climate reconstruction from sub-Antarctic Auckland Islands. The data make an important contribution to the SHAPE initiative, providing a ca. 4000 year reconstruction from a climatically important yet data sparse region. The paper is well written and should be published following some corrections.

The strengths of this paper lie in the fact the authors have undertaken a detailed modern, process-based study to understand the fjord's circulation and how this may relate to the Southern Hemisphere westerly winds and precipitation at their site. They use this as a basis for interpreting the palaeo-record. This is followed by comparisons to other studies, which as currently presented are not as clear as they could be.

Please note: I do not have enough experience with stable isotope analysis to comment on this aspect of the paper.

## **Specific comments**

### ***Core sub-division (lines 269-274)***

It appears the core was divided into four main periods and that this was done visually rather than statistically, for example by hierarchical cluster analysis. If possible, it would be better to use a more objective approach to divide the record into different periods, especially as there are times of little variation or where some proxies appear to be changing more than others, and it is somewhat subjective where to separate different parts. For example, one could also just divide the core into three zones (i.e. combine zones 2 and 3).

Line 364 onwards: The authors refer to figures using depth and age-scales (Figures 6 and 7). To make it easier to follow please include the depths relating to the different zones identified (i.e. depths associated with ca. 4000-1600, 1600-900, 900-500 yr BP). The authors state there is little variation in the proxies from ca. 4000-1600 yr BP, however there are two distinct peaks (albeit based on one sample each) in C/N during this time. What are the causes of these?

### ***Selection of records used for comparison***

While there are changes in the proxies (Figures 6 and 7), some are quite subtle. To aid comparisons to other studies it would help if periods of interpreted stronger or weaker winds from this study

were marked on Figure 9. Also include an arrow showing the interpretation in 9c. Clearer acknowledgement of the errors in the age-depth model and implications when comparing to other studies should be considered. There are six  $^{14}\text{C}$  dates for nearly 400 cm of core, which means relatively large uncertainties (Figure 3).

### 1. *Southern South America*

The authors compare their record to two studies (Strait of Magellan, 53°S, Lago Guanaco, 51°S) because they are at comparable latitudes to the Auckland Islands (line 478). There are other records from southern South America for these latitudes that would be worth considering. Including, but not limited to:

- (a) Lamy et al. (2010) Holocene changes in the position and intensity of the southern westerly wind belt. *Nature Geoscience* 3: 695–699 (53°S)
- (b) Schimpf et al. (2011) The significance of chemical, isotopic, and detrital components in three coeval stalagmites from the superhumid southernmost Andes (53°S) as high-resolution palaeo-climate proxies. *Quaternary Science Reviews* 30: 443–459 (53°S)
- (c) Moreno et al. (2014) Southern Annular Mode-like changes in southwestern Patagonia at centennial timescales over the last three millennia. *Nature Communications* 5:4375 (Lago Cipreses 51°S)
- (d) Turney et al. (2016) A 250-year periodicity in Southern Hemisphere westerly winds over the last 2600 years. *Climate of the Past* 12:189–200 (Falkland Islands 52°S)

While the authors say they compare their record to select records from a range of latitudes (line 468), the Strait of Magellan and Lago Guanaco are the only two referred to. I suggest looking at what studies are available north of 51°S and south of 53°S, to help support the authors' interpretations. Including, but not limited to:

- (a) Lamy et al. (2001) Holocene rainfall variability in southern Chile: a marine record of latitudinal shifts of the Southern Westerlies. *Earth and Planetary Science Letters* 185: 369–382 (41°S)
- (b) Borromei et al. (2009) Multiproxy record of Holocene paleoenvironmental change, Tierra del Fuego, Argentina. *Palaeogeography, Palaeoclimatology, Palaeoecology* 286: 1–16 (Las Cotorras 54°S)
- (c) Mauquoy et al. (2004) Late Holocene climatic changes in Tierra del Fuego based on multiproxy analyses of peat deposits. *Quaternary Research* 61: 148–158 (54°S)

## 2. *Western Antarctic Peninsula*

The authors refer to Shevenell et al. (2011) and their ocean temperature reconstruction. There are other Antarctic records that may be of use, such as Koffman et al. (2014, Centennial-scale variability of the Southern Hemisphere westerly wind belt in the eastern Pacific over the past two millennia. *Climate of the Past* 10: 1125–1144), who link WAIS Divide ice core dust to the westerlies. I suggest broadening this section to other regions of Antarctica to include such studies.

## 3. *Assessment of SHWW symmetry during the LIA*

It is not clear how the authors are defining the Little Ice Age. The record ends ca. 500 yr BP, however, it is after this time that most evidence for cooler conditions in the Australasian region exists (e.g. PAGES 2k consortium (2013) Continental-scale temperature variability during the past two millennia. *Nature Geoscience* 6: 339–346). I acknowledge no records from the sub-Antarctic are included in this work. Given the timing of the end of the record, I suggest removing this section and integrating any relevant studies mentioned into sections 5.4.1-5.4.3.

### **Technical corrections**

Line 29: Remove SAM and ENSO – not needed in the Abstract.

Line 161: Remove 'and'.

Lines 161-163: Break up the sentence. For example – Seawater samples collected in 2014 were analysed for oxygen isotopes using a Picarro 2120 wave-length-scanned cavity ring-down spectrometer (WS-CRDS), in the Isotrace Laboratory at the University of Otago. The average standard deviation for 11 duplicate measurements (fjord, lake, and stream samples) was 0.027 ‰ for  $\delta^{18}\text{O}$ .

Line 242: Remove 'sediment samples'.

Line 244: ratios.

Line 268: Remove 'for core 36P4'.

Line 364: Include MS in the list of generally unchanging proxies.

Line 414: Include '(AR)' after 'accumulation rates'.

Line 904: Change 'negative' to 'lower'.

Figures 8 and S3: Enlarge open circles or change the shape as it is hard to see them.

Figures 6, 7, 9: Include in the legend the C/N values are reversed and why.

Figure S1 legend: Include that Enderby Island is part of the Auckland Islands archipelago, otherwise it is a bit confusing as to why data from here are used for those that do not know this.