Clim. Past Discuss.,
doi:10.5194/cp-2016-135-AC4, 2017

Climate of the Past Discussions

Interactive comment on "Hydroclimate of the Last Glacial Maximum and deglaciation in southern Australia's arid margin interpreted from speleothem records (23–15 ka)" *by* Pauline C. Treble et al.

Pauline C. Treble et al.

pauline.treble@ansto.gov.au

Received and published: 30 March 2017

We thank Reviewer 3 for their constructive review. In particular, we thank them for pointing out the relevance of the Mohtadi et al (2014) study. Our responses are embedded below.

Anonymous Referee #3 Received and published: 26 January 2017

The manuscript by Treble et al. presents a novel multiproxy speleothem record from the under-represented region of southern Australia. This record will fill-in a key spatial gap in the paleoclimate proxy network, and in particular, provide new information

on the hydroclimate variability, and associated tropical ocean-atmosphere teleconnections, during the LGM and early deglaciation. It is particularly encouraging to see the addition of multiple proxies to better help constrain the oxygen/carbon isotopes, despite the interpretation of the Mg/Ca and Sr/Ca being quite complex. Nevertheless, the addition of multiple proxies, and particularly the coherence between them through the termination, suggests that the author's interpretation that the d18O/d13C changes were primarily driven by hydrological-related kinetic fractionation is robust. In addition, the close association between Mairs Cave and nearby lake (Frome) and marine (GAB) records, along with tropical speleothems (i.e. Liang Luar, Ball Gown, C126), does seem to indicate that tropical teleconnections, via shifts in the ITCZ, likely played a critical role in delivering excess moisture to southern Australia during the 16-19 ka period. Hence, I agree with the authors overall interpretation of the records with respect to the regional proxies, and thus recommend this manuscript for publication. Though I do ask the authors consider the following:

Specific comments: 245 – Echoing Reviewer#1 comment re: IOD/ENSO: it would benefit the reader to have some details as to the potential impacts of these modes on the recharge in the Flinders Ranges. As is indicated in the paper, the IOD has a big influence on SE Australian rainfall under modern boundary conditions, though to what extent would have these teleconnections operated in the past? The Sumatran marine sediment records of Mohtadi et al. (2014, Nature) indicate that the period from 19-15 ka was relatively dry in the eastern Indian Ocean, in stark contrast to the speleothem records from Flores, Cape Range etc. Modeling results from this same study show an anti-phasing in precipitation between western and eastern Indonesia during the LGM-HS1; this was interpreted to reflect a reorganization of the Hadley circulation and associated shifts in the ITCZ. Hence, given that the marine record of Mohtadi et al. (2014) lies at the core of the IOD zone of upwelling (increased during +IOD events and reduced mositure), and that this marine record displays an anit-phase behavior to the Flinders record presented here, it seems unlikely that changes in eastern Indian Ocean hydroclimate had an overriding influence on the recharge in southeastern Aus-

tralia. Therefore, in support of the conclusions reached by Mohtadi et al. (2014), via proxy and modeling results, the climate signal in the Flinders Ranges during the 16-19 ka period is most likely attributable to changes in the strength of the Hadley circulation and thus shifts in the ITCZ. It would be worth adding the Mohtadi d18Osw record to Fig. 6 to illustrate this or maybe provide an additional figure that focuses more on the tropical-mid latitude teleconnections? Might also be worth plotting the Greenland and Antarctic ice core records to the figure containing the MC and GAB records, just to put into the context the timing of the changes in southern Australia with respect to higher latitudes.

Response: We thank Reviewer 3 for pointing out the relevance of the Mohtadi et al (2014) dataset to this study. We will add the Mohtadi marine record to Fig 6 as suggested and modify text in the Discussion (Section 5.2.4) to include this. We will modify the text of Section 5.2.4 according to the attached document (Supplement to this response) in order to accommodate this change while maintaining a clear flow in the interpretation. We will also modify the final paragraph of the Conclusions to remove the interpretation of IOD being a possible driver of enhanced recharge through 19-16.

681 – Whilst I agree that it is difficult to fingerprint changes in moisture source via speleothem d18O (owing to impacts of other effects such as evapotranspiration), the _5‰ decrease in precipitation-weighted d18O during the large flooding event of 1974 is quite significant, and thus deserves more attention in my opinion. For example, if the hydroclimate interpretation is correct, that the pluvial event between 16-19 ka is due to an increase in tropical moisture via a southward shift in the ITCZ, then the 'continental effect' would likely have been exacerbated? i.e. larger contribution of tropical air masses (with lower d18O) to the karst aquifer over a given year(s) should result in more negative speleothem d18O. Response: See response to Reviewer 1 regarding line 689.

889 – Agree with Reviewer 1 that it would be beneficial to cite some climate modeling studies (e.g. Hosing experiments) that validate the interpretation during HS1 i.e. more

moisture in southern Australia. Response: See response to Reviewer 1 regarding first general comment.

Figure 6 caption: the caption for (f) and (g) does not correspond with the figure. Panel (f) should indicate Ball Gown Cave NOT Cape Range as it currently stands. Response: Thank you. We will amend this error in the caption.

Please also note the supplement to this comment:
http://www.clim-past-discuss.net/cp-2016-135/cp-2016-135-AC4-supplement.pdf

Interactive comment on Clim. Past Discuss., doi:10.5194/cp-2016-135, 2016.

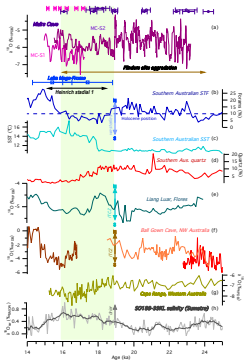

Figure 6: The Mairs cave $\delta^{18}O$ record (a); compared with the foraminifera record of the position of the sub-tropical front (b) SST (c) and the quartz record (d), in marine core MD03-2611 from Southern Australia (De Deckker et al., 2012); and speleothem records from Liang Luar, Flores (Ayliffe et al., 2013) (e); and Ball Gown Cave also in Western Australia (Denniston et al., 2013a) (f); C126 Cave in Cape Range, Western Australia (Denniston et al., 2013b) (g). Reconstructed Eastern Indian Ocean salinity from foraminifera in marine core SO189-39KL off the coast of Sumatra (h) is interpreted to be a record of local precipitation.

Above: Modified Figure 6 showing addition of Mohtadi et al. (2014) record as suggested by Reviewer 3.

Fig. 1. Fig 6