

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.

Anonymous Referee #4

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Treble et al. present new and invaluable speleothem data from the southern central arid region of Australia. The new data alone mean that this paper will represent a significant contribution to our understanding of lateglacial climate variability in a chronically under-sampled part of the Southern Hemisphere. The other reviewers have highlighted several questions/issues arising from this manuscript that warrant further consideration. I concur with these suggestions, whilst making some additional comments.

The authors raise the conundrum of apparently wetter conditions in the Flinders Ranges coincident with a southwards migration of the subtropical front. This appar-

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ent contradiction leads to the interpretation that tropical sources may have led to the apparent increase in extreme precipitation, a central conclusion of the manuscript. I suggest at least two alternative explanations warrant consideration before this conclusion is made:

Firstly, several papers (e.g. Kohfeld et al. 2013; Liu et al. 2015) have highlighted the disparity (a) between marine, dust and terrestrial moisture records and the perspective they place on the position and strength of the Southern Westerly Winds (SWW); (b) that in models that best represent SH LGM conditions, behaviour of the SWW and subtropical front (STF) appear decoupled or even inversely related, due to the shielding effect of sea ice on oceanic wind stress. Thus, although evidence from the Murray Canyons are interpreted to reflect changes in the position of the STF (De Deckker et al. 2012), we can be less certain that these changes track the position of the SWW. If true that the SWW and STF do not necessarily migrate in concert, then the apparent disconnect between a southwards migrating STF and increased precipitation in the Flinders Ranges becomes less controversial.

Secondly, whilst detailed discussion is provided re. the latitudinal origin of precipitation in the Flinders Ranges, little attention is given to seasonality. Could it be that the wetter phases observed during the LGM actually relate to an increase in summer precipitation, or summer humidity (lowering summer evaporation rates)? It's appreciated this is difficult to constrain, but it should be considered.

Specific comments

Line 67 'The nature and timing of climatic episodes'. This sentence doesn't really make sense. I don't think we can seek to redefine the timing of HS1 from Australian records – what the paper really aims to do is to investigate the nature of SH climate variability during episodes such as HS1.

Overall, while the first two paragraphs introduce post LGM climate variability in the SH, and role of the ITCZ, they fail to highlight the important point here – that is that

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during events such as HS1, we might observe both oceanic and atmospheric teleconnections with the Northern Hemisphere, and they might impart different effects upon SH or Australian climate. Whether we agree with it or not, the bipolar seesaw hypothesis is widely cited, and if correct describes an oceanic teleconnection between the Southern Ocean and the North Atlantic which leads to a lagged period of SH warming during episodes of North Atlantic cooling and ice rafting. This in turn may effect the position and strength of the SWW. By contrast, H events may also lead to atmospheric teleconnections, e.g. changes in the position of the ITCZ in response to cooling in the North Atlantic. Those atmospheric shifts may/may not impact upon Australian climate, but if they do, presumably their effects would be different in terms of climate response and time lag. It's therefore important to consider at the outset how a mixture of these two effects would lead to changes in Australian rainfall or evaporation.

Line 93, up until now the discussion has centred around HS1, but the Kohfeld paper relates to conditions at the LGM, which is a bit of an unnatural jump. It would be helpful to specify which window of time we're interested in, or at least note that the Kohfeld paper is interesting as a potential analogy for HS1.

Line 100. According to the International Hydrographic Organisation, the coring location of MD03-2611 is indeed within the Great Australian Bight. However, the Australian Hydrographic Service would disagree, defining the eastern boundary of the GAB as the tip of the Eyre Peninsula. This latter definition is certainly the one I am most accustomed to, and had always thought of the location of MD03-2611 as being in the Murray Canyon(s), which is how it's referred to in other papers on the same core (e.g. Moros et al. 2009). I would suggest that referring to this record as being from the GAB is slightly misleading to some readers.

Line 102. In reference to the De Deckker et al (2012) paper (note De Deckker, not DeDeckker), be more specific as to which foraminifera you're referring to as proxies for the position of the STF.

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Line 109-110. There is a circular argument arising here. Is the objective of this paper to examine the terrestrial hydrological response of changes in the westerlies, or is it to use an assumed teleconnection between the westerlies and terrestrial hydrological change to infer past changes in the westerlies? I don't think it's possible to do the latter if you aren't confident about the former.

Line 131. Spelling: Callabonna, not Callabonne.

Line 133. On the subject of mega Lake Frome (and indeed Torrens, Eyre), have you considered the effect of these lakes being filled and the $\delta^{18}\text{O}$ of precipitation that would result from their evaporation?

Line 152. 'climate-speleothem $\delta^{18}\text{O}$ signal' – here, I think you mean 'climate-speleothem $\delta^{18}\text{O}$ relationship/response' or similar.

Line 236. Missing full stop after 'years'

Line 234. I suggest: 'is one of the most significant hydrological episodes in..'

Line 268. Capital 'F' in 'For example, 3 m of water.'

Line 286. 'Rapid connectivity'. I'm not sure this is a phrase. By this, do you mean 'rapid throughflow' or 'greater connectivity'?

Lines 308-314. This paragraph largely repeats what was said in lines 264-276.

Line 347. Insert 'a' before slit?

Lines 353-354. '...standardised to using NIST 612...'. Delete either 'to' or 'using'

Line 362. Delete 'The' from 'The petrographic..'

Line 374. '.. examined in thin section and fabric and possible dislocations...'. Clunky repeated use of 'and' could be improved.

Line 383. '... age models using Monte Carlo simulation of equation 1 of Hellstrom...'. This sentence could be clarified slightly.

Line 407. 'Thus the short lived.' Starting sentence with 'Thus'. Would read better as 'On these grounds, the short lived..' or similar.

Line 525. '2s' – you mean 2 sigma?

Line 529. Both 'a' and 'years' are used to describe time in this manuscript. Be consistent. Also, although 'a' is correct, it is sometimes hard misleading.

Line 531. Spectral analysis. Did you do a wavelet analysis too? It would probably offer a useful comparison.

Line 559. As far as I can tell, the frequently used acronym 'PCP' is not defined in this manuscript, which is very confusing to the non speleologist.

Line 673. Delete 'natural'?

Line 691. 'it has to be' – reword using a more circumspect tone.

Line 696. This is not a clear sentence. I think you mean 'This modelling suggested that the effects of global ice volume (and temp? how did you do that?) could account for a 2‰ change.'

Line 727. This reference to the 'Flinders silts' is very vague – I'm not sure that 'Flinders silts' is even the best way to name that archive. What are they, where are they, what types of process do they record. This archive warrants a more detailed/rigorous description.

Line 739. 'remarkably well' is something of an exaggeration.

Line 849. 'and the Liang Luar records' Delete 'the' and 'records'

Line 860. 'are experiencing recharge' – use past tense here, consistent with the rest of the paper.

Line 866. Ditto above.

Line 924. Change the wording of this first sentence to something like. 'Two stalagmites

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from Mairs Cave, Flinders Ranges, are interpreted to record...'

Line 964. 'Cohen, (year?); Haberlah et al. (2010)...'

Figure 2b. Is there an age reversal (18.9, 18.2, 18.9 ka) at this key transition? I don't recall reading about that in the manuscript.

Figure 3. Fabric log. Please remind us in the caption what the fabric log means.

Figure 5 a-b. Please plot spectral analyses using the same x- axis.

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