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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 #3

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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 interpretationâĂŤthat the d18O/d13C changes

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were primarily driven by hydrological-related kinetic fractionationâĂŤis 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 Australia. 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.

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.

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 HS1âĂŤi.e. more moisture in southern Australia.

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.

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