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.

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Anonymous Referee #2

In "Hydroclimate of the Last Glacial Maximum and deglaciation in southern Australia's arid margin interpreted from speleothem records (23>15 ka)", Treble et al. present the first southern Australia drylands speleothem paleoclimate record spanning the LGM through H1. Using multiple speleothem climate proxies (speleothem growth, calcite fabrics, oxygen isotopes, carbon isotopes, and Mg/Ca and Sr/Ca), the authors conclude that the area studied (Flinders Ranges) was relatively wet from 23 to 16 ka,

particularly from 18.9 to 16 ka. This wet period was followed by an abrupt shift to dry conditions at 15.8 ka. A marine record (DeDeckker et al., 2012) south of the site (in the Great Australian Bight) previously suggested Westerly winds to have shifted southward from 19 to 16 ka. This period is coincident with the wet phase now suggested by the new S. Australia speleothem records. Therefore, based on comparison with northern Australia/Indonesia monsoon-influenced speleothem records, the authors conclude that the speleothem site wet phase is driven by sub-tropical/ tropical moisture, with the overlap during the early half of HS1 possibly influenced by a southerly-displaced ITCZ.

General comments: The scientific data and proposed interpretation presented in this manuscript are of high quality. Specific comments are detailed below, as well as a few technical corrections, but overall I am satisfied with the paper's methods, results, and conclusions. Specific comments: 1. Intro/Conclusion: The paper begins with a strong argument for the investigation of terrestrial climate records in S. Australia to improve our understanding of (i) the nature and timing of HS1 in southern hemisphere owing to the potential role of the Westerly winds in driving CO_2 ventilation in the Southern Ocean and (ii) the latitudinal position of the Westerly winds at the LGM. At the end of the paper, the conclusion states "The source of moisture responsible for enhanced recharge could not be reliably isotopically fingerprinted for the Mairs Cave record: : : However [record comparisons] raises an intriguing possibility that wetter intervals in the southern Australian drylands appear to be more sensitive to the availability of subtropical/tropical moisture rather than the position of the westerly winds. Thus it appears that westerly rainfall may have been relatively ineffectual at driving recharge to southern Australia during the LGM." As such, it appears that the records have not answered the Westerly winds issues raised in the intro (as the records are not appearing sensitive to the Westerly winds). Thus, the authors should mention suggested future complementary work that would bring us closer to resolving these particular scientific questions, to close the initially proposed issues presented at the beginning of the paper. Notes on additional work that could help support the author's conclusions re: tropical moisture would also be helpful. Response: We will add a sentence to the Conclusions regarding the need

for a follow-up modelling study regarding tropical moisture. We will also add to the Conclusions a sentence to direct future research efforts towards terrestrial high-resolution reconstructions for this period from higher latitudes that are more sensitive to the westerly winds and less influenced by tropically-sourced moisture e.g. southwest Western Australia.

2. Chronology: I would like to see age-depth plots for these 2 speleothems included in the manuscript. As figure 3b presents growth rate on a log scale, it is difficult to get a sense of the large variations in growth rate visually. Additionally, an age-depth plot could (should) also include the age model on a non-log scale, which would demonstrate the smoothness or abruptness of growth rate shifts visually. Response: Will include age-depth plots (linear scale) to Fig. 2 or in the Supplementary section. We have uploaded these.

3. Calcite fabric: This section was quite confusing to me, in comparison to the others. I believe some small adjustments could make the material more understandable to non-expert readers. To begin, it may be fitting to include an image of the flat versus rhombohedral crystal tips. Response: An image will be added to Figure 2 labelled with the features described in the text (figure uploaded). We will provide additional text in the Methods on the construction of the fabric log. This will clarify the interpretation of the petrography.

Specifically, regarding lines 440-443: Occurrence of rhombohedral tips, in fact, points to a thicker film of fluid, and thus higher recharge. Flat laminae suggest a thinner film thickness, thus reduced recharge with respect to the rhombohedral terminations. Typically, laminae group in bundles with flat or rhombohedral tips (Fig. 3). First, does "rhombohedral terminations" refer to rhombohedral "tips" or a termination associated with climate? If it is the former, removing the word "termination" may avoid confusion. Response: It refers to rhombohedral "tips". We will reword to 'tips'.

Next, the last sentence copied above refers the reader to Fig. 3. I would first adjust this

to "Fig. 3c"; however, before sending the reader to the figure, I believe the body text needs to explain how Fig. 3c is set-up (i.e. what is a fabric log? What do numbers 1-9 refer to, etc.). This information is found at the end of the figure caption, but I do not think that the reader should need to go digging just to understand something referenced in the text. The text states that the figure demonstrates bundles of laminae groups, but it is not apparent to me where on Fig. 3c I see these: : : I am not even certain what numbers on the y-axis I should be referring to. Perhaps having a separate figure devoted to the calcite fabric, that can clearly mark each period within the record that is significant because of its calcite fabric, and how it is interpreted (high or low recharge? etc.) would help with interpretation. Thin section (or SEM?) images on such a figure would further help to clarify this section. An image showing the difference between flat versus rhombohedral crystal tips, for example, could be quite useful. Response: As per the response to query #3, we will add text to the Methods a description of the fabric log and an annotated thin section image to Fig 2.

4. Figures: On Fig. 3 and Fig. 6 it is very difficult to draw lines from the x-axis at the very bottom of the figure up to subplots near the top of the figure, i.e. to use to determine variability in the record at certain ages cited in the text. I would suggest to either add gridlines or to add additional x-axes in the center and/or the top of the figures. Response: We will add vertical gridlines and duplicate the x-axis along the top.

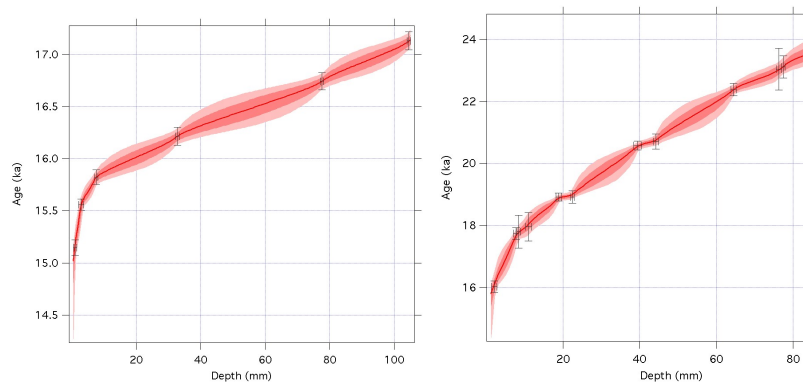
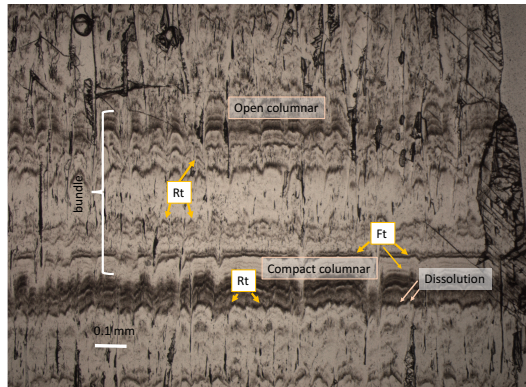
Technical comments: Line 151: Moerman et al., 2014 (dripwater paper) may be more appropriate Response: We will replace Moerman et al 2013 with Moerman et al 2014.

Line 228: I would suggest saying "austral winter" months, to avoid confusion seeing rainfall during May to August in the figure. Response: We will replace 'winter' with 'austral winter'

Line 236: Missing period (.). Response: We will insert period after 'years'.

Line 268: Missing capitalization of "for" Response: We will capitalize 'For'.

Line 671-672: This may be calling the wrong figure subsection? Response: We will replace '3b' with '3c'.

Line 917: "This is feature" remove "is" Response: We will remove 'is'.

Above: Age-depth plots for MC-S1 (left) and MC-S2 (right) in respons Reviewer 2, comment 2. These will be added to Fig 2 or to the Supple section.

Above: Annotated thin section in response to Reviewer 2, comment 3 be added to Figure 2.