General comments:

The manuscript “Multi-Proxy speleothem-based reconstruction of mid-MIS 3 climate in South Africa” presents new records of speleothem stable isotopes, strontium concentrations and temperature reconstructions based on fluid inclusion methods from Bloukrantz Cave, South Africa. In my opinion this manuscript addresses relevant scientific questions within the scope of Climate of the Past. Overall I think this manuscript would be a valuable publication in Climate of the Past after some major additions outlined below.

This is the first record of speleothem trace element compositions and fluid inclusion-based temperature reconstructions from this region. Since this is a very short and highly resolved record comparison to existing proxy records (which are usually much lower resolved) and the conclusions that can be reached are somewhat limited, nevertheless, I think this is a very relevant and important dataset and that the conclusions are substantial. The methods and assumptions used in the manuscript are valid and clearly outlined and their descriptions are sufficiently complete to allow for traceability of results. The results also support the interpretations and conclusions.

There is a clear distinction between previous work (including proper citations) and the addition of the current work. The title and abstract are clear and reflect the content of the article. I only have minor comments about the overall presentation and language (see below); symbols and abbreviations are correctly defined and used and references are appropriate except for a few minor additions/comments below.

Specific comments:

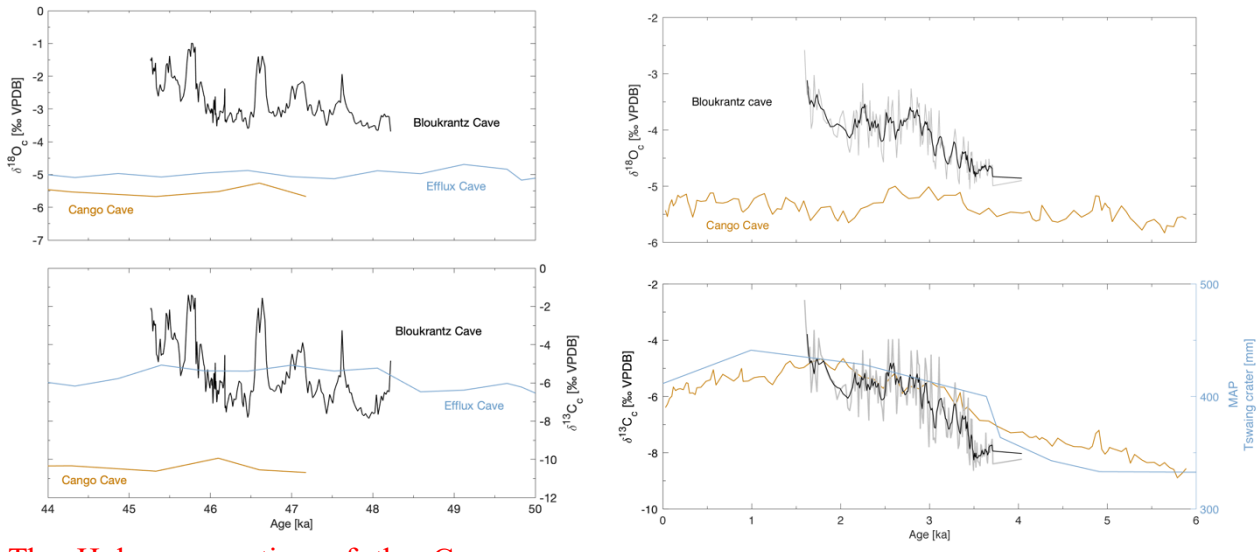
I have on major technical correction regarding the dating data tables in the supplementary materials. In the current form there is not enough information about the U-Th ages to judge their quality or to re-calculate them in the future e.g. if half-lives of some of the involved isotopes are updated. Ideally the following parameters (and their uncertainties) should be reported for each dating analysis: depth in sample (this is provided already), weight, uncorrected age result, 238U concentration, 232Th concentrations, 230Th concentration, 230Th/232Th ratio, 230Th/238U ratio, 234U/238U ratio, corrected age, reference (are ages before 1950, 2000, or relative to the year when the age was measured [give the year in this case]). - We agree that the reporting of the U/Th data can be improved. We will add the missing data in the revised documents following data reporting requirements (Dutton et al. 2017 doi:10.1016/j.quageo.2017.03.001).

I also have two main points that I think could be improved in the discussion

First, I think the section ‘Hydroclimate reconstructions’ is well written, but in it’s comparison to other proxies it focusses a lot on very distant records in the summer rainfall region. The authors mention other speleothem records from the South African south coast in the Introduction and I understand that these records are very low resolved at the time when the sample used here was formed preventing a direct comparison. There are also two records from the Little Karoo that are not mentioned in the paper (Talma, A. S., & Vogel, J. C. (1992). Quaternary Research, 37(2), 203–213. https://doi.org/10.1016/0033-5894(92)90082-T; Chase, B. M. et al. (2021). Geology, 1.

https://doi.org/10.1130/G49323.1). I think that something might might be learned from comparing the range of d18O and d13C values at the different caves sites – do they overlap or not and what might be the reasons? I also think that the Talma & Vogel (1992) record has a decent resolution for the Holocene section that overlaps with this new record and a comparison of that section might be feasible (the Chase record is a composite that mostly replicates the Talma & Vogel record in the Holocene). I think it is also worth mentioning that the pattern of the presented record with increasing stable isotope values during phases of global cooling is also found in previously published records (e.g. most of the published records from this region have somewhat higher values for d18O and d13C during cooler phases like MIS 4 than the warmer MIS 5), despite the very different resolution. The previously published records have been interpreted in a very different way, but this similarity in the relation to global change might suggest that the processes mentioned here also affected the other records.

We thank the reviewer for bringing these studies to our attention and for providing the Cango cave data. With regards to the MIS 3 section, the comparison is unfortunately limited by the resolution (see figure below, left column)). The d18O values are higher compared to Bloukrantz cave, which can be explained by the higher altitude of Cango cave (~850 m) and the location further inland. The ranges in d13C values are more complicated to compare, as Bloukrantz cave speleothems are most likely influenced by PCP (based on the good correspondence between d13C and Sr/Ca we observe), which increases the d13C values compared to systems not influenced by PCP. This influence is, however, difficult to distinguish from other influences like vegetation change (C3 vs C4 plants) unless additional constraints are available.




The Holocene section of the Cango cave record presents a higher resolution and can hence be compared with the data from Bloukrantz cave (see figure, right column). In the Holocene part of the Bloukrantz cave record, we see strong covariation of both d18O and d13C with each other and also with Sr/Ca, similar to the MIS 3 section. This covariation suggests that PCP seems to exert the main control on the proxies also in the Holocene section of BL3, with values increasing with increasing PCP. We believe this to limit direct comparison of the absolute values with other regional records.

Regarding trends: In the Cango cave record, the d13C values are interpreted in terms of change in vegetation type (C3 vs C4 plants) as both vegetation density changes and PCP have been ruled out (Chase et al. 2021). Both the Cango cave and Bloukrantz records display an increase in d13C

values from 4 to 2 ka, interpreted as relative drier conditions at Bloukrantz cave and an increase in C4 plants at Cango cave associated with SRZ conditions dominance. Interestingly, the d13C increase correlates with an increase in reconstructed precipitation at Tswaing crater in the SRZ (Partridge et al. 1997). The observed drying at Bloukrantz cave could tentitavely be interpreted as decrease in Winter rain contribution and hence weaker westerlies (or southward displacement).
The Cango cave record displays significantly lower d18O values than the Bloukrantz cave record (as in the MIS3 part) with little variations.
Though these comparisons are indeed interesting, we believe including a discussion on the Holocene section would dilute the primary focus of our manuscript which is on the MIS 3 part, where we have significantly more data (temperature estimates from FIWI and Microthermometry). However, we agree that these records from Cango Cave, and their climatic control, need to be mentioned, and we will revise the text both in the introduction and the discussion to include them and other studies from Madagascar and Namibia.

Second, I think the section on "Significance for the archaeological record" should be rephrased. I think this section is not very clear in its current form and it could be improved. E.g. The Howieson's Poort is a complex microlithic technology dating to late MIS 4 that can be found at many archaeological sites in southern Africa. It's disappearance at the beginning of MIS 3 and the decrease of site use intensity on the south coast may suggest a decrease of interactions between different hunter-gatherer groups and possibly a population decline and/or shift of activities towards inland locations. - We agree that this section's focus was not sufficiently clear. Our record covers a short (~3000 yrs) time period and is difficult to tie to the archeological records. We have thus decided to remove this short section from the current manuscript. We are in the process of working on a longer paleoclimate record where connections with the archeological record can be made more clearly.

Technical corrections:

Line 33-35: in sentence "Homo sapiens was anatomically modern as early as …" I think it is convention to italicize species names, also I would delete the words 'behavioral proxies in' later in this sentence - We will italicize *Homo Sapiens* and delete 'behavioral proxies'.

Line 38: "Episodes of significant cultural changes, …" there is an 'e.g.' before the second citation at the end of this sentence, either delete it or move it in front of the first one. – The 'e.g.' will be moved in front of the first citation.

Lines 68ff: "In the speleothem record, this is illustrated…" add some information and references to Talma & Vogel (1992) and Chase et al., (2021) here. - We will revise the text to add regional information and the mentioned references.

Line 85: "The theoretical background of this approach dates back to the 1960s…" – all the citations that follow are from the 40s' and 50s'- Indeed, we will revise the text.

Line 114: Chapter 2.2 Sample description: the authors mention the calcite fabrics throughout this chapter, but only one image of the fabric is included in the Supplementary Materials. I think a

few examples of the different fabrics mentioned here in the Supplement would be useful. - We will add figures of the different fabrics in the supplementary materials.

Starting in Line 215: sections 3.2 Trace elements and 3.3 Stable isotopes as well as Figure 2: the text in the results describes the Sr/Ca record and both stable isotope records in terms of their temporal changes, yet, the figure that presents the results (Figure 2) plots them against depths. And the Sr/Ca and d13C records are not plotted against age in any of the figures. I think this should be harmonized, either by changing figure 2 to be plotted against age (the plot against depth could still be presented in the supplement if needed) or by referring to depths here (ages could be mentioned along with the depths maybe in parentheses). I also think that the order of Sr/Ca, d13C and d18O in Figure 2 from top to bottom should be the order in which they are mentioned in the text. - We agree that the figures and text should be consistent. We will keep figure 2 plotted against depth as it allows better to refer to the proxy transects (and related offsets). We will revise the text accordingly and add a figure in the supplement of the three proxies plotted against age. We will also make sure that the proxies are discussed in the order in which they are plotted.

Line 119: "After the hiatus, the Sr/Ca signal drops markedly and shows little variation with an average of 348,…" This sentence sounds like there is little change for the whole Holocene section and that the values stay below what they were before the hiatus. I don't think this is entirely true. I would rephrase to something like: "After the Hiatus, the Sr/Ca signal drops markedly and shows little variations with an average values of 348 between depths of 200 and 150 mm/ages of __ to__ ka. Between 150 and 70mm (__-__ka) values gradually increase to ~500. The top 70mm (__ to __ ka) show some of the highest variability of the record with averages around 500 (not sure about that value). - We agree, we will revise the manuscript and add a more thorough description of the proxies in the upper (post-hiatus) section.

Line 336 ff: "The inferred overall drying observed in our record…" I think the publication by Engelbrecht, F. A., et al. (2019. Quaternary Science Reviews, 226, 105879. https://doi.org/10.1016/J.QUASCIREV.2019.105879) could be cited here. They show that a northward shift of the westerlies during the LGM might reduce the amount of winter rainfall along a very narrow stretch of the south coast due to downwind effects along the Cape Fold Mountains. – We hank the reviewer for bringing this work to our attention. We will revise the manuscript including this reference and discussing some of its results.

Line 383: "Here, the water content displays little variation…" refer to Fig 4 along with Fig. S7 in this sentence. - We will revise the manuscript to refer to both Fig 4 and S7.

Figures:

I have two general suggestions:

1. Remove the line breaks/paragraphs from the figure captions, I think it is not standard practice to do this. - We will.
2. I would add subfigure denominations(a, b, c) to figures 2 and 3 instead of referring to 'top', 'middle' and 'bottom'. Especially in Figure 3 the authors refer to the bottom for

the plot for ages as well as temperature reconstructions which is not very clear. I would advise the same for the supplementary figures. - We will add denominations for both figures 2 and 3.

Line 217: Figure 1: blue shading indicates bathymetry of the surrounding oceans; is the current shown as SAC (South Atlantic Current) not the Antarctic Circumpolar Current? The SAC would be the section in the south Atlantic that also represents the southern branch of the subtropical gyre that then is deflected north into the BC, the ACC is what continues east. - Indeed, the current is wrongly labelled SAC. Figure 1 will be modified.

Figure 2: Line 726: "Dashed Lines indicate the isotope transects." Add 'along the main growth axes of the speleothem' since in the text this is what they are said to indicate. - We will revise the text.

Line 730: "Dashed lines indicate the onset of darker layers…" It looks like the dashed lines were taken from the depth along the isotope profile but were not adjusted for the difference in depth in the Sr profile; are the depths of the dark layers known for the TE profile and could this be adjusted similar to what is shown with the grey boxes? - Indeed, the dashed lines were not adjusted for the depth offsets between the TE and stable isotope profiles. We will correct this.

Line 744: Figure 4: in the text the authors often refer to the outlier data cluster in this plot and that they represent a specific age range. I think these outliers should be marked here, maybe just with a simple circle around the younger samples that are more offset from the meteoric water lines or by using different symbols for them? - We will indicate the cluster by a circle.

Line 749: Figure 5: I think more recent versions of the EDML d18O record do not have the gap between 45 and 44 ka, see here: EPICA Community Members (2010): Stable oxygen isotopes of ice core EDML. doi:10.1594/PANGAEA.754444 - Indeed, thank you giving us the complete dataset reference. We will replot the EDML using the complete record.

Supplements:

I recommend adding a title page to the file that states the title of the paper and names of authors and corresponding author. - We will add a title page.

Caption to Fig S2: correct 'Mars' to 'March'. - We will correct that.

**Citation**: https://doi.org/10.5194/cp-2023-1-RC1