

Response to reviews for Manuscript No. egusphere-2024-1691

Speleothem evidence for late Miocene extreme Arctic amplification - an analogue for near future anthropogenic climate change?

by Umbo et al, submitted for publication in *Climate of the Past*.

Dear Arthur

Thank you for your kind words and considered feedback. To address points (1) and (2) in turn:

1. We agree that CO₂ cannot be considered the sole driver of regional warming during the Miocene. Indeed, the absence of perennial northern hemisphere ice sheets would likely have played a dramatic role in the regional energy budget. However, we would argue that since the Arctic is projected to become increasingly ice free in the near future, even with modest planetary warming (Crawford et al., 2021), this in fact strengthens our argument that the Tortonian, where perennial Arctic sea ice was also largely absent (Stein et al., 2016), is a suitable analogue for near future warming.

We agree that environmental conditions will have differed from those we're likely to observe in the near future. However, we argue that large scale climate drivers were similar to those projected in the near future - namely atmospheric CO₂ concentrations, global temperature, and Arctic sea ice conditions (see references in the manuscript). We therefore stand by our assertion that the Tortonian makes a suitable palaeo-analogue for near future warming.

2. Our findings provide evidence for regional temperature and precipitation seasonality, not global temperature anomalies. However, from your suggested edits, it is clear that we need to highlight this point more strongly. Since our study region is in the Arctic, and occupied a similar latitude during the Tortonian (Steinthorsdottir et al., 2021), we argue our findings provide a direct estimate for regional temperature given global warming of a magnitude similar to that seen in the Tortonian. We cite existing studies (e.g. Pound et al., 2011) for our estimates of mean global surface temperature anomalies since a global temperature reconstruction is beyond the scope of our study. We stress here that we do not wish to make any assertions about global Tortonian temperature from our regional study.

Your feedback has highlighted the need to be clearer in discussing the role sea ice would likely play in regional warming and emphasising that we are not attempting to reconstruct global temperature anomalies. We shall amend the text of the manuscript to emphasise these points.

Yours sincerely

Stuart

References

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