

Clim. Past Discuss., referee comment RC2
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Referee comment

Anonymous Referee #2

Referee comment on "Evolution of mean ocean temperature in Marine Isotope Stage 4" by Sarah Shackleton et al., Clim. Past Discuss., <https://doi.org/10.5194/cp-2021-8-RC2>, 2021

This paper presents a new MOT reconstruction from noble gas measurements between 74 and 59.5 ka. These new data are combined to other MOT data obtained over the last climatic cycle. They are compared to benthic d18O and Antarctic dD and used to discuss the effect of solubility pump.

As all previous studies showing MOT reconstructions based on noble gas measurements, these data represent a huge analytical effort and they are worth to be published because they will be very useful. The discussion of the data could however be improved in a future version of the manuscript. The conclusions conveyed by the abstract are fine and the discussion and conclusion of the manuscript should thus be reorganized to be in line with the abstract.

List of comments:

What is the exact scientific aim of the paper ?

- Make the link between CO₂ atmospheric concentration and MOT ?
- Discuss the link between MOT and Antarctic temperature ?
- Compare the MOT between MIS 2 and MIS 4 ?
- Discuss the MOT dynamic over millennial-scale DO events ?
- Separate sea level and deep ocean temperature contribution in benthic d18O stack ?

Figure 1: I find it confusing to have identification of MIS4 and MIS2 through intervals between vertical dashed line and black bars of different width to define MIS 4 and MIS 2 MOT -> Better find another definition for the black bars like "cold MIS 4 MOT" + better explain how these black bars were defined.

Figure 2: The MOT temperature increase between 64 and 60 ka is not discussed in the manuscript while it seems that a strong MOT increases occurs between 62 and 60 ka while the EDC dD increase is less marked than between 64 and 62 ka when the MOT is stable. It could be argued that there are not enough MOT points and some scattering but this is equivalent to the period between 70 and 68 ka which is discussed in the text as the second phase of MOT decrease during MIS 4.

How robust is the MOT increase during GS 20 ? If we consider only the GS 20 data points (I.e. do not consider the two GI 20 data points), there is no MOT tendency over GS 20.

Except for the GI 19 evolution, there is not so strong evidence for a fine scale correlation between dD and MOT on this figure.

Figure 3: Following last comment, I am not confident that the Model MOT can be drawn as shown on the bottom panel with details at a scale of a few ka. Without more MOT data between 120 and 75 ka, and especially over the 120 – 110 ka strong modelled MOT decrease and large MOT increase and decrease between 88 and 78 ka, the modelled evolution is not robust which casts doubt on the interpretation in term of CO2 solubility pump between MIS 5d and MIS 5a.

p.5, l. 142-146: it is difficult to understand what is described here. It would help to clearly give the period (with dates) that you are discussing here. + the evolution after 70.5 ka is not very clear due to the lack of MOT data and scattering.

Section 4.2 is confusing while it is a good idea to use MOT to decipher sea level contributions from deep ocean temperature on benthic d18O. What is the purpose of this section ? Quantify the uncertainties in the reconstruction of MOT through sensibility to sea level value ? If so, it is probably better in the annex or in the result section ? // then you again discuss the link with benthic d18O and sea level in section 4.4. The flow of ideas is difficult to follow.

Sections 4.3 and 4.4 present the link between Antarctic temperature and MOT and invoke change in AMOC. The discussion on the link between Antarctic temperature and MOT should be gathered in a unique section for an easier reading of the manuscript.

The end of section 4.3 focuses on the temperature and ice volume of MIS2 vs MIS 4 which is quite disconnected from the beginning of the section. Try to reorganize the full discussion to convey clear conclusions and messages.

It seems that you want to discuss:

- the MOT at MIS 4 compared to MOT during MIS 5e and MIS 2 with implication on the CO₂ atmospheric concentration
- The link between MOT and Antarctic dD at glacial – interglacial and millennial scale with a discussion on the associated mechanisms

The discussion on d₁₈O_{benthic} is not very clear here – Is it a perspective of this study to compare with d₁₈O_{benthic} or should these data be used to refine uncertainty in the MOT determination.

Conclusions:

- to be rewritten (the abstract is more explicit)
- the discussion on MIS 4-3 beginning on l. 266 was not present (or I missed it) in the sections of the discussion.
- The paragraph beginning l. 276 seems disconnected.