

We acknowledge the 2 reviewers and the editor for their appreciation of our work to revise the manuscript. We thank them again for their reviews and comments that helped to improve our manuscript. We have revised it considering the minor comments detailed below. For the corrections, we provide the line numbers from the revised manuscript (clean version).

## Response to the comment of Editor

Dear Dr. Cauquoin and co-authors,  
Following the referees' comments your revised manuscript needs only some technical/minor revisions. The revised version has very much improved. Please, adjust the manuscript considering these final adjustments suggested by both referees.

We thank the editor for her appreciation of our work on the revised manuscript. We adjusted the manuscript considering the minor comments of the 2 reviewers below.

## Response to the comments of Reviewer 1

I found the R1 manuscript by Cauquoin et al. largely improved after revision. The authors carefully addressed my (few) and reviewer#2 (more extended) comments. While still long, I believe the manuscript improved especially in readability, e.g. by highlighting the main processes behind each simulation set. I also really enjoyed reading the new discussion part. It is excellent that slopes now are more consistent with observations because of change in the use of annual T instead of P-weighted T.

The aim of the study and its limits are discussed very well, in my opinion. Therefore, my previous positive comment at initial submission stage doesn't change after this revision. I find this manuscript and how the results are presented relevant for CP audience. Therefore, I suggest to accept the paper for publication. I only have a few minor comments about terms/typos, reported hereafter:

We thank the reviewer for his/her appreciation of the revised version of our manuscript.

L367. Please rephrase, very hard to read/understand. Maybe something like "Water vapor  $\delta^{18}\text{O}$  in coastal and.... is controlled by nearby local sources"

This sentence has been rephrased (l. 367-368): "Water vapor  $\delta^{18}\text{O}$  in coastal and western low-elevated sites is controlled by nearby local sources, while evaporative moisture source of high-elevation East Antarctic ice cores is typically further north, around 40-45° S (Sodemann and Stohl, 2009)."

L402 I believe it would be more correct to say "a decrease of transport of enriched water vapor" or something similar, rather than speaking of concentration.

Indeed. The sentence has been corrected (l. 404-405): "This can be explained by a decrease of transport of enriched water vapor from the Indian Ocean..."

L473 The word "changed" is repeated.

**Corrected (l. 472):** "The transport of moisture to Antarctica is generally only slightly changed with variations..."

## Response to the comments of Reviewer 2

The authors have done a lot of work to improve their paper. The manuscript is in a much better place, with improved analysis and discussion.

I have only some minor technical comments for the authors to address (below.)

**We thank the reviewer for his/her appreciation of our efforts to improve the manuscript. His/her comments helped to improve significantly our manuscript.**

Line-by-line comments. Important: Line numbers are from the "marked changes" document, not the clean version!

Line 25: change various to variable

**Done (l. 25).**

Line 462: ice core site location and elevation.

**Done (l. 370).**

Line 474: Maybe specify here than an increase in the isotope slope means that the imposed changes impact the water isotopes more strongly than the temperatures – correct?

**Done (l. 379-381):** "...temporal slope values higher between 0 and 90°E longitude compared to the other simulations (meaning that  $\delta^{18}\text{O}_p$  is more impacted than temperature)."

Line 481-484: I do not understand how you know the  $\delta^{18}\text{O}$  of water from the Amundsen sea without having moisture tagging? Please clarify.

**We know the  $\delta^{18}\text{O}$  of water vapor everywhere in the globe. This part has been clarified (l. 388-393):** "A larger SST cooling near the Amundsen Sea (i.e., Tierney et al. SST compared to GLOMAP, Figure 5c) impacts the temperature from this region to western Antarctic sites (2 to 4 °C, left map of Figure 5c). On the other hand, the  $\delta^{18}\text{O}$  of water vapor and precipitation in the Amundsen Sea area is not so impacted by imposed stronger SST cooling (by 2 ‰ at maximum, right map of Figure 5c). The decrease of the transport of this not so depleted water vapor to western Antarctic sites (Figure S7) increases the temporal slopes by  $\sim 0.1 \text{ \% } ^\circ\text{C}^{-1}$  at WDC and Byrd stations (orange marker in Figure 12)."

Line 485: "making decrease" should be "decreasing"

**Corrected (l. 394).**

Line 490: What is the "eastern part" of the Southern Ocean? Do you mean Indian ocean sector?

**Yes (l. 398-399):** "A more extensive sea ice in the Atlantic and Indian sectors of the Southern Ocean changes the transport..."

Line 493: More extensive sea ice where?

It is now specified (l. 402): “The more extensive sea ice in the Indian sector of the Southern Ocean...”

Line 495 “and south of Australia”?

Corrected (l. 404): “...from the Indian Ocean and marine region at south of Australia...”

Line 519: North America instead of Northern USA?

Ok (l. 427).

Line 590: conclusions section: there is some repetition here from section 4 that could be removed I think.

We shortened the first paragraph of the conclusion section.

Line 598-599: “changed” twice in sentence. Remove one.

Corrected (l. 472): “The transport of moisture to Antarctica is generally only slightly changed with variations...”

Line 601: “We found that temporal slopeS...” (make plural)

Corrected (l. 474).

Line 604: like before, what does the south of Australia mean? Do you mean south of Australia, or actual moisture coming off the land area?

Corrected (l. 475-476): “marine region at south of Australia”

Line 671: “if ECHAM6-wiso showS biases...”

Corrected (l. 518).

Line 675: “orographic effects” or “effects of orography”

Effects of orography (l. 522).

Line 679: Yes, I agree. The Antarctic inversion is probably involved.

This is quite a common issue in AGCMs.

Line 697: Maybe an additional conclusion could be that your study shows that the isotopic slopes in Antarctica in model simulations are extremely sensitive to ocean boundary conditions. Therefore, it is dangerous to rely on models to find the slopes one uses in interpreting isotope data, as has been done in the past (for example, Jouzel et al. 1997, 2003, Markle et al. 2022)

Done (l. 539-541): “Finally, by showing the sensitivity of  $\delta^{18}\text{O}_p\text{-T}_{2m}$  temporal slopes to sea surface boundary conditions, the potential uncertainties of the latter could have an impact on the reconstruction of the former (Jouzel et al., 1997, 2003; Markle and Steig, 2022).”