

We thank our reviewer for constructive feedback. The manuscript has improved as a result of the minor revisions implemented following this review.

The paper has significantly improved, particularly addressing my main criticism regarding the assumption that Lagrangian trajectory analyses of future warming are only affected by changes in transport, without considering temperature changes (L150-160). Figure 2 and the related new discussion demonstrate that potential future temperature changes, as diagnosed in a few ACCMIP climate models (Lamarque et al., 2013), can be accounted for as an offset to all trajectories. This improvement enhances the consistency and justification of your procedure.

However, since this assumption holds significant importance, I would recommend mentioning it both in the abstract and in the conclusions.

For example, in the abstract:

"...Here, we investigate the impact of modified vertical and zonal wind velocities on the temperature histories of trajectories computed using ERA5 data, allowing us to examine the response of TTL transport during boreal winter to idealized changes in the BDC and Walker Circulation. Based on the findings of climate models, we assume that in Lagrangian trajectory analyses of future warming, changes in transport influence the trajectories, while temperature changes can be accounted for as an offset to all trajectories..."

We have added the following sentence to the abstract:

*Future changes to TTL temperatures can be applied as an offset to these temperature histories, including enhanced warming of the cold trap due to "El Niño"-like warming, which has a secondary impact on the fraction of air that is dehydrated by the cold trap.*

The enhanced warming of the cold trap in ACCMIP projections is already discussed in the conclusion, so we opt to focus on our analysis of zonal wind changes and not add more on this temperature assumption in that section.

Lastly, I would like to note that in relevant publications such as Held and Soden (2006) or Vecchi and Soden (2007), the "El-Niño-like" future implies that the cold traps in the future over the Eastern Pacific should be more effective (i.e., colder) compared to the cold traps over the Western Pacific. Although the climate models used in Figure 2 do not support this expectation, I would recommend, not necessarily in this paper, to examine the newest versions of the models, such as those participating in CMIP6.

This is an interesting point. The cold temperatures over the Eastern Pacific do not increase as much as the cold temperatures over the Western Pacific in Figure 2, which should make the Eastern Pacific cold trap slightly more important for dehydration. The coldest temperatures

remain over the Western Pacific, but future work on the relative importance of these two cold traps could be important.

...and here some additional minor comments:

L22:

The seasonal and interannual variability of water vapor concentrations in the lower stratosphere can also be explained by the respective temperature variability in the TTL

Thank you for the suggestion. We prefer our current wording.

L26:

Surface climate is most sensitive to changes to water vapor concentrations near the tropopause (Forster and Shine, 1999; Solomon et al., 2010 and Riese et al., 2012

doi:10.1029/2012JD01775,1 2012), which are predicted to increase with

Thank you for the suggestion. We have added the citation.

L41:

This is crucial for explaining the dehydration of air entering the stratosphere, and it reconciles the incompatibility of the previous “stratospheric fountain” hypothesis with observations (Newell and Gould-Stewart, 1981).

I do not think there are any observations of net subsidence in coldest regions

We have added the citation for this (Sherwood 2000, *A stratospheric "drain" over the maritime continent*).

L78:

but is less impactful for input data with ERA5's resolution (Liu et al., 2010?, I think, you have to cite here other papers like Bourguet and Linz (2022) or maybe Legras and Bucci, 2020)

Thank you for the suggestion. We have added the citations as suggested.