1 Reviewer 1 (RC1)

The authors would like to thank the reviewer for their kind words and their comments on this manuscript. We detail our response and how we will address each comment in the following section. We have included our responses in red.

1.1 Adding Line Numbers

Consider adding line no to each line for future submission.

We used the EGU Weather and Climate Dynamics template, and we are not aware that we can change it.

1.2 Figure Quality

The authors may consider improving the overall figure quality, for instance, by increasing the font size. To enhance visual consistency, the colorbar in figure 7c could be aligned with those used in the adjacent figures.

The authors agree, we have included vectorized figures instead of rasterized figures to improve resolution, and we increased the font size. For figure 7c, we centred the figure to be aligned with figures 7a and 7b, and we modified the colour bar to resemble the colour bars used in the climate experiment section that represent relative differences.

1.3 Impact of convective relaxation and radiation schemes on WV age.

In line number 130, the authors mentioned 'In this model, evaporation from the surface and immediate condensation interact with the convective relaxation and radiation schemes to calculate moisture tendencies that drive the evolution'. They also discuss the role of convection on the age distribution of water vapor (WV). This reviewer is curious: How sensitive are WV age distribution to convective schemes and strenght of vertical mixing?

The authors thank the reviewer for this comment as it is an interesting and important detail of this study.

We explored how turning off the convection scheme and only keeping the large-scale condensation (LSC) can affect the WV age distribution, following Frierson et. al. 2007. That study found that the convective relaxation time was the parameter for which the model was the most responsive, but also analyzed how only considering large-scale condensation (LSC) compared to the SBM scheme. We did a similar analysis for our realistic configuration at T42 and averaged 5 years of data.

In Frierson et. al. 2007 and visible in our experiment, the LSC configuration yielded an increased vertical velocity in the Tropics (figure 1A), large amounts of precipitation at small scales, more tropical precipitation (figure 1C) and a stronger Hadley cell stream function (figure 1B), to name a few. We note that these large-scale climate differences change the large-scale circulation, as well as the mixing of water vapor and its eventual age.

We also saw a drier tropical mid-troposphere LSC (figure 2A), resulting from the intense precipitation at the lower levels and lack of convection, visible in the reduced/increased magnitude of the lower/upper-level sinks of WV (figure 2B). Therefore, the WV that reaches the mid-troposphere without precipitating will stay there longer since there are fewer sinks of WV in the region. This results in an increase in tropical mean WV age in the mid to high troposphere (figure 3A). On the other hand, the increase in precipitation around 800 hPa decrease WV age due to the more intense precipitation. This is visible in the 2D maps of the change in mean WV age at 860hPa and 620 hPa (figures 3C and 3D). In the stratosphere, the lack of convection reduced the exchange with the troposphere, increasing the WV age, specifically over the Tropics (figure 3B). Lastly, in the Tropics, the mean age of precipitation increased (figure 3A) while the vertically integrated mean age decreased (figure 3B). As we saw before, since there is less moisture in the upper levels, the moisture-weighted vertical integral will favour "young" WV from the lower levels. As for the precipitation age, large-scale condensation seems to have increased above 800 hPa (figure 2B), so the precipitation is from higher up in the column, resulting in higher precipitation age.

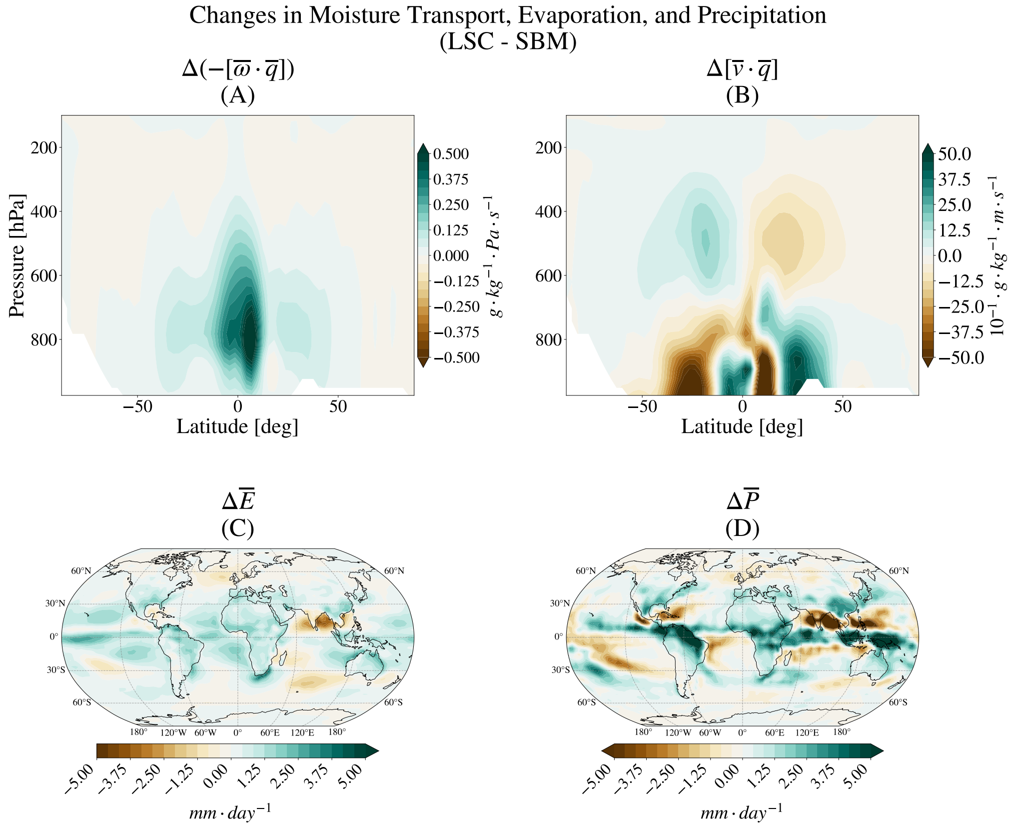

Figure 1. Changes in time and zonally averaged vertical moisture transport (A), zonally averaged meridional moisture transport (B), evaporation (C) and precipitation (D) between the SBM and LSC configurations.

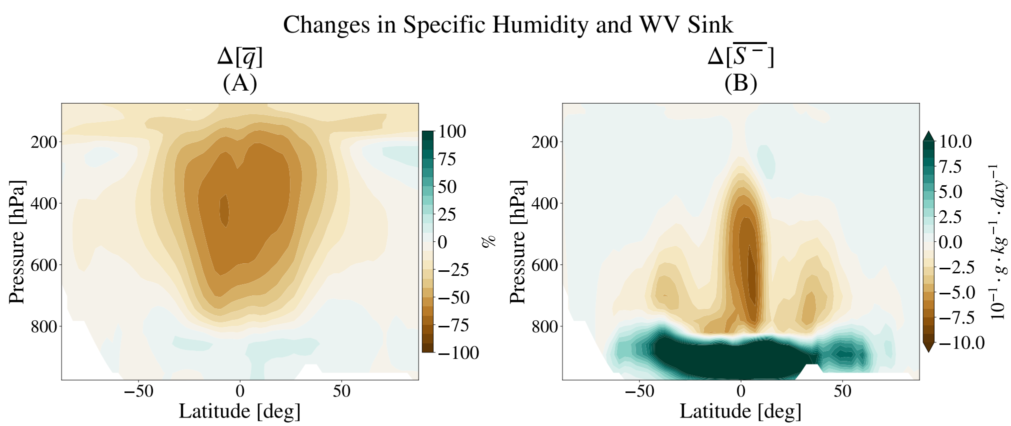

Figure 2. Changes in time and zonally averages specific humidity (A) and water vapor sinks.

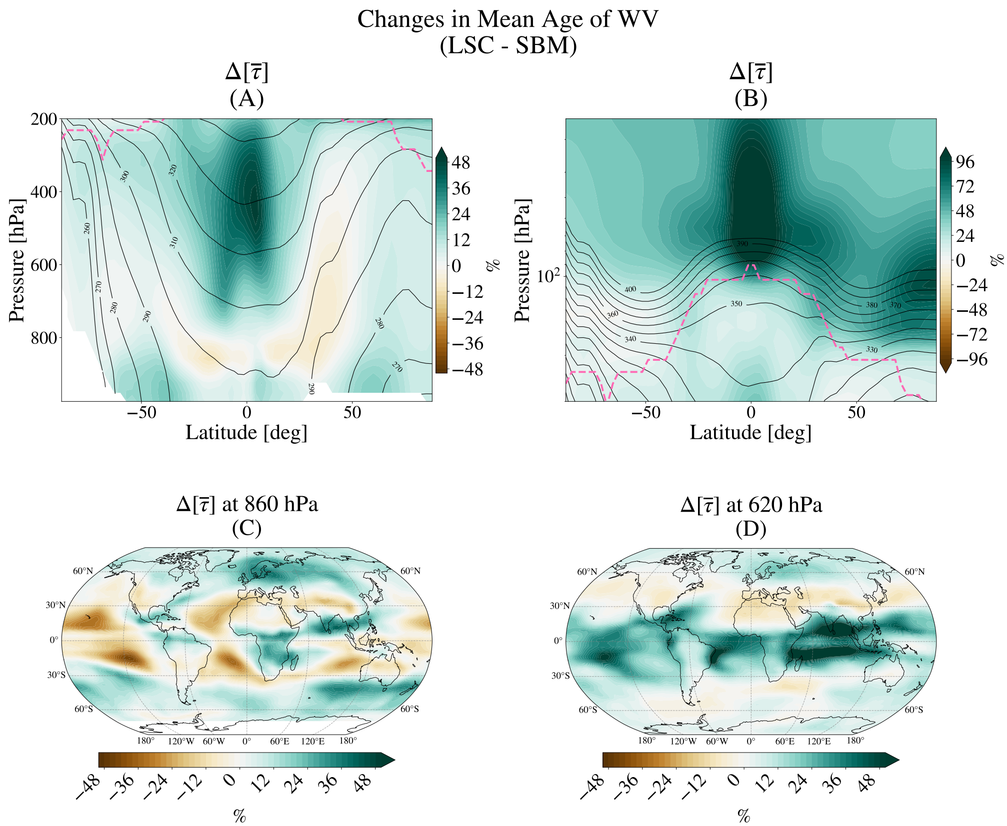

Figure 3. Changes in time and zonally averaged mean WV age in the troposphere (A), stratosphere (B), at 860 hPa (C) and 620 hPa (D).

All in all, this experiment shows that since our WV age tracers depend on the parametrization of WV sinks in the model, which is affected by the absence of a convective scheme. WV age generally increased, but followed what we would expect based on the changes in WV transport.

For the vertical mixing, we did not directly test this as our convection scheme does not have a mass flux, but parametrizes convection through a moisture adjustment scheme (Simple Betts Miller). However, from this analysis, we can infer how a stronger updraft would reduce the mean WV age in the mid-troposphere by injecting "younger" WV from the surface, since when we turned the convection off completely, we saw the opposite effect.

An abbreviated version of this discussion was added in the discussion (around line 490) so that the reader can be aware that we did, in fact, test the impact of the convection scheme. As mentioned by the reviewer, this is an interesting area of study that could be investigated in the future, once the tracers are implemented into a more realistic model. We hope that our study can spark interest in those kinds of studies of the age of tracers.

1.4 Linking shape parameters to known large-scale circulation patterns

The paragraph around lines 220-227 appears somewhat mechanical in its presentation. The authors may consider strengthening the discussion by linking the results related to the shape parameters to known large-scale circulation patterns, as done elsewhere in the Results section.

The paragraphs between lines 209 and 241 were combined to improve readability, and to discuss the physically relevant processes, at the same time as how they shape figures 4a and 4b, more akin to the other parts of the Results section.

1.5 Numerous typographical and grammatical errors

The manuscript contains numerous typographical and grammatical errors. The authors should carefully identify and correct them throughout the text.

The authors apologize for this oversight and went over the text carefully to correct any typographical and grammatical errors.