

Interactive comment on “Shift of subtropical transport barriers explains observed hemispheric asymmetry of decadal trends of age of air” by Gabriele P. Stiller et al.

Anonymous Referee #2

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This study aims to demonstrate that a southward shift of the Brewer-Dobson circulation could be a reason for the observed spatial pattern of the age of air trend in the stratosphere during the MIPAS observation record. This is done by analyzing the changes in the subtropical transport barrier position and their impact on the age-of-air distribution using MIPAS observations and CLaMS model simulations driven by ERA-Interim. The obtained results can benefit the interpretation of the recent age-of-air trend and provide important implications regarding the changes in the Brewer-Dobson circulation. However, more careful descriptions of the methodology and results would be required. I would advise the authors to revise the manuscript accordingly. Below, I present my general remarks and specific points.

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1. It is important to describe whether the overall summary and statistics are sensitive to the choice of the latitudinal shift. There are large interannual variations in the transport barrier position during the two periods, and the average period is short (i.e., four years). Also, the interannual variability is largely different between MIPAS and CLaMS. It is thus required to carefully describe the statistics of the latitudinal shift (e.g., the statistical significance of the trend at each levels) in MIPAS and CLaMS and their influences on the estimated impact on the age-of-air distribution.

2. The interannual variation of the transport barrier mostly disappeared after 2009 in both hemispheres in CLaMS and in the southern hemisphere in MIPAS (Fig. 2); this could explain large parts of the latitudinal shift between the two periods. The age spectrum at least should be obviously different in the absence of interannual variability, which may also influence the mean age through complicated transport processes, even if the period mean position is the same. This point needs to be discussed.

3. MLS data is used to evaluate the position of the transport barrier and is compared with MIPAS and CLaMS. Although the mean latitudinal shift is similar, there are large differences between MLS and MIPAS (and CLaMS), for instance, in 2008 in the northern hemisphere and in 2012 in the southern hemisphere. These differences need to be discussed more thoroughly, and summary statistics must be shown. Also, descriptions would be required on why both MLS and MIPAS are needed and why only MIPAS is used for the age-of-air calculation in this study. Information on the accuracy, precision, and coverage of each dataset would be helpful.

4. The CLaMS model performance needs to be evaluated more seriously. The authors show that the shift of the transport barrier position is similar between CLaMS and MIPAS. However, the mean position and the interannual variation exhibit large differences. Please provide a statistics summary on model performance and clarify if the model performance is sufficient for the purpose of this study.

5. It is described in P11L13 that the strongest negative trend of about -0.25

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year/decade occurs in the northern tropics (from Fig. 6) and is consistent with trends derived from model calculations (e.g., Waugh, 2009), but this is confusing to me. The previous model calculations including the result of Waugh (2009) did not consider the effect of the latitudinal shift explicitly in their estimated age-of-air distribution, same as in the left panels in Fig 5 (not Fig. 6) in this study. I do not understand why these previous results can be compared with the result in this study after the influence of the latitudinal shift is removed (Fig. 6). I may be wrong, but further clarification would be useful.

- Specific comments:

P1L1” “is expected to accelerate...” Please describe what the expectation is based on.

P2L6: “380 and 420 K for the lower latitudes” Please describe the data used.

Section 2.3: Please describe the model resolution and discuss whether this is sufficient to realistically simulate the subtropical transport barrier.

Miyazaki and Iwasaki (2007) should be Miyazaki and Iwasaki (2008).

Figure 1: Color bars are required. Please change the color scale to clearly indicate the differences.

Figure 3: Please change the colors for the lines and shaded areas.

Figure 4: Please add the same results using MIPAS data and discuss the difference between CLaMS and MIPAS.

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