

# ***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 #1**

Received and published: 12 February 2017

This paper uses satellite measurements and global model output to identify a recent shift in the latitudinal position of the stratospheric tropical pipe region and the subsequent impact on trend estimates throughout the stratosphere, especially in the extratropical regions where a north-south asymmetry has been found in the trends of mean age and a number of trace gases. This is an interesting analysis that highlights another complication in interpreting decadal scale trends and in comparing measurement and model trends.

My main suggestions are to clarify some of the figures and spend a little more time describing the techniques used. Some of the figures make it difficult to see the features described and the paper would benefit from adding a couple of more figures to

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more clearly show the changes in the subtropical regions. The topic of the paper is appropriate for ACP so I recommend publication with consideration of the modifications suggested below.

### Specific comments

Section 2.4: Need to include more description here, likely at least one equation, to help the reader understand the Miyazaki and Iwasaki method.

Figure 1: There is no color bar to indicate the mixing ratio values of the colors. Also, why are there gaps in the time series of black crosses, such as in the NH in 2009 and 2012? It would actually be nice to see the PDFs that you used to derive the transport barriers. This could include an average over a particular season for a few years, such as the 2005-8 period and the 2009-12 period. The NH and SH could be shown on the same plot to compare them. As it is, the color scale on Figure 1 makes it difficult to see how well the subtropical barrier represents the tracer gradient region.

Figure 3: Really hard to see everything in this plot. Too many lines and the filled contour colors are too similar to the over-plotted contours. It would also be nice to see a line plot for each of the two time periods of  $w^*$  as a function of latitude, along with the transport barrier metrics, gradient genesis regions, etc. Might need to limit the number of lines you put on each plot though to make it clearer.

In Figures 2 and 3 the southern shift of the southern subtropical barrier is clear after 2009 but it should also be noted that it appears to move back north in 2014. This suggests the shift of the tropical pipe to the south may be a temporary one. I understand this is past the end of the MIPAS record and so doesn't affect the trend analysis. But it's still worth pointing out.

In Figures 4 and 5, the magnitudes of the changes explained by the shift, especially in the lower stratosphere in CLaMS, are lower than the total changes. This is mentioned in the text as perhaps due to a competing process or processes. Is it possible that your

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shift of the tropical pipe in latitude is not enough at some levels? Is there a way to test how much shift can best explain the total changes?

Figure 6 shows a positive age trend everywhere but in the tropical lower stratosphere.

#### Minor comments

Pg. 7, line 1: change “for” to “of” Pg. 7, line 14: remove “in reality” Pg. 8, lines 2-3: “...found an increase in HCl volume mixing ratios in the Northern Hemisphere and a decrease in volume...” Pg. 8, line 4: “...change in age of air...” Pg. 10, line 15: “...during the westerly...”

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[Interactive comment on Atmos. Chem. Phys. Discuss., doi:10.5194/acp-2016-1162, 2017.](#)

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