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Atmospheric Chemistry and Physics Discussions

# *Interactive comment on* "On the impact of future climate change on tropopause folds and tropospheric ozone" *by* Dimitris Akritidis et al.

**Anonymous Referee #1**

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General comment:

This manuscript by Akritidis et al. analyzes the impact of future changes in the tropopause fold frequency on concentrations of tropospheric ozone. The authors use an atmospheric chemistry global model and a well-known tropopause fold identification algorithm, to analyze variations in the stratosphere-to-troposphere transport (STT) of ozone, under the RCP6.0 scenario.
The study is certainly of interest, since the topic of stratosphere-to-troposphere exchange (STE) is of great importance, especially for what concerns the future ozone variations, which would naturally undergo a decrease in the lower troposphere, as projected by precursors emissions reduction.
This is an interesting study and a well written paper, and I recommend publication



in ACP after addressing the comments listed below. In particular, the study could be more complete if also the role of troposphere-to-stratosphere transport (TST) is taken into account, especially to quantify whether the ozone reduction in the middle and upper troposphere (due to precursors emissions reduction) is "overcome" by the increase in ozone due to STT, which seems to occur globally.

Specific comments:

1. Page 3, Line 7. The authors should motivate the choice of the RCP6.0 scenario. Apart from the RCP8.5, which was already assessed in the past, why not choosing, e.g., RCP2.6 or RCP4.5?

2. Page 4, Lines 23–28. Do the authors take into account any limitations of the work by Škerlak et al. (2015)? How would these affect the comparison between the two methodologies?

3. Page 6, Lines 14–23. The strengthening of the BDC would imply more rising air in the tropics, which would then be reflected in a decrease of ozone in the tropical lower stratosphere. Is there any evidence on this, also based on TST (troposphere-to-stratosphere transport) studies? In particular, is Line 19 ("increased upwelling of tropospheric ozone-poor air into the lower stratosphere"), supported by any result? At line 20, the authors indicate a "global STE increase" as the main cause of tropospheric ozone increase, but would this include an increase in both of the two components, i.e., STT and TST, or does it refer to STT only?

4. Page 7, Lines 2–3. In which way is the increase in GHGs concentrations related to the increase in STE of ozone?

5. Page 7, Lines 12–14. Again, the role and quantification of TST in not taken into

account here. What role would it play in modulating the increase of ozone STE reported in the paper?

6. Page 8, Lines 28–31. Would it be possible to “quantify” the effect of these two contributions (i.e., reduction of ozone precursors emissions and increase of ozone STT), so that one could quantitatively see that the ozone decrease due to emissions reduction is effectively canceled out by the global ozone increase due to STT?

Technical corrections:

1. Page 5, Line 21. “Green contours”, please revise Fig. 4 caption, i.e., “black”→“green”.
2. Pag. 6, Lines 28–29. Please check correspondence between Figure numbering and seasons.
3. Figure 7. “concnentrations”→“concentrations”.
4. Page 7, Line 21. “EM” or “EMME”? Please be consistent.
5. Page 7, Lines 25 and 30. “positevely”→“positively”.

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