

## ***Interactive comment on* “The underestimated role of stratosphere-to-troposphere transport on tropospheric ozone” by Thomas Trickl et al.**

### **Anonymous Referee #2**

Received and published: 7 March 2018

The paper entitled “The underestimated role of stratosphere-to-troposphere transport on tropospheric ozone” presents an analysis of the influence of the stratosphere-to-troposphere transport on the ozone levels observed in the troposphere using the ozone and water vapor lidar database available at Garmisch-Partenkirchen from 2007 to 2016. Results obtained here are of interest for the scientific community and are very well supported by the lidar data and the ancillary information used from in-situ measurements, radiosondes and modelling tools. I recommend this paper for publication after major revisions. As a general comment, a thorough review of the language is recommended. The structure of some paragraphs and sentences is not clear at some points, complicating the understanding of the text. This is especially relevant in Section 3, where the main findings are sometimes unclear because of the writing. Besides, I

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strongly suggest to include a final paragraph in Section 4 or a new section where the main conclusions of the study are clearly highlighted in a concise way. The main conclusions should be also included in the abstract in a concise statement. Sections 3 and 4 would also benefit from a more extensive and updated bibliography if possible. More detailed comments are included below:

P2, I2: “but it is not only persistence that matters.” Please, add reference or develop this idea.

P2, I8: “. . .from 1970 to about 2003”. Remove about.

P2, I29: Rephrase “the result cannot be too wrong”.

P6, I9: “. . .interpolated to with. . .” Remove with. Idem for line 23.

P7, I27: Please, add Pappalardo et al. (2014).

P7, I35: Replace “has not been available” by “was not available”.

P7, I36: Replace “ore” by “or”. What is the descent you mention here referred to?

P8, I1: Add “were” before “preferred”.

P8, I2: “This was fulfilled for most cases, 8-10% RH being the exception” Do you mean 8-10% of the cases? It is not clear.

P8, I5: Even though the reference Trickl et al (2010) is provided, the authors should provide more details about the intrusion types, especially for Type 6, which is recurrently mentioned in the text. A definition should be explicitly included.

P8, I15. Rephrase this sentence. It is not clear what the 235 ppb are referred to.

P8, I2: Rephrase “They mostly reach low altitudes above Garmisch-Partenkirchen and occur very reliably. . .”, it is not clear.

P9, I14-22: Consider replacing LAGRANTO trajectories in Figure 3 by those obtained with HYSPLIT: According to the text here, it seems that HYSPLIT trajectories will be

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more illustrative.

P9, I23-25: Check format.

P9, I33: Is it possible to add the plot of the water vapor in Fig 4?

P9, I34: Definition of Type 6 intrusions is necessary here if not included before.

P9, I37: The sentence “are shown here to become more important” is not clear.

P11, I20: Replace “to quantify easily” by “To easily quantify”.

P11, I25: Can you provide here the most relevant details on the approach followed by Beekman et al. (1997)?

P12, I5: Is the fraction of days on which 3.0 km was reached the so-called Zugspitze fraction in Fig 10? Please clarify.

P12, I32-40: Additional discussion is required here. There is a large difference between the estimate based on lidar data and the estimate based on Be data. How reliable is the lidar estimate? What are possible causes for the large difference?

P13, I7: Is the period 1996-2013 is analyzed in a previous study, please provide reference and add relevant information required for the comparison with current results.

P14, I1-5: The difference between the fraction of stratospheric intrusions obtained here (84%) and previous studies is striking. A more exhaustive discussion on the possible causes is necessary. If possible increase the bibliography including additional studies for comparison. Could this difference be related to the location of the different stations and their relative position to the subtropical jet?

P14, I23-26. Do you get a better agreement if you apply these stricter criteria to your analysis?

Fig. 1. Remove 1981 from the caption.

Fig. 3. Consider replacing by HYSPLIT trajectories.

Fig. 4. Include a similar plot for the water vapor data if available.

Fig. 7. If possible, use the same vertical scale on both figures. Idem in Fig. 9.

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