

## ***Interactive comment on “Dynamics and composition of the Asian summer monsoon anticyclone” by Klaus-D. Gottschaldt et al.***

**Anonymous Referee #2**

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### **General:**

This is very interesting and important paper which is worth to be published. The most important finding is the explanation of high ozone within the Asian summer monsoon anticyclone. The authors show that photochemical ozone production in the circulating air masses as well isentropic in-mixing from the stratosphere are key processes defining ozone. In this picture the anticyclone can be understood as a photochemically active and not well-isolated reactor. In this reactor there are two parts: “convectively driven” eastern (Tibetan) part and more “chemistry driven” western (Iranian) part. Although the paper is well-written, it suffers from an inadequate presentation (see major points). Because of this, the paper needs a major revision.

### **Major points:**

C1

1. As you show in many places, isentropic mixing between the stratospheric air (you call it TP layer) and the interior of the anticyclone is an important process in your chain of arguments. In Fig. 7 you show how such isentropes connecting the extratropical lower stratosphere intersect the tropopause (some almost perpendicular) and penetrate into the anticyclone itself. The mixing (stirring) happens on such isentropes and is almost a 2d process. So I do not understand, why you do not show the respective tracer distributions at such isentropes. I guess  $\theta = 360$  K would be the right choice instead of using the 168hPa level (e.g. Fig. 8, Fig 9 or Fig. 10). I would recommend to show Fig. 7 much earlier in the text (e.g. as the second figure of your paper) and than use much more isentropic analysis. As you mentioned, such isentropes are tilted in pressure space, but transport occurs much more on such isentropes.
2. For me it is unreasonable to include 16 figures into the supplement! If your story exceeds something like 10-12 main figures and 2-5 figures of your appendix, you should divide the story into two parts or make your story shorter. The last point seems for me to be more your case. Your abstract roughly describes your main results (see also my general comments). So maybe, you can go through the text and remove everything what is not supportive for your main results (see also my minor points).

### **Minor points:**

1. P 1/L 18-19  
“contrasted by...in autumn and winter” - ASM anticyclone does not exist in autumn and winter. Why we should talk about it.
2. P 1/L 20  
“is regularly entrained a the eastern flank” - This is the isentropic in-mixing mentioned in my major point and not correctly described in your paper

C2

3. P 1/L 24  
“by northerly” - I think “by southerly”
4. P 1/L 24  
“Although...” - this sentence is not clear for me. I would remove it
5. P 2/L 11  
I think that also “the eastward propagation of eddy shedding” is important now (Dethof et al., 1999; Vogel et al., 2014).
6. P 2/L 15  
“the associated heat low” - do not understand what you mean
7. P 3/L7-34  
I would recommend to focus the attention of the reader on ozone (observation very high in the core, but why, you will discuss it in the paper, also in the inter-annual context, etc). Instead of this you talk here too much about general aspects...
8. P 5/L1-6  
For me this is the main motivation for the paper and it should roughly replace the part in P 3/L7-34 !
9. P 5/L14-16  
“The extratropics are dominated...” - this sentence is unnecessary.
10. P 5/L24  
...dominate the averages in the chosen regions.
11. P 5/L29-32  
too much. I can only recommend to remove this material

C3

12. Figure 1, caption  
dynamical proxy of what.... I do not see any gray parts of the flight. “Panel a additionally shows...”????
13. P 7/L21-24  
“slowly descending HCl...” - this feature is very strange. Typically, during the considered season (JJA) there is a strong diabatic upwelling in the UTLS region confined by the anticyclone. Maybe you should explain it with model or remove it...
14. P 8/L7  
“...differ between the summer monsoon season and the rest of the year..” - I would say the strong difference is during AMJJA and not only during JJA
15. P 8  
The main part of  $\text{NO}_y$  in the stratosphere should be  $\text{HNO}_3$ , so I expect a much stronger correlation with HCl. Please comment.
16. P 8-9  
Section 3.4 contains for me too much information. I would reduce it by considering only the ozone-relevant  $\text{NO}_x$ ,  $\text{NO}_y$  features.
17. P 10, L5  
 $\text{NOx}$ , typo
18. P 10  
Section 4 is a very important and novel part of the paper. It combines in situ observations (tracer-tracer correlations) with the model. It shows in a very nice way the interaction between the photochemical ozone production and stratospheric in-mixing. Because it does not use so much the observed  $\text{NO}_x$ ,  $\text{NO}_y$  features, it is the next motivation to shorten section 3.4.

C4

19. P 12, L23

“because HCl ...are decreased” - with the vertical mixing lines you argue that HCl should be constant. Maybe you should reformulate

20. P 13, L20-31 and P 14

Here you show how important is the isentropic transport (mixing between the stratospheric and tropospheric air) on tilted isentropes. Here is also the origin for my major points.

21. On the following pages there are too many references to the supplement (see my major point) I can only recommend to shorten the following sections.

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