

Interactive comment on “Impact of different Asian source regions on the composition of the Asian monsoon anticyclone and on the extratropical lowermost stratosphere” by B. Vogel et al.

Anonymous Referee #3

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Review of “Impact of different Asian source regions on the composition of the Asian monsoon anticyclone and on the extratropical lowermost stratosphere” by B. Vogel et al.

General remarks:

The paper presents a model study of the Asian monsoon anticyclone; the development during the year 2012 from May to October is shown as a case study. The paper tackles a number of important topics:

- the variation in the position and shape of the Asian monsoon anticyclone over the

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year from formation to break-up;

- the chemical composition of the air within and around the anticyclone with respect to the geographical sources of the pollutants, and its temporal evolution;
- the vertical and horizontal transport pathways out of the anticyclone, and potential transport barriers.

Over all, the paper is rather descriptive and wordy instead of analytical (in a quantitative sense) and concise. For none of the topics listed, the authors got to the bottom of the issue. For this reason, a leaner paper focussing on just one of these topics, but doing this more exhaustively, would have been probably more helpful. With such a wealth of material to analyse, the authors should indeed think of splitting this paper into two or even three. However, this is fully at the decision of the authors.

Some comparisons to satellite observations of trace gases are performed, however, these are by far not extensive. Thus, the presented results have mainly to be taken as model reality rather than real world.

The section on the identification of a two-peak structure of the anticyclone (elongated or even split into two smaller ones) (discussion related to Fig. 6) is not very convincing, in my opinion. The two-peak structure searched for could easily be taken as one single broad maximum. More quantitative analysis would be needed here, should the authors decide to keep this section.

The section on the anticyclone tropopause as vertical transport barrier (section 3.2.2) is very important and interesting, in my opinion. The authors should consider publishing this part of the paper separately, in order not to hide it at the end of a lengthy paper.

I recommend publication of the paper after consideration of my general remarks and specific comments as listed below.

Specific comments:

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Abstract:

General: The abstract is very detailed and a bit confusing. This is a pity because the paper might not get the attention it deserves. In line with my earlier general remarks, I find it would be easier and more interesting for the quick reader if the abstract was focused on fewer details; consider to boil down the abstract to few main messages of the paper.

Page 9942:

Lines 9-11: Isn't this obvious when the anticyclone is split into two smaller ones? I'd remove this sentence.

Lines 14-19: This is maybe too much detail; consider removing this sentence.

Introduction:

Page 9943:

Lines 19-21: Really? Later you show that the tropopause above the anticyclone is an effective transport barrier; at least you should state here if this pathway is direct uplift or by isentropic poleward transport. Or maybe just change this sentence to: "... The Asian monsoon circulation IS BELIEVED to provide ..."

Page 9944:

Line 20-23: Is this in contradiction to your own findings?

Page 9951:

Line 3-5: "... two peaks are simultaneously found forming a double peak structure". This is a redundant statement.

Line 12-18: These statements here are a somewhat speculative hypothesis, and this would be fine if further elaborated and proved in the paper. Without further proven evidence, however, these statements remain speculative and should be removed.

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Page 9952:

Line 19: What is shown from MLS is not the same as from the model – make clear from the beginning that you show a stratospheric tracer, namely ozone, and a tropospheric tracer, namely CO.

Line 23/24: "... i.e. low ozone corresponds to high percentages of the emission tracers for India/China and vice versa." This sentence is confusing. What you mean is low ozone = tropospheric air masses in contrast to high ozone = stratospheric air masses. However, polluted tropospheric air is expected to be higher in ozone than clean tropospheric air (still lower in ozone than stratospheric air, though). These relationships need to be clarified, otherwise it is hard to understand why polluted air loaded with emissions should come along with low ozone abundances.

Page 9953:

Lines 26 ff: I find the discussion in this section not very convincing; in particular, the lower panels of Fig.6 are interpreted as giving evidence to the bi-modal distribution. For me, I must admit, it looks merely like a broad maximum distributed over the entire longitude range. There is no evidence provided that the minimum between the "two maxima" is indeed significant. For me, the only obvious and convincing feature in Fig. 6 is the shift of the tracer distributions towards the South from July/August to September/October. To prove the significance of the double peak, a statistical analysis needs to be performed. E.g. one could count the days over a larger number of periods and then assign uncertainties to the numbers; a gap between the two peaks then would be significant if the difference between the peak values and the minimum in-between is larger than 2 sigma; or any other reasonable measure.

Page 9958:

Lines 24 – page 9959, line 8: This justification why the 4.5 PVU isoline can be used as boundary of the Asian monsoon anticyclone should come much earlier, e.g. page

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9950, after line 9.

Pages 9959-9961, discussion of Fig. 8:

How are the variations of the contributions from various source regions related to the variations of emissions from these source regions? Have the emissions assumed to be constant over time? This should then be mentioned here. In reality, emissions strengths may also have a variation over the year, thus complicating the situation.

Page 9964, section 3.2.2:

I was particularly impressed by this analysis demonstrating that the Asian monsoon anticyclone tropopause acts as a vertical transport barrier, and personally I find this is a very important result that should not be hidden at the end of a lengthy paper. I'd really encourage the authors to split the paper and to make a separate short paper out of this. When discussing the results against previous literature, the paper by Randel et al., Science, 2010 must not be ignored.

Technical comments:

Page 9942, Abstract: Line 26: typo "still"

Page 9943: Line 26: "... water vapour HAS a ..."

Page 9945: Line 23 and 26: typo ":source regions" (without s)

Page 9964:

Line 6: Correct the sentence: "...are uplifted in the tropics are widely distributed ..."

Line 13: Remove one "the": "... air masses from the the Asian monsoon ..."

References:

William J. Randel, Mijeong Park, Louisa Emmons, Doug Kinnison, Peter Bernath, Kaley A. Walker, Chris Boone, Hugh Pumphrey, Asian Monsoon Transport of Pollution to the Stratosphere, SCIENCE, VOL 328, doi: 10.1126/science.1182274, 30 APRIL 2010.

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Interactive comment on Atmos. Chem. Phys. Discuss., 15, 9941, 2015.

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