

Interactive comment on “A PV-based determination of the transport barrier in the Asian summer monsoon anticyclone” by F. Ploeger et al.

Anonymous Referee #1

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General Comments:

This is an excellent paper. It is clearly written, well organized, and describes well-executed analysis that attacks important science questions regarding the role of the Asian monsoon upper-level anticyclone for chemical transport. Below I mention two minor issues, the first is substantive and should be addressed before the paper is accepted for publication. The second is more philosophical; I would like to see the authors address it, but do not insist that they do so.

Issue 1: The authors have done a wonderful job of describing their analysis with examples from a particularly good case that occurred July 6 2011. They have also performed analysis over 3 summer seasons as demonstrated by Table 1 and Fig. 11 (although

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this figure only shows 1 season). However, the paper relies too heavily on the July 6 analysis. This applies to the discussion of Figs. 3, 12, and 13 that should, in my opinion, relate seasonal data and not just values from 1 day. Fig. 3 is important because it demonstrates that results from CLaMS (the transport model) agree with MLS data. The agreement between models and satellite data can be very fickle; one might get great agreement one week and terrible the next. It is therefore important to provide the reader with a more thorough indication of how good the agreement actually is. For the early figures, it is appropriate to focus on July 6. The analysis afterward (Figs. 11-13) is essentially a demonstration of how good the ‘barrier model’ is and should not be restricted to July 6. However, after showing seasonal data in Fig. 11, the authors return to the July 6 analysis for Fig. 12 and 13. I think that these figures should show seasonal results. In addition, Fig. 11 should have two more panels: one for O₃ and one for age of air.

Issue 2: This issue concerns the use of the term ‘barrier’. This term is widely used in the literature and, so, I understand why the authors might choose to use it as well. However, I think it is misleading and the maps in Fig. 9 seem to support this contention. I would prefer it if the authors referred to the PV gradient as a diagnostic of how strong (or weak) cross-gradient transport is likely to be – the stronger the PV gradient, the weaker cross-gradient transport is. The reason that the term ‘barrier’ is not appropriate is because it invokes the concept of an external restriction on the flow (e.g., a wall) and of causality. However, PV and cross-gradient transport are both merely related properties of the circulation; they are highly correlated but neither causes the other to occur.

Specific and technical comments:

Page 10594, line 25: Regarding “the linear response . . .”. One obtains a strong anticyclone over Asia as the linear response to low-level convective heating associated with the Asian monsoon. However, the anti-cyclone has nonlinear components. I suggest rewording the is sentence to reflect that fact.

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Page 10595, line 5: Remove 'characterized'.

Page 10595, lines 24-25: Here and throughout the text, the authors use 'has been' where 'was' is appropriate. 'Has been' should be used when something started in the past and continues into the present. In this particular case, the use of PV gradients originated at a particular time in the past – it is not continually being originated. Change 'has been' to 'was'.

Page 10595, line 26: Change 'In fact, the' to 'This'

Page 10595, lines 26-27: Change 'relies on the characteristics of PV being an approximately conserved quantity' to 'relies on the fact that PV is approximately conserved'

Page 10597, line 2: Change 'for suppressed' to 'of suppressed'

Page 10597, line 2: Change 'has been' to 'was'

Page 10597: 'Age of air' should be defined here.

Section 3: Why not show CO from MLS?

Page 10599, lines 10-11: Change 'has been' to 'was'

Page 10599, line 16: Change 'has been' to 'was'

Page 10600, line 5: Change 'has been' to 'was'

Page 10600, line 8: Change 'barrier of the subtropical jet' to 'barrier for the subtropical jet'

Page 10600, line 14: Change 'has been' to 'was'

Page 10600, line 16: Change 'change of our results' to 'change to our results'

Page 10600, line 17: Change 'In analogy to' to 'Following'

Page 10600, line 18: Delete 'in the following' (within parentheses)

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Page 10601, lines 27-28: The statement that 'barrier is located ... in the latitude range of decreasing circulation' seems to contradict Fig. 7, which shows that circulation increases with equivalent latitude. Please clarify.

Page 10604, line 19: Change 'has been' to 'was'

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