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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Rapid transport of East Asian pollution to the deep tropics" *by* M. J. Ashfold et al.

Anonymous Referee #2

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The paper presents observations of marked intra-seasonal variability in the anthropogenic tracer perchloroethene (C2Cl4) collected in Borneo during the NH winter of 2008/09. Observed enhancements in C2Cl4 are caused by rapid meridional transport. Trajectory calculations show that these polluted air masses are from East Asia and can subsequently be lifted to the tropical upper troposphere. Data from the Monitoring Atmospheric Composition and Climate reanalysis support the results. The paper suggests a potentially important connection between mid-latitude pollution sources and the very low stratosphere.

The paper is significant and appropriate for publishing by ACP. The conclusions and potential impacts of the paper are clear. It is well written, however at some points

the authors should be more precise or add some details. The paper is worth to be published in ACP, after minor corrections.

General comments:

I recomment to emphasize stronger in abstract and summary that cold surges cause both the meridional transport from the north and the enhanced uplift in the tropics. This is mentioned in the text, but I think the authors should expressly underline this result of the study.

Further, a lot of details are discussed in Section 6 (Summary and discussion), but it is not mentioned the important results about the transport times of pollution from tropospheric sources in East Asia into the upper tropic troposphere. I propose to add this in the summary.

1 Introduction, p. 30708, lines 20:
'Strong uplift of polluted air masses, and an associated impact on stratospheric composition, has already been demonstrated during the Asian (NH) Summer Monsoon (Lawrence and Lelieveld, 2010; 20 Randel et al., 2010).'
However, the mechanisms for transport into the stratosphere are subject of current debate (see also e. g. Park et al. JGR, 2009; Bourassa et al., Science, 2012, ...)

1 Introduction, p. 30708, lines 24-36:
'East Asian pollution has also been shown to affect atmospheric composition further afield, in both western North America (Cooper et al., 2010) and Hawaii (Lin et al., 2014). '
For which seasons is that valid?.

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1 Introduction, p. 30708, line 5:
Please add 1-2 sentences to explain in more detail “cold surges”. (...transport of cold air from the north... ?)

2 Observations, p. 30710, line 3:
’We have observed similar features in measurements collected in Borneo during subsequent winters...’
Please add which winters? (2009-xx)

3 Transport pathways
Which vertical velocities are used in NAME?

3 Transport pathways, p. 30711, line 15:
What are the typical transport times from $>$ 35°N to Borneo?

4 Wider air quality implications, p. 30711, line 20:
’We are not aware of any continuous air quality measurements in Northern Borneo that are unaffected by local pollution...’
What is the impact of local sources on the C2Cl4 observations?

4 Wider air quality implications, p. 30712, line 12:
’Corresponding daily mean air history maps, in which transport timescales are marked to highlight the strength of the cold surge events, are also presented.’
Please add the transport timescales in the text.

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5 Uplift of polluted air masses, p. 30712, line 25:
'Cold surges are known to affect the intensity of convection in Southeast Asia (e.g. Chang et al., 2005).'
Please explain briefly how the convection is affected. What exactly is enhanced? The convection height or its spatio-temporal distributions? Is there a shift of the location of convection by the cold surges?

5 Uplift of polluted air masses, p. 30713, line 1/2:
'..analysing this type of vertical transport ..such transport'
What means by 'this type of vertical transport'? Convection? Is the convection in NAME described by the upward transport in the Unified model?

5 Uplift of polluted air masses, p. 30713, line 4:
'surface box..'
Please add 'over East Asia'

5 Uplift of polluted air masses, p. 30713, line 6:
'The aim was not to simulate any particular pollutant,..'
Does that mean that 'Chemistry is not calculated along the trajectories' ?

5 Uplift of polluted air masses, p. 30713, line 7:
'originating in the polluted mid-latitudes'
Please add 'in East Asia'

The same in line 16.

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6 Summary and discussion, p. 30714, line 19:
'Its importance needs to be investigated further.'
What would be possible impacts of enhanced C2Cl4 in the stratosphere?

Figure 2:
What is the altitude/pressure range of the trajectories?

Minor comments:

Observations, p. 30709, line 1:
Please add 'Perchloroethene C2Cl4'...

Observations, p. 30709, line 26:
'r^2 = 0.85).'
'r' is not introduced.

5 Uplift of polluted air masses, p. 30713, line 3:
'introduce ..to the upper tropical troposphere' $->$ 'uplift ...to the upper tropical troposphere'

5 Uplift of polluted air masses, p. 30713, line 4:
'kilometre' $->$ 'kilometer'

Figures:
In general, r and n is not always explained in the figure captions.

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Figure 4:
The blue circle is difficult to see?

Figure 5b:
What is the meaning of 'km asl'?

Interactive comment on Atmos. Chem. Phys. Discuss., 14, 30705, 2014.

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