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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Fast transport from Southeast Asia boundary layer sources to Northern Europe: rapid uplift in typhoons and eastward eddy shedding of the Asian monsoon anticyclone" *by* B. Vogel et al.

Anonymous Referee #1

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In this work, air masses of tropospheric origin measured in the TACTS aircraft campaign in the lower stratosphere over Northern Europe are tracked back in time using a Lagrangian trajectory model to their source near the boundary layer in Southeast Asia ∼5 weeks earlier. The transport mechanism involves rapid vertical uplift by typhoons, eddy shedding of the Asian monsoon anticyclone and subsequent transport by the subtropical jet. This article presents novel results on a fast transport pathway of air masses from the Asian monsoon region to the extratropical lower stratosphere. It is well written and constitutes an important contribution to the field; I recommend

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Interactive Discussion
Discussion Paper

its publication in ACP after addressing the following minor comments and suggestions (general and specific).

General comments:

The paper is focused on a novel rapid transport mechanism from the Southeast Asia boundary layer to the lower stratosphere over Europe. However, only a minor fraction of the computed parcel trajectories follow this pathway (2%, Table I), while another ∼35% of the parcels in the region of interest are likely of near-surface origin but have longer transport times. What is the relative contribution of the 2% parcels to the tropospheric-like composition of the measured air masses? The transport mechanism involves the interplay of several factors; how frequently is this pathway expected to take place as compared to other (slower) transports from the tropical troposphere into the extratropical lower stratosphere?

In particular, a non-negligible fraction of the parcels in the region of interest (22%) is also transported from the Asian monsoon region towards Northern Europe (green and yellow lines in Fig.6). In order to assess the geographical origin of these air parcels it would be interesting to follow these backtrajectories further beyond the 40-days limit, until they reach the boundary layer. Although the main focus of this work is on the fast pathway and the authors may consider this additional analysis beyond the scope of the article, there are a few points throughout the manuscript where some related discussion is highly recommended, as specified below.

First, in the lower right panel in Fig. 3, the location of the 'origin' of the parcels is shown, although these do not correspond to surface locations as in the corresponding left panel (this could be misleading). Another example is the event observed about one hour before the region of interest (Fig. 2), which is of similar magnitude but shorter duration than the main event: what are the geographical sources for these parcels? Finally, parcels originating near the Tibetan Plateau could reach the boundary layer at higher potential temperatures than 300 K, is this the case for any of the trajectories

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considered?

Specific comments:

- P18463 L5: Water vapour H_2O → Water vapour (H_2O)

- " L19: remove 'in addition' (redundant)

- " L20: please consider changing 'caused by' to 'transported by'

- " L29: anticyclone isolated → anticyclone, isolated

- P18464 L1: move references to the end of the sentence (after 'in the anticyclone').

- P18465 L9: occurred → occurs

- " L12: remove 'enhanced'

- P18466 L19: the flight was flown → the aircraft was flown

- P18468 L13: (Confusing sentence, please revise) This is also evident in the Fig. 2, where within the flight part shortly before the dive (≈ 13:00 UTC) conducted within the hexagon enhanced CO, CH_4 , and H_2O and reduced O_3 was measured simultaneously. → This is also evident in Fig. 2 where, within the flight part conducted within the hexagon shortly before the dive (≈ 13:00 UTC), enhanced CO, CH_4 , and H_2O and reduced O_3 was measured simultaneously.

- P18468 L20: Why use ERA-Interim data and not operational data with higher resolution? What is the temporal resolution of the heating rates used for the trajectories (e.g. do you consider daily cycles)?

- P18469 L7-L9: How many trajectories are run?

- P18471 L21: extend. → extent (not shown).

- P18475 L21: the the → the

- P18475 L26: stratosphere where → stratosphere, where

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- P18476 L4: on the Rossby wave → on a Rossby wave

- P18479 L21-L24: Please revise the sentences: 'The backward trajectories show that the transport time of water vapour and pollutants from the Asian monsoon anticyclone to Northern Europe [...] is about 8–14 days in the case study discussed here. Thereafter, the trajectories travel further northeastwards [...] to Northern Europe'. It seems that parcels arrive in Europe after 8-14 days of transport in the jet and thereafter continue traveling.

Interactive comment on Atmos. Chem. Phys. Discuss., 14, 18461, 2014.