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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Balloon-borne measurements of temperature, water vapor, ozone and aerosol backscatter at the southern slopes of the Himalayas during StratoClim 2016-2017" *by* Simone Brunamonti et al.

Anonymous Referee #2

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General comments

Brunamonti et al. present results from the StratoClim balloon campaigns. They measured vertical distributions of temperature, ozone, water vapour and aerosol in the south Asian UTLS during one post-monsoon and two monsoon campaigns. They identify three significant thermodynamic levels and layers, which provide a framework to understand the UTLS structure within the Asian summer monsoon anticyclone. The paper is sound and clearly within the scope of ACP(D). It is based on a new and important data set that needs to be published.

Some arguments regarding the confinement effect of the ASMA are not yet clear to me, or at least do not sufficiently consider alternative explanations: Convective height might primarily control H2O, O3, and confinement. The effect of confinement on H2O and O3 needs to be clarified. Details are given in the specific comments.
It's hard to tell whether addressing those requires minor or major revisions.
Alternatively, the paper would be worth publishing even without discussing the relative importance of confinement and other processes in the ASMA. The outlook at the end of the paper shows its importance for ongoing other studies.

Presentation

(1) Too many acronyms make the paper hard to read. I suggest to count the number of occurrences of each (not well established) acronym, then write out those 50 % that occur least.
(2) Consider to reduce redundancy in the figures (e.g. T vs p for DK17 and NT16AUG is shown in Figs. 1, 4, 6a, 13).
(3) Consider to annotate curves etc. in the figures only, rather than the captions. For instance in Fig.13, the campaigns and the meaning of the colours impede reading of the caption, but are already obvious from the panels.

Specific comments

Line numbers in the following are approximate, sometimes referring to the arguments of an entire paragraph.

P3L7: What about aircraft measurements? CARIBIC provides a lot of species in high resolution. Dedicated campaigns (ESMVal/HALO, OMO/HALO, Strato-Clim/Geophysica) sampled higher altitudes and also did some profiles. There are a

few aircraft in-situ monsoon papers, at least from CARIBIC and ESMVal.

P7L2: Fig. 2 shows snapshots of individual days. Are those days chosen to be representative in some respect? Please consider to provide time averages for the respective measurement periods (or for the sounding days).

P7L9: There are different PV thresholds for the dynamical tropopause. Please provide a reference or justify your choice.

P7L17: Given the structural differences of the tropopause region between summer and autumn: Why do you choose the same pressure altitude to compare the two seasons? You might consider to show trajectories started over some altitude range, or from a specific distance to the respective tropopause altitudes.

P8L23: What is the spacing between trajectory starting points?

P8L26: The ASMA box seems to be rather big. Please justify or provide a reference.

P9L19: Formulation for O3 is ambiguous. Please revise.

P10L25: What do you mean by "feature" here: H2O max, O3 min, or the combination of both? Anyway, neither the H2O feature, nor the O3 feature is necessarily related to differences in the strength of convection alone. The time since the last convective influence on the air mass might also be important. If NT16Aug by chance sampled older air on average, the H2O feature would have been smoothed out. Also, convection increases the availability of O3 precursors, leading to enhanced photochemical O3 production. The absence of an O3 minimum just above the LRM in NT16Aug might be due to longer confinement or to higher O3 production. Please discuss.

P11L5: This is consistent to older samples in NT16Aug.

P11L8: This argument is not quite clear to me. H2O in the CLS is compared to H2O in higher altitudes. The difference is attributed to the horizontal confinement effect of the ASMA. However, first order this might just reflect the decreasing frequency of convec-

tive tops with altitude. To quantify horizontal (isentropic) confinement, you might consider comparing back-trajectories according to their respective lengths in the ASMA. Please discuss.

P11L14: Not necessarily, see previous comments on convective strength versus age. Age is related to confinement. Please disentangle.

P11L16: Confinement tends to increase O3 via photochemical production. Please discuss horizontal confinement versus the altitude profile of convective influence. The argument regarding the quality of the TOC definition could go the other way round i.e. (simplified): ASMA is driven by convection -> convection reaches to a certain altitude -> no confinement above convective influence.

P11L20. Ditto.

P11L28: Could different temperatures or different ages (time since last convective influence) be alternative explanations for the difference between DK17 and NT16Aug?

P12L19: Comparing NT16Aug to NT16Nov per se generally reflects seasonal variation. Air mass origins might be totally different in August and November, even if there was no ASMA confinement in August. Please reformulate or elaborate, why NT16Aug without ASMA would be like NT16Nov.

P12L29: The parameters affecting the threshold depend on region and season. Is the threshold of Vernier et al. applicable to your measurements without adjustments?

P13L21: Could the thermodynamic conditions at the CPT enhance aerosol formation from gaseous precursors? In that case convective outflow or confinement might not be as important.

P13L22: "its level": Does this refer to confinement or aerosol enhancement? Please reformulate.

P13L25: There is no convective supply of aerosols/precursors in November. Addi-

tionally there is no confinement. The ASMA might to some degree enhance ATAL. Consider revising to clarify causes and effects.

P14L33: Please also discuss alternatives to confinement.

P15L3: Please discuss convective height versus confinement.

P15L6: Comparing different altitudes is of limited use for estimating the effects of confinement.

P15L7: Please also consider convective height and possible vertical variations of aerosol formation.

P24, Fig. 2: White contours for water vapour are not discernible. Please revise, e.g. consider omitting or doing an extra plot for them. Insets in panels a, c, e are too small. Consider to include those lines in the right column's panels.

P25, caption of Fig. 2: "Note that in panel c (NT16Nov), trajectories stared . . ."
- Panel c is not about trajectories.
- stared -> started
- ppmm -> ppm

P27, Fig. 4: Consider to use ECMWF data only from the times of the respective soundings.

P30, caption of Fig. 6: Consider to give a short explanation of "GPS geometric altitude"

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