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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Statistical analysis of water vapour and ozone in the UT/LS observed during SPURT and MOZAIC" *by* A. Kunz et al.

Anonymous Referee #1

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The paper addresses a very important question about the representativeness of airborne measurements for climatological analyses. The authors focus on the extratropical UTLS and use MOZAIC and SPURT measurements of H2O and O3 to address the question how these different measurement strategies cover the time scales of underlying atmospheric processes.

The authors use a Kolmogoroff-Smirnoff test and variance analyses to investigate how atmospheric variability is represented by the data and which differences between the data sets occur. The statistical tools are well described and documented and can be applied by others to test their own data. The reduction od the data sets to match each other is well explained, bur not entirely clear to me (see below). The focus of the authors is on the description of the method and the climatological comparison of

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both data sets, which is very well done. However, they eventually could extend their very interesting results by discussing a bit more the link to the underlying atmospheric processes (partly leading to the observed differences between both data sets, see also last point). Therefore I recommend the manuscript for publication in ACP with some minor corrections and one important point concerning the data selection:

Main point: Stratospheric H2O (see also last remark):

Looking at Fig.3 and the selection of MOZAIC-H2O (but also SPURT H2O) I'm a bit surprised to see that the entire extratropical stratosphere seems to be as moist as indicated by the measurements. In particular the increasing MOZAIC H2O with increasing distance to the tropopause is difficult to understand. How representative is the selection of data in a given DTP-bin comparing the amount of data in the original data and in after the selection process (a plot showing the fraction of selected data relative to the total number in each DTP bin would be useful here)? Could it be the case, that after the selection process only the extreme cases remain or the sensitivity of the MOZAIC H2O sensor is still overestimated (compare Fig.3A, white lines)? How does the data reduction influence the variability analysis, since the "unperturbed" background H2O values and therefore variabilities are removed from the data.

abstract: p.12562,l.7 sems to be in contradiction with the conclusions: "While the SPURT data...": Does this hold for both species? I guess the conclusion on p.12579,l.2/3 is, that O3 from SPURT can be used for climatological studies. Please change the abstract accordingly (slso l.9, "The SPURT H2O data set does not..."). p.12567, end of par3.: Why is the region of 5 K around the 2PVU iso surface not analyzed?

p.12567., l26.f: What is meant here? The 5% RH-uncertainty lead to a decreasing precision of H2O volume mixing ratio deeper in the stratosphere?

p.12568,l.2 do instead of does

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p.12569,l.9:tropospheric instead of troposphere?

p.12569,l.18:According to?

p.12571,l.22: each other

Fig.5: Please rescale stratospheric ozone

Fig.6 and p.12572,l.21: What do you mean with ".. all cases, despite the troposphere?" Isn't it in contradiction to the next sentence where you state, that tropospheric ozone is larger in that case? Maybe you should introduce arrows in Fig.5 for the means and medians instead of the symbols.

p.12572,l.25: Which critical value is meant?

p.12572, l.28/29: The cumulative distribution functions for O3 and H2O for the stratosphere are consistently different between SPURT and MOZAIC (higher ozone corresponds to lower water). Why is are the distributions for the troposphere inconsistently different? Is this what you mean with the term sampling difference?

p.12573,l.2: Each campaign consisted of typically four flights, therefore 8 flights per season.

p.12574,l.9 and Fig.7(bottom): Do the authors have an idea about the discrepancy around 10-15 minutes?

p.12574,l.19-22: The separation into four slopes is rather arbitrary, one could also deduce an almost continuous increase of tropospheric MOZAIC H20-variablity from hours to 100 days.

p.12575: Stratospheric H2O from MOZAIC: How does a larger uncertainty of the measurements in the stratosphere at low H2O affect the stratospheric variability of MOZAIC H2O? Could this lead to a higher 'artificial' variability on the short time scales? In the presented analysis most MOZAIC low H2O-data have been excluded, but can one expect still some enhanced variability at low water vapour due to limited measurement

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sensitivitiy?

p.12576,l.18:,but on a...

p.12577,l.16-20: You find the same variabilities of MOZAIC and SPURT H2O high above the 2PVU surface. However, if you state that the MOZAIC H2O data are ('difficult to use'(p.12577, l.21) above DTP$>$20 K), why are they included in the analysis (Fig.3)? Either data quality is sufficient, then it would be very valuable to show that plot for DTP$>$20K. If however, the variability is dominated by instrumental noise, then the data should be excluded from the whole analysis. Given, that the same variabilities in both observations are the result of real atmospheric dynamics, this would be an important result, since it could help to constrain the processes which are responsible for water vapour in the extratropical UTLS or to investigate the role of convection versus quasi horizontal transport. Could one conclude, that mainly convection strongly affects H2O in the region above DTP=20K (maybe also using other tracers?). Since interseasonal time scales are not covered by SPURT the fact, that MOZAIC and SPURT-H2O show the same variability seems to indicate that processes, which require timescales of days to several weeks (e.g. slow decay of tropospheric filaments in the stratosphere over several days, stirring over a broader spatial and temporal scale) do not significantly affect water vapor variabilities on these time scales.

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