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Atmospheric Chemistry and Physics Discussions



# *Interactive comment on* "Highly resolved observations of trace gases in the lowermost stratosphere and upper troposphere from the Spurt project: an overview" *by* A. Engel et al.

**Anonymous Referee #3**

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Review report Engel et al.

This manuscript tends to provide an overview of the SPURT project. Since it is has been a major initiative that may generate many scientific publications, a general overview is warranted and should be available for the community. I therefore regard this paper important enough for ACP after considering the comments below.

Plots and presentation

I find the presentations of the results somewhat biased. Most data is only presented

on equivalent latitude - potential temperature coordinates. Although its usefulness is clear, why not show other features of the data? For example, vertical profiles relative to the observed tropopause. The difficulty with PV is it's poor representation of the instantaneous tropopause. ECWMF PV can greatly vary at the local tropopause. Although I understand you don't want to show all kinds of details, an overview with the data binned relative to the observed tropopause would be valuable addition. As presented, there is many of the same. The general features of a long-lived tracer show up in every plot, without giving additional information. I would suggest showing one typical long-lived species, ozone, CO and CO2, since the latter species has a seasonal cycle. Vertical profiles of CO, NOy and ozone would be interesting to show. Another example is tracer-tracer correlations. You could present these only for tracers with short en long chemical lifetimes to cover the time scales involved. Further, Figure 2 in the current setup is not clear in comparing both data. Why not show a similar comparison with N2O as with O3 in Figure 1?

Figure 3 is nice, but I would like to see an additional Figure showing the measurement area in a latitude - altitude frame. I have seen such pictures including potential temperature and the tropopause, which very nicely shows the measurement coverage in a view that is often used to demonstrate STE. The reader then clearly sees the area superposed on the LMS and relative to the tropopause.

I would also like to see an example of the meteorological information available in the SPURT data set. Given all the interesting information and efforts put to generate them, an example Figure would be justified. A suggestion could be to show certain clustering of air origin based on trajectories. For example, were there fast excursions from the troposphere into the MLS, or do all MLS trajectories basically show similar behaviour? You could also compare ECWMF temperature (and perhaps water vapor) with the observed quantities.

The reason behind all these suggestions is not just to give you a lot of work, but I believe that an overview paper should really provide an overview of the SPURT data.



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Detailed comments

Page 5083 Line 25: You don't specify the layer. Which layer do you mean here? Line 27: I would rephrase this sentence: "the observed seasonal variability of ozone changes rapidly"

Page 5084 Lines 1-2: I don't understand the whole sentence. Please rephrase.

Line 9: Similar behaviour for CO2? This can't be right! CO2 is not temperature driven as H2O is. You probably mean something else, so please correct.

Lines 25-29: Who gives this simplistic view? Is that Holton et al. (1995)? I may have missed it, but I cannot find any publication that presents such a simplistic view. If you can't find it too, than the sentence is meaningless, otherwise provide the references.

Page 5085: Line 2: I do not understand what you mean with "more closely coupled'. In what respect? Radiatively? Dynamically? Chemically?

Line 4: More likely than what?

Line 5: I disagree with this point. It depends on the time scales of transport and chemical kinetics. Balancing these it could mean that the mid-upper stratosphere is a more vulnerable region! Chemical changes in ozone in the extra-tropical LMS are slow.

Page 5086 Line 6: the word climatology is too strong. SPURT does not provide a climatology. Although later in this para you come back to this point, I'd rather see the emphasis towards seasonality and latitude coverage here, because that is the strong point of SPURT.

Page 5093 Line 16: Could you be a bit more specific on the ECWMF data used? Is it all analyses, 6-hourly or 3-hourly? I presume it was the 60-layer version, but what horizontal resolution?

Page 5101 Line 7: As mentioned earlier, ECWMF PV provides an inaccurate presentation of the local tropopause. Any quantification of tracer changes based on PV is



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therefore meaningless. Line 10: Influence => Influenced Line 11: I do not fully understand your point here. Local emissions are not subject (or too a small extend) to seasonal variability. Convection does (too some extend) which would influence the mid-troposphere when bringing boundary layer pollutants upwards. On the long term it would average out, but the impact could be very large. You may as well skip this sentence since I believe it is not very relevant.

Page 5105 Lines 16-17: I have difficulties with this conclusion. I do not believe isentropic transport occurs in the sub-tropical tropopause break, where the jet will cause sufficient baroclinic instability, including cloud formation etc. that will prevent isentropic transport to take place. Please provide a reference if it proves the contrary, since I guess the Rosenlof paper refers the second pathway you mention and not the first one.

Finally, I find the conclusions somewhat too general, given all the work that has already been performed. Could you more strongly specify what we have learned from SPURT so far? Do SPURT results change of the traditional Holton et al (1995) view on STE en TSE?

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Interactive comment on Atmos. Chem. Phys. Discuss., 5, 5081, 2005.