Atmospheric
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Discussions

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comment

Interactive comment on "Climatology and long-term evolution of ozone and carbon monoxide in the UTLS at northern mid-latitudes, as seen by IAGOS from 1995 to 2013" *by* Yann Cohen et al.

Anonymous Referee #1

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Cohen et al., 2017 ACPD

Major comments: This paper presents the more recent results of IAGOS measurements. There is a lot of data presented, with certain behavior explained. But there is little in the way of science interpretation of these the observations. I found it hard to distill down the main points of the paper. However, I think with a little additional work, this paper could be a lot stronger.

The authors present both O3 and CO data but rarely combine these observations in

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Discussion paper

their analysis. For example on Pg 16, they discuss that some increased CO in North East Asia may be due to biomass burning but never discuss how these fires would impact O3. Maybe consider the implications of the dual tracers you have here. How does the CO:O3 ratio vary across the UT, TPL and LS. There is no real testing of the definition of TPL using both tracers either, and this could be an important result. The authors compare their O3 and CO trends with other results but don't do any investigation into what is driving those trends. There are a lot of "may" and "could". I think the paper would be a lot stronger if the trends in CO were compared with estimated CO emissions from BB (using GFED?) and anthropogenic emissions. Or included a direct comparison with the MOPITT trends (rather than just discussion).

The paper could be made more concise (maybe the time series plots could go in an SI?). The summary/conclusions section is great and should be the lead in to more of the paper overall.

Technical comments (I'm sure I've missed some) Minor detail: The use of all the acronyms makes this paper really difficult to read. If you could remove some and replace things like NEA with North-eastern Asia, it would not add much length but would make it easier to get through the text.

Pg 1, 6 western Maritime continent? Not sure what this is. Pg 1, 8 You have very little southern hemisphere data and nothing over the pacific in this paper. quasi-global is an overestimate.

Pg 2, 14: clarify what you mean by NMVOCs Pg 2, 16: emitted by lightning? Do you mean produced by lightning? Pg 4, 30: I like this section. I was wondering about it. Pg 5, 30: What is the uncertainty in the PV calculation? How much would this uncertainty affect the partitioning of data between UT, LS, and tropopause? Pg 6, 30: Do you really mean data points? Or do you mean 5ox5o binned data? This also invites the question: As a rough idea, many O3 (4s) and CO (30s) data points do you fit into a 5o x 5o box? Pg 6, 29: I think the use of 7 months and 3 seasons is a nice compromise

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between representativeness and data coverage. Do you get the same results if you used 6 or 9 months or 4 seasons (the statistics probably won't be robust but it could act as a sensitivity study)? Pg 6, 33: I haven't heard for the Theil-Sen slope estimate or the OpenAir package before so I can't comment on these. PG 7 12; "Except this one". Do you mean "Aside from this region, the next least sampled regions are..." Pg 9, 10: What longitudinal averaging is done in the 25-75 bands? Or is this all the data the data or all the data averaged over 5o (the grid basis)? Pg 9, 14: "eastern Asia and northern Pacific". You dont have any northern Pacific data included in the map. Stick with the regions you have identified (NEA) Pg 9, 30: Could you make the comparison with the satellites a new paragraph and extend it a little? This seems to just be tacked on at the end here. Pg 11: These graphs need axis points. You refer to gradients between e.g. 60E to 135E but I have to guess where those are on the plots. Pg 11, Fig 3: Also need lat/long labels on this figure. Pg 12, 9 Definition of STE? Pg 15, 5 How many years of CO data is included? Pg 15, 7 This should not be a new paragraph. You are discussing the same figure Pg 15, 10 "In most re- gions, there is no noticeable seasonal variation in the LS." Really? At least half of them show a similar range of seasonal changes in the UT and TPL. Which begs the question: What is the uncertainty/range of variability within each of the monthly mean values shown in Fig 5? Are any of these regional seasonal trends statistically different? Pg 16, 5 What is the uncertainty range on all these means? Are the results statistically different? Pg 16, 15 Definition of WCB? Pg 16, 21 "percentile 95" What is this? How did you calculate it? What data was used to define it? There needs to be some detail on this here (or did I miss something earlier?!) Pg 16, 22 What is the uncertainty/variability on these twin "peaks". Are the differences between April, May and June statistically significant so that you can call this a double peak? How much of this difference could be attributed to uncertainty in the calculation of the TPL height? Pg 16, 29 Can you check GFED for the timing delay between peak fires and the peak you see? The peak fire season has been shifting towards August in recent years so has the CO signal from BB also been delayed in the UT? You also don't define GFED or GFAS. Pg 17, 25 "All these

features seem to indicate less frequent springtime STE events in WNAm." You never explained what STE is so I've no idea what this is. This whole paragraph needs to be re-written in simpler language. P5 and P95 have not been explained so far aside from the abstract. Pg 25, 12 "mentioned" mis-spelled throughout paper Pg 25, 12 what years did the Thouret paper cover? 9 years is a bit vague. Pg 25, 23 "a more frequent sampling, thus smoothing the temporal variability". This doesn't make sense. Do you mean you have more data available within the greater sized grid box, allowing for a more significant statistical analysis? Pg 27, 24 "We assume that in the UT, the spatial variability is too weak to be responsible for the discrepancies between the two studies." Could you use the longitudinal trend from Fig 2/3 do quantify the expected changes? How significant is the P95 trend you see? Pg 27, 25 do you mean O3 increasing over time? Pg 27, 34 what O3 trend do you get using only 1994-2008? Pg 27, 32 "Although no trend calculation was performed in WNAm, it may confirm the upper tropospheric O3 increase as effective in the whole northern mid-latitudes, except the Pacific ocean." If there was no trend calculated due to a lack of data, then this sentence should not be included. You can't confirm or deny anything! Pg 27, 35 Fig 8 shows an increase in O3 in the UT because there is missing data! How is the mean/smoothing calculated for each region when there is a data gap? 2011 probably has one of the lowest O3 minimums with missing data before. Pg 28, 3 "mentionned" should be mentioned Pg 32, Fig 16, 17: What do the hatched areas mean? (I assume insignificant trend but you should state it). You should also explain in one of these figures what regions each of the labels represented. All info to interpret the figure should be in the caption. Specifically to Fig 16: What do you gain from including the 5%, 50% and 95% trends? How is computed? Are the 95% CI for the Pg 34, 2: extend should be extent

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