

Review of manuscript by H. Petetin et al.

“Characterizing tropospheric O₃ and CO around Frankfurt over the period 1994-2012 based on MOZAIC-IAGOS aircraft measurements”

Indeed, the manuscript strongly improved and the concerns raised by the reviewers were addressed in a very detailed way, very good! Also the English spelling is much better, although there are many (>40 or so) cases where e.g. the article was misplaced. I support the publications when the minor revisions below are considered.

Minor remarks:

- p.1, l.15 delete “(due to dry deposition at ground and titration by NO)”, as this is first only half of the truth and secondly not inferred from the data
- p.1, l.17 delete “(due to stratosphere-to-troposphere in-mixing)”, same explanation
- p.7, l.13f In the mid- and high latitudes, where passenger aircraft can reach the tropopause, the ozone tropopause is far below 150 ppbv, see Bethan et al. (1996) and well measured by Zahn and Brenninkmeijer (Atmos. Environment, 2001) and thereafter verified by Thouret et al (ACP, 2006). Your argument “Therefore, the DT derived from PV values tends to be located below the 150 ppb O₃ - isopleth, which may bias low the O₃ mixing ratios in the UT.” is thus not okay, especially because you may attribute data points with >100 ppb (which may be stratospheric) are attributed to the UT. The UT defined here using $p_{2PVU} + 15$ hPa is basically a conservative parameter, as 2 PVU is quite low as definition of the DT. Your DT study/statistics indicates (in my opinion) that the PV field from ECMWF is quite often not a suitable parameter to define the tropopause. You should discuss this shortly.
- p.9, l.10-12 delete “(due to dry deposition and enhanced titration by NO in the BL)” and “(due to STE)”
- p.9, l.15 What are O₃ episodes? high/low, short/long ... episodes?
- p.9, l.20 Citations for the « C » shaped profile
- p.10, l.6 Not so simple to understand what you describe with “daily variability” on different scales. I guess “day-to-day variability” sounds more plausible here. Please use this synonym throughout the text.
- p.10, l.12 Do “transient exchanges” exist? → “transient exchange processes”
- p.13, l.3f I would first discuss the vertical profile (para starting at l.13) and thereafter the long-term time series (Fig. 6).
- p.13, l.18f No! The shown O₃ values in the UT are significantly affected by unwanted attribution of stratospheric air (see my argument above), as in-

icated by the 95th percentile showing levels of up to 115 ppb. Modify this para.

- p.14, l.4f "... CO emissions at northern mid-latitudes when the photolysis is limited". Upps & boah, I didn't know that photolysis controls the decay of CO. Correct this somewhat embarrassing part!
- p.16, l.12 "the year 2000 is taken as a reference (i.e. the origin of the time series)". Why only as of 2000 and not 1994? Explain!
- p.18, l.12 "... which is consistent with the trends found here over the period 1994-2012". Again, did you consider the entire period or only as of 2000?
- p.18, l.14 "The persistent positive trends found higher in altitude suggest that wintertime O3 has increased at a large scale". Refer also here to the supplement.
- p.18, l.19f The numbers given here differ from the ones given in the supplement.
- p.18, l.29 "the reference year 2004" instead of "the 2004 reference year"
- p.19, l.2 You often write "all the ...". Skip there "the"
- p.19, l.5 ... a decrease of the total column of CO over Europe
- p.19, l.19 "The seasonal variation of O3 can be well approximated by a sine function". I don't see this in a figure.
- p.20, l.5 "The differences of amplitude change between the different layers all remain statistically insignificant." I don't understand this sentence. The numbers in tab. 2 differ and more than the standard deviations indicate.
- p.20, l.10 "... O3 on the 18th June in the LT and on the 23th June ..." and later in the text the same.
- p.22, l.16 "day-to-day" instead of "daily"
- p.22, l.19 "Maximum day-to-day variability of CO" instead of "A maximum of variability"
- p.22, l.25 "the entire troposphere" instead of "in all the troposphere"

A couple of times you write "variability and trends of ...". Why once singular and the other time plural? "variability and trend of ..." fits best.