

Review to: A gas chromatograph system for semi-continuous greenhouse gas measurements at Puy de Dome station, central France, by Lopez et al.

The paper by Lopez et al. describes the GHG measurement system at Puy-de-Dome, and three years of data 2010 – 2013. The paper includes:

- a description of the station particularities
- a description of the instrumentation at Puy-de-Dome, with focus on the gas chromatographic (GC) system
- an overview of three years of measurements including quality check and atmospheric measurements
- an estimation of the regional CO₂, CH₄ and N₂O fluxes using the radon tracer method.

My main concern with the paper is related to the suitability for publication in AMT in the actual form. The declared focus of the paper is the setup of the GC system (this is also what the title indicates). However, the authors state themselves, “similar instrument configurations are installed at the Gif-sur-Yvette and Trainou stations” (pages 3131 – 3132). The setup of the GC at Trainou has already been described in detail in Schmidt et al., 2014; the ECD detectors at all three stations (Gif-sur-Yvette, Trainou and Puy-de-Dome) are described in Lopez et al., 2012. I see thus no reason to publish yet another paper that centers on the same GC setup.

The paper however includes interesting information besides the description of the GC. In my opinion the focus of the paper should be a more general description of the Puy de Dome station – including the general technical setup, and the three years of data (as it does now) and with fewer technical details on the GC system (i.e., sections 3.1., 3.1.1., 3.1.2. shortened). If there are significant differences between this system and the ones from Trainou and Gif, these should be mentioned. The title should be adapted as well.

General comments

- The paper is not very well organized and seems to have been put together from disparate pieces. Some parts that should be in the Results section are instead in the Methods and vice-versa (see specific comments)
- The comparison with the WMO recommendations: in the abstract is stated: “the GC system meets the WMO recommendations” (and this is said several times through the paper). Comparing the reported numbers, e.g. Table 6, with the WMO recommendations (page 3140, lines 23-24), it looks like this statement is not true. Please clarify what do the WMO recommendations refer to, what should be compared to what, and please check again the comparison and change the text as need. See also the specific comments.
- Puy de Dome is a mountain station. Is there no special atmospheric circulation or behavior due to the fact that this is a mountain station? (see e.g. Thompson et al., 2009) This does not seem to be taken into account, for example when comparing to the PBL height.

Specific comments

1. page 3123, lines 9 – 11: the phrase “Comparisons ... the GC system meets the WMO recommendations” – this doesn’t seem to be true for all species at all times, please clarify.
2. page 3123, lines 20 – 22: I suggest to give the errors of the fluxes
3. page 3125, line 2: I think “These approaches” should be “Some of these approaches”
4. page 3125, line 6: Lopez et al., 2013 did not use radiocarbon in CO₂ – please reformulate
5. page 3126, line 5: remove “can be cited”
6. page 3126, line 7: “achieve equivalent or superior repeatability...” – please give references

7. page 3126, line 16: “anthropic” should be “anthropogenic”. Please check the whole document, this appears several times.
8. page 3126, line 16: “SF6 ...is the forth ...GHG in terms of radiative forcing” – please give reference
9. page 3127, lines 5 – 6: “which demonstrated that our measurement system reaches the WMO recommendations” – please check how much of this is true, and adapt text
10. page 3127, lines 18 – 19: “is surrounded by meadows (36.4 %), forests (33.4 %) and arable land (17.6 %)” - in which area or radius around the station?
11. page 3128, line 25: give the coordinates in the same units as for the station (see page 3127 line 13)
12. page 3128, line 25: why were the ECMWF data extracted at 575 masl and not at the station altitude?
13. page 3129, line 15: what was released, air masses or particles?
14. page 3129, line 19: “particles arriving at the station” should be “air masses arriving ...”?
15. page 3133, line 4: not sure whether “CO₂ catalysis” is the right term – should it be “CO₂ reduction over the Ni catalyst”?
16. page 3133, line 9: “valve shunting” – should it be “valve switching”?
17. page 3133, line 15: “ECPs” should be “EPCs”
18. page 3134, lines 1- 3: for calibration, the whole air samples are compared to synthetic air-based calibration gas, which is missing many components normally present in atmospheric air (e.g. He, H₂, CO, short lived gases). Is it known that this has no influence on the calibration? I.e. has it been proven that none of the gases present in atmospheric air has any influence on the measurement? In the same idea, please specify whether the calibration cylinders for the CRDS are also based on synthetic air. If not, could this be (part of) the cause of the difference between the GC and CRDS?
19. page 3135, line 1: “a linear fit is sufficient to account for the non-linearity of our uECD”; also, line 4: “a two-point calibration strategy is well adapted to correct for the uECD non-linearity”. The linear fit by definition does not account for any non-linearity. Also, a two-point calibration cannot correct for any non-linearity. I think what the authors wanted to say is that the non-linearity is not corrected, and the error due to not accounting for non-linearity over this range is small / acceptable within errors. Please reformulate.
20. page 3135, line 11: what is the starting gas pressure in working standards?
21. page 3135, line 15: the initial and final analysis of these cylinders at LSCE showed significant differences, at least for CO₂ and N₂O. Please specify: are these differences statistically significant? (give errors?); which of the values were used for calibrating the Puy de Dome data? what is the known / suspected cause of this difference, drift in the cylinders (did both standards show similar differences?), LSCE lab calibration or measurement stability, other? If the cylinders are suspected to have drifted, how is this taken into account for the calibration at Puy de Dome? If the LSCE lab is the problem, which data are considered “true”?
22. page 3135, line 26: the tables are not numbered in order. The last was Table 3, so this one should be Table 4.
 - the same at page 3136, line 11
 - change also the name and the order of the tables at the end of the document
23. page 3135, from line 27: the text from here till the end of this subsection belongs to the results and discussion
24. page 3136, line 1: “data holes” – better “data gaps”?
25. page 3136, lines 5, 6: “SD at 1-sigma” – SD (standard deviation) is sigma. Remove “at 1-sigma”
26. page 3136, line 7: “Table 4” should be “Table 5”
27. page 3136, lines 14-17: I cannot understand the phrase starting with “The same ...” – please consider reformulating.

28. page 3136, lines 22-24: Were the data corrected, or the calibration was just re-done with one standard instead of two? More explanations are needed on how the correction was done. If the data including Target were corrected or recalibrated, why is the 10 ppb difference still there in Fig. 3?
29. page 3136, lines 25-27: The phrase starting with "The analysis of TG2 ..." – these data after Sep 2013 are not shown in the paper; also the WMO recommendations are not specified. I suggest to remove this phrase, or support it with data.
30. page 3137, line 7: "as the GC" should be "as the GC trap"?
31. page 3137, lines 25-27: what are the similarities between the two stations that are relevant here? (technical setup? atmospheric circulation? other?)
32. page 3138, lines 17-18: here it is said that the reference cylinder is analyzed for 10 min every hour; but the CO₂ analyzer is differential and has a reference cell that should be flushed continuously. Or is the reference cylinder not the gas that goes through the reference cell? Please clarify.
33. pages 3139 – 3141, Sect. 3.4: Most of this section, except for the first paragraph, should be in the Results. Some additional information on the comparison method should be given here in the method, e.g.: how were instruments compared, since they have very different data frequencies? The CRDS works at 1 Hz, the GC gives 1 data point every 5 min, and flask sampling is weekly – they cannot be compared without some data processing.
34. page 3140, lines 1 – 20: were any of the station gases (reference or target) measured by both GC and CRDS? If yes, was the difference similar with the ambient air difference?
35. page 3140, lines 1 - 20: The CO₂ differences between instruments listed here (and in Table 6) are obviously not within the WMO targets. Please check the affirmation made through the paper on this subject.
 - Similar for lines 23-24: "the comparisons between GC in situ measurements and flask analyses reached the desirable comparison levels (see Table 6 for more details)" – in Table 6 it is shown that CO₂ and N₂O (in-situ – flasks) are not within the WMO targets. Please adjust text or, if "desirable" in this case is not WMO, please specify.
36. page 3141, line 20: 1013 should be 2013
37. page 3142, line 17: remove "than in winter" or move to the end
38. page 3143, lines 14-15: how was the time interval for the "background" chosen? Looking at Fig. 5, there are quite some differences between the start and the end of this interval, probably most evident in Rn and CH₄. The continental offset and thus the computed fluxes depend on this choice
39. page 3144, Sect 4.3.1: I think most of this should sit in the Methods.
40. page 3145, lines 1-9: Schmidt et al., 2003 calculated the decay correction based on the 3 days continental residence time for the air masses at Schauinsland. I do not understand how the fact that "most of the air masses arriving at the Puy de Dôme station and having a lifetime of three days are also from the continent" proves that the air arriving at Puy de Dome has a continental age of 3 days. In short: if all the 3-days air is from the continent, it does not mean that all the air is 3-days old. Please clarify.
41. page 3145, lines 6-7: Please give the Schauinsland coordinates. Is there any study that compared, and showed that the two stations are similar? (give reference)
42. page 3145, line 16: why was the 222Rn not extracted for the station footprint? How was this 300 x 300 Km area decided?
43. page 3145 line 28: typo "therefor"
44. page 3146, lines 6-8: Only random errors were considered here (GC repeatabilities). What about possible systematic errors, e.g. due to imperfect choice of background time intervals?
45. page 3148, lines 4-5: Is there an explanation for the negative CH₄ fluxes? From Fig. 4, it seems that for the negative fluxes – months there were fewer measurements. Can this be the cause, that the baseline is not well defined during these months?

46. page 3148, line 29: I do not get the meaning of “ with lower fluxes as expected” – please check.
47. page 3149, lines 4 – 7: Please check the comparison with the WMO targets. From the flask comparison, it seems that the CO₂ and N₂O are not within these targets; for the cylinder comparison, N₂O does not match.
48. page 3149, lines 12-14: phrase starting with “ At stations...” : the discussion till here was about the difference between the two analyzers. At stations with only one analyzer, there can be no bias between analyzers.