

## ***Interactive comment on “Measurements of greenhouse gases and related tracers at Bialystok tall tower station in Poland” by M. E. Popa et al.***

### **Anonymous Referee #1**

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This paper fulfills a valuable role in documenting methods for measuring multiple gases (CO<sub>2</sub>, CH<sub>4</sub>, CO, N<sub>2</sub>O, SF<sub>6</sub>, O<sub>2</sub>/N<sub>2</sub> from a tall tower site in Poland. The measurements were done as part of the European CHIOTTO project, which presumably ultimately has the goal of using such measurements to track surface fluxes using inverse calculations. Careful documentation of the methods is critical to establish the scientific credibility of these results and as a guide to others wishing to make high quality measurements elsewhere. The data are presented as simple time series, interpreted in terms of trends and cycles, as appropriate, which helps describe the basic phenomenology. One general issue is that the discussion needs to be sharpened to clarify if the detected phenomenology was expected based on prior work elsewhere, or if it entails novel findings. This is done in a few cases, but needs to be done more systematically. I recommend that the paper be published if this general concern can be addressed, as well as my

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minor comments below.

I would also welcome, but not require as a reviewer, additional analysis to explore for novel phenomenon. For example, the emphasis on cycles and trends of individual species, might profitably have been expanded to look more closely at correlations between species. The strongly (anti)correlated patterns in  $\text{O}_2/\text{N}_2$  and  $\text{CO}_2$  should allow a quite precise daily ratio to be computed. It would have been interesting to examine whether this ratio varied with season or on other time scales. Developing a monthly time series of this ratio should be easy based on the analysis done to prepare in Fig 9. Correlations in the synoptic variations between species, e.g. at the 300m elevation might have pointed to correlations in sources at the larger scale. How variable was the  $\text{N}_2\text{O}/\text{CH}_4$  diurnal ratio with time of year? A thorough examination of all these topics would admittedly have made the paper unwieldy, considering the paper is designed mostly to describe methods. Nevertheless, the paper would probably have much more impact if it highlighted one or two such novel results.

Minor comments. Probably should replace ppm, ppb, and ppt with  $\mu\text{mol mol}^{-1}$ ,  $\text{nmol mol}^{-1}$ , etc, or at least define them as such somewhere in the manuscript.

Page 1: The text needs to clarify that “measurements of  $\text{O}_2$ ” and “measurement of  $\text{O}_2/\text{N}_2$ ” are being used equivalently. At other sections, the term “oxygen” is also used to mean  $\text{O}_2$ . Better to stick with  $\text{O}_2$ . Page 2, line 20: Delete text “at the moment” Page 3, line 26: In Europe, tall tower measurements were first brought into operation. . .” Page 6, line 7, Air motion is highly variable, so it’s not correct to state categorically that the air flow follows an average pattern. Page 6, Section 2.2. Need to clarify what material was used for sampling lines. Page 7, line 15: Note inconsistent use of the term “standard” and “reference” between equation (1) and the text. Page 8, line 18: Use of the word “target” is confusing, in that it is used to describe the gas from a particular cylinder. The “target” is not something being targeted in any normal sense of the word. It might be less confusing to use the term “surveillance gas” (Note it’s the gas that’s being measured not the “cylinder”). Page 8, line 25.  $\text{O}_2$  tends to accumulate relative

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to N<sub>2</sub>... Page 9, line 3. The statement that no plastic is used in flow paths doesn't seem credible, because most seals use elastomers, and because the commonly used Synflex tubing has a polyethylene liner. The relevant point is that "plastic" is not used anywhere where it can present a significant permeation leak. path. Is the term "plastic" acceptably precise here? Perhaps there's a better term. Page 10 line 9. The term ArCH<sub>4</sub> is not clear. Page 12, line 5. Not entirely clear what is meant by "Target" measurement. Also, note early point about using "surveillance" versus "target". Page 12, line 9 and Table 2: The standard deviations are based on averages over what time frame. This is critical to understand achieved precision. Page 13, line 17. Sentence is hard to follow due to the word "with" appearing twice. Page 17, line 16. Not clear what is meant by "signal". Synonymous with "concentration"? Page 17, line 23. Need to clarify if local time allows for resetting the clock for daylight savings. Page 25, line 10. How can midnight be at 2:00 local time? The use of two clocks here is confusing. Page 26, line 4. Couldn't the similarity in the diurnal cycles in N<sub>2</sub>O and CH<sub>4</sub> result simply from the fact that the sources are only weakly diurnally varying, so that the variations in the atmosphere are due to variations vertical mixing, common to both? Page 26, line 25. Need to cite prior work on CO<sub>2</sub> diurnal cycle, as this cycle is well described elsewhere in the literature. Figure 1: What is meant by min.m<sup>2</sup>.kg<sup>-1</sup>? If this is a units, one needs to delete the period marks and also clarify in the caption that this is the unit that applies to the concept of "footprint". Also, the meaning of "min" doesn't seem very clear, Figure 5. This figure doesn't seem very successful, given that the overlapping symbols reveal only broad limits of the data ranges. It would be good to try using smaller symbols. Also, the O<sub>2</sub>/n<sub>2</sub> plot reveals a period in 2008 that looks like that data is bad, at least at 300m, judging from the persistent high variability unlike previous years. Figure 6. Confusing the color scheme is reversed for APO versus CO<sub>2</sub> & O<sub>2</sub>/N<sub>2</sub>.

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