

## ***Interactive comment on “Five-year flask measurements of long-lived trace gases in India” by X. Lin et al.***

**Anonymous Referee #1**

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Overall comments:

This study investigates the results of five-year sampling measurements of long-lived greenhouse gases (i.e. CO<sub>2</sub>, CH<sub>4</sub>, N<sub>2</sub>O, and SF<sub>6</sub>) and trace gases (i.e. CO and H<sub>2</sub>) at three stations (Hanle, Pondicherry, and Port Blair) located in India. By the compounds in the collected air samples that measured by different analytical techniques, many approaches are made to investigate the regional features of the target compounds. The authors have characterized these trace gases with delta value ratios at these stations in different seasons. The data at numeric stations over Europe and the United States are also estimated and discussed.

My overall feeling to this manuscript is that all the target compounds are put together

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for discussion but little is mentioned regarding the relationship between them, especially for N<sub>2</sub>O, SF<sub>6</sub>, and H<sub>2</sub>. What are the integrated findings that these compounds can together indicate? The authors are required to make more efforts to describe the scientific connections between these compounds. If the authors cannot adequately find major contribution of N<sub>2</sub>O, SF<sub>6</sub>, and H<sub>2</sub> that are relevant with other compounds, I would suggest to remove them from this manuscript.

In addition, from the description and data presented in this manuscript, the PON site seemed to be easily influenced by local emissions, e.g. Pondicherry city with a population of ~ 240,00 at a distance of 8 km southward and a four-lane highway at ~ 80 m to the station. These can make the station not able to act as the regional background representative for the trace gases, especially for CO. I would suggest to filter out the data that are possibly polluted significantly by local emissions at PON.

I suggest that this manuscript can get warranty for publication if these issues can be carefully revised or improved.

Specific comments:

Introduction: The authors have clearly indicated the their research motivation on studying the GHGs in the introduction section. However, little is discussed about the additional trace gases (i.e. CO and H<sub>2</sub>). What are the relationships between the GHGs and the additional trace gases scientifically? Please also address the importance of CO and H<sub>2</sub> for this study.

Section 2: Please provide the data availability. For example, the website of the data provided by LSCE, NOAA, aircraft measurements, etc.

Figure 1: Not just CO<sub>2</sub> being discussed in this manuscript. Therefore I think the elevation of a trajectory is more important than its CO<sub>2</sub> level in this figure. By doing so, the 3-D traveling routes of air masses can be clearly viewed, which also can provide useful information for other trace gases. The authors can try to merge the vertical data of the

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trajectories in Figure S5 into Figure 1.

Section 2.2.2: It seems that there were three channels for separating respective compound pairs (i.e. channel #1: CO<sub>2</sub> and CH<sub>4</sub>, channel #2: N<sub>2</sub>O and SF<sub>6</sub>, channel #3: CO and H<sub>2</sub>). However, the descriptions are given based on different part of a GC technique (e.g. sample loop, column, detector, etc.), which is quite easy to get readers confused. In order to improve the readability, the authors are encouraged to rephrase this paragraph based on different compound pairs.

Page 7181 Line 24: stemmed

Figure 2: The 4 subplots are recommended to be merged into 1 or 2 plots. This comment also applies to Figure 4, 6, 8, 10, and 12.

Figure 3: The CO<sub>2</sub> levels are shown in relative scales. What are those “zeros” on the y-scale representing? Please clarify. Furthermore, the mean seasonal variations can contain some errors obtained from the increasing trends. In order to avoid this, the authors can estimate the detrended seasonal curves by subtracting the growth rates.

Figure 3(b): There are three lines in the figure, but only two are shown in the legend.

Page 7186 Line 11: How good is the agreement between the flask measurements at HLE and aircraft measurements over New Delhi? Please quantify.

Page 7186 Line 29: than those at HLE by ...

Page 7188 Line 24 “The annual mean N<sub>2</sub>O mole fraction at HUN was higher than at Mauna Loa (MLO) and Mace Head (MHD) by only 1.6 and 1.3 ppb, respectively.” : I think this sentence is referring the study at HUN and is irrelevant to this study.

Page 7188 Line 25: I do not think it is necessary to use the data observed at so many stations in this manuscript. It is better to choose just one background station at similar latitude or in nearby region to be compared with the Indian sites. For instance, the authors may choose GMI or MLO as the reference to be compared with PON and PBL.

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Or use NWR and JUN (Jungfraujoch) as the background reference station for United States and Europe, respectively. This comment is not only for N<sub>2</sub>O, but also for other compounds such as SF<sub>6</sub> discussed in other sections.

Page 7189 Line 17 “more noisy due to regional sources and synoptic variability” : Why is N<sub>2</sub>O the only compound influenced by the regional sources and synoptic variability? Why are other compounds like CO<sub>2</sub> and CH<sub>4</sub> not influenced due to the same reasons?

Page 7191 Line 14 “the SF<sub>6</sub> mole fractions at HUN over the years of 1997-2007 are higher than those at MLO and MHD by ...” Line 19 “At HFM, the SF<sub>6</sub> mole fractions are higher than those of the NWR on average by 0.15...” : I think these sentences are irrelevant to this study.

Page 7193 Line 13 “The PON and PBL stations are influenced by CO regional emissions, mainly due to biofuel and agricultural burning over South and Southeast Asia.” : As mentioned above, I think PON station can be easier affected by local emissions from the Pondicherry city or the four-lane high way nearby.

Section 3.3 : It seems that the PBL and PON site are at a similar location and elevation. Were CH<sub>4</sub> and CO elevated at PON due to the SW monsoon as well? How about the impacts of the monsoon prevails at PON? Please discuss that in this section.

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Interactive comment on Atmos. Chem. Phys. Discuss., 15, 7171, 2015.

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