

## **Anonymous Referee #1**

Received and published: 4 March 2019

The authors present and discuss data of column-averaged greenhouse gas abundances collected during several months with a high-resolution FTIR spectrometer in Shadnagar, India. The information about a new ground-based spectrometer operated at this site is a valuable information and deserves publication, but the observation period is too limited and the elaboration presented in my opinion needs extension.

### **Reply to Referee#1**

**We appreciate your constructive comments. The comments and proposed corrections have been taken into account and helped to improve the paper. Each comment has been addressed as follows. There is an extensive discussion among the authors regarding how to revise the content.**

**1. Why are only data recorded between start of and mid 2016 taken into account? Is the observatory inactive since?**

**Reply: We sincerely appreciate your comments and suggestions. Present data were collected during clear sky days only. Data were not collected after May 2016 due to failure of HeNe source. We initially ordered FTIR 125M with MCT detector and KBr beam splitter configuration in 2014 and continued observations with this set up till 2015 during clear sky days. Later, we understand TCCON recommendations for precise column GHGs are different configuration. Hence immediately we started the procedure for augmenting the 125M system with InSb detector and CaF<sub>2</sub> beam splitter while meeting TCCON standards. The IFS125M was augmented in December 2015 and started collecting NIR spectral data in 2016 only. Unfortunately HeNe laser source was failed in the middle of 2016. Hence we could not collect data beyond 2016 May. Therefore, the presented data analysis only focused on the available data in 2016. Instrument is again operational since March 2019. Future analysis will focus on long-term data analysis as suggested. Objective of the present study with the available data to attempt retrievals column GHGs using GFIT model while meeting the TCCON standards.**

**2. Although GFIT is used for the data analysis, a huge bias in XCO<sub>2</sub> versus OCO-II data is found (- 1.5%). I wonder whether the GGG suite and same retrieval setup is applied as used by TCCON? If not, the analysis of GHGs should be repeated with the standardized TCCON code.**

**Reply: We obtained GFIT (GGG, 2014V) and utilized the same retrieval setup as used by TCCON to process the data. Comparison approach is changed in the revised manuscript. We adopted median based method to compare OCO-2 retrieved XCO<sub>2</sub> with FTIR retrieved XCO<sub>2</sub> and found mean bias with RMSD is  $-2.82 \pm 3.01$  ppm.**

**3. A presentation of XAIR instead of the current figure showing VCD of O<sub>2</sub> would be more useful for the reader for judging the level of stability achieved by the spectrometer. Presenting VCDs of other gases is also not too useful (XGas is the relevant quantity), so Fig. 3 could be removed**

**Reply: Thanks for the comment. We have computed Xair for our site, which is shown in below figure and updated in the revised manuscript. The typical Xair value for TCCON**

measurements is about 0.98 and exhibits a small diurnal variation. The mean value of the current measurement site is 0.98 with a standard deviation of 0.006.

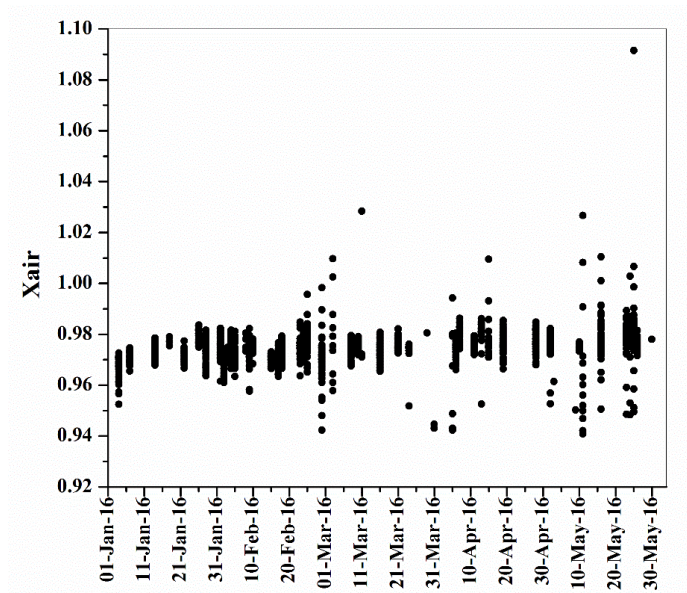
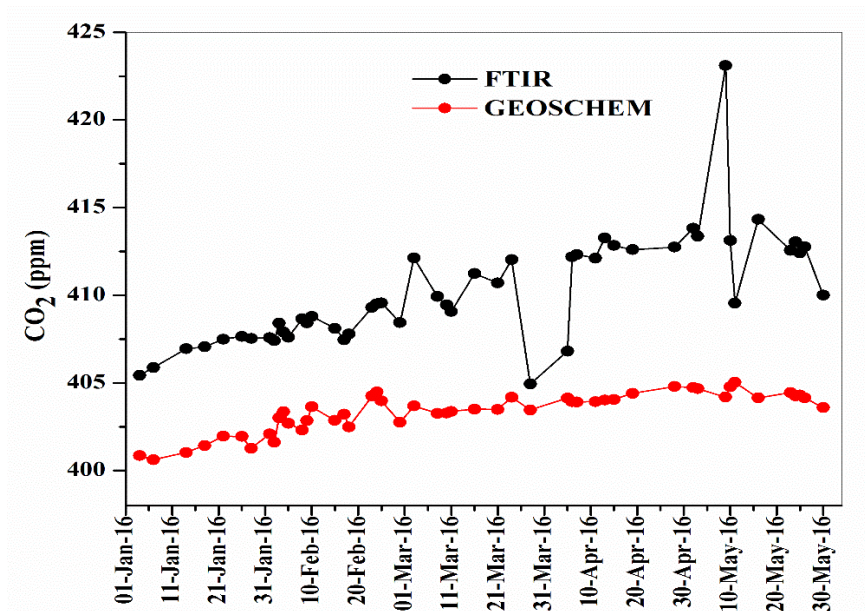


Figure. Xair for the measurement site.

As suggested Figure 3 is removed from the revised manuscript.

4. I would suggest to include an intercomparison of the observed annual cycle with a model or climatological expectation for the variability of Xgas.

**Reply:** Please excuse us for not adding this result. Our division is not running GEOS-Chem model. However, we took the support to understand the GEOS-Chem column CO<sub>2</sub> simulation against FTIR retrieved XCO<sub>2</sub> during the study period. It is observed to be consistent in the trends with varied bias. Please see below figure for your reference.



## Detailed comments:

Abstract, line 31: not clear how the specified range of precision is established.

**Reply: Precision for the current measurements are calculated on daily basis. In the present manuscript minimum and maximum achieved daily precision is reported.**

Introduction, line 45: consistently -> continuously

**Reply: updated in the manuscript**

Introduction, line 55: should be: “their contribution to CH<sub>4</sub> emissions remains uncertain”

**Reply: updated in the manuscript**

Introduction, line 67: The Petri et al., 2012 reference is hardly appropriate here.

**Reply: Thank you suggested reference, updated in the manuscript**

Introduction, line 73: offer the potential

**Reply: Updated as suggested.**

Introduction, line 79: a record : : : has been available

**Reply: updated in the manuscript**

Introduction, line 83: measurements with high precision Introduction section starting line 88: it might be useful to mention the COCCON network in this context, see Frey et al., AMT, 2019 and references therein.

**Reply: updated in the manuscript**

Section2, line 115: cloud free conditions

**Reply: updated in the manuscript**

Section 2, line 116: omit make, Bruker Optics

**Reply: updated in the manuscript**

Section 2, line 136: DC signal recording

**Reply: updated in the manuscript**

Section 2: Please specify the data source or instrument of the ground pressure values used for the data analysis

**Reply: Dear Referee, ground pressure values are used from the Automatic Weather station data measured at the same location.**

Section 3, line 151: The common code used by TCCON is GFIT, PROFFIT is used by several NDACC groups.

**Reply: Thanks for the information. Updated in the manuscript**

Section 3, line 156 ff: NDACC uses WACCM climatological profiles, the standardized GFIT TCCON analysis should not use this dataset.

**Reply: The a priori profiles generated by the TCCON retrieval algorithm are based on the National Centre for Environment Prediction (NCEP) reanalysis data for temperature, pressure, and humidity.**

Section 3, line 164: a priori

**Reply: updated in the manuscript.**

Section 3, line 177: omit “and O<sub>2</sub>”, instead state “: : :that affect the target gases (Washenfelder et al., 2016).”

**Reply: Thanks for suggestion. Updated in the manuscript**

Section 4, line 188 ff: preferably discuss XAIR, not VCD (O<sub>2</sub>), as the latter quantity varies with ground pressure.

**Reply: Thanks for the suggestion. We updated as suggested.**