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Atmospheric Measurement Techniques Discussions

Interactive comment on "Characteristics of the Greenhouse Gas Concentration Derived from the Ground-based FTS Spectra at Anmyeondo, Korea" *by* Young-Suk Oh et al.

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Response to interactive comment of Referee on "Interactive comment on "Characteristics of the Greenhouse Gas Concentration Derived from the Ground-based FTS Spectra at Anmyeondo, Korea" by Young-Suk Oh et al. T. Blumenstock (Referee) Received and published: 24 May 2017

General comments: The authors present a new TCCON site in Korea. This paper characterizes the instrumentation and gives an example of its application: inter-comparison with OCO-2 satellite data. This site really fills a gap in the existing TCCON network and will be very useful to assessing sink and sources of GHGs. The data and also

the comparison with OCO-2 data are of good quality. The subject is appropriate for publication in AMT. The paper is well written and I recommend publication after major revisions, in particular a more comprehensive description. Response First of all, we would like to strongly appreciate referee's very constructive and valuable comments on the manuscript. We have tried to address all the issues (major and minor comments) raised on this paper one by one. The referee makes strong comments to give more details about OASIS and its influence on ILS (Instrumental Line Shape) by including some illustrations so that we added some more brief on it. Our replies and respective changes are described below. Technical comments regarding spellings and grammatical errors are corrected in the final version of the manuscript.

Major comment: A specific feature of the described instrumentation is the so called OASIS (Operational Automatic System for Intensity of Sunray) system. While analog systems are used in active remote sensing systems, for example laser output control in LIDAR systems, an intensity control of passive systems is typically not used. In the TCCON network the variability of the DC signal is used to quality check and correct the recorded interferograms and resulting spectra. Since you remove this signal you cannot apply this kind of quality check anymore. Do you record and use the actual setting of the aperture to do so? Response In addition to OASIS system, we have also simultaneously used the variability of DC signal similar to TCCON network for quality control of the spectra and its retrieval results. Yes, the spectra are recorded with the actual setting of the aperture having a diameter of 0.8 mm throughout the observation period.

If the motivation to introduce such a system is to limit the intensity to avoid non-linear response a smaller constant aperture or smaller preamp gain or a smaller sensitivity of the detector might be more appropriate. Would you please add a statement for the motivation to add this system? Or a comparison of XCO2 time series recorded with and without OASIS system which might demonstrate the difference, for example in terms of signal to noise ratio. Response The OASIS system is developed for improving the

quality of the spectra. To ensure the quality of the spectra, this system will be useful for minimizing the noise that induced in the spectra due to rapid intensity fluctuations of the incoming solar radiation that reaches to the instrument. This rapid intensity fluctuations are be occurred in the presence of clouds, aerosol loading etc. along the path of incoming radiation within the instrument field of view. To minimize this intensity fluctuations due to the changing weather conditions, OASIS system regulates in such a way that by varying the aperture size at the source compartment based on the signals from photon sensor which depends on the levels of incoming sunlight intensity. Thereby, it avoids non-linear response of a smaller constant aperture or smaller preamp gain or a smaller sensitivity of the detector. In this study, we are not able to show the whole time series of XCO2 without OASIS system during the study period since all spectra that are used for analysis of species are obtained after the OASIS system equipped to our FTS spectrometer. However, for a typical example, we illustrated the time series of XCO2 in both cases. Based on TCCON community suggestions regarding the OASIS system, it would be recommended to use a consistent g-b FTS measurement set up throughout TCCON network so that we plan to fix a constant aperture size at the source compartment during the FTS operation at Anmyeondo station.

Where is the variable aperture positioned? Response A variable aperture is placed inside the OASIS system which is at the source compartment.

Is it in the parallel or focused beam? Response It is a focused beam.

Did you check the influence on the ILS (Instrumental Line Shape) due to the variable aperture while scanning? Response Yes, we assessed the influence of ILS due to the variable aperture and the result showed that it has no impact on the ILS.

I assume a lamp was used and hence the OASIS system was not active while performing cell measurements. Cell measurements using the sun as source might be an option to check the ILS while the OASIS system is active. Or, if the HCl lines in the atmospheric spectrum are covered by interfering species you might do cell measure-

ments with the lamp using different fixed aperture settings to check the influence of the OASIS system on the ILS. How does your system and its influence on the ILS compares with the results of the recent paper by Sun et al, AMT, 2017 on the 'Sensitivity of instrumental line shape monitoring for the ground-based high-resolution FTIR spectrometer with respect to different optical attenuators'? While most of the site complies with the TCCON standard setup the OASIS system does not. Therefore a more detailed description is needed as well as a discussion on its influence on the ILS. Response We have carried out experiments to investigate the influences of ILS due to the presence of OASIS system, and then considered HCl cell measurements using sun as source while OASIS system active and tungsten lamp as a source while OASIS inactive. The result confirmed that the ILS was not affected by the variable aperture during the operation of OASIS system. Sun et al. (2017) reported the detailed characteristics of the ILS with respect to applications of different optical attenuators to FTIR spectrometers within the TCCON and NDACC networks. They used both lamp and sun cell measurements which were conducted after the insertion of five different attenuators in front of and behind the interferometer. In Sun et al. (2017) paper, the ILS result was indicated by considering optical attenuator no .1 which is in good agreement with our findings.

Specific comments: - In Chapter 3.1 the time series of the O2 columns is compared with atmospheric pressure. Therefore including surface pressure in Fig. 8 might support your statement. Response The time series of surface pressure is included in bottom panel of Fig. 8 and compared with the time series of O2 column.

- The errors are shown in Fig. 9. How is the error calculated and which sources of errors are included? Response The main sources of errors are; laser sampling error, zero level offsets, ILS error, smoothing error, atmospheric apriori temperature, atmospheric apriori pressure, surface pressure, and random noise. The total error is then computed from the sum of each error components.

- Can you specify 'regular cell measurements'? Response Regular cell measurements

are conducted one time approximately in every month.

Technical comments: - p.1 + 12: were generally agreed => generally agreed . . .,both instruments generally agreed in capturing seasonal variations of the target species. . .. - p.2: space born => space borne . . .a number of instruments deployed in various platforms (e.g., ground-based, space-borne). . . - p.3: area is; => area is: . . ...climatic condition of the area is: the minimum temperature. . ... - p.4: with oil-free => with oil-free pump . . ..FTS is kept at 0.1 to 0.2 hPa with oil-free pump to maintain the stability of the system. . .. - p.5: beamspliters =< beamsplitters In Table 1. Beamsplitters

- p. 7: to these derived => to those derived (?) . . .mole fractions were used only to those derived (?) below the solar zenith angle. . . - p. 9: - orbit, devoted => orbit. It is devoted launched on July 2, 2014 into low-Earth orbit. It is devoted to observing - can available => is available . . ..instrument is available in different papers. . .. . . - p.10: are varied => varied . . .column amounts varied . . .. - p.11: - over the land => over land . . .the OCO-2 data over land within. . .. - square => squares ..RMSE - Root Mean Squares Error. . ..

- p.12: - and this suggesting => suggesting . . ..OCO-2, suggesting that the variability. . ... - new page within Table 4 p.13: - the source and sink of them. => their sources and sinks. . . .for investigating their sources and sinks. . .. . . - outcome this => outcome of this Therefore, the outcome of this study reflects. . ... - Is ‘: : : to be withered that turns out to be weak photosynthesis : : : a grammatically correct sentence? . . ... weak photosynthesis phenomenon is occurred because of low plant flourishing and CO2 reaches the highest values. . .. . Interactive comment on Atmos. Meas. Tech. Discuss., doi:10.5194/amt-2017-88, 2017.

Please also note the supplement to this comment:
https://www.atmos-meas-tech-discuss.net/amt-2017-88/amt-2017-88-AC1-supplement.zip

Interactive comment on Atmos. Meas. Tech. Discuss., doi:10.5194/amt-2017-88, 2017.

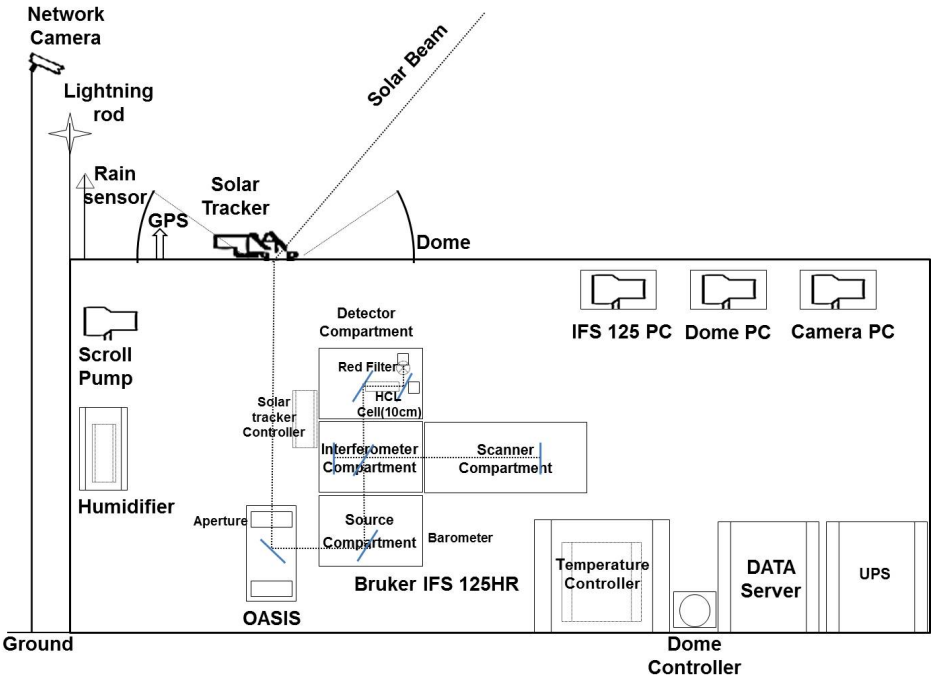

Fig. 1. Photographs of the automated FTS laboratory.

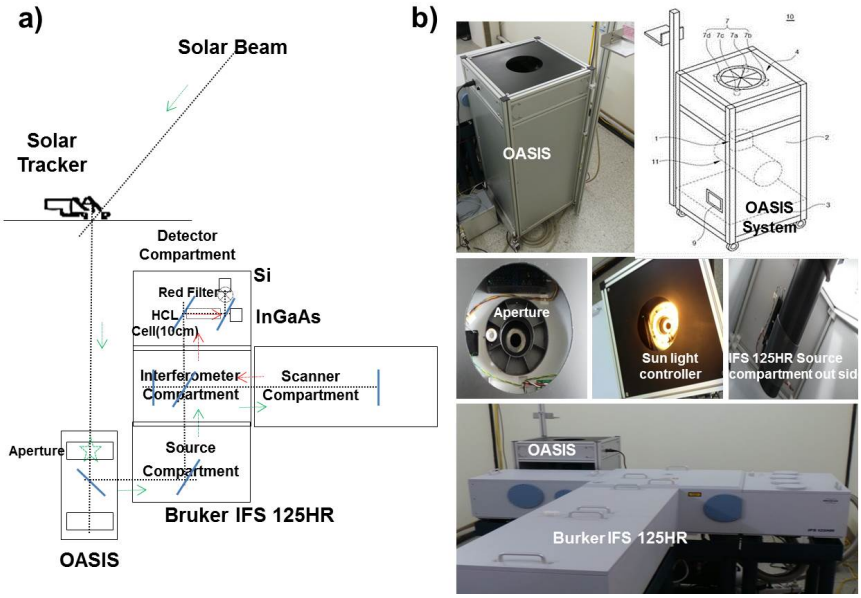

Fig. 2. Schematic views of the OASIS system.

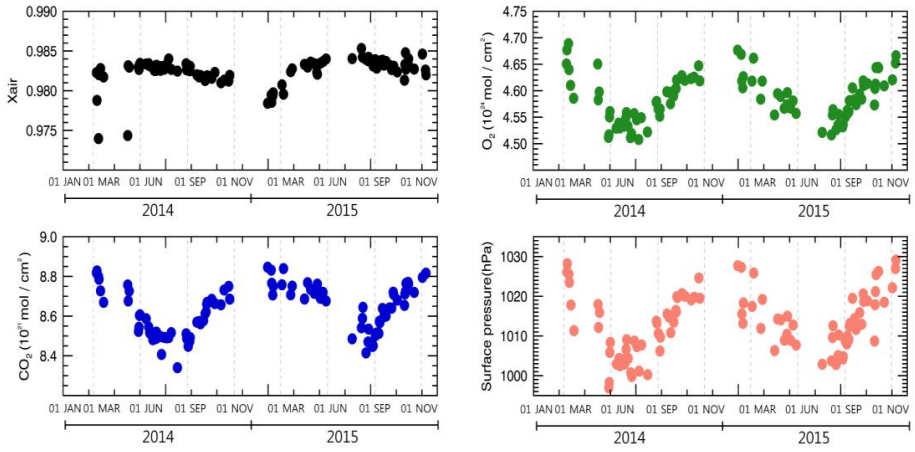

Fig. 3. Time series of Xair, CO2, O2, surface pressure from the g-b FTS

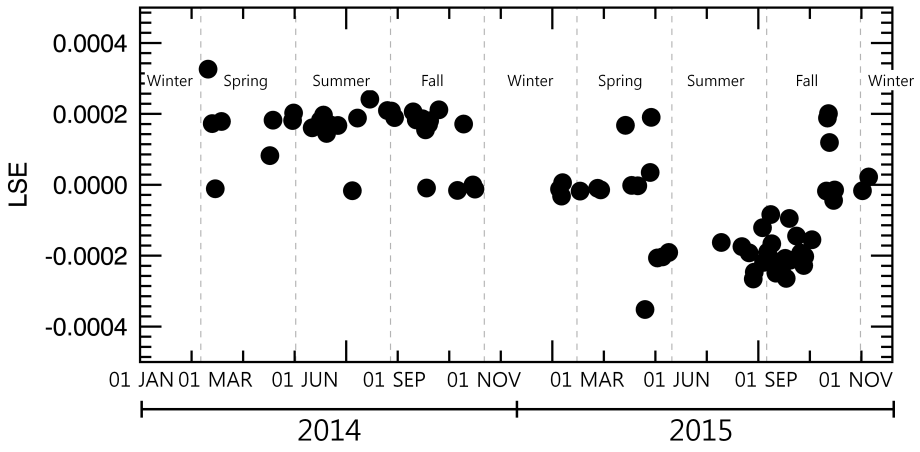

Fig. 4. reference fig 1.

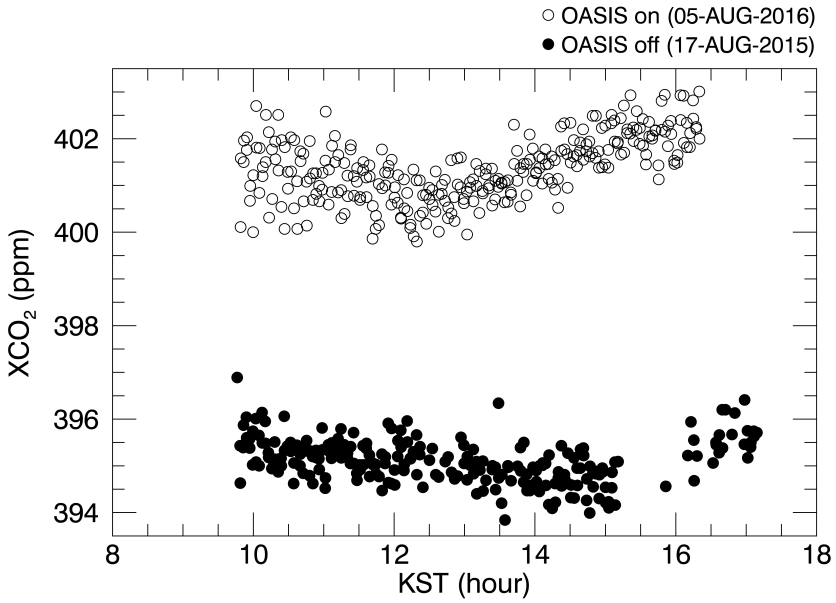

Fig. 5. reference fig 2.