Measurements of atmospheric CH_4 and CO_2 column averaged concentrations in Sichuan Basin, China using a desktop optical spectrum analyzer

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INTRODUCTION

In accordance with the global warming problem is increasingly stringent, in order to evaluate the emission reduction effect as the emissions of greenhouse gas properly, and, to be able to provide the action of the verification and improvement in satellite observation data, which can be portable analysis of the development and data observation device has become most important. In this study, We have measured atmospheric CH_4 and CO_2 column averaged concentrations in Sichuan Basin using a desktop optical spectrum analyzer (OSA) and a portable sun tracker. Solar absorption spectra in the regions of 1673–1679 and 1569–1575 nm were measured for the CH_4 and CO_2 rotational lines, respectively, from September to November in 2013. The obtained column average values of CH4 (XCH_4) and CO_2 (XCO_2)are compared with the results of GOSAT and TCCON observations.

STUDY AREA AND INSTRUMENTAION

- The previous research show that the spatial distribution of GOSATXCH_4 is abnormal high XCH_4 values can be seen in the Sichuan Basin [1,2,3]. Therefore, we conducted ground-based observation of XCH_4 and XCO_2in Sichuan Basin (Yanting, E105.45° N31.27°) (Figure 2).
- The primary components of the proposed ground-based concentration observation system are shown in Figure 3.
- Here a nonlinear least squares method is used to fit the simulated atmospheric optical thickness with the measured optical thickness iteratively before the optimal solution of the measured gas concentration is derived.

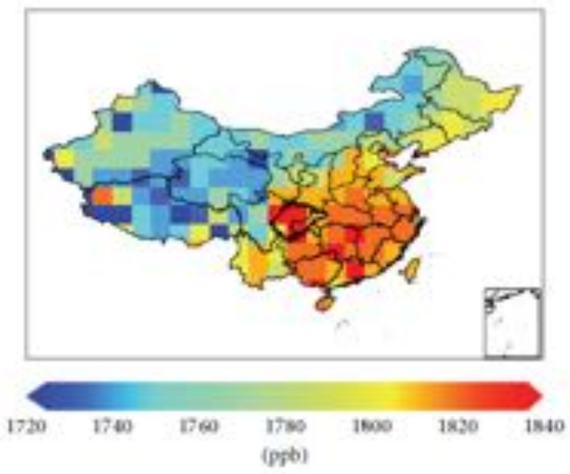

Figure 1. The Sichuan Basin (black line polygon) presents the highest XCH_4 concentration in China.

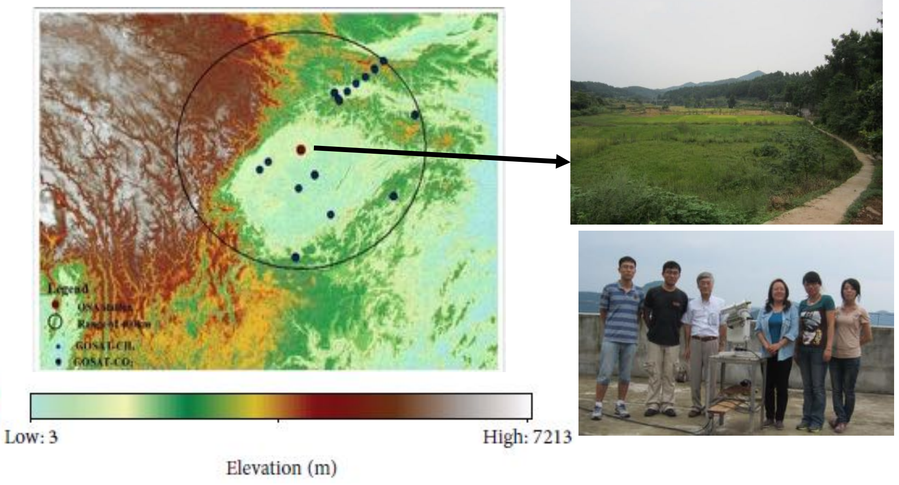

Figure 2. Selected GOSAT data (blue point) within range of the observation center 400 KM and altitude less than 1KM from September to November in 2013.

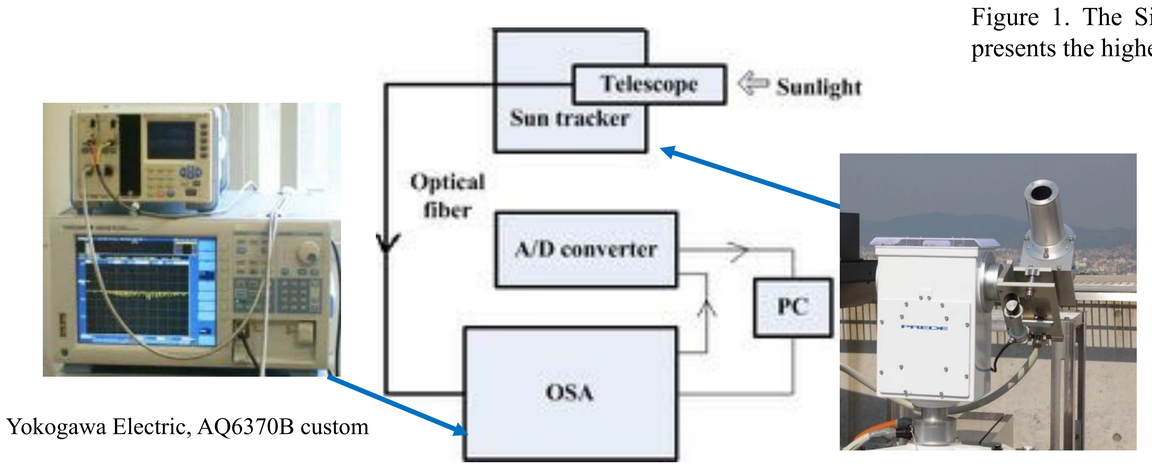

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Figure 3. Diagram of the instrument architecture.

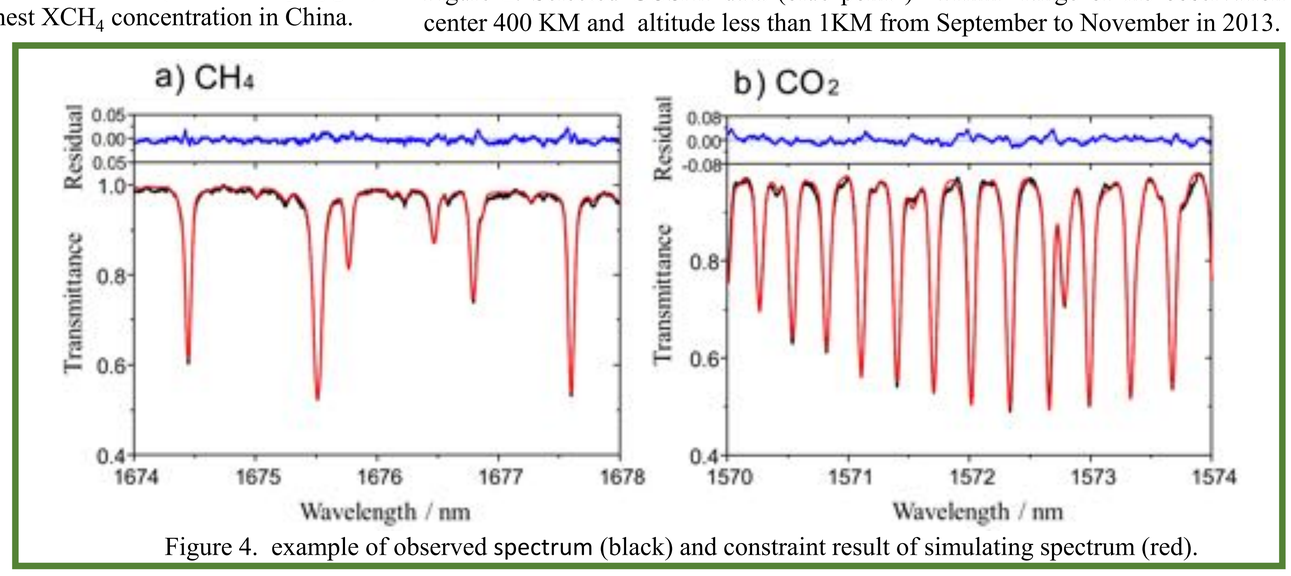


Figure 4. example of observed spectrum (black) and constraint result of simulating spectrum (red).

RESULTS

- The GOSAT data within range of the observation center 400 KM and altitude less than 1KM (Figure 2) is chosen to compare with values XCH_4 of and XCO_2 of OSA . The results shown in Figure 5.
- The seasonal variations of CH_4 and CO_2 is consistent with GOSAT , Observing the same date, the daily averages difference of XCH_4 and XCO_2 were -0.028ppm and 0.38ppm respectively (Table1).
- The same observation days, observations OSA variation is relatively stable (Figure 6).
- The TCCON LAMONT (Figure 7) in The corresponding same latitude zone for Comparison of XCH_4 and XCO_2 variation. The seasonal variations of CH_4 concentration higher than TCCON (Figure 8(left)), The seasonal variations of CO_2 is consistent with TCCON except September (Figure 8(right)).

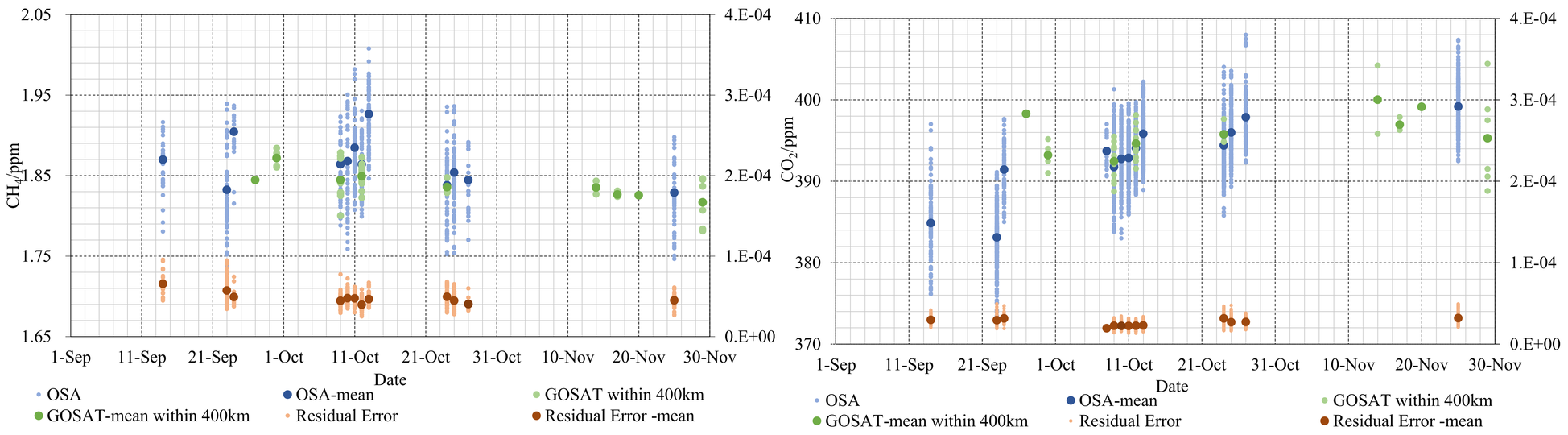
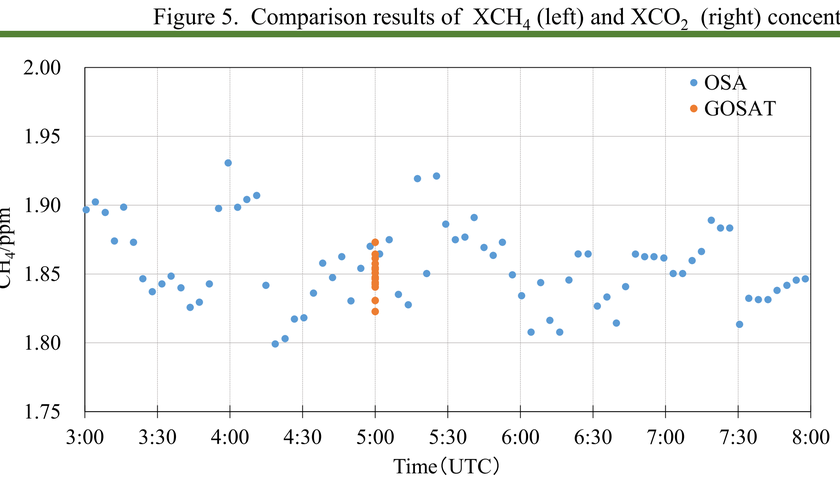


Figure 5. Comparison results of XCH_4 (left) and XCO_2 (right) concentration of OSA with GOSAT from September to November in 2013

Table 1. OSA and GOSAT CH_4 (top) of and CO_2 (bottom) column average concentration of the average daily value

Date	OSA mean/ppm	GOSAT mean/ppm	OSA－GOSAT/ppm
10/9	1.833	1.845	-0.011
10/12	1.833	1.849	-0.016
10/24	1.807	1.836	-0.028

Date	OSA mean/ppm	GOSAT mean/ppm	OSA－GOSAT/ppm
10/9	394.243	392.467	1.776
10/12	396.576	394.635	1.941
10/24	396.153	395.774	0.380



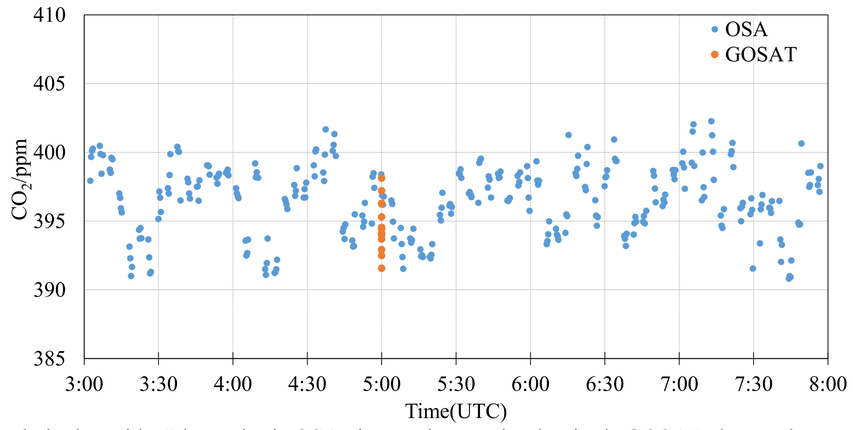


Figure 6. The same observation days(October 12, 2013), observations OSA variation is relatively stable. Blue point is OSA observations and red point is GOSAT observations.

Figure 7. Location of LAMONT (green) and the OSA observation site (smile)

CONCLUSIONS

The results show, OSA means and the calculated results to a certain extent can already be trusted. The results of the paper have important reference value to develop ground movable greenhouse gas observation device and Improve its concentration calculation program. This result is expected to apply to inversion of other air pollutants concentrations.

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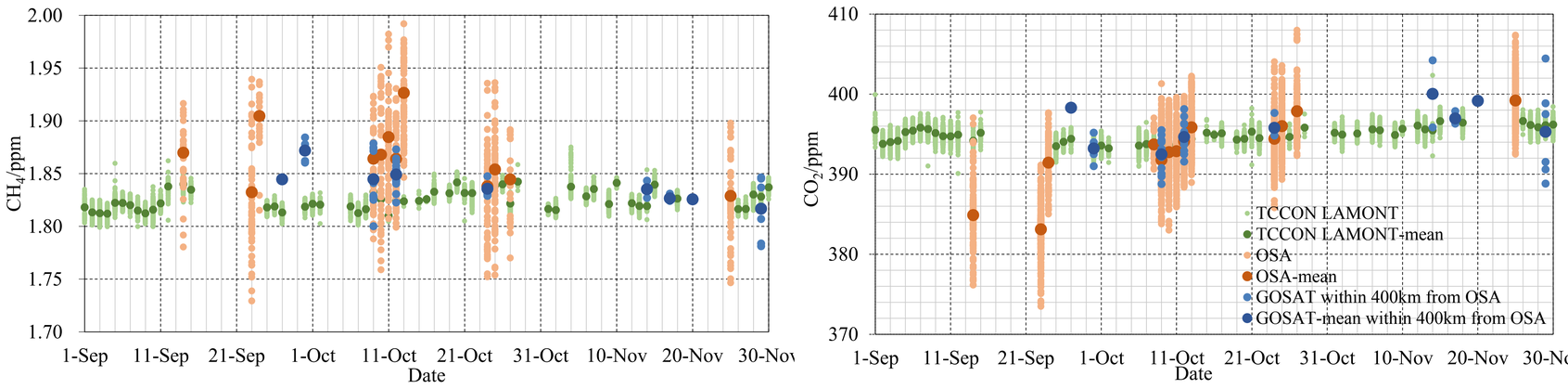

Figure 8 Comparison results of XCH_4 (left) and XCO_2 (right) concentration of OSA with TCCON LAMONT in the same latitude zone from September to November in 2013

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