Response to Reviewer 2

Jia Chen

Manuscript Title:
"Differential Column Measurements Using Compact Solar-Tracking Spectrometers"

We would like to thank reviewer 2 for carefully reading the paper and giving helpful comments.

Below, the reviewers' original text is included in typewriter font. The answers are highlighted in blue, sans-serif fonts.

`In Fig. 2 results of different days of observation are presented. To compare results obtained with different retrieval codes the same days should be presented for both cases. Side by side measurements were conducted over many months, but just a few days are presented in this paper.`

Thank you for this comment. Now the same days are presented for GFIT and PROFFIT to infer the mean calibration factors: three days in Boston and five days in Pasadena.

The side-by-side measurements are conducted since August 2014. For clarity reasons, we chose 8 days for deriving the calibration factors that are used for the field study.

The modified figures please find below:

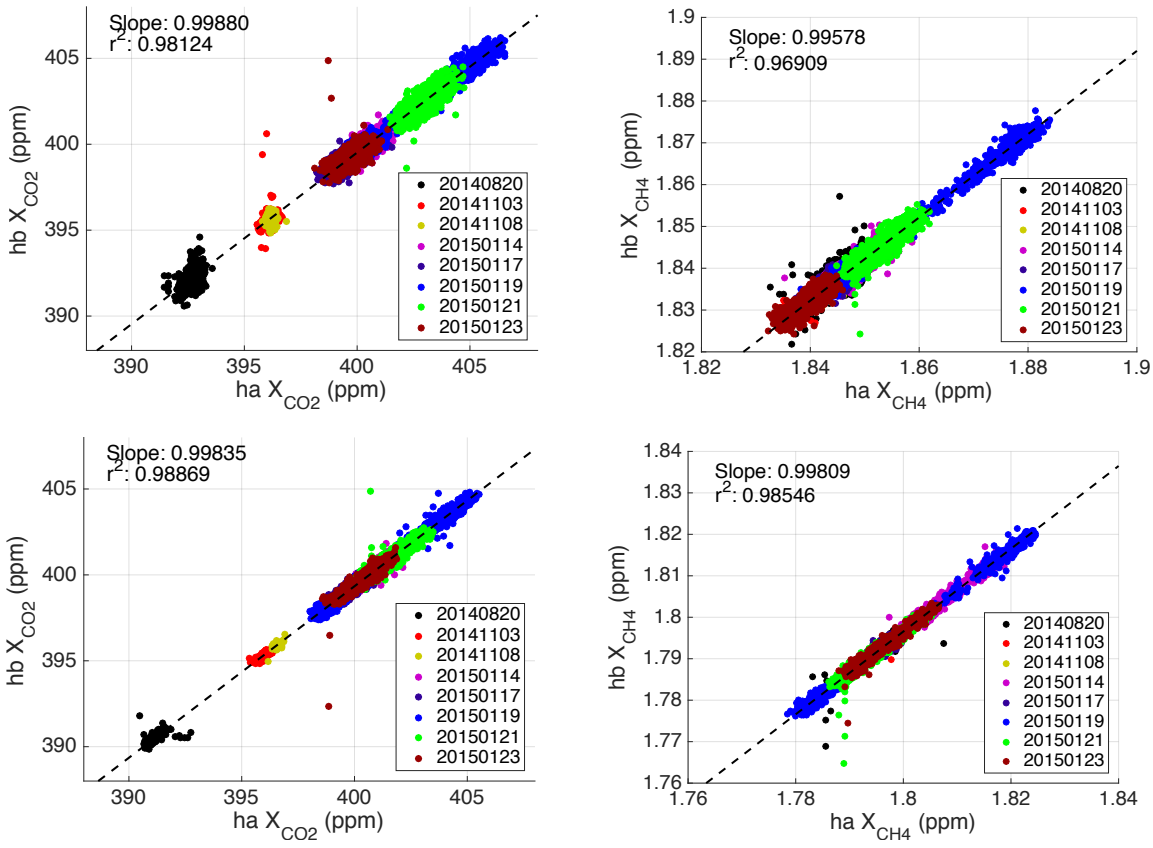

Figure 1: Scatter plots with the slopes representing $\overline{R_G}$ for different days using I2S/GFIT retrieval (top panels) and PROFFIT retrieval (bottom panels). January measurements are carried out in Pasadena, others in Boston. The first four days are before the field study, others are during the campaign.

In the time series of the upwind site a transient peak is observed (Fig. 3). When the up- and downwind sites are located along the trajectory a downwind peak should be present as well? Such peaks travelling from up- to downwind site may provide a proof of sampling the same air mass.

We thank the reviewer for the very useful hint. Yes, we think the transient peak is also observable at the downwind site, but much weaker probably due to dispersion. More discussions are added in Section 4.3.2:

Transient Peak at Chino

Not only for side-by-side measurements, but also in the field measurement, short term peaks are observed, as mentioned in Sec. 4.1. Transient peaks are moving from the upwind to the downwind site: they are observable at upwind site hb between 0.1 and 0.7 hours after solar noon, and at ha between 0.5 and 1.1 hours after solar noon (Fig. 2). They are not observable at pl site, probably because the plume is very narrow. Compared to the upwind peaks, the downwind peaks have a time shift, and are weaker and broader due to air dispersion. The peaks travelling from upwind to downwind site along the trajectory provide a proof that the same air mass is sampled.

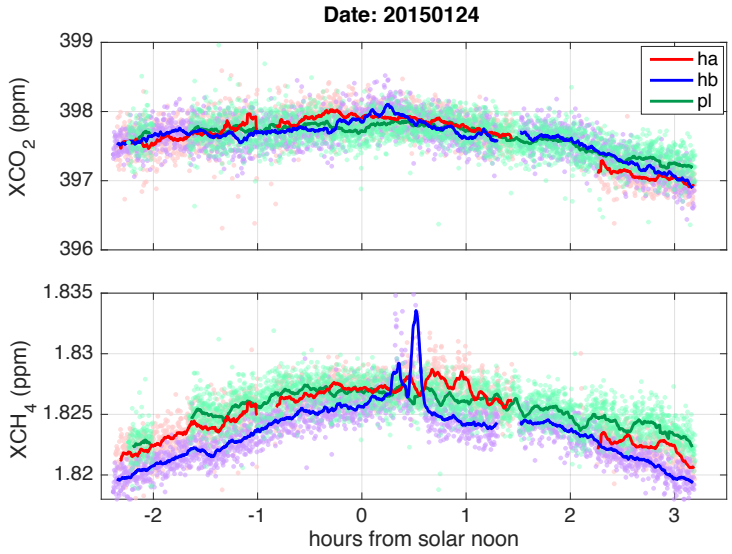

Figure 2: Observed column differences ΔX_{CO_2} (upper panel) and ΔX_{CH_4} (bottom panel) on 24 Jan. 2015, the transient peaks in X_{CH_4} are not observed for X_{CO_2}.

The transient peaks are not observed in X_{CO_2}, indicating they are not caused by passing clouds, or from a powerplant. They may come from natural gas leaks from the pipelines in the Chino area, with some evidents being reported by environmental defense fund (EDF (2016)). The transient peaks are removed from the column difference study (Sec.4.1), because they are not associated with the local dairy farms.

Table 3 lists the calibration factors for the spectrometers. I recommend to include these factors for side by side measurements performed before and after the campaign. In order to show the stability of the instruments these factors obtained before and after the campaign should be discussed and compared with those presented by Frey et al., 2015.

Thanks for this comment. We add Tab. 1 to the paper and list the calibration factors before and during the campaign. After the transport after the campaign, one screw for the flipping mirror was loose for ha and we opened the instrument to fix it, which might have changed the instrument behavior and resulted in a slightly different calibration factor. Since it is a technical problem, not representative for the overall behavior of EM27/SUN and differential column measurements, we decided to not report the calibration factors after the campaign in the paper.

The added table please find below:

	$\overline{R_{CH_4}}$		$\overline{R_{CO_2}}$	
	GFIT	PROFFIT	GFIT	PROFFIT
Before	0.99575	0.99812	0.99878	0.99838
During	0.99580	0.99808	0.99880	0.99834
Both	0.99578	0.99809	0.99880	0.99835

Table 1: Calibration factors $\overline{R_G}$ for X_{CH_4} and X_{CO_2} before and during the field campaign, determined by forcing linear regression line go through zero. $\overline{R_G}$, determined using all data, are provided in the last row and used for the field study.

References

EDF: Natural gas: Local leaks impact global climate, https://www.edf.org/climate/methanemaps, last visited 22 May 2016, 2016.