

## ***Interactive comment on “Comparisons of CH<sub>4</sub> satellite GOSAT and ground-based FTIR measurements near Saint-Petersburg (59.9 N, 29.8 E)” by N. M. Gavrilov et al.***

**Anonymous Referee #4**

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My original comment should have been posted on September 30, but I failed to do it because of my failure due to my lack of experience of interactive discussion. After reading all referees' comments and authors' replies to those comments dated on October 26 (but not revised manuscript), I found some problems in the paper and authors' opinion as below.

Major comments

1. The aim of this paper is not focused clearly. I cannot read if the authors intend

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to validate satellite data using a reliable ground-based instrument, or to compare two equivalent instruments, GOSAT TANSO-FTS and FTIR of SPbU. In this paper, the authors cite many papers on GOSAT validation, and therefore, their aim looks like adding another validation of GOSAT data at high latitude using a reliable ground-based instrument. However, the authors replied to Referee #2, “Indeed, one of goals of our paper is not “introduction”, but “validation” of Saint-Petersburg measurement site.” I do not think it is good way to validate a ground-based instrument by using satellite data, because satellite measurements could contain more uncertainties and assumptions than ground based measurements. In particular, I do not agree to their opinion “the GOSAT data seem to be better validated than Saint-Petersburg ground-based measurements.” As also mentioned by the authors, no TCCON site is at higher latitude than 55 degrees, which means that no GOSAT data have ever been validated at higher latitudes than 55 degrees. I think the most (and almost the only) merit of this paper is to validate GOSAT data at such high latitude.

I recommend the authors should state possible uncertainty of FTIR measurements first and then interpret the difference between FTIR and GOSAT data as uncertainty of the GOSAT retrievals. I believe satellite data should have more uncertainties than ground-based measurements. Actually, in the last paragraph of section 2, the authors described that the random relative errors of individual XCH<sub>4</sub> measurements by FTIR do not exceed 0.3–0.5%, which is much better than the errors of satellite measurements. If the authors are concerned with possible difference between their FTIR and TCCON instruments, they should discuss on it clearly in this paper.

2. The authors mentioned in discussion section as follows: “One should keep in mind that these measurements are carried out near the Saint-Petersburg megalopolis, so the total methane variability there might be higher than that for background measurements.” I recommend the authors should describe the condition of their FTIR site in the introduction section, so that readers can understand the situation better.

In addition, the authors should add more discussion on differences of XCH<sub>4</sub> ( $\delta\text{XCH}_4$ )

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that could be originated from the methane emissions from surrounding areas. Most of GOSAT validation studies have been carried out at the background regions so far. However, comparison studies at the emission regions are very important to verify the inverse analysis of methane budget using GOSAT measurements. Discussion of the effect of methane emission on this comparison would be very informative for researchers doing inverse analysis. This is, I think, another advantage of this paper, because methane emission from Arctic region has lately attracted considerable attention.

On the other hand, the regions where the emissions affect on ambient methane concentration, comparison of measurements at different times is difficult because of large variability of XCH<sub>4</sub>. As Makarova et al., (2006) reported, the site of FTIR-SPbU can be affected by methane emissions from surrounding urban areas and wetlands, then the authors must investigate the range of permissible time difference and distance more carefully. The distance of +/- 3 degrees in latitude and longitude is quite large. Careful discussion is needed on the surface conditions and possibility if those areas are related to methane emission sources or not. One idea to confirm the effect of such variability is to identify which data pairs were obtained on the same day or with 2-day-difference in Figure 2 by showing them in different symbols. Then it is possible to confirm if the difference of XCH<sub>4</sub> depends on the time difference of the two measurements.

3. I have checked the GOSAT V1 and V2 retrievals in the vicinity of Saint-Petersburg. I found V2 data are also available on 2011-04-25 and 2011-09-06, though the authors include only V1 data for those days (Table 1). As the V2 data on both days are open for all general users (GU), they should be included in the analysis. As the retrieval algorithm has been revised thoroughly in V2 (Yoshida et al, 2013), comparison with V1 data is not recommended at present, though only V1 data are available for some period (e.g., April 2009).

In my original comment dated on September 30, I included some minor/technical comments, most of which are the same by other referees, and the authors have already replied to them. Then I would not add any more comments on technical problems.

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Interactive comment on Atmos. Meas. Tech. Discuss., 6, 7041, 2013.

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