

Review of Gavrilov et al: *Comparisons of  
CH<sub>4</sub> satellite GOSAT and ground-based  
FTIR measurements near Saint-Petersburg  
(59.9° N, 29.8° E)*

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The manuscript presented by Gavrilov et al. discusses comparisons of retrievals from ground-based mid infrared (MIR) fourier transform spectra using solar absorption spectroscopy, with those retrieved from the space-based instrument, GOSAT. The main conclusion seems to be that the ground-based data from the Saint-Petersburg (Peterhof) site “could” agree with the GOSAT data. The manuscript introduces a site that could potentially provide interesting information for satellite validation, especially for methane. It does, however, seem to be undecided somewhat as to its focus. To be published in AMT, the “measurement technique” should be clearer - if the goal is to introduce the site (which I think would be sufficient and interesting for AMT), then this should be addressed in the abstract and title. Otherwise, there is nothing particularly novel about what is presented compared to other stations making NDACC style measurements. I could envisage the paper being published in AMT with a more clearly expressed scientific aim and emphasis on what about this study and/or site is novel.

## General Comments

- As discussed above, I feel that the paper lacks a clear focus and novelty. This needs to be clarified.

- There is a considerable amount of discussion and presentation of the differences between the satellite and ground-based  $X_{CH_4}$  values that reads largely like a review of previous work. I feel that the value of your site could be examined in more detail by assessing something like inter-algorithm differences (from the GOSAT retrievals).
- I'm missing a reference in your discussion to Sussmann et al, 2013 - regarding comparisons between MIR and NIR  $X_{CH_4}$  retrievals - something that is especially relevant considering previous published GOSAT comparisons focus on TCCON NIR data and you are presenting retrievals from the MIR. I realise you cite this paper in the introduction, but you never describe what it means for your work.
- In fact the whole GOSAT validation literature review seems to have recent work simply appended to a previously written section referring to GOSAT V01.xx. While it is interesting to know what has changed between V01.xx and V02.xx at your site, and you should refer to how these differences compare to the rest of the globe (or at TCCON sites), I feel that the focus should be on the latest (and presumably best) product.
- p7042, 19: "could agree" - this seems to be quite a weak conclusion of the work. What is perhaps more interesting is not whether or not they agree, but rather whether or not they can add additional value for GOSAT calibration or validation. The manuscript would be strengthened by taking this focus. It would require more assessment of the potential differences between Saint Petersburg and other sites currently used for GOSAT validation.
- I would also like to see comparison of the Saint Petersburg measurements to model simulations, though I could be convinced that this is indeed outside the scope of the paper and leave this up to the editor to pass judgement.
- While the paper reads generally quite well, there are still some minor English language problems. I have endeavoured to highlight these in the technical comments, but a final proof-read by a native speaker would probably still be useful.

## Technical Comments

- The title needs rewording. Something more like “Comparisons of CH<sub>4</sub> measurements from GOSAT and ground-based FTIR near Saint Petersburg (59.9N, 29.8E)” would sound better. Alternatively, to bring the focus on to the measurements described here, you could phrase it “CH<sub>4</sub> measurements near Saint Petersburg from a ground-based FTIR, and their comparison to GOSAT”.
- p7042, l5: “-13ppb less” - this is a tautology. Lose the minus sign.
- p7042, Intro: Numerous instances where acronyms need to be defined at their first use, rather than later.
- p7043, l2-3: the parties responsible for GOSAT also include the Japanese ‘Ministry of the Environment’ (MOE).
- p7043, l5: should also mention that these are ‘dry-air’ column average mole fractions.
- p7043-7044, TCCON-GOSAT comparisons: this is an incomplete list of comparisons. The discussion later is much more detailed, and publications such as Butz, Schepers, etc. should also be mentioned here.
- p7044, l9: should mention that the NIES-GOSAT product is compared, otherwise it could be from any (or all) of the algorithms.
- p7044, l19: delete the before optical path differences.
- p7044, l20: ”times of accumulation”? I assume you mean collection times. But in truth, I do not understand what you are adjusting here. Or is the sample rate simply chosen so that a single spectrum with 10 co-adds is collected in 12 minutes?
- p7044, l22: PROFFIT, not PFOFIT. Also, GFIT is not exclusively for TCCON - it can and does also do some MIR retrievals for NDACC.
- p7044, l23: interpreting → interpretation (or better still would be a description of what the algorithms do - i.e. that they retrieve atmospheric column gas abundances via fitting the spectra...)
- p7044, l27: again, remove ‘the’ at the end of this line

- p7045, l4: consequent → subsequent?
- p7045, l8: Peterhof → Peterhof's
- p7045, l10: retrieving → retrieval
- p7045, l10-11: rearrange to "...are taken from Voejkovo, the nearest site of upper air soundings located 50km eastward of Peterhof"
- p7045, l13: at → by
- p7045, l19: "a long time" sounds strange to me. Maybe say "that have been recommended in the NDACC documentation for many years". A reference to back that up would be nice, however. Also here it should be mentioned that two of the microwindows used are shared between the Sussmann and Sepulveda approaches.
- p7045, l21: According to → Following
- p7045, l28: 'spectra series'? What does this mean? Also, it would be nice to see some evidence for your statement that variations do not generally exceed 1%. Perhaps a figure focussing on a short time series of retrievals.
- p7046, l10-13: either a formula or a reference for how the adjustment to dry-air would inspire confidence.
- p7046, l13: "European Centre" is redundant (the EC from ECMWF stands for European Centre').
- p7046, l15-17: Have you considered trying to obtain co-incidences using a dynamic tracer, such as potential temperature? Or increasing matches by requesting additional processing of GOSAT spectra by NIES?
- p7046, l23/Table 1: Table 1 should include the number of spectra (both GOSAT and ground-based) within each day, and shortly define that your differences are GOSAT - ground-based.
- p7047, first paragraph: I find it interesting that the GOSAT retrievals (V02.xx) show less variability than the ground-based retrievals. In fact, there seems to be minimal temporal variability in the GOSAT

values over the whole time series. On the other hand, the ground-based (SPB) retrievals have several days with extremely low  $X_{CH_4}$ , like 2010-04. Have you investigated whether there are any prevailing conditions or reasons for this? While the long-term variability in the GOSAT data seems smaller, Figure 2 seems to suggest that in 2010 and 2012 the GOSAT scatter is at least as large as that from the SPB data. Have you thought about including some measure of shorter-term 'reproducibility', such as daily or weekly standard deviations?

- p7047, l9: How does the variability compare to desired figures necessary for satellite validation?
- p7047, l27: respective  $\rightarrow$  with respect (or relative)
- p7048, l6: ground-based is missing the final 'd'
- p7048, first paragraph of discussion: The argument for compatability of SPB with TCCON is somewhat weak. How does TCCON relate to the aircraft measurements to which you refer?
- p7049, l6: fraction  $\rightarrow$  fractions
- p7049, l13: There should be a 'The' at the start of the sentence.
- p7049, l20: emission  $\rightarrow$  emissions
- p7049, l17-23: given that local urban emissions could contribute 2% enhancement to the column, it's surprising that there seem to be unusual low days. Also, have you tried filtering for the data that are influenced by local emissions (by wind direction or enhancements in other gases)?
- p7049, l24-27: an order of magnitude is pretty large. How much do the biases vary when using different co-location criteria? How are the number of coincidences affected?