Atmos. Meas. Tech. Discuss.,
doi:10.5194/amt-2018-193-RC2, 2018

Atmospheric Measurement Techniques Discussions

Interactive comment on "On sampling bias adjustment for sparsely observing satellite instruments for the example of carbonyl sulfide (OCS)" *by* C. Kloss et al.

Anonymous Referee #2

Received and published: 19 October 2018

The paper is dedicated to important issue: sampling bias adjustment of satellite measurements with a sparse sampling pattern, for the creating climatology. The method for the sampling bias correction based on regression model is developed and applied to the carbonyl sulphide measurements by ACE-FTS.

MAJOR COMMENTS

1) The assumptions of the applied method are not discussed sufficiently. The method uses an assumption that the spatio-temporal pattern can be represented by a smooth Fourier-Legendre expansion, the same for all years. This approximation is significantly simpler than, e.g., CTM simulations or a real evolution. Associated uncertainties should

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be at least mentioned.

2) The advantages of the developed method are not demonstrated convincingly. In particular, evaluation using MIPAS data might be done in a more proper, from my point of view, way. In the present manuscript, the authors compare the histograms in 60-90S from 12 years on ACE-FTS measurements with those from 2 years of MIPAS measurements and conclude that the sampling bias correction improved climatology because histograms are similar. This is not very convincing, from my point of view.

A more proper way would be: select from the MIPAS measurements (the full dataset) a subset corresponding the ACE-measurements approximately, and apply the sampling bias adjustment described in the paper to this subset. Then compare the climatologies from the ACE-subsampled MIPAS dataset with and without sampling bias adjustment to the climatology from the full MIPAS dataset. Such evaluation would demonstrate the advantages and potential problems of the proposed method. In particular, the following can be studied/illustrated:

- Quantitative assessment of the sampling bias adjustment

- Changes in variability and trends (or their absence) due to sampling bias adjustment (see also minor comment #6)

- Changes in seasonal cycle

3) For evaluation of the method, it would be useful to compare the regression fit of ACE-FTS data shown in Fig 1 b with the analogous morphology using the MIPAS data.

4) The Section 4.3 , “Significance”, with the first sentence starting with “To investigate the scientific relevance and applicability of the proposed sampling bias adjustment. . .” is expected to be a more deep analysis of the sampling bias correction. However, in the paper, the difference between adjusted and original datasets at 60-90°S are compared, without demonstration that the sampling adjustment improves the data record.

In particular, P.8, L.14: “There is a marginal impact on the amplitude of the seasonal

cycle" – Add quantitative values, please. Demonstrate that this is an improvement (by comparison with MIPAS, for example).

L. 15: "No significant trends are apparent in either the original or adjusted data" add quantitative estimates, please (here or in Fig. 6).

The statements at the end of the Sect 4.3. "Theoretically, ..." related to changes in trends are not evident, especially taking into account that your sampling adjustment uses only on latitude and day of the year, i.e., it does not have a temporal dependence. The changes in trends need a more detailed analysis/discussion.

MINOR COMMENTS

1. Title of the paper needs a revision, from my point of view. It can be simply : "On sampling bias adjustment for sparsely observing satellite measurements", or "Sampling bias adjustment for sparsely observing satellite measurements with applications to ACE-FTS carbonyl sulphide measurements" or "On sampling bias adjustment for sparsely observing satellite measurements using regression modelling", or similar.

2. P.2., lines 18-19: Authors state: "To our knowledge, to date, no method has been reported where the quantification of a sampling bias, and the adjustments made to correct for it, does not require additional independent information."

It seems to be impossible to make a sampling bias correction without an additional information. It should not be confused here: the proposed method also relies on the additional assumption (information) that the spatio-temporal evolution can be developed into the regression model (Eq.1).

3. P.3, lines 16-17: "Partial columns are then accumulated into 1° x 1° bins over the chosen time period (e.g. one season: DJF, MAM, JJA, SON)". Is this the method for creating your climatology? Please clarify. Also the next sentence "Values for bins with no profiles are linearly interpolated or, close to the poles, are extrapolated from the two bins closest to the respective pole" seems to be in the contradiction with the method

described later in the paper. So, please describe the climatology in more detail: in particular, its spatial and temporal resolution, averaging method etc.

4. P.4, Eq.(1). I think it is worth to mention that you are characterizing the climatologic features only, not the temporal evolution.

Since you state that the method can be applied not only to OSC, I suggest changing variables in equations to more generic: i.e., Xest, Xorig etc.

5. P.5, Eq.(2) and the text: your model for fitting is the average in zones, while you refer to OSCest (lat, long, t). Please correct or explain.

6. P.5, lines 20-21: "The advantage of applying Equation (2) rather than simply using OSCEst as the zonal mean seasonal mean is that trends and year-to-year variability observed in the data set remain" This is not evident and needs to be shown. Since the sampling adjustment modifies the values, the trend and the variability can change. This can be evaluated/justified using the approach suggested in Major comment #2.

7. P.8, line 14. "Figure 5" Do you mean Figure 6 here?

8. P.9., last sentence: "...the influence of the sampling bias is too small to significantly alter the scientific conclusions of climatologies". What do you mean by "scientific conclusions of climatologies"?

9. P.13, Figure 2. I guess, the title of the right panel should be simply "Regression model output"

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