

# Review of : "Retrieval of SO<sub>2</sub> columns from FY3F/OMS instrument observations" by Huanhuan Yan et al.

## Overview

This work describes SO<sub>2</sub> column retrievals for the Ozone Monitoring Suite (OMS) onboard the Chinese FENGYUN-3F (FY-3F) satellite. A detailed description of the retrieval algorithm is provided, along with data samples and comparison with TROPOMI SO<sub>2</sub> data. Retrieval error sources are also discussed and future improvements for the retrieval algorithm are outlined. Better spatial and temporal coverage for satellite SO<sub>2</sub> monitoring is important for the scientific community, making this work highly relevant.

The description of the retrieval algorithm is quite detailed and clear. A thorough discussion on the choice of spectral windows is also included. The authors provide many samples of retrieval, that are compared with TROPOMI data. In my opinion, parts of the manuscript (e. g. the spectral window discussion and some of the comparisons with TROPOMI) are overly technical and seem to focus on documenting all the work done on OMS SO<sub>2</sub> retrievals to date, rather than providing a comprehensive discussion of data quality and algorithm evaluation (see general comments and specific comment #1).

The main text of the paper is clear and well-written, but it sometimes contains lengthy technical discussions that could perhaps be summarised for clarity. Figures are generally of good quality, but but some of them do not seem to fully comply with journal standards. I also feel that some of the figures could be combined or removed to provide a better focus on the main points the authors are trying to make (see general comments #4 and #5).

In general, I can recommend this manuscript for publication subject to minor revisions.

## General/major comments

1. **Treatment of missing retrieval data.** It is understandable that the test retrievals can fail to produce valid data in certain circumstances for certain areas. However, I find the treatment of this missing data in the manuscript to be rather odd. The authors take great care to document the technical nature of missing data in retrieval output (e.g. they explicitly state how "nan values" and fill values are represented in color maps), which I do not believe to be relevant in a scientific publication. However, in most cases they do not explain why this data is missing, which would be highly relevant, and often essential. These explanations should be added.
2. **Lack of summary/conclusions of agreement between OMS and TROPOMI.** I would have liked to see more clear statements and a summary regarding agreement of OMS and TROPOMI data. The authors provide quite a few possible reasons for differences in SO<sub>2</sub> column values, but do they generally believe that those reasons are sufficient to explain the differences? How do these differences compare to OMS and TROPOMI error estimates? Also, although error analysis was discussed in detail, a clear representation and discussion of the resulting error values seems to be missing.
3. **Details mostly relevant to future work.** I am not quite convinced that the rather long Section 5.2 should be included in the manuscript in its current form. As far as I understood, the retrievals presented in this paper were performed using the highly simplified AMF as described in Section 3.5. Section 5.2 introduces a much more advanced AMF treatment which was not used in the rest of this work (unless I missed something?). While these results do offer some insights into the uncertainties of the simple AMF implementation, the entire Section 5.2 seems to be focused on the Box-AMF which is envisaged to be much more than just means of error analysis for the simple AMF used here. Therefore, I would suggest to either remove the whole

discussion of Box-AMF, leaving it for future publications, or introduce it properly as one of the main methods, rather than just means of error analysis as the current manuscript structure seems to suggest.

4. **Amount of figures.** The manuscript contains a number of multi-panel figures that result from repeating the same analysis on different areas (or different spectral windows, etc.). This results in a large number of multi-panel figures, not all of which are adequately discussed in the main text (e.g. specific comment #1). I would suggest to remove some of the figures (or panels in the figures) to keep the focus on the details that the authors actually want to discuss.
5. **Some figures do not conform to journal standards.** Some figures span multiple pages and have no labels for panels. As far as I know, this does not conform to journal standards.

### Minor/specific comments

1. Figure 2: Retrievals from the spectral windows of 325–335 nm and 360–390 nm appear to be complete failures. The authors should comment on why they failed, which would be far more useful than explicitly showing clearly unphysical retrieval results in (already overloaded) figures 2 and 3. The statement that a lot of NaN values were produced by the retrieval is very uninformative in this case.
2. L114: "ISRF exhibits a flat top". Ideally, this should be accompanied by a figure or reference, so that the reader can get a sense of the nature and extent of the problem.

### Minor typos and suggestions

This is a list of typos that I noticed and minor suggestions. Point-by-point replies to these are not necessary.

1. L83-95: This paragraph contains a list of eight points. I think using numbers and/or special formatting would be more helpful to the reader than words like "seventhly".
2. L133: Present tense here would be more consistent with the rest of the paragraph.
3. Figure 4 caption: I would suggest not to provide so many numerical values in a caption, but rather present them in a table, either as part of Figure 4 or separately.
4. L343: The comparison of results from [...].
5. L503: Replace "difficult to be monitored and calibrated" with "difficult to monitor and calibrate".