Atmospheric Measurement Techniques

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Discussions

Interactive comment on "Potential of the TROPOspheric Monitoring Instrument (TROPOMI) onboard the Sentinel-5 Precursor for the monitoring of terrestrial chlorophyll fluorescence" *by* L. Guanter et al.

Anonymous Referee #3

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Manuscript "Potential of the TROPOsphericMonitoring Instrument (TROPOMI) onboard the Sentinel-5 Precursor for the monitoring of terrestrial chlorophyll fluorescence" from Guanter et al. covers an interesting scientific topic relevant for Atmos. Meas. Tech., presents new material and is well written. I therefore recommend publication after the items listed below have been carefully addressed by the authors.

Abstract:

Concerning: "Our results illustrate the enormous improvement in SIF monitoring

achievable with TROPOMI with respect to comparable spectrometers currently in-flight, such as the Global Ozone Monitoring Experiment-2 (GOME-2) instrument. We find that TROPOMI can reduce global uncertainties in SIF mapping by more than a factor 2 with respect to GOME-2 . . .": This statement is based on the assessment of simulated retrievals essentially assuming that the retrieval precision improves with the square root of the number of observations added (i.e., using Eq. (6)). Although reasonable, it is strictly speaking unclear to what extent this is valid. As the authors have published SIF retrievals based on real GOME-2 data I recommend to provide evidence based on real data that Eq. (6) is appropriate to model the precision improvement expected from averaging individual SIF retrievals. If this seems not possible, e.g., due to lack of validation data, this should at least be clearly mentioned (e.g., already in the abstract by adding "Assuming that the precision improves with the square root of the number of measurements added, our results . . .").

Concerning: "Finally, we discuss the potential of TROPOMI to accurately map other important vegetation parameters, such as leaf photosynthetic pigments and proxies for canopy structure, which will complement SIF retrievals for a self-contained description of vegetation condition and functioning.": To my knowledge it has not yet been shown using real satellite data (e.g., GOME-2, SCIAMACHY) that this is possible. I therefore recommend to modify this sentence as follows: ". . . which, if feasible, will complement . . .".

Introduction:

Page 12550, line 3 and following: Concerning "This wide spectral sampling will potentially allow to exploit the information carried by the full SIF spectrum and not only by the longer wavelength peak at the NIR". Existing satellite instruments (GOME-2, SCIAMACHY) also have wide spectral coverage. TROPOMI is not unique here. It is therefore unclear why this should be possible with TROPOMI but not with existing instruments.

2.3 Retrieval random error

Page 12554, line 15: Please check formula for J(alpha) (I guess v_{2-nv} needs to be replaced by v_i). Please also use subscript s in Fs.

Section 3:

Please add (here or later, e.g., when discussing Fig. 8) more information on the difference of the training data set and the data used for the sensitivity studies especially with respect to systematic differences so that the reader can better judge the relevance of the results with respect to systematic SIF errors ("accuracy").

4.1 Estimates of retrieval precision and accuracy

Page 12560, line 26 and following: Concerning "However, despite those biases we consider these results to be of high interest, as they show the potential for red SIF retrievals with TROPOMI.": Again: TROPOMI is not unique here. Are the conclusions supported using real data from existing missions (GOME-2, SCIAMACHY). If not this should at least be clearly mentioned.

4.3 Global estimates of retrieval precision

Page 12562, line 8 and following: Concerning "The results discussed in Sect. 4.1 demonstrate that instrumental noise is the main contribution to the error budget in SIF retrieval for clear-sky observations.": This statement is too strong as no attempts have been made to establish a full error budget. What about various instrument related errors not discussed (e.g., zero-level-offsets, effects of inhomogeneous scenes resulting in slit function variations and other issues) ? Please use a less strong statement here.

5.1 Validation . . .

First paragraph: Are any results available based on real data showing that the indicated airborne measurements can be used for validation? If yes please add the relevant references. If not please state that so far this has not been demonstrated.

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5.2 Towards a global representation . . .

See also my comment on the last part of the abstract: As far as I know it has not yet been demonstrated that this is possible using real data although existing instruments (GOME-2, SCIAMACHY) should also be able to deliver the discussed parameters.

6. Conclusions

Page 12568, line 20 and following: Concerning: "However, this is only a worst case scenario because of the conservative, mission requirement-based SNR curve used for TROPOMI in this study.": I am not convinced that this is "worst case" because of the assumption used with respect to precision improvement with square root of n and because several instrument related errors have not been addressed (see above).

Page 12569, line 24 and following: Concerning: "This includes TEMPO . . . and . . . FLEX . . .". This also includes CarbonSat, which needs to be added, see the assessments reported in Buchwitz et al., Atmos. Meas. Tech., 6, 3477-3500, 2013.

Figures:

Figures 1 and 2: The (very thin) lines are hardly visible in a printout, especially the yellow (and green) lines. Please improve. I recommend to use thicker lines.

Figure 3: Annotation and numbers (radiances? If yes please add units) given on top unclear.

Figure 5: What are "Accesses"? Are these the number of overpasses for a given latitude?

Interactive comment on Atmos. Meas. Tech. Discuss., 7, 12545, 2014.