

Pre-launch calibration results of the TROPOMI payload on-board the Sentinel 5 Precursor satellite, Quintus Kleipool et al., MS No.: amt-2018-25,

General comments

Initial paragraph or section evaluating the overall quality of the discussion paper.

The paper is well written and of good quality, with a considerable number of new interesting topics and techniques, and shall certainly be published.

There remain a number of issues that I think would improve the quality of the paper, also in comparison with similar papers of other missions and instruments (for comparison), in line with the comments and suggestions provided below. After these comments and suggestions have been addressed, the paper shall certainly be published. Since this is the second submission I leave it to the scientific editor to decide if and how he/she wants to proceed with the implementation of the comments and suggestions below.

1. Table 6:

I (still) think that the uncertainties presented in table 6 for absolute radiance, absolute irradiance and BSDF are unrealistically low at 1-sigma, given the complications and issues described in the text in this paper:

- a. There is a relatively large unexplained measurement discrepancy that dominates ABSRAD and BSDF.
- b. There is a relatively large unexplained FEL lamp discrepancy in ABSIRR and BSDF.
- c. The external diffuser calibration accuracy is quite low. It is mentioned in the text that the diffuser(s) have been calibrated twice at two different institutes, but no results or comparisons are given. I would suggest to add a small section with these external diffuser BSDF calibration results, since this is an important contributor to the BSDF accuracy.
- d. The text refers in some cases to the fact that the preferred sun beam simulator method could not be used for more accurate BSDF calibration accuracy. This seems to suggest that with a well working sun beam simulator the results could have been much more accurate, while the results with the FEL lamps are already now quite accurate. This seems strange.
- e. On page 25 the impact of stray light in TROPOMI measurement data is mentioned, which is explained further in sections 6.6 (in-band stray light) and 6.7 (out-of-spectral-range stray light). It is not clear from the text if stray light was (had to be) corrected for the calculation of the radiometric CKD for which the accuracies are given in table 6. It is not clear what additional uncertainty this would add to the accuracies in table 6. Please explain this in more detail in a few sentences and, if necessary, add a line with uncertainty due to all types of stray light. See also table 7 and 8, which suggest that stray light can add up to 1-5% uncertainty before correction and 1-3% after correction, or figure 25, which seems to suggest even higher uncertainties due to stray light in some wavelength areas (e.g. 450-500 nm, and in NIR).
- f. The accuracies listed in table 6 suggest that with the use of the CKD presented in this paper in-orbit comparisons of TROPOMI L1b measurement data to sun irradiance, earth radiance and earth reflectance spectra should agree within some 1-2% at 1-sigma. Do the authors think that this will be the case? To me that seems unlikely, given the above uncertainties.

2. Section 9:

The conclusions are still very qualitative. I think it would be useful to add a few quantitative numbers for some of the key parameters / CKD.

Specific comments

Section addressing individual scientific questions/issues.

1.

Page 15, line 4:

In figure 3 the smear correction appears after the dark current correction, while here it seems to be the other way around. Please explain, since I understood from the text that the idea is to use the operational 0-1b data processor in the process of deriving CKD.

2.

Page 15, line 17:

For the detector exposure smear correction the reader is referred to ATBDKNMI (2017) (issue 8.0.0). In that ATBD a rather complex matrix inversion method is described. However, I doubt that this smear correction has been implemented / activated in the 0-1b operational data processing software. Please confirm that this is the case, or else describe (in a few sentences) how the smear is corrected with a simplified approach.

3.

Page 25, line 20. Please clarify in a few words what this “optical feature” is (since it seems to be quite important, since it causes stray light).

4.

Page 27, line 15ff:

I have some concern with the CKD smoothing procedures. This is normally avoided, to avoid that important instrument spectral features are removed from CKD and then show up in L2 fit residues. What are the main reasons for performing this rather unusual CKD smoothing? Is it diffuser (speckle) features, or also other effects? Are the spectral diffuser features mainly from the external diffuser plate, or also (partly) from the internal diffusers? Please explain this in a bit more detail in the text.

5.

Page 31, lines 2-4:

This argument about the FEL lamp cross-hair is a bit strange, since the lamp is calibrated by NIST using the same cross-hair target. I therefore don't quite understand how this specific effect can lead to uncertainties in the distance. Please explain.

6.

Page 35, figure 18:

It is essential to also provide a plot with the BSDF CKD plotted as function of wavelength, showing also the band overlap regions, in order to see if uncertainties exist in the band overlap spectral ranges. Please add such a plot (this should be easy to produce from the data that is already there).

Technical corrections

Compact listing of purely technical corrections (typing errors, etc.).

1.

Page 18, figure 7:

The horizontal units are electrons. This is understood and agreed.

The vertical units seem to be unitless [-], with values up to 15000. This is not understood. Is this really unitless, then how is this to be interpreted? Or should it be electrons after all? Please clarify.