Referee 1

General comments

The proposed publication provides a new contribution to typical key topics for space instrumentation: the monitoring of any trend in the instrument response, and proposed solutions to compensate the degradation (trend corrections). For space payloads designed for radiance/irradiance measurements, it is important to maintain the radiometric scales and instrument response. It is here presented for the SWIR channel of TROPOMI. Usually, the strategy is to use internal light sources or external references. This publication wants to demonstrate that PICS (here mainly selected in Arabia and North Africa) can be used for the SWIR channel and L1b data. The paper is clearly written. It presents the different tools that must be applied for the monitoring of instrumental trends. There is good quality for the discussion and the argumentation, for the selection of sites, the constraints and filtering of the data, the data processing and associated uncertainty calculations and conclusions. The proposed paper is of good quality and this work is clearly performed by a team expert in their own instrumentation and their general scientific domain (atmospheric sciences, monitoring of trace gases).

- Dear Referee, thank you fort he kind comments

Specific comments

- It is well understood that a main discussion concerns the standard deviation of the PICS radiance monitoring (in the range of 3-5%), larger than 'expected', which cannot be explained by instrumental uncertainty calculation for single measurement (~0.1%, line 129). The discussion is conducted on possible non-lambertian effects, but inconclusive as wrote in the conclusions (line 179) due to the lack of difference using filters '50°' and '7.5°', but it is not a main issue for the publication to present open questions. However, these uncertainties of 3-5% impacts also the quality of instrument trend retrieval using PICS in the SWIR, as clearly seen in the Figure 3 right (large distribution of slopes). So, one crucial objective of this paper (to validate the use of PICS in SWIR in addition to internal lamps of TROPOMI) is maybe not enough discussed: only in the conclusions where the average value (0.3%/year) obtained from PICS monitoring is compared to the results of internal calibration (line 177). Maybe some more sentences on the opinion of the researchers could be added. For example, to answer to these questions: better to use internal lamps? better to use PICS? important to use both for cross-checked, while knowing that PICS monitoring will not provide a lower uncertainty than the use of internal light sources?

> To better illustrate these points, several lines have been added to the conclusions. The main conclusion is that even the average value does not constrain TROPOMI degradation very well. For that one needs to let go of the Lambertian assumption. However, this point is not stressed too importantly due to the limitations of the method here. Current research in our group is underway to understand the BRDF effects over RailRoad Valley. However, it is clear that these effects are complicated and currently cannot be verified over non-instrumented PICS sites.

- Concerning the yearly variation correction: this topic is well discussed even if it is still an open question. It is clearly well corrected (sine correction), but it is to note that the amplitude of these events is not so negligible (in the 10-9 radiance unit, the same order than the standard uncertainty of the final, filtered products).

> Very likely this is also a BRDF effect due to the position of the sun.

Technical corrections

- • Line 72 – '....to track the temporal variability of the SWIR and NIR channel continuum signal ...'. *Why to invoke here the NIR spectral range? It is not discussed elsewhere in the publication.*

➢ Corrected, this was a mistake from an earlier version.

- • Maybe, some sentences or paragraph structure could be readjusted to present a better logical link between the filters (viewing angle, cloud cover, irradiance measurement, overpass separation, instrument zenith angle, ...) and the discussion on them.
  For example, the applied filters are described at the beginning of section 3. One of them (' ...the viewing zenith angle must be smaller than 50 degrees ...') is presented at line 82. Then a discussion tarts at line 88 on the pixel size, and the need to maintain any side length below 20 km (to have a pixel located at less than 20 km away from a PICS), which justify the need to reduce the viewing angle below 50° (line 94). So the explanation comes here. Also at line 82 ('... a successful and valid irradiance measurement should have been taken within a day ...'). It seems redundant with the sentences at line 111 ('... Last but not least, soundings are required to have a valid irradiance measurement using TROPOMI-SWIR within a day ...') but in fact, the discussion of this filter comes here.

➢ The structure of this section was reconsidered.

- • It could be useful also to add the column 'slope' in Table 4. The reader can find the new slopes (after a filtering of zenith angle to 7.5°), but it is not possible to compare the numerical values presented in Figure 3, even if you wrote some sentences for the discussion (line 147-148-149: Interestingly, the fit parameters were nearly identical ...').

➢ This was omitted on purpose to avoid over-interpretation. If done correctly, it would also need to include the errors on the slopes in both tables. These errors are (due to BRDF and yearly nonsinusoidal variations in a few plots, see append) not true standard deviations. As such only the sentence was included.