Dear Reviewer,

We would like to thank you for your remarks and comments, which have helped us to improve the manuscript. Please find below our answers (marked in bold blue color).

General Comments:

The study “Quantifying particulate matter optical properties and flow rate in industrial stack plumes from PRISMA hyperspectral imager” by Calassou et al. addresses the issue of industrial stacks plumes retrieval by means of PRISMA satellite data. The topic is scientifically relevant and the paper is well structured and written. I recommend the manuscript for publication after addressing the following points and clarifications.

- Is it the first time that PRISMA data have been used for this type of research? If yes it would be valuable to highlight that, if not you should provide references in literature.

To the best of our knowledge, this is the first study published on this subject.

- Have you checked if other studies on the same test sites have been conducted in literature?

Only the site of Hassi Messaoud have been investigated for CH4 emission: Lauvaux et al. 2022) already in the text and we have added Varon et al. (2021). L90.

- Have you considered the issue of clouds influence? Are the images you’ve taken into account (both PRISMA and L2/MSI) free of clouds?

We have selected cloud free pictures and the cloud influence is not accounted for in the present article.

- Have you considered the possibility to provide an independent validation of the presented results? Maybe with existent satellite products/derived satellite products/other ground truth sources; in line 354-357 you mention that the validation with in situ measurements remains virtually impossible. Have you investigated if there are satellite products that provide the same parameters you estimated?

Yes, we have considered this possibility, but so far we haven't found any equivalent products at the same spatial resolution and on the same study cases as ours. Ground-based optical measurements (eg DOAS or scanning lidar system) might be valuable for vicarious validation in future researches.

Specific Comments:

- Line 100: do you mean only detection or also retrieval?

Detect and quantify methane emission. Added to the text.

- 1 -> Is there a reference in literature?
- 2 -> Is there a reference in literature?

Yes. We have added the following references : Liou (2002), Vermote et al. (1997) and Kaufman et al. 1997. Line 124.

- Line 128: Is there a reference in literature to the COMANCHE software?

Yes. Poutier et al. 2002. Added in the text.

- 3 -> Is there a reference in literature? -> Could you clarify why there is no direct component of the solar irradiance related to δ?

No reference. It's a new formalism. As mentioned in the text, δ is the AOT for the upward irradiance so there no direct component of the solar irradiance. δ* is the AOT for the downward irradiance. It's now clarified in the text. Line 135.

- Line 165: "the uncertainties due to the water vapor concentration are empirically fixed to 10%" -> Is there a reference in literature for the uncertainty due to the water vapor concentration?

And

- Line 166: "the uncertainties of the background aerosol visibility is set to 5 km" -> -> Is there a reference in literature for the uncertainty of the background aerosol visibility?

Uncertainties in the estimation of water vapor range from 1 to 15%. For a PRISMA-type instrument, a value of 10% error on this parameter seems relevant. In the same way as for water vapour, the visibility error estimate is around 5 km.
We have explained this point in the text and added the following references:

Yang, H.; Zhang, L.; Ong, C.; Rodger, A.; Liu, J.; Sun, X.; Zhang, H.; Jian, X.; Tong, Q. Improved Aerosol Optical Thickness, Columnar Water Vapor, and Surface Reflectance Retrieval from Combined CASI and SASI Airborne Hyperspectral Sensors. *Remote Sens.* 2017, *9*, 217. https://doi.org/10.3390/rs9030217

Andrew Rodger,SODA: A new method of in-scene atmospheric water vapor estimation and post-flight spectral recalibration for hyperspectral sensors: Application to the HyMap sensor at two locations,Remote Sensing of Environment,Volume 115, Issue 2,2011,Pages 536-547,ISSN 0034-4257,https://doi.org/10.1016/j.rse.2010.09.022.

Nitin Bhatia, Alfred Stein, Ils Reusen & Valentyn A. Tolpekin (2018) An optimization approach to estimate and calibrate column water vapour for hyperspectral airborne data, International Journal of Remote Sensing, 39:8, 2480-2505, DOI: 10.1080/01431161.2018.1425565

- Line 227: LM acronym has not been defined previously.

This has been done on Line 170

- Line 236: “the combined plume mask based on DOF and iteration number (Figure 5c)” -> Could you clarify how DOF and iteration number are combined to get the plume mask (ex.: “pixels corresponding to DOF threshold of ... and?/or? pixels corresponding to number iteration of ... are taken into account...”)

Yes. The resulting mask is the product of both masks, ie. DOF>0.5 and Number of iteration<10. We have clarified this point in the text.

- Caption of Figure 5: OEM acronym has not been defined previously.

This has been done on Line 148

- Line 238: “The initial value of AOT is set to 0.5 with an uncertainty of 1.0. The retrieved AOT map (Figure 6a) reflects[...]” -> Could you mention/briefly recall the process to retrieve the parameters in Figure 6 (how to obtain Figure 6 from Figure 5 basically). Is the process mentioned in line 192-193 (“The aerosol optical properties are simulated using the MOPSMAP T-matrix algorithm (Gasteiger and Wiegner, 2018)”) ?

We recall briefly the procedure L240:
The AOT is a component of the state vector in the optimal estimation procedure. Its value is retrieved by minimizing the cost function that integrates the look-up tables computed using the direct radiative transfer model and the aerosol optical properties (section 3.3 and 3.4).

- Line 256: “The median radius of the accumulation mode is on average equal to 0.11 ± 0.02 µm in the pixels present in the plume mask.” -> The plume mask (as well as the DOF and Number of iterations) have been shown only for case 1 (Gas flaring, Fig. 5), I suppose the procedure is exactly the same for all the sites, is that correct?

Yes. Now explicitly given in the text. L252.

- Line 262-263: “The partial detection can be due to a poor reconstruction of the vegetated soils[...]” -> May be the partial detection caused also by the fact that the plume may be less thick/more dispersed in that areas?

Correct. For every pixel where the surface reconstruction error is high there is a low sensitivity to aerosol optical depth so the detection is not possible. We have mentioned this point in the text. Line 270.

- Line 263-264: “Further downstream, an artifact due to the sunglint on a water retention bassin can observed” -> Where the artifact/water retention bassin is located in the map?

Actually this sentence is awkward. The sunglint is not clearly visible. We have removed this sentence.

- Figure 8: May the point B be a false positive?

No. Point B is clearly identified as a retrieval and the AOT is out of the noise.

- Line 290-291: “The relative error on the surface reflectance reaches 60% at 550nm for this particular cases” -> Could you specify which case? In the previous sentence the coal-fired plant has been mentioned while from Figure 10 it seems that the flaring site exhibits a relative error of 60% at 550nm. Could you clarify that and check the correspondence between text and Figure 10 from 285 to 291 lines?

The corresponding text has been clarified. The 60% error at 500 nm is for the coal-fired plant. Figure 10 legend is updated.

- Line 292: “The error associated to the surface reflectance estimation and to the aerosol properties retrieval process”-> Could you provide a reference in the text on where in the manuscript the error associated with the aerosol properties retrieval process is computed? Is the 3.3 section?

Yes. The error associated with the aerosol properties retrieval is given by the error matrix $\hat{S}$ in equation 8. We add this point in the text. Line 301.

- Line 330: “There are several limitations (low revisit time, cloud cover, ...)”-> Could you specify limitations of the “applicability of the proposed framework to monitor the air quality around the facilities”

You are right, the two last sentence are unclear and probably clumsy. We have rephrased them. Line 340.

“Although the proposed method is not dedicated to the monitoring of air quality around the facilities, high spatial resolution observations of plume transport can provide unique information for understanding the impact of industrial emissions. The main limitation for an operational survey of plume emissions are the reduced amount of observations due to the cloud occurrence and the revisit time of the satellite.”

Technical Comments:

Thank you for your careful proofreading. We have proofread the text and corrected the typos.

- Line 26: stationnary -> stationary
- Line 30: developped -> developed
- Line 47: impletation -> implementation
- Line 50: betwen -> between
- Line 116: space after the point “[...] m^2).For a flat, [...]”
- Line 165: visibily -> visibility?
- Line 271: “The radius is equal to 0.20 µm” -> Do you mean the radius of the point B? Could you specify?

Correct. Aerosol radius at point B.

- Line 290: “dractic”->drastic
- Line 302: “contribution contribution”-> contribution
- Line 311:” dominated by the error on large error”-> Could you review this part of the sentence?