

Response to the reviewer's comments for the paper by Sofiev & Kouznetsov

Observation operator and detection limits for MODIS and VIIRS Fire Radiative Power products

First of all, we would like to thank both reviewers for their efforts and very useful comments. We used them to improve the paper. The point-by-point responses are presented below.

Reviewer 1

The best aspect of the paper is the analysis that leads to the comparison of the two systems. It could be improve by a bit more explanation of how the "symmetric OOp application" (line 289) is performed.

Thank you! The section 3.5 has been extended, and a step-by-step procedure of the application of the OOp for comparison of the satellite datasets is now presented in the section 3.5.

The weakest aspect is the pixel size analysis, which could be reduced and summarized for readability.

Thank you for the comment! We followed the suggestion and reduced the sections 3.1 and 3.2 with stronger reliance on the MODIS and VIIRS ATBDs.

Reviewer 2

Major Comments:

Section 3.4, the treatment of aerosol and thin-cloud attenuation is simplified using an exponential attenuation relationship. Please provide further justification for this assumption and discuss its limitations, considering that MODIS/VIIRS FRP retrievals involve multi-spectral algorithms and atmospheric corrections.

Thank you for pointing it out. Indeed, MODIS/VIIRS FRP retrievals rely on several wavelengths: Table 1 of (Giglio et al., 2016). However, absolute value of FRP is computed exclusively from the 4 μm channel, Eq. 16, (Giglio et al., 2016) and Table III, (Cao et al., 2013). Other channels are used only for fire detection / rejection steps. Therefore, our approximation, being a simplification, still meets the logic of the FRP algorithm. We introduced the corresponding remark in the paper.

Line 296, the methodology for calculating the “mean cloud cover for the MODIS overpass hours” shown in Figure 7a is unclear. Please specify the MODIS cloud product used, the temporal sampling strategy, the cloud mask algorithm, and the aggregation method used to derive the gridded cloud fraction. Since cloud obscuration is a key component of the proposed grid-level observation operator, this information is essential for evaluating the reproducibility and uncertainty of the results.

Explanation added.

Section 4.2, The evaluation of the proposed observation operators is mainly based on comparisons with the original MODIS and VIIRS datasets. However, such an evaluation only demonstrates internal consistency. An independent validation dataset (e.g., higher-resolution fire observations or alternative satellite products) would be valuable to assess the reliability of the proposed observation operators. If such data are unavailable, the limitations associated with the lack of independent validation should be discussed.

There is a misunderstanding: the paper already contains section 5.3 considering the GEO located instrument SEVIRI and comparing the FREEVAL project results for SEVIRI with our study. Somewhat confusing, this section is actually mentioned in the below comment. That section brings a semi-qualitative comparison for VIIRS, which is all that can be done because there is no other satellite with FRP product and resolution comparable with that of VIIRS.

Section 5.2, the omission error estimates are presented as global statistics, but the uncertainty associated with these estimates is not discussed. Please provide brief sensitivity analyses or/and uncertainty estimates considering factors such as spatial averaging scale, fire-season definition, and cloud-screening criteria.

This comment mostly refers to the section 4.2, where the omission error was quantified (in the section 5.2 it is only compared with other studies).

We added the sensitivity assessment of the omission error estimation into the section 4.2, in relation to the inspected area around each fire pixel – the most uncertain parameter of the assessment.

Section 5.3, the comparison with SEVIRI and VIIRS sensitivity is mainly qualitative. More quantitative evidence is needed to support the conclusions, such as statistical comparison using collocated observations, case studies of representative fire events, or additional analysis demonstrating the consistency between the proposed detection limits and previous SEVIRI/VIIRS assessments.

Thank you for pointing out the imperfect presentation. The section has been revised for more rigorous presentation style. We also took a note on repeating the full SEVIRI data processing to obtain its detection limit and to make its OOp. However, our procedure may be inapplicable to geostationary satellites: the procedure of creating the FRP distributions and identifying its critical values suggests spatially homogenous signal. Being a meaningful assumption for low-orbit satellites, it may be not correct for geostationary location, where constant observed area means that land-use and fire patterns are directly mapped to viewing angle and pixel size. Investigation of this case and adaptation of our methodology to geostationary instruments will be the subject of the follow-up paper.

Minor Comments:

Line 36–37, “It allowed” should be “It allows”.

changed

Line 42, “(Schroeder et al., 2008)” should be “Schroeder et al. (2008)”.

Corrected

Line 66, “every type of observation requires own OOp” should be “every type of observation requires its own OOp”.

Corrected

Line 77–78, this sentence is presented as a standalone paragraph. Please consider merging it with the surrounding text for better paragraph structure and readability.

This sentence is the main motivation for the development. Therefore, we preferred to keep it as a standalone paragraph but modified to highlight its connection with the previous and next paragraphs.

Line 89, “These are discussed in section 5”, what is discussed in section 5, please specify.

The word “results” is added

Line 96, dataset citation information should also be provided in the Code and Data Availability section.

We are somewhat confused: line 96 describes the input data for the analysis, whereas the Code and data availability section presents the locations of our results.

Line 106, please specify the unit of FRP threshold ($P_p > 500$).

MW

Equation 3, please clarify the definition and units of parameters in the equation, since it appears to represent different quantities for MODIS and VIIRS.

All parameters of the Eq.3 are defined. Their meaning is exactly the same for both MODIS and VIIRS, just absolute values differ.

Line 140, “Figure 3-1 of (Nishihama et al., 1997)” should be “Figure 3-1 in Nishihama et al. (1997)”.

Corrected

Line 146, “Figure 1, (Schroeder et al., 2014b)” should be “Figure 1 in Schroeder et al. (2014b)”.

Corrected

Line 155, the authors shall specify why I-band observation is chosen in this study, instead of M-band observation.

Because I-band gives twice higher resolution

Line 157, for better readability, consider separating the MODIS and VIIRS swath geometry into two independent figures.

The figure has been split

Line 189, the statement “the FRP distribution densities (Figure 2, Figure 3)” is ambiguous. Please specify which subplot(s) of the figures are being referred to.

Panels c and d

Line 279, “Denoting aerosol column optical depth AOD” should be “Denoting aerosol column optical depth (AOD)”.

Corrected

Line 295, the parameter “ β_{miss} ” is introduced without a clear definition. Please provide its definition and explain its physical meaning.

Apologies, obsolete notation. Should be $1-\beta_{ret}$ with β_{ret} introduced at Eq.10

Figure 7a, the terminology of Figure 7a should be consistent with the main text. Please clarify whether the colorbar represents cloud fraction or missing pixel fraction due to cloud obscuration.

Corrected.

Line 388, the term “Collection 5” is not clearly defined. Please specify which dataset collection is referred to and provide relevant details.

Details are provided down to granularity given in the reference (Maier et al, 2013)

Line 541–548, the citation of the dataset appears to be repeated. Please check and remove the redundant citation.

Not really. Similarly looking citations are for MOD and MYD datasets of MODIS and VJ1 and VNP datasets of VIIRS.

References

Cao, C., Xiong, J., Blonski, S., Liu, Q., Uprety, S., Shao, X., Bai, Y., Weng, F., 2013. Suomi NPP VIIRS sensor data record verification, validation, and long-term performance monitoring: VIIRS SDR CAL/VAL AND PERFORMANCE. J. Geophys. Res. Atmos. 118, 11,664–11,678.

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Giglio, L., Schroeder, W., Justice, C.O., 2016. The collection 6 MODIS active fire detection algorithm and fire products. Remote Sensing of Environment 178, 31–41.

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