Answer to referee 2

General comments

This work presents the results of what can be considered a great step forward in the use of photometry for the study and monitoring of atmospheric aerosol, extending to the marine domain what until now has been a technique possible only in fixed locations.

The work is very well written and clear, also from the point of view of English.

We sincerely thank Referee 2 for the constructive and encouraging feedback, and we grateful for the recognition of the value of this work as a significant step toward extending high-quality photometric aerosol monitoring to the marine environment. We address below each of the comments in detail.

My only concerns are the following:

- the introduction seems a bit too long containing perhaps too many details on the description of aerosols, their role in the climate, on measurement techniques. Furthermore, in the second part the history of the development of this system suitable for operating on ships is reconstructed. This information is then repeated in section 2 (where it is certainly more suitable)

We thank the reviewer for this observation. While we have shortened and reorganized the second part of the Introduction—moving the historical account of the shipborne system to Section 2, where it is more appropriate—we have opted to retain the first part, which reviews the importance and characteristics of marine aerosols. This section was carefully written in collaboration with Dr. Alexander Smirnov, principal developer and coordinator of the Maritime Aerosol Network (MAN), with the aim of recovering key past contributions regarding marine aerosol research. We believe this overview provides valuable context not only for interpreting the present study, but also as a resource for new generations of researchers entering this field.

That said, we have reviewed the structure and wording of this part to ensure conciseness and focus, avoiding unnecessary digressions and overlap with Section 2.

- section 2.2 reports in too much detail what is the standard analysis procedure of AERONET. I think it is enough to refer to the article that is in fact cited several times (Giles et al. 2019)

We have carefully revised Section 2.2 and trimmed down parts of the explanation regarding standard AERONET processing steps. Nevertheless, we retain some key points to clarify the context and applicability of certain procedures in a shipborne context. These include explicit details about calibration, cloud screening, and Level 1.5 data assignment, as these are critical for validating and understanding the reliability of marine-based data and the differences from ground-based scenarios. All relevant sections now emphasize references to the main AERONET documentation, particularly Giles et al. 2019 for procedural details.

- the results are illustrated in detail in section 3. It is therefore not clear to me the usefulness of repeating them in section 5

We thank the reviewer for this remark, which has led us to revise Section 5. The preamble of the Discussion has now been substantially shortened to avoid repeating material from Section 3. Instead, we have focused on a more concise synthesis and interpretation of the findings in the context of previous literature and future applications.

Specific comments:

L27 Which is the meaning of specifying the percentage of international waters?

We agree this detail may be overly specific at this early stage of the paper. This sentence has been removed in the revised version to improve the flow and focus of the Introduction.

L209 Not only the Sun, but also the Moon, so I would say "locked onto the target"

All this section 2.1 has deeply evolved but we have kept on mind to add the Moon for the tracking issue.

L222-223 What about sea spray?

This part now is in 2.1.2 and we have added the airshield information to avoid sea spray as presented in figure 1.

L230-231 It's not clear to me what this means "SUN, MOON, (Sun and Moon direct measurements)". Maybe the second comma is not necessary?

We agree with the reviewer that the original phrasing was unclear. The terms "SUN" and "MOON" referred to internal CIMEL codes used to designate direct Sun and direct Moon observation scenarios. As these are not meaningful to general readers, we have removed these internal references from the manuscript to avoid confusion.

L234 "identical to those applied at regular fixed ground-based sites". This concept has been repeated many times.

We acknowledge the redundancy pointed out by the reviewer. The affected sentence has been revised and shortened to avoid repeating that the AERONET protocols are identical unless such emphasis is necessary—for instance, when highlighting specific adaptations for shipborne or moving platforms. Additionally, in several parts of the text we now use the term "AERONET-compatible" to streamline the discussion and avoid unnecessary repetition.

L231-234 120+220 days doesn't make a full year

We thank the referee for pointing out the discrepancy in the total number of operational days per year. In addition to the 220 days operated by Ifremer and the 120 days under TAAF, the remaining ~25 days per year correspond to periods when the R.V. Marion Dufresne is docked for port operations, vessel maintenance, and technical upgrades. These intervals are also used for maintenance and recalibration of the scientific instruments installed on board. This clarification has now been incorporated into the revised manuscript (Section 2.3).

L264 Why 5% percentile is not reported as you did with 95%?

Thanks for the remark, the 5% has been added.

L401-407 Could you give more details or put a reference on the evaluation of indetermination of Angstrom Exponent at very low AOD?

We thank the reviewer for this observation. As explained in the manuscript, the increased variability of α under very low AOD conditions is primarily due to the relative nature of the uncertainty: while AOD errors are generally considered absolute (e.g., 0.01 for standard channels), their impact on the α calculation becomes more significant as AOD decreases. This can be easily shown since α is derived from a least-squares fit in log–log space, where the error in log(AOD) mathematically increases for smaller AOD values.

More specifically, since the α is calculated from a linear regression of log(AOD) versus log(λ), the uncertainty in α is influenced by the propagation of the relative error in AOD. As $\Delta[\log(AOD)] = \Delta(AOD) / AOD$, the error contribution becomes larger as AOD decreases. This effect is particularly relevant for marine environments, where very low AOD values are common, especially in the near-infrared range.

We believe the current explanation in the manuscript provides a clear and sufficient account of this limitation, particularly for readers familiar with AERONET methodologies. However, should the editor consider a more formal treatment necessary, we would be happy to include additional clarifications or references in the revised version.

L425-432 Is not clear to me which is the meaning of give all this numerical details (e.g. different percentiles) on the AOD and AE values during the BB event

We thank the reviewer for this observation. The numerical details, including percentiles and maximum values, are provided to objectively characterize the intensity and uniqueness of the biomass burning event within the context of the three-year dataset. While the AOD values observed during this episode are moderate when compared to AERONET sites frequently affected by biomass burning, they are the highest in our dataset and clearly distinguishable from the background pristine marine conditions.

Importantly, this episode is not only statistically prominent but also temporally isolated: all elevated values are confined to that specific week, and there are no other days or isolated measurements with similarly high AOD or low Ångström exponent values throughout the entire dataset. This reinforces the exceptional nature of the event and justifies its selection for detailed analysis in Section 4, where inversion products are presented. The statistical description therefore supports both the identification and the scientific relevance of this unique case.

L482-484 Could you provide a reference for this?

We thank the reviewer for this observation. A reference has now been added to support this statement. Specifically, we cite Holben et al. (1998), which reports that the total uncertainty in AOD from a newly calibrated field instrument is typically below 0.01 for wavelengths above 440 nm and below 0.02 for shorter wavelengths under cloud-free conditions. These uncertainty levels are based in part on root-mean-square differences observed during intercalibrations with AERONET reference instruments and are consistent with the AOD biases observed in our own current intercomparison/intercalibration. Please note also that several authors of this study are directly involved in the calibration of a large number of AERONET instruments worldwide, and in this context, we confirm that these thresholds with respect to the master instrument are routinely applied as acceptance criteria for valid calibrations.

L517 How is calculated this bias? I don't find it

We thank the reviewer for the comment. As stated in the manuscript, the bias is calculated using the AERONET Saint-Denis site as a reference. It is computed as the mean of the signed point-by-point differences in AOD between both instruments. We preferred not to overload the text with additional technical details, but should the editor consider it necessary, we would be happy to add a clarification.

L538 "aerosol retrieval" sounds too generic in my opinion. Maybe you can "optical-physical"?

We thank the reviewer for this suggestion. We agree that "aerosol retrieval" could be interpreted as too generic. To improve clarity, the title of Section 4 has been updated to: "First quality-assured shipborne AERONET retrievals of aerosol optical and microphysical properties."

L596 "exceeding the 95% percentile value of 1.46" of the total period?

We thank the reviewer for this observation. Yes, the 95th percentile value of 1.46 refers to the Ångström exponent distribution over the entire three-year dataset from the R.V. Marion Dufresne. This clarification has now been included in the revised manuscript to avoid ambiguity.

L595-598 In these sentences there are repetitions of AOD and SZA values.

We thank the reviewer for this observation. However, upon careful review, we believe there is no repetition in the referenced sentences. The text describes two distinct SZA–AOD combinations observed during the biomass burning event. Each pair is presented to illustrate the range of conditions contributing to elevated Ångström exponent values. We hope this clarifies the intended structure.

Typos:

L67 analyzes

We thank the reviewer. “Analyzes” has been corrected to “analysis” in line 67.

L94 platformS

Added, thanks.

L164 andber, imprimproved greatlypared

Thank you for pointing this out. We believe this issue resulted from a text rendering problem during the PDF conversion process. We expect the issue to be resolved in the revised version.

L167 for all alls

This part has been completely edited and this sentence has been corrected.

L170-171 “This solution was shown inefficient for our proposed automated independent final solution”. Repetition

This part has been completely edited and we have avoided the repetition.

L186 I would suggest “identified” instead of “discovered”

Ok, thanks for the suggestion, we have changed it.

L190 I would write “the first instrument fully compatible with AERONET” or “the first fully AERONET compatible instrument”

L192 “marking a significant milestone in achieving 100% AERONET compatibility” is a repetition of what stated at line 190

We thank the reviewer for these suggestions. To address the redundancy and improve clarity, we have revised the text accordingly. Specifically, we consistently use the term *AERONET-compatible* throughout the manuscript to simplify the expression and avoid repetition. The phrase in line 192 has also been shortened to eliminate redundancy with line 190.