

Reviewers Comments and Authors Response

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Title: Impact Comparison of Different Aerosol Types on Atmospheric Correction of Landsat 8 over Land

Dear reviewers,

We sincerely thank the reviewer for the valuable and constructive comments and suggestions.. We have carefully revised the manuscript and addressed all comments point by point below. All changes have been marked in the revised manuscript.

Thank you very much.

Shuning Zhang

On behalf of all authors

In this study, a comprehensive analysis of how different aerosol types (MOD04, MOD09, and Urban Clean) affect the accuracy of atmospheric correction (AC) is conducted using Landsat 8 data acquired at 100 Aerosol Robotic Network (AERONET) sites for the first time, and some meaningful results are obtained as well.

The authors give proper credit to related work and clearly indicate their own new contribution.

The findings of the study emphasize the critical importance of aerosol-type assumptions in AC workflow. And also, a mixed strategic implementation framework that can serve as a novel concept or idea is proposed.

The description of experiments and calculations is sufficiently complete to allow their reproduction by fellow scientists since the datasets used in this work are publicly available remote sensing and ground-based observation products, and also further information about the datasets used in this study can be provided by the authors upon reasonable request.

This manuscript sits between a methods paper and an application or survey paper. Overall, the manuscript was well written, however, some of the issues (as stated below) need to be solved/ clarified:

1.As shown in Line 20 of the Abstract, “The results indicated that, in terms of aerosol optical depth (AOD), the MOD04 aerosol type exhibited the highest accuracy, with an R^2 of 0.762, Root Mean Square Error (RMSE) of 0.0437, and bias of 0.0876. The accuracy, precision, and uncertainty of the SR products corresponding to the three aerosol types were within the ranges of 0.00036–0.00043, 0.02382–0.02468, and 0.02337–0.02425, respectively.” These key data related to the research conclusions, such as R^2 of 0.762, RMSE) of 0.0437, bias of 0.0876, A(0.00036–0.00043), P(0.02382–0.02468), U(0.02337–0.02425), cannot be found in the main text (in line 439, “The total A, P, and U values for the four SR products are 0.00036–0.00377, 0.02382–0.02544, and 0.02337–440 0.2598, respectively”, Table 4 and 6?).

Reply: Thank you for carefully identifying this issue. After re-examining the manuscript, we found that the inconsistencies originated from two aspects.

First, the AOD-related statistics reported in the Abstract (Line 21) were not fully consistent with those presented in Table 4. This has now been corrected by revising the Abstract to match the values reported in Table 4. In addition, the coefficient of determination has been clarified as R^2_{AerT} to ensure consistency with the definition used in this study.

Second, the inconsistencies among the Abstract, Section 4.2(1), and Table 6 for the SR-related metrics (A/P/U) were mainly caused by inconsistencies in reporting during manuscript revision. Specifically, the values in Table 6 correspond to the final results, which include the calculation of confidence intervals, whereas the values reported in the Abstract and Section 4.2(1) were not updated accordingly. In addition, formatting issues in Table 6, such as missing scientific notation (e.g., E-03, E-02), further contributed to the confusion. These issues have now been thoroughly corrected by updating the Abstract and the main text to match Table 6, and by fixing the formatting in Table 6. All A/P/U values are now fully consistent across the Abstract, the main text, and Table 6.

The relevant values have been corrected in the Abstract (Lines 21–23), Section 4.2(1) (Lines 439–441), and Table 6, and the detailed revisions are provided below:

“

Lines 21–23: The results indicated that, in terms of aerosol optical depth (AOD), the MOD04 aerosol type exhibited the highest accuracy, with an R^2_{AerT} of 0.76362, Root Mean Square Error (RMSE) of 0.0437, and bias of 0.08760052. The accuracy, precision, and uncertainty of the SR products corresponding to the three aerosol types were within the ranges of -0.000297536–0.003770030145, 0.02318482–0.026020544, and 0.0233667–0.26040, respectively.

Lines 439–441: The total A, P, and U values for the four SR products are -0.0002975–0.0030145, 0.023184–0.026020, and 0.023366–0.26040, respectively.

Table 6. Overall A, P, and U of four SR products.

	A (E-03)	P (E-02)	U (E-02)
MOD04-based	3.0145 [3.0111, 3.0178]	2.3184 [2.3181, 2.3186]	2.3366 [2.3310, 2.3418]
MOD09-based	0.7451 [0.7416, 0.7486]	2.4274 [2.4272, 2.4277]	2.4304 [2.4258, 2.4355]
Urban Clean	1.1465 [1.1431, 1.1500]	2.3870 [2.3872, 2.3877]	2.3911 [2.3857, 2.3963]
LaSRC	-0.2975 [-0.3013, -0.2937]	2.6020 [2.6017, 2.6022]	2.6040 [2.5966, 2.6112]

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2. Line 156, “.....after rigorous spatiotemporal matching (e.g., image selection based on site coordinates.....)” Due to the significant impact of scene screening on evaluation results, please provide additional information on the spatiotemporal matching method between Landsat 8 scenes and AERONET sites in this study, as well as the quality control method for cloud detection (or explain which cloud detection product was used and how accurate it is?).

Reply: Thank you for this valuable comment. We agree that the spatiotemporal matching and cloud screening procedures are critical for ensuring the reliability of the evaluation.

The relevant information was already included in the original manuscript; however, your valuable comments made us realize the original description was not sufficiently explicit or easy to follow.

Specifically, Landsat 8 scenes were selected based on AERONET site locations, and AOD measurements were matched within ± 15 min of the satellite overpass time. In addition, all scenes were cropped to a 6×6 km window centered on each site to ensure spatial homogeneity.

For cloud screening, we used the QA band provided in the Landsat 8 LaSRC product, which is generated based on the CFMask (C Function of Mask) algorithm. This algorithm identifies clouds and cloud shadows using spectral tests and thermal information, and has been widely validated for Landsat data, with an overall accuracy of approximately 90% (Foga et al., 2017).

To improve clarity, we have revised and reorganized this part of the manuscript to present the spatiotemporal matching criteria and cloud screening procedure in a more explicit and consolidated manner. The temporal matching criterion (± 15 min), spatial window (6×6 km), and cloud screening method (CFMask-based QA band threshold) are now more clearly stated. The revised description is provided in Section 2.1 (Lines 155–163, as shown below:

“

After rigorous spatiotemporal matching and quality screening, 634 scenes were retained as the final dataset (Fig. 2). Specifically, AERONET measurements were matched with Landsat 8 images within ± 15 min of the satellite overpass time. For each site, Landsat scenes were cropped to a 6×6 km window centered on the AERONET location to ensure spatial homogeneity, which is finer than the 9×9 km window commonly used in previous validation studies (Doxani et al., 2023). Cloud and cloud-shadow pixels were identified using the LaSRC QA band (CFMask), a widely used cloud masking algorithm for Landsat data that has been extensively validated with an overall accuracy of approximately 90% (Foga et al., 2017). Scenes with more than 20% cloud-contaminated pixels within the study window were excluded. All processing steps were implemented on the Google Earth Engine (GEE) platform to ensure consistency and computational efficiency.

Foga, S., Scaramuzza, P. L., Guo, S., Zhu, Z., Dille, R. D., Beckmann, T., Schmidt, G. L., Dwyer, J. L., Hughes, M. J., and Laue, B.: Cloud detection algorithm comparison and

validation for operational Landsat data products, *Remote Sens. Environ.*, 194, 379–390, <https://doi.org/10.1016/j.rse.2017.03.026>, 2017.

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3. The Figure caption is inconsistent with the textual description in the main text. e.g., Line 475, “Fig. 7 illustrates the results: the x-axis represents SR values within the 0-1 range, the left y-axis denotes the number of pixels (with tick marks at 10^4 , 10^5 , 10^6 , 10^7 , and 10^8), and the right y-axis presents accuracy metrics.” Line 578, “Figure 7: A, P, and U (y left axis) and the number of pixels (y right axis) of the four surface reflectance products within the 0.1 Surface Reflectance Range.”

Reply: Thank you. The inconsistency in Fig. 7 between the main text and the figure caption was caused by an oversight during manuscript revision, where the description of axis definitions was not fully updated in a consistent manner. We have revised the corresponding parts to ensure consistency and clarity. Specifically, the left y-axis is now consistently defined as the number of pixels, while the right y-axis represents the accuracy metrics (A, P, and U). In addition, the description of the SR intervals (0–1 with a step of 0.1) has been clarified.

In particular, the caption of Fig. 7 has been corrected to properly reflect the axis definitions, and the corresponding description in Section 4.2(3) (Lines 476–478) has been revised for consistency. **The revised contents are provided below:**

“

Lines 476–478: Fig. 7 illustrates the results: the x-axis represents SR values ranging from 0 to 1 with intervals of 0.1, the left y-axis denotes the number of pixels (with log-scale ticks at 10^4 , 10^5 , 10^6 , 10^7 , and 10^8), and the right y-axis presents accuracy metrics (A, P, and U).

Figure 7: Number of pixels (left y-axis) and accuracy metrics (A, P, and U; right y-axis) of the four surface reflectance products across different SR intervals (0–1 with a step of 0.1)

”

4. Line 476, “Gray bars denote pixel counts per interval, and the red, green, while red, green, and blue dashed lines represent A, P, and U, respectively.” Delete “and the red, green,” ?

Reply: Thank you for catching this error. The duplicated phrase was introduced inadvertently during manuscript preparation. It has now been corrected to improve clarity (Line 478–479).

The revised sentence in Section 4.2(3) (Line 478–479) is provided below:

“

Gray bars denote pixel counts per interval, while red, green, and blue dashed lines represent A, P, and U, respectively.

”

5.Line 584, “.....as shown in Fig. 8–9..... across different surface types.” Line 636, “Figure 8: Scatter Plot of Measured vs. 6S-Simulated SR over Building-Surface”. Line 639, “Figure 9: Scatter Plot of Measured vs. 6S-Simulated SR over Snow-Surface.”

Reply: Thank you for pointing out this inconsistency. We confirm that the issue was caused by figure captions that were not properly updated during manuscript revision. The content description was correct, where Fig. 8 and Fig. 9 present RMSE and bias, respectively, across seven spectral bands.

The captions of Fig. 8 and Fig. 9 have now been revised to accurately reflect their contents. In addition, the in-text reference in Section 4.2(4) (Lines 584–586) has been slightly clarified to explicitly indicate that Fig. 8 corresponds to RMSE and Fig. 9 to bias, in order to improve clarity and avoid ambiguity.

The revised description in Section 4.2(4) (Lines 584–586) and the revised captions of Fig. 8 and Fig. 9 are as follows:

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Lines 584–586: The performance of the four SR products was assessed using RMSE and bias across seven spectral bands, as shown in Fig. 8 (RMSE) and Fig. 9 (bias).

Figure 8: RMSE of the four surface reflectance products across seven spectral bands.

Figure 9: Bias of the four surface reflectance products across seven spectral bands.

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6.Regarding geographical regions and land cover types, vegetation and snow cover exhibit significant seasonal and interannual variations. Will there be corresponding changes in the accuracy of aerosol types? How to conduct further evaluation?

Reply: We thank the reviewer for raising this insightful point regarding the potential impact of seasonal and interannual variability of surface types (e.g., vegetation and snow) on the performance of different aerosol types.

In this study, we did not explicitly perform a seasonally stratified evaluation. However, it is worth noting that part of this effect has been revealed in our current results. Specifically, the MOD04-based aerosol type incorporates seasonal and geographical variability in its aerosol subtype selection scheme, whereas the MOD09-based approach relies primarily on an error-minimization strategy, and the Urban Clean type remains fixed. This difference in aerosol representation may partly explain the observed performance variations across surface types.

For example, our results show that the MOD04-based aerosol type achieves consistently lower RMSE and Bias over snow surfaces across all spectral bands, and also demonstrates advantages in the green, blue and deep-blue bands over vegetation surfaces. These findings suggest that aerosol schemes incorporating seasonal and regional variability may offer improved robustness for surfaces with strong temporal

dynamics.

Nevertheless, a more rigorous assessment of seasonal and interannual effects would require a dedicated analysis framework, including explicit temporal stratification, finer land cover classification, and potentially an expanded dataset. Such an investigation is beyond the scope of the present study but represents an important direction for future research. We have added a brief discussion of this aspect in Section 5.2(3) (Lines 794–802) to clarify this point, as shown below:

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It is important to note that vegetation and snow surfaces exhibit pronounced seasonal and interannual variability, which may influence the performance of different aerosol-type assumptions. Although explicit seasonal stratification was not conducted in this study, the current results provide partial evidence of such effects. Specifically, the MOD04-based aerosol type achieves consistently lower RMSE and bias over snow surfaces and shows advantages over vegetation in several spectral bands. This behavior is likely related to its aerosol subtype selection scheme, which incorporates geographical and seasonal information, enabling better adaptation to temporally varying surface–atmosphere conditions. A more comprehensive assessment of seasonal and interannual variability would require finer land cover classification, explicit temporal stratification, and an expanded dataset. These aspects are beyond the scope of the present study but represent important directions for future research.

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