

Response to Referee #1

First High-Resolution Surface Spectral Clear-Sky Ultraviolet Radiation Dataset across China (1981–2023): Development, Validation, and Variability

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Dear editor and reviewers,

We would like to thank the editor for handling our manuscript and the reviewers for their careful evaluation of our work and the valuable comments, suggestions, and questions. Our point by point response to the comments made by Reviewers are given below, we have also marked changes in the manuscript. Please find a detailed point-by-point response to each comment.

Yours sincerely,

Wenmin Qin, Qinghai Qi and co-authors

General Comment:

The authors present a high-spectral-resolution clear-sky ultraviolet radiation dataset for China, which features unprecedented 0.5 nm spectral sampling across the 280-400 nm range. The integration of reanalysis data with physical radiative transfer model (SMARTS) represents a robust approach. Its credibility is further strengthened by comprehensive validation against ground-based CERN stations and CERES satellite products. The dataset appears to be a valuable resource, particularly given its spectral resolution and spatial coverage over China. The manuscript merits publication after addressing the following minor revision.

Response:

Thank you for your thorough and insightful review of our manuscript. We appreciate the detailed review and suggestion. We have carefully considered each of your comments.

Specific Comments:

1) Abstract: Please correct "Earth's Radiant Energy System" to the full name "Clouds and the Earth's Radiant Energy System".

Response:

Abstract has been changed as suggested.

2) Section 2.2: The sun-earth distance correction factor have two different letters, "S" and "s"; standardise the format.

Response:

The sun-earth distance correction factor has been unified as "S".

3) Section 2.3: Phrase “concentration and distribution” is redundant, as the distribution characteristics of errors already encompass the concept of central tendency.

Response:

We thank the reviewer for this insightful comment. As suggested, we have revised the manuscript by removing the redundant term “concentration and” and now simply refer to the “distribution” of errors throughout the text.

4) Figure 3: Part of the site name is obscured in Figure 3.

Response:

Thank you very much of your careful review of our research. We have replaced the Figure 3 with a new version.

5) Table 1: How are the variables presented in Table 1 incorporated into the SMARTS model?

Response:

We thank the reviewer for this insightful question regarding the role of the input parameters in the SMARTS model. In section 4.3, the discussion focused on three key input variables (aerosol , ozone and albedo) within the SMARTS model.

6) Figure 4: The unites of solar radiation in Figure 4 are inconsistently represented, with both “Wm-2” and “W m-2” being used.

Response:

As suggested, the unit of solar radiation is unified as “W m⁻²”. Meanwhile, the Figure 4 has been replaced with a new version.

7) Figure 5: The same issue as in Figure 4.

Response:

We have replaced the Figure 5 with a new version.

8) Line 263: “The normally strong aggrement ...” is an inaccurate statement.

Response:

The word “normally” has been removed to enhance the accuracy of the statement.

9) Section 4.2: The conclusion could be enhanced by providing additional analytical insights regarding the distinctive features and relative performance of the two products, which would help users make informed selections.

Response:

Thank you for pointing out the problem. We have added the statement in Section 4.2: “The CERES SYN1deg product exhibits systematic biases in its representation of UV radiation, overestimating at high values and underestimating at low values. This results in a border and flatter probability density function compared to the new CHUV product, which indicates larger errors and lower overall precision. Consequently, the SYN1deg product also demonstrates a significantly weaker agreement with daily mean observations than the CHUV product.”

10) Line 315: “-50.06% to -40.90% per AOD unit” change in UV irradiance require clarification.

Response:

We thank the reviewer for this astute observation and the opportunity to clarify this critical point. The original phrasing has been replaced with a more precise statement. *“The sensitivity analysis revealed a strong negative relationship between AOD and surface UV irradiance. Specifically, a one-unit increase in AOD was associated with a fractional reduction in UV irradiance ranging from -50.06% to -40.90%.”*

11) Section 4.4.1: Replace the imprecise term “near 400 nm” with the scientifically accurate designation of either “UV-A range (315-400 nm)” or “long-wave interval (380-400 nm)”.

Response:

The suggested alterations have been implemented. It is evident that the statement “near 400 nm” has undergone a modification, with the numerical values now expressed as “380-400 nm”.

12) Section 4.4.2: The comparative analysis of the three regions would be strengthened by establishing a unified reference baseline, such as expressing their UV radiation levels as deviations from the national average value.

Response:

We thank the reviewer for this suggestion. In our initial analysis, we utilized a national map of UV radiation to provide the spatial context, which indeed allows for a visual assessment of how the three regions compare against the national distribution.

13) Figure 12: Please briefly quantify the radiation differences between transitional seasons (Spring/autumn).

Response:

We thank the reviewer for this valuable suggestion. In the revised manuscript, we have added a quantitative analysis in Section 4.4.2: *“The average national UV radiation levels experienced a notable increase of 0.8962 W m^{-2} in the spring months when compared to the annual mean. Conversely, during the autumn season, a decline of approximately 0.9277 W m^{-2} was observed.”*

14) Line 389: “considerable altitude” is not appropriate.

Response:

We thank the reviewer for pointing out this imprecise terminology. We have rephrased the sentence to state the specific average altitude: *“From a spatial perspective, the Tibetan Plateau consistently records the highest UV radiation levels across all seasons due to its considerable high-altitude (mean elevation exceeding 4000 meters) and thinner atmosphere.”*

15) Line 431: “coinciding with” inappropriate wording.

Response:

We have added the statement in Section 4.4.3: “*Since 2010, clear-sky UV radiation has risen sharply at a rate of $+0.0670 \text{ W m}^{-2}\text{yr}^{-1}$, following the implementation of stringent air pollution control policies in China that led to a reduction in atmospheric aerosols, ozone, and other pollutants through curbed coal consumption and industrial emissions.*”