

Dear Editor-in-Chief,

Thank you for inviting me to review the paper entitled "High-Resolution Snow Water Equivalent Estimation: A Data-Driven Method for Localized Downscaling of Climate Data." This manuscript presents a novel approach for downscaling Snow Water Equivalent (SWE) to high-resolution datasets using a K-nearest neighbor algorithm. The study focuses on two regions in the western United States and demonstrates that the proposed method effectively generates high-resolution SWE data that closely match observed reanalysis data. The authors extensively validate their approach by comparing the downscaled results with established datasets such as SNODAS, Daymet, and University of Arizona SWE, and by cross-validation.

The manuscript is well structured, provides a clear rationale for the chosen methodology, and makes a significant contribution to the field of hydrology by addressing the challenge of obtaining high-resolution SWE data in regions with complex terrain. However, the manuscript would benefit from further clarification of the methodology and a more concise discussion of the results. In addition, the inclusion of visual aids such as flow charts could enhance the clarity of the proposed algorithm.

Overall, the study is a valuable addition to the literature, providing a robust and scalable approach to downscaling SWE data with broad applications in climate research and water resource management. I recommend it for publication after minor revisions to improve clarity and conciseness.

General Comments:

The manuscript is generally well-structured, with a clear flow from the introduction to the methodology, results, and discussion. However, some sections could benefit from further clarification, particularly where the methodology is complex.

Consider adding a diagram or flowchart in the methodology section to visually represent the steps of the proposed downscaling algorithm. This would help readers better understand the process.

Introduction:

- The novelty of the approach is well articulated, but a more explicit statement of how this method advances the field compared to existing approaches would strengthen the introduction.

Methodology:

- The methodology is thorough, but some sections are densely packed with technical details, making it challenging to follow. The description of the Manhattan distance metric, in particular, could be expanded to enhance reader understanding. Explain how the Manhattan distance operates within the context of your downscaling approach. This will help make the concept more accessible, especially for readers less familiar with the metric.
- The choice of parameters (e.g., FI and NI intervals) is justified through sensitivity analysis, which is appropriate. However, the manuscript could benefit from a brief discussion on the potential limitations or assumptions made in the parameter selection process.

Results:

- The results are comprehensive and well-presented with relevant figures and tables. However, the discussion on the comparison between different models and resolutions could be expanded to provide more insights into why certain models perform better in specific regions.
- Consider including a more detailed comparison of the proposed method with existing downscaling techniques. This could be done in the discussion section, where you could highlight the strengths and limitations of your approach relative to others.

Conclusion:

- The conclusion could be more definitive in summarizing the key findings and contributions of the study. The main quantities results should be added in the conclusion.
- Given the limitations of ground observations in data-scarce high mountain regions, to what extent do you believe that the method used in your study can provide accurate and comprehensive insights into SWE? Are there any potential sources of uncertainty or bias that need to be addressed?

Specific Comments:

- Abstract (Lines 1-20): The abstract is informative but could be condensed to focus more on the results and implications rather than the background. The key findings should be more prominently highlighted.
- Please describe the study regions in the abstract to provide context for where the proposed method was tested. This addition will give readers a better understanding of the geographical relevance of the study.
- Section 2.3 (Lines 115-130): The explanation of the K-nearest neighbor algorithm could be clarified. Please further illustrate how the algorithm works in the context of downscaling SWE.
- Ensure consistency in the use of terms such as "high-resolution" and "low-resolution" throughout the manuscript. Some sections use these terms interchangeably with "HR-SWE" and "LR-SWE," which could confuse readers.

Table 3:

- There seems to be an issue with Table 3, as some information might be missing or incomplete.

Lines 268-269:

- The reference to "Evaluation criteria Table 1" appears to be incorrect. Please check this sentence and ensure that the correct table is referenced.

Figure 6:

- The legend and boxplot in Figure 6 require revision, as they currently do not appear to be properly formatted. Please ensure that the legend is clear and correctly labeled, and that the boxplot is visually consistent with the rest of the figure.

Figures 9, 11, 13, and supplementary figures:

- The Y-axis values in Figures 9, 11, 13, and the supplementary figures need to be revised. Please check that the scales are appropriate and clearly labeled to ensure that they accurately represent the data being presented.

Tables and Figures Captions:

- Please remove the bold formatting from all table and figure captions. The current formatting detracts from the overall appearance of the manuscript. Standardize the captions to match the style used throughout the manuscript.
- There are a few minor grammatical errors and typos that should be corrected. For example, in line 30, "Snow Eater equivalent" should be corrected to "Snow Water Equivalent."