This study evaluates the impact of spatial resolution on hourly flood simulation accuracy in large watersheds. It identifies key flood characteristics that influence multi-grid simulation performance and provides practical guidance for selecting spatial resolutions. The study is interesting, and the methodology offers valuable insights. However, there are still some points that should be addressed to improve the quality of the paper.

We sincerely appreciate your positive, insightful and constructive comments. We fully agree with all the concerns you raised and will make the revisions accordingly in the revised manuscript.

Major comments:

1. Section 2.3.2 selects flood characteristics potentially sensitive to grid resolution, but the criteria for selecting these characteristics are unclear. Additionally, the manuscript lacks detailed explanation of how these indicators are calculated. It is recommended to provide the selection criteria and explain the calculation process in detail, which would help improve the clarity and credibility of the paper.

We thank the reviewer for the constructive comments. In Section 2.3.2, we selected 14 flood characteristics relevant to hydrological modeling. These indicators are derived from existing studies (Wang et al., 2021; Liu et al., 2022; Zhang et al., 2025) and adequately represent rainfall, underlying surface conditions, and watershed characteristics. Among them, the rainfall indicators specifically reflect the intensity, magnitude, and spatiotemporal distribution of rainfall, while the indicators for underlying surface conditions and watershed characteristics capture the relevant attributes of the hydrological model's underlying surface data and watershed features. In the revised manuscript, we will clearly state the sources and selection criteria for these indicators within Section 2.3.2. Furthermore, the detailed calculation processes for all indicators have been provided in Appendix A.

2. The manuscript uses partial dependence plots (PDPs) for feature-effect interpretation. Since SHAP values are more commonly used for nonlinear analysis, the authors should explain why they chose PDPs instead of SHAP.

Thank you for your valuable comment. As a global interpretation method, partial dependence plots (PDPs) provide a clear and intuitive visualization of the marginal effects of each flood characteristic on model predictions. In contrast, SHAP values are more suitable for analyzing the contribution of specific samples to model predictions. Since our study focuses on revealing the global average effects of flood characteristics, PDPs are a more direct choice. Moreover, PDPs have been widely used in previous studies to investigate the nonlinear impacts of key flood features (e.g., Wang et al., 2026; Razavi-Termeh et al., 2025; Yao et al., 2026). We will further clarify the rationale for choosing the PDPs method in the revised manuscript.

3. In section 2.3.4, three different criteria are used to determine the optimal spatial resolution.

What is the purpose and rationale behind setting different scenarios? This should be explained in the manuscript.

Thank you for the comment. The purpose of setting three different schemes is to select the optimal spatial resolution from both accuracy and computational efficiency perspectives, as the optimal resolution is not unique. In the S1 scheme, the optimal spatial resolution is determined solely based on flood simulation accuracy. In contrast, the S2 and S3 schemes, while satisfying predefined accuracy thresholds (e.g., NSE > 0.8 or relative error < 5%), prioritize selecting coarser grids to improve computational efficiency. Observing the differences in the optimal spatial resolutions obtained from these schemes provides valuable insight for selecting appropriate spatial resolutions in large-watershed modeling. We will further clarify this point in the revised manuscript.

4. Results and Discussion section has limited discussion or reference to other studies. For example, Section 4.3 lacks a discussion of the results from previous studies on grid controlling factors. Section 4.6 should also include a discussion of how previous studies have analyzed the impact of rainfall gauge density on the accuracy of different grid resolutions.

Thank you for your valuable suggestion. We will include a more extensive discussion in the revised manuscript by incorporating references to previous studies:

(1) Section 4.3 on Grid Controlling Factors: Previous studies on spatial resolution in hydrological modeling (e.g., Cao et al., 2020; Aerts et al., 2022; Jiang et al., 2025) have highlighted key flood characteristics, such as watershed area, topographic features, and rainfall distribution, that significantly influence model performance. In the revised manuscript, we will incorporate a detailed discussion of these studies. This will strengthen the credibility and applicability of our research findings.

(2) Section 4.6 on the effect of rainfall gauge density: There is substantial research on the impact of rainfall input spatial resolution, such as Michelon et al. (2021), Pan et al. (2024), and Zhu et al. (2024), all of which recognize the significant impact of spatial resolution on flood simulation accuracy. In the revised manuscript, we will discuss how previous studies have analyzed the impact of rainfall gauge density on model performance at different grid resolutions.

Minor comments:

1. Figure 1: Please include the control areas for all hydrological stations.

Good point. In the revised manuscript, we will update Figure 1 to clearly show the boundaries of the control areas for all ten hydrological stations.

2. Lines 100-105: Add the sources of the DEM and soil data. Additionally, please provide information on the number of reservoirs and their storage capacities within the study area.

We will include the sources of the DEM and soil data in Section 2.1 “Study Area and Data” of the revised manuscript. Additionally, we will provide information on the number of reservoirs and their storage capacities within the study area, along with an analysis of their impacts.

3. Figure 2: Is there a reference for this figure? It would be helpful to add one.

We will clarify the source and citation of the model in the revised manuscript.

4. Section 2.3.1: The title “Equations” may not clearly convey the content of the section. It is recommended to revise the title to “Evaluation of GDHF Model Performance at Different Spatial Resolutions” for greater clarity and alignment with the section's focus.

In the revised manuscript, we will modify the title of Section 2.3.1 to “Evaluation of GDHF Model Performance at Different Spatial Resolutions” as recommended.

5. Line 190: The statement "spatial refinement yields a significant improvement (IMPNSE > 0.10, IMPBIAS > 5%, IMPRPE > 5%, or IMPPTE > 1 h)" requires further clarification. The rationale behind selecting these specific thresholds should be provided.

The selection of thresholds is crucial for model training. We selected these specific thresholds to identify the flood types for which grid refinement leads to significant improvements in model accuracy and performance. In the revised manuscript, we will clearly explain the rationale behind these threshold selections.

6. Figure 4: Please ensure that it clearly specifies that the modeling process is based on a 10 km resolution.

In the revised manuscript, we will specify that the modeling process in Figure 4 is based on a 10 km spatial resolution as an example.

7. Figure 12: The y-axis should be clearly labeled to indicate whether it represents the results of grid resolution selection or the precision of different grid resolutions.

In the revised manuscript, we will modify Figure 12 to clearly display the results of optimal spatial resolution selection under different scenarios.

8. Appendix A: Why are references not included in Appendix A? Any references used to describe details and equations in the appendix should be cited.
In the revised manuscript, we will include citations for the sources of the flood characteristic indicators and the formulas used to describe the calculation principles in Appendix A.

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