Dear Reviewer,

Thank you for your comprehensive and detailed evaluation of our manuscript. Your valuable comments on the importance of this research are of great significance to us. And we will do our best to improve the depth of the analysis and make this research a more significant contribution to the field.

To distinguish your comments from our responses, we will present your comments in blue bold font and our responses in regular black font. Please find our detailed responses to your concerns below:

1. **The four scenarios using HLU and CLU seems intuitive and simple to apply, which might become a lightly novel or highlight of the methodology that could be potentially widely-applied. However, insufficient details about "all built-type land uses" and the process of "The HLU pattern involves reverting all built-type land uses in both watersheds to their pre-construction conditions" are provided. This is not addressed explicitly in the discussion or supplementary, which could become a valuable contribution to future studies.**

Thank you for your valuable feedback. We understand the importance of providing detailed information on the treatment of land use types and the reversion of built-up land to its pre-construction state.

As for the **current land use pattern** construction, we utilized the 2020 10-meter resolution raster data from the Dynamic World Project (Fig. R1a). For each triangular mesh grid in our study area, we assigned the land use type that occupies the largest proportion of the area within that grid. This approach ensures that each mesh grid is classified based on its dominant land use, resulting in the current land use pattern (Fig. R1b).

To derive the **historical land use pattern**, we modified the current land use data by converting all mesh grids classified as built-type land uses within both watersheds to the trees land use type (Fig. R1c). This transformation effectively reverts built areas to their pre-construction conditions, allowing us to simulate a scenario without urban development.

Both the original raster data and our model incorporate eight distinct land use types, as outlined in the legend of Fig. R1. Each land use type is assigned specific parameter values within the model, including leaf area index (LAI), albedo, roughness, root zone depth, and impervious area fraction. For instance, for the type of trees land use, the impervious area is 0%, while for the type of built land use, the impervious area is 94%. We acknowledge that the initial manuscript lacked sufficient detail regarding the treatment of built-type land uses and the methodology for reverting them to historical conditions. In the revised version, we will describe the method more comprehensively and explain the parameters in the model.

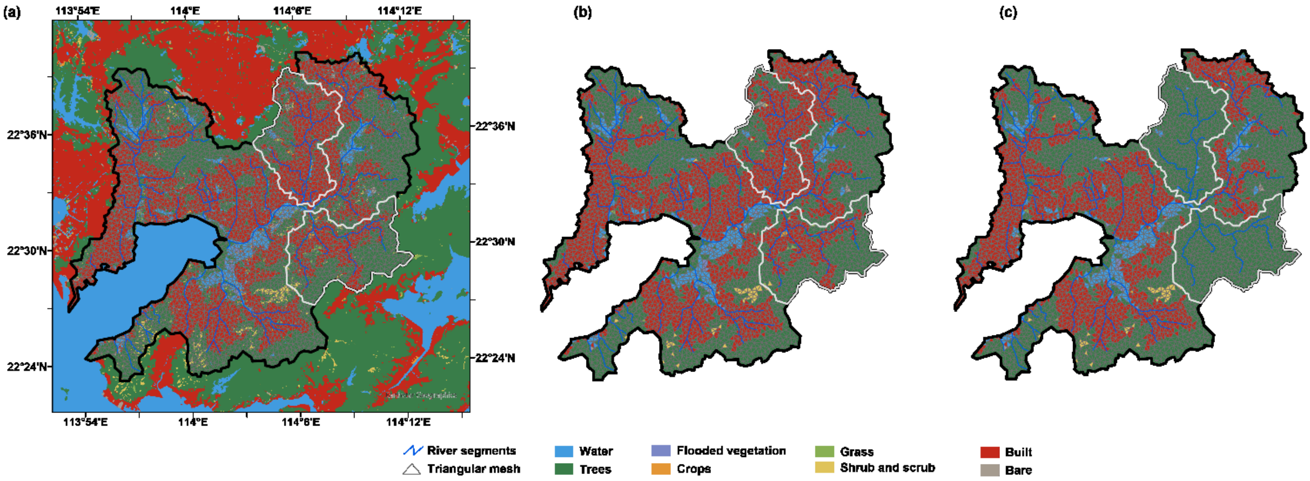

Figure. R1 Land use types within the study area, with the base map provided by the 2020 10-meter resolution raster data from the Dynamic World Project (a). Current land use pattern in the model (b). Historical land use pattern in

the model (c).

2. **L73-74: consider adding reference to support the statement "they are mainly based on single and spatially homogeneous watersheds".**

   Thank you for your valuable suggestion. We will make an effort to add appropriate citations to support this claim. When suitable references are limited, however, we will revise the wording to more accurately reflect the current state of research and add relevant literature to ensure the accuracy and persuasiveness of the statement.

3. **L77: may consider adding one or two sentences to describe "crucial economic zone" in China to highlight the importance of the study area.**

   Thank you for your valuable suggestion. We will add a description of the Greater Bay Area (GBA) to emphasize its significance as a critical economic zone. The revised sentence will be as follows: *"We simulate the hydrological processes of the two watersheds in the Greater Bay Area (GBA), a critical economic zone in China that encompasses major cities such as Guangzhou, Shenzhen, Hong Kong, and Macao. According to the latest data, the GDP of the GBA exceeded 14 trillion yuan in 2023. However, the region faces significant challenges in achieving sustainable growth and coordinated spatial planning under rapid urbanization. These factors make the GBA an ideal area for studying hydrological processes. For this study, we use the Simulator for Hydrologic Unstructured Domains (SHUD) as an ISSHM."*

4. **In section 3.4, the four scenarios using HLU and CLU seems intuitive and straightforward to apply, which might become a highlight of the methodology that could be potentially widely-applied. However, insufficient details about "all built-type land uses" and the process of "The HLU pattern involves reverting all built-type land uses in both watersheds to their pre-construction conditions" are provided. This is not addressed explicitly in the discussion or conclusion, and could be a valuable contribution in future studies.**

   Thank you for your valuable comments. In the first question in the response, we have provided a preliminary explanation of "all built-up land uses" and the process of reverting them to their pre-construction state. Considering that the main focus of the study is land use change and terrain slope, we plan to restructure section 3.4 in future revisions. This section will provide more precise and detailed explanations of the four scenario settings.

5. **L187: consider adding reference of 40 meter, at which Zone 1 and Zone 2 are divided.**

   Thank you for your valuable suggestion. The division of each zone was determined based on two main criteria. First, we calculated the average elevation of each triangular mesh grid using DEM raster data. Then, we applied the natural breaks method to classify all grids in the two watersheds into six elevation groups, with the natural breakpoints for the first two groups being approximately 40 meters and 120 meters. We also considered the number of mesh grids within each zone, ensuring that each zone contains enough mesh grids for reliable statistical analysis. Since the number of grids in groups three through six was too small for meaningful analysis, we combined them into a single Zone 3. We will clarify this process in the revised manuscript to ensure that this division is clearly explained.

6. **L192-203: consider having a flowchart or a table instead of a long paragraph to demonstrate the key factors/processes, could also help the readers better understand the results.**

   Thank you for your helpful suggestion. We will incorporate a flowchart in the revised version of the manuscript.

7. **Figure 8: the text in the x and y-axis are too small to read**

Thank you for pointing this out. We will revise Figure 8 to enlarge the text on both the x and y-axes.

8. **Figure 9: the current figure is busy with many equations/texts embedded with the dots, may considering make it concise by leaving the p-values in the figure but putting the equations in the captions or texts.**

   Thank you for your valuable suggestion. We will revise the figure by keeping the p-values within the figure and moving the equations to the caption or text to make the figure less busy and more concise.

9. **Figure 10: similar to Figure 9.**

   Thank you for your suggestion. Like Figure 9, we will revise Figure 10 by keeping the p-values in the figure and moving the equations to the caption or text.

10. **L373-379: the author may consider adding more specific examples or related references about how hydrologic management or local watershed agencies could use this study to improve their methodology and strategies. Thus, the application of this publication could not only benefit not only the future studies in academia but also shed light on the practical water management or engineering world.**

    Thank you for your insightful suggestion. Providing more specific examples and references would significantly enhance the usefulness of our research. In the revised manuscript, we will give some specific examples and add relevant references to illustrate the impact of these research results on practical water resources management and engineering solutions.

11. **It lacks the in-depth analysis of evapotranspiration (ET), which correlates with climatic factors such as solar radiation, temperature, humidity, etc. It is worth noting that ET is different from surface runoff, subsurface flow, and infiltration. The author may consider adding sentences in the limitation/discussion section.**

    Thank you for your valuable feedback. We admit that the ET process is quite different from surface runoff, subsurface flow and infiltration processes. In addition to land factors, ET is more closely related to climatic factors such as solar radiation, temperature and humidity. Our research focuses mainly on terrestrial hydrological processes, so the discussion of ET is relatively limited. In the revised version, we will appropriately expand the discussion of ET while ensuring the accuracy of the analysis. In addition, we will address this limitation in the "limitations/discussion" section.

12. **Groundwater dynamics was mentioned in other sections except the discussion part, considering address it in section 4.4.**

    Thank you for your valuable suggestion. We acknowledge the importance of groundwater dynamics in our study. The revised manuscript will address groundwater dynamics in limitations and future work section. This addition will include an analysis of groundwater processes within the different watersheds and their implications for hydrological processes.

13. **L258-262: consider adding text about the statement that "topographic indices more accurately reflect hydrological responses under steady-state conditions" in discussion part.**

    Thank you for your insightful suggestion. We agree that elaborating on how "topographic indices more accurately reflect hydrological responses under steady-state conditions" will strengthen our discussion.

    For example, research conducted in a Swedish till catchment demonstrated that groundwater levels near streams closely follow runoff dynamics, but this correlation diminishes with distance from the stream.

Groundwater levels in upslope areas can rise independently of streamflow, indicating a deviation from the steady-state assumption (Seibert et al., 2003). This finding highlights that groundwater flow exhibits high spatial variability over short periods. Consequently, when the model simulation period or event scale is short, it is crucial to account for the non-steady-state differences caused by recharge on groundwater flow. In the revised manuscript, we will provide a clearer and more detailed explanation.

14. **Considering the study areas are the important economic zone, the author may consider relating it to other economic zone or highly-urbanized areas in other regions of the world. It may worth thinking and adding texts about how this publication could shed light on the practical water management or engineering world**

Thank you for your valuable suggestions. Due to differences in topography and planning strategies, there are significant differences in the urban planning patterns of the two watersheds we studied. Despite these differences, Shenzhen and Hong Kong are highly economically developed cities. In the revised manuscript, we will appropriately add a sentence or two to discuss how these contrasting urbanization models and topographic features provide meaningful insights for other highly urbanized and economically developed regions worldwide.

15. **The abstract is also suggested to revise based on the updated revision.**

Yes! We will revise the abstract according to the updated manuscript.

References

Seibert, J., Bishop, K., Rodhe, A., and McDonnell, J. J.: Groundwater dynamics along a hillslope: A test of the steady state hypothesis, Water Resour. Res., 39, 1, https://doi.org/10.1029/2002WR001404, 2003.