

Response to Anonymous Referees

Dear Editor Marleen de Ruiter ,

Thank you very much for the constructive feedback from you and your reviewers. We have addressed all the reviewers' comments. Please find a point-by-point reply below.

Kind regards

Ayenew

Response to Referee One

The manuscript titled “Unveiling Hydrological Dynamics in Data-Scarce Regions: A Comprehensive Integrated Approach” authored by Ayalew et al., is a compelling work that is both well-structured and comprehensive. It provides a detailed analysis of hydrological changes in the Rift Valley lakes region, Ethiopia, presenting valuable and transferable methodological approaches in the context of regionalization, specifically in donor and pseudo watershed categorization. Additionally, the numerical analysis resulted in a valuable database for the study region.

However, I have two points that require clarification:

In reference to the SWAT+ modelling approach, the authors used the variable storage routing method for river routing. Could the authors provide justification for the choice of the variable storage routing method?

Response: *There are two methods for channel routing currently implemented in SWAT+. These are Muskingum and Variable Storage Routing (VSR) methods.*

The VSR is the standard method and has the following advantages

- 1. flexibility: it allows for variable storage coefficients for each reach, providing a more flexible representation of channel routing behavior*
- 2. solving: it involves a set of differential equations that describe the dynamics of flow and storage in each channel reach. It introduces a diffusion wave approach to better represent the kinematics of wave propagation in a channel.*
- 3. Representation: It considers the storage-discharge relationship for each reach, allowing for a better representation of channel routing processes.*

While the study effectively highlights substantial hydrologic changes in the region, the authors attribute these changes to climate change and human impacts. It would be beneficial for the authors

to elaborate on which driver—climate change or human impacts—had a more pronounced effect on altering the hydrologic regime in the study area. These clarifications would enhance the understanding of the methodology and findings presented in the manuscript.

Response: *We appreciate the valuable feedback. We will incorporate this clarification into the discussion section of the paper: Our previous work has particularly targeted the attribution of Land Use and Land Cover (LULC) and climate change to the changes in hydrology in the study area (Ayalew et al. 2023). The findings indicate that the influence of human activities exerted a more significant impact compared to climate change. The hydrological regime of the lakes is affected by human-induced factors (mainly abstraction, urbanization, and deforestation) associated with rapid population growth. In the Northern part of the study area high water abstraction for irrigation and industry was the main driving factor for the changing hydrology. However, in the Southern part of the study area, high runoff and sedimentation associated with high deforestation are the main driving factors for the hydrological alterations.*