We highly appreciate your review and the suggestions you proposed in response to Gao et al. (2023) 's opinion paper. Taking your suggestions into consideration, we will revise our comments accordingly. For the main points that require discussion or specific responses, we replied and outlined below.

In our revision, we will briefly address the suggestion to make our comment more accessible to audiences like catchment hydrologists. In respect to the comments related to scaling issues such as REW applicability and emergent properties, we will clarify the content provided in the lines 201-204 "*Exploring scaling and emergent behaviors, along with network and optimality principles, aligns with a Darwinian approach that aims to understand the origins of these patterns through the processes that generate them (Harman and Troch, 2014). The credibility and applicability of hydrological optimality theory are enhanced when its historical evolution is clarified, guiding its relevance to specific watersheds.*" and lines 125-129 "*This process, observed at various scales, suggests that future studies should identify the specific scale of interest, highlighting the idea that emergent behaviors depend on the observational scale. Similarly, certain variables, such as evapotranspiration, allow for upscaling from micro-scale processes like root water uptake, which can be scaled consistently across various levels.*"

Concerning the development of PTFs, we will incorporate the new suggestions by citing Weber et al. (2024). Additionally, we will reference another recent paper by Li et al. (2024), presented at the International Soil Modelling Consortium (ISMC) in Tianjin, which proposes using convolutional neural networks (CNN) as a cross-scale transfer approach. In line with your considerations, we will also emphasize the primary driving concept for fluxes, as highlighted by Novick et al. (2022), to address the advancements in soil-biophysical and hydropedological theory.

We appreciate the reviewer's three suggestions to substantiate our points regarding the role of soils: i) work out the essential biophysical controls by soils, ii) highlight the theoretical advances and how they could be incorporated in simplified hydrological models and iii) elaborate the theoretical necessity of biophysical principles more clearly. While we agree with points i) and iii), we consider addressing these suggestions in more detail beyond the scope of our comment. For suggestion ii), we will further clarify the statements made in lines 129-138 "*Recent developments have led to methodologies for upscaling root water uptake processes and defining effective parameters grounded in micro-scale analyses (e.g. Vanderborght et al., 2023). These methodologies can be easily integrated into both catchment scale and land surface models. A significant advancement in hydrologic modeling is the access to spatially detailed and continuous data, which offers new opportunities for using large-scale system responses to refine parameters, tackle heterogeneity, and enhance model selection and structure. Ideally, the optimal approach involves developing scale-aware parameterization for such models such as multiscale PTFs to span a continuum of scale, considering soil's role in the interconnected geology-plant-atmosphere system such as hydrological connectivity between different model domains (Janzen et al., 2011).*"

Finally we see the need for a joint community effort to move forward some of the more fundamental issues raised by this reviewer and reviewer 3.

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