This study makes a notable contribution by extending the Horton–Strahler and hierarchical river-network pyramid representations to the analysis of runoff and discharge characteristics across 228 river basins worldwide. In particular, the study moves beyond conventional geometric scaling analyses by examining whether hydrological properties exhibit recurring statistical patterns across different levels of network organization, from the H–S hierarchy to pyramid-based basic units. The identification of common hydrological scaling patterns across diverse geographic and climatic settings represents an important contribution of the study.

The current manuscript is already well developed in terms of both theoretical background and methodological description. The results are supported by sufficient graphical presentation and detailed interpretation, and the discussion is comprehensive, offering readers ample opportunity to reflect on the findings and consider their broader implications. In my view, the manuscript is suitable for publication after minor revision, mainly to address a few points that may otherwise cause confusion for readers, as outlined below.

1. Although Table 2 suggests that the 228 study basins were selected across multiple continents, their actual spatial distribution is not immediately clear. I recommend adding a global map showing the location and extent of all selected basins. Such a figure would help readers more readily assess the geographical coverage of the analysis and identify any potential regional clustering or gaps in basin representation.
2. The manuscript uses a relatively large number of notations, with subscripts, superscripts, overbars, and related modifiers distinguishing different concepts based on the same symbols. Although these notations are generally defined in the text, the overall notation system can still be difficult to follow, particularly across different sections of the manuscript. I therefore recommend adding a summary table listing the main symbols and their definitions. This would improve readability and make it easier for readers to distinguish among closely related quantities.
3. Line 235: The characteristic length of a basic unit is conceptually defined in the preceding section, but the symbol λ does not appear to be explicitly introduced as its notation before being used here. I suggest explicitly stating that λ denotes the characteristic length of a basic unit.
4. Lines 398–403: It is not clear whether R_C and R_A have been explicitly defined earlier in the manuscript. Although Horton-type ratios are familiar concepts in river-network analysis, these quantities should still be clearly defined within the manuscript to ensure that the notation is fully self-contained. I suggest providing explicit definitions and, where appropriate, relevant references. Additional details could also be included in an Appendix if a more extensive explanation is needed
5. Equation (8): The derivation appears to assume that mean precipitation and runoff coefficients are approximately invariant across consecutive stream orders. This may be a strong assumption for the relatively large basins considered in this study, where precipitation can vary substantially in space. I therefore have two related questions.
   1) the runoff and discharge attributes provided by HydroATLAS are, to my understanding, derived from hydrological modelling that accounts for spatially heterogeneous climatic forcing. If so, the interpretation of Eq. (8) may be limited unless the assumption of order-wise similarity in precipitation and runoff coefficients is demonstrated.

   2) Second, can the authors show that α_ω, P_ω do not vary systematically across stream orders despite spatially heterogeneous precipitation? Such evidence would

strengthen the interpretation of Eq. (8).

6. Line 538: This is an Appendix section, but an unnecessary chapter number appears to have been included. Please remove the chapter number.

I would like to add one relatively long comment regarding the conceptual interpretation of river network formation.

In the Introduction, the authors state that "these universal hydrological patterns emerge as a direct consequence of the optimal channel network (OCN) hypothesis…" (Lines 71–72) and that river network evolution is governed by "deterministic self-organization principles rather than stochastic randomness" (Lines 27–30). I therefore interpreted the manuscript as placing greater emphasis on optimality and deterministic self-organization than on chance or stochastic processes. However, later sections appear to introduce a somewhat different perspective. Section 3.2 refers to self-similarity emerging during "random iterations" (Mantilla et al., 2010), while Section 4.4 states that stable Horton-ratio statistics have a theoretical basis in "stochastic network theory" (Wang and Waymire, 1991). These statements suggest that similar self-similar patterns may also emerge from stochastic processes.

I fully acknowledge that the relative roles of chance, self-organization, and optimality remain open to scientific interpretation, and the manuscript should reflect the authors' own view. Nevertheless, the current presentation may cause some confusion because the Introduction appears to favor a relatively strong optimality-based interpretation, whereas later sections recognize stochastic explanations for similar scaling behavior. I therefore recommend either improving the consistency of the conceptual discussion throughout the manuscript or slightly softening the wording in the Introduction to acknowledge that stochastic mechanisms may provide an alternative (or possibly complementary) explanation.