OVERVIEW

The study describes an open-source toolkit in R to facilitated the pre- and post-processing steps in using the SHUD hydrological model.

GENERAL COMMENTS

The paper is well written and clear. The topic is relevant as the toolkit in R is expected to facilitate the users of SHUD model. However, I have one major comment that needs to be addressed.

Reading the title, I expected to read about the development of an open system tool to apply multiple hydrological modelling approaches, with the possibility to consider different configurations of the processes to be simulated (title: "Advancing Unstructured Hydrological Modelling"). However, the paper describes a toolkit to facilitate the use of a single model, SHUD. That's fine, but it needs to be made clear in the introduction and in the title. Otherwise the reader would expect a different content.

Thank you for your feedback. We appreciate your perspective on the title and the content of the paper. Our intention with the title "Advancing Unstructured Hydrological Modeling" was to emphasize the broader applicability of the rSHUD toolkit beyond just the SHUD model. While the primary focus of the paper is on the SHUD model, many functions within the rSHUD toolkit are designed to be versatile and can be applied to other similar hydrological models.

For instance, functions like MeshData2Raster() can convert values on an unstructured triangular mesh into a regular grid raster through spatial interpolation. Similarly, the shud.triangle() function, which generates the geometry of an unstructured triangular mesh from a Shapefile Polygon, is not exclusively tailored for the SHUD model. In fact, out of the 160+ functions in rSHUD, a majority are not strictly limited to SHUD and can be utilized for modeling and analysis tasks in other similar hydrological models.

However, in light of your feedback, we recognize the potential for confusion and consider revising the title and introduction to more accurately reflect the content and scope of the paper. Now we change the title as “rSHUD v2.0: Advancing SHUD and Unstructured Hydrological Modeling in the R Environment”.

SPECIFIC COMMENTS (L: line or lines)

L53: GUI, acronyms should be defined.

Thank you.

We updated the text in revise manuscript. GUI is Graphical User Interface.

L57: Exactly the same in this paper, a toolkit developed for just one model. As mentioned above, I would suggest changing the introduction.

Thank you for your feedback. We acknowledge the concern raised. While the primary focus of the rSHUD toolkit is to support the SHUD model, its functionalities extend beyond just this model. However, to ensure clarity and avoid potential confusion, we revised the introduction to more accurately reflect the scope and capabilities of the rSHUD toolkit. Your insights are invaluable, and we appreciate your guidance in this matter.

L77-88: I believe it is not needed to introduce R in the paper.

Thank you for your feedback.

We included a brief introduction to R to cater to readers who might be less familiar with it. However, recognizing that many in our target audience might already be well-acquainted with R, we revised this section to be more concise. We aim to strike a balance between providing context and ensuring the content remains directly relevant to the primary focus of the paper.

L93: "The rSHUD version matches the SHUD model version". Which version? Where is it implemented? Which programming language?

Thank you for pointing that out. In the revised manuscript, we will clarify as follows:

"The current version of rSHUD is 2.0, designed to support SHUD v2.0. To ensure compatibility and streamline user experience, The development team maintains concurrent versioning for both rSHUD and SHUD. While rSHUD is developed using the R programming language, SHUD is implemented in C/C++. The versioning process is managed manually to ensure consistency between the two."

L95-96: Two lines of code for what? To be defined.

Thank you for pointing it out. The two lines of code mentioned are intended to facilitate the installation of the rSHUD package and its dependent libraries in a fresh R environment. This allows new users to easily set up and start using the rSHUD package. We have now added this clarification in the manuscript for better context.

L98: Table A1 does not contain the libraries, please check.

Thank you for pointing it out. Due to formatting issues, Table A1 was mistakenly placed on page 36. We have now rectified this oversight, and Table A1 is correctly positioned in Appendix A.

L129: “coupled with other systems such as …”. To be removed or clarified. How can it be coupled? Add details.

Thank you. Upon reflection, the phrase "coupled with other systems such as …" does introduce ambiguity without adding substantive information to the context. To maintain clarity and conciseness, this phrase has been removed from line L129 as recommended.

L200-204: This part is in first person “We”. Different to everything else in the text, please revise.

We revise the paragraph as:

"Multiple data processing stages were involved in this step. Holes were removed, modeling boundaries were projected, and buffer zones were generated in sequential procedures. Irrelevant data from the Digital Elevation Model (DEM) were excluded, retaining only pertinent information within the study area. The DEM data underwent reprojection and simplification into a Projected Coordinate System to facilitate analysis. The river flow direction consistency for the river network data was verified and corrected, while duplicate points and segments were eliminated, and the data format was standardized."

L371: 59.4 mm of evapotranspiration seems to low, and the water balance in the basin is not closed. Please check.

Thank you for pointing that out.

The data originally cited was sourced from the Shale Hill introduction of the Critical Zone Observatory website (https://czo-archive.criticalzone.org/shale-hills/infrastructure/field-area/susquehanna-shale-hills-critical-zone-observatory/). Upon further review, the value may not accurately represent the evapotranspiration for the region. Consequently, it has been replaced with data from more recent literature, including studies by Jin et al. (2011), Shi et al. (2013), and Brantley et al. (2018).

According to these references, the total annual precipitation is approximately 1000 mm/yr. The annual evapotranspiration ranges between 500-600 mm/yr, and the annual runoff is estimated to be between 400-600 mm/yr. This suggests that runoff constitutes about half of the total precipitation.

Shi, Y., Davis, K. J., Duffy, C. J., & Yu, X. (2013). Development of a Coupled Land Surface Hydrologic Model and Evaluation at a Critical Zone Observatory. Journal of Hydrometeorology, 14(5), 1401–1420. https://doi.org/10.1175/JHM-D-12-0145.1

Jin, L., Andrews, D. M., Holmes, G. H., Lin, H., & Brantley, S. L. (2011). Opening the “Black Box”: Water Chemistry Reveals Hydrological Controls on Weathering in the Susquehanna Shale Hills Critical Zone Observatory. Vadose Zone Journal, 10(3), 928–942. https://doi.org/10.2136/vzj2010.0133

Brantley, S. L., White, T., West, N., Williams, J. Z., Forsythe, B., Shapich, D., et al. (2018). Susquehanna Shale Hills Critical Zone Observatory: Shale Hills in the Context of Shaver’s Creek Watershed. Vadose Zone Journal, 17(1), 1–19. https://doi.org/10.2136/vzj2018.04.0092

RECOMMENDATION

On this basis, I found the topic of the paper relevant, and I suggest a moderate revision before the paper can be published in GMD.

Thank you for your feedback. Your insights are invaluable and we hope our revisions address your concerns.