Review of "rSHUD v2.0: Advancing Unstructured Hydrological Modeling in the R Environment" by Shu et al.

The basic idea behind the paper, that is, availability of an easy-to-use modeling package is good. The rSHUD package should be useful for easier and convenient use of the model. However, the important question is why someone should choose the SHUD model. There are many other distributed hydrological models such as VIC, tRIBS, and MIKE-SHE which are doing something very similar to what the SHUD model is doing. Also, these models have a long legacy. In this case, how does a hydrologist decide upon which model should be used? Perhaps, the better question is what are the advantages of the SHUD model over the other already existing and well tested models? This information needs to be discussed in the paper.

The description of the model is quite unclear. Does the model use 1-D or 2-D shallow water equation for surface runoff? Is there any provision for capillary fringe above the saturated zone in subsurface? Does the model simulate both the Hortonian and Dunnian overland flow? How is the infiltration calculated, using Richards equation? How is potential ET and, subsequently, actual ET calculated? I think it is important to provide this information in the paper since a hydrologist would want to know what does this package offer that the other packages do not? In fact, the most difficult part of running a giant hydrological model such as SHUD is that these are somewhat opaque to a beginner and the conceptual comparisons with other existing models are difficult.

The model estimates soil hydraulic parameters using pedotransfer functions (PTFs)? Are the PTFs used by the rSHUD package universal in some sense? Also, would the PTFs be able to account for macropores which can be very important for percolation? This brings another crucial point: Most of the effort in hydrological modeling is in calibration of the model parameters. This issue has not even been discussed in the paper. Then, there are uncertainties associated with the modeling and hydrological data which are known to the hydrological community for the last 40 years. Should not a package like rSHUD which aims to make data pre-processing easier provide a program for accounting of uncertainties in data?

Why are the observed streamflows not shown in Figure 8. In fact, the simulated streamflow does not seem very realistic to me; look at the pronounced recession? It seems like a consequence of using unrealistic parameters for the simulation. Therefore, the question is if the rSHUD package provides any tool for model parameter adjustment (calibration)? This is a very important question given that most of the time in modeling is spent in the calibration, not preprocessing or postprocessing of data? The latter is important as the authors point out, but not the main problem in my mind. Further, the monthly Q values are zero for all the months in Figure 8 which does not make sense given that daily values are pretty significant. Why are the result for SHCZO basin not shown?

The way the paper is written, it is unclear at many places what parts of the modeling process are automated and what parts the user needs to take care of?

Specific comments:

Line 47: mathematical equations

Line 49: Also, for hypothesis testing

Line 61-64: Should completely automated modeling even be the aim of process-based modeling given that we want to understand our watershed's functioning which is not possible by ML/DL methods? Note that DL models are still based on correlations and as such do not yield much understanding about physics. Also, given the uncertainties in data which are dominantly epistemic, a fully automated procedure does not even seem like a scientifically sound goal. So, should not the rSHUD package contain some program for data pre-processing so that the user is able to take care of these epistemic uncertainties?

Line 132: solver

Line 146: Really? I am not sure what you mean by 'river outlets at the edge of the watershed'?

Line 161: What slope? Slope of the phreatic surface or the bedrock?

Line 171: Combination of functions

Line 185: What is mean by 'reference data'?

Line 207: Is user supposed to standardize these files? Any guidance on how to do it?

Line 215: "It is necessary that … can occur otherwise".

Line 241: What about the depth to bedrock?

Line 251: 'the' instead of 'The'

Line 275: Any references for this?

Line 285: Explain how the hydraulic parameters are generated.

Line 288: What do you mean by 'overlapping relationship'?

Line 300: a cell

Line 308: 'Vertical flux of water from the surface to the soil' is infiltration? Why not just write infiltration?

Also, adding a table of all the model parameters would be really helpful for the readers.

Line 317-324: Clarify what the user needs to do to tackle this issue?

Line 327: reads

Line 332: What is 'experiential'? So, the melting factor stays the same for each day in a month? Would this not introduce any artifacts at the end of the month where the melting factor suddenly changes?

Equation 1: Subscripts in the equation should not be italic as these are not variables. Same comments apply for equation in the Appendix B.

Line 341: But a modeler would always want to and should use the observational data to constrain the model if such data are available? Your results in Figure 8 show that the parameters used are not adequate.

Why are the results for SCHZO not shown?

Line 406: What do you mean by 'expected minimum resolution of the modeling'?

Line 409: Thiessen polygons are generated for interpolating meteorological data, right? If so, mention this. Also, I am assuming that the meteorological data are used in distributed manner by the model, right?

Line 439: Not clear what you mean by other spatial analysis and hydrological data processing?

Line 445: archived