Geoscientific
Model Development
Discussions

Interactive comment on "Solver for Hydrologic Unstructured Domain (SHUD): Numerical modeling of watershed hydrology with the finite volume method" *by* Lele Shu et al.

Anonymous Referee #2

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The paper introduce the SHUD model, which is a descendant of PIHM (Penn State Integrated Hydrological Model). The paper is very well written and it represents the model structure, mathematical equations employed in the model and examines the model for three different case studies.

Major comments: - The paper specifies changes in the flow simulations and model discretization to be the major improvements to PIHM hydrological model. The authors need to provide information about how they implement the discretization. will the discretization be implemented through the model or using different software such as PIHMgis? This information needs to be provided as a user manual in Github or Zen-

odo. - The link to the model source code is not really useful for other users since there is not any user manual that explains how to implement the model. Without providing examples and a thorough user manual the model cannot be applied by other users. - One clear disadvantage of the SHUD model relative to Flux-PIHM, which is the PIHM model coupled with Noah-LSM, is using a temperature index approach instead of energy balance for snowmelt estimations. - In SHUD model deep groundwater cannot be considered in subsurface flow simulations while in Flux-PIHM it is, which is another shortcoming to SHUD model that authors tried to justify by assuming most rocks are impermeable, which is not the case in some cases. - Adding irrigation to the simulation is not possible in the PIHM model and based on what the authors mentioned on page 8, line 198, it is possible in SHUD model simulations. If true, authors need to add this to the list of differences between two models and explain in the model user manual how is that possible. - One drawback to the PIHM model was the assumption of homogeneous soil properties within each cell, which is the same in SHUD. - Page 9, Line 230: Authors claim that it is realistic to assume that the water exits the watershed only through stream discharge, considering that the groundwater lateral flow is insignificant and minimal in so many cases, which is not true. -Authors mention that the mathematical equations are different than what used in PIHM such that they produce different results using the same parameters. The difference and how they are "better" than equations that were used in PIHM should be explained. - Flux-PIHM addresses most of the improvements mentioned on page 28 such as checking the range of forcing data, exporting initial condition, supporting human-readable input and output. The authors do not clearly show how the SHUD is better than the current existing versions of PIHM.

Minor comments: - Page 5, Line 95: snowmelt unit could not be m3/s. - Page 5, Line 101 and 102: Two different parameters have the same annotations. - Page 15, Equation 13: Define L_j.

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