

Interactive comment on “Hortonian overland flow closure relations in the Representative Elementary Watershed Framework evaluated with observations” by E. Vannamettee et al.

Anonymous Referee #5

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This paper presents an interesting exercise in rainfall-runoff modelling contributing to the literature body of hydrological research. The paper lies well in the scope of the HESS journal.

The authors claim it is an evaluation of the closure relation developed for the concentration overland flow in the REW framework. However, this claim triggers a major concern that the work presented here seems not in line with the original REW framework. The essence of the Representative Elementary Watershed approach is that it attempts to describe hydrological process with the mass balance and thermodynamic principles then guide hydrological modelling at the watershed scale, namely describing

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the flux exchanges between the zones within a REW and between the REWs. The set of balance equations developed in the “REW approach” needs to be mathematically closed so to be numerically solvable. When rainfall-runoff modelling is of the concern, closure of the mass balance equations in the REW approach is the key. That is the reason why research on exploring “closure relations” – the functions to close the balance equations - has been the topic since the “REW approach” was introduced. Ideally, the closure of the equations should be sought on the principles and laws of physics, or on the physically-based descriptions. In practice, however, constrained by our knowledge in hydrology, geology, soil physics etc. at the watershed scale, we might have to lean back on the conceptual descriptions as for the closure functions for the REW equations. Without describing the flux exchanges between the zones of a REW and between the REWs, however, it loses the ground to claim a hydrological modeling to be “within the REW framework”. The rainfall runoff modelling presented in this paper largely deviates from the original “REW approach” although the way to develop the functional description for Hortonian runoff process and the evaluation of such functional description are valuable exercises. It is therefore probably advisable to rename the work.

The major deviations of this work from the “REW approach” appear to be:

1) Delineation of REWs, i.e. discretisation of the catchments into to REWs – apparently the REWs shown in the paper are more like HRUs (hydrological response units). These REWs are not watersheds, on which the “REW” balance equations are built. Virtually, the HRUs could be treated as Representative Elementary Units for which the balance equations can be applied to seek appropriate hydrological process descriptions at a scale finer than the REW scale while still respecting the REW concept.

2) Modelling of the hydrological process – it does not show if the flux exchanges within a REW (essentially HRUs in this work), e.g., flux exchanges between unsaturated zone and the saturated zone (percolation and capillary rise), between the saturated zone and the channel zone (i.e. contribution to baseflow and recharge from channel to aquifer) were modeled. Neither does it show the flux exchanges between the REWs (i.e. HRUs)

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have been modelled.

In addition, some clarifications and justifications are required in the paper:

1) Is it an assumption that the Hortonian flow is the only runoff generation mechanism in the catchments under study? No baseflow contributes to the catchment discharge at all?

2) It is stated in the paper that “based on this relation, the scaling parameters can directly be estimated from observable REW characteristics and measurable boundary conditions without the need for calibration of conceptual parameters.” I am not sure if the properties and boundary conditions at the “REW”-scale, except for the geometries, such as the hydraulic conductivity, infiltration capacity etc. can be observable with the technology currently available, although such properties at the point-scale can be measurable. Even the “REW scale” is often arbitrary depending on the choice of discretisation of a catchment to REWs.

3) It is assumed that the “L” and “M” catchment are independent from each other. If looking at a larger scale, these catchments can be the REWs of the parent catchment of them. Then how could we say that there is no dependence between them? This assumption is not convincing if no data to support/justify it.

4) It is subjective to state the model performance as good with those low values of Nash-Sutcliffe values.

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