Hydrol. Earth Syst. Sci. Discuss.,
https://doi.org/10.5194/hess-2019-533-RC2, 2019

Hydrology and Earth System Sciences
Discussions

Interactive comment on "Surface water and groundwater: Unifying conceptualization and quantification of the two "water worlds"" *by* Brian Berkowitz and Erwin Zehe

Anonymous Referee #2

Received and published: 10 December 2019

The authors present a contribution stressing the observation that surface and subsurface systems should be described by a single model, since both systems are "a manifestation of self-organization". While (of course) I agree with the obvious observation that surface and subsurface systems are governed by the same physical principles (conservation of mass, momentum and energy) I do not agree (in general) with the observation that a "single model" can efficiently and with the same level of accuracy capture the behavior of all systems. Taken to the extreme: we all know that the Navier-Stokes (NS) equations can describe incompressible fluid flow in (simple and complex) systems. However, direct solution of the NS equations is typically not feasible (in general) for turbulent flow or flow in large aquifers. This is why, in various disciplines and

with reference to specific topics, diverse (simplified) models/approaches have been developed, both with reference to surface and subsurface flow conditions.

Then, the authors stress the ability of Continuous Time Random Walk (CTRW) to describe non-Fickian transport in heterogeneous (surface and subsurface) systems. CTRW has a long history (it was originally introduced by Montroll and Weiss (1965), to the best of my knowledge). It has been widely used by the subsurface hydrology community and it allows including the impact of heterogeneity on transport. The model fully depends on the pdf of transition time (i.e., the weighting time in between two jumps). This pdf is an input function in CTRW; it has to be known "a priori" and it is (usually) modeled as a truncated power law, thus embedding fitting parameters. Here, the authors argue that CTRW could be used also to simulate transport in surface systems. Indeed, several studies along this line have already been presented in the literature, as also acknowledged by the authors, albeit not at the catchment- scale.

In summary, I do not clearly see the novelty of the present contribution. No original works/results are presented. The manuscript looks like an "opinion" paper where the authors present an overview of previous work in surface and subsurface systems (with particular emphasis to CTRW approach). The "novelty" should be the suggestion of future works where CTRW could be applied to simulate the transport feature at the catchment scale. This observation appears not at all surprising to me. CTRW is a tools allowing to embed the effect of the heterogeneity of the system on transport features via the use the transition time distribution, regardless the system considered (surface of subsurface). The drawback of this approach is that the pdf of the transition time must be known "a priori" as well as its parameters (that are fitting parameters and must be estimated via available data).

In conclusion, given the flavor of the study (at least the way it is perceived through my analysis), my suggestion would be to reconsider the scope of this contribution. This can be achieved it by framing it in the context of a review or, probably better, an opinion paper. This is the spirit with which I would recommend a set of major revisions.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., https://doi.org/10.5194/hess-2019-533, 2019.