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Interactive Comment

Interactive comment on "A measure of watershed nonlinearity: interpreting a variable instantaneous unit hydrograph model on two vastly different sized –watersheds" *by* J. Y. Ding

Anonymous Referee #3

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General Comments

This paper gives a detailed description of a unit hydrograph derived from a non-linear storage relationship. The first part of the paper gives a reasonably detailed description of the derivation of the subsequent form of the unit hydrograph, though it must be noted that the some of this material has been published previously, and therefore is more a review of the literature than a new piece of work (of the first 21 equations, 14 appear in Ding (1974). The only difference the derivation in these papers (other than the order of the equations and the accompanying text) is that this paper lets delta t tend to zero, giving tp = tL. This does not imply that the derivation in this paper should be removed, only that most of the first 12 pages is a review of previous work rather than a significant new contribution.

The second part of the paper applies the approach to two catchments of considerably different sizes (0.11 and 186 km2). While I find the concept of the use of a non-linearity interesting, there is insufficient evidence presented to evaluate whether the form of the non-linearity described in this paper is appropriate (see specific comments).

While the paper is well written, the language used will limit the potential readership of the paper. The paper would also be considerably improved by including more figures showing the application of the VIUH to the recorded events.

Specific Comments

My main concern about this paper is the data used to test the approach. With only 2 catchments, and a total of 9 events included, it is difficult to access how generally applicable the approach is. At best, the observations tend to support the approach, but are insufficient to verify that the approach is reproducing the observed profiles. This is particularly highlighted in the comment on the application to ungauged basins. In my view, a considerable increase in the number of catchments and events in each catchment are necessary to shed light on the variability of parameter values noted by the author. As it stands, the data suggest that the parameter values are variable, but there is little indication what the nature of the variation is.

The results for the Edwardsville catchment suggest a relative constant N for 4 of the events (mean = 1.79), dropping to 1.47 for the first event which has a significantly higher rainfall intensity. On the basis of 1 event, the tentative conclusion is that the rainfall intensity is causing a change in the value of N. There is low confidence in this result as it is based on only 1 event, and there is no information concerning how the value of N varies with rainfall intensity (e.g. is it an abrupt change at a particular rainfall intensity, or a continuous change above some threshold).

For the Naugatuck River catchment, rainfall intensity data are not given, so no relationship between the value of N and rainfall intensity can be explored. There is a relationship between peak discharge and N, though how much the peak discharge is due to rainfall depth versus intensity cannot be determined. A key interest of mine would be how could this form of the unit hydrograph be applied in data poor areas such as developing nations? This issue is a key component of application of the approach to ungauged basins. In such areas, typically only daily climate and streamflow data are available.

Technical Errors

page 2117, line 22:

I do not think the author is correct in stating that u(t) represents the flow acceleration. This would only be the case if q(t) is the flow velocity. Since q(t) is the flow discharge, q = Av, where A is the cross sectional area, and v is the flow velocity. Thus dq/dt = Adv/dt + vdA/dt. Consequently, u(t) is related to the flow acceleration, but does not represent it unless the second term (vdA/dt) is significantly smaller than the first term (Adv/dt); or that the second term could be expressed somehow in terms of dv/dt.

page 2120, line 4:

replace ! with 1

Interactive comment on Hydrology and Earth System Sciences Discussions, 2, 2111, 2005.