Hydrol. Earth Syst. Sci. Discuss., 2, S896–S899, 2005
www.copernicus.org/EGU/hess/hessd/2/S896/
European Geosciences Union


Hydrology and Earth System Sciences Discussions

# *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 #2**

Received and published: 9 November 2005

General comments

The author presents a study that in essence splits into two different (although related) topics. The first part of the manuscript discusses similarities in mathematical descriptions of channel routing, overland flow, and catchment runoff. It is demonstrated how the concept of the variable instantaneous unit hydrograph (VIUH) can be applied to tackle all of the above phenomena. The second part of the manuscript applies the VIUH model to two datasets reported ca. 45 years ago. The two datasets are from two catchments that differ in size significantly (11 hectares vs. 186 km2). My first concern is that although the two topics are related, it is not totally clear how they support each other in the same manuscript. The title of the study refers solely to the second topic, and the conclusions presented in Section 9 also mainly concern the case stud-

ies using the two datasets (i.e. the second topic). I would encourage the author to present a clearer link between these two topics to help the reader to understand, how the similarity discussion supports the objective of the study given in the title.

I pay a lot of credit to the author for referring to many earlier studies, some of which are many decades old. It surely is valuable to have such a list of earlier work reported in one place, allowing hydrologists practising now to gain an understanding how the science of hydrology has developed over the last decades.

In derivation of the variable IUH (Section 6.1), I would suggest the author to rely still more on his own (and if needed others') earlier work. The author states in Section 6 in line 18, that 'only those results required for this review are summarized below', but still there is a long derivation presented before arriving at Equation 15, which is the same equation as Equation 22 in Ding (1974). In Ding (1974) there does not seem to be an explicit equation for the time to peak, but maybe its derivation is somewhere else. There is a risk that the long derivations of such equations get too much emphasis compared to the actual message of the manuscript, and it is not necessary to repeat them if they can be referred to easily accessible hydrological literature (such as Ding, 1974, in Journal of Hydrology).

The model calibration methodology remained somewhat unclear to me. The author applies a methodology that he calls 'the variable IUH shape factor method', detailed in Section 7.1, then inserts the resulting parameter values into the convolution integral (Equation 7), and finally compares the resulting hydrograph peak rates with observations. Now, should the modelled peak rate differ from the observed one, does it suggest that 1) the VIUH model is not flexible enough to describe the hydrograph (even if Equation 7 and some optimisation method was used to obtain the best match between modelled and observed flows), or 2) that the 'shape factor' calibration method is not yielding the optimal parameter values? I would urge the author to be very clear when presenting the 'shape factor' calibration method, and in particular when discussing the differences in modelled and observed flows - and their implications to modelling.



**HESSD**

2, S896–S899, 2005

In Section 9 (Summary and conclusions) the author should clearly state what is the message of this manuscript, and make a clear distinction between earlier work and current work. Some comments on the individual points from a. to l.

a. and b. These are results from earlier work, right?

c., d., e. and f. These all discuss how the parameter values differ between different event intensities and different catchment sizes. In particular the former (i.e. validity of the linear IUH for events of varying intensities) has been studied extensively in the literature, with the author having an appreciable contribution there himself. If this is the main finding of the manuscript, I would encourage the author to include a much more detailed discussion on the topic - instead of just listing the parameter values. Also, the author discusses the degree of nonlinearity. By far the greatest nonlinearity in the hydrological response of streamflow to rainfall is in conversion of rainfall into effective rainfall, which is highly dependent on antecedent moisture conditions. This should be mentioned.

g, h. Not relevant, see author comment in the discussion forum.

i. See comment on calibration method above.

l. Even in a gauged catchment, the VIUH parameters change according to the event size. Hence, in order to be able to apply the method to a gauged basin, one should be able to relate the intensity of effective rainfall to VIUH parameters? Is this correct? Has it been done? Now, in particular if the above is correct, I would encourage the author to argue the applicability of the method to ungauged basins in much more depth.

Specific comments

Section 2, line 6 Is it necessary to give the unit as mm/dt? Picking some unit for time would look better.

Section 6.3, line 17 Doesn't u(tp) (Equation 15) depend on c, too?



HESSD

2, S896–S899, 2005

Interactive Comment

Section 6.4, lines 16-18 It is a bit confusing to change the notation. E.g. earlier i(0) referred to the input at the beginning, now i(1) refers to the input at the beginning.

Section 6.5, equation 15 Unit of q? I get from the right hand side of the equation: (mm h-1)ˆ1/N mm-1 mmˆN h = h ˆ (1-1/N) Did I do something wrong?

Section 6.9, line 19 Remove the word ‘elsewhere’.

Section 7.1, line 25 Please explain what you mean by the ‘finished form of unit hydrographs’.

Section 8.1, line 8 Is the shape factor really a function of N only? Please see comment “Section 6.3, line 17”

Section 8.1, line 11 It might be worth mentioning also here that the storm duration was three hours. Now it is only said in the table.

---

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