

## ***Interactive comment on “Bringing it all together” by J. C. I. Dooge***

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General Comment

The paper highlights the author’s astounding insights, perceived connections and fusion, developed during a lifetime of involvement and creativity in defining the science of hydrology.

The almost artless way in which he presents the means of simplifying mathematical models to achieve solutions for “all practical purposes” hides a considerable background of understanding, development and mathematical rigour. If there is one message that jumps out of the paper, it is: “Be conscious of the scale of the observations and devise models which describe the phenomena as simply and faithfully as needed.” This paper presents a timely reminder of a valuable heritage, which might be ignored in the hunt for faster, more detailed models describing a perceived hydrologic “truth”. It

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is a reminder that there is a large number of phenomena (by no means all) that can be elegantly and simply modelled using linearizing assumptions.

## Specific Comment

The abstract suggests a more substantial treatment of “Parallels between stochastic and deterministic analysis” than appears in the body of the paper. The description of the linkage is limited to a comparison between linear storage models and the GUH, the latter having a stochastic genesis which was not emphasized in this treatment. The only other reference to the link is in section 10, where it is noted that the gamma distribution appears in deterministic and stochastic applications in two guises. In retrospect, compared with the detailed and insightful modelling of physical processes in the remainder of the paper, this tenuous link seems to have been given too much weight in the introduction. Finally, a concluding paragraph is noticeably absent.

## Technical Comment

The most important thing to repair is the set of Figures, which appear to be photocopies and are unclear; these should be redrawn where they are not electronically available. In addition, the captions of the Figures would benefit from being expanded to fuller descriptions in line with the text.

In more detail:

Fig. 3: enlarge A, B, C & D

Fig. 4: distinguish between curves for different ponding mechanisms

Fig. 5: annotation is too small and is illegible

Figs. 6 & 7: LSV = Linearized St. Venant? is not mentioned in text nor caption; SLR = Single Linear Reservoir? Circle is offset in Fig. 6; should be positioned at point (1, 2); Weighted outflow = Muskingum?; Cascade = Kalinin & Milyukov = Nash?

Fig. 11a: 2.5 mm/h should be 25 mm/h?

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Textual corrections and suggested modifications follow:

P42:25 that a large

P43:25  $10^8$  not  $10^6$

P44:2 are distinctly

:5 consider 'hydrogen sulphide'?

:13 elements (36

:14 viscosity, by

:end Consider adding a paragraph such as: "Remarkably (and to some, paradoxically) as will be shown in the sequel, it is often the case that the careful approximation of non-linear processes by linear ones yields solutions which are close enough for practical purposes at the scale of the phenomenon."

P45:2 surface water

:22 moisture content, c

:25 Wang & Dooge missing in references

p46:3 conditions (lower right quadrant in Fig. 3) these

:13 consider adding a sentence such as: "Even Horton's linearizing approximation yields solutions which are uncannily close to of the more complex models."

:24 hydrology is often

p46:6 & 7 terms, .. coefficient,

:13 replace: probability by permeability

:16 perhaps add: "Again, the strength of the linearity assumption is observed."

:18 The primary process in

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:23 This idea

:26 approximation,

p48:10 lower case 's' and define  $q_{[sub]e}$

:12 integral symbol missing from lhs of equation

:14 s & q should have  $_{[sub]e}$ ; last parenthesis should be raised to power 1/c; equation label (1d); define  $s_{[sub]e}$  in terms of  $q_{[sub]e}$

p49:4 lower case  $s_{[sub]0}$  and  $q_{[sub]0}$ , not  $_{[sub]c}$

:12 dividing the discharge by

:13 Fig. 5a; twice

:14 single curve

:21 Eq. (1c)

p50:4 consider adding such as: "The scaling, in this case, does not linearize the treatment, but permits a simple, single, sensible dimensionless expression to describe a family of processes."

:14  $U_{[sub]1}^{[sup]prime}$

p51:3 LCR already defined on previous page

:7 These higher moments can .. to two

:8 & 9 parameters,  $s_2$  and  $s_3$ , by

:18 & 22  $F_{[sub]0}$  is given as F in Fig. 6

p52:7 solutions in

:13 A matter of style: should the footnote not be removed to the References ?

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:16 insert: shown as a dotted curve in Fig. 6

:16 solution region in the range (0.192, 0.577) which corresponds to values of the Muskingum  $x$  in the range (0.22, 0.40). This interval corresponds

:18 the relationship (not shown) is

p53:3 & 4 Kalinin and Milyukov (1957) and Nash (1958)

:18 solution is given by

p55:24 Shamseldin and Nash (1998, 1999)

:28 In this case, for a GUH of order between 2 and 5,

p56:6 the dynamic equation are

:9 Fig. 5a

:10 parameter  $c$  in Eq. (1a), the

:11 the use of dimensionless relationships as demonstrated in Fig. 5b

:12 The latter simplification indicates

:18 the equation for the  $i$ th storage element ( $i = 2, 3, \dots$ ) as:

:20 volume  $S_{i=0}$  for  $i = 0$  and

:21 given by Eq. (1d)

p57:1 can be written (for  $i = 2, 3, \dots$ ) as:

:2  $S_{i-1}$

:3 end  $I(t)$  into 1st storage element is multiplied

:5 on rhs of equation:  $I'(t)$

:8 Eq. (11c)

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:17 Eq. (13)

:18 storms of a given recurrence interval (T) have .. is nearly inversely

p58:10 unit hydrograph using Eq. (13b), results in Fig. 10b,

:15 two of the

:16 they experience similar

p59:6 hydrograph by the

:7 catchments.

:19 New York, 329 pages,

p60:11 approach, Bulletin

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