

Interactive comment on “The geomorphic structure of the runoff peak” by R. Rigon et al.

Anonymous Referee #2

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General comments:

The paper describes a valuable methodology for the investigation of the dependence of peak flows on geomorphic and hydrodynamic characteristics of river basins.

The paper is well written (very good English grammar and usage). However, the description of the methodology should be improved. Also, the organization of the figures illustrating some aspects of the methodology is not helpful, if fact, the captions generate confusion (as explained below in the detailed comments linked to the text). In summary, the methodology and the organization of figures need to be improved for the paper to be clear and useful to the hydrology community.

Detailed comments linked to text:

1) The methodology for the determination of the time to peak is unclear. The paper

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states: “The time-to-peak, t^* , can be found either for $t = t_p$, or by solving Henderson’s equation” Why “either”, later in line 20, the authors mention “Therefore the solution, t^* , of Eq. (4) needs to be searched in the interval $[t_p, c]$ ”. This seems to indicate that the solution is also valid for t_p . It also indicates that it is valid for τc then equation (4) should probably be valid for $t_p \leq \tau c$.

2) Figures 2 and 3 are mentioned respectively in the last paragraph of section 1.1 (page 1034) and in section 1.2 (page 1036), however both figures refer to kinematic wave celerities that are introduced within the framework of the geomorphologic width function approach described later in section 2.1 (page 1038). The next two points give more details for each figure.

3) Fig. 2 mentions the use of hillslope velocities u_h , and the yet undefined celerities u , and has been derived using the “rescaled” width function approach not discussed in the paper. Instead, the paper discusses the derivation of the geomorphologic unit hydrograph using the width function approach in section 2.1 (page 1038) and the definition of u (flood wave celerity in channels) is in line 18 in that page. The caption mentions q that has not yet been defined in the paper (q is defined in section 3, page 1041). The caption also mentions the existence of secondary peak flows, not mentioned anywhere else (it might be more appropriate to remove the grey line from this figure), this is confusing, as the steps for obtaining this figure are not properly discussed. Therefore, this figure does not help in clarifying the methodology; instead as it stands, it generates confusion.

4) Figure 3 also generates a similar degree of confusion. It gives the graphical solution of equation (9), in section 1.2. However, as in the previous figure, the caption explains that the figure was derived using several concepts not yet described in section 1.2 (that is the width function approach). How is it relevant at this point the selection of different celerities if the link between celerity and the hydrograph has not yet been done? The notation for celerity in this figure is not consistent with that adopted in the rest of the paper. Note also that associated with the lack of description of the particular

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application that leads to this figure, is the selection of $m=0.63$, for the Longo basin which looks “arbitrary” at this point, as the selection of case study catchments has not yet been discussed (it is discussed in section 3).

A solution to the issues mentioned in points 2-4, regarding Figures 2 and 3 (probably not the only one, as the authors might find a better alternative) would be to move the figures and explain the concepts that they illustrate after section 2.1, probably in section 3 (case studies). If hillslope celerities have been used in the derivation of the hydrograph using the width function approach (as suggested in fig. 2), then the corresponding equation should be probably included and briefly discussed so the readers could understand the application of the methodology.

5) Page 1040/1041, the portion of the methodology explained in the last paragraph of section 2.2 is unclear. Line 17 in page 1040 states: “once the function $W(u t)$ in Eqs. (13), (14) and Eq. (14)” Should it be Eq. 15? The variable “ x^* ” has not been defined. Please explain clearly why the domain of $w(t)$ is infinite if eq. (17) has a well defined domain. The concepts in this last paragraph need to be explained in more detail, and some of the derivations that are mentioned here (i.e, substituting the time to peak into Eq (18)) included, so that the explanation becomes more clear.

6) Page 1042, line 1 states: “It is observed that $\tau_c \dots$ ”, it is not clear “how or where” it is observed. Please include a more thorough and clear discussion (a figure might help in clarifying this “observation”). Line 2 states: “In all these cases...” : it is unclear “which” cases, does it refer to the different basins? Please illustrate and/or explain the impact of hillslope extent on τ_c .

7) Section 3/Figure 5. This figure mentions hillslope celerities, but as mentioned before, the equations in the paper do not include the effect of hillslopes. Section 3, page 1042, line 19 also mentions $r=100$ (which was only defined in the caption of figure 2). Please, add the necessary equations and discussion so the methodology and application becomes clearer.

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8) Figure 5b seems to have some grey points, are they different from the black points in that figure? What are these grey points?

9) Figure 6. The caption mentions: “Notice how $Q_p/(p AT)=A^*/AT$ does not depend on channel flow velocity, since Eq. (5) remains valid also in this more general case” The figure does not seem to display any variation of $Q_p/(p AT)=A^*/AT$ with channel flow velocity, so this comment seems misplaced here.

10) Page 1044, line 4. Channel velocities are denoted “uc”, in other parts of the paper channel velocities (celerities) are denoted as u. Please unify notation.

Minor corrections:

11) Abstract, line 6: “Semi-analitical” should be replaced by “semi-analytical”.

12) Page 1034, line 13. “D’Odorico and al.” should be “D’Odorico et al.”

13) Page 1037, line 10: evaluated as a function “of” time to peak.

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