Hydrol. Earth Syst. Sci. Discuss., 5, S389–S392, 2008
www.hydrol-earth-syst-sci-discuss.net/5/S389/2008/

Hydrology and Earth System Sciences Discussions

Interactive comment on "Effects of runoff thresholds on flood frequency distributions" *by* A. Gioia et al.

Anonymous Referee #2

Received and published: 16 May 2008

The paper continues the series of efforts to estimate the flood frequency curve analytically. It is a very difficult task taking into account all the uncertainties connected to runoff production and the obvious requirement that it has to be mathematically tractable. As a result very strong simplifications are necessary. The authors of such a procedure must have a perceptual model in their minds which represents some average behaviour of some groups of catchments. The work done by the authors of the present paper is valuable in this sense but the presentation needs much improvement. The terminology and description of the two mechanisms of runoff generation referred to in the paper are rather imprecise. I would suggest the authors go through some book or review article on experimental hydrology and correct their text. There is e.g. a series of books on hillslope hydrology, starting with Kirkby, M.J. Hillslope Hydrology, Wiley

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(1978). A brief summary written for modellers is in Beven, K. Rainfall Runoff Modelling, The Primer, Wiley, 2001. What I find especially misleading is the description of the saturation overland flow. The saturated areas near the stream are saturated from below by the shallow groundwater which gets to the level of the soil surface. There may be return flow in some places on those areas, i.e. water going in the opposite direction to infiltration. In catchment studies also other mechanisms are found than just saturation and infiltration excess mechanisms. However, I do not think it wrong to model only those two, it is often done and it might work well. It is possible to parametrise the catchment behaviour in different ways. Trying to capture all the processes makes more harm than benefit because each new process requires new parameters. More parameters mean a better fit on the data available but more problems on future different periods of data because of overparametrisation. So, I would not really mind if the process is continuous or has a series of thresholds. It is possible to get acceptable results with a more or less wrong model for the catchment, as long as we are interested only in the discharges at the outlet. Remember Horton overland flow which does not occur very often on permeable natural catchments and it had been used and it worked. Horton new much better than that, but had no computers at his disposal (see Beven, 2004, Hydrological Processes, 18, 3447-3460). If, however, we want to do spatial predictions the simplifications must be done much more carefully. In the rainfall-runoff modelling the most difficult part (the key component) is the computation of the loss because of the large non-linearity. Every hydrological model has a problem to model correctly the first runoff response after a longer dry period. This concerns wet catchments as well. It seems reasonable to base the thresholds on the losses but the treatment is still rather simple and we are getting no idea about how large the uncertainties are. The positive thing about this paper is perhaps the expression of the losses (eq. (8)) which seems to me more suitable than soil parametrisation because soil parameters are scale dependent (at least at this difference of scales between soil samples and the catchment scale. On the whole catchment preferential pathways might be of overwhelming importance). Similarly, like the 1st referee I find the paper rather unreadable and surprisingly,

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the previous articles too. I would suggest to include a worked out example of a selected catchment which would go step by step and would be documented by a small figure of the functions and observed data at each step. Also a list of symbols with the equations repeated would be helpful and more precise references to things overtaken from previous studies. I think the unreadability problem is partly a problem of the two communities of hydrologists - one used to look quite closely at the catchments in reality and the other looking at mathematical functions. We need more communication. I am looking forward to seeing the paper published after correcting the terminology and making it more readable and for the future work of the authors to their looking at the losses more deeply and quantifying uncertainties in their estimates.

Technical suggestions (stylistics, specific questions) On several places "to individuate" - to distinguish?? 908/15 "effects....is explained" 908/2 How are the IDFs constructed ? total or net rain??? Probably total?? 908/3-4 What are the definitions of lag time and critical rainfall duration ? I have the same problem as the referee no.1 908/6 Again the same problem but I know from the previous article. I agree with the referee 1 that a precise reference should be given. 909/15 "....testifies the strong control of climate-soil-vegetation factors on flood frequency" I think everyone is sure about that but some proportions of this for different cases would be helpful if it does not get lost in the uncertainty of the loss. 909/24 "rainfall are likely" 910 The actual equation of the 2000 paper is not given. 912/10 I do not understand about "the first threshold" eq. (18) Is there not lambdaH missing? 916/15-19 How do the estimates of C compare to those computed from rainfall-runoff data? For how long period are they meant (just for the event??, how long falling limb would you consider?) C would very much depend on the antecedent precipitation. 917/24 How many events were there in the tail ? i.e. those you consider HIGH?? Have you tried e.g. bootstrap to look into the variability?? 918/4 we are all hoping for new technologies but you should realize that for your problem we would need an estimate on the whole catchment and pretty deep in depth 918/10 is the U.S. Weather Bureau data good for your part of Italy - what about orography?? Please check prepositions going with verbs.

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