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Hydrology and Earth System Sciences Discussions

Interactive comment on "A robust and parsimonious regional disaggregation method for deriving hourly rainfall intensities for the UK" *by* D. Maréchal and I. P. Holman

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1. This paper deals with the study of the statistical distribution of hourly rainfall depths of the most intense rain hours during a day. Hourly depths are previously made dimensionless by dividing them by daily depth. The dimensionless depth of the hour with most intense rainfall is assumed to be distributed according to the lognormal distribution, which can be used to generate the peak hourly rainfall given the daily rainfall depth. For hours that are ranked second to fifth (in terms on rainfall intensity) some complex regression relationships are developed, which estimate the dimensionless depth of each hour based on those of hours with lower ranks.

2. The method is applied to a huge data set of rainfall observations in the UK, com-

prising 23 229 days with at least 15 mm of precipitation from 238 weather stations throughout the UK, classified in several climatically homogeneous regions. The extent of the application and the data set certainly makes the paper useful for those interested in the UK rainfall.

3. The authors call their method a disaggregation method and characterize it robust and parsimonious. I would not agree that the method performs disaggregation, because it does not preserve (or consider) the temporal structure of the process. Also, I am not sure about robustness (given some theoretical weaknesses discussed below) and parsimony (given that the number of parameters used – six per season – is rather typical in rainfall models). Here I would like to note that a theoretically sound stochastic rainfall model (e.g. the Bartlett-Lewis model) with six parameters can describe the rainfall process on a range of scales simultaneously, whereas the rather ad hoc method of this paper requires this number of parameters for one scale only - the hourly scale. Not to mention that for the complete description of distributions of all 24 hours the method would require 25 parameters at least.

4. I am not sure if I have understood the motivation of this work. Also, I have some problems to follow the literature review given in the introduction. For example, is the target of the paper to develop a simulation technique, conditional on daily depths being known? Or is it to reconstruct rainfall records at hourly scale for raingauges where only daily measurements are available? The second problem is different from the first and requires a multivariate modelling approach, as shown by Koutsoyiannis et al. (2003). Why existing modelling approaches are not sufficient for the authors' target? Is the practical and ad hoc technique they develop really needed?

5. In my opinion, if the authors would really wish to develop a regionalized base for a rainfall disaggregation model, they could simply adopt one of the available stochastic rainfall models and regionalize its parameters. As it was shown by Koutsoyiannis and Onof (2001), the adaptation of a typical model (in their case, the Bartlett-Lewis model) into a disaggregation model can be done in a rather simple manner.

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6. On the other hand, even if one wishes to avoid the use of a stochastic model, again disaggregation could be performed based on simpler tools such as the intensity-duration-frequency curves. Such an approach has been demonstrated by Koutsoyiannis (1994).

7. In contrast to the consistent approaches mentioned in points 5 and 6 above, the approach chosen by the authors, in my opinion, is very complicated if one wishes to give it a theoretical basis, rather than present it as an ad hoc practical technique. To justify theoretically a certain distribution function for the ratio of hourly to daily rainfall, based on the distribution of, say, hourly depth is very hard, if not intractable. Then, to produce the distribution of the highest among 24 hourly dimensionless variables, based e.g. on the theory of order statistics, is again very difficult given that the process of interest is temporally correlated. Not to mention how difficult the theoretical derivation of a regression relationship, such as that of equation (2), is.

8. Apparently, one may argue that the theoretical derivation of distributions may not be necessary and their choice based on exploration of the available data suffices. I have, however, a different opinion. For example, in the last years evidence has been accumulated that the distribution tails of rainfall are power type rather than exponential type (e.g. Koutsoyiannis, 2004a, 2004b, 2005). I think that this must be taken into consideration and I doubt if the (exponential type) log-normal distribution suggested in this paper for the dimensionless variables is consistent with power type behaviour of hourly rainfall. In this respect, I am afraid that the distribution tails are underestimated by the method.

9. Given the importance of the tails in hydrologic practice, it has become a standard manner to present and compare distributions on probability plots that magnify the behaviour of distributions at the tails, rather that to use Cartesian plots. In this respect, the plots of Figures 2 and 5 do not provide the appropriate information to the reader.

10. The indexing convenience used in the mathematical part of the paper creates

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confusion. Thus, around equation (2), it seems that h_1 (for k = 1) denotes the dimensionless depth for the first hour, whereas around equation (4) the same symbol denotes the highest of 24 dimensionless depths. I would suggest using h_k for the first case and h_(k) for the second case (i.e. putting the index in parenthesis).

11. The cumulative depth H_k defined in equation (3) is not used further on. The fact that successive H_k are dependent is more than obvious, so this discussion is not required. So, I would suggest deleting the whole discussion about cumulative depths. What is certainly needed is a discussion of the dependence of successive h_k and this is missing.

12. The threshold of 15 mm adopted in this analysis needs some justification.

References

Koutsoyiannis, D., A stochastic disaggregation method for design storm and flood synthesis, Journal of Hydrology, 156, 193-225, 1994.

Koutsoyiannis, D., Statistics of extremes and estimation of extreme rainfall, 1, Theoretical investigation, Hydrological Sciences Journal, 49(4), 575-590, 2004a.

Koutsoyiannis, D., Statistics of extremes and estimation of extreme rainfall, 2, Empirical investigation of long rainfall records, Hydrological Sciences Journal, 49(4), 591-610, 2004b.

Koutsoyiannis, D., Uncertainty, entropy, scaling and hydrological stochastics, 1, Marginal distributional properties of hydrological processes and state scaling, Hydrological Sciences Journal, 50(3), 381-404, 2005.

Koutsoyiannis, D., and C. Onof, Rainfall disaggregation using adjusting procedures on a Poisson cluster model, Journal of Hydrology, 246, 109-122, 2001.

Koutsoyiannis, D., C. Onof, and H. S. Wheater, Multivariate rainfall disaggregation at a fine time scale, Water Resources Research, 39(7), 1173 , 1-18, 2003.

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Reviewer's assertion: It is my opinion that a shift from anonymous to eponymous (signed) reviewing would help the scientific community to be more cooperative, democratic, equitable, ethical, productive and responsible. Therefore, it is my choice to sign my reviews.

Interactive comment on Hydrology and Earth System Sciences Discussions, 2, 1047, 2005.