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Hydrology and Earth System Sciences Discussions

Interactive comment on "Mapping mean and variance of runoff in a river basin" *by* L. Gottschalk et al.

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The paper presents an approach to the description of spatial patterns of mean and variance of runoff in a river basin. Using simplified assumptions, the authors derived the closed form expressions for the time-space covariance of runoff. An ability of the presented approach to be used for mapping the runoff statistical properties is demonstrated by the example of the Moselle basin in France.

General Comments

This is an exploratory study which is, to my knowledge, one of very few attempts to derive analytically spatial statistical properties of runoff in a real river basin. The paper contains interesting ideas which could make a useful contribution to future studies of the spatial patterns of runoff.

There are a few minor changes I suggest to take into account by the authors.

1. Application of the presented approach for estimating statistical properties of runoff of small durations (1 hour, 1 day, 5 days, etc.) seems to be questionable for most of rivers because of non-stationary of the corresponding time-series. In particular, if runoff in the Moselle River shows distinct seasonal variation, than it is not clear what is meant by Cv of 1hour (1 d, 5 d, 30d) runoff shown in Fig. 3. Also the maps of Cv for 1d and 30d runoff (Appendix A) are difficult to interpret in this case. So more attention should be concerned in Section 2 on problem of seasonality in the observed runoff series. Additionally, it may be useful for a reader if the authors show typical runoff hydrographs for the river under consideration.

2. The sentence “The first order moments (the long term mean values) do not depend on the duration D ...” (Page 7; Line 5) is not supported by Fig. 2. A reader can suggest that the different durations of runoff are shown in Fig. 2, since the number of points in this Fig. exceeds the number of gauges in Fig. 1. If this is the case, I suggest to separate (e.g. by color) runoff of different D in Fig.2

3. The autocorrelation function of the monthly averaged runoff is shown in Fig. 4a for the time-lags up to 2 months. In order to make a conclusion (Page 9; 2nd line from the bottom of the page) about a heavy tail of the function, it should be shown for the longer lags. Moreover, it is difficult to compare the autocorrelation functions of runoff of different durations, which are shown under the same time-lags. I suggest showing the functions (Fig. 4a) in separate figures.

4. Of course, “It has not been possible to explain all the details in the behavior of the correlation functions” (Page 10, Line 14). However, the fact that the functions show “small increase before decaying” (Fig 4d) may be explained. The cross-correlation between the outlet and the upstream site should reach maximum where the time-lag equals the time of concentration between the sites (at least if there are no large tributaries between the sites).

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5. “The characteristic space scale was estimated to K=50 km” (Page 12, Line 11). Is it constant for the whole basin including sub-basins of area about 100 km2?

6. It would be interesting for a reader if in the Discussion Section a little more attention was focused on the problem of the parameter determination. In consistency with the presented, pure statistical approach the parameters of the IPR-model are based fully on the available streamflow records and not related to the basin conditions. Beyond any doubt that the improvement of the presented approach as well as the extension of its feasibility are connected with determining relationships between the parameters (e.g. the correlation function of IPR) and the spatial conditions of the catchment (e.g. river network structure, spatial patterns of soil, topography, etc). Obviously, searching these relationships is a very complex problem. In my opinion, the progress may be achieved in the context of the derived distribution approach. The authors mention the pioneered paper of Eagleson (1972) as an example of this approach. Among the numerous extensions of the derived distribution approach, I suggest to refer also the papers (Blöschl, Sivapalan, 1997; Robinson, Sivapalan, 1997) where the physical causes of the relationship between the runoff Cv and the basin area are studied.

Blöschl G., Sivapalan M. Process controls on regional flood frequency: coefficient of variation and basin scale. Water Resour. Res., 33: 2967-2980, 1997

Robinson J. S., Sivapalan M. An investigation into physical causes of scaling and heterogeneity of regional flood frequency. Water Resour. Res., 33: 1045-1059, 1997

Technical Corrections

Most of needed technical corrections are listed in the detailed comments of Prof. Blöschl. Additionally, the following corrections are needed:

1. Abstract (Line 7): the word “theoretical” I would suggest to replace with the word “analytical”

2. Fig. 4: I suggest removing analysis of the shown results from the caption.

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3. Eq. 1: the spatial point standard deviation (SigmaX) should be explained just after the equation.

4. Page 14, 2nd equation: (6) should read (5). The corresponding changes should be done in the text.

Concluding Remarks

1. Does the paper address relevant scientific questions within the scope of HESS? YES

2. Does the paper present novel concepts, ideas, tools or data? YES

3. Are substantial conclusions reached? YES

4. Are the scientific methods and assumptions valid and clearly outlined? YES

5. Are the results sufficient to support the interpretations and conclusions? NOT COMPLETELY

6. Is the description of experiments and calculations sufficiently complete and precise to allow their reproduction by fellow scientific (traceability of results)? YES

7. Do the authors give proper credit to related work and clearly indicate their own new/original contribution? YES

8. Does the title clearly reflect the contents of the paper? YES

9. Does the abstract provide a concise and complete summary? YES

10. Is the overall presentation well structured and clear? YES

11. Is the language fluent and precise? YES

12. Are mathematical formulae, symbols, abbreviations, and units correctly defined and used? NOT COMPLETELY (see Referee's Comments)

13. Should any parts of the paper (text, formulae, figures, tables) be clarified, reduced,

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combined, or eliminated? NO

14. Are the number and quality of references appropriate? YES

15. Is the amount and quality of supplementary material appropriate? YES

I recommend the paper “Mapping mean and variance of runoff in a river basin” by Gottschalk et al. for publication in HESS. All the suggested changes are minor and no additional review is needed.

Interactive comment on Hydrology and Earth System Sciences Discussions, 3, 299, 2006.