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

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We thank you Prof. Bolgov for his critical comments on our paper. We agree that the task we try to solve is complex. We are well acquainted with the Russian works on the genesis of runoff formation referred to by the reviewer and also other works on the same topic by other Russian and East European authors. We do not share the opinion that such a reductionistic approach is the way forward. Neither do we agree that the isochrones concept is good starting point for such an attempt. The runoff data at hand will never allow us to identify the basic processes as Prof. Bolgov correctly states. Our point of departure are observations of runoff at different sites in a drainage basin and we want to be able to describe and map the statistics of runoff in this basin based on these observations. We do not intend or need to identify all runoff formation processes as Prof. Bolgov suggests which hardly could be the topic for a journal paper.

To be able to explain the variability in the statistics of these observations it is necessary

to postulate an IPR-process. We need to identify the covariance function of this process and we do it numerically by numerically adjusting the variance function (Eq. B1) to the observed data. This is clearly described in the paper in Section 5. For the time being, we postulate that the IPR process is a composite process and we were able to identify two distinct time scales. The type and parameters of the covariance function are introduced relying of the plot of its aggregated values over basins compared to the corresponding features from discharge data.

In our response to the comments to our paper by Prof. Blöschl we already indicated that in future we intend to bring in more of process understanding when postulating the covariance function. Prof. Blöschl states: “the assumptions made in the paper are consistent with the exploratory nature of the analysis”. Yes, we start with simple assumptions. Our arguments for this are well formulated by the Principle of Parsimony (Tukey, 1961): It may pay not to try to describe in the analysis the complexities that are really present in the situation. Tukey stresses the importance of reconsidering a model structure towards a simpler representation, which might improve the performance of the estimation method. Process understanding might thus help to make better postulation of the covariance function and maybe thereby to improve our results. However, the major problem is the quantity and quality of available data. There must be a reasonable balance between the complexity of the model that we use and the available data.

The IPR is a stationary function of location in space, at point (x,y), and expresses runoff in mm/year, so volume per year and per area unit. It is considered through the paper as spatially homogeneous with order two stationary (expected value and correlation function do not depend of location), a common assumption in random field statistics. Conversely, IPR is not a function of the location along the river, and especially it is not considered per unit width of hillslopes. Despite previous attempts by us (Gottschalk, 1993a) and others, the rather irregular variation of the number of sub-catchments along a river-coordinate and the non stationary character of this lateral inflow function or its correlation function make it quite complicated to rely on it as a working tool, as

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the reviewer himself states. Due to non-linearity in water flow celerity, the isochrone perspective is just a very rough description of water transportation. The shape of the covariance function fitted to data just shows two scales of variability that eventually could be traced back to such hillslope processes or climatic processes, but the focus of this paper is not to elaborate on the link with such processes. Local averaging of water flow along the network is the only process investigated. The lag time that Prof. Bolgov is missing in our paper is clearly expressed as a time of concentration which we relate to the size of the basin area.

In the paper stationarity is postulated in time. The seasonal variability is not treated. We refer to our papers Sauquet et al. (2000) and Sauquet (2006a,b) for how this topic can be handled. Another manuscript on this topic is in preparation. These references will be inserted in the paper. We cannot bring all aspects of the problem into one paper.

The methods used enables to make sound runoff maps from readily available data, and respecting their spatial consistency before turning into any detailed process modelling. The way to do this directly from data, with minimum inference, is the core of the paper. The scientific background of the paper is the theory of random fields (Vanmarcke, 1988) and the paper develops its application in hydrology. The fact that, for the time being, basin process formulations are not part of it, in our opinion, does not reduce its scientific value.

References

Sauquet,E., Krasovskaia,I & Leblois,E. (2000) Mapping mean monthly runoff pattern using EOF analysis. HESS, 4 (1): 79-93.

Sauquet E., Gottschalk L., Krasovskaia I. and Leblois E. (2006a) Predicting river flow statistics at ungauged locations - a hydrostochastic approach. In V. Andréassian, A. Hall, N. Chahinian, J. Schaake (Eds.) “Large sample basin experiments for hydrological model parameterisation - Results of the MOdel Parameter Experiment (MOPEX) Paris (2004) and Foz de Iguaçu (2005) workshops”, AISH Publ. n°307. In print.

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Sauquet, E. (2006b) Mapping mean annual river discharges: geostatistical developments for incorporating river network dependencies. Journal of Hydrology. In print.

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