Hydrol. Earth Syst. Sci. Discuss., 3, S390–S393, 2006
www.hydrol-earth-syst-sci-discuss.net/3/S390/2006/

Hydrology and Earth System Sciences Discussions

Interactive comment on "Catchments as space-time filters – a joint spatio-temporalgeostatistical analysis of runoff and precipitation" *by* J. O. Skøien and G. Blöschl

L. Gottschalk (Referee)

lars.gottschalk@geo.uio.no

Received and published: 7 July 2006

Comments on

Catchments as space-time filters - a joint spatio-temporal geostatistical analysis of runoff and precipitation by Skøyen and Blöschl submitted to HESS

1. GENERAL COMMENTS

The paper is a valuable contribution to the development of approaches/methods for systematic structural analysis of fundamental hydrologic variables over large territories and data sets. The approach gives important indications about process properties.

The study is performed on an impressive set of observations over precipitation and runoff in Austria. The detailed comments below are rather points for discussions than corrections. They might be of help to express the basic assumptions for the analysis and the conclusions more clearly.

2. DETAILED COMMENTS:

p945

The results are evaluated as averages over basin size classes. This approach actually assumes that all basins are non-nested. The covariance and thereby also the semi-variogram have different principal structures between nested and non-nested basins (Gottschalk, 1993a). The covariance is non-stationary with the growth of catchment area along a river.

p946

hs is taken as the distance between the centres of gravity between catchments. For me this is not an obvious distance measure between catchments. The average over all possible distances between pairs points in the respective catchments, or shortly the Ghosh distance as I suggest to call it (Ghosh,1948) , is a more logic alternative. It behaves better when we deal with nested and non-nested catchments. Furthermore it gives a correct variance estimates for a catchment for which the distance between centres of gravity is zero while the Ghosh distance is not.

It is not clear to me how nested catchments have been handled. The correlation between nested catchments is usually very high compared to non-nested ones, as was commented on above. Have the nested catchments been excluded?

p947

Several spatio-temporal semivariogram models have been applied in the structural analysis. The criteria for the selection are that they should satisfy the condition of conditional positive definiteness and be non-separable. The number of parameters dif-

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fers between the four models selected. If I have understood it correctly, the exponential model contains 7 parameters, Cressie-Hung 8, product-sum 11 and fractal 4. The only firm conclusion drawn in the paper is that the fractal model alone does not give a sufficient good fit to the data set. So with this exception the models are flexible enough to give a good fit to the sample semivariograms. This is maybe good enough for a structural analysis.

What I find more problematic is to evaluate what these models really tell us about the hydrologic processes. It is very difficult to tell what the many parameters reflect. Taking the Matèrn class of covariance functions as an example we now that the two parameters of these represent scale and smoothness of the process. Covariance functions can also be derived with a starting point in partial differential equations where then the parameters of the covariance function are referred back to the parameters of these equations. It would be worthwhile to narrow the class of semivariogram models to those more process oriented and try to reduce the number of parameters. Both for the structural analysis, as well as the estimation (interpolation) it is a general observation that the results are not very sensitive to the choice of the theoretical semivariogram/covariance. It is not until we turn to simulation that we really see the effect of the theoretical model.

The scaling exponent "kappa" is a fundamental parameter in the paper, as well as the parameter "mu". It is never shown straightforward how they are determined. I understand it as two extra parameters added to those of the theoretical semivariogram models. If so, it would be of help for a reader if they appeared in the final versions of the applied semivariogram models (eqs. 9-12).

p949

All semivariogram models contain fractal components for time and space to compensate for non-stationarity. Would it be sufficient with only a fractal model in space? The estimated parameter values of the fractal part of semivariogram models shown in Ta-

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ble 6 give a very confusing picture. They differ very much between models. What conclusions can be drawn about non-stationarity and about semi-variogram models? On page 948 it was commented that daily precipitation is almost stationary in time but not in space.

3. MINOR CORRECTIONS

p949, eq (8)

the exponent "a" should be changed to "alfa";.

p967, line 15.

my copy of this paper is from volume 136 and not 16.

4. RECOMMENDATION

This is a very good paper and I recommend publication in HESS.

Lerberget 7 July, 2006

Lars Gottschalk

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 3, 941, 2006.