Hydrology and Earth System Sciences Discussions

Interactive comment on "Top-kriging – geostatistics on stream networks" *by* J. O. Skøien et al.

Anonymous Referee #2

General comments (page P and line L)

This paper presents an innovative geostatistical method that estimates streamflow-related variables by incorporating the nested nature of catchments into account. This method was termed topological-kriging or top-kriging by the authors. This subject is within the scope of HESS as it presents a novel method for spatial modelling in hydrology. The methodology presented is very convincing and easily understood with a lot of relevant and well integrated mathematical formulae. The figures are also very helpful to understand the scope. All the others expectancies for evaluating this paper are fulfilled except maybe for one point.

This concerns the results data mining. Actually, a new geostatistical method is developed from a theoretical process and results concern two examples. I understand it is

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not easy to act differently. However I do not know if results concern in fact the whole dataset. In my point of view, we do not know if some parts of the results and some parts of the conclusions are an inductive reasoning or a deductive reasoning. I mean that it is not specified if they are induced from comparative results or deduced from the theory and confirmed by illustrative results. To overcome this problem, conclusions should just be enunciated more carefully. I suppose it's because you have in mind the results from the 600 gauged catchments. So it is necessary either to reformulate a few sentences in order to separate more clearly what is deduced from theoretical concepts (for example from what is suggested by Fig 3) and/or what is induced from illustrative examples (mainly the comparisons between Ordinary and Top-kriging outputs), or to specify that the two examples are assumed to be representative for the whole dataset and thus can lead to pertinent conclusions (see below for more details).

Specific comments

1- Sentences that may be confusing (see general comments)

P2265 L8 "The Top-kriging results are shown ... of the method" this means that more estimated values are available. Are the two examples representative and demonstrative or just exemplifying ? Why not use all the dataset results to confirm the results from the two presented regions ?

P2266 L4 "the Ordinary Kriging estimates differ significantly from the Top-kriging estimates." Here "significantly" has an ambiguous meaning with any statistical test that could be performed to check this assumption.

P2266 L14-25 this part would be more pertinent if one incorporates cross validation results from all the dataset (or with all data also focusing on the tributaries), for example in order to perform a paired t-test between uncertainties from the two methods. Thus Fig. 8 should be changed or eliminated.

P2265 L22-28 same comment than the previous one. Fig 12 should also be different

or eliminated.

P2269 L10-14 "Overall, the Ordinary Kriging ... In contrast, Top-kriging captures exactly this information" I don't know if it is a deduction from for the methods and confirmed by results or an induction from results.

P2269 L26 "In general, both ... will depend on the location of the gauges". In general means from the two examples together or from all the dataset? Again I think this is not clear.

P2270 L4-8 "In addition ... to the longer records" Is this ability induced from all results or only from the two examples?

P2270 L14-21 "On the main stream, ... where most of the uncertainty resides." still the same remark. Are those results and conclusions formulated from the two illustrative examples or more basins?

P2270-2271 L1 "... and it was demonstrated that the Top-kriging estimates are much better than the Ordinary Kriging estimates." Finally, we still ignore if the demonstration is based upon the 18 gauges, as an illustration of the theory or not, or upon the whole dataset. This influences the credibility of the demonstration.

2- Other comments and technical corrections

P2254 L6 "The concepts builds on ..." use passive form

P2254 L9-10 "Top-kriging also provides estimates OF the uncertainty OF the variables OF interest" please reformulate.

P2254-2255 L1 "The main advantage ... unbiased meaning that the mean expected error is zero" nice summary for the BLUE definition, but more information or a reference would be perfect.

P2255 L1-6 "Geostatistical methods ... from the point example." Could you provide some references (e.g. D.G. Krige, G. Matheron (1962) and L. Gandin).

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P2255-2256 L1 "..., in an approximate way,..." why ?

P2256 L4 "This allows us to deal with variables that are non-stationary" why ? explain.

P2256 L22 "In a similar way, ... as a point process" vague sentence

P2257 L15 "... (such as Ordinary Kriging) ..." as you will use this particular Kriging method, present it, even succinctly (e.g. differences in respect to Simple Kriging or Universal Kriging).

P2258 L17 "...(Cressie, 1991 p.66)" the last version of this reference is now Statistics for Spatial Data, revised edition, by N. Cressie. Wiley, NY, 1993 (900pp.)

P2259 Eq.(4) If I understand well, the semivariances between two catchments is set from something like their averaged covariance minus their respective averaged variances. But I think that a discussion about hierachical relationships between two catchments should be addressed. Actually, the influence of tributaries over the main streams is not the same as the influence of main streams over the tributaries. That fact seems to be an intrinsic part of Top-kriging, but this is not discussed. Thus, I suggest to add a part about that topic in discussion.

P2259 L16 "In most cases ... analytically." Explain

P2261 L10 "... the de-clustering effect of kriging" could you provide a reference.

P2262 L2 "From these data, ... using Gumbel distribution" I suppose you did that in order to eliminate any temporal variability problem. Explain it.

P2263 L16 "..., A1 was always chosen as the smallest area of the two pairs." I don't understand. Do you mean the smaller area of the RESPECTIVE pairs ?

All Fig. "To display" is a nice synonym for "to show".

Fig. 6,7,9,10,11,13 legends should be named (with units).

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