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Hydrology and Earth System Sciences Discussions

Interactive comment on "Topological and canonical kriging for design-flood prediction in ungauged catchments: an improvement over a traditional regional regression approach?" *by* S. A. Archfield et al.

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I enjoyed reading this manuscript that quantitatively compares three methods for predicting flood quantiles for ungauged catchments. The paper is well written, but could be improved in a number of areas, in particular by providing some more detail (or reference to where details can be found) of the methods used.

The authors claim that "To provide a more equally-weighted assessment of the fits be-

tween the empirical and predicted quantiles across all flood quantiles, the NSE value computed from the natural logarithms of the empirical and predicted flood quantiles (NSE-L)", it was not clear to me in which respect this assessment would be more equally weighted. What is the operational meaning, or advantage, to work with logarithms of quantiles? Obviously, as NSE is a linear measure, everything will change after a non-linear transform of the data. Why is this an improvement?

In terms of prediction accuracy, "TK consistently outperformed GLS and CK". This is not surprising, as TK is the only technique that exploits spatial correlation in the residuals for spatial prediction. The authors then continue to try to combine TK's and CK's strenghts, but I wondered why they did not combine TK with GLS's strenghts. This method, essentially universal kriging (sometimes called external drift kriging or regression kriging) would further improve TK by including the physiographical variables in a regression setting, which may be easier to comprehend than working in the space of the first two canonical variables. If multiple collinearity would play a role, ridge regression alternatives might be considered.

Both TK and CK involve a number of details in the procedure that raise questions from a data analysis perspective.

1. The description of TK claims that the point variogram can be derived from area support (catchment summary) data. For me it is still an open question whether this is the case, and if yes, how; a reference to the paper that explains the details how the nugget effect of the point variogram is estimated would be helpful. (More in general, it might be worth thinking about what the point variogram exactly represents in this context, whether observation at a point support is possible at all, and how measurement error at the area support is modelled, and dealt with).
2. for CK, the authors decide to work with two canonical directions. Why two? How much of the variability in the dependent do these two directions explain? Why not three or four? Then: how are the scores in this new space normalized: do

they have unit variance, or variance proportional to the explanatory power of a dimension? Is it reasonable to assume isotropy (assuming the authors did this) in this new space? Are the physiographical properties of ungauged catchments averaged before a point CK is carried out for this average, or are CK predictions averaged over the physiographical space covered by the catcment (and does this matter)?

3. it was not clear to me what the authors meant by “distance in terms of residuals” (Fig 7). If they mean difference between risuals (absolute?), then I could not follow the conclusions drawn from this figure.

I am not sure whether the authors have in mind to publish their data and scripts in a way that allows us to reproduce the results published here, but if this is not the case, the authors may want to reveal some more detail, e.g. about how (and for CK in which space) variogram models were chosen, and fitted to sample variograms. Also, when combining methods, it would be useful to describe the statistical model adopted, rather than the algorithmical procedure followed. This would make it more transparent which assumptions were made at what point.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 9, 12193, 2012.