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Hydrology and Earth System Sciences Discussions

Interactive comment on "Mapping snow depth return levels: smooth spatial modeling versus station interpolation" *by* J. Blanchet and M. Lehning

Anonymous Referee #1

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1 General Comments

In their manuscript "Mapping snow depth return levels: smooth spatial modeling versus station interpolation" Blanchet and Lehning compare various spatial interpolation techniques for GEV parameters with a smooth spatial modelling of the GEV using spatial information as covariates. Besides this comparison, the second aim of this study is to derive a map of 50-year return period for maximal snow depth for Switzerland.

The paper is very well written and has a clear structure. The introduction as well as the

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motivation of the problem is concise and a pleasure to read. All the methods used are quite well explained; brief but understandable also for non-experts in this field. Credits to existing works have been given in an adequate manner. Figures are illustrative and well designed.

The framework proposed is highly relevant for the modelling of extreme snow depths and also for a wide variety of other climate related (and even many other) spatial extreme value problems. Its superior performance in this case has been impressively demonstrated by the comparison to a range of "classical" methods of spatial interpolation using a well designed validation study and a set of intuitive measures of goodness-of-fit.

I am pleased to recommend this manuscript for publication in "Hydrology and Earth System Sciences". I have only very few and very minor suggestions/comments which the authors might consider before publication, see below

2 Specific Comments

2.1 Section 2

- I expected a comment on temporal dependence. This comment came later in Section 4, which is OK but was a little disturbing in the beginning.

2.2 Section 4

- "Annual maxima snow depth at a given location s_i is then expected to follow a GEV distribution with parameters (μ_i, σ_i, ξ_i) to be estimated." A priori, it is not known that annual maxima are sufficient for convergence to a GEV. It is to be

HESSD

7, C2236–C2240, 2010

shown that the annual block size is already large enough. Here, it turns out to be large enough but your sentence suggests that it can be known in advance.

2.3 Section 5

- You might consider the quantile verification score for future works (Wilks, 2006; Friederichs and Hense, 2007; Maraun et al., 2009).

2.4 Section 6

- p.6151, l.7ff: It is not immediately clear what combinations of models are meant. A short repetition of possible model variations might be useful, e.g., are only straight-line relationships allowed or higher order polynomials, the mentioned drift term did not show up earlier and comes in very surprisingly here; can the degrees of freedom of the spline be specified here?
- p.6163: The squared score statistics $J(\beta)$ should be explained or at least a reference given.

3 Technical Comments

3.1 Section 2

- The unexperienced reader might be confused by the notation $\xi = 0$ because it cannot be set to zero in Eq. (2). I prefer the notation $\xi \to 0$ for all the relevant cases.

HESSD

7, C2236–C2240, 2010

- "The return level q_p associated with the return period $1/p$ is the ...". Later in the this paragraph return periods are denoted as r. This could be introduced in this sentence already as: "The return level $r = q_p$ associated with the return period $1/p$ is the ..."
- ".. convex with the asymptotic limit as $p \to 0$ ..." You might add "$(r \to \infty)$" here.

3.2 Section 5

- p.6139, l.5: "In Inverse distance ..." small "i" for "inverse".
- p.6141, l.24: "It can be made by maximum likelihood ...". Suggestion: "in the Gaussian process, which can be realized by maximum likelihood ..."
- p.6143, l.25: The abbreviation "DEM" appears without a first explanation.
- p.6144, l.13: "As previously, we denote η the function ...", please reformulate this sentence.
- p.6146, l.2: "Model (16) is used with F BEING a Gaussian ..."
- p.6149, l.9: "lie on the 1:1 line", I think this line may also be called bisector, which I find more elegant.

3.3 Section 6

- p.6150, l.7: "... to directly estimate the regression parameters FROM the data ..."
- p.6151, l.25: "Note that here only the equationS of the best models .."
- p.6163, l.10: "We use THE Takeuchi Information Criterion ..."

HESSD

7, C2236–C2240, 2010

- p.6154, l.23: "... σ is a polynomial of elevation ..." polynomial of which order?
- p.6155, l. 20: "...even in thesE..."

3.4 Section 7

- p.6157, l.15: Abbreviation "IMIS" not explained
- p. 6158, l.25: "Combining both, the... ", a missing comma, also in the next sentence.

3.5 Appendix A

- p.6159, l.12: "Consider the spline ..." with out the "Let".

References

P. Friederichs and A. Hense. Statistical downscaling of extreme precipitation using censored quantile regression. *Mon. Weath. Rev.*, 135(6):2365–2378, 2007.

D. Maraun, H. W. Rust, and T. J. Osborn. The influence of synoptic airflow on UK daily precipitation extremes. Part I: observed spatio-temporal relations. *Clim. Dyn.*, 2009. doi: 10.1007/s00382-009-0710-9.

D. S. Wilks. *Statistical Methods in the Atmospheric Sciences*. Academic Press, 2 edition, 2006.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 7, 6129, 2010.