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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

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The authors would like to thank the Anonymous referee #1 for his/her helpful comments.

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.
Response: We agree with the reviewer. We now explain in section 2 the D-condition that allows to apply Extreme Value theory for short-term dependent time-series.

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Interactive Comment

A priori, it is not known that annual maxima are sufficient for convergence to a GEV. It is to be 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.
Response: This is true, Extreme Value theory gives the asymptotic distribution of block maxima. In practice, we obviously always have a finite number of observations, so the most common way of proceeding with block maxima (annual maxima for example) is to fit a GEV and to check (usually on QQ-plots or return level plots) that the fit is satisfactory. Here we checked that all fit are broadly satisfying (as illustrated in Figure 3 for three stations). This has been more clearly stated in the paper (see section 4).

You might consider the quantile verification score for future works (Wilks, 2006; Friederichs and Hense, 2007; Maraun et al., 2009).
Response: We thank the referee for these references, which have be added in the article (see end of section 5.4). The four scores used in our article differ from the quantile validation scores used in Friederichs and Hense (2007) and in Maraun et al. (2009) in that they equally penalize cases of overestimation (i.e. when $z_i^{(k)} - \tilde{q}_{p_k,i} < 0$) and underestimation (i.e. when $z_i^{(k)} - \tilde{q}_{p_k,i} > 0$) of the observed quantiles.

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?
Response: If K_μ models are considered for the μ parameter, K_σ models for σ and K_ξ for ξ, then in total, by combination of all possible models for each of the three

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parameters, this means that $K_\mu \times K_\sigma \times K_\xi$ should be fitted: this is what we mean by "each combination of these three models". This has been clarified in the paper (see section 6.1).
By "linear drift" we simply mean "linear dependence" (this is the linear part of equation 18).
As in section 5.3.3, all splines considered here have order 3 with 15 knots. As in section 5.3.2, all linear models are polynomials of maximum degree 3.

The squared score statistics $J(\beta)$ should be explained or at least a reference given.
Response: A reference for the information matrix and the score statistics is for example the book of D.R. Cox and D.V. Hinkley (1974) "Theoretical Statistics", Chapman & Hall. The reference has been added in section 6.2.

The inexperienced 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.
Response: The Gumbel distribution with $\xi = 0$ is interpreted in (2) as the limit when $\xi \to 0$, leading to the distribution function

$$G(z; \mu, \sigma, \xi = 0) = \exp\left\{-\exp\left[-\left(\frac{z-\mu}{\sigma}\right)\right]\right\}.$$

We prefer adding this explanation in the paper (section 2) and keeping $\xi = 0$ in the rest of the paper.

Other technical comments (mainly typos) have been directly addressed in the text.

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