

Interactive comment on “Accounting for Non-stationarity in Extreme Snow Loads: a Comparison with Building Standards in the French Alps” by Erwan Le Roux et al.

Anonymous Referee #2

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Dear authors

I am happy to see this field getting attention. The paper is nice to read and due to the simple language mostly easy to follow. It provides valuable results certainly worth to be published. However, prior to final publication I recommend consideration of one major point and a number of technical corrections summarized below.

General comments:

My main concern is about a missing (short) elaboration on the data the study is based on. I miss a validation of the GSL values (or at least a description of the errors) produced by the reanalysis of Vernay (2019), in particular that of the yearly maximum

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values. In addition it would be nice to have an explanation of how GSL values are assigned to the massif scale. Moreover, the text contains many spelling and grammar mistakes. However most of them are repetitive.

Specific comments:

The manuscript lacks a description of (i) error measures of GSL data used as basis of the extreme value statistics, and (ii) general remarks on the reanalysis used to provide that data. In particular it would be crucial to tell something about the BIAS or absolute errors of the yearly maximum GSL values. Otherwise provided uncertainty assessments are less valuable. Furthermore a general description of some aspects of the reanalysis is missing. How is GSL calculated for the massif scale? Is the 50-year GSL return level computed by your models valid for the whole massif just depending on altitude? The abstract of Vernay (2019) states also a dependency on aspect and slope. You should clarify if your results are valid for distinct elevations or elevation bands (as it is stated here and there). In the latter case you should explain, how GSL values are assigned to that band (see lines 59, 71 in your manuscript).

Technical corrections:

I added a list of technical corrections. Most of them are language related.

A general comment about the figures: Smaller fonts in plots are difficult to read even with 200% enlargement (e.g. Fig. 8).

8: ...from snow depth `_maxima_` and constant...

9: You do not talk about layers in the snowpack, so it is clear that always the full snowpack is concerned. I suggest to remove `_full_` (also in line 281)

12: I would the year 2006 not call recently...

20: This is where snow water equivalent is introduced. The short form SWE could be added here instead of several other places in the manuscript (caption of Table 1, lines

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64, 262).

25: past trends . . . show a decreasing trend.

29: check format of first reference

32: Table 1: Column name is “Trend”, in the caption it is “trend”.

36: remove i.e.; on instead of in average

48: of 50-year return levels instead of in 50-year return

60: denote

70: remove the before SWE

75: Caption of Figure 2: w.r.t. altitude. Remove the

76: at stations, not in

78: the characteristic

80: As maximum values are relevant in this study, the procedure of removing the top annual maximum when considered exceptional should be shortly addressed. I can imagine that one can find information about that in the given reference, but this is in French. . .

84: What exactly do you mean with relative change? Relative to what? (see also line 48)

85: of not in

89: replace rarer extremes with extremes that are more rare or similar; parenthesis: (EVT, Coles, 2001)

112: remove that; correspond s to

119: represent, not represents; its not an elevation band but a distinct altitude, right?

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(see also lines 59, 71, 123)

122, 126: I wonder if these complex expressions are necessary to understand the content? If not you could remove them.

130: this test `_assesses_`; you could replace the sloppy term `_move_` with something more statistical like `_to reject the stationary Gumbel model M0 in favor of the selected model MN_` or similar.

134: Shouldn't there somewhere be the M0 model in the expression of the LR test?

136: remove `_it means that_`

137: If the selected. . .; remove `_then_`

138: Return level `_s_`

141: `_on_ average`

150: For the selected model MN the return level is defined as. . .

151: remove `_that_`

159: `associated_with_` the maximum

161: Therefore, under regularity: remove `_we have that_`

168-169: fit models `_to_ time series`

169: only those `_models_`; we `_make_ this choice`

173: Result `_s_`

177: Gumbel models are always more `_often_ selected_ than_ their`

180: model `_s_`; that `_the_ majority`

181: `_are white colored_`: white is not a color. At the end of the sentence: replace `_It_ with_ This_`

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184-185: You should rephrase the sentence “This uncertainty. . .robustly.”

186: `_In_` instead of `On` figure

187: The altitude in Fig. 4 is 1800 m, not 1500 m

188-191: Your hypothesis was already raised for snow depth by Blanchet & Lehning, 2010, Blanchet & Davison, 2011 and Schellander et al., 2018, who all found similar results in terms of the shape parameter.

Figure 4: The legend is somewhat hard to read. I guess these are jpgs or similar, which should be replaced by pdfs. The grey color in the rightmost panel has no description. In the caption: `model_s_`; `significant_trends_`.

196-197: you say: “Gumbel or GEV distribution (diamond-shaped filled markers).” But diamond shaped filled markers describe only Gumbel models, and not GEV models.

197: you say “no trends”, but actually I see one trend (green colored massif in the south at 2700m); `_white_color_`: white is no color

Figure 5: Grey color has no description (see Figure 4). In the caption: `symbolize_a_significant_trend`.

200: Sect. A should be Appendix A

201: `_on_average`

201-202: What is a null decline? I think a decline is always non-null, isn't it?

204: The word “growth” is misleading (growing decline?). You could instead say “less declining”; Lüthi et al. (2019) `_who_found`

208: `trend_s_`

209: What do you mean with “sometimes important” here?

210: You mention “recorded annual maxima”. Do you compare with observed GSL

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values? How are they recorded? If manually (weekly or biweekly) you cannot be sure to get the maximum. Or does recorded mean "modeled" here?

212: precipitation not precipitation_s_; season_al_

212-213: "the 2 massifs with important increasing trends (red color) might be caused". The trends may be caused but not the massifs.

216: decreasing trend_s_; comma instead of dot after parenthesis in "(Fig. 5, Fig. 6 and Fig. A1). While"

Figure 7: No description for grey color.

219: Why of all things 1800 m? Is this because Vercors top heights are around 1800 m?

221: associated _with_

224: (_l_ eft); replace above with _larger than_; (_r_ ight)

225: While reading and coming from Fig. 8 one assumes that Fig. 9 sums up only two massifs. You could state here that Fig. 9 encompasses all 23 massifs.

228: There should only be one dot at the end of the sentence.

229: _the_ French standards; _l_ eft

232: remove "the" in "...computed with with the snow water equivalent..."; _the_ re-analysis

234: _c_ enter

235: _r_ ight

236: _more than_ half of the massifs

Figure 8: I suggest to put parts of the legend in the caption for a cleaner layout. E.g. all additional information with respect to the left plot except the "Change per decade". Top

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left panel: Do you have a clue, why the uncertainties at lower altitudes are larger than at higher altitudes? With respect to the smaller number of available reanalysis stations at higher altitudes, this should be inverted, as can be seen in all other panels. Caption: All panel references should start with a small letter (`_top_` instead of `Top . . .`). Several times `_the_` return level. The change in return level `_s_` per decade

Figure 9: Title: “Stationary Gumbel model M0 (stationary)”: I suggest to omit Stationary at the beginnig. Caption: `_larger than_` instead of above. Remove `_the_` in “. . .computed with the snow water equivalent. . .”. It should be `_the_` reanalysis (2 times) and `_the_` return level.

245: we focus on `_a_` simple function

257-258: You obtained the “same” results for time series with less than 10% of zero GSL values. Can you provide a similar number used by French standards for the decision to switch to a mixed discrete-continuous distribution?

267-273: This paragraph is a little bit confusing. Descriptions in the text do not match the plots parameters and captions. The easiest way to fix that would be to interchange left and right panels.

267: HS instead of GSL? Annual maxima `_are_`; `_The_` main reason; `_l_`eft etc.

268: `_are_` reached; `_on_` average

269: `_c_`enter

270: `_on_` average (2 times)

271: `_are_` reached

272: `_r_`ight

280: estimated from `_maximum_` snow depth `_s_`?

281: What do you mean with “full snowpack”? You could use only “snowpack” or “bulk

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density”, which refers to the density of the whole snowpack.

282: `_in_` Fig. 2; You could say e.g. “French standards return levels increase linearly with altitude in three steps” instead of “French standards return levels augment linearly by parts w.r.t the altitude.”

285: Remove “might” in “French standards might underestimate”

286: percentage of exceedance `_observed with_` altitude; `_r_ight`

288-289: considering time series of annual maxima as `_spatially_` independent

290: reference without parenthesis: (e.g. Soci et al., 2016)

291: `_to_` a wider geographical scale

294: remove comma in (e.g., snowpack model errors)

295: `_r_ight`297: return level `_s_`

298: remove second parenthesis

299-300: This statement is unclear. I suggest to either remove it, or to provide more details. If you really would like to leave that here, you should provide at least a reference for the European construction standards, and elaborate a little bit on those safety coefficients that might alter very widely according to country, professional, construction material, etc.

306, 310: E.L.R or ELR

309: `_The_` dataset

311: for `_his_` “extRemes” package

Figure A1: No explanation of the grey massifs.

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