

The Cryosphere Discuss., referee comment RC1  
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## **A valuable work with minor weaknesses**

Anonymous Referee #1

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Referee comment on "Elevation-dependent trends in extreme snowfall in the French Alps from 1959 to 2019" by Erwan Le Roux et al., The Cryosphere Discuss.,  
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The paper by Le Roux et al. analyses past trends in snowfall extremes in the French Alps based on the SAFRAN regional reanalysis. Several non-stationary extreme value models are considered, and the best performing model according to the Akaike information criterion is chosen for each individual case to model the parameters of the underlying GEV distribution. The study finds a diverse spatial pattern of changes in annual maximum snowfall with variability both in the vertical (elevation classes) and horizontal space (individual mountain ranges). A general pattern, however, is an increase of return levels of extreme daily snowfall at higher reaches, and decreases at low elevations. The results have implications for the design of infrastructures that are potentially affected by heavy snowfalls.

Overall, the paper is well thought-through and well written. All details of the different statistical methods employed are provided. The figures are informative, and the conclusions are well based on the results obtained. Regarding the general scope, I certainly consider the paper relevant for the reader of The Cryosphere. The single main deficiency of the work is the missing validation of the SAFRAN data with respect to extreme snowfall amounts and their temporal trends. Several previous works are cited, but much more information is necessary in my opinion. Potential deficiencies of the reanalysis dataset in representing extreme snowfall would ultimately affect the conclusions of this work. I strongly suggest that the authors try to better motivate the use of this reanalysis dataset for their purpose. Apart from this, several minor issues are listed below which also should be improved in a revised version of the paper.

Overall, I suggest to return the paper to the authors for minor revisions before considering a publication of this work.

Minor issues:

Line 28: Skip "globally"

Line 30: You probably mean "maximum atmospheric water vapor"

Line 31 : I suggest to replace by" ... the observed global mean temperature scaling for annual maxima ..."

Line 55 : Meaning of "max-stable" is unclear

Line 58 : " ... by assessing past temporal trends"

Line 70: Change to "... observations and provides, among others, snowfall data for each ..." (SAFRAN provides more than snowfall data)

Line 78-80: This section is far too short, a much better motivation for using SAFRAN instead of, for instance, station series, needs to be provided (see above). A dedicated validation exercise would help.

Chapter 3.1: The information that block maxima are used (instead of POT) should be clearly given.

Equation 1: The meaning of  $y$  is not ultimately clear and needs to be defined

Line 95: "... represents an annual maximum ..."

Line 104: "represent" instead of "represents"

Chapter 4.1 and further: I'm not sure if the term "pointwise" should be used here. I understand the meaning and the difference to "piecewise" in statistical terms, but pointwise could be misunderstood as being based on observations taken at individual locations/points (which is not the case here)

Lines 189-199: This section is basically a very brief description of one figure after the other. It should be extended and some more information on each figure and a brief description of what they show and what this means) needs to be provided.

Chapter 5.1: This chapter is very important as it highlights potential limitations of the work. However, the implications of these limitations for the interpretation of the results and for the conclusions remain largely unclear. Are the conclusions valid nevertheless or do they have to be questioned?

Lines 244-245: This implication does actually only hold if the past trends would continue into the future. Do you have any evidence for this?

Lines 275-277: What this basically means is that mean temperature is not the only control. This could be written much clearer.