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Climate of the Past Discussions

Interactive comment on "On the variability of return periods of European winter precipitation extremes over the last five centuries" *by* A. Pauling and H. Paeth

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1. Foreword

I carefully read this very interesting paper from the point of view of his objectives and organized very well. As for followed methodology, I go tried hereafter to put forward some criticisms constructive.

2. The data

The Mitchell and Jones (2005) girded precipitations dataset has been used for the period 1951–2000 and the Pauling et al. (2006) dataset for the period 1500–1900.

By definition, the winter season covers three months: December, January and Febru-

ary. For each year, the datum is the sum of daily precipitations over the winter season in each gridpoint of the studied area.

I have a question with the winter definition. The climate in the western Europe is rather maritime while the climate in the eastern Europe or central Europe is rather continental. In the latter areas, couldn't the winter extend on more that three months?

But the most important point is not there. The more one moves back in the past and the less one has information. We must as admit as the richness of the data is unequally distributed in space. Consequently, the precipitation reconstructions in points of grid are all the more dubious as one is far in the past and/or on few monitored areas.

This obviousness should be to keep in mind at the time of interpretation of the results of this study.

3. The statistical methods used for extremes analysis are there adequate and sound?

3.1 Choice of the sampling model

A fundamental hypothesis of this work is that winter precipitations follow a gamma distribution. Being given one period of reference and one area, it is necessary to fit a distribution gamma on a time series of winter precipitations. This task is not trivial, especially if the series in hand is short. As the data are obviously not available, I simulated the Northern Ireland dataset over the period 1951–2000 by drawing winter precipitations in a gamma distribution with shape parameter alpha = 16 and scale parameter beta = 25. Next, like the authors, I estimate them starting from the data. Using the function gamfit of Matlab©, I found respectively 18.1 (alpha) and 21.9 (beta) with the following 90% percent confidence interval [13.0, 25.1] (alpha) and [15.7, 30.4] (beta). One cannot deny the great uncertainty which enlarge these estimates. This remark remains valid for any area whatever the reference period over which the authors project to determine the return period associated with any characteristic value of

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modern winter precipitations (dry and wet winters located over the period 1951–2000).

3.2 Are return periods changed over both gridpoint areas and past periods?

To investigate the changing return period (RP), the authors chose four areas, namely: Northern Ireland, Southern Spain, Eastern Europe and Central Europe. For each of them, they selected some years of the modern period (1951–2000) that have been anomalously dry or wet. For instance, in Northern Ireland, according to tables 1 and 2, the return value (RV) 304 mm (1956, dry winter) has a return period (RP) of seven years while RV 480 mm (1999, wet winter) has a RP of six years. Next, using three reference periods (1500–1644, 1645–1715, 1716–1900), the authors fitted a gamma distribution on the corresponding dataset in order to determine the RP associated with any RV selected on 1951–2000 period (Tables 1 and 2).

Unfortunately, the parameters of the gamma distributions given the data are never given in their paper. This is very tedious because uncertainties on the estimates flash back over the period of return.

To conclude this section, it is possible that return period associated with any characteristic value found in the modern period moves over the past but such a conclusion should be taken with precaution. Indeed, it is possible that the announced results (Tables 1 and 2) are skewed, on the one hand by the fact that the oldest data are also most dubious, on the other hand by uncertainty affecting the two parameters of the distribution gamma.

3.3 How variable the recurrence of extreme seasonal winter precipitations has been over the last 500 years?

The authors estimated the return values corresponding to several return periods for a moving 50-year-window over the period 1500–2000 (Figures 2 to 5). What about the shape and scale parameters of the gamma distributions attached to all these subperiods?

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3.4. A complement about the extremes.

The authors use the term extreme value in an unusual sense. If a standard probability distribution, such as the gamma, can be used to model winter precipitations this is because it is a good model near its mode. Such a model might not be a good fit to real data in the tails and a more complex model might be needed to describe the full range of the data. Two models, in addition related one to the other, can be used for this purpose.

The generalized extreme value distribution is often used to model the smallest or largest value among a large set of independent, identically distributed random values representing measurements or observations. For instance, the daily precipitations during the winter period define a annual block of 90 single values. If we record the largest precipitation in each block over a defined period, e.g. 1951–2000, the data are known as block maxima (or minima if we record the smallest). The generalized extreme value distribution (GEV) models those block maxima and leads to some return period associated with some return value.

Similarly, the generalized Pareto distribution can be used to model the winter precipitations larger (or smaller) than a certain threshold, e.g. 304 mm (smaller) or 480 (larger). The generalized Pareto distribution provides also a good fit to extremes data.

4. My conclusion

The estimate of the parameters of the distribution gamma starting from the data is in the heart of this contribution since this estimate conditions all the remainder. Out the authors do not speak about it. I believe that this publication would be better if it explicitly took into account all uncertainties. This stage, I believe that it is at least necessary to recommend the addition of a section concerning the calibration of a distribution gamma on data. Then, it would be necessary to hold account of these uncertainties in the calculation of the periods of return and the associated values (in the two directions).

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