

## ***Interactive comment on “The early Spörer Minimum – a period of extraordinary climate and socio-economic changes in Western and Central Europe” by Chantal Camenisch et al.***

### **Anonymous Referee #2**

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General Comments: Overall, I believe this article makes a valuable contribution to LIA European climate reconstruction and impacts, and I definitely recommend publication with revisions.

I am primarily a historian rather than climate scientist, and so I will focus mainly on the (climate) historical aspects of this paper.

1) Parts of the article, particularly the introduction, need very thorough editing, if not complete rewriting. There are simply too many phrases that could use correction and improvement to point them all out as a referee. Some ideas and conclusions are all but lost in poor prose. In places the language is too imprecise. For example, cooling “events” and “periods” seem to possibly cover everything from a year to centuries.

C1

Since the author list includes many native speakers of English, I would expect more thorough editing for language.

2) The long-term demographic and economic context of Spörer Minimum societal impacts deserves even more emphasis. In the case of the 1310s and 1590s-1600s, issues of population pressure, diminishing land-holdings, and falling real wages have played a central role in explaining vulnerabilities and impacts. The case of the 1430s, when population was relatively low and real wages much higher, is very different. Indeed, I am surprised at the level of impacts described here, given that real wages in England for example were far higher in these years - despite the terrible weather - than during the early 14th and late 16th centuries.

Moreover, the bulk of Little Ice Age research has recently tended to emphasize runs of bad years related to volcanic eruptions and/or exceptional activity in the NAO in regard to climatic extremes and subsistence crises in Europe. In this case, we appear to have neither.

All of this leads to me wonder how Europeans of the 1430s still proved so vulnerable to bad weather and harvest failures. Without having a particular conclusion in mind, I would suggest that this puzzle might require further explanation. Perhaps the vulnerabilities created by conflicts (e.g., the Hundred Years War) deserve more emphasis. Or perhaps institutional factors, such as the lack of organized famine relief, exacerbated hunger and mortality. It may be that the demographic contraction of the period, while driving up wages, also created other vulnerabilities – a lower tax base, for instance, or higher transport costs, or fewer incentives to improve land and innovate in food production.

None of this is to say that I disagree with the authors' finding. Rather, I would suggest the authors have a chance here to make a larger contribution to our understanding of climatic vulnerabilities by emphasizing - and further explaining - the exceptional nature of this event. This discussion could go into the conclusion.

C2

3) From the beginning of part 3 (p5, l25) onward, it is clear that one of the central features of this article is demonstrating how a period of apparently unforced internal variability could be quite extreme and bring significant impacts. This needs to be more clearly highlighted from the outset rather than going unmentioned in the title and buried at the end of the abstract. I would even recommend retitling the article something like: "The 1430s: A Period of Extraordinary Internal Climate Variability and Its Impacts in Europe." Even starting with "The early Spörer Minimum" may prime the reader with thoughts of multi-decadal solar-driven cooling.

4) The descriptions of specific weather-related impacts in different parts of Europe might be easier to follow if the authors first offered a summary of relevant political, economic, and demographic factors (such as the long-term population decline since the Black Death, the Hundred Years War, etc.) rather than filling that information in later. It would help to set the stage, so to speak.

5) Are the authors suggesting that this event had any long-term consequences? Or was it just an unusually bad decade? In either case, how did the human perception and impact of the event compare to the more famous volcanic-induced cooling of the 1450s? In other words, did a climatic event arising from internal variability look and feel any different to Europeans than one driven by eruptions? The conclusion would be stronger if could address questions such as these.

6) In theory, the reader could look back and forth between figures 2 and 3 in order to figure out what climate anomalies occurred in each reconstructed region. In practice, however, that is difficult and time-consuming. I would prefer if the authors had a better way to visualize that data.

7) I do not mind the level of detail in section 4. However, parts of the text could be just as informative in half as many words. More importantly, it is not clear what the organizing principle of the section is. Sometimes it proceeds topically, sometimes geographically, sometimes chronologically (from one level of impact to the next). The text could use

### C3

some re-organization to make it more manageable.

8) I am disappointed that there is not a single historical quotation in section 4. If we want to know how people of the past perceived and experienced climate, it helps to hear their own words and narratives sometimes. Just a few well-chosen phrases would not only enliven the prose but also help establish what people of the time actually observed and regarded as noteworthy.

Specific Comments: >page 1, line 1: This statement is so vague that it could be misinterpreted in any number of ways.

>p2, l3: "normal but wet" appears contradictory; reword to indicate that summers had average temperatures but above-average precipitation. "strong seasonal cycle" is also vague and confusing (it's a phrase I would normally associate with something like the annual sales of winter coats)

>p2, l12: "affected the socio-economic systems" is so vague that it could be misinterpreted in any number of ways.

>p2, l14-15: This wording seems to conflate the gradual and increasing effects of orbital forcing with the short-term sporadic effects of eruptions.

>p2, l25: "end-to-end assessment" appears to be a term of art in need of explanation

>p3, l3: does "Western Europe" here in include the Iberian Peninsula?

>p5, l6-7 and 13-14: I believe that Sigl et al. 2015 have updated this, and now assign the volcanic forcing of the 1590s-1600s to Huaynaputina and Nevado Ruiz (1595) not Raung (1594). In any case, I believe the Nevado Ruiz eruption was the larger, and it is certainly well documented by contemporary witnesses.

>p5, l15-18: The article seems to have several poor explanations of winter temperature impacts on crops. It needs one good, well-placed explanation instead.

>p9, l13-14: The interactions between crop failures and plague deserve some brief

### C4

explanation.

>p11, l11-21: The authors may wish to compare the way Gypsies were blamed for bad weather in the Spörer Minimum to the way witches and Jews were blamed for weather and weather-related misfortunes in the late 16th-17th centuries (see Wolfgang Behringer, "Climatic Change and Witch Hunting: The Impact of the Little Ice Age on Mentalities," *Climatic Change* 43 (1999): 335–51; Dean Phillip Bell, "The Little Ice Age and the Jews: Environmental History and the Mercurial Nature of Jewish-Christian Relations in Early Modern Germany," *AJS Review* 32 (2008): 1–27.) It is interesting to see this transition, since it appears to confirm the thesis that Europeans transitioned from magical to demonic views of (weather) disasters—that is, from a belief that magical spells could cause bad weather to a belief that recourse to the devil or demons (as through witchcraft) could bring bad weather.

>Throughout the article, could the authors distinguish what measurement is used in "tree ring" data (i.e., ring width, density, or isotopes)?

>On page 33, figure 9, I don't see an explanation of the acronyms "w.r.t." or "W (B/O) YPS".

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