

Interactive comment on “Human response to severe drought in Early Modern Catalonia. The case of Barcelona, Western Mediterranean (1620–1650)” by Santiago Gorostiza et al.

REVIEWER 1: Scientific significance. The authors used a new interesting source, but is not clear its contribution to organize new data about climate of the past. Most part of data were already worked by previous studies. The novelty begins on line 413, always using the connections with the Llibre de les Fonts but without a truly contribution for the reconstruction of the climate in the past. It seems that this article could be more appropriate for a journal like “Ecology and Society” or Water History, about the long-term evolution of urban waters in an environmental perspective.

Authors: Thanks for your comments.

After reading the comments of both reviewers, we understand that we have not explained clearly enough the novelty of the research presented in our article. First, our manuscript provides new, unpublished data about climate history in the 17th century (section 2, “Climatic context”). Second, we present, interpret, and contextualise a rare source about urban water knowledge: a manual of urban water supply written during the period studied (which also includes some information on climate history). The new data provided at daily/monthly resolution in our article on the climate reconstruction of the period of study is key to interpret and contextualise the Book of Fountains (sections 3 and 4).

In other words, the novelty of our work resides *both* in climate reconstruction and in the source presented (The Book of Fountains of the city of Barcelona). For these reasons we believe that the article falls within the scope of the journal, and particularly in this special issue, which calls for research of a “truly interdisciplinary character” and includes topics such as drought “impacts on human society, and human responses to droughts”.

Previous publications for this region of the Mediterranean analyse drought frequency at monthly resolution with climatic indexes, according to criteria developed into EC Project “Millennium”. But in the present work, the same original information has been analysed at daily resolution, improving previous frequency indexes already available. On the other hand, we introduce a new monthly index that classifies drought situations by duration. With this new approach, drought is considered by frequency of events and duration of each one. In fact, crossing both variables, we detect a very severe event in central decades of 17th Century, not so well detected with previous indexes.

Perhaps when presenting historical climatology data in the first section of the paper, setting the scene for the analysis of the institutional responses of the city government to drought, we may have not stressed enough that the information provided was new in itself. For our article, historical reconstruction of drought does not simply set the scene for our analysis of institutional responses but has been part of the overall research effort. In order to clarify this, we would like to discuss the novelty of the data presented in the section “climatic context” paper, figure by figure.

“Figure 1. Drought Frequency Weighted Index. Standardised values. 11 years moving averages from 4 locations: Girona, Barcelona, Tarragona and Tortosa. Data adapted from Oliva et al., 2018.”

Annual data in this figure is not new. It is the general context of drought in the Catalan coast between 1501 and 1861. This information has been published and a bibliographic reference is provided.

“Figure 2. Drought Frequency Weighted Index. Standardised values. City of Barcelona (1521-1825).”

Figure 2 comes originally from the sources collected for the PhD thesis of Mariano Barriendos and published in Martín-Vide & Barriendos (1995). However, these sources have been subsequently updated and improved by adding new documentary materials to the database and applying statistical standardization processes. As stated by Mariano Barriendos, Figure 2 has been elaborated with new data.

In the revised version we will clarify this and add to the figure’s caption “Data improved from Martín-Vide and Barriendos, 1995.”

“Figure 3. Drought Duration Index. Standardised values. City of Barcelona (1521-1825).”

Figure 3 comes from information compiled by Mariano Barriendos and so far unpublished. Drought duration of level 2 had not been studied in our geographical context. Data analysis and the preparation of this figure have been elaborated exclusively for this manuscript.

In the revised version of the manuscript we will highlight that this information on drought duration reconstruction is new.

“Figure 4: Monthly drought rogations levels in Barcelona, 1601-1650. Data improved from Martín-Vide and Barriendos, 1995.”

Figure 4 comes from information compiled by Mariano Barriendos and so far unpublished. It is the first time that information of drought in our geographical context is analysed at daily resolution. Data analysis and the preparation of this figure have been elaborated exclusively for this manuscript.

In the revised version of the manuscript we will delete from the figure’s caption “Data improved from Martín-Vide and Barriendos, 1995”. Instead, we will highlight that this information on monthly drought rogations levels in Barcelona is new and had not been published before. We will also explain better the importance of this figure, to which we refer to several times throughout the rest of the paper.

Finally, while the Book of Fountains is a manual of urban water supply, it does provide information useful for the reconstruction of the climate of the past. When writing the book in 1650, during a severe drought episode, Socies pointed out that it was the first time in his life that he saw some of the water mines dry, and wrote that as years passed by, the flow of water in the city had been decreasing. In fact, he specifically pointed out to the years 1626-1627 as the moment when the “lack of waters” had started, and underlined the importance of the Sant Gervasi *qanat*, whose construction he had led in the late 1620s, to keep Barcelona supplied in these dry years (AS1, chapter 65). One of the achievements of our joint work in this article is precisely to find out how Socies’ assessment of drought in 1650 and in 1626-27 fits perfectly with the picture that emerges from the data analysis of *pro pluvia* rogations. This cross-check reinforces the validity of both sources.

In other words, the background of the institutional response portrayed in the article are several decades of drought, which we document with a multiproxy description (*pro pluvia* rogations at daily/monthly resolution and the written testimony of the city water officer, who was in charge of urban water supply and maintenance during the worst decades of drought).

In conclusion, the revised version of the manuscript will devote more space to section 2 (“Climatic context”), explaining better the data presented and emphasizing its novelty.

Reviewer 1: Scientific quality. The methodology is appropriated when the authors used pre instrumental sources (such rogations) submitted to a well-known process of index construction (climatic context). The part 3 (3. Struggling for water supply in Barcelona) was much more descriptive, deserving a new methodology in order to organize the human response. Which response were given from different social classes, authorities, which impacts were felt in short and long-term?

Authors: Thanks for this comment. Together with the suggestions of reviewer 2, we have decided to specify that our research deals with *institutional* response to drought. All the strategies we describe focus on the action of the city government (and its conflicts with other urban institutions such as the Cathedral’s Chapter). In the revised version of the manuscript, the new title will be “Institutional responses to severe drought in Early Modern Catalonia. The case of Barcelona, Western Mediterranean (1620-1650)”. The explicit focus on institutions justifies placing our attention on the Barcelona city government.

While in our research in general we aspire to examining human response to drought, for this article we have decided to narrow our focus. As you point out, a general analysis of human responses to drought would require broadening our work to include different authorities, social groups, social classes and individuals. We consider this article a first step in this direction, to be continued in the future.

Reviewer 1. Presentation quality: The article must insert a plan of the town, the urban structure, the visualization of the space and the main points of water supply.

Authors: If needed, in the revised version of the manuscript we can include a general map of the situation of Barcelona to contextualise where the events narrated took place.

However, the focus of our article are the institutional adaptations to drought. The Book of Fountains is a superb source for the urban history of water in Barcelona, but such a study would require an article on its own right (and in a different journal).

Reviewer 1. Bibliography about the demographic evolution (showing the decline of the city - a 17th century) in order to prove how the Llibre de les Fonts was a preventive measure.

Authors: No detailed census were elaborated in Barcelona during the 17th century that allow to track the evolution of the population in detail. Historical context with very frequent social conflicts and wars didn't allow it. First personal census for Barcelona is in 1717.

Just for the record, we believe that the value of the Book of Fountains as a preventive measure consisted in that it could improve the efficiency of urban water management, systematising repairs and maintenance, reducing expenditure and avoiding conflicts about water rights in a context marked by drought and diminishing urban water flows.

Reviewer 1. The second part needs an organization of information in figures in order to assemble the evidences.

Authors: If needed, in the revised version of the manuscript we can provide a new figure with a chronological axis 1620-1650. Here we could include and summarise the main events narrated in the second part of the paper. In one colour, we could summarise the main events related to the institutional response to drought (date of the Llobregat water transfer project, building of windmills, conflict between the Consell de Cent and the Cathedral, excommunication, water thefts, petition to write the Book of Fountains, writing and delivery of the book). In a different colour, we could include other events of the period (King Philip IV meetings with the Catalan *Corts*, war with France, Catalan revolt against Spain).

Reviewer 1. The writing English much be organized because there are repetitions of ideas.

Authors: Thanks. Reviewer 2 has also suggested to summarise some parts of the paper to avoid repetitions. The revised version will reduce some parts to allow for a more detailed explanation of section 2 about climate reconstruction.

Reviewer 1. Please also note the supplement to this comment

Authors: Many thanks for the detailed comments and suggestions for references in the PDF. Most of them will be incorporated in the revised version of the manuscript.

