

Referee #2 responses:

Overall comment:

- **RC:** This paper is very interesting and brings a new insight on methodological approaches of historical climate reconstructions based on documentary data. The authors apply a new method of hydrometeorological reconstruction and attempt its validation by applying it simultaneously with other two already known methods. The manuscript is well designed and properly supported on up to date bibliography. However, this version exhibits some problems that must be overcome, and some questions should be attentively considered in order to improve the quality and robustness of the work.
- **AR:** Thank you for your kind considerations and for your very pertinent clarifications and qualifications. We appreciate these comments, which will undoubtedly increase the quality, reliability and robustness of our paper. We hope that after these changes are implemented, the proposed new methodology could become useful for future research.

Main comments:

- **RC:** As the most innovative contribution of this paper is the method named “COST”, some important details are missing in its description. For instance, along the study period (1600-1900) the “Actas Capitulares” (AC) of the city council have maintained the same model, that means, the same periodicity, structure and general dimension? If the answer is positive, so clarify by stating it. Note that a single example of AC is shown but the reader has no information if this sample is valid over the three centuries. Does the frequency of the council meetings is satisfactorily suitable to permit the data collection with monthly resolution? The authors only mention the total number of consulted sheets of paper but did not make any reference to the number of books and municipal chapter acts and its interannual distribution. In my opinion this must be clearly justified, because it concerns the consistency of the study.
- **AR:** Thank you for raising this important point, which is undoubtedly of great importance and must be clarified accordingly. Indeed, the AC have maintained the same structure and composition throughout the full studied period. We have shown this by adding an additional panel (Figure 1 below) with up to 6 examples of AC distributed throughout the full period. In these examples, we can observe how the structure and composition of the ACs have barely changed through time. This is so because the ACs were official documentation that had to be endorsed by official state paper. As such, the government required (and it was mandatory by law) that the structure should be the same, and that it should be consistent through time.



Figure 1: Caravaca city council meeting sample (April 18, 1698) (Panel a) and different examples of AC throughout the study period (Panel b). The year of each example is labeled besides the photo

However, the amount of paper used each year exhibits an important inter-annual variability. This variability could be related to the variable amount of issues that needed to be addressed by local authorities in a given period. In addition, it could also be dependent of the available budget of the municipality, since more money available implies a less restrictive use of sealed paper. Still, this year-to-year variability is not likely to cause systematic biases in the methodology, as it does not present any temporal behavior that could affect the trends detected in the variables Drought and rainfall extremes (See Figure 2 below).

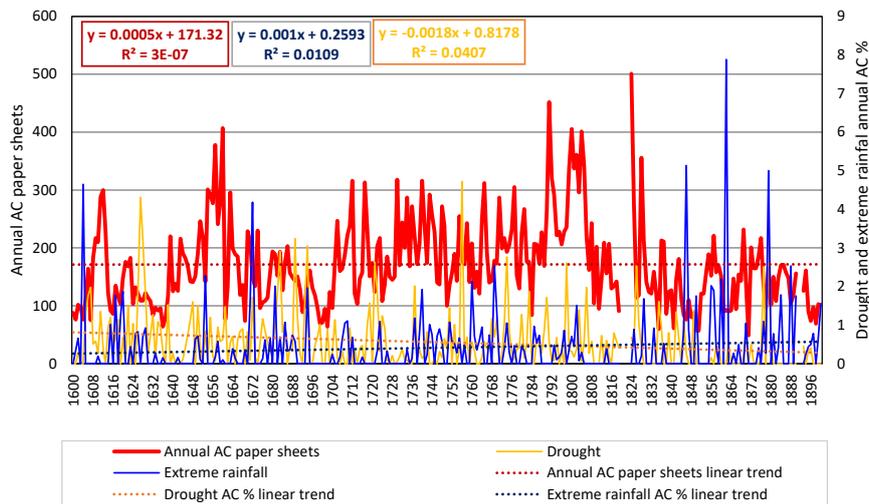


Figure 2: Annual AC paper Sheets and Sheets percentage used for drought and Rainfall extremes in Caravaca (1600-1900).

The fact that the variability in the use of sealed paper does not affect drought and rainfall extremes estimation using the COST method is further demonstrated when observing that there is no significant statistical correlation between the amount of sealed paper and the percentage used to inform about droughts and extreme rains (See figure 3, Panels a and b below). Even more clearly, in anomalous years with the largest (fewest) use of sealed paper, there is no anomaly whatsoever in the amount of paper dedicated to inform about droughts or extreme rainfalls.

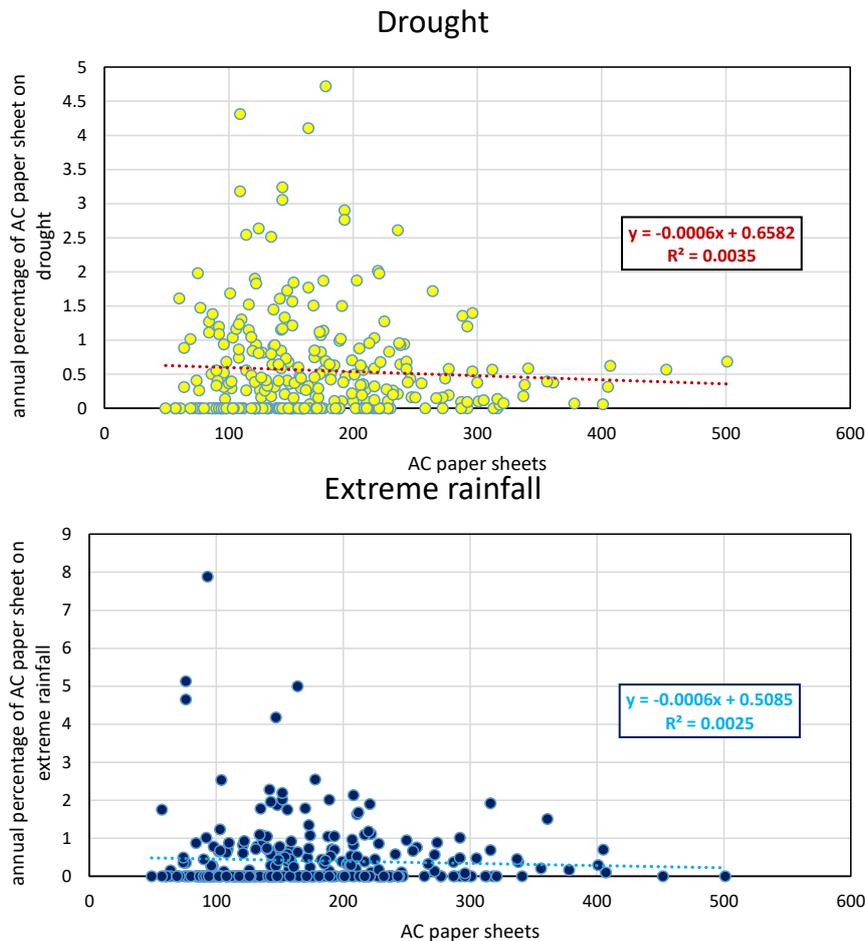


Figure 3: Relationship between the annual amount of AC paper sheets and the annual percentage of AC paper sheets dedicated to inform about droughts (top panel) and extreme rainfalls (bottom panel b).

Regarding a possible seasonality of the use of sealed paper, the law dictated that the meetings of the Cabildo should be held once a week, regardless of the time of the year. For this reason, the use of sealed paper should not present any obvious seasonality, having every month a similar amount of used paper. November and December show a somewhat lower use of sealed paper (Figure 4, Panels a and b below), but even in these months, and from the examples used in Figure 1, we observe that the amount of sealed paper used to discuss climatic events is never below 4% of the total. Therefore, we can conclude that the percentage of the sealed paper used exhibits no strong seasonality.

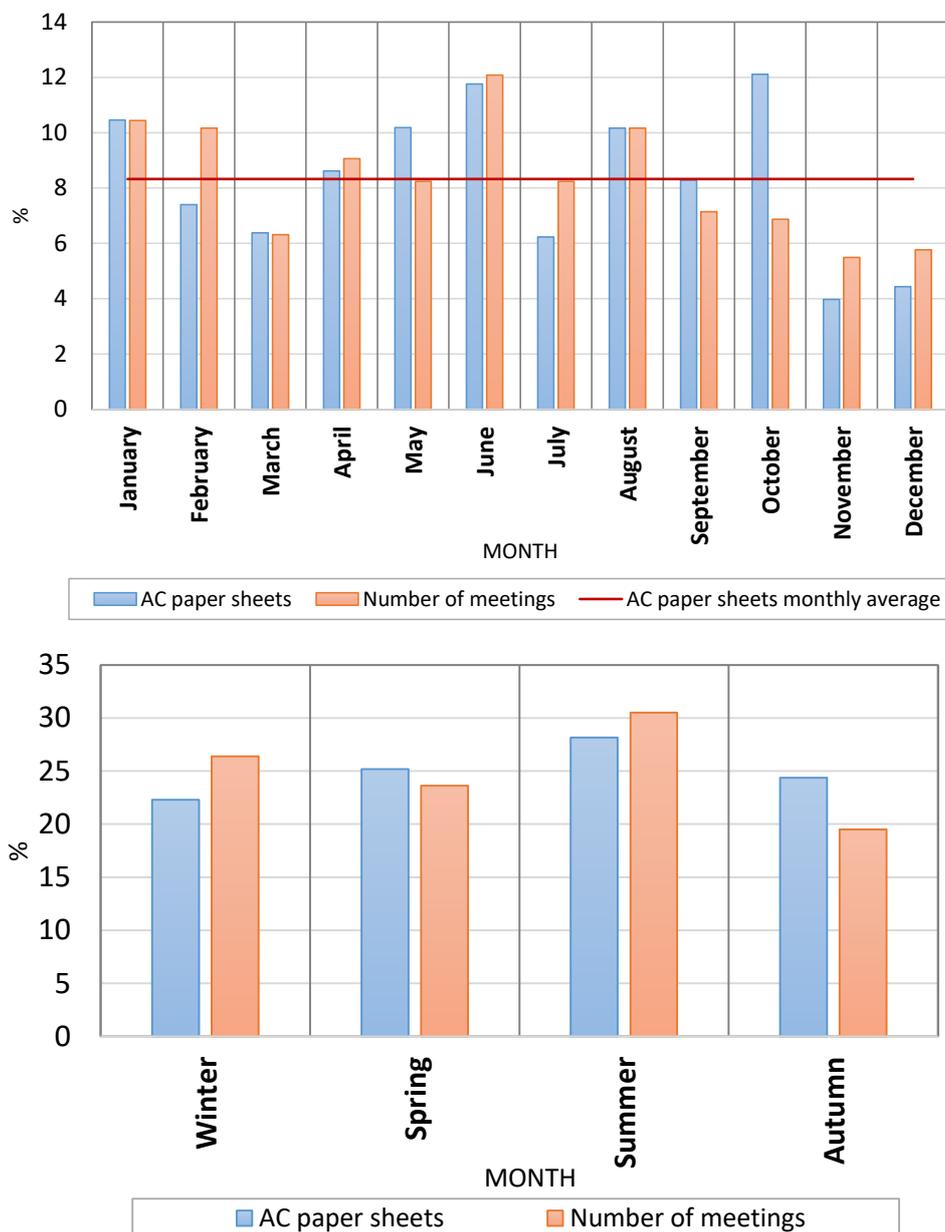


Figure 4: Amount of AC paper sheets used by month (Panel a) and season (Panel b) in Caravaca. The values are the averages for the years 1698, 1614, 1657, 1749, 1800, 1850 and 1983.

Certainly, the rule of celebrating weekly meetings was not always fulfilled, and the number of meetings was affected by the urgency of the topics to address and with administrative matters. This is, it is clear that the frequency and importance of the meetings responded to the daily problems of the municipalities. For this reason, there are years with several weeks without meetings, while sometimes several meetings

were held within the same week. In any case, there is no seasonality in the amount of AC, as evidenced by similar studies in other areas of Spain (Pérez, 1987, Gutiérrez, 2005). Anyway, the most important fact is that there was no period of the year when the town hall meetings should stop. Therefore, the importance of the issues and the conjuncture of a given year explain variations in the amount of paper used in a specific year, but it is always sure that if something extraordinary happened (such as lack of water or heavy rainfall), the town hall met to discuss the details regardless of the date and epoch of the year. The fact that the COST method offers the data as a percentage of the total annual paper sheets AC, normalizes the paper difference between the different months and seasons. Therefore, we consider that the COST method is valid for conducting studies with monthly and seasonal resolution.

In order to implement the reviewer's requirements, Figure 2 of the manuscript has been modified (See Figure 1 above), including a second panel (Panel b) showing different examples of AC along the studied period, so demonstrating that composition and structure of the ACs prevails over time. Section 3.3 includes now part of the previous explanations about the variability in the annual amount of sealed paper, and how it does not affect the reconstructed data, as well as the fact that the amount of sealed paper used should not affect the ability of the COST method to conduct monthly or seasonal studies.

Finally, we have prepared a new annex (See attached Annex 1) which contains the figures here presented, with the goal of showing how the annual variability of the amount of sealed paper exhibits no statistically significant trend and therefore does not affect the trends detected in the reconstructed events (Figure 1 Annex 1). Figure 2 of Annex 1, shows that there is no statistical correlation between the annual amount of paper and the percentage of paper used to talk about droughts and extreme rainfall by the COST method. Finally, Figure 3 of Annex 1, shows how the ACs do not present seasonality, nor monthly bias that could affect the validity of the COST method to perform reconstructions at monthly or seasonal time scales.

- **RC:** Regarding the methodology, there are several important details that should be clearly stated in the text instead of being included in the tables and figures captions. The reading and comprehension of paper is diffculted by this fact, in my opinion. I suggest an improvement of section 3, providing a more clear and detailed description of all methodological procedures undertaken through the study.
- **AR:** Thanks for your comment, which overlaps to some extent with the comments by Reviewer #1. We have worked to make clearer explanations of each methodology. In this version of the manuscript, Section 3 has been modified including now several clarifications regarding the steps followed in each method. Additionally, Figures 3, 4 and 5 (See Figures 5, 6 and 7 below), include now explanatory panels showing the flow chart for each method and the examples in figures are now more detailed along the text of Section 3.

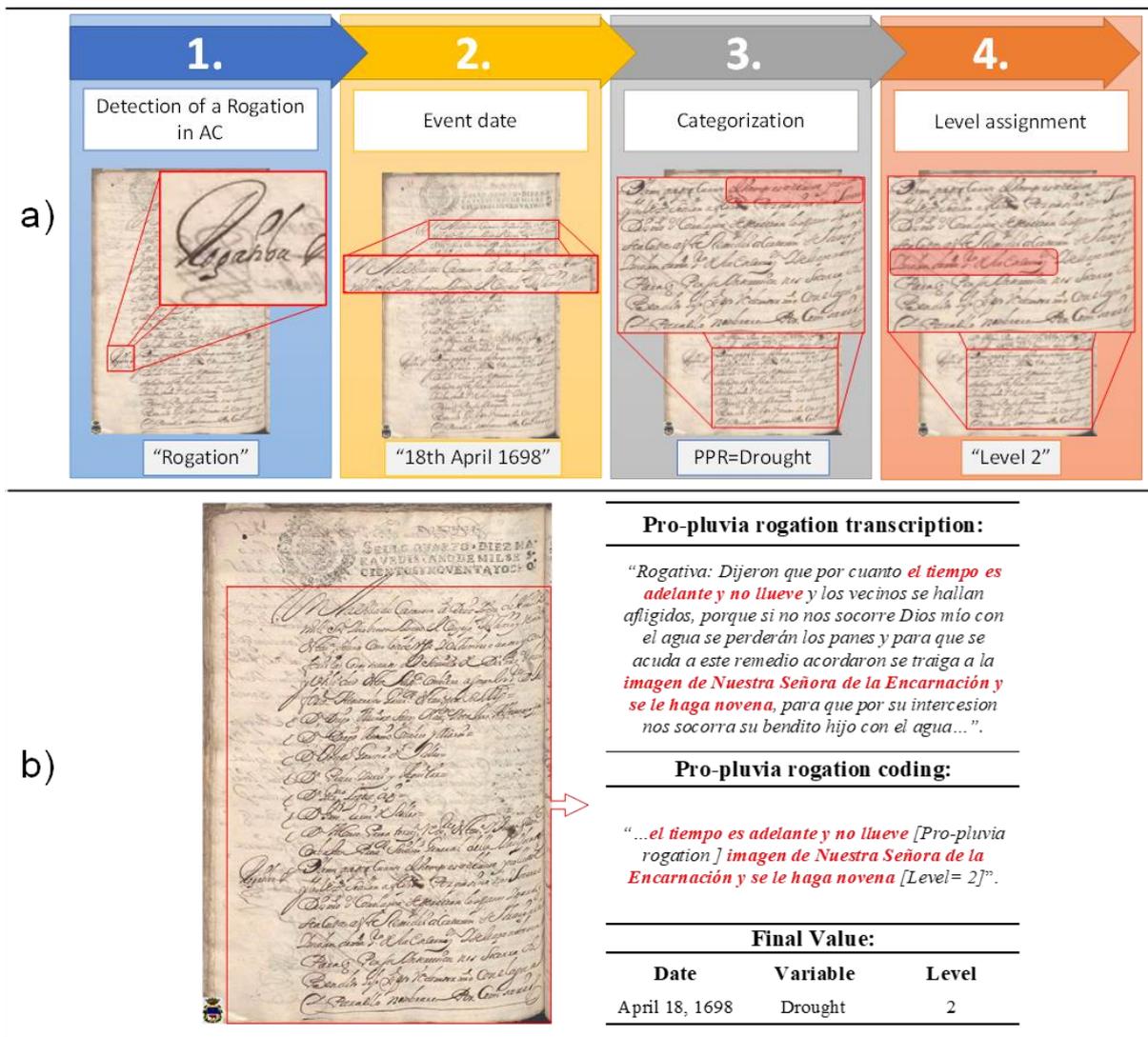


Figure 5: RO method by step (Panel a) and encoding example of the RO method (Panel b). This particular example refers to a Pro-Pluvia RO on 18th April 1698, so the reconstructed variable is drought. Source: the Carmesi Project

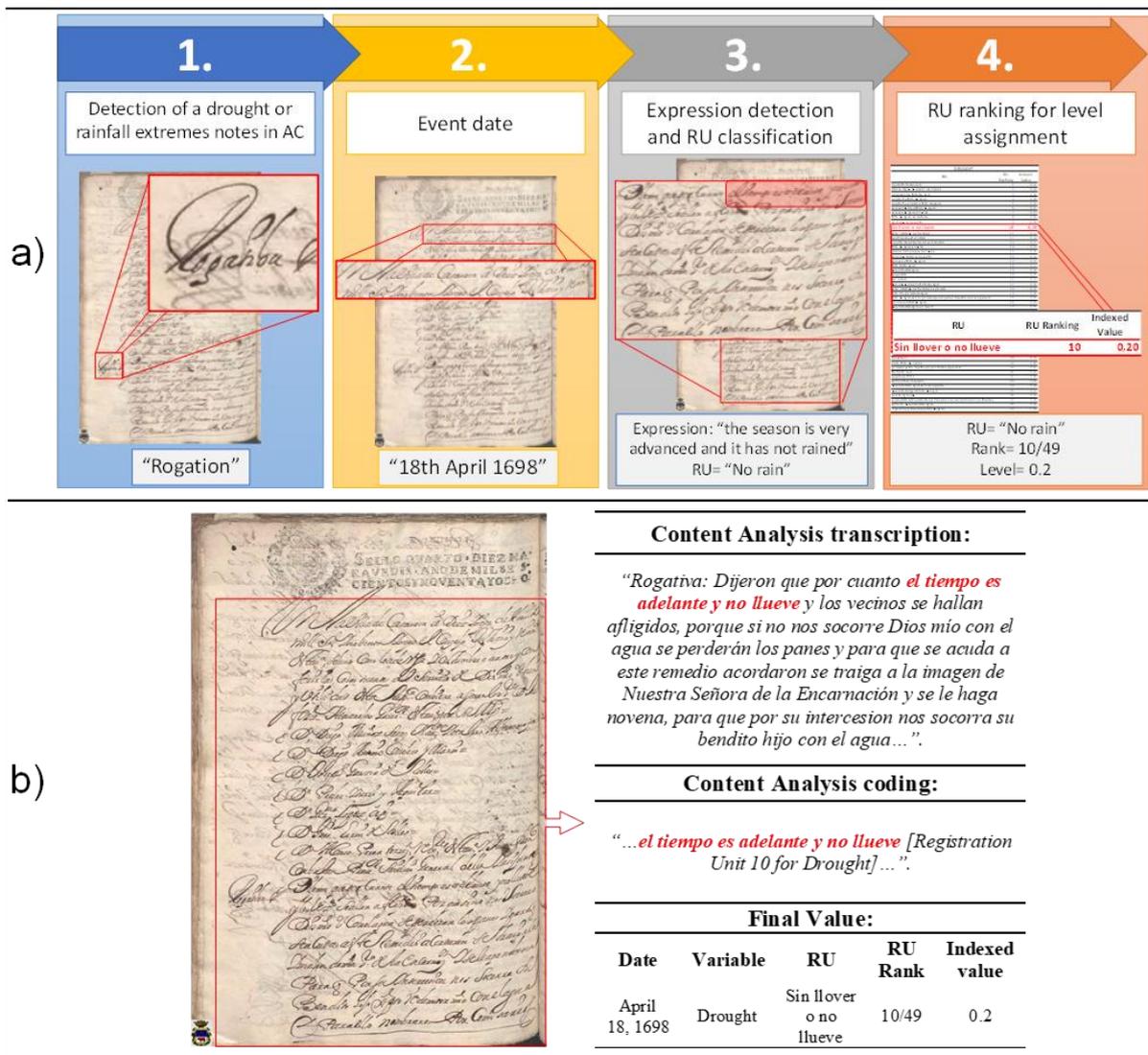


Figure 6: Content Analysis method by step (Panel a) and an example of the encoding of the Content Analysis (CA) method (Panel b). The coded source is the same as in Figure 2 to emphasise how the three different approaches are applied in practice. This particular example refers to a PPR on 18 April 1698, so the reconstructed variable is drought. Source: the Carmesi Project.

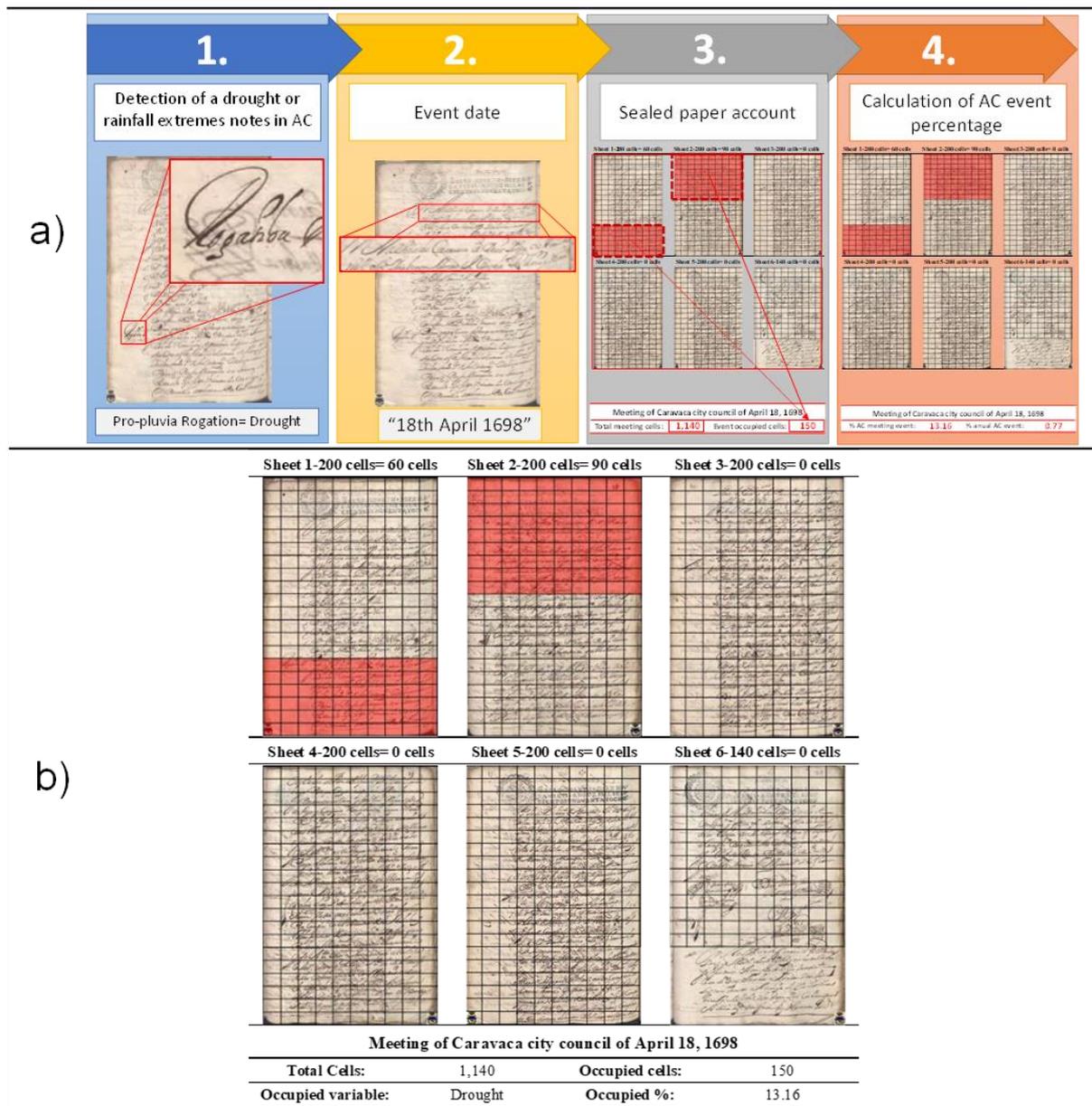


Figure 7: COST method by step (Panel a) and an example the COST method encoding (Panel b). The coded source is the same as in Figure 2 and 3 to emphasise how the three different approaches are applied in practice. This particular example refers to a PPR on 18 April 1698, so the reconstructed variable is drought. Source: the Carmesi Project.

- **RC:** There are some important problems detected in Figures as follows: a) Title of Figure 7 (drought variability) is not suitable and should be modified according to the Figure 8 title (extreme rainfall variability). b) Figure 9 is not legible and must be resized.
- **AR:** These errors have been corrected by modifying the title of Figure 8 and resizing Figure 9 (See Figure 8 below).

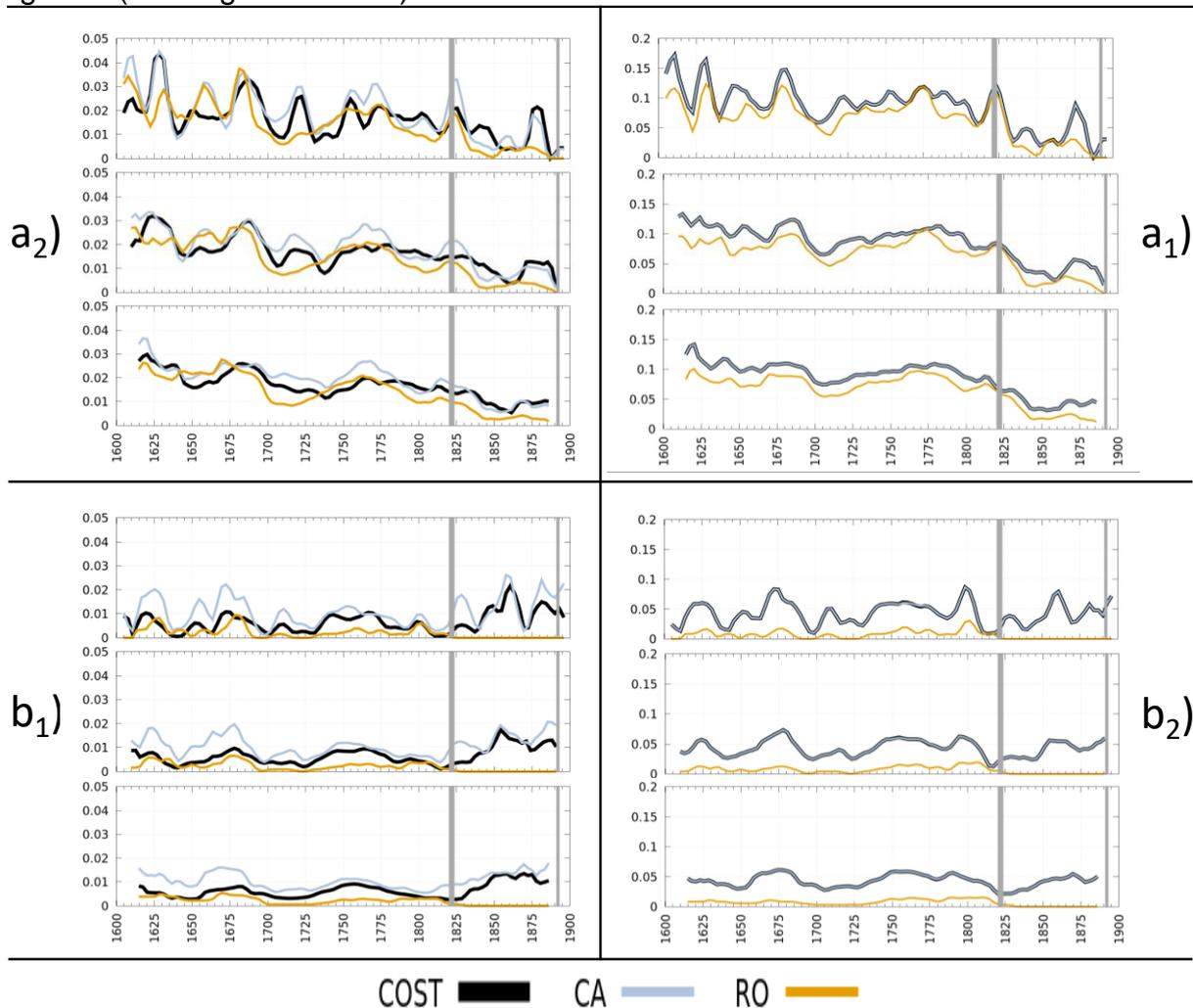


Figure 8: Normalised intensity and occurrence of droughts and extreme rainfall in Caravaca between 1600 and 1900. Series are normalised by dividing each datum by the maximum value of each series. Intensity is defined as the normalised monthly value, while occurrence is defined dichotomously by differentiating between the months when an event occurred, 1, from the months with no event, 0. **Panel a₁** shows the running mean of drought intensity, while **Panel a₂** shows the running mean of droughts occurring. **Panels b₁** and **b₂** depict the same information, but for extreme rainfall reconstruction. All the panels show the running mean with a temporal window of 10, 20 and 30 years, respectively. *Data gaps (from 1820 to 1823 and 1891 to 1892) are shown in grey.

– **Minor comments.**

- **RC:** 1) The text needs a general revision of the English. There are several unclear expressions, some mistakes and missing words. I suggest a general revision of the text redaction. 2) The titles of sections 2 and 3 should be modified because the authors should point out the sources and methods used in their own study and not in such general mode as “Sources in Historical Climatology”. In my opinion this is incorrect. 3) The final section must be a “Conclusion” instead of “Results” (repeated section title).

- **AR:** All the mistakes have been corrected. Further, and pointed out in the response to reviewer #1, the text has been carefully reviewed by a professional translator.
- Here is a more detailed description of the changes carried out:
 - 1) We have made a deep revision of the language in order to improve their understanding, shortening some sentences and try to improve the redaction style. In addition a native English speaker has performed a full revision of the manuscript.
 - 2) Section 2 has been renamed to “Documentary sources” and Section 3 to “Methodology”.
 - 3) We have corrected the name of Section 5, now is “Conclusions”, as pointed out by the reviewer.

ANNEX 1:

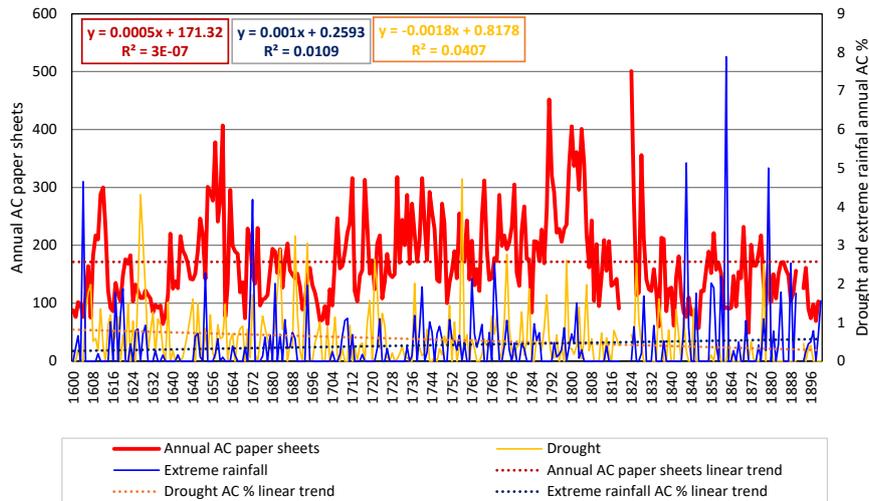


Figure 1: Annual AC paper Sheets and Sheets percentage used for drought and Rainfall extremes in Caravaca (1600-1900).

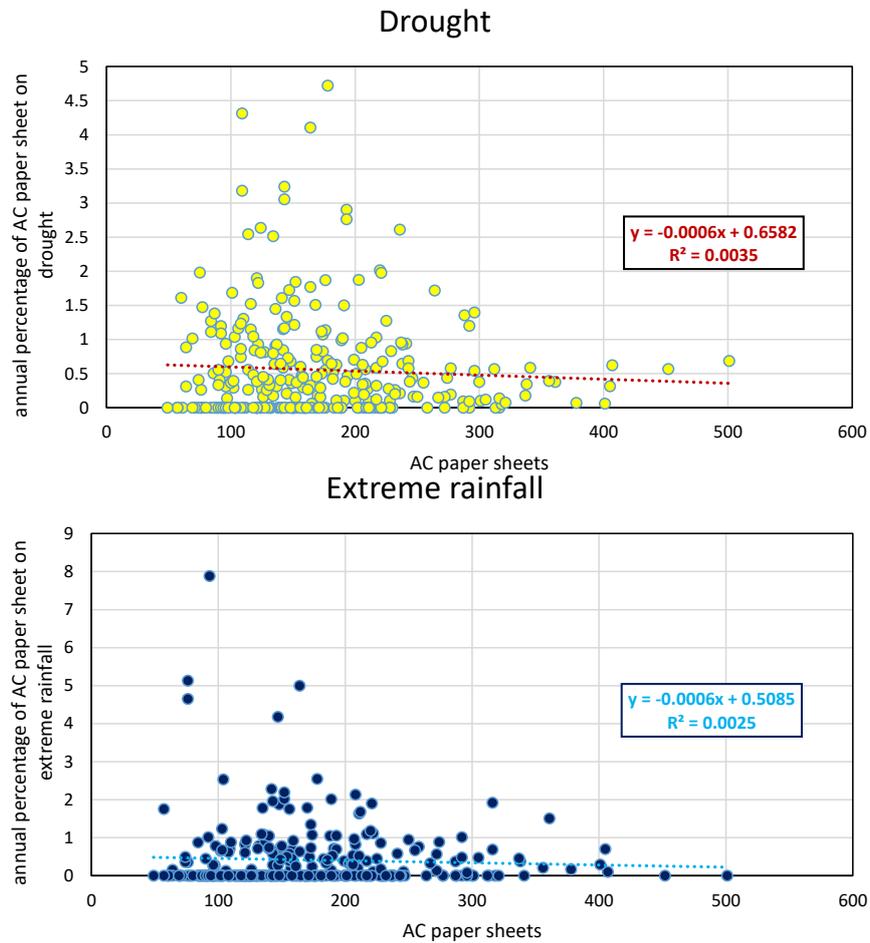


Figure 2: Relationship between the annual amount of AC paper sheets and the annual percentage of AC paper sheets dedicated to inform about droughts (top panel) and extreme rainfalls (bottom panel b).

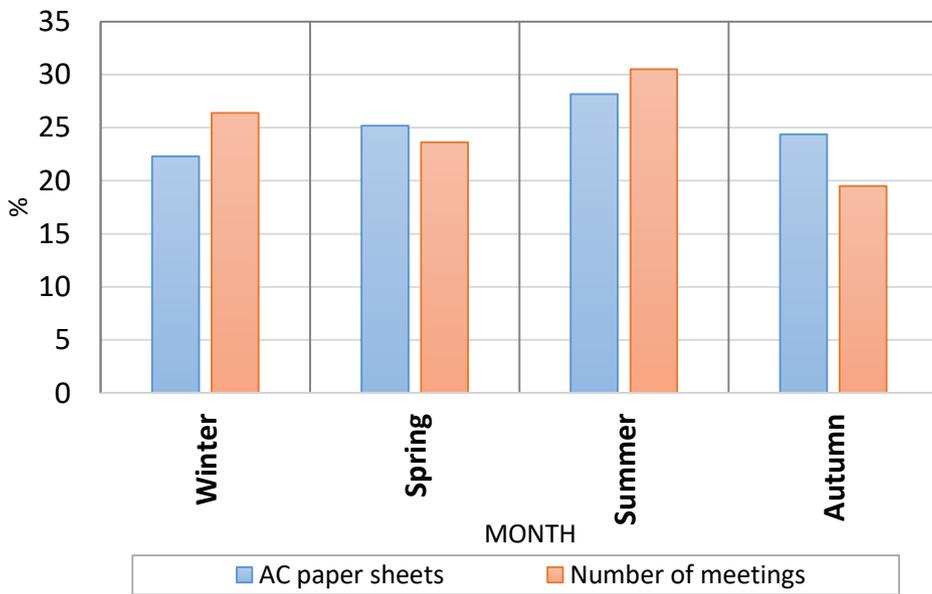
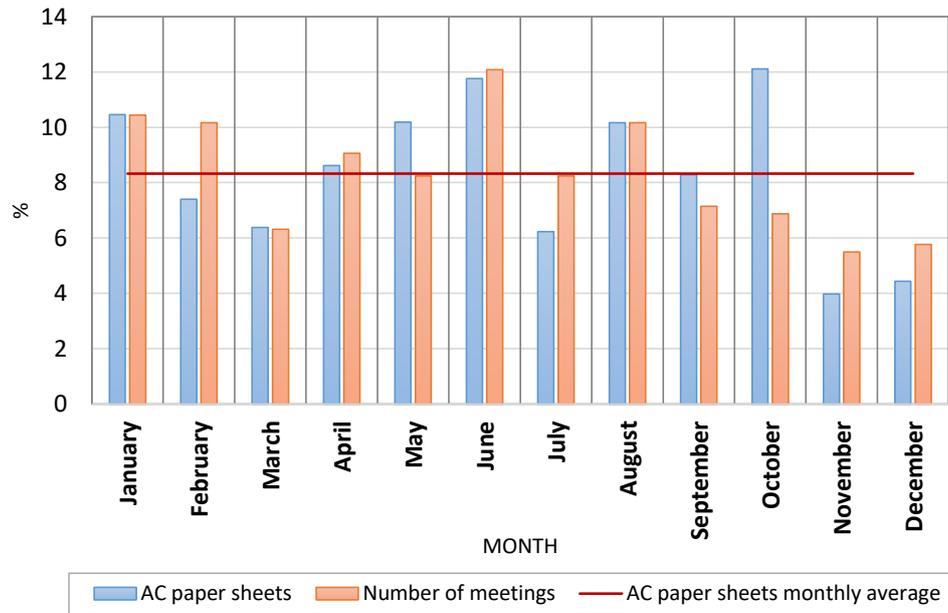


Figure 3: Amount of AC paper sheets used by month (Panel a) and season (Panel b) in Caravaca. The values are the averages for the years 1698, 1614, 1657, 1749, 1800, 1850 and 1983.