Hydrol. Earth Syst. Sci. Discuss.,
https://doi.org/10.5194/hess-2018-241-AC1, 2018

Hydrology and Earth System Sciences
Discussions

Interactive comment on "Do users benefit from additional information in support of operational drought management decisions in the Ebro basin?" *by* Clara Linés et al.

Clara Linés et al.

c.lines@un-ihe.org

Received and published: 3 September 2018

Reply to Anonymous Referee #1

We thank the reviewer for taking the time to review the manuscript and for the helpful comments and suggestions. Here we provide answers to the specific comments and indications of how the manuscript could be improved to address the issues raised by the reviewer.

. . . . . .

[Referee] This paper studies the value of extra information regarding water availabil-

ity for drought management decisions, focusing on reservoir managers and irrigators. This is an interesting topic and the outputs of the work are relevant to the scientific community. However, there are a few issues in the current version that need to be explained further so the manuscript can be ready for publication.

1) In Section 2.1, when describing your study area, it would be nice to add something related to how droughts have impacted this basin in the past and what were the implications for agriculture in the area.

Reply: Three drought events that produced impacts on the agriculture and other sectors have been recorded in the area for the period 2000-2014: a short drought spell in 2002, a multiyear event that lasted from the winter of 2004-2005 to the spring of 2008, and another during the years 2011 and 2012 (Linés et al, 2017). The impacts of the multiyear drought of 2004-2008 in the Ebro basin have been widely studied. The north-eastern part of the basin was the most impacted (Hernández-Mora et al, 2013). Agriculture was the most affected sector, with 540 million of euros of estimated losses in crop production during the hydrological year 2004-2005 and further losses of 272 million in related industries (Perez y Perez & Barreiro-Hurlé, 2009).

Suggested change: We will include this information in the study area section.

References: Hernández-Mora, N., Gil, M., Garrido, A., & Rodríguez-Casado, R. (2013). La sequía 2005-2008 en la cuenca del Ebro. Vulnerabilidad, Impactos y Medidas de Gestión (p. 62). Universidad Politécnica de Madrid - Centro de Estudios e Investigación para la Gestión de Riesgos Agrarios y Medioambientales - CEIGRAM.

Linés, C., Werner, M., & Bastiaanssen, W. (2017). The predictability of reported drought events and impacts in the Ebro Basin using six different remote sensing data sets. Hydrol. Earth Syst. Sci., 21, 4747–4765.

Perez y Perez, L., & Barreiro-Hurlé, J. (2009). Assessing the socio-economic impacts of drought in the Ebro River Basin. Spanish Journal of Agricultural Research, 7(2),

269–280.

2) In Section 2.2.1, there is hardly any information about how many people do they interview from each group (reservoir operators, irrigators), what type of questionnaire/survey method was used (you mentioned it briefly in the discussion but I think it should be explained here in more detail), etc. I think this is needed to understand a bit better how the assumptions you are making in your model are representing the sector. Authors acknowledged that doing a larger survey would be ideal although out of the scope of the work. But still I think readers need to know more about the survey process. Also, they stated that irrigators are very different in their risk aversion levels and this will affect their decisions during a drought. Without information of the sample, readers might wonder if the participants in the survey are representing that spread.

Reply: One interview session was held at each of the locations (the basin authority, the irrigation association and the farm) with two or three people participating in each of them. In the interview that was held at the basin authority, the participants included the head of one of the basin's management units and two members of the hydrological planning office, both with expertise in drought management in the basin. In the interview at the Irrigation Association, the participants were the head of the Irrigation Association and the engineer in charge of the information service about current and expected water availability. And in the interview at the farm level, two people participated: the head of viticulture and engineer responsible of the information service.

The method used was semi-structured interviews. We had a prepared set of questions to ensure we collected all the details that we needed about their decision processes, the data they use to inform them and the gaps or limitations they identify in the information available to them. These questions were used during the interview as a guide and checklist of the topics of interest that we wanted to cover. As is commonplace in semi-structured interviews, we asked the participants to tell us about their own practices, as well as the practices of the groups they deal with in relation with drought management, letting them tell the story in their own way. We only used the questions to bring out the

topics that were not mentioned by the participants to ensure we covered all the topics we intended to cover.

As indicated in section 3.1.3, the information about the practices and attitudes of farmers in the study area was to a great extent obtained from the interview with the Irrigator Association who works in close collaboration with all the farmers in the area and has therefore a wider view than individual farmers. We acknowledge that the sample of interviews is held among a small sample. The objective of these interviews was primarily to build our understanding of how the farmers behave as a function of their expectation of water availability. Although important to the assumptions made in the development of the decision model that we constructed, we would readily agree that our representation of the farmer behavior and the diversity of responses across farmers may be over simplified. A more complete interview would reveal more information, but we feel that is outside the scope of this paper.

Suggested change: We will add this additional detail on the interview of the participants and method to the section 2.2.1. In the revised version we also propose to put less emphasis on the interviews as we acknowledge that the sample of interview is small, and that the representation of the diversity of farmer responses may be simplified.

3) In page 13, line 4, you said that you explore different thresholds "keeping the same thresholds at each of the four points where the farmers make decisions during the season". However, in page 16, you give different thresholds for Nov, Feb, April and May. Could you clarify this?

Reply: In page 13, line 4. We apologise for the confusion. For each of the four decision moments (Nov, Feb, Apr, May) different thresholds are used, but we meant that the same set of 4 thresholds is kept for all the years analysed.

Suggested change: We agree that is confusing and we will rephrase the sentence in page 13, line 4, to make it clearer.

4) In Table 3, is there any way authors can add some kind of information to show how dry or wet each of the years under study was. From what I understood, 05 and 06 will be drier years as even with high allocation factors the result is not very good...But maybe adding some information (e.g., a standardized precipitation index) could help to interpret the results.

Reply: Yes, in 2005 and 2006 there was a drought event, as well as in 2002 and 2012 (see answer to comment 1). This is indeed well represented by the SPI data of the study period (Fig 1).

Suggested change: We will include the timeline for SPI-12 for September information in the header of table 3 of the manuscript to provide an indication of the dryness of each year.

5) Figure 4, after looking at it a few times, is still a bit confusing to me. Authors could review the explanation of it and/or the presentation of it to make it easier to follow.

Reply: We agree that Figure 4 is complex and contains a lot of information. This figure aims to illustrate the optimised thresholds. A threshold is required when taking the decision to choose between two options as a function of a certain indicator. In this case the threshold is the value above which the farmer would consider that the availability of water is good enough to plant the most productive crops (this corresponds to following the paths marked with a blue A in Figure 3). The threshold is perfect if it always makes the farmer take the decision that results in a higher benefit at the end of the season. Using perfect information, we first identified the decisions that result in the highest benefits to the farmers. These decisions are represented in Figure 4 by the coloured points, with the level of the reservoir on the y-axis. If the point is red, then it is best for the farmer to follow the path marked with a red A in Figure 3, while if it is blue then it is best to follow the blue A path. If it is yellow, then it does not matter which of the paths is followed. A perfect threshold for the reservoir level to divide between good and poor water availability would be selected such that all the red points are below and all the

blue points above the threshold. As can be seen in Figure 4, it is not possible to select a perfect classification of the reservoir levels with a single threshold. The dashed lines mark the thresholds that maximises the points correctly classified. The fact that the classification cannot be perfect means that the reservoir level alone does not provide enough information on what is the best decision to take. Additional information would be valuable if it contributes to improve the classification and, therefore, results in the decision that maximises the benefits being taken more often. In this case the additional information we consider is the snow coverage data. We show this in the lower part of the figure. Again the figure shows that this information alone does not lead to a perfect classification either (dashed lines).

This is different when the combined information of reservoir level and snow cover extent is used to inform the expectation of water availability. We incorporate this additional information by amending the threshold of the reservoir level. This is the solid line in the figure for the Months Nov, Feb and Apr. Snow cover is not considered in May as that is too late in the season to be of significance. When snow covers an area larger than the threshold coverage (dashed line in the lower plot), then the original threshold for the reservoir level is used. However, when the snow coverage is smaller than the identified threshold, and therefore the future contribution to the reservoir level from snowmelt is expected to be lower, a second, more conservative threshold for the reservoir level is used. With the second threshold some of the red points incorrectly classified above the original threshold are now classified below the thresholds.

Suggested changes:

- We propose to improve the explanation of figure 4 in the manuscript, describing this step by step to ensure the reader does not get confused.

- We will include the missing label in y axis (“reservoir level”) in Figure 4

- We will mention in the caption of Figure 4 that the colours marked in the legend are considered as the “optimal course” and refer to the paths illustrated in Figure 3.

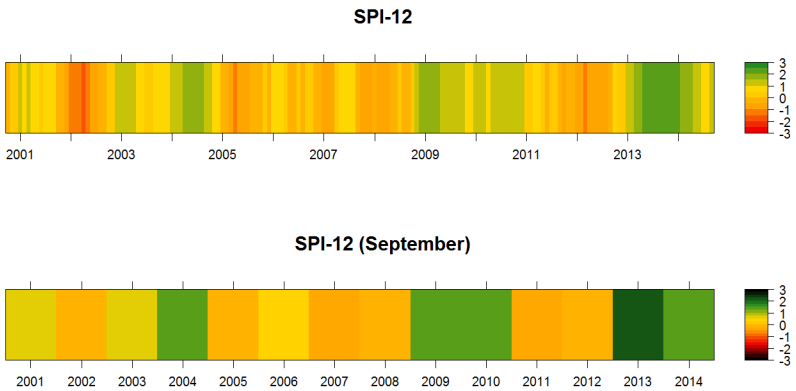

Fig. 1. Monthly SPI-12 (upper plot) and SPI-12 for the month of September (lower plot) for the catchment area of Barasona and Santa Ana reservoirs. Calculated with CHIRPS precipitation data for the p