

Interactive comment on “Probabilistic modelling of the dependence between rainfed crops and drought hazard” by Andreia F. S. Ribeiro et al.

Anonymous Referee #1

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The study aims at advancing agricultural drought risk management through providing a probabilistic model for assessing the risk of crop loss and drought for two regions of the Iberian Peninsula with rainfed cropping systems. The authors apply the concept of copula models for this purpose and infer probabilities of crop loss under drought and non-drought conditions for the two regions and two crops.

Overall, the authors address an important topic by transferring the use of copula models to agricultural drought risk management. The paper is very well organized, easy to follow, and clearly written. The methods are precisely described, including a flowchart of the concept. Also, adequate reference to existing literature is presented.

However, I am concerned about two issues that should be further addressed:

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1) Data and methods: The study focuses on crop loss of rainfed agriculture due to drought. While the data base is 27 years, only 7 years seem to be years with drought conditions according to Figure 3. Since only one value per year is retained for analysis, this seems like a very small sample size for making robust probabilistic inferences, especially regarding the tail of the distribution. One could argue that the study is not only focused on drought, since crop loss under non-drought conditions is also investigated; however, if the authors' intention was to assess the risk of crop loss more generally, in my view a stronger focus on other hazards or drivers of crop loss would have been beneficial to include. In addition to the sample size issue, the spatial and temporal scale of the selected drought indicators seems rather coarse. Spatial scale: I assume some spatial average or aggregate measure of drought indicators over the two clusters was used (not clear from the manuscript). How representative is such a spatially aggregated drought intensity measure for explaining crop loss, which likely results from small-scale interactions of hazard, vulnerability of the plants, soil type, additional irrigation systems in parts of the clusters, etc.? Temporal scale: monthly SPEI (as used for cluster two) is a commonly used indicator; however, for this specific purpose, wouldn't sub-monthly drought conditions be more suitable given the effect during different growth stages, as the authors point out themselves? Given these data issues, I am a bit concerned about the meaningfulness of the inferred results on probability of crop loss under drought and non-drought, as presented in section 3.2.

2) Aim of the study versus methodological setup: The aim of the study is to quantify the risk of crop-loss under drought and non-drought conditions for two regions and two crop types; for this purpose the authors model the dependence between drought conditions and crop anomalies. What actually is the practical value of assessing the probability of rainfed crop loss under non-drought conditions with this setup, where the focus is solely on drought indicators? The aim of the study on the one hand and the deployed data and statistical methods on the other hand seem a bit separated or not well aligned at times. While for drought conditions the data does not seem fully suitable for analysis (see issue 1 on sample size), for non-drought conditions the value of the

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analysis is not entirely clear to me, at least how it is presented currently. It would be beneficial if the authors could elaborate further on the applicability of their method for agricultural drought risk management.

Detailed comments:

2.1 A bit more background how the drought indicators per cluster and crop were calculated and selected in the authors' previous study would be useful (especially how the spatially variable indicators were regionally averaged). In contrast, details about SPEI and vegetation condition indicator calculation could be shortened by pointing to existing references.

Fig. 3: What is the dotted horizontal line?

Fig. 4 bottom row: Due to the filled marker style it is hard to discern details; I'd suggest making a density plot of points.

References: duplicate reference Ribeiro 2018a and b

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