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## Reply on RC3

Juan Antonio Luque-Espinar et al.

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Author comment on "Spatio-temporal analysis of the role of climate cycles on landslide activity: the case of Majorca (Spain)" by Juan Antonio Luque-Espinar et al., Nat. Hazards Earth Syst. Sci. Discuss., <https://doi.org/10.5194/nhess-2022-50-AC3>, 2022

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The manuscript presents a spatio-temporal analysis of climate cycles on the island of Majorca and seeks to explore correlations with evidence of historic landslides, i.e. a landslide inventory featuring 423 events.

Albeit the general idea (especially the topic of identifying main climatic cycles) is interesting, I am afraid that there are several major issues with this manuscript in its present form:

We would like to express our sincere gratitude for your in-depth revision.

- I am missing a clear red thread throughout the article, thus rendering it slightly difficult to read. It is not ultimately clear to me why these particular methods were chosen to tackle the problem under consideration and what the main findings are that the authors want to convey.

Different authors linked landslides/floods to meteorological processes such as ENSO and NAO. However, there is a lack in the literature regarding the relationship between hydrometeorological disasters and the spatio-temporal behavior of the influence of natural climatic cycles. We will proceed to a better drafting and restructuring of the article to make it easier to understand.

- Moreover, findings are not put into context, and a discussion section is missing completely.

We will rewrite and restructure this section and a "Discussion section" will be included.

- Sections are not clearly separated. Some parts of section 3.4 on rainfall series data seem more like results than "Materials and Methods" to me.

We will rewrite and restructure the entire manuscript for a better understanding.

- The joint consideration of different process categories, which are simply summarized as "landslides", would need better justification. After all, these different processes are most likely characterized by different trigger conditions (e.g. rockfall - earth slides - debris flows). The authors could explore results per process category (at least for those categories where enough events are available).

We use the term "landslides" as generic. The landslide inventory reveals that most of them are rockfalls. Earth slides and debris flows are negligible in the Tramuntana range. Nevertheless, we will carry out a new analysis including the complete rockfall inventory as well as the flooding records on the island. A robust and complete validation will be done.

- Some sections are not written in a balanced way. Especially section 3 does not really present the methods applied in a stringent and reproducible manner. For instance, Section 3.3 provides a rather general introduction of geostatistics, but ends quite abruptly with the last paragraph somehow falling short of actually explaining what is done here and why. Why was OK chosen specifically? I assume that there is a trend due to the topography? Also, it is quite common to perform cross-validation on kriging results, but it is unclear at this point if any validation was performed and if yes, how?

A balanced approach has been sought between the description of the methods, and the extension of the article. Section 3.3 describes the main concepts and the key equations. In addition, some new references have been added to support the concepts used. Finally, it will be revised to complete the description given in the previous version of the article.

The OK was used because provides the least restrictive assumptions and do not also exhibit drift in calculation of experimental variogram. In some cases, points of the experimental variogram, separated by large distances, are distributed around the variance value. This is due to the differences among the precipitation values. The validation of the results has been carried out by matching the values of the estimation variance obtained for each of fitted variogram models. Many author accepts this validation process.

- I am under the impression that some important details were omitted or are at least hidden in the manuscript. For instance, statistical confidence values estimated at each rainfall station have been reclassified from 0 (not detected) to 4 (more than 99% statistical confidence). How were these thresholds chosen, and where are they listed? I assume this information is hidden in l. 136?

We will considerably improve this section.

The methodology is described in the article, although we have rewritten this section to clarify it. When the power spectrum is calculated (Pardo-Igúzquiza and Rodríguez-Tovar, 2004), four statistical confidence values <90%, 90%, 95% and 99% are obtained. Value 0 is assigned when a climatic cycle is not estimated (not detected). Therefore, five categories from 0 to 4 are obtained, which will be used to analyze the spatial behavior of each climate cycle (variogram) and subsequently estimate it (kriging).

- I think that the connexion between the climate cycles and landslide events should be motivated in a better way. Currently, I fail to see this connection. Maybe a more detailed exploratory analysis of the landslide inventory against the identified climate cycles might provide interesting insights?

We understand your advice. We will carry out a new analysis including the complete rockfall inventory as well as the flooding records on the island. A robust and complete validation/connexion will be done.

- On a more general note, all recorded landslides seem to have occurred in the north-western part, i.e. in the Serra de Tramuntana. This is stated in l.68, and indicated by the white dots in the maps (Figs. 5, 7). I do not really understand why a geostatistical estimation of the whole island does relate to landslides that only occurred in a quite specific sub-region near to a mountain range?

We have only a rockfall inventory in the Tramuntana range. The rest of the island has a

gentle relief and slope movements are not a serious problem. In this sense, to complete the entire island, we will include the flooding records.

- Only some large landslides are prominently mentioned. Consequently, the main connection seems to be event magnitude, not event frequency. An exploratory analysis of event frequency could provide interesting insights as well.

We agree. All the rockfall inventory will be included to take into account not only magnitude but also frequency. In this sense, we would like to note that the rockfall inventory is more complete since 2001 (Mateos, 2001). Most of the events before this date are lost, except for those of the largest magnitude that left a "footprint" in the media. That is the main reason we used the 5 largest ones.

Overall, I do not think that the manuscript is suitable for publication in its current form due to these limitations. However, I do encourage the authors to work out the proposed connection between climate cycles and landslides in a more elaborate manner.

We will improve the article and in depth modifications will be done taking into account the reviewer's comments.

Many thanks and kind regards,