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Reply on RC2

Juan Antonio Luque-Espinar et al.

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-AC2>, 2022

The article entitled "Spatio-temporal analysis of the role of climate cycles on landslide activity: the case of Majorca (Spain)" discusses the possibility of using spatio-temporal analysis of climate cycles climate cycle and its role as landslide occurrence possible reference phenomenon. And concluded that the 5 largest landslides of the series are very well located in the areas of highest statistical weight.

We thank all the interesting and useful comments provided by you. Please, find attached a point-by-point response, including all relevant changes that we will made in the manuscript to solve your considerations.

- However, the problem statement that need to be solved here is well known hypothesis. In addition, the research carried in this article dint come up with interesting facts. More or less the outcome was highly expected.

The originality of this work lies in the methodology of the spatial and temporal analysis of the climatic cycles on the island of Mallorca. In this sense, the words "ENSO, NAO, landslides" were only included in three publications, one of them is the preprint of this review, and there are only 4 papers with the words "ENSO, NAO, Kriging" (Web of Science). The authors would like to highlight that the hypothesis put forward in this article is not stated in the previous bibliography. In the present work, authors attempt to solve the lack of methods of spatial analysis of climatic cycles, which would be of great interest to study the occurrence of geohazards (i.e. landslides and floods). The analysis has allowed verifying that the cycles behave as spatial continuous variables, but with a percentage of unstructured behavior due to the uneven influence of these cycles in the rain gauges. The island of Mallorca presents a special topography with a mountainous area in the northern part of the island (Tramuntana range), the rest being of lower altitude and gentle relief. This method provides similar assessments in areas with a complex topography, where the results of the rainfall spatial/temporal distribution will also be more uncertain and complex to determine.

- I wish to see a clear sentence that stress on the validity of using the applied method, or compare to current methods that might need to be improved using the presented approach.

Undoubtedly we will rewrite this part of the article. The literature shows that the climatic

analysis carried out has not been proposed so far. This approach shows two well-known robust methods: spectral analysis to estimate the relevance of each natural climatic cycle and geostatistics to determine their spatial behaviour. We will improve the text to emphasise these aspects.

- Some prosaic sentences were mentioned: "the island suffered persistent and abnormal precipitations", "In this work, ordinary kriging (OK) has been chosen as it is better adapted to the problem under study."

We will rewrite the text to clarify both sentences. The first one can be deleted, as certainly, it is "prosaic". In the second one, we wanted to emphasise the analysis of spatial variables carried out by the Theory of Regionalized Variables. This theory was formulated by Matheron (1963, 1965) and applied in different fields of science by authors such as Chilès, Delhomme, Journel or Goovaerts.

- 4 with table 1. you mentioned the wet years, like 2003 but the amount of landslide compare to following years (average to wet) clearly saying different story "dry to wet"

We appreciate the suggestion of the reviewer. We think that Figure 4 and Table 1 are not comparable. Figure 4 only reports the statistical confidence and number of cycles detected, providing different information from Table 1.

You are right on this observation. From 2001 (Mateos, 2001), the inventory is more complete, as it includes all the events detected by Civil Protection authorities and the Road Maintenance Service of Mallorca. Most of them are of small volume. This is one of the reasons we decided to use only the 5 major landslides. 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.

- 5 However, when there are a significant number of stations where the cycle has not been detected, a dichotomous transformation has been chosen, i.e. observed (1), not observed (0), as in the case of ENSO (6.4y) and Sunspot (11.2y).

Indicator kriging (IK) is a non-parametric estimation method commonly used to solve problems related to the risk of presence of a given dichotomous value (presence-absence). For example, it is very common in pollution problems.

In this case, the method allow estimating the risk of presence of a climatic cycle because it does not reach 90% statistical confidence in some rainfall gauge.

- What about the false negative and false positive of landslide occurrence within the climate cycle??

Thanks for your comment. We will improve the statistical analysis adding the complete landslide database, and also floods recorded in the study area. To quantify the spatial matching (or mismatching) between spatial distribution of climate cycles and hazards density maps.

I prefer to stop here, as i tried to get along with article searching for significant findings. But, I think due to the poor structure of the manuscript and presented figures, the idea behind it was difficult to follow. Unfortunately, my decision is against the publication and I recommend to reject the article. In meantime, I ask the authors to have more time to develop the current approach by consider more robust problem statement and methodology.

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

improve the article considerably and to have another chance. We hope these improvements will lead you to reconsider your decision. Many thanks and kind regards.