

Dr. Vassiliki Kotroni  
Editor

*Natural Hazard and Earth System Sciences*

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Re: Review of manuscript egusphere-2022-498

Dear Dr. Vassiliki Kotroni,

We thank you for the diligent handling of our manuscript. We are very grateful for each comment and suggestion made by the referees, which improved our manuscript. We addressed all the points raised by referees in the table below:

Observation	Our comment	Original text	Modifications made in the text
<b>Referee #1</b>			
L564: A further explanation is required about the sum of models. The method must be clear to the readers. Please explain that all 3 weather indices are examined as predictors of the losses associated with data from clusters 2,4,6....or something like that!	Thank you for the suggestion. We adapted and added further explanations about the sum of models.	The sum of the models (gray line in subfigure	Text: The sum of losses estimated with models M1 and M2 (Figure 5b) [...]  Figure 5 caption: [...] including the sum of the losses estimated with two loss models
L107: fifth step?? Inconsistent text compared to Figure 1 and previous text (L91). Overall many different numbering of steps is mentioned. E.g., again in L112...	Thank you for noticing the error. We rephrased the sentence	This evaluation excluded papers that did not provide information on index insurance design. Finally, in the fifth step, we critically reviewed the 26 most relevant studies.  The first crucial step for this analysis was defining the main concepts and definitions used to	The fourth step was performing a critical review of the 26 most cited papers published in the last five years of the dataset (2018 to 2022).  Before analyzing the full papers, it is critical to specify the main concepts and definitions

		analyze the material	
L551-557 is very important but very difficult to follow. At least, the beginning should be corrected. The illustrative example does not suggest that....I assume it 'highlights' the following...Otherwise, this phrase is not connected well with the next, from a grammar point of view.	We thank you for the comment. We connected the text avoiding separating the arguments in numbering, and rewrote all the sentences.	The illustrative example suggests that...	The illustrative example highlights the multi-hazard nature effects of extreme weather events on crop yield losses. We used cluster analysis to identify what hazards were dominant each year that a crop loss event occurred [...]
Figure 2: state the exact period reviewed to show that 2022 was not fully covered	Thank you for the comment. We corrected it accordingly		
Figure 5: Please correct TX090p. Also, the entire caption should be improved. The Latin numbering (i)(ii) is not shown in the Figure, and the other lines (observed, sum) are not included in the caption.	We rewrote the text in the legend to explain the models and include the other lines in the caption.	Risk analysis module applied to one specific location. Legend: (a): historic crop losses in the studied period for the city of Toledo; (b) crop loss probability in the studied period for the city of Toledo. (i) multi-hazard model M1(SPI,TX90p): using SPI and TX90p as inputs; and (ii) multi-hazard model M2(SPI,pmax,TX90 p): using SPI, TX090p, and pmax as inputs	Risk analysis module applied to the city of Toledo for demonstrating the multi-hazard model M1(SPI,TX90p); multi-hazard model M2(SPI,pmax,TX90 p), the sum of the two models; and observed crop losses in the studied period; (a) simulation of crop losses and (b) crop loss probability in the studied period including the sum of the losses estimated with two models
L77, correct: 'out'	Thank you for the comment. We corrected it accordingly	pointing ou limitations and recommended future works	pointing out limitations and recommended future works
Figure 1: Correct the legend of the 4th step	Thank you for the comment. We corrected it accordingly		

L86: inconsistent writing ('by' is missing or parenthesis for the reference)	Thank you for the comment. We corrected it accordingly	We used a double-step analysis to analyze the data, following the PRISMA protocol Liberati et al. (2009)	We performed the literature review following the PRISMA protocol (Liberati et al. 2009)
L312: ...interaction with what?	Thank you for the comment. We rewrote the sentence.	A multi-hazard approach requires understanding the frequency of each hazard and its interaction	A multi-hazard approach requires understanding the frequency and magnitude of multiple hazards and the possibility of them occurring simultaneously.
L354: both K & k are used for strike value? Please select between uppercase or lowercase	Thank you for the comment. We corrected it accordingly	critical variables (i) strike value K, and (ii) degree of coverage dc. The [...]	critical variables (i) strike value K, and (ii) degree of coverage dc. The K [...]
L374: correct 'were'. Is it 'when'?	Thank you for the comment. We corrected it accordingly	It is well known that climate variables present a certain degree of uncertainty were they are predicted	It is well known that climate variables present a certain degree of uncertainty when they are predicted
Figure 3. Correct 'communitary contract' in E2. I suppose the correct is 'community'?	Thank you for the comment. We corrected it accordingly		
L536: correct the sentence	Thank you for the comment. We corrected it accordingly	The method applies a wavelet-based algorithm for multiple sites and requires and was applied using the R-package PRSim (Brunner et al., 2021))	The stochastic simulation was performed using a wavelet-based algorithm that allows multi-site simulation. The simulation was implemented in R-Environment with the package PRSim (Brunner et al., 2021)
L527: correct 'clusters 2 adn 4'	Thank you for the comment. We corrected it accordingly	The multi-hazard model M1 was trained and validated using data from clusters 2 adn 4	The multi-hazard model M1 was trained and validated using data from clusters 2 and 4

L559: correct the sentence	Thank you for the comment. We corrected it accordingly	[...] severely impacted by extreme weather occurrences in Figure 5. t is [...] possible to observe that:	[...] severely impacted by extreme weather occurrences in Figure 5 it is [...] possible to observe that:
L567: please change the 'study case' to 'illustrative example'	Thank you for the comment. We corrected it accordingly	The study case in this subsection illustrates one possible application of the framework,	The illustrative example in this subsection illustrates one possible application of the framework,
L573-578: this paragraph is repeated...please delete	Thank you for the comment. We deleted the repeated paragraph		
L588: Please rewrite. This sentence is not clear to me, including grammar errors: The vulnerability in the insurance design was characterized by selecting a loss models and defining threshold values that characterized loss events	Thank you for the comment. We corrected it accordingly	The vulnerability in the insurance design was characterized by selecting a loss models and defining threshold values that characterized loss events	The vulnerability analysis for insurance design was composed of the selection of a loss model selection and the definition of threshold values
L605: the sentence is not well-written. Please rephrase: Both excessive rainfall and high temperature and droughts and high temperatures were detected by the clustering analysis.	Thank you for the comment. We corrected it accordingly	Both excessive rainfall and high temperature and droughts and high temperatures were detected by the clustering analysis	Two examples of multi-hazard events were detected by the clustering analysis, one is the combination of excessive rainfall and high temperature, and the other is the combination of droughts and high temperature were detected by the clustering analysis
L606: put ': ' before 'the first was...', and correct for grammar	Thank you for the comment. We corrected it accordingly	The cluster model demonstrated that historic crop losses were divided into three groups, the	The cluster model demonstrated that historic crop losses were divided into three groups: the first was

		first was precipitation deficit dominated, the second was precipitation deficit and high temperatures, and the third was excessive rainfall and high temperatures.	precipitation deficit dominated, the second was precipitation deficit and high temperatures, and the third was excessive rainfall and high temperatures
L610: Please rephrase. Grammar mistakes: ... but also on analyzing the right data for right the hazard or multi-hazard selection	Thank you for the comment. We rewrote the paragraph correcting the grammar mistakes.	but also on analyzing the right data for right the hazard or multi-hazard selection	This example illustrates that the problem of the mismatch between actual losses and losses predicted from the index insurance contract, also called basis risk, does not depend only on having enough historical records of loss events but also on having enough understanding of what were the major drivers of loss events in the historical records
L614: correct 'Testing' with 'testing'. And 'specially' with 'especially'	Thank you for noticing the error. We corrected it accordingly	Testing different hypotheses of the interaction between hazards, specially	testing different hypotheses of the interaction between hazards, especially
L615: add 'and' before 'analyzing...'	Thank you for noticing the error. We corrected it accordingly		and analyzing the trade-offs between loss model accuracy and the policyholders willingness to pay
Referee #2			
List of affiliations: add the affiliation number	Thank you for the comment. We corrected it accordingly		
Line 4: including the methodologies for calculating natural hazards' indices	Thank you for noticing the error. We corrected it accordingly	including a methodology for calculating natural hazards' indices	including the methodology for calculating natural hazards' indices

Line 81: check the citation format. I suppose it should be (Liberati et al., 2019) Line 86: check the same citation as in line 81	We are sorry about this formatting error. We updated the citation.		We performed the literature review following the PRISMA protocol (Liberati et al., 2009)
Line 132: insert an empty line before "Food security", which is a new definition	Thank you for the comment. We corrected it accordingly		Corrected
Line 176: check the dot after 2011		According to Cobo et al. (2011). Density is a measure ...	According to Cobo et al. (2011), density is a measure ...
Line 281: Li, Z., Zhang, Z., Zhang, J., Luo, Y., and Zhang, L. (2021). A new framework to quantify maize production risk from chilling injury in Northeast China. <i>Climate Risk Management</i> , 32.doi:10.1016/j.crm.2021.100299. This study proposes a Chilling Index to evaluate the effects of low temperatures on maize. However, it does not show the application of an index insurance scheme even if in the conclusion the index is considered promising for possible practical applications in the insurance field.	Thank you for the suggestion. This paper is very interesting and is adequate for studying temperature variation hazards. However, we will not include this paper in the discussion because we focused exclusively on indices for index-based insurance design.		
Line 300: basis risk	Thank you for noticing the error. We corrected it accordingly	In order to lower the base risk	In order to lower the basis risk
Line 314: check the brackets on Martinez Salguero	Thank you. We corrected the citation style	The assumption of independence was considered prior knowledge by (Martínez Salgueiro, 2019) and Guo et al. (2019).	The assumption of independence was considered prior knowledge by Martínez Salgueiro (2019) and Guo et al. (2019).

<p>Line 345 and following: Monteleone, B., Borzì, I., Bonaccorso, B., and Martina, M. (2022). Quantifying crop vulnerability to weather-related extreme events and climate change through vulnerability curves. <i>Natural Hazards</i>, (0123456789). doi:10.1007/s11069-022-05791-0 This study shows crop vulnerability functions for various weather-extremes and reviewed the methodologies used to derive them, among which crop modelling.</p>	<p>We thank you for the comment. We included this paper in the discussion.</p>		<p>Monteleone et al. (2022) reviewed methods used to model the functional relationship between a given extreme event and crop losses. They also highlight the need for studying crop vulnerability to other less studied climate-related hazards, such as extreme temperatures.</p>
<p>Line 357 to define</p>	<p>Thank you for the suggestion. We corrected this grammar mistake.</p>	<p>will be the key to defining the premium</p>	<p>will be the key to define the premium</p>
<p>Line 366: remove 365</p>	<p>Thank you for noticing. We removed this number.</p>	<p>365 tails, leading to underestimating pure risk premiums.</p>	<p>tails, leading to underestimating pure risk premiums.</p>
<p>Line 406: Figueiredo, R., Martina, M. L. V, Stephenson, D. B., and Youngman, B. D. (2018). A Probabilistic Paradigm for the Parametric Insurance of Natural Hazards. <i>Risk Analysis</i>, 38(11), 2400–2414. doi:10.1111/risa.13122. This study, even if not focused on crop insurance, provides a nice overview of basis risk and the issue you are addressing in the paragraph.</p>	<p>We thank you for the suggestion. We adapted the text accordingly</p>		<p>Figueiredo et al. (2018) proposed a probabilistic framework for tackling uncertainties in trigger selection and damage modeling, improving basis risk quantification, evaluation, and communication [...]</p>
<p>Line 427 and 429: check the brackets on Turvey et al. and Sacchelli et al.</p>	<p>Thank you for noticing. We corrected this editing mistake.</p>	<p>(Turvey et al., 2019), for example, followed a path A1-C1-D2-E1-F1, i.e., drought insurance (A1) with a static threshold (C1), a loss model based on losses projected by an index (D2), for single</p>	<p>Turvey et al. (2019), for example, followed a path A1-C1-D2-E1-F1, i.e., drought insurance (A1) with a static threshold (C1), a loss model based on losses projected by an index (D2), for single policyholders</p>

		policyholders (E1) for many farmers in a region (F1). (Sacchelli et al., 2018) provides another example	(E1) for many farmers in a region (F1). Sacchelli et al. (2018) provides another example
Lines 425-430: please refer explicitly to figure 2 to enable the reader to clearly understand the meaning of the paths mentioned in the text.	Thank you for the suggestions. We updated the text with the adequate citation of figure 3.	This framework elicits paths	This framework (Figure 3) elicits paths
Line 491: check the font of the citation (Bhering et al.)	Thank you for the suggestion. We corrected it accordingly.	of medium-grained soils such as cambisols (BHERING et al., 2009)	of medium-grained soils such as cambisols (Bhering et al., 2009)
Line 507: check citeppeterson2001report	Thank you for noticing this editing mistake. We corrected it in the text accordingly	Climate Change Detection and Indices (ETCCDI) citeppeterson2001report	Climate Change Detection and Indices (ETCCDI) (Peterson et al., 2001)
Line 517: close the bracket after (values below K)	Thank you for noticing. We closed the bracket.	unfavorable crop yields for farmers ( (values below K and favorable crop yields (values above K)	unfavorable crop yields for farmers ( (values below K) and favorable crop yields (values above K)
Line 525: model M1	We improved this sentence about model M1. Thank you for the suggestion.	Multi-hazard model 1 drought and thermal stressed using SPI and TX90p as inputs (M1(SPI,TX90p)); and (ii) Multi-hazard model excessive precipitation and thermal stressed model using SPI, TX90p, and pmax as inputs (M2(SPI,TX90p,pmax))	Multi-hazard model M1 drought and thermal stressed using SPI and TX90p as inputs (M1(SPI,TX90p)); and (ii) Multi-hazard model M2 excessive precipitation and thermal stressed model using SPI, TX90p, and pmax as inputs (M2(SPI,TX90p,pmax))
Line 539: it seems from the following lines and Table 4 that you identified 6 clusters and not 5. Please correct or explain the reason for which you state that you identified 5 clusters.	Thank you for noticing it. We corrected the sentence.	We identified 5 clusters that are described in Table 4.	We identified 5 clusters that are described in Table 4.



Line 559: it is possible	We are sorry about this formatting error. We updated this part.	Figure 5. t is possible to observe that:	Figure 5 it is possible to observe tha
Line 571: I do not find figure 7. Maybe you would like to cite Figure 5?	Thank you for noticing the error, we wanted to cite figura 5		
Line 614: testing should not have a capital letter	We are sorry for the mistyping. Thank you for noticing it.	Testing different hypotheses	testing different hypotheses