Anticipating a risky future: LSTM models for spatiotemporal extrapolation of population data in areas prone to earthquakes and tsunamis in Lima, Peru

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We would like to thank the editor very much for the very valuable and helpful comments. We considered the remaining point and carefully revised the manuscript accordingly. Please find our detailed response to the comment below.

In the response below, the comment of the editor is reported in *italic*. Responses from the authors do not feature any special formatting. Quotations from the manuscript in its revised or in its original form are reported in blue.

Editor:

In particular, please revise the following:

1. It seems to me that there is a unit error in the Peak Ground Acceleration (PGA) values reported throughout the paper. PGA of the order of 200 m/s2 are ~ 20 g which is unphysical. I suppose it should read cm/s2 , please revise (see also Pulido et al., 2015: https://pubs.geoscienceworld.org/ssa/bssa/article/105/1/368/323556/Scenario-Source-Models-and-Strong-Ground-Motion)

Thank you very much for identifying this glitch! We revised the whole paper accordingly using [cm/s²] as physical unit and also adapted Figure 1, 5, 10, 11.

2. Please check the references to figures in the text. Sometimes you use "Fig." and other times you spell "Figure".

Thank you for sharing this observation. We consistently use the abbreviation "Fig." across the text now.

3. Please check the use of passive and active verbs (e.g. "were adopted", "was carried out", "we carry out") since they are used indistinctively. For instance, what it is done in the work, should be in present (e.g. we carry out, we adopt, we compute).

Thank you very much for sharing this observation. We revised the whole paper accordingly and avoid the use of passive sentences generally and in particular when we refer to what was done in the work.

4. P. 1, L34-35. "thus, induces the need to constantly update and accurately anticipate future geospatial population distributions in hazard-prone areas." Please revise the sentence, I think "thus" is misleading here. A possible alternative: "demands a frequent update and anticipation….."

Thank you for this suggestion. We revised the sentence according to the suggestion.

5. P.2, L41: "methods can be considered generally". Would it be "methods can be generally considered"?. Please check.

Thank you for this suggestion. We revised the sentence according to the suggestion.

6. P.2, L47: "However, especially recently, multiple authors". Please check the sentence, maybe "A second family of …. has been proposed recently".

Thank you for this suggestion. We revised the sentence according to the suggestion.

7. P.2, L56: "earth observation data are very valuable". Please revise the sentence. It may be something like "Earth observation is customarily used to…"

Thank you for this suggestion. We revised the sentence according to the suggestion.

8. P.2, L63-64: "from a data-oriented perspective, we mitigate the often expensive process of compiling time series data through innovatively make use of existing time series global population data sets". It is a cumbersome sentence, please check.

Thank you for this suggestion. We revised and shortened the sentence accordingly.

9. P. 2, L71: "encode topological and spatial contextual relationships". I think it should read "to encode ….." . Please check.

Thank you for this suggestion. We revised the sentence according to the suggestion.

10. P.4, L123: "i.e., "vegetation" "built-up",". There is a comma missing between "vegetation" and "built-up". Please check.

Thank you for identifying this error. We revised the paper accordingly.

11. P.4, L128: "Especially the natural conditions of an area shape geospatial change trajectories.". Please check, this sentence is not clear to me.

Thank you for this comment. We deleted the mentioned sentence and added content to the subsequent sentence: One very important geographic input factor for modelling population dynamics is the terrain, since human settlements mostly appear on terrains with flat or solely moderate slopes (Dobson et al., 2000).

12. P.4, L129: "for population dynamics is the terrain". Specify that it is the "terrain topography", isn't it? Please check.

Thank you for this suggestion. We revised the paper accordingly: one very important geographic input factor for modelling population dynamics is the topography of the terrain…

13. P.4, L133: "indicating the distance to water for the study area". It might be more precise to write "water bodies". Please revise.

Thank you for this suggestion. We revised the paper accordingly:

14. P5, L137: "The compilation of a powerful and exhaustive set of geospatial covariates". It is not clear to me the meaning of "powerful and exhaustive" in this sentence. Should it read "large" dataset? Please check.

Thank you for sharing this observation. We revised the paper as follows: The compilation of a set of geospatial covariates that enables accurate estimations is a frequent challenge.

15. P5, L140: "variables in studies of predicting geospatial change trajectories". Should the sentence read "for predicting geospatial..."? Please check.

Thank you for this comment. We deleted this unclear statement and write now: Here, the collected driving factors represent frequently adopted variables in past studies (Gómez et al. 2020; Liu et al. 2017; Pijanowski et al. 2002).

16. P.5, Caption of Figure 3. "deployed for spatiotemporal forecasting of population data". Should it read "deployed for the spatiotemporal"? Please check.

Thank you identifying this error. We revised the paper accordingly.

17. P.6, L173. "The internal operations thus use convolutions". Is think the use of "thus" should be avoided here. Please check.

Thank you for this comment. We deleted "thus" here.

18. P8, Figure 5: Please check the units of the PGA.

Thank you very much for identifying this glitch! We revised the whole paper accordingly using [cm/s²] as physical unit and also adapted Figure 1, 5, 10, 11.

19. P8, L213: "which provides a suitable tradeoff here between". It is not clear for me the use of the word "suitable". Is it an acceptable tradeoff to have the smallest possible temporal windows? Please check.

Thank you identifying this unclear point. We revised the paper accordingly: (which provides an acceptable tradeoff here between the forecasting capability of the model and having a sufficient number of time steps available for training the model)

20. P.12, L303: "PGA≥ 207 m/s²." Please check, these are unphysically large PGA values.
Thank you very much for identifying this glitch! We revised the whole paper accordingly using [cm/s²] as physical unit and also adapted Figure 1, 5, 10, 11.

21. P.12, L306-307: "to live in areas which are at peril of a maximum tsunami flow depth of more than two meters". Please check the sentence, it is difficult to read. May I suggest something like "may face tsunami flow depths of two meters or more."?
Thank you very much for the suggestion. We altered the paper accordingly: Furthermore, more than 600,000 people are anticipated to live in areas which may face tsunami flow depths of two meters or more.

22. P.12, L308-309: "Waves of up to 20 meters are modeled, and most of the affected people would". I think that "modeled" is too generic, maybe refer to "anticipated scenarios". Similarly, "most of the affected people" is too vague. Please to "exposed people" and specify the %.
Thank you very much for those suggestions. We revised the paper accordingly and write now: In the considered scenario, waves of up to 20 meters are anticipated, and more than 430 thousand people of the exposed population would be hit by waves higher than 5 meters.

23. P12, L309-310: "The areas with the largest modeled waves of more than 12 meters only have a small part of the population today, but these will even double in the forecasted 15 years". Similar comment the one before, be more precise and check the sentence which is somehow cumbersome.
Thank you for sharing this observation. We deleted the sentence accordingly.

24. P13, Figure 10. Check the units of the PGA.
Thank you very much for identifying this glitch! We revised the whole paper accordingly using [cm/s²] as physical unit and also adapted Figure 1, 5, 10, 11.

25. P15, L335: "In this paper, we learned population-related geospatial change trajectories over time and provide". Please check the use of the verb "learned"...we derived? We estimated?
Thank you for sharing this observation. We revised the sentence as follows: In this paper, we encoded population-related geospatial change trajectories over time in an ML model and provide population forecasts for Peru's capital Lima and Callao…