Nat. Hazards Earth Syst. Sci. Discuss.,
https://doi.org/10.5194/nhess-2019-405-SC1, 2020

Natural Hazards and Earth System Sciences
Discussions

Interactive comment on "Space-time clustering of climate extremes amplify global climate impacts, leading to fat-tailed risk" *by* Luc Bonnafous and Upmanu Lall

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Received and published: 20 May 2020

The authors present a well thought out and essential study that exposes sectorial vulnerability to correlated climate risk.

It would be interesting to get the authors' opinions on the following issues.

Issues directly related to the study and can help improve its presentation

The authors present the overall risk exposure frequency plots (Figure 1), which clearly shows a tail risk. On this, they could consider the following: 1) Can they show separate exposure probability density plots for dry and wet events along with the overall

exposure? This might reveal which risk is more impactful.

2) For simulating the risk due to chance, they assumed a binomial distribution with an at-grid independent probability of 0.1 depending on dry or wet. This assumption for a null distribution is reasonable for wet events as the spatial resolution is 0.5 degrees, and the time resolution is a month, i.e., every grid has an equal chance of experiencing an extreme wet event, and they are not spatially correlated. Under this assumption, we can compare the exposure risk due to wet events. However, under dry events, is it reasonable to consider uncorrelated probability at the 0.5-degree resolution? Even under as a null-hypothesis, drought has some spatial extent that they manifest in, and it is much greater than 0.5 degrees. Perhaps a regional (climate-region based) hypothesis would be better than assuming independence of dry events in such small resolution. Against this regional hypothesis, a global exposure distribution would reveal large and simultaneous spatial extents for dry events. By showing both wet and dry together, it is unclear if the tail risk is solely due to dry or wet or a combination of both.

3) It is also interesting to see that the exposure of Bauxite mines while having a tail risk is no different than chance. Or, it would be interesting to know why the null hypothesis for Bauxite is generating a tail risk as opposed to a Gaussian type distribution, as seen in other mines.

4) Based on the wavelet and MTM analysis, it is somewhat clear that large-scale climate indices have some effect in creating this spatial risk. Can the authors show how much of the tail risk is due to these events? In other words, if they take the tail probability (or events) from Figure 1, can they show how many of these extreme exposure events are ENSO years? A simple measure like Pr(Exposure > 0.4 | |ENSO| > 0.5) and its inverse Pr(|ENSO| > 0.5 | Exposure > 0.4), could give a first-order idea. I am using the 0.5 ENSO threshold as an example.

Issues that are worth discussing under caveats or future directions

The authors assume that production is constant every year and across the regions and

then develop exposure risk due to climate extremes. Access to data would have been a key limitation here, but the authors could point out that the risk could be different if the production is asymmetric; i.e., the major risk could be few regions out of the areal exposures. Further, it would be interesting to see, in the light of production shortfalls, if other tail risks due to economic downturns or pandemics (as we see now) outweigh the climate risks.

Minor issues Figures 1 and 2 can be improved. Axis labels are missing in Figure 1, and the local-regression is not shown (as indicated in the caption) in Figure 2.

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