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Hydrology and Earth System Sciences
Discussions

Interactive comment on "A water risk index for portfolio exposure to climatic extremes: conceptualization and an application to the mining industry" *by* Luc Bonnafous et al.

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Dear Dr. Money, Thank you very much for your comments on our paper analyzing portfolio exposure to climate extremes. Your suggestions and comments are right on target. We considered using data from annual reports of mining companies for a longitudinal analysis. Some challenges we faced in developing such an analysis were:

1) Asset level impact data is not reported, and hence a direct quantification of the impact is not readily available

2) For significant losses, mining company annual reports may contain such information. However, we have not found a way to easily digitize this information. Specific instances

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of loss can indeed be identified. We could look at production losses (see the attached figure), but attributing them in each case to weather events may still be tedious since labor disputes or other market driven factors may be responsible and their effect may or may not be readily available.

3) The return period associated with each event that may be reported is likely to vary substantially. If we had a lot of such events for which we had data, and were able to estimate the return period for each, we could indeed develop a loss probability distribution associated with extreme rainfall events. However, noting that multiple events at multiple mining sites may happen in a given year, as we demonstrate in the paper, it is not clear whether we can disentangle this information from the mining company reports and the rainfall data.

Given these challenges, we took a forward (as opposed to inverse) modeling approach and sought to create an index where a standardized exposure could be identified from a climate perspective, noting that mine facilities are indeed designed to address extreme rainfall or drought events with a standard that relates to a nominal return period or probability of exceedance. This threshold may indeed vary by country and company, and by the amount and actual period of rainfall data used for the analysis. This complicates the analysis as well. However, the principle we advanced was that we could indeed identify from long records what the thresholds should be at each mine, and hence what the exposure characteristics with respect to those thresholds would be. If the mining company were asked to then disclose their design thresholds, and potential financial exposure if the threshold were exceeded, then a modified version of the analysis we present that used weights at each site that reflected the site by site exposure could be readily developed. The web app we have created would allow for such an analysis and also for its uncertainty analysis. It could be used internally by the mining company to assess and calibrate their potential exposure against loss data that may be available to them, or estimates, and then the result would be reported as part of their financial disclosure.

We felt that getting the idea out in the academic literature was a first step towards moving in this direction, and we have tried to add a discussion along the above lines to the revised version of the paper, thanks to your comment.

We can for instance investigate given events such as the Queensland floods. As shown in the plot below, commodity production of nearly all mines dropped in 2011.

Even for this example, where we know from news media that production was halted due to flooding for 6 months or longer for most mines, attribution to such events in a longitudinal analysis may not be easy. For the year in question, one could take the % drop in production relative to the prior year, or the average of the prior and the succeeding year. However, there are other years with significant production drops across several of the mines where floods may or may not be an issue, and just for this region, one would have to build a statistical model with appropriate covariates to isolate the flood effects in a longitudinal sense. This is of interest, and we do intend to consider developing such a methodology to support risk analysis for the mining industry.

We are planning to tackle the topics listed above in a more thorough paper on decision-making, which requires further data gathering.

With regards to your comment on the financial consequences of "excess exceedance," we acknowledge that the financial aspects of our approach are uncalibrated or in your words unsubstantiated at this point. Our primary assumption here is that for a particular rarity of the extreme event, relative to the design levels used by the mine, one could potentially expect a certain fraction of the NAV to be exposed. What this fraction is, and what an appropriate threshold is for such an impact are tuning parameters that indeed have not been worked out yet. Consequently, in this paper we focused on the spatial correlation structure of the exposure in the tails of the rainfall distribution, since we saw early on that this sort of clustering was emerging as a concern even for extreme rainfall events. Using the proportional loss idea basically only allows us to make a relative comparison of the exposure of the companies, and the numbers we cite in that regard

as to the fraction of NAV exposed are in that spirit. We will clarify this further in the revised version.

This is an aspect we hope to tackle in future research, which will necessitate extensive data gathering. Part of our goal is to encourage disclosure by having companies challenging the aspects of the paper that rely on simplified (albeit logical) estimations of financial loss once it is published. Our hope is that this will encourage better disclosure to allow investors, companies and regulators to better understand the risks which impact mining stakeholders.

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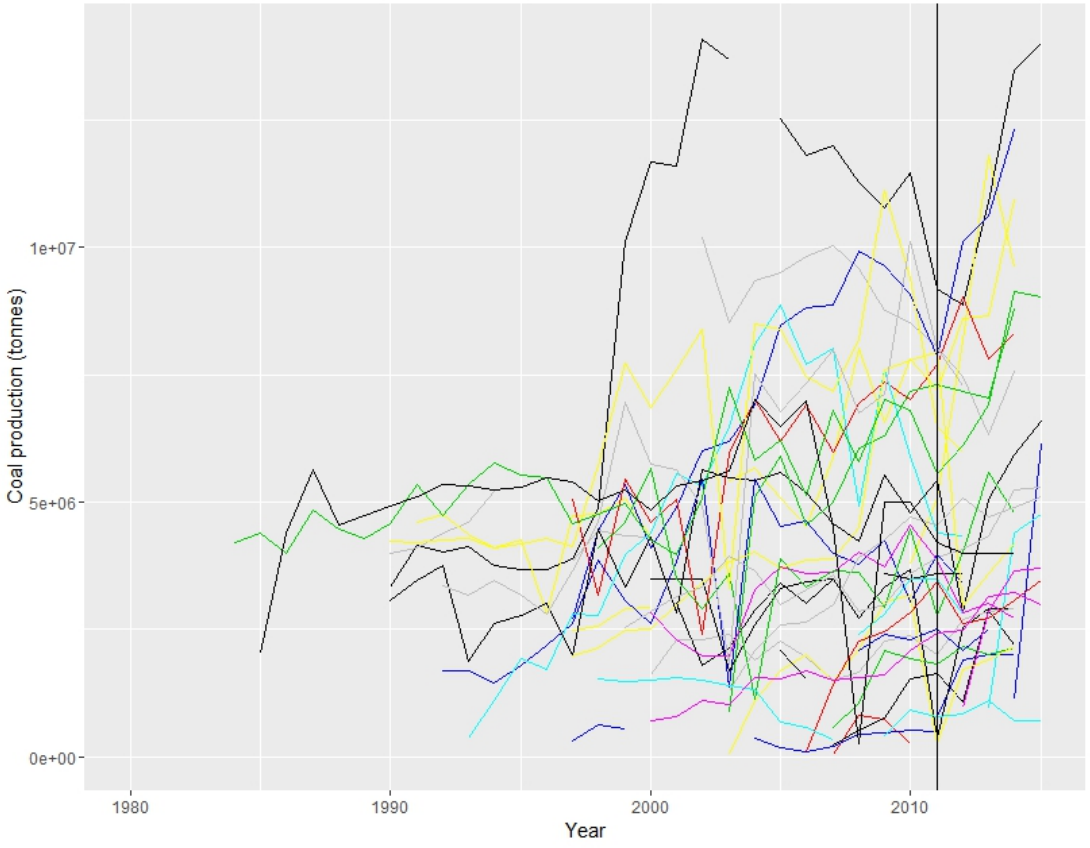

Fig. 1.

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