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Discussions

Interactive comment on "Comparing an insurer's perspective on building damages with modelled damages from pan-European winter windstorm event sets: a case study from Zurich, Switzerland" *by* Christoph Welker et al.

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The main objective of the paper is to demonstrate the value of catastrophe modelling analysis in respect of estimating the frequency of high intensity storms, compared to a pure statistical analysis of the claims history from a portfolio that has a limited record of a few decades. Two catastrophe models with different vulnerabilities and exposures are used to calculate the losses, GVZ's proprietary model and the open source CLIMADA platform. Both models perform very well in calculating the losses of a numbers of historical storms (e.g. Vivian, Lothar, Burglind) so are clearly appropriate tools

for the stated job. The selected hazard inputs include the: (i) WISC historical set of 75 years with 142 events and (ii) a probabilistic perturbation of the above event set, where every storm has 29 altered offsprings, thus the set is extended to have 4,260 storms covering 2,250 years. On the other hand, the insured claims dataset consists of about 40 years of losses that provides 18 storms which are available in the WISC historical set. Overall, I think that the presented work is of high quality: there are no obvious methodological errors and the findings are robust regarding the stated purpose, to complement claims-based risk assessment with a modelling approach. The conclusion that the return period of intense storms (like Lothar) cannot be determined sufficiently from a simple analysis of claims history is robust, but also well established in the Insurance industry. The proposed approach to produce a probabilistic event set by perturbing/expanding the WISC historical events, then calculate the losses using one or more damage models is technically correct and appropriate but it is not novel. Focusing on the results, I think that risk assessment at the tail will benefit from an attempt to build a more focused estimation of the uncertainty associated with the WISC probabilistic exceedance probability curves in Figure 2. The confidence interval based on the WISC historical set (CHF 19M to 33000M) is very conservative and negates much of the fundamental advantage of complementing risk assessment with probabilistic catastrophe modelling. I think that this is the major point to be addressed in the analysis, thus I would recommend publishing the article conditionally the authors provide a substantial response to this question (see below, bullet points: 2.a-c). Also, suggestions to further expand the work (beyond the scope of the current article) are available in the end of bullet point 1.

More specifically, I will address the following scientific question/issues:

1. The proposed approach to produce a probabilistic event set by perturbing/expanding the WISC historical events is technically correct and appropriate given the scope of the analysis. Having said that, although acceptable, the approach is not novel. Several (re)insures have proprietary cat models that follow similar methodologies. A limited

historical 'seeding' data-set (often based on reanalysis data, e.g. 20C_R, ERA-Int, ECMWF_R) is extended either by a statistical perturbation/resampling approach (e.g. Swiss Re) or extensive use of dynamical modelling (usually regional climate modelling-RCM) outputs (e.g. Weather Predict/Renaissance Re, Partner Re) to produce a realistic probabilistic event set. The advantage of the latter is the physical consistency of each individual stochastic event due to the physics-based simulation of the RCM. Furthermore, the main catastrophe model vendors in the market (RMS, AIR, AON Impact forecasting and more) tend to provide probabilistic windstorm solutions based on outputs extracted for a variety of long global climate model (GCM) runs, calibrated (often fitted) against the available historical record. The advantage of this approach is that the simulation generates physically realistic storms that are not constrained by the attributes/parameters of the seeding historical windstorms. Such methodologies directly address the main limitation of the WISC probabilistic expansion approach used by the authors that results to almost identical AAD values in Tables 2 (1.4M CHF) and A1 (1.1M-1.2M CHF) for the WISC historic and probabilistic sets. The probabilistic expansion adds very little further risk hazard information compared to the seeding historical set. A possible avenue for the authors to continue the current work would be to look into calibrating the WISC synthetic gusts distribution (in figure A1, lines 793-797) against the WISC historical event set to address the low gust speed intensity. Then repeat the loss calculation with the 'enhanced' WISC synthetic event set.

2. The approach to expand the WISC historical events and determine the frequencies of the offspring probabilistic storms (GEV distribution fitted to the historical SSI values) has merit, and the concluding results in paragraphs 3.2 and 3.3, also provided in table 2, are realistic. I am not surprised the two WISC-based analyses reduce the calculated AAD value between 1.1 and 1.4M CHFs. Also, Lothar/Martin's return period is (correctly) positioned at and above 75 yrs, potentially beyond 125 yrs. Considering the disproportional yet uncertain impact of the extreme event Lothar/Martin on the claims data analysis, the above results are plausible, yet the authors do not follow with a narrower estimation of the uncertainties. I understand why the authors prefer to re-

tain the confidence interval based on the WISC historical set (CHF 19M to 33,000M), yet this reduces somewhat the functionality of the probabilistic expansion model. It's main objective is to provide a tail view. Here are a few suggestions: (a) The 4,260 storms in the WISC probabilistic set provide the equivalent of 2,250 years of storm activity (based on the analysis assumptions). You may sample randomly the equivalent of 250 or 500 years of storms and build multiple exceedance frequency curves for each sample. A spaghetti plot of the 'secondary' exceedance frequency curves will enable a reviewed estimation of the uncertainty around the curve. Essentially the idea is not dissimilar to the re-sampling approach described in paragraph 2.4.3 for the Pareto Pricing. (b) Estimate multiple probabilistic extensions of the WISC historic event set with different initial assumptions including (but not limited to) fitting different extreme distributions (e.g. Weibull, Pareto), inclusion/exclusion of Lothar/Martin in the seeding WISC historic set to quantify the sensitivity of the methodology in the most extreme event in the set, for both damage models (GVZ & CLIMADA). This will produce an ensemble of exceedance frequency curves that can be visualized as a spaghetti plot. (c) A combination of the above two ideas can work as well.

3. One aspect which is underrepresented in the discussion is the role of the loss uncertainty due to the vulnerability (and exposure) components. GVZ's damage model has a stochastic component as seen in figure 4, also described in the text (lines 443 to 449), yet it is unclear whether the damage (given by the red bars in figure 4) informs the process of building the exceedance frequency curve of the modeled damage based on the WISC probabilistic extension of figure 2. Please clarify.

4. The two modelling approaches (GVZ damage model & CLIMADA impact model) use different input exposures as described in lines 272 for GVZ's model and 303 for CLIMADA. Is it possible to get a feeling regarding the difference between the two input exposures (e.g. 10%, 50%)?

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