Review „Invited perspectives: Current challenges to face knowns and unknowns in natural hazard risk management - an insurer perspective“ by Madeleine-Sophie Déroche (NHESSD)

The manuscript describes the development of risk models used in the insurance industry over the past three decades and discusses the need for further improvements. The paper touches on a wide range of topics, such as the need for detailed loss and exposure data or the challenge of climate change. A review paper on these topics from the perspective of the insurance industry is very valuable and is desired by the scientific community. However, the paper remains very superficial and lacks a real insurance perspective. I suggest more rigorous structural leasing to better present the content. I strongly encourage the author to rewrite and restructure the manuscript; it is truly of great interest and could have a high impact for the community.

Major revision points:

1) I suggest revising the structure of the manuscript. The current version sometimes jumps from one topic to another and sometimes back again (e.g., paragraph 65-87); some statements refer only to individual hazards (e.g., flooding), while the next sentence is a general statement.
   My suggestion is the following structure: (i) Loss / risk model development from a historic perspective, including a detailed discussion of the three components (hazard, exposure, vulnerability); (ii) Cncertainty inherent in each of the components (e.g., uncertainty in hazard modeling due to a lack of appropriate observations and/over observation data over longer time periods is not mentioned); (iii) Possibilities/measures to reduce uncertainty, including past and future developments (e.g., numerical model simulations used in CAT models today); (iv) Perspectives: Challenges, further needs, and expected developments to address these needs (e e.g., role of crowd-sourced data).
2) Be more specific and give more details throughout the manuscript (see also minor points).
3) Loss/risk models are not appropriately described. In the hazard module, I miss the description of the (historic) event set, relevant parameters of the footprints/tracks (e.g., magnitude, width, length, orientation), and – based on this – stochastic modeling (indicated in Figure 1, but not mentioned in the text).
4) Refer to Solvency II and the need to assess probable maximum losses for 200-year return periods (PML200), as well as the need for a basic understanding of the models applied by the insurance companies.
5) Even though the insurance perspective is explicitly mentioned in the title, I miss a thorough discussion in the manuscript (see also point 1). Which perils are well represented by the models (and where), which are not? What are difficulties and challenges? What are new perspectives that might emerge in the future (e.g., role of machine learning / Big Data)? Some of these points are formulated as questions, but without providing answers or at least some hints (e.g., L109-111; L140-143).
6) In the context of global change, the manuscript only mentions climate change (very briefly) and increased population/wealth. However, global change has several other implications, such as the energy transition with an increased share of renewables with other vulnerabilities (e.g., solar panels are very susceptible to hail), increased reliance on critical infrastructure, or societal changes. All these issues have the potential to significantly change vulnerability and risk.
7) Section 5 is a summary rather than conclusions.

Minor revision points:

1. L4: the models assess **both** the risk of **experienced** events and **not yet experienced**

2. L10: “protect clients’ property and activities”; it’s rather risk transfer than protection
3. L16-19: maybe instead of formulations such as “unknowns unknowns”, you may refer to their statistics? Further, is would be very helpful to learn more about how “unknowns unknowns” are considered by the insurance industry
4. L19-20: see comment 1 above
5. L30: explain “actuarial methods”; specify “extreme losses” (e.g., PML200, cf. major revisions point 4)
6. L34: “…whose impact was unexpected…”: In what sense and why?
7. L42 briefly explain why each peril and region is usually modelled separately (you may refer here already to the global loss models suggested in the conclusions)
8. L45-47: I’m not sure what you mean by “format”. If this refers to the data format only, then I would say that this problem is much easier solvable compared to the uncertainty inherent in each of the four model components (cf. major revision point 1).
9. L48-52: Is a storm like Hurricane Andrew accounted for in today's risk models, so has it turned from an “unknown unknown” to a “known known”?
10. L56-58: Mention that both monitoring of extremes as well as numerical modeling has substantially improved over the last decades leading to a better hazard estimation.
11. L60: “..notably the location at **high** granularity and the physical properties of building.” Be more specific, give details; what granularity is required for what (exposure vs. hazard) depending on the different perils?
12. L66: “building damage” and “hazard magnitude” are two different topics; I wouldn’t include both in one sentence.
13. L68-69: “It is less the case for other perils”; I cannot follow this statement, considering the devastation by, for example, tornadoes or hurricanes. “population is evacuated” is to general; evacuation is a measure in case of hurricanes, but usually not in case of windstorms, floods, or large hail.
14. L71 “Damage information…” Move this sentence to the beginning of this paragraph.
15. L80-81: this sentence is unclear (but becomes a bit clearer when reading the next sentence); I suggest to reformulate and to explicitly mention serial clustering at the beginning.
16. L84: you may also cite Vitolo et al. (2009, MZ, DOI 10.1127/0941-2948/2009/0393), the first paper on that topic
17. L88: Expand the discussion about uncertainty as this is highly relevant (cf. major point 1)
18. L96 and elsewhere: the expression “loss simulation **engine**” is strange. You mean a model? And why loss and not risk (if probability is considered in the hazard module)?
19. L98: explain “epistemic uncertainty”
20. 1st paragraph of Section 4m & Introduction: in the last sentence of the introduction, it was written that the paper focuses on the impact of natural hazards to **property exposure**. Section 4, however, describes supply chains and related interlinks. Of course, that topic is highly relevant for the general impact of natural hazards, but not for property exposure/loss.
21. L127: “shortages of cameras and smartphones”. Even more important were shortages in HDs (hard discs) and chips reducing the overall computation power (cameras and smartphones at that time were mainly gadgets not generating real added value).
22. Check the references for consistency (e.g., some journals or manuscript titles are in bolt letters, other not)

Edits:

1. Check the appropriate use of \citep and \citet throughout the paper
2. L2: “undertaken” is not appropriate here
3. L41: “…here before cited…” needs rewording

4. L42: “peril x region” is unclear
5. L63: “all **being** critical…” loss**es**
6. L74: “…**to** collect…”
7. L83: “~~winter~~ windstorms”; “**Serial** clustering” (note that there are different kinds of clustering, thus **serial** is important to include)
8. L85 process → probability
9. L86 exhibited in → shown by
10. L87: what do you mean by “dimensioning”?
11. L88: could → should
12. L115: “is intersected with hazard” → is interlinked with the hazard
13. L121/L124: “have become more interconnected” is mentioned twice here; further, mention the interrelation and dependencies of supply chains
14. L133: clients → companies; siloed → ?
15. L137: to which case study do you refer here?
16. L138: “exercise” is not an appropriate expression