Review on „Linking source with consequences of coastal storm impacts for climate change and risk reduction scenarios for Mediterranean sandy beaches "

by Marc Sanuy, Enrico Duo, Wiebke S. Jäger, Paolo Ciavola and José A. Jiménez

Recommendation: Major Revisions

The authors present a decision support framework to assess the effect of risk reduction measures on impacts of coastal storms under current and future conditions. A Source-Pathway-Receptor-Consequences (SPRC) model is implemented in the form of a Bayesian Network and applied to two Mediterranean sandy coast case study areas.

The study is well written and structured, provides interesting insights and presents an interesting approach for decision support for coastal risk managers. In a previous review round, the reviewers identified 2 main aspects which require major revisions before the manuscript can be considered for publication:

1) The use of Bayesian Networks as implementation of a SPRC model in this study

2) The storm intensity used for the scenario testing

I acknowledge that the authors have addressed all the mentioned issues. However, some important information are still missing or should be rephrased/restructured to make all aspects of the study clear and comprehensible to the reader. This especially includes the use of the BN approach, which in the previous version of the manuscript has been a major source of confusion, which is still not entirely resolved in the current version. Therefore, I would recommend to accept this manuscript for publications only after the two main issues have been resolved.

Specific Comments

1. Bayesian Network

The authors use BNs as graphic implementation of a SPRC model, to use it for an intuitive communication of different risk reduction scenarios under different storm scenarios for decision makers. To my understanding the authors combine in their BN the spatial distribution of receptors (e.g. buildings) with spatial distribution of the boundary conditions (storm properties) to gain a deterministic joint distribution, where each bin represents the hazard at the location of the receptor and eventually of the consequences. Although the revised version of the manuscript does not provide detailed information about the advantages of BNs compared to established raster based GIS analysis, the general approach seems valid to me. One reason the authors gave in their response but did not mention it in the revised manuscript is that using the BN framework "facilitates the integration of multiple simulations when assessing scenarios". In case the authors are convinced that their approach has considerable advantages over established approaches, I recommend to clearly give reasons in the manuscript why this is the case (apart from the pragmatic reason that the framework was already there).

In general, I think the term "Bayesian Network" in this context is at least confusing and should be avoided. Bayesian Networks are generally described as representation of the probabilistic dependencies between a given set of random variables as a directed acyclic graph (DAG). Since the network in this study rather represents spatial than probabilistic dependencies, I would recommend renaming it to "Decision Network" or "Conditional (In)dependence Network" to avoid confusion. One of the main reasons for the application

of BNs in the domain of natural hazards is the representation of uncertainties through probabilistic inputs and outputs. As mentioned in the previous reviews, this study is not using BNs in a real probabilistic sense. That's why it should be made clear that uncertainty is only considered by using two different variations of each storm scenario and not by the model itself. Therefore, the manuscript should be carefully revised to avoid claiming that the network model incorporates uncertainty (i.e. last sentence of the conclusion). In addition, in Section 3.6 and 3.6.1 it should be made clear that the structure as well as the parameters of the network model were pre-defined by the user and not learned by an algorithm (at least that's how I interpret the model description).

2) Storms used for scenario testing

This issue was previously raised by Reviewer 1 and revised in the manuscript, but I found it still difficult to follow the point of the authors. According to the revised text in Section 4 and 5, all storm variables are described with a uniform distribution. However, it is not clear what a uniform distribution means in a deterministic setup. In order to get one result per scenario like shown in Figure 10 to 14 one would either have to set the boundary conditions (wave height, storm duration) constant or calculate each scenario for each wave height – storm duration combination and calculate the average. In order to make clear how the different storm simulations are used in the BN to generate the plots in Figure 10 to 14, I would recommend to include an example in the text for at least one of the plots. It should also made clear why these in total 48 storm scenarios described in Section 3.1 were calculated in the first place, as they don't seem to be considered in the generation of the results.

Other comments

Figure 4: I recommend changing the illustration in Figure 4 Panel (IV) since the dashed arcs between the nodes do not represent actual direct connections between the nodes and can potentially be confusing to the reader.

P.7 L. 14-22: What is the reason for simulating the 12 storm combinations exactly twice? I would assume that one would need more than 2 simulation runs to get an acceptable range in variability of storms. I also don't understand how this corresponds to the 16 recorded events. Why is it necessary to slightly change the parameters of the storm for the 12 combinations if you already have 16 measurement points with observed representations of storms?

P.9 L.4: Please provide information how the model was qualitatively validated.

P.23 L20-23: I think this conclusion cannot be made here, since the study compares the projected MSL for the year 2100 for the Spanish site and 2050 for the Italian site.

Technical Corrections

P.4 L.29: food service instead of restoration?

P.5 L.7: EWS = Early warning system?

P.7: Wrong table number

P. 8 L.19: “will be as good as the model is accurate”

P.8 L. 22: S-O-A: jargon, please revise

P.8 L23: …provided if they…

P. 12 L1: with stakeholders

P.12 L15: there is

P.12 L15: where it was not

P. 12 L21: switch of incoming storms