Response to Reviewer #1

The authors would like to thank Reviewer #1 for taking the time to read the manuscript and provide valuable comments and constructive suggestions. We address the comments (*our responses in italics*) follow the comments.

A number of sensitivity analyses are performed by modifying given parameters that were initially based on expert opinion [Table 2; Figs 8-12]. The rank of the results, in terms of adaptation uptake and building losses, are broadly as expected given the direction and magnitude of a parameter change. For example, implementation of measures is primarily driven by flood experience, and subsequently delaying implementation makes a community less prepared for the next event [Fig 12]. Considering the results, could the authors comment on the benefits of using the sophisticated ABM approach compared to simpler methods? The challenge is going from sensitivity studies to scenarios. For example, it would be of interest to explore proactive, rather than reactive strategies, examining the role of media on the uptake of measures to inform policy (although this goes beyond the current research).

AC: As mentioned in Lines 401-405, we conducted sensitivity analysis only on the initial conditions and parameters as varying these factors is not of interest for the study. See Table 2 for the factors, and Appendix D and Figure D-1 for the SA result. We carried out model experimentation (or scenario analysis) on the second group of factors mentioned in Table 2.

Regarding the general benefits of using ABMs compared to simpler methods, we have discussed that in a previous publication (see Abebe et al. 2019a, p. 483-485). In the current study, we applied the protection motivation theory to investigate household-level decision making, but we simplified how we modelled the threat and coping appraisals. We used decision trees that are somehow deterministic and linear, which may have contributed to the predictability of some model results. The social network is also modelled in a simplified manner, which could be improved with more data. However, there are several stochastic elements that could have led to unexpected results. Future researches may use intelligent decision-making models such as Bayesian Networks as in (Abdulkareem et al., 2018). In addition, as the Reviewer commented, model conceptualization could include institutions that govern proactive strategies and the role of media in agents' protection motivation behaviour if that is of particular interest. The current manuscript aims to provoke communities and decision-makers in the study area to investigate further the role of household adaptation measures in mitigating potential flood damages.

We will address this limitation in the "Discussion and conclusion" section in the revised manuscript.

Figure 7: I can only see 5 lines on this figure (either scenario 1 or 6 is missing or they overlap – it is difficult to differentiate between the colours). Also, it would be expected that there would be a jump in measures implementation following a flood; why is there no jump in year 2 for scenario 2?

AC: We assume that the Reviewer meant to comment on Figure 9. As we mentioned in Line 461, the curves appear to overlap are that of Scenario 1 and Scenario 4. The reason there is no big jump in the number of houses that implemented primary measures in year 2 for Scenario 2 is that flood event B is a small event, and it only affects a few houses. Hence, its effect on the number of primary measures is minimal (but not zero). The line appears flat but zooming in at year 2 shows there is a minor change in the slope of the curve.

We will add explanations concerning the overlapping curves and why there is no big jump in year 2 for Scenario 2 in the revised manuscript.

Line 331: I do not understand the sentence starting "An important aspect...".

AC: As mentioned in Lines 235-237, when a shared strategy drives a system, agents do what the majority in that system does. However, the household also has the option not to implement the measure without incurring any punishment. In our conceptualization, the SN factor is the same for all households who live in a similar house category. That means, if the value of the SN factor is "High", all households who live in that house category will follow the same behaviour. But, as discussed above, households have the option not to develop that behaviour though most follow the crowd. To reflect this property of shared strategies, we introduced another factor, the shared strategy parameter (SSP). The SSP is a kind of threshold that defines the percentage of household agents that follow the shared strategy. For every agent, if the SN is High, and a randomly drawn number (from a uniform distribution) is greater than the SSP value, the agent develops the intended behaviour (i.e., the coping behaviour).

We will improve the referred sentences according to the above explanation in the revised manuscript.

Reference

Abdulkareem, S. A., Augustijn, E. W., Mustafa, Y. T. and Filatova, T.: Intelligent judgements over health risks in a spatial agent-based model, International Journal of Health Geographics, 17(1), 8, doi:10.1186/s12942-018-0128-x, 2018.