Response to Referee 1:

Below, we respond (**R**) to the more general and major comments (**C**) of the reviewer. The changes in the revised text are mentioned in the response letter in *italics* along with line numbers referring to the revised manuscript (which is not uploaded yet). The revised manuscript includes one more figure and an additional subsection, hence the figure/section numbers of the preprint [*preprint: figure/section number]* are included in the response letter, when they differ between both manuscript versions.

General comments

C1.0: This paper aims to identify the drivers of flood losses in microbusinesses by employing a Conditional Random Forest on survey data collected from microbusinesses in Ho Chi Minh City in Vietnam. Based on the drivers identified, probabilistic loss models (non-parametric Bayesian Networks) were developed using a combination of data-driven and expert based model formulation. The transferability of these models was assessed by applying data from a different city to evaluate their broader applicability. I have read the paper with great interest, and the main objective addressed by the manuscript is within the scope of the journal. Nevertheless, major revisions are necessary to make a few points clearer and I recommend accepting it only after these revisions.

R1.0: We thank the referee for taking the time and effort to provide comprehensive feedback on our manuscript. We have implemented almost all the suggestions, otherwise, an explanation is provided in this response letter. In particular, the data and methodology sections in the revised version of our manuscript are adapted and extended significantly.

Major comments

C1.1: I believe the paper could benefit from separating the results from the discussion to enhance clarity. As someone without extensive expertise in ML algorithms, I found it challenging at time to connect the information in the figures and tables with the text. For instance, on pages 10 and 11, Figure 3 is only referenced once, and while the authors discuss correlations among variables, they do not always provide specific numerical values from the figures. The paper contains a substantial amount of results, which makes it difficult to easily connect the text with the accompanying figures and tables. Please, check the figures axes names. Sometime you start with capital letter and sometimes with small

R1.1: In the revised manuscript, we made an effort to better link the figures and tables to the text. In particular,

1. To better highlight the important aspects in the text, namely the chosen factors and their dependencies in the BN graphs. The rank correlation coefficients from

Figure 3 and 4 *[preprint: Figure 2 and 3]* are now consistently mentioned in the text, for example (lines 287:288):
"It is the predictor with the strongest rank correlation to both flood loss types (rho: 0.34 in Fig. 3, rho: 0.23 in Fig. 4) and was also previously identified as a relevant predictor by the CRF model."

2. To ensure traceability of the construction process of the BN graphs, we substantiated the selection of each factor and its dependencies in the graphs with findings from selected literature, for example (lines 325:330):
"The moderate dependencies in the BN graphs are in line with the findings of various studies, which highlight the usage of structural measures as an efficient individual precautionary measure (Scussolini et al., 2017; Trinh and Thanh, 2017; Du et al., 2020; Harish et al., 2023). The efficiency of these measures is represented in the BN graphs indirectly by lower water levels in the shophouses and directly by less severe flood losses, e.g. in elevated buildings, there is less chance that flood water will enter the building during a flood event."

3. We want to set these results directly into context with findings from other flood loss studies and the regional conditions of the study area. Separating results and discussion section may lead to repetitions and increasing the manuscript length. Hence, Sect. 4.1, 4.3 and 4.4 present relevant study findings in the beginning and discusses them in the end of the respective subsection. In this way the results are separated from their discussion within each subsection. We hope this improves the clarity of the manuscript.

C1.2: Additionally, I recommend simplifying certain figures (e.g. Figure 5) or providing more detailed descriptions of them in the text. Given that this journal focuses on natural hazards research and is accessed by readers who may not be experts in ML algorithms, a clearer structure with separate results and discussion would aid.

R1.2: We fully agree with the referee in regard to Figure 6 *[preprint: Figure 5]*. Thus, we improved this figure as well as Figure 8 *[preprint: Figure 7]*. In addition, the revised version of the manuscript provides more description of them. Regarding Figure 8 we would like to refer to our response **R1.4**. Please find below the modified description of Figure 6 and its description in Sect. 4.3.1.

Adapted figure description of Figure 6 *[preprint: Figure 5]*:
"(a) Distribution of observed (either 0.0 or 1.0) and predicted probabilities of chance of content loss from the ML-based classifiers. A vertical dashed line separates the observed and predicted cases of zero-loss from the observed and predicted loss cases. (b) The corresponding confusion matrix for chance of content loss. The values in front of the brackets are the sample numbers; values in the brackets the sample numbers normalized over the observations."

Adapted sentence in Sect. 4.3.1 (lines 355:358):
"The predicted probabilities for chance of content loss show that the observed small prediction bias is caused by the circumstance that the logistic regression estimated instances of chance of content loss usually as zero-loss cases. Thus it assigns low probability of losses to most predictor combinations (see, the high share of cases predicted as zero-losses in the left half of Fig. 6.a)."

As mentioned in **R1.1**, we have made an effort to improve the clarity of the manuscript by restructuring the sections separating the discussion from the results and not introducing a separate discussion section.

C1.3: In the methodology section, I suggest that the authors provide further clarification in certain areas. For example, in the abstract, content losses are reported 317 and business interruption losses as 361. However, in the section presenting the data is noted that 250 responses were collected resulting in 397 loss records in the HCMC and for Can Tho, responses were received from 373 microbusiness, of which 313 provided information on losses. It is unclear how these numbers were derived and calculated. So, please check the numbers and a more detailed explanation of the methods used would be helpful.

R1.3: In fact, we did not adequately explain the different sample sizes in the manuscript and have therefore improved Sect. 2.2.1 and 2.2.2 *[preprint: Sect. 2.1 and 2.2]* in the revised version of the manuscript, as well as Sect. S1 in the Supplementary Information. In the following, we provide further information about the pre-processing steps and the returned sample sizes for the two survey datasets.

HCMC dataset (Sect. 2.2.1, *[preprint: Sect. 2.1]*):
Some of the 250 interviewees in Ho Chi Minh City did not provide information on both flood loss events. In addition, information about the flood loss type (interruption loss or content loss) was missing or could not be derived resulting in 361 samples for interruption losses and 317 for content losses. The section now clearly explains how the different sample sizes for relative interruption losses and for relative content losses were derived from the HCMC dataset (lines 126:134):
"However, not every interviewee provided information for both events, which leads to a number of 397 loss records in the HCMC dataset. Each record in this dataset comprises information about one or two types of flood losses experienced during an event. In detail, 361 samples of the loss records contain information about business interruption losses reported as relative values (e.g. reduced sales and production), while a similar sample size comprises flood losses to business content but reported as monetary values (e.g. to furniture, electrical devices, stored products and vehicles). Conversion to relative scales reduced the number of content loss samples by using exposure information about the value of business content, as described in the Supplementary Information, Sect. S1. Consequently, the sample size referring to relative content losses (n=317) is smaller than for relative interruption losses (n=361).

Hereinafter both types of relative flood losses are referred to as flood loss variables (Table 1).”

The above citation mentions that the building values were needed to convert the reported content losses to relative scales, however, in some records information about the building value was missing. Therefore, the final sample size for relative content losses is reduced. Two sentences explaining this aspect are added to the revised version of the Supplementary Information (Sect. S1, lines 21:24):
“However, some interviewees did not report the building value and thus relative content losses were not calculated for these records, resulting in a reduced number of 317 records for relative contents losses. Since business interruption losses were already queried as relative values in the HCMC survey, their number of 361 records remained unchanged.”

Can Tho dataset (Sect. 2.2.2 *[preprint: Sect. 2.2]*):
The revised version of the manuscript now points out that relative content losses were calculated differently for the Can Tho survey compared to the HCMC survey (lines 145:150):
“The survey was undertaken in January-February 2012 and received responses from 373 microbusinesses out of which 313 furnished information on losses to business content and due to business interruption. The questionnaire is comparable to the survey undertaken in HCMC, with the exceptions that each interviewee reported only about the most severe flood event during 2011 and provided information about the value of the business content. The latter information was used to calculate relative content losses. Furthermore, the microbusinesses’ locations were not queried. All other pre-processing steps were the same as for the HCMC data.”

C1.4: Additionally, presenting the equations for the error formulas mentioned in lines 147–150 would enhance clarity. There are also methods referenced in the results that are not described in the methodology section. For instance, cumulative distribution functions (CDFs) are discussed in line 357, yet they are not explained in the methods. Including these details would improve transparency and ensure a more complete understanding of the approach used.

R1.4: We included the equation for the error formulas in a revised version of the Supplementary Information (see, Table S1). A brief explanation of cumulative distribution functions is added at the end of Sect. 3.2.2 in the revised manuscript (lines 231:237):
“Cumulative distribution functions (CDFs) were used to visualise the results of the transfer experiment. The cumulative distributions shown in this study (Fig. 8.a and 8.b) represent the change in the predictive accuracy of a model due to regional transfer. In other words, the CDFs provide insight into the extent to which a transferred flood loss model suffers from the different information contained in the Can Tho samples. For example, Fig. 8.b shows that the reference RF underestimates interruption losses in nearly 90 % of the Can Tho samples, but in only 30 % of the HCMC samples. The

CDFs are examined in their normalised versions to keep the plots of the cumulative distributions comparable, regardless of their different sample sizes."

C1.5: In the introduction, the authors place emphasis on the case study to motivate the analysis. It may be beneficial to move the detailed description of the case study to a separate section, allowing the introduction to focus more directly on the research gaps. This would help to clearly establish the broader motivation and context for the study before delving into the specifics of the case study.

R1.5: Thank you for this suggestion. In the revised version of the manuscript, we moved the description of the case study to a new subsection of Sect. 2. Furthermore, we renamed Sect. 2 from "*Data – Post-flood survey of microbusinesses*" to "*Domain and data*" (line 76) with subsections covering the case study and the post-flood survey datasets. We hope this will make the broader motivation and context for the study clearer.

C1.6: The discussion and conclusion sections could be enhanced by further exploring how the findings may be utilized by other experts and their implications for flood risk management. Expanding on these aspects would clarify the broader relevance of the outputs.

R1.6: To illustrate the broader relevance of the study, we have improved the discussion and conclusions by highlighting the need of flood loss models to stakeholders and how reliable loss model predictions can improve decision making in terms of risk assessment.