Response to Reviewer #2

We are grateful to the Reviewer for the valuable suggestions to improve our manuscript. Below, we provide point-by-point responses to each comment.

Original review comments are in **black,** and our responses are in **blue.** *Changes introduced in the revised version of the manuscript are shown in italics.* Where necessary, references are provided using a 10-point font size.

After the flood of 2022 in the Marche region, Italy, colleagues from several Italian universities collected data on 123 damaged residential buildings, as well as on 133 affected commercial or industrial premises using standardized forms that have already been proven fit for such a purpose earlier. The paper describes the survey forms and the two datasets that are available online at: https://doi.org/10.5281/zenodo.15591850. Data can be downloaded and processed in Excel.

The joint effort of collecting damage data after such an extreme event and of providing these two unique datasets to the scientific community is noteworthy and much appreciated since it allows further development or validation of flood damage models.

The paper itself is well structured, clearly presented and well written. I have a few minor suggestions for further improvement:

- Throughout the paper, the authors use the term "business activities". I my view "premises" instead of "activities" would better describe that mostly the physical items (stocks) at the place of operation (i.e. buildings, equipment, vehicles) were surveyed, not the economic activities in terms of processes or flows.

> We thank the reviewer for the suggestion. In the revised manuscript, we will replace the term “activities” with “premises” throughout the text and dataset.

- Another term that needs some clarification, i.e. a proper definition, and some more explanation on what was collected in the field, is the term "indirect damage". For example, business interruption is not always seen as indirect damage, but as a separate category (e.g. Meyer et al, 2013: https://doi.org/10.5194/nhess-13-1351-2013).

> We acknowledge that, in the literature, the classification of business interruption varies (e.g., Meyer et al., 2013). In this study, however, we classify business interruption as an indirect damage, as in our view it represents a secondary consequence of the direct contact of flood water with the business premises. In the revised version of the manuscript (line 79), we will explicitly state the types of indirect damages collected in Form E to clarify our definition, thus avoiding possible terminological misunderstandings:
>
> > *indirect damages (i.e., delayed or secondary consequences, such as lack of usability, activity disruption, missed orders, unemployment, damage due to humidity)*

- Line 56/57: "The flood caused extensive damage to buildings and infrastructure and [...]": Do you have some official numbers on the amount of damage? Please add.

At present, no official assessment of the total damages is available.

The Marche Region has announced the availability of approximately 460 million euros as resources to support reconstruction and recovery, while journalistic sources such as La Stampa have reported damage estimates of around 2 billion euros. However, since these estimates are either partial or not official, we will not make changes to the manuscript.

References

- Marche Region, *RESOCONTO ATTIVITÀ A DUE ANNI DALL'ALLUVIONE DI SETTEMBRE 2022: https://www.regione.marche.it/portals/0/Comunicati_stampa/Slide%20Alluvione%202022_settembre_def.pdf*
- La Stampa: https://www.lastampa.it/economia/2023/12/05/news/alluvione_marche_danni_fondi_ue-13911536/

- Line 89: "which is tailored for masonry and wooden buildings" should be "... tailored to..."

We thank the Reviewer for the correction.

- Line 100: refer explicitly to Fig. 2.

We will add the reference to Figure 2 as follows:

as illustrated in the framework diagram of Fig.2.

- Line 112: The weekly discussions and decisions are a bit unclear to me. I thought that the three municipalities were agreed upon at the beginning of the campaign. Later in the paper (e.g. on line 120 and in line 142) it is mentioned that measures were taken to avoid duplications etc. Why was that a risk at all? And were the measures undertaken successful? Please clarify.

Line 112: Every week, a decision was made on which municipality to survey among the chosen three defined at the beginning of the campaign. Line 112 therefore refers to which of these three each team was assigned, to ensure homogeneous coverage of surveyed assets across municipalities.

Lines 120 and 142: The field campaign involved numerous researchers conducting surveys on separate occasions, which created the risk of different teams surveying the same buildings multiple times. To minimize this risk, surveyors recorded the coordinates of surveyed buildings in a shared file (see lines 133-134), which was then used in a geographic information system application on mobile devices to support the field teams by showing which assets had already been surveyed, thus helping to avoid duplication. Nevertheless, verification carried out by the external surveyor (line 142) was essential to

confirm the effectiveness of this measure and to detect duplicate entries. Based on this external review, only two housing units within the same building were found to have been entered in separate forms. These were subsequently merged into a single Form A containing two Forms B. Therefore, we can conclude that the measures undertaken were successful, although a final check remained necessary.

No changes will be made in the revised version of the manuscript.

- Line 128/129: Obviously, each building was surveyed not by an individual team member alone, but by a whole sub-team with several members having different roles. How many people were involved in one sub-team and would you recommend to keep this?

Each sub-team consisted of two or three people, as indicated in line 111. This team size was effective for the fieldwork, and we would recommend maintaining a minimum of two members, as form completion involves multiple tasks, including form filling, taking pictures, and undertaking measurements.

No changes will be made in the revised version of the manuscript.

- Line 259-261: Please add an example.

In the revised version of the manuscript, we will add an example related to Figure 5(b) at line 261:

For instance, the high frequency of damage to systems recorded in residential buildings shown in Fig. 5(b) suggests that an effective preventive measure could be relocating electrical and heating systems to higher levels.

- Line 285: Is this correct? Rodriguez Castro et al (2025) only report data from Belgium.

The Reviewer is right. Rodriguez Castro et al (2025) used an adapted version of the survey form for Belgium only. In the revised manuscript, we will then remove "the Netherlands" from the text.

- Line 289: What does "a significant portion" mean in terms of numbers?

According to a press release of the Marche Region published in September 2024, 3,095 damage compensation claims were submitted by private citizens and 643 by businesses. This means that the datasets cover about 4% of the damaged residential buildings and 20% of the affected business premises. At line 289 of the revised version of the manuscript, we will add these quantities and clarify that the survey only partially covered the territory affected in the Marche Region:

According to the Marche Region, 3,095 compensation claims were submitted by private citizens and 643 by businesse (Regione Marche, 2024), indicating that the present datasets cover only 3% of the damaged residential buildings and 15% of the affected business premises. In addition, surveys were conducted in only 3 of the 14 most affected municipalities within the region.

Reference

Regione Marche, RESOCONTO ATTIVITÀ A DUE ANNI DALL'ALLUVIONE DI SETTEMBRE 2022: https://www.regione.marche.it/portals/0/Comunicati_stampa/Slide%20Alluvione%202022_settembre_def.pdf , last access: 25 August 2025, 2024.

- Line 295-297: This is an interesting aspect. Do most of the residents only live in the affected area during the spring and summer season? If yes, please add that information earlier.

We thank the Reviewer for the observation. According to ISTAT (Istituto Nazionale di Statistica – National Institute of Statistics), 28% of the residential housing units in Senigallia are not occupied by permanent residents. This reflects the city's touristic character, with part of the population residing there only during the spring and summer seasons. In line 61, we will add the following sentence:

Moreover, Senigallia is a coastal touristic city, where 28% of the residential dwellings are not occupied by permanent residents (ISTAT, 2021), and part of its population live there only during the spring and summer seasons.

Reference

ISTAT, Basi territoriali e variabili censuarie: https://www.istat.it/notizia/basi-territoriali-e-variabili-censuarie/, last access: 25 August 2025, 2021.

- At the end of the paper, a brief outlook on future uses of the data and the forms would be nice. Consider shifting lines 281 to 285.

We agree with the Reviewer that providing an outlook on the future uses of the data and the forms is important. This aspect is already covered in Section 5.1 which provides an exhaustive discussion of the main potential uses of the data and forms. To avoid repetition, we have chosen to maintain the current structure of the section.

- Figure 1: Since the Figure consists of three parts, all parts should have a number or a letter (A, B, C) and a brief description in the figure caption.

We have updated Figure 1 and the caption according to the reviewer suggestion:

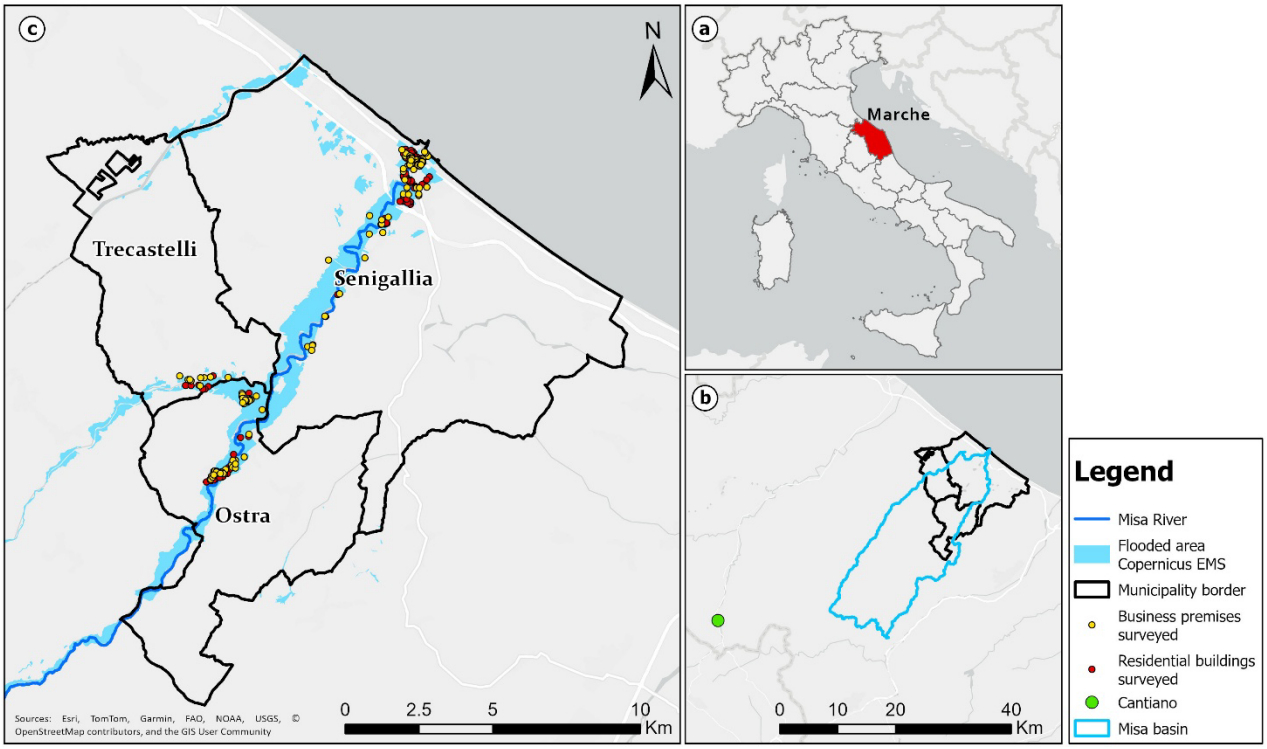


Figure 1. (a) Marche region shown in red; (b) location of the three municipalities of Ostra, Senigallia, and Trecastelli surveyed within the Misa Basin, and the municipality of Cantiano, depicted with a green dot; (c) points representing the buildings surveyed within the three municipalities, and the flooded area of the 2022 event, as provided by the Copernicus Emergency Management Service (EMS).

- Figure 2: Check figure caption. Do you mean "tool**s** used" instead of "tool used"?

> "Tool**s**" is the correct form, and we will correct the caption of Figure 2 in the revised manuscript.

- Figure 3: The figure is clear and the structure can be found in the datasets. I was wondering whether this nested structure is feasible and ready/easy to use for data analysis. Please comment (in the discussion).

> In our view, the proposed nested structure is feasible for data analysis, as it allows for a clear hierarchical organization of information and facilitates the selection of information at different level of detail and by damage type. Given this structure, users can easily navigate between aggregated summaries at the building level and records of damages to specific content types. Finally, the integration of the datasets with well-documented supporting information further strengthens its usability. The forms allow for clear interpretation of the variables present in the datasets, while the data dictionary provides clear definitions of variables and units.
>
> In the revised version of the manuscript, at line 239, we will add the following paragraph:

The structure of both the datasets and the forms offers a clear hierarchical organization of information, enabling analysis between multiple levels of detail, from aggregated summaries at the building level to damages occurred to specific content types. The availability of the data dictionary further facilitates the usability of the datasets by providing variables' definitions and units (see Table 1).

- Figure 5: Please sort items in a descending/ascending order in both figures. And in 5b: The item "Damage due to high velocity" does not match with the other items since it describes a causing process, not a damaged item or activity. Please comment. The answer option "other damage" was chosen very often. Please briefly describe in the text what is included in this category. Would you recommend adding further answer options in future surveys?

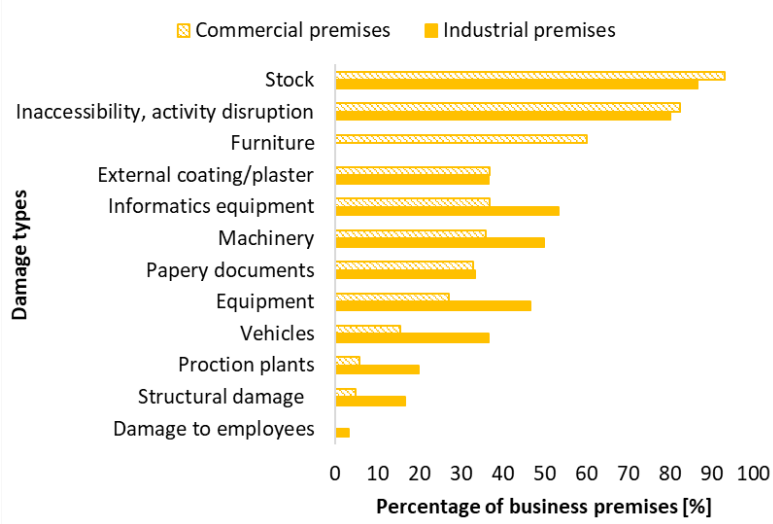
We thank the reviewer for this comment. We agree that "Damage due to high velocity" refers to a damage causing process rather than a type of damage; therefore, we have removed this item from Figure 5b. The comment also helped us identify and correct an error in the original figure affecting the value of "Other damage". After correction, "Other damage" accounts for only about 10% of the damages recorded per flooded floor.

Regarding the content of the "Other damage" category, the field specifications provided by respondents are highly heterogeneous, ranging from "textbooks" to "bicycles" to damage to "wine barrels". Given this diversity, it is not possible to define a new answer category. In the revised manuscript, we will include the following paragraph at line 259:

For residential buildings, Form B also allows respondents to select the option "other damage" when the predefined answer choices are insufficient to describe the type of damage observed. In our dataset, 10% of affected floors were reported under this category. Field specifications for these cases revealed a high degree of heterogeneity, ranging from damages to "textbooks" and "bicycles" to "wine barrels".

In the revised Figures 5a and 5b below, the types of damage are now sorted in descending order. The caption has been revised accordingly.

(a)



(b)

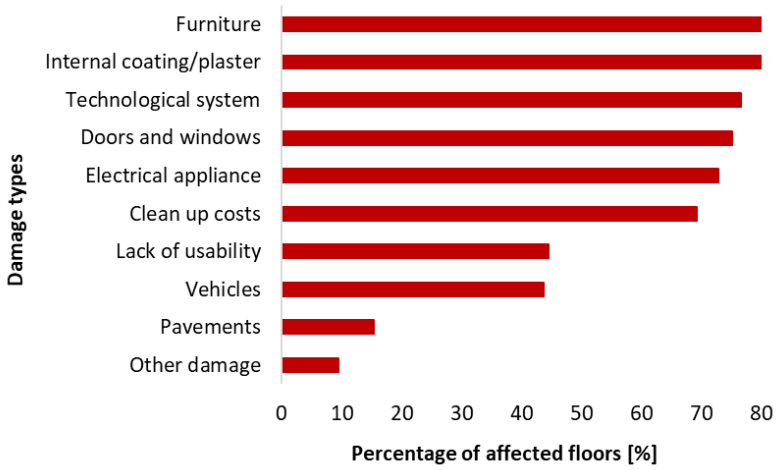


Figure 5. (a) Types of damage collected for business premises, disaggregated by commercial (n = 103) and industrial (n = 30) sectors, based on data from Workbooks A and C. Damage types are sorted in descending frequency order, considering commercial premises as reference. (b) Damage types collected for residential buildings floors (n = 137), based on data from Worksheet 2 of Workbook B. Damage types are sorted in descending frequency order.

- Figure 6b: Only one dataset is shown in Fig. 6b, but two are mentioned in the figure caption. Please clarify.

> The term "datasets" in the figure caption refers to the two distinct datasets: one for residential buildings and one for economic activities. Figure 6b shows the datasets combined. We will clarify which datasets are referred to in the figure caption as follows:
>
> > *Water depth frequencies for the two datasets: residential buildings and economic activities. Water depth measurements were available for 247 out of 256 buildings surveyed.*

Thank you for this valuable effort and data.