

Responses to comments on egusphere -2025-6376

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“Learning from the past to inform flood risk management: Analysis of public survey data in Belgium on flood early warning and response during the July 2021 flood”

Heather J. Murdock, Daniela Rodriguez Castro, Benjamin Dewals, Anna Heidenreich, and Annegret H. Thieken (Submitted 19 Dec 2025)

Thank you for your review. In the text below we provide a point-by-point response to the comments made. For clarity we have organized the comments and responses into tables with comments on the left and responses on the right in italic for clarity.

Referee 2 – Francisca Vergara-Pinto (Referee)

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Referee Comments

Comment	Response
<p>This manuscript provides a necessary and detailed behavioral analysis of the July 2021 flood in the Walloon Region of Belgium, a landmark event that exposed critical vulnerabilities in regional early warning systems. Using the Protective Action Decision Model (PADM) to investigate the "warning gap" is a sound approach that adds valuable empirical data to the field of disaster risk management. I have a few comments and observations for your consideration, which could improve the manuscript (see attached PDF).</p> <p>Congratulations on this timely contribution to disaster studies.</p>	<p><i>Thank you for your detailed comment about our paper including support for the method used and the topic addressed.</i></p> <p><i>We appreciate your time and comments that help improve the manuscript.</i></p>
<p>line 24 - I suggest moving “background” to the next subheading (1.2)</p>	<p><i>We would prefer to keep the heading as is because this section is a merged section with both introduction and background information organized by topic.</i></p>

<p>line 37 - I suggest concluding this section of the introduction by also highlighting the need to study this case, as it contributes to the discussion on the interplay of underlying institutional, communication and social factors, among others, which were brought to light by the disaster; furthermore, the authors could mention that this study aims to address a certain gap in the literature on this type of hazard (floods).</p>	<p><i>Thank you for this comment. We will add more detail on the need to study the case of the July 2021 flood in the Belgian context including the addition of this sentence at the end of the introduction to Section 1:</i></p> <p><i>“In addition, the case of the July 2021 flood in the Walloon Region revealed both technical and governance challenges for rapid onset flood events and the underlying factors which influence warning and response behaviour.”</i></p>
<p>Figure 1 - Is emotion-focused coping always considered a situational impediment, or is it variable? (An emotion associated with survival might facilitate evacuation?)</p> <p>On the other hand, could the search for information also be a situational impediment? (When seeking and finding incorrect information?)</p>	<p><i>Emotion-focused coping is part of the Behavioural response pillar (see fig. 1). Situational impediments can have an impact on the Behavioural responses, which is indicated with the small arrow between both bubbles.</i></p> <p><i>In this study we don’t analyse situational facilitators or impediments but they are part of the overall PADM framework and could be studied using the method we present here.</i></p> <p><i>We will add some additional explanation about facilitators and impediments and make it clear that they are not part of this analysis.</i></p>
<p>line 79 - This appears to be the general aim of the paper. If so, I suggest stating it as such: “The aim of this paper is to examine what makes flood warnings...”</p> <p>If the aim is different, it should be stated explicitly here.</p>	<p><i>The sentence on lines 79-80 is a concluding sentence for this section which introduces Flood Forecasting Warning and Response Systems and the Protective Action Decision Model.</i></p> <p><i>The focus and general aims for the paper are stated in “Section 1.3 Focus of this article” with a summary of the paper’s aim on lines 203-204. We will edit the sentences with the papers aims to make it more clear with the following new version:</i></p> <p><i>“The aim of this paper is to learn from the past by first gaining a baseline understanding of the FFWRS performance in the Walloon Region during the July 2021 flood and then develop further insights into factors that influence warning and response behaviour through statistical modelling of survey based empirical data at the household level.”</i></p>

line 194 - Please explain in more detail what is meant by 'situational awareness' and which authors or bibliography have been used to analyse it.

We noticed that in the manuscript we used the term situational awareness once. This is actually a typo and the correct term is situational knowledge. We will correct this.

In addition, we will add the following definition of situational knowledge with appropriate references in Section 1.1 as follows:

“Situational knowledge on protective behaviour refers to having knowledge of appropriate response actions, when they should be implemented, and how they should be applied or adapted to a particular situation or hazard. (Lindell and Perry 2012; Rogers, 1983; WHO, 2025)”

line 428 - This is interesting. Could you provide an example of this finding or suggest an explanation? (perceived surprise of the threat as an outcome variable shows a small effect of gender with men being more surprised than women.)

We will add more explanation here and on the gender effects more broadly. We will add the following:

“Several studies have shown that risks tend to be judged as lower by men than by women before the occurrence of a hazard event (Slovic, 2010). Therefore, if men expected the flood to be less severe than it was, then it follows that they were surprised by the intensity. However, other research suggests that this effect is not strong in countries with high gender equality and other factors may play a bigger role such as cultural and racial background or education (Olofsson & Rashid, 2011, Palmer, 2010).”

line 521 - I wonder if this finding is related to the type of question asked of the respondents. How were they asked about 'the situational'? Which questions in the questionnaire are related to this? (few respondents reported that they had situational knowledge on protective behaviour)

We describe situational knowledge on protective behaviour in the paragraph starting on line 393 and include how the question was asked there. Respondents were asked if they knew what to do and if they did something. We investigate both variables in this analysis.

As stated above in this document we will also now add a detailed and referenced definition early in the article in Section 1.1.

In the results summary for section 3.3 we can add a clear statement that respondents were asked directly what they did in a multiple choice question with typical response action examples given.

line 636 - Gender differences are often overlooked but are highly significant when it comes to anticipating how women and men will behave in future situations. I suggest reviewing and citing this study by Romero et al (2023) (on debris flows), which provides a qualitative account of the importance of the local context when considering gender-specific warnings.

<https://link.springer.com/article/10.1007%2Fs10346-021-01830-2>

Thank you for the comment. Indeed, gender differences are often overlooked and in our study we wanted to investigate where gender may have an effect on warning and response behaviour among other variables.

The paper suggested (Romero et al., 2023) mentions gender differences with regards to social vulnerability and response behaviour following a debris flow event in Chile.

It found that with this case of debris flow in Chile, men often have response roles outside the home, while women often respond with actions inside the home.

In our study gender was not a significant variable for either of the response actions indicators. However, that could be because of what actions were about. We didn't distinguish between actions inside and outside of the home, for example. We will add a sentence to the discussion in Section 3.3 as follows on this point:

“While our study did not find gender to be a significant explanatory variable for response behaviour other studies suggest that it does play a role. Many studies have found that women are more likely engage in protective behaviour after receiving a warning but there are some nuances (Enarson et al. 2007, Fothergill, 1996). For example, several studies have also observed that women are more likely to take certain type of response actions such as focusing on people and actions inside the home (Romero et al., 2023; Cvetković et al., 2018). While our survey did ask about helping people as a response action, we could ask more explicitly about where response actions took place to further investigate the role of gender in response behaviour.

line 653 - Nice. I suggest adding a conclusion to help understand this phenomenon in other regions both in the Global North and the Global South.

Thank you for the supportive comment. This work is related to the early warning for all goals from the WMO and point to gaps which can be uncovered during extreme events. We will add the following text to the conclusion:

“The Early Warnings for All initiative has the stated goal of all countries being covered by an early warning system. The existing gap lies mostly in least developed countries and small island developing states. This work highlights, that even once an early warning system is set up, hazard events can occur which overwhelm its capacity and expose vulnerabilities. Studies on early warnings for all call for inclusive strategies that address the needs of the most vulnerable populations (Budimir et al., 2025).”

Added citations for this response:

Budimir, M., Trogrlić, R. Š., Almeida, C., Arestegui, M., Vásquez, O. C., Cisneros, A., ... & McQuistan, C. (2025). Opportunities and challenges for people-centered multi-hazard early warning systems: Perspectives from the Global South. *Iscience*, 28(5).

Cvetković, V. M., Roder, G., Ōcal, A., Tarolli, P., & Dragičević, S. (2018). The role of gender in preparedness and response behaviors towards flood risk in Serbia. *International journal of environmental research and public health*, 15(12), 2761.

Enarson, E., Fothergill, A., Peek, L. (2007). Gender and Disaster: Foundations and Directions. In: *Handbook of Disaster Research. Handbooks of Sociology and Social Research*. Springer, New York, NY. https://doi.org/10.1007/978-0-387-32353-4_8

Lindell, M. K., & Perry, R. W. (2012). The protective action decision model: Theoretical modifications and additional evidence. *Risk Analysis: An International Journal*, 32(4), 616-632.

Olofsson, A., & Rashid, S. (2011). The white (male) effect and risk perception: Can equality make a difference?. *Risk Analysis: An International Journal*, 31(6), 1016-1032.

Palmer, C. (2003). Risk perception: another look at the 'white male' effect. *Health, risk & society*, 5(1), 71-83.

Romero, J. E., Vergara-Pinto, F., Aguilar, G., Garcés, A., & Montserrat, S. (2022). Triggering factors, behavior, and social impact of the January 2021 hail-debris flows at the Central Valley of Chile. *Landslides*, 19(4), 865-883.

Slovic, P. (2010). The feeling of risk. *New perspectives on risk perception*.