Response to RC1
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General Comments:

The paper analyzes flood-related social media conversations using a watershed-based approach, uncovering spatio-temporal dynamics during the 2021 Western European flood. It highlights the importance of a transboundary river basin perspective for improving disaster management and cooperation across borders.

The manuscript is well-organized, with clear objectives, methods, and results. Its use of geo-social media data combined with watershed characteristics is innovative and supported by a solid methodology.

Strengths:

1. ***Innovative Methodology**:*
    - *The use of BERTopic for semantic classification and the integration of watershed-level characteristics are cutting-edge approaches.*
    - *The methodology is well-documented and replicable.*
2. ***Relevance and Applicability**:*
    - *The paper addresses critical challenges in flood risk management across national borders, providing practical insights for preparedness and response strategies.*
3. ***Effective Use of TF-IDF**:*
    - *The application of Term Frequency-Inverse Document Frequency (TF-IDF) effectively extracts meaningful insights from social media data, demonstrating strong analytical rigor.*
4. ***Comprehensive Data Analysis**:*
    - *The study incorporates a range of datasets, including precipitation models, flood mapping, and socio-environmental data, ensuring a robust and multi-dimensional analysis.*

Authors' response:

We are pleased that the reviewer recognizes the innovative nature of our methodology, the practical relevance of our study, and the robustness of our data analysis. We acknowledge the valuable suggestions and have made the necessary clarifications and additions to strengthen our manuscript further.

Specific Comments:

1. ***Terminology Update****:*
    - *Could the authors explain why the references to "Twitter" and "Tweets" are not inline with the platform's updated name, "X," and use "posts" instead of "Tweets" to align with the rebranding.*
    - *A brief clarification can be added in the methodology section, such as: "In this paper, we refer to user-generated content on the platform formerly known as Twitter as 'X posts.'"*

Thank you for the comment and the opportunity to clarify this point further. Our dataset was collected during a period when the platform was known as Twitter, operating under its established content moderation policies and user dynamics. With the rebranding to "X," the platform has undergone substantial changes, including shifts in content moderation, user engagement patterns, and available data access. Notably, key data that was accessible through Twitter's APIs at the time of our study is no longer available under the current X platform policies.

By using the terms Twitter and Tweets, we ensure consistency with the historical context of our data, additionally aligning with the terminology commonly used in prior academic literature for this specific data. In its core, this terminology is supposed to highlight the fundamental differences between the dataset we analysed and any data that could be collected from X today. In other words, our study is based on data generated under Twitter's original policies and user environment, which we aim to distinguish from current data available on the X platform.

To address reviewer's concern, we added a clarification in the methodology section stating:

"Throughout this study, we refer to user-generated geo-social media posts from the platform formerly known as Twitter (now X) as 'Tweets', and for consistency with our dataset, we continue to refer to the platform as Twitter. This choice of terminology is intended to reflect the historical context of the data collection process, including specific content moderation practices and data accessibility, that set the original dataset apart from the data available on X today."

We hope this explanation balances accuracy with readability, while acknowledging the platform's rebranding and changes in data and content moderation guidelines.

2. ***Choice of Translation Tool****:*

- *The paper uses the Google Translate API for translating posts into English. However, there are several free and open-source tools available (e.g., MarianMT, DeepL). Could the authors justify this choice, explaining why Google Translate was preferred (e.g., for its accuracy or language coverage).*

We appreciate this suggestion to motivate the choice translation tool used in this study. We initially selected the Google Translate API due to two major considerations:

Google Translate offers an extensive support for a wide range of languages, including numerous regional dialects, which is essential for analysing geo-social media conversations across diverse countries. This is because, some local communities post in languages that extend beyond the official national tongues, such as local dialects or other languages for instance Turkish or Arabic variants. Hence, by utilizing a translation tool with such broad language coverage, our study minimizes the risk of inadvertently excluding or misrepresenting discussions from sub-communities, thereby ensuring a more inclusive and representative analysis.

To clarify our choice, we added the following justification in the methodology section:

"Furthermore, we relied on the Google Translate API due to its extensive language support, including regional dialects, which reflects geo-social media discussions across diverse communities. This also offers a higher likelihood that languages beyond official national tongues, such as Turkish or Arabic variants, are included, minimizing the risk of excluding or misrepresenting sub-community discussions"

3. ***Data Biases**:*

- *Social media data tends to underrepresent remote and less urbanized areas. The paper could elaborate on how this bias may affect the interpretation of dominant topics and the generalizability of the findings.*

We do agree that inherent biases in geo-social media data, particularly its tendency to underrepresent rural and less urbanized areas, need to be addressed carefully. This important limitation was highlighted in section 4.2.1.:

"Twitter data represents a non-uniform sample of the population (Mislove et al., 2011) and exhibits significant biases towards specific age groups, often male and urban populations (Malik et al., 2015)..." (lines 493-494).
*"This limitation was verified in our analysis with multiple dominant topics being the most frequent in densely populated and urbanised watersheds (**Error! Reference source not found.**; F1:11 and G F1:11). To address this drawback, future studies could integrate additional data sources, such as traditional field surveys or official news media sources such as press article (Vicari et al., 2019) in order to provide a more comprehensive view of public responses."* (lines 501-504)

We now further provide additional comments explaining *how* this can affect topic interpretations:

"Such a type of underrepresentation of rural areas in social media data can affect the interpretation of flood impacts. For instance, rural towns such as Schuld (BBC, 2021) and Pepinster (DW, 2021) were severely devastated by the floods, resulting in a high proportion of casualties per capita. Residents in these areas might have been less likely to tweet updates due to power outages (Reuters, 2021), mobile network failures (Koks et al., 2021), or simply because of lower digital engagement rates. Therefore, the implications for emergency response are that an overreliance on social media signals could lead emergency responders to underestimate the severity of flooding in low-social-media-usage regions and prioritize urban relief efforts over rural recovery needs."

We believe this addition will strengthen the study's critical perspective on the representativeness of the dataset.

4. ***Comparison with Traditional Data Sources**:*

   - *While the study effectively demonstrates the value of social media data, including a comparison with traditional sources like official reports or surveys could enhance its relevance and contextualize its strengths and limitations*.

While the primary focus of our study is on leveraging social media for rapid flood impact assessment, we recognize that integrating traditional data sources could provide a valuable comparison to evaluate geo-social medias capabilities.

This is the main reason why we integrated first-hand the remote sensing-based flood maps from the Copernicus EMS to delineate the extent of flooded zones along the Meuse and Rhine Rivers during the period from 14 to 16 July 2021 and compare them to geo-social media topic occurrences (see section 2.2.1. Precipitation and flood data, and Figure 7, column B).

Meanwhile, we also acknowledge that additional damage-related information from traditional surveys, public reports or high to very-high resolution (VHR) remote sensing data would help to further highlight the capabilities of geo-social media data.

Yet, the availability and comparability of such types of data sources can vary significantly across countries, making comprehensive comparisons both complex and challenging. Such a comparative analysis of data source strengths and weaknesses is beyond the scope of the current study.

Accordingly, we have now integrated the following clarification in the discussion section:

"To address this drawback, future studies could triangulate additional types of data sources (when available across countries), including remote sensing-based data and questionnaire field surveys for detailed damage assessments or official news media sources from press articles for verified ground-level information (Vicari et al., 2019). An information fusion approach (Wieland et al., 2025) would also help to identify disaster hotspots and evaluate potential cross-border biases in geo-social media data during crisis management situations. (lines 524-528)

We do believe our added additions give weight to the reviewer's concern and improve the contextual depth of our findings.

5. ***Policy Implications**:*

   - *Expanding on how the identified topics can inform flood preparedness and cross-border coordination efforts would improve the study's practical relevance, especially for policymakers and emergency responders.*

We fully agree that elaborating on the practical implications of our findings will enhance the study's relevance for policymakers and emergency responders. While we expand clearly on this in section 4.3. in the discussion section, we clarified the following points:

- Linking discussion topics to specific phases of flood management (early warning, response, or recovery).

- Highlighting similar examples where social media data has been shown to improve flood risk management (if available) to further demonstrate its practical utility for policy recommendations and decision makers.

This enhancement ensures that our study not only provides methodological contributions but also actionable insights for stakeholders in disaster risk reduction. Please find our improvements in section 4.3.