Review of manuscript egusphere-2026-2454

Impact attribution of compound flooding from Tropical Cyclone Idai: Assessing the influence of land cover change and underlying socioeconomic drivers using a mixed-methods approach.

by Poppy E. Webb et al.

This manuscript investigates how climate change, land-use/land-cover change, and underlying socio-economic processes influenced compound flooding during TC Idai in Mozambique using a mixed-method approach. The manuscript would benefit from a clearer distinction between flood-hazard attribution and impact attribution, as the quantitative analysis estimates changes in flood depth, and extent. However, it does not quantify impacts through exposure and vulnerability analysis. The integration between the qualitative and quantitative components should also be explained more explicitly. These revisions would strengthen the methodological part and interpretation of the results. I therefore recommend major revisions before the paper can be considered for publication.

Introduction

1. The definition of compound flooding in terms of fluvial, pluvial and coastal flooding is appropriate for the focus of this study. However, I wonder whether it would be useful to briefly clarify at this point that these represent the flooding-related drivers considered in the study, rather than the complete set of physical hazards associated with a tropical cyclone. TC Idai also involved strong winds, as the authors themselves acknowledge later in the Introduction (lines 74-76). Previous studies on tropical cyclones in Mozambique, including TC Idai, have shown that wind and flooding may contribute differently to direct and indirect impacts (e.g. Mühlhofer et al., 2023; Espejo et al., 2025). A short clarification here would help distinguish the broader physical drivers of TC impacts from the specific compound-flooding processes investigated in this study, without changing the scope of the analysis.

   References

   Espejo GG, Stalhandske Z, Mühlhofer E, Röösli T, Brönnimann S, Bresch DN and Zischg AP (2025) From hazard to disruption: forecasting direct and indirect tropical cyclone impacts on infrastructure in Mozambique. Front. Clim. 7:1666586. doi: 10.3389/fclim.2025.1666586

   Link: https://www.frontiersin.org/journals/climate/articles/10.3389/fclim.2025.1666586/full

   Link: https://scholar.google.com/citations?view_op=view_citation&hl=en&user=2TrzxOQAAAAJ&citation_for_view=2TrzxOQAAAAJ:eQOLeE2rZwMC

2. In line 69 in the introduction. There is a typo error probably. “This can be achieved by using a mixed-method approach that combines qualitative and qualitative methods”. It is maybe quantitative?

Methods

The quantitative framework itself is clear: The combination of KIIs/causal mapping with a SFINCS- workflow compound-flood chain and four factual/counterfactual scenarios. But I see the following points worth checking.

3. In Section 2.2.2, the authors describe the use of the 30 m Lisboa et al. (2024) LULC dataset and use the 2020 map to represent factual land-cover conditions for TC Idai, which occurred in 2019. I assume this choice is related to the lack of a comparable regional dataset at that resolution for 2019. However, the current description raises some questions, since the objective is to represent land-cover conditions before the TC Idai 2019. Could the authors clarify why the 2020 dataset is considered representative of conditions during TC Idai, and whether land-cover changes between March 2019 and 2020, including changes caused by Idai itself or post-event recovery/reconstruction, could affect the factual scenario?

   The manuscript also states that the Lisboa et al. dataset was "minorly" merged with the 2019 Buchhorn et al. global LULC product to cover the full model domain. Could the authors clarify which parts of the domain required this additional dataset and approximately what proportion of the model area it represents? If feasible, a brief sensitivity check comparing the results with and without this merged area would help demonstrate whether the merging has a significant influence on the results and would support the statement that the merge is minor.

4. After line 105 the Figure1; I suggest reviewing it and modified

   Figure 1 may be slightly misleading in the way the qualitative and quantitative components are linked. The arrow from the causal loop diagram directly to "Flood hazard (extent & volume)" suggests that the qualitative analysis is used as an input to the flood-hazard calculation. However, as I understand the methodology, the quantitative modelling chain assesses how the LULC and climate scenarios influence flood hazard, while the KIIs and CLD are used to identify and interpret the socio-economic drivers underlying the observed LULC changes.

   I therefore suggest revising Figure 1, or adding a complementary schematic, to make the sequence of the mixed-method approach clearer. For example, were the KIIs conducted and analysed first to develop the CLD, and was the CLD then used to interpret the observed differences between the 2000 and 2020 LULC maps? Or were the LULC changes identified first and then used to guide the qualitative analysis? Clarifying this sequence would help the reader understand how the two components are integrated and avoid the impression that the CLD directly feeds into the quantitative flood model.

   Explain it for steps maybe to understand the sequence

5. Figure 4 effectively shows the spatial differences in maximum flood depth between the factual and counterfactual scenarios. However, the interpretation of the positive and negative differences, particularly in the LULC-change panel, could be explained more explicitly in the text. For example, it would be useful to clarify why some areas experience increased flood depth while others show decreases under the factual LULC scenario, and to relate these spatial patterns to the main LULC transitions identified earlier (e.g. deforestation, cropland expansion, urbanization or reforestation). This

would help connect the mapped differences more directly to the physical mechanisms discussed in the study.

For example:
Please clarify the physical mechanism proposed for the local decrease in flood depth northwest of Beira. The statement that reforestation reduces land-cover roughness and therefore decreases water velocity appears counterintuitive. Could you please review it. Is right the description?

6. In line 260 there is a part to edit maybe: of "socioeconomic deprivation ... was
   Those points .....

7. Section: Impacts of changes in climate and LULC on flood hazard.
   The combined climate + LULC scenario results in a 12% increase in flood volume, compared with 9% and 2% for the individual effects. Could the authors clarify whether this difference is due to rounding?

8. In lines 377–382, the manuscript refers to assessing impacts and integrating exposure and vulnerability. However, these components are identified qualitatively rather than quantitatively assessed. I suggest using more cautious wording and clearly distinguishing flood-hazard attribution from qualitative interpretation of exposure, vulnerability, and socio-economic drivers. If the authors wish to claim impact assessment more explicitly, this could be strengthened in future work by combining the hazard results with exposure data such as buildings, population, or crops.
   I am referring to this part: "We combine a quantitative attribution framework with KIIs visualised in a CLD to assess cascading drivers, impacts, their interactions and consequently reinforcing socio-economic feedback cycles in rural and urban areas. We propose a mixed-methods approach to truly understand real-word impacts and identify drivers of vulnerability and exposure for compound flooding after TC Idai. By doing so, we consider all risk components (Simpson et al., 2021), particularly integrating exposure and vulnerability as they drive the experienced impacts"
9. The dataset referenced at https://doi.org/10.5281/zenodo.19328562 could not be accessed. Please check that all the data is available and code. You could add also add the repository in GitHub for the modelling chain, as it is open source so far I understand.