

Learning from warnings: turning evidence from past events into better warnings

Abstract

The University College London (UCL) Warning Database is an open access resource for documenting and analysing how warnings are produced, communicated and acted upon. It builds on outputs from the World Meteorological Organization (WMO) World Weather Research Programme's HIWeather Project and extends the approach across multi-hazards and a wide range of stakeholders. Bringing evidence from different hazardous events into a common warning value chain framework, the database supports systematic learning, comparison and improvement.

Key points

- A global open access database.
- Supports evaluation and review of the end-to-end warning process.
- Enables post-event learning and evaluation.
- Enables cross-case study and multi-hazard analysis.

Why is a warning database needed?

Warnings are not single products. They are produced from connecting scientific, operational and social processes. In the weather context, observations inform weather forecasts; forecasts inform hazard and impact assessments; warning organisations communicate risk; and people and institutions decide how to respond. The warning value chain (Figure 1; Golding et al., 2019) makes the links between each of these visible. It shows where expertise and information add value, where exchanges between organisations are strong, and where gaps and bottlenecks can weaken the warning communication and uptake.

Post event reviews often contain rich evidence, but this can be dispersed across reports, forecast products, media coverage, surveys and organisational records. A common database structure helps preserve that evidence and makes it easier to revisit events, identify effective practices and test research questions across different hazards and geographic contexts.

The UCL warning database

The newly launched UCL Warning Database builds on the world's first global warnings database developed through the WMO HIWeather Project. HIWeather created tools to examine high-impact events through the warning value chain. This includes a detailed questionnaire and a rapid assessment template, with accompanying video explainer (Ebert et al., 2024; WMO, 2024). Following the conclusion of the HIWeather project in 2024, the UCL Warning Research Centre worked with WMO to publish the resource openly and broaden its scope.

The UCL platform is designed to accommodate hazardous and multi-hazard events, including both natural hazards and human-made threats. Cases may range from major disasters to smaller, localised events. The breadth matters because useful learning is not confined to the most extreme outcomes. Near misses, warning updates, modest events and complex multi-agency responses can all reveal how information moved, where decisions were difficult and what could be improved. An important addition that UCL has made is the inclusion of dynamic risk. Incorporating vulnerability and exposure is important because these shape how hazards translate into disaster, allowing warning systems to better inform risk prevention and reduction.

Contributing to the database

The full warning value chain questionnaire is organised in three parts. The first captures essential information for each high impact event – its hazards, impacts, warnings and responses. The second gathers evidence for each component of the chain (Figure 1).

Contributors are prompted to identify successes, issues, challenges and lessons learnt. Individuals can include narrative analysis, forecast and warning graphics, observations, impact information, photographs, links and supporting publications. The third part invites a subjective score of each warning stage, how effectively each component added value and how well information flowed between components. Scores can help users locate stronger and weaker links within one event, but their subjective nature means they shouldn't be treated as a direct ranking between separate events.

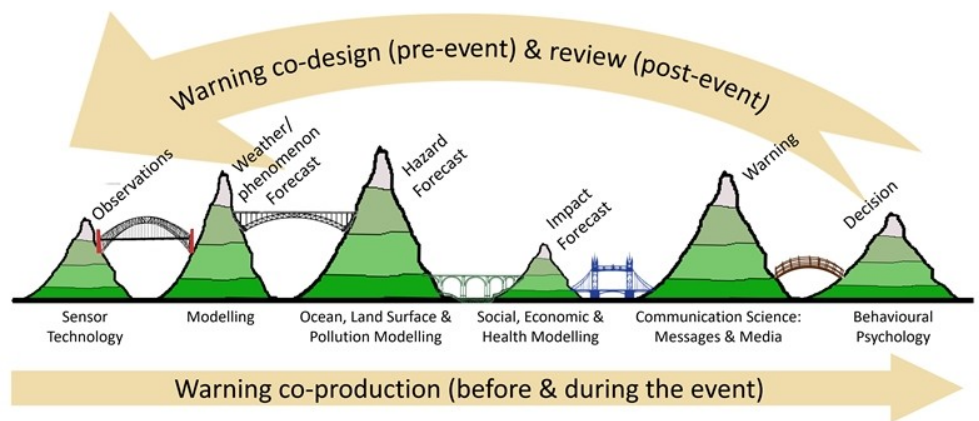


Figure 1: The warning value chain (Golding et al., 2019).

The rapid assessment template offers a shorter route when time is limited during or immediately after an event, allowing perishable information to be preserved quickly, or when key findings from a complete review need to be presented concisely. Together the two formats lower the barrier to contribution while retaining a consistent conceptual structure.

HuT Project adoption

Within the HuT Project, researchers from the Met Office, Flood Forecasting Centre and British Geological Survey applied the warning value chain approach to two UK storms (Storm Eunice – 18/02/2022 and Storm Ciarán – 02/11/2023). The assessment brought together operational meteorologists, hydrometeorologists, geohazard experts, civil contingency advisors and scientists and provided a cross-organisational perspective on how effectively information is exchanged and interpreted (Neal et al., 2026).

For Storm Eunice, the chain performed well overall. The assessment highlighted strong observations, effective cross-agency collaboration and wide warning reach. It also identified challenges in communicating uncertainty, limited use and availability of hazard impact models and difficulty adjusting response to the second red warning which was issued overnight.

For Storm Ciarán, small changes in the forecast track had implications for whether the strongest winds were over populated areas or the English Channel. The multi-hazard context added complexity because different approaches and communication strategies are used across different hazards. However, the collaboration between the organisations involved supported effective response, but uncertainty, changing warning narratives and the integration of information across hazards remained difficult.

Three priority areas for stronger warning systems were identified:

1. **Streamline information flow.** Data volumes and the number of specialist products available to operational users is growing. Tools

should be co-developed, presented through compatible platforms and supported by training so that useful information is not overlooked or missed.

2. **Improve warning communication.** Warning colour alone can obscure the distinction between likelihood and impact – fundamental to the UK's impact-based National Severe Weather Warning Service. Communication should make uncertainty, impact level and warning evolution clear, including for low probability, high impact situations and multi-hazard events.
3. **Strengthen cross-organisational knowledge sharing.** Shared post-event reviews build understanding of roles, terminology and dependencies. Better alignment across weather, flood and landslide services can reduce conflicting messages and support more holistic risk assessment and response.

Find out more

The UCL Warning Database turns individual event reviews into a shared learning infrastructure. For researchers, it offers structured qualitative evidence for investigating warning effectiveness, uncertainty, multi-hazard warning practices and decision-making. For practitioners, it provides examples, review tools and lessons that can inform warning service design, training and partnership working. To learn more, visit the UCL Warning Research Centre and the UCL Warning Database webpages: ucl.ac.uk/.../ucl-warning-database.

References

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Learn more about The HuT project:

<https://thehut-nexus.eu>



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