

# Enhancing Weather Preparedness: Towards an Impact-Oriented Warning Strategy at the Deutscher Wetterdienst

Dinah Kristin Leschzyk  
Bodo Erhardt  
Kathrin Feige  
Andreas Lambert

Deutscher Wetterdienst (DWD) Frankfurter Straße 135,  
63067 Offenbach, Germany

**Abstract:** Effective weather warning communication is essential for supporting public preparedness and timely response. The German Meteorological Service (Deutscher Wetterdienst, DWD) is advancing new approaches through the RainBoW program (Risk-based, Application-oriented and INdividualizaBle Provision of Optimized Warning Information) to enhance the clarity, accessibility, and societal as well as individual relevance of warnings. Building on interdisciplinary insights, RainBoW aims to establish a consistent, user-centered foundation for warning communication. This includes the introduction of a streamlined three-level warning hierarchy, terminology for temporal warning phases, and the integration of return period information to illustrate event rarity. Accessibility, impact orientation, and actionable information are key priorities. Preliminary findings from external studies indicate that these criteria have the potential to enhance user understanding, support informed decision-making, and foster action readiness [1].

**Keywords** — weather warnings, impact-oriented warnings, meteorological communication, public preparedness, user-centered design

---

**SUGGESTED CITATION:** Leschzyk, D. K., Erhardt, B., Feige, K., & Lambert, A. (2025). Enhancing weather preparedness: Towards an impact-oriented warning strategy at the Deutscher Wetterdienst. *Proceedings of the 2025 International Crisis and Risk Communication Conference*, 13(1) 56-58. <https://www.doi.org/10.69931/001c.142842>

## INTRODUCTION

Weather warnings are among the most visible services provided by national meteorological agencies. However, their effectiveness depends not only on the quality of the data but on the clarity and relevance of the communication. Within the RainBoW program, DWD is rethinking how meteorological warnings are communicated. This includes shifting from hazard-centered to impact-oriented communication, ensuring messages are not just scientifically correct but also actionable and accessible for all segments of society.

RainBoW is embedded in a broader national and international discourse on risk and crisis communication and builds on interdisciplinary research, notably the WEXICOM project (Weather Warnings: from EXtreme Event Information to COMmunication and Action). The program benefits from continuous exchange with a wide range of international meteorological services, including the National Oceanic and Atmospheric Administration (NOAA), MeteoAlarm, GeoSphere Austria, the Royal Netherlands Meteorological Institute (KNMI), UK Met Office, and MeteoSwiss.

RainBoW is actively represented in international working groups on warning communication and impact-based forecasting and contributes to joint learning through recurring conferences and training initiatives such as the EMS Annual Meeting, the International Conference on Risk Information Management, Risk Models and Applications (RIMMA), and the EUMA Winter School.

This broad engagement ensures that developments are grounded in international best practice while remaining tailored to the German context.

ISSN: 3068-6539

© 2025 Copyright is held by the owner/author(s).

Publication rights are licensed to ICRC.

<https://doi.org/10.69931/001c.142842>

The devastating 2021 flood in the Ahr Valley has become a widely recognized example of why warnings must not only be timely and accurate, but also accessible, understandable, and actionable. The event highlighted critical gaps in communication structures and spurred new collaborative efforts, including a co-design project between DWD and regional flood forecasting centers aimed at improving multi-level warning communication. Another key initiative in this context is the development of the Natural Hazards Portal (Naturgefahrenportal, NGP), which seeks to standardize and harmonize risk information across Germany to support clearer and more effective public communication [2, 3].

RainBoW contributes to these broader efforts by focusing specifically on enhancing meteorological warning communication. Its approach integrates modular system design with interdisciplinary research and iterative feedback from operational practice.

## APPROACH AND METHODOLOGY

RainBoW follows a modular development structure, combining operational expertise with interdisciplinary research. The program strives to combine scientific rigor with practical testing in operational environments, while acknowledging that pragmatic decisions are sometimes necessary due to inherent uncertainties and knowledge gaps. RainBoW's communication strategy builds on key principles of effective risk communication—clarity, relevance, empathy, and trust—which serve as normative orientation for the development of user-centered warning products (e.g., [4], [5]).

These principles guide the program's efforts to design warnings that are not only accurate but also understandable, emotionally resonant, and credible across diverse user groups.

Prototypes of warning products will be tested through surveys, interviews, and co-design formats. Crowdsourced data from the WarnWetter app will serve as an additional basis for refining impact proxies. RainBoW also conducts experiments with users to explore alternative message designs. Collaborations with universities and research institutions enable structured evaluations of terminology, visual presentation, and the sequencing of warning messages.

## KEY INNOVATIONS

The RainBoW program is working towards a more user-centered warning strategy that aligns meteorological information more closely with societal and individual needs. The overarching goal is to strengthen people's ability to make informed decisions in the face of weather and climate-related risks. To that end, RainBoW is pursuing a set of interrelated objectives:

- Enhancing comprehensibility by simplifying the warning criteria within each hazard type and by introducing a standardized three-level system across different warning elements to ensure greater consistency and reduce complexity.
- Extending the forecast horizon through seamless warning management—from immediate alerts to seven-day trends—incorporating probability information.
- Enabling individualization by developing a configurable system that delivers warnings tailored to the specific needs and contexts of different user groups.
- Integrating impact information to support users in assessing risk more accurately, considering local exposure and vulnerability.

To support this development, impact definitions have been formalized in a dedicated glossary. These clarify how meteorological phenomena may affect people, infrastructure, and the environment—often with spatial or temporal distance from the actual hazard.

Within this evolving framework, RainBoW explores a range of potential innovations aimed at better aligning weather warnings with user needs:

- A uniform three-level warning hierarchy that merges similar hazards and reduces system complexity, informed by international practice.
- Temporal warning phases that segment the warning timeline into 'Warning Prognosis', 'Preliminary Information', 'Warning', and 'Acute Warning'. These phases help the public track the evolution of forecasts and align protective actions with increasing certainty.
- Return periods serve as proxies for impact severity by conveying the statistical rarity of events through standardized, intuitive language. This approach is currently planned for gusts and rainfall warnings. The phrasing is currently under development and will be empirically validated in upcoming studies.
- Crowdsourcing through the WarnWetter app provides real-time user data (1,000–4,000 reports/day) which can be used to validate model performance and refine warning thresholds. Early observations regarding wind gusts and reported impacts point to useful research directions.
- The individualization of warning information is being developed through a new prototype warning portal, which aims to allow users to set personalized thresholds, confidence levels, and spatial filters. This concept is particularly relevant for institutional and professional users.

## DISCUSSION

RainBoW operationalizes a gradual shift from purely hazard-based to more impact- and risk-informed communication. While meteorological thresholds remain the decisive basis for issuing warnings, future developments aim to supplement

warnings with contextual information on exposure and vulnerability where appropriate. This approach is conceptually aligned with the Impact-Based Forecasting and Warning (IBFW) framework promoted by the World Meteorological Organization.

Communicating uncertainty remains a critical challenge. Terms such as 'Prewarning' or 'Warning Trend' must be precise, intuitive, and culturally appropriate. Likewise, return period classifications must strike a balance between informativeness and realism. Depending on the use case, RainBoW explores the use of qualitative, standardized wording as an alternative to numerical precision—particularly where forecast uncertainty is high.

Testing is central to the approach. As highlighted at RIMMA 2025, neither expert intuition nor public instinct reliably predicts message effectiveness. Only empirical evaluation reveals what works. By incorporating testing and user feedback into successive development steps, RainBoW aims to ensure that warning formats are continuously improved and meet practical needs.

## CONCLUSION

The RainBoW program represents an important step toward future-ready warning systems. With its emphasis on simplification, clarity, and user engagement, it contributes to a new generation of risk communication practices. Key challenges moving forward include refining terminology through user testing, maintaining continuous dialogue with different user groups, and translating conceptual innovations into scalable operational systems. By putting users and impacts at the center of warning design, RainBoW seeks to build a more resilient, better-informed society.

## Authors Biography

Dinah Kristin Leschzyk, PhD and postdoctoral degree (habilitation) in Linguistics, Justus Liebig University Giessen; Socioeconomist at the Deutscher Wetterdienst (DWD), Business Area Weather Forecasting Services, [dinah-kristin.leschzyk@dwd.de](mailto:dinah-kristin.leschzyk@dwd.de).

Bodo Erhardt, Master of Disaster Management and Risk Governance, University of Bonn; Deutscher Wetterdienst (DWD), Business Area Weather Forecasting Services, [bodo.erhardt@dwd.de](mailto:bodo.erhardt@dwd.de).

Kathrin Feige, PhD in Computer Science (RPTU Kaiserslautern); Coordinator of the RainBoW program at the Deutscher Wetterdienst (DWD), Business Area Weather Forecasting Services, [kathrin.feige@dwd.de](mailto:kathrin.feige@dwd.de).

Andreas Lambert, PhD in Earth Sciences, University Hamburg; Deutscher Wetterdienst (DWD), Business Area Weather Forecasting Services, [andreas.lambert@dwd.de](mailto:andreas.lambert@dwd.de).

## REFERENCES

- [1] Schulze, K., & Voss, M. (2023). *Wetterwarnungen wirksamer gestalten: Vorschläge für den Deutschen Wetterdienst basierend auf Erkenntnissen aus WEXICOM III*. KFS Arbeitsmaterial Nr. 07. Katastrophenforschungsstelle, Berlin. <https://doi.org/10.17169/refubium-41167>.
- [2] Deutscher Wetterdienst (DWD). (2025). *Naturgefahrenportal (NGP)*. Retrieved April 28, 2025, from <https://www.naturgefahrenportal.de/en>.
- [3] Erhardt, B., Brendel, C., Hafer, M., Haller, M., Koziar, C., Lengfeld, K., Leschzyk, D. K., Rauthe-Schöch, A., Riede, H., & Walawender, E. (2025). *From Information to Action: Standardizing and Harmonizing Warnings in Germany's Natural Hazards Portal for Effective Public Communication*. Abstracts of the International Cartographic Association, 9, 10. <https://doi.org/10.5194/ica-abs-9-10-2025>.
- [4] Grice, H. P. (1989). *Logic and conversation*. In P. Cole & J. L. Morgan (Eds.), *Studies in syntax and semantics: Vol. 3. Speech acts* (pp. 41–58). Boston, MA: Academic Press. (Original work published 1975)
- [5] Renn, O. (2019). *Krisenkommunikation und Risikodialog: Strategien für eine rationalere Kommunikation in Krisensituationen*. Wiesbaden: Springer VS. <https://doi.org/10.1007/978-3-658-25779-8>.