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# Editorial: New approaches to local climate change risk analysis

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## Editorial on the Research Topic

### New approaches to local climate change risk analysis

This special Research Topic presents results from the project «Unpacking climate impact chains: A new generation of action- and user-oriented climate change risk assessments» (UNCHAIN) consisting of 11 local cases in seven European countries (cf. [Figure 1](#)). The overall objective of the UNCHAIN project was to improve climate change risk assessment frameworks aimed at informed decision-making and adaptation action. The research approach was based on the existing concepts of Impact Chain ([Fritzsche et al., 2014](#)) and insights from practices on the co-production of knowledge ([Dannevig and Aall, 2015](#)).

Despite the increasing sophistication of climate projections, their translation into adaptation decisions and actions is often not optimal ([Klein and Juhola, 2014](#)). The primary barrier is that climate information providers frequently lack a full understanding of the contexts in which the decisions they aim to inform are being made ([McNie, 2007](#); [Klein and Juhola, 2014](#)). Even when climate information is available, barriers to its accessibility and effective utilization in decision-making persist, a phenomenon often referred to as the “usability gap” ([Lemos et al., 2012](#)). The prevailing inability of existing climate information to catalyze the necessary policy and action ([Daniels et al., 2020](#)) has spurred a growing body of scholarship on how scientific knowledge production should be conducted to better inform policymaking and facilitate climate change action ([Gerger Swartling et al., 2019](#)). A fundamental lesson from this body of work underscores the importance of how climate change knowledge is generated, communicated, translated, and customized to align with the requirements of users ([Chiputwa et al., 2020](#)). While substantial efforts have been dedicated to producing usable climate information for adaptation and other interconnected human-environmental issues, climate services have often been skewed toward a supply-based perspective ([Lourenço et al., 2015](#)). To bridge the current usability gap ([Lemos et al., 2012](#); [Vincent et al., 2020](#)), future models and platforms for a science-user interface on climate change risk and adaptation must mirror the complexity of real-world needs and situations faced by policymakers and practitioners vested with the authority to make policy decisions and act ([Daniels et al., 2020](#)). This necessitates a heightened focus on interaction, co-ownership, and a recognition of the dynamics of power in researcher-politics-community relationships, alongside strategies to surmount these challenges, thereby empowering all involved stakeholders to drive effective action toward a more climate resilient future.

The UNCHAIN cases highlight five research innovations presented in the project plan for UNCHAIN: (1) Societal transformation: testing approaches to capture both short and

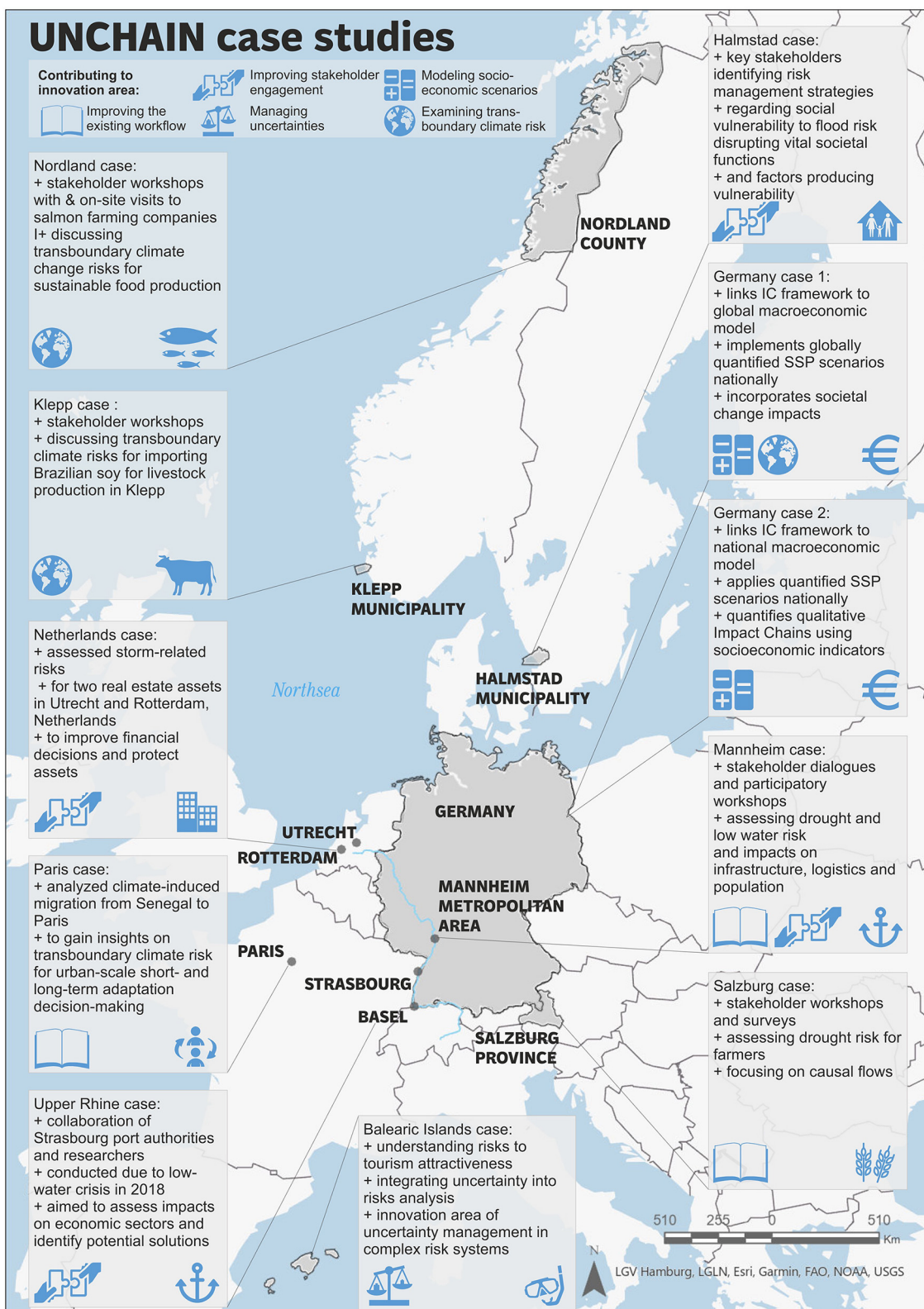


FIGURE 1 The geographical and thematic distribution of UNCHAIN case studies (Petutschnig et al.).

long-term climate change risk and adaptation; (2) Co-production: integrating participatory methods into impact modeling and adaptation assessment; (3) Incorporating societal trends into

scenario analysis: accounting for socioeconomic developments as well as climate projections in addressing societal vulnerabilities and adaptation options; (4) Addressing uncertainties: combining

qualitative and quantitative methods of impact assessment to test the Impact Chains approach; and (5) Transboundary climate risks: Expanding the logic of the impact chains approach to encompass transboundary climate risks and to link adaptation and mitigation response. Below we summarize the 11 articles of this Research Topic.

An increasing number of countries are recognizing the importance of addressing transboundary climate risks in their national adaptation policies. Aall et al. examines the potential for sub-national levels of governance addressing such risks in three case studies: Paris, France, focusing on issues related to migration and integration; Klepp, Norway, centered on agriculture and livestock production; and the river harbors in the Upper Rhine region of France, addressing concerns related to freight transportation and river regulation.

Sun and sea tourism play a pivotal role in the economies of southern European countries. This economic sector faces significant threats from climate change, including anticipated challenges such as the depletion of beaches, diminished thermal comfort, water scarcity, and extreme weather events, among other consequences. Agulles et al. illustrate an approach to evaluating climate-related risks affecting sun and sea tourism, using the case study of Mallorca.

There is a growing recognition that effective climate risk assessments greatly benefit from well-structured processes of knowledge co-production that actively involve key stakeholders and scientists. André et al. presents an improved methodology for co-producing climate services to support risk-informed decision-making and adaptation actions.

It's widely acknowledged by academia, funding agencies, and decision-makers that involving stakeholders in co-producing knowledge is essential for ensuring effective decision support. Englund, André et al. presents a Research Topic of methodological guidelines to assess co-produced climate services effectively.

When evaluating flood risk, it is crucial to extend the analysis beyond its climatic and technical aspects to encompass its differentiated impact on society. Englund, Vieira Passos et al. offers a practical example of how to quantify and map social vulnerability at a sub-municipal level in Sweden, specifically within Halmstad Municipality.

In the article titled "*Rhine low water crisis: from individual adaptation possibilities to strategic pathways*," Gobert and Rudolf discusses the unprecedented low water crisis that gripped the Rhine transport sector in 2018, rendering large cargo vessels incapable of navigating certain segments of the river. This crisis severely disrupted inland waterway transport operations.

As the climate crisis accelerates, the resilience of Europe's aging critical infrastructure systems becomes an increasingly focal concern. Lückerrath et al. introduces an innovative approach for assessing the climate vulnerability and risk within value applied in a case study set in a German metropolitan area situated along the Rhine River.

As the rail sector grapples with the unprecedented challenges posed by climate variability and change, there is a growing emphasis on generating pertinent climate data and information. Attoh et al. analyses the nature of climate risk information services required to support the rail sector's adaptation needs.

Contemporary scientific discussions surrounding the evaluation of loss and damage resulting from climate change

predominantly center on quantifiable factors. However, the spectrum of potential harm caused by climate change extends far beyond these tangible aspects, especially in the context of residual risks that surpass the limits of adaptation. Menk et al. proposes an approach for assessing the risk of loss and damage from climate change.

The use of composite indices is prevalent across various fields of knowledge. However, a recurring challenge associated with these indices is how to incorporate uncertain knowledge into their construction. Melo-Aguilar et al. propose the utilization of a probabilistic framework which enables the integration of uncertainty considerations into the computation of composite indicators.

The last contribution brings together insights across all UNCHAIN-cases and discusses advancements in the methodological toolset used in Impact Chain-based climate risk and vulnerability assessments (CRVA), and new application fields (Petutschnig et al.). The authors propose several advancements in the stakeholder engagement process, including methods to capture dynamics between risk factors, resolve contradictory worldviews of participants, uncover hidden vulnerabilities, use scenario-planning techniques, and retain consistency between Impact Chains across policy scales. Furthermore, the authors examine IC-based CRVAs' applicability to address transboundary climate risks and climate risks for industry stakeholders. They conclude that the modular structure of IC-based CRVA enabled the integration of various methodological advancements from different scientific disciplines and that, even after a decade in use, the method still offers possibilities to further its potential to understand and assess complex climate risks.

The insights garnered from the UNCHAIN project offer a solid foundation for proposing the broad implementation and ongoing refinement of the Impact Chain-based approach. This approach aims to streamline existing climate risk assessment strategies across EU member states, various levels of governance, and sectors. Furthermore, it seeks to enhance cross-border collaboration and the sharing of knowledge.

By adopting this approach, Europe can speed up the process of achieving more effective adaptation. It achieves this by enhancing comparability between countries and regions, facilitating the transfer of knowledge and best practices, reducing ambiguity related to terminology and methodology, and fostering knowledge exchange and collaborative learning.

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CA: Funding acquisition, Project administration, Writing – original draft, Writing – review & editing. ÅG: Project administration, Writing – review & editing. EA: Writing – review & editing.

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## Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships

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