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Editorial: Identifying hotspots of hydro-hazards under global change

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Editorial on the Research Topic
Identifying hotspots of hydro-hazards under global change

Hydrological hazards ("hydro-hazards") can be defined as extreme events related to phenomena phenomena of water distribution in the context of floods and droughts. Flood hazards are of water overflowing due to one or combined sources (e.g., surface, surface, sub-surface, coastal, fluvial); on the contrary, drought hazards derive from a shortage of precipitations, river flows or sub/surface water over prolonged periods (Van Loon et al., 2016). Considering the effect of climate change on global and regional weather patterns, in the future flood and drought hazards are expected to alter their nature and location (Visser-Quinn et al., 2019). Ongoing research is applying climate projections to hazard and impact assessment to determine such future trends worldwide. Projections uncertainties, modeling approaches and relative implications are now becoming measurable, due to increasing computational capability and advanced data analytics (Jafarzadegan et al., 2021; Songchon et al., 2021). However, despite such progress in regional understanding, a complete and coherent picture is still missing at global level.

Considering this hydro-climatic context, the Research Topic "*Identifying hotspots of hydro-hazards under global change*" aims to identify future hydro-hazard hotspots across the world as a result of climate change, to ultimately build a global picture. The scope of the Research Topic was within novel research focused on determining hydro-hazards, for which we suggested a number of lenses:

1. Future hotspots of changes. Where will these hazards intensify and what does that mean for underlying populations? Which spatio-temporal characteristics (e.g., seasonality, regional trends etc.) can be determined?

Böhnisch et al. developed research on hotspots and climate trends of meteorological droughts in Europe, evaluating the percent of normal index (PNI) in a single-model initial-condition large ensemble. They compared the present-day climate and a pre-industrial reference to the potential future under the Representative Concentration Pathway 8.5 (RPC8.5).

Beevers et al. identified hotspots of hydro-hazards under global change through a worldwide review. The work followed a systematic literature review, analyzing and categorizing 122 published papers. This analysis emphasized the geographical areas where changing hazards are expected (e.g., Europe for both floods and droughts), and those areas where little significant research has been carried out so far (e.g., Northern Africa).

2. Novel datasets and data analytics. What do new datasets and methods allow in the context of hydro-hazards assessment? How do they improve the understanding of future hydro-hazard trends?

Aitken et al. presented EURO-CORDEX, a multi-model ensemble fit for assessing future hydrological change. They explored the validity of the 68 chain MME flow projections by considering its capability to reproduce observed flow records (over the period 1975–2004) in the UK. The work investigated magnitude through quantile and seasonality matching by means of time-series decomposition of trends. At regional level the validation of EURO-CORDEX flow projection data enabled a wide range of applications, such as the investigation of future changes in local/national river flows.

Arrighi studied UNESCO's World Heritage sites by developing a global scale analysis of river flood risk. The analysis included 1,121 sites and showed that river floods threat 35% of natural and 21% of cultural and mixed sites. The hazard was evaluated at global scale by using river flood maps for six probabilistic scenarios; the exposure classification was obtained from the World Heritage List selection criteria; the vulnerability was developed from the site typology.

3. Decision-making. What do these hazards imply for water management, risk planning, adaptation and policy? What advances are available to reduce the risk from future hydro-hazards?

Lane and Kay investigated how the magnitude and timing of hydro-hazards across the UK are affected by climate change, adopting the latest UK Climate Projections (UKCP18) and a national grid-based hydrological model. They reflected on the implications of hydro-hazard changes in relation to national policy and decision making, for example to ensure appropriate adaptation measures.

Future directions

Across the papers within this Research Topic, one particular recurring theme arose regarding potential future research directions. Aitken et al. and Lane and Kay both advocated the use of ensemble projections in future research. By using such an approach, uncertainty can be captured and explored to examine dominant uncertainty sources in future projections. Arrighi discussed how these uncertainties need to be examined at different spatial scales, from local to regional to national. In fact, across all five of the papers there was a strong message that future research needed to capture, quantify and communicate uncertainty throughout future analyses.

Conclusions

The papers in this Research Topic showed that some progress has been advanced regarding on hydro-hazards and climate change over the last decade, e.g., by developing the percent of normal index (PNI), validating EURO-CORDEX flow projection data, analyzing flood risk for heritage places at global scales. However, more research is still necessary to investigate the geographical distribution of hydro-hazard alterations as a result of climate change. Moreover, there is a growing need for the research community to support decision makers by developing novel methods for generating data for ungauged catchments and improving methods for data-poor environments.

Author contributions

All authors listed have made a substantial, direct, and intellectual contribution to the work and approved it for publication.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's note

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