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Editorial: Extreme Events in the Developing World

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Editorial on the Research Topic

Extreme Events in the Developing World

INTRODUCTION

The frequency and/or magnitude of extreme events is changing in the context of climate change, and this is clearly projected to continue (IPCC, 2021). Extreme weather has been the top global risk in terms of likelihood in each of the last 5 years, according to the World Economic Forum's Global Risks Report (World Economic Forum, 2021). On the grounds that risk is a function of hazard, exposure and vulnerability, developing countries are disproportionately at risk. Whilst changing the nature of hazards in the short-term may be challenging, it is possible to change exposure and vulnerability, and thus reduce risk.

This Research Topic "*Extreme Events in the Developing World*" showcases a selection of articles that develop our knowledge of extreme events in the developing world. Papers range from those presenting recent evidence for and future likelihood of changes in the occurrence and exposure to extreme events, together with examples of the impacts of extreme events in a variety of sectors. Papers also consider the range of climate services responses to this challenge, highlighting the need for new types of weather and climate information, new methods of producing and communicating that information in order to reduce risk, as well as providing some key examples of success stories, with a particular focus on Africa. Our intention here is to balance some of the bad news with what might work, and how we might learn from such examples.

CHANGING NATURE OF EXTREME EVENTS

Three papers in the Research Topic focus on the changing nature of hazards, covering South America, Africa and Oceania. Looking at the changing trends in rainfall extremes in the metropolitan area of São Paulo, Marengo et al. show that there has been a change in rainfall distribution. Observed trends show an increase in extreme rainfall events over the last 60 years, particularly during summer, as well as an increase in the number of consecutive dry days. They attribute this to intensification and movement in location of the South Atlantic Subtropical Anticyclone, with implications for the transport of humidity and therefore precipitation.

Luhunga et al. analyse extreme rainfall and temperature trends based on observational records, and project this into the future. In the Kagera and Geita regions of Lake Victoria in Tanzania, there has been a statistically significant increasing trend in temperature and numbers of warm days and warm nights, whilst the numbers of cold days and cold nights have decreased significantly.

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Based on modeling under two different Representative Concentration Pathways, temperature increase is projected to continue, as is an increase in rainfall.

Sabunas et al. consider how climate change is projected to affect storm surge and sea level rise around Vitu Levu, Fiji. They find differential levels of exposure to flooding and inundation considering the topography of Fiji, where exposure is highest in areas affected by the western wind direction, and in flat areas.

IMPACTS OF EXTREME EVENTS

The changing nature of extreme events has implications for developing countries, affecting their vulnerability and adaptive capacity. Msemo et al. analyse the socio-economic costs of weather impacts in Tanzania. Between 2000 and 2019 severe weather accounted for just over two thirds of disasters in Tanzania, destroying over 35,700 houses and 1,000 examples of critical infrastructure (roads, bridges, schools, and hospitals), affecting 572,600 people and requiring the government to spend over $20.5 million in response.

Henriksson et al. take a longitudinal approach to explore the adaptive capacity of sugarcane contract farming schemes in Malawi. As well as noting differences in the composition of adaptive capacity between two schemes, they also highlight how adaptive capacity is eroded after exposure to a hazard. This increases risk of negative impacts from future events, particularly in the context of increasing frequency of exposure, which has already been highlighted as a key risk (Funk, 2020).

IMPROVING CLIMATE SERVICES AND EARLY WARNING SYSTEMS FOR DISASTER RISK REDUCTION

In this context of increasing hazard and exposure, improving climate services and early warning systems is essential to enable disaster risk reduction. Papers in this Research Topic highlight opportunities for plugging data gaps and ensuring interoperability, generating new climate services and ensuring improved communication for uptake by decision makers.

Plugging or addressing data gaps is an important need for many developing countries, where incomplete observational records impede modeling and forecasting capacity. Landman et al. show how the extended records of rainfall data recorded by farmers at their properties in South Africa and Namibia enable development of farm-specific forecasts. In this way, additional data enables more localized tailoring of forecast information.

Oftentimes data is available, but is not necessarily accessible. This is particularly the case for extreme events and disasters, when such data is curated by different actors who may not formerly have collaborated. To overcome the issues of interoperability and lack of standardization, Davis-Reddy and Hilgart propose an open-access system for national hazard events in South Africa. Their database is based on a standardized, scalable design method that can be used to improve data collection and enable reporting that fulfills the mandate of South Africa's National Disaster Management Framework.

As well as more data, translating available data into more decision-relevant products increases its useability in risk reduction. Conventional weather forecasts focus on meteorological thresholds for extreme events, when it is the likelihood and potential severity of weather impacts that is more useful for decision makers. New and emerging information types are outlined in papers covering west and southern Africa. Impact-based forecasts that focus on storms, droughts and heatwaves have been developed in Ghana, Nigeria, and Senegal, as outlined by Nkiaka et al.

Two papers focus on examples from Malawi where there is potential to improve decision-relevant early warning. The findings of Calvel et al. show that early warning systems for slow-onset extreme events such as drought can be effective in triggering early warning and enabling better disaster preparedness. With the intention of improving the useability of seasonal forecast information for maize farming, Mittal et al. identified specific agro-climatic indices where temperature and rainfall thresholds were associated with different phenological stages of maize growth. As yet, the forecast skill of the UK Met Office's coupled initialized global seasonal forecasting system (GloSea5) over Malawi remains too low to provide confident predictions of total wet season rainfall and the agro-climatic indices correlated with it—but this represents a focus area for further development of models to enhance forecast skill.

In addition to generating more decision-relevant climate services, it is important to ensure effective communication to ensure it is available and accessible to relevant decision makers (Findlater et al., 2021). In their paper that undertakes a systematic review of literature in Kenya, Muita et al. find that there are differences in accessibility to, and use of, seasonal to sub-seasonal forecasts among crop farmers, pastoralists and agro-pastoralists on the basis of gender, availability of resources and mode of communication.

Ensuring effective communication of climate services is essential to ensure effective use in risk reduction, as addressed by many of the papers. Effective communication requires understanding the decision contexts and needs of users so as to be able to meet them. In Tanzania, Msemo et al. highlight a need to better understand the value of weather warning information at short timescales (1–5 days) and how this information can be better used in the individual decision-making processes of those receiving advisories and warnings. In West Africa, Nkiaka et al. highlight that increasing uptake of climate services will require the national meteorological and hydrological services to improve communication channels with user communities, as well as developing impact-based forecasts. In Malawi, Calvel et al. highlighted the need for drought early warning to be people-centered and timely and tailored to agricultural decision making, as well as provided through several channels.

Effective communication of climate services and early warning information often requires novel partnerships and greater collaboration between producers and users. In Kenya, Muita et al. recommend engagements with producers in the development and evaluation of forecast products and communication pathways to improve uptake and use of forecasts in decision-making. In Malawi, Mkwambisi et al. highlight that

conservation agriculture can be an effective adaptation strategy for dry conditions, but that in the 2015/16 El Niño drought farmers were reluctant to use seasonal weather forecasts, even though they had access to them. They recommend that extension agents should be encouraged to advise on what techniques, or farm system actions, can be used to respond effectively to seasonal to sub-seasonal forecasts. Recognizing that an enabling policy framework might support more effective generation, communication and use of climate services and early warning information, both Nkiaka et al. and Msemo et al. recommend a review of policies, and the establishment of a National Framework for Climate Services (e.g., Hewitt et al., 2020).

CONCLUSION

Whilst extreme events are likely to continue to change in character in the context of a changing climate, the papers in this Research Topic elaborate that the extent of negative impacts can be minimized through the locally-appropriate use of new knowledge and warning systems. There have been significant improvements in scientific capacity to predict extreme events, and to project the changes in climate in which such extreme events occur. At the same time, there has been growth in the field of climate services, which is concerned with generation and effective communication of decision-relevant information that enables people and society to reduce the risk of extreme events. The empirical findings from across the range of case study insights in this Research Topic demonstrate that improving information availability and communication systems has the potential to reduce the risk of extreme events translating into negative impacts for developing countries.

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