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Editorial: Citizen Science: Reducing Risk and Building Resilience to Natural Hazards

Jonathan D. Paul[1]*, *David M. Hannah*[2] and *Wei Liu*[3]

[1] Department of Civil and Environmental Engineering, Imperial College London, London, United Kingdom, [2] School of Geography, Earth and Environmental Sciences, University of Birmingham, Birmingham, United Kingdom, [3] International Institute for Applied Systems Analysis, Laxenburg, Austria

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Editorial on the Research Topic

Citizen Science: Reducing Risk and Building Resilience to Natural Hazards

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Carmine Galasso, University College London, United Kingdom

***Correspondence:**
Jonathan D. Paul
jdp06@ic.ac.uk

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RATIONALE

Natural hazards are becoming increasingly frequent within the context of climate change—making reducing risk and building resilience against these hazards more crucial than ever. An emerging shift has been noted from broad-scale, top-down risk and resilience assessments toward more participatory, community-based, bottom-up approaches. Arguably, non-scientist local stakeholders have always played an important role in risk knowledge management and resilience building. Rapidly developing information and communication technologies such as the Internet, smartphones, and social media have already demonstrated their sizeable potential to make knowledge creation more multidirectional, decentralized, diverse, and inclusive (Paul et al., 2018). Combined with technologies for robust and low-cost sensor networks, various citizen science approaches have emerged recently (e.g., Haklay, 2012; Paul et al., 2018) as a promising direction in the provision of extensive, real-time information for risk management (as well as improving data provision in data-scarce regions). It can serve as a means of educating and empowering communities and stakeholders that are bypassed by more traditional knowledge generation processes.

This Research Topic compiles 13 contributions that interrogate the manifold ways in which citizen science has been interpreted to reduce risk against hazards that are (i) water-related (i.e., floods, hurricanes, drought, landslides); (ii) deep-earth-related (i.e., earthquakes and volcanoes); and (iii) responding to global environmental change such as sea-level rise. We have sought to analyse the particular failures and successes of natural hazards-related citizen science projects: the objective is to obtain a clearer understanding of "best practice" in a citizen science context.

HYDROLOGICAL HAZARDS

See notes a major gap in the literature regarding the contribution of citizen science to pluvial flooding. Her article reviews the role of crowdsourced data in flood early-warning systems (EWS) and in the development and validation of forecasting models; such data have the potential to yield greatly enhanced resilience at the community level. If pre- and post-flood applications were integrated, developments in one could benefit the other, e.g., technological innovation in flood reporting apps and automated flood detection systems will yield data useful for model validation.

The validity of citizen science approaches to expand the shrinking observational database is becoming increasingly apparent: Lowry et al. and Seibert et al. detail two projects that seek to increase the number of observations of water level and (indirectly) streamflow, respectively. Established in 2010, the CrowdHydrology network of Lowry et al. has recently expanded to a national scope, involving a huge database of river and lake level data sent via text messages. The relatively early genesis of this project has allowed the authors to draw useful conclusions regarding the highly variable contribution rates of citizen scientists, while also offering reasons for potential barriers to participation, and suggestions as to the best ways to expand a citizen science network sustainably.

By contrast, public engagement in streamflow observations has, so far, been limited. Seibert et al. discuss this difference in terms of the relative complexity of data and instrumentation needed. As a means of obviating this complexity, the authors present a smartphone app—a virtual staff gauge—that allows stream level to be estimated, as an alternative approach. While the degree of uptake was encouraging, certain “birthing problems” were encountered, the discussion of which will benefit workers involved in the development and deployment of new smartphone apps.

Two further hydrology-flavored papers propose more general methodologies for citizen-led data collection and knowledge co-production. Witkop et al. provide a new framework to incorporate the knowledge of emergency managers into the hazard modeling process. In essence, the purpose is to enable local experts to contribute actionable knowledge to otherwise “black box” numerical modeling approaches. This framework—involving semi-structured interviews and participatory mapping—can usefully be combined with climate models to assess potential hazard consequences; in their case study, for hurricanes on the eastern US seaboard.

Similarly, Cieslik et al. argue for the immediate inclusion of indigenous knowledge in the co-production of knowledge: specifically in generating and supporting resilience to landslides in western Nepal. Cieslik et al. propose a new typology of citizen science interventions (in hydrology and beyond), distinguishing between community science, participatory environmental monitoring and virtual citizen science, and provide examples of how they can benefit stakeholders at different levels and/or different types of research.

GEOPHYSICAL HAZARDS

Geohazards like earthquakes and volcanic eruptions have rich potential to be monitored and reported upon using recent technological innovations, like the accelerometers present in most smartphones. Through their presentation of the MyShake global platform, Rochford et al. contribute one of the largest examples in terms of datapoints of a citizen science project in the special issue. They discuss the components of the platform, which includes both ground shaking data and qualitative descriptions of users’ experiences, with the goal of reducing earthquake risk and enhancing environmental awareness. The authors discuss barriers to, and successes of, continuing participation, including an interrogation of the iterative process of re-designing the platform in response to users’ views from interviews and surveys.

In Taiwan, Liang et al. describe a similar yet more localized system, where non-scientists are actively encouraged to visit the epicentral area of an earthquake when safe, to document variations in ground damage via text and smartphone image upload. This platform also serves as a means of passively sharing educational materials (e.g., geological maps) to the volunteers.

Moving away from specific platforms, Navakanesh et al. focus in greater detail on enhancing situational awareness (rather than participatory monitoring). Citing a disconnect between subjective perception and scientific knowledge of earthquake hazard in a region of Malaysia, the authors describe a process of integrating stories from earthquake victims with updated scientific data, culminating in a documentary movie that is used to educate affected communities about the causes and nature of earthquake hazards.

Shah et al. agree that emphasis should be shifted to local preparedness from prediction, in the case of earthquakes and flooding in Jammu and Kashmir. Similar to the findings of Navakanesh et al., these authors identify an urgent need to educate local students and community leaders about the science and mitigation of natural hazards. They propose a framework involving a series of workshops, training sessions, public talks, and international conferences.

GLOBAL ENVIRONMENTAL CHANGE

Our final four contributions do not focus on particular case studies or hazards; rather, they interrogate the use and usefulness of citizen science approaches in the context of global environmental change. Hicks et al. conduct a systematic mapping of 106 citizen science projects in the realm of disaster risk reduction (DRR). Analyzing the effectiveness of each example, they underline the importance of building connections between different methods of citizen science and practitioners; and of ensuring both scientific rigor and attending to questions of responsibility, empowerment, and equity of those most vulnerable to disaster risk.

Marchezini et al. review projects that directly link a citizen science component to hazard EWS (people-centered or participatory EWS). Importantly, they identify a gap in the literature between citizen science and disaster prevention: most effort has been concentrated on developing new technologies, platforms, and methodologies, rather than understanding the livelihoods of non-scientist stakeholders, or elucidating ways of better engaging them. The authors provide a social science framework to bridge the gap between citizen science and participatory EWS globally.

Becker and Kretsch and Haworth et al. both focus on resilience building. Becker and Kretsch stress the difficulty in securing resilience investment against the effects of climate change on coastal communities. In a diverse group of stakeholders, conflicting perceptions of leadership responsibility must be reconciled; else, they contribute to an institutional void, which impedes long-term planning efforts. In contrast, Haworth et al. discuss the emergence of volunteered geographic information (VGI) and its role in changing the nature of community involvement in DRR and resilience building. They present a nuanced picture in which VGI and social media have the potential to undermine resilience (e.g., compromised privacy and highly variable data quality). In conclusion, training individuals in the use of VGI in DRR will foster greater inclusivity, reliability, and complementarity with scientifically generated datasets.

AUTHOR CONTRIBUTIONS

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

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