Editorial: Citizen science and climate services in cities: current state, new approaches and future avenues for enhancing urban climate resilience

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Editorial on the Research Topic
Citizen science and climate services in cities: current state, new approaches and future avenues for enhancing urban climate resilience

The increasing impacts of climate change, coupled with the growing urban population, require enhancing the climate resilience of urban areas. As explained by Koedel et al., a diverse array of stakeholders significantly influences life and development in urban areas. In particular, citizen engagement and co-design between various stakeholders, such as representatives from public administration, citizen groups, community organizations, advocacy groups, academic institutions, and industry partners, involving the equitable sharing of power and resources, has the potential to drive transformative societal change.

The introduction of advanced interactive technologies in climate monitoring efforts provides innovative, bottom-up, and community-driven strategies improving urban climate resilience. Crowdsourcing and citizen sensing campaigns enable citizens to observe, collect, and share local data on climate events, conditions, and impacts. This participatory approach not only informs about the local environment, but also empowers people to more effectively mitigate climate change impacts in their immediate surroundings. Co-produced climate services for urban decision-making and adaptation efforts are increasingly recognized as a solution to progress the efficiency of climate resilience. Furthermore, citizen science plays an essential role in environmental research by involving the public in data Research Topic and analysis, thus broadening the scale and scope of scientific investigations. By democratising the scientific process, citizen science empowers non-experts, ensuring that diverse perspectives contribute to more informed and effective environmental policies. This public participation not only enriches scientific efforts but also strengthens the science-policy-society nexus by enhancing

community involvement in policy development. This highlights citizen science's significant impact on advancing environmental research and democratization.

This Research Topic, "*Citizen science and climate services in cities: current state, new approaches and future avenues for enhancing urban climate resilience*", aims to establish this Research Topic as a landmark in the scientific literature, illustrating the potential, challenges, and opportunities of citizen science in urban climate services. The Research Topic falls within diverse scientific communities and articles for this Research Topic have been sourced from three discipline-specific journals: Frontiers in Environmental Science, Frontiers in Earth Science, and Frontiers in Ecology and Evolution. This demonstrates the broad utility and potential of citizen science methodologies. Articles explore the role of citizen science in urban climate service development, future potential of citizen sensing, and issues of democracy and inclusion, while critically evaluating stakeholder selection processes and the link between citizen science data and official data sources.

The opinion article "Issues of democratization in citizen science for urban climate services" by Strähle and Urban underlines the need to address unbalanced influence when integrating citizen science into climate services, in order to promote democracy and inclusion. To avoid instrumentalisation, it is important to assess and mitigate stakeholder interests. Citizen science has the potential to improve climate conditions in poorer areas; however, without proper safeguards, it can intensify inequalities, benefit property owners, and promote gentrification. While citizen science research can positively influence individuals' livelihoods and political opinions, unbalanced influence may undermine the overall effectiveness of climate services. Hence, the authors suggest that more thoughtful approaches are needed to amplify citizens' voices in research and policy-making.

The authors of "Localizing the Sustainable Development Goals in Smart and Sustainable Cities: How can citizen-generated data support local monitoring of the Sustainable Development Goals (SDGs)? A case study of the Brussels Capital Region" (Borghys et al.) emphasise the lack of reliable, timely, actionable and accessible information in traditional data sources for measuring Sustainable Development Goals (SDG) performance and explores the potential of citizen-generated data improving local environmental sustainability in the Brussels Capital Region. The article discusses the use of citizen-generated data for selected environmental SDGs and their indicators, and describes how citizen science initiatives can be better integrated into the local SDG monitoring. It offers local stakeholders, particularly policymakers, valuable insights on overcoming barriers to integrating citizen-generated data into local SDG monitoring of environmental indicators.

The paper "Assessment and simulation of thermal environments in Taiyuan urban built-up area, China" (Qiao et al.) presents a study serving as a reference for regulating the regional thermal environment, optimizing land cover patterns, and supporting the planning and construction of urban green spaces in Taiyuan, China. The simulation results show numerous hot and cold spots representing a high spatial heterogeneity in the built-up area. This case study exemplifies an opportunity for citizen environmental sensing to deepen our understanding of microclimate variability in urban domains.

In the paper by Graf "Building and maintaining a volunteer community: experiences of an image archive", the ETH Library's

image archive is described as having utilized volunteer expertise for over 15 years to identify, correct, and enhance images, yielding positive outcomes. Benefits include improved metadata quality, reduced costs and time for indexing images, and increased outreach and awareness. However, challenges remain in finding enthusiastic participants, maintaining a lasting community, and establishing quality assurance. Ensuring metadata accuracy from volunteers requires training, guidance, and a collaborative environment. The paper discusses practical experiences, offers tips and outlines "do's and don'ts" of crowdsourcing. Learnings from this paper can be applied to the crowdsourcing of urban climate data, such as historical weather records or amateur weather station data.

The article "Enhancing citizen science impact in environmental monitoring: Targeted engagement strategies with stakeholder groups" (Koedel et al.) suggests business marketing strategies such as stakeholder analysis, value proposition canvas, and key performance indicators to be implemented in citizen science projects in order to improve recruitment, retention, project management, and evaluation. The proposed marketing approach was demonstrated in a case study focused on collecting mobile urban climate data. The results demonstrate the potential of this approach, equipping project coordinators with a toolkit to enhance the success of citizen science projects.

In summary, the articles presented here provide meaningful insights into the potential of citizen science to enhance urban climate resilience. Given the significance of this topic and the promise of citizen science, further research and publications in this area are highly anticipated. In closing, we extend our sincere thanks to all the authors who have contributed their valuable papers to this Research Topic, enriching its content with diverse perspectives and insightful experiences.

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