frontiers | Frontiers in Climate

EDITORIAL
published: 23 June 2022
doi: 10.3389/fclim.2022.943534

Editorial: Open Citizen Science Data and Methods

Carolynne Hultquist[1], *Alex de Sherbinin*[1]*, *Anne Bowser*[2] *and Sven Schade*[3]

[1] *Center for International Earth Science Information Network (CIESIN), Columbia Climate School, Columbia University, Palisades, NY, United States,* [2] *NatureServe, Arlington, VA, United States,* [3] *Joint Research Centre, European Commission, Lombardia, Italy*

Keywords: citizen science, research methods, FAIR data, data validation, data management

Editorial on the Research Topic

Open Citizen Science Data and Methods

This Research Topic was launched on April 22nd, 2020, the 50th anniversary of Earth Day, in alignment with the Earth Challenge 2020 initiative. It provides a collection of articles that aim to advance the broader open science agenda by facilitating academic inquiry into open, and findable, accessible, interoperable, and reusable (FAIR; Wilkinson et al., 2016) citizen science data.

Citizen science is a historic paradigm that is growing in importance. It is an approach to science that involves members of the public in voluntarily contributing to the scientific research process, including by asking research questions, collecting data, and/or analyzing and applying results. While citizen science projects can be initiated with a range of goals and outcomes in mind, what distinguishes citizen science from related paradigms—such as Volunteered Geographic Information (VGI), or crowdsourcing—is the emphasis on scientific research. As with other forms of scientific research, citizen science is a multi-disciplinary and increasingly a trans-disciplinary practice.

The articles in this special issue explore key considerations related to the pursuit of strong scientific outcomes, primarily by offering a dedicated platform for discussing both research methodologies (including quality assurance and quality control (QA/QC) practices), and the datasets that result from citizen science research. While not all citizen science can also be considered open science, the vast majority of the articles in this Research Topic bridge both domains. All *Frontiers* titles are offered as open access publications. *Frontiers* also supports open data, including through issuing Digital Object Identifiers (DOIs) to datasets as part of certain publication processes.

This collection contains different types of articles, which are all peer-reviewed. *Methods papers* include those works that describe data collection processes, QA/QC management plans, and other strategies used to produce high-quality citizen science data and research (Paul et al., Herodotou et al., Diviacco et al., Ramírez-Andreotta et al., Moustard et al., Pudifoot et al., Turicchia et al., Kohl et al., Fischer et al.). Describing the methods used in a particular research study is a common practice across scientific disciplines that can enable external parties to evaluate fitness-for-purpose or fitness-for-use of a study's data and other results. Describing methods can also support replication, increasing transparency and trust. In the context of citizen science, methods papers are also particularly beneficial for generating research frameworks that are proven to work in one particular context, and can be customized in other environments to meet local needs.

OPEN ACCESS

Edited and reviewed by:
Sirkku Juhola,
University of Helsinki, Finland

***Correspondence:**
Alex de Sherbinin
adesherbinin@ciesin.columbia.edu

Specialty section:
This article was submitted to Climate Risk Management, a section of the journal Frontiers in Climate

Received: *13 May 2022*
Accepted: *25 May 2022*
Published: *23 June 2022*

Citation:
Hultquist C, de Sherbinin A, Bowser A and Schade S (2022) Editorial: Open Citizen Science Data and Methods. Front. Clim. 4:943534. doi: 10.3389/fclim.2022.943534

A second type of publication, *data reports*, document existing citizen science datasets and provide context to facilitate re-use of the data for scientific purposes (Bonter and Greig, Turicchia et al., Low et al., Carlson et al.). These papers demonstrate concrete alignment between citizen science and broader open science agendas through emphasis on open data. This collection also includes publications that showcase the results of original research that relies on citizen science data in analysis (George et al., Marlowe et al., Bailey et al., Moyo et al., Castell et al., Nuje et al., Møller et al.).

Finally, this Research Topic offers curated *perspectives* on topics including why citizen science data is so important (de Sherbinin et al.), which power dynamics arise at the nexus of citizen science and other open science agendas (Cooper et al.), and data quality (Downs et al.) of citizen science. These perspective pieces also include general reviews on citizen science data quality by type (Stevenson et al.) and perspectives particular to application domains, such as invasive species (Encarnção et al.).

In line with the Earth Challenge 2020 initiative, a priority of this collection is to showcase datasets related to six priority research areas: (1) air quality (Pudifoot et al., Rubio-Iglesias et al., Castell et al.), (2) water quality (George et al., Diviacco et al., Bailey et al., Nuje et al.), (3) insect populations (Møller et al., Encarnção et al.), (4) plastics pollution (Moustard et al., Rubio-Iglesias et al.), (5) food security (Moyo et al., Ramírez-Andreotta et al.), and (6) climate change (Turicchia et al., Low et al., Herodotou et al., Marlowe et al., Bailey et al., Kohl et al., Pudifoot et al.). Overall, this collection also describes research projects that advance knowledge or drive decision-making in scientific disciplines ranging from oceanography (Turicchia et al., Marlowe et al., Turicchia et al.) to ecology (Fischer et al.), to plant sciences (Moyo et al.), among other disciplines. The citizen science data collections more specifically include wildlife (Fischer et al., Bonter and Greig, Turicchia et al.), biodiversity (Rubio-Iglesias et al., Herodotou et al.Møller et al.), landcover (Low et al., Kohl et al.) and green spaces (Pudifoot et al.), hazardous waste (Ramírez-Andreotta et al.), sediments (Nuje et al.), rainfall (Paul et al.), coastal reef monitoring (Turicchia et al.), and water temperature (Carlson et al., Marlowe et al.).

Collectively, these publications reveal a number of cross-cutting themes relevant to the importance of data in citizen science. Information about data quality is essential for the use of datasets. To this end, Findable, Accessible, Interoperable, and Reusable (FAIR) (Wilkinson et al., 2016) principles are guidelines to capture quality information, maximize discovery, and provide access for stakeholders (Peng et al., 2022). Papers in this collection use FAIR principles and while it can be necessary to meet privacy concerns by not having the data open, one can still meet FAIR principles with adequate description (Bailey et al., Ramírez-Andreotta et al.). When citizen science projects communicate their data management practices then data quality can be assessed by what is appropriate for the data type (Stevenson et al.). Quality assessment and quality control can help to improve data quality and offer advice for conducting research on related topics (Downs et al.). The nQuire platform was created to support data quality assurance and control for non-professionals who design their own or take part in existing investigations by providing an expert review on data quality (Herodotou et al.). Besides internal data quality, data fitness for use evaluation methods can help to improve the external quality of a dataset to address particular research or monitoring questions (Fischer et al.).

Papers in this collection also underline important social and ethical implications of citizen science activities including Collective benefit, Authority to control, Responsibility, Ethics (CARE) principles (Cooper et al.). Practices with indigenous communities used CARE principles for data governance which encouraged co-design and consent through a socio-technical approach to establish a participatory science process (Moustard et al.). The Environmental Protection Agencies (EPAs) in Europe demonstrated their use of citizen science along with engagement on best practice to encourage broader adoption for environmental monitoring and policy-making (Rubio-Iglesias et al.). Ethical environmental justice work was demonstrated through a health study that addressed challenges in integrating citizen science and social variables (Ramírez-Andreotta et al.).

This collection welcomed contributions from citizen science researchers, practitioners, and volunteers to bring a diversity of perspectives. The participants in the projects included students in primary (Castell et al.), secondary (Paul et al., Low et al.), and college (George et al.) education, scuba divers (Turicchia et al., Marlowe et al., Turicchia et al.), and indigenous communities (Moustard et al.). Some of the papers are of projects part of the NASA GLOBE program that uses a standard GLOBE Observer (GO) mobile application (Low et al., Kohl et al.) while others use mobile applications developed for their use (Turicchia et al., George et al., Bonter and Greig, Bailey et al., Moustard et al.). Projects collected data through records from visual observation (Bonter and Greig, Møller et al., George et al., Turicchia et al.), sensors (Carlson et al., Diviacco et al.), and image collection (George et al., Low et al., Herodotou et al., Bailey et al.). Many projects perform direct physical environmental sampling using only simple collection devices (Paul et al., Castell et al., Nuje et al., Moustard et al.), and some also involved laboratory analysis in the study (Pudifoot et al.). In addition, through a spatial and temporal sampling approach for citizen science it was demonstrated that standardized data can be produced (Moustard et al.).

At the time of writing, the Research Topic on Citizen Science Data and Methods is not open for submission anymore. Moving forward, the editors believe that research conducted using citizen science methodologies should be published in appropriate disciplinary journals, including through the *Frontiers* journals that published the articles associated with this Research Topic. We encourage journals to consider submissions that use citizen science methodologies as scientific contributions to their fields on equal footing with research conducted through more traditional scientific methods. We believe that research on how to conduct citizen science is perhaps most appropriate to publish in journals such as *Citizen Science: Theory and Practice*, or through titles that focus on outcomes of citizen science that include

(for example) enhanced public education or understanding of science.

AUTHOR CONTRIBUTIONS

CH reviewed the articles in the Research Topic and provided an initial summary. AS, AB, and SS co-edited the Research Topic and provided an analysis of how these articles fit within and help advance the fields of citizen science and open science. All authors contributed to the article and approved the submitted version.

FUNDING

CH and AS acknowledge funding from NASA contract 80GSFC18C0111 for the continued operation of the Socioeconomic Data and Applications Center (SEDAC).

REFERENCES

Peng, G., Lacagnina, C., Downs, R. R., Ganske, A., Ramapriyan, H., Ivánová, I., et al. (2022). Global community guidelines for documenting, sharing, and reusing quality information of individual digital datasets. *Data Sci. J.* 21, 1–20. doi: 10.5334/dsj-2022-008

Wilkinson, M. D., Dumontier, M., Aalbersberg, I. J., Appleton, G., Axton, M., Baak, A., et al. (2016). The FAIR guiding principles for scientific data management and stewardship. *Sci. Data* 3:160018. doi: 10.1038/sdata.2016.18

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: All claims expressed in this article are solely those of the authors and do not necessarily represent those of their affiliated organizations, or those of the publisher, the editors and the reviewers. Any product that may be evaluated in this article, or claim that may be made by its manufacturer, is not guaranteed or endorsed by the publisher.

Copyright © 2022 Hultquist, de Sherbinin, Bowser and Schade. This is an open-access article distributed under the terms of the Creative Commons Attribution License (CC BY). The use, distribution or reproduction in other forums is permitted, provided the original author(s) and the copyright owner(s) are credited and that the original publication in this journal is cited, in accordance with accepted academic practice. No use, distribution or reproduction is permitted which does not comply with these terms.