

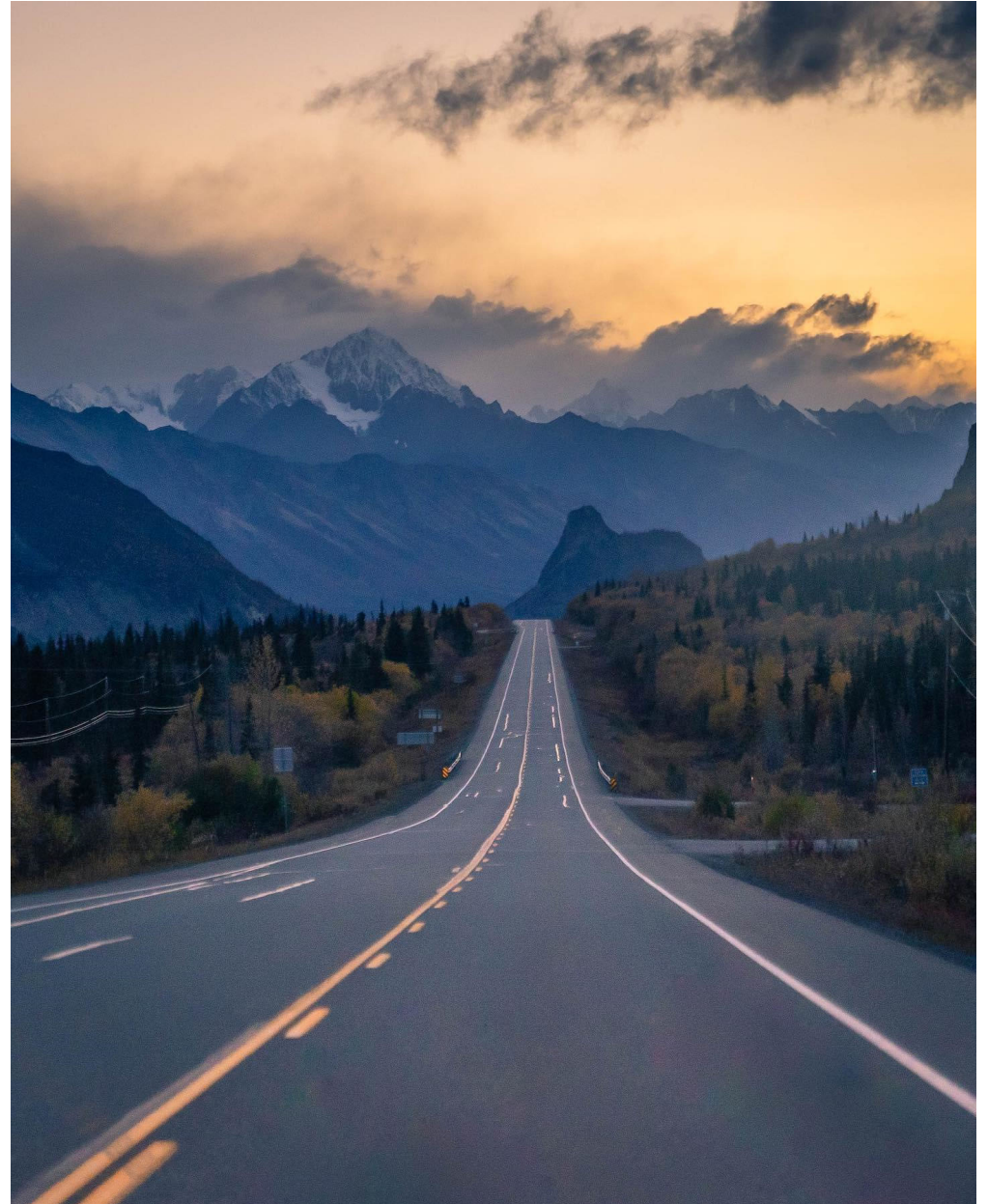
# Citizen Science Primer



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# Topics

1. What is citizen science?
2. What is driving it?
3. What role does it play?
4. Potential impact on state agencies and regulated entities?
5. Potential concerns?
6. Agency response?
7. Ongoing EPA citizen science projects
8. Takeaways





# What is citizen science?



*Citizen science* is the involvement of the public in scientific research.<sup>3</sup> This activity includes gathering, analyzing, and sharing environmentally related scientific information, often obtained through advanced monitoring (increasingly through the use of new, lower-cost technologies that are deployed by organizations or individuals other than governments or regulated companies). It can take many forms, ranging from projects led by professional scientists in institutions (*contributory* citizen science),<sup>4</sup> to community-led efforts that orient toward community goals (*community science*, *community citizen science*, or *collegial* programs),<sup>5</sup> and many variations in between.



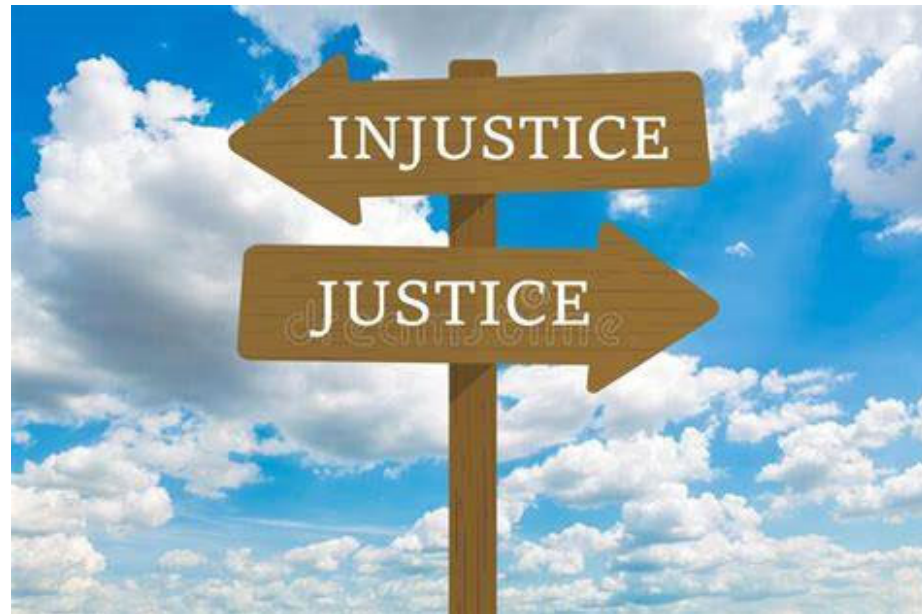
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# What is driving citizen science?

Many citizen science organizations say that the desire to impact government motivates their work,<sup>26</sup> and many citizen science project volunteers are motivated by the impact and relevance—or potential impact and relevance—of their efforts.<sup>27</sup> A recent emphasis in citizen science on the

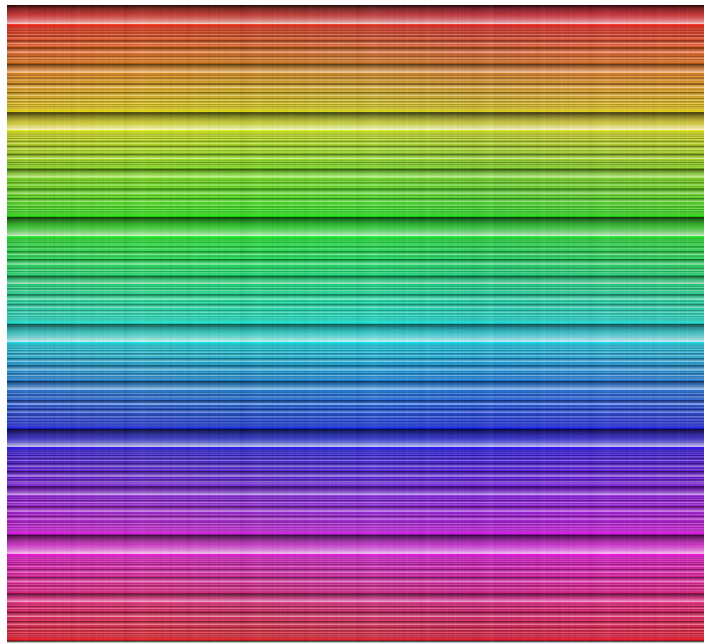
Community citizen science projects are often initiated as a response to the perception that government entities are not taking needed action to deal with local environmental concerns.<sup>29</sup> In this role, citizen and community science groups often perceive themselves, and are perceived by others, as adversarial to government rather than cooperative



might help with improving non-scientist literacy. Likewise, it might help to provide new scientific breakthroughs related to higher spatiotemporal resolution understandings of air pollution. Both claims could be made about our project with BOS. However, “not even the strongest sensor with the highest-resolution open-source real-time data will be enough to magically manifest environmental justice, especially if that injustice is built on a firm foundation of inequality and oppression” (Davies and Mah 2020, 239). We do not want an approach focused just on the gathering of more, “better” data, but instead an approach that sees improving scientific literacy as a two-way street, where scientists and non-scientists learn from each other. Therefore, it was particularly important for our collaboration with BOS to focus on air quality’s sociomateriality. This can also be illustrated

CS is often heralded to provide three main benefits: *democratising science* through wider stakeholder participation in decision-making, which reduces the likelihood of marginalising communities; *improving scientific literacy* to the scientific process; and *providing new scientific breakthroughs* made possible through massive citizen participation (Strasser et al. 2019). It is easy to see the potential links between CAQS’s tenets of reflexivity and power and justice, and CS’s *democratising science*: both aim to open the black box of knowledge production and reconfigure it with new knowledges in the pursuit of environmental justice. However, some have questioned whether CS necessarily leads to

# What role does citizen science play?

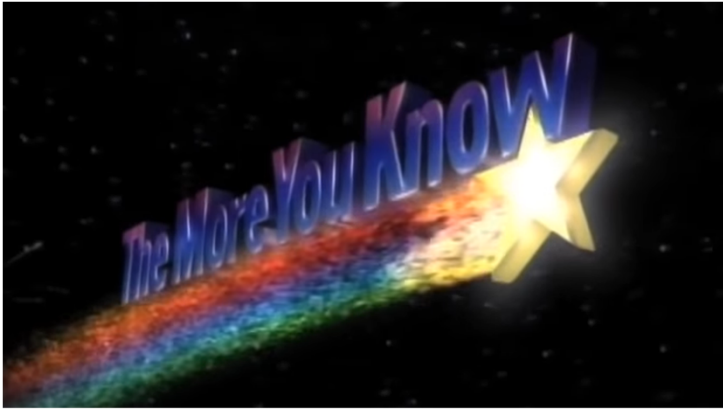


Categories of Data Use	Intended Project Purpose	Quantitative	Qualitative	Level of Detail
Increasing public understanding	Community engagement			
	Education			
Scientific studies and research	Environmental condition indicators (screening, exposure)			
	Studies and research			
Legal and policy action	Regulatory decisions			



# Potential Impacts on State Agencies and Regulated Entities:

1.



2.



3.



4.



5.



6.



# Potential Concerns?

1. How do we ensure quality data?
2. What quality assurance/control measures must people use?
3. Were sampling locations representative?
4. What sampling and instrument calibration methods should be utilized?
5. What controls were used to isolate background and other sources?
6. Documenting chain-of-custody?
7. How are samples stored and shipped?
8. What methods are used to analyze samples?



9. What data verification and validation methods are utilized?
10. How is data that does not meet analytical method validation requirements handled?
11. Is the sampling repeatable?



# Agency response?



## Citizen Science Quality Assurance Toolkit

### 5 STEPS TO IMPROVE CITIZEN SCIENCE DATA QUALITY

Citizen science, or community science, provides an opportunity for everyone to explore environmental protection questions to support community change. Quality data are the key to answering these questions. One of the best ways to ensure data is for citizen science groups and governmental agencies to work together. This fact sheet outlines the quality assurance steps used by citizen scientists when conducting field analyses or by governmental laboratories when a sample is analyzed.

#### THE IMPACT OF A QUALITY PROCESS: DATA THAT COUNTS

These steps provide a neutral, consistent way to produce quality data. With proper documentation, anyone can trace the life of a result.

PROJECT ID

## NOAA Citizen Science Applying the Power of the Crowd Action Plan 2023–2027



#### NOAA Science & Technology Focus Areas:

Uncrewed Systems • Artificial Intelligence • 'Omics • Cloud • Citizen Science • Data

April 2023



## Quality Assurance & Documentation

"Never doubt that a small group of committed citizens can change the world; indeed, it is the only thing that ever has."

—Margaret Mead



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## science in ACTION INNOVATIVE RESEARCH FOR A SUSTAINABLE FUTURE

### CITIZEN SCIENCE OPPORTUNITIES FOR MONITORING AIR QUALITY

#### What is Citizen Science?

Citizen science includes public participation in scientific research and many other activities designed to improve the public's understanding of their environment, including local air quality. The U.S. Environmental Protection Agency develops, supports and participates in citizen science projects and conducts research to support citizen science activities.

#### Citizen Science and Air Quality Monitoring

Air quality in the United States is tracked using a network of national monitors located across the country. The monitors use established technologies that provide regional data on air quality for implementing the nation's air quality standards, enforcement and research.

The monitoring network, while critical to protecting air quality, has limited use for direct personal or local air quality information. EPA is evaluating and developing new air measurement technologies, including sensors, to increase the ability of individuals and communities to learn about their local air quality.



Equipment at a typical regulatory monitoring site.

A wide variety of small, portable and lower-cost monitoring devices are being developed by industry, universities and individuals to potentially enhance air quality monitoring capabilities. EPA scientists are collaborating with other federal, state and non-governmental institutions to encourage the development of new sensor and app technologies for measuring air quality and are evaluating the performance of these new technologies.

The Next Generation Air Monitors (NGAM) are:

- Less expensive (\$100 to \$5,000)
- Highly portable and easy to operate (often mobile)
- Require minimal training to start collecting data
- Inexpensive to operate



The AirCasting App and Air Monitor enable users to record, map and share health and environmental data using their Smartphone and the portable air monitor. This example and the one below represent types of new technologies available for citizen science activities. EPA encourages new technology development, but does not endorse any products.



The CarClip air sensor fits in the palm of a hand and collects data on ozone and nitrogen dioxide in the air.

#### Air Sensor Citizen Science Toolbox

EPA's online Air Sensor Citizen Science Toolbox supports citizen science air monitoring initiatives in communities. The toolbox provides resources and tools for air quality monitoring. The Air Sensor Citizen Science Toolbox includes:

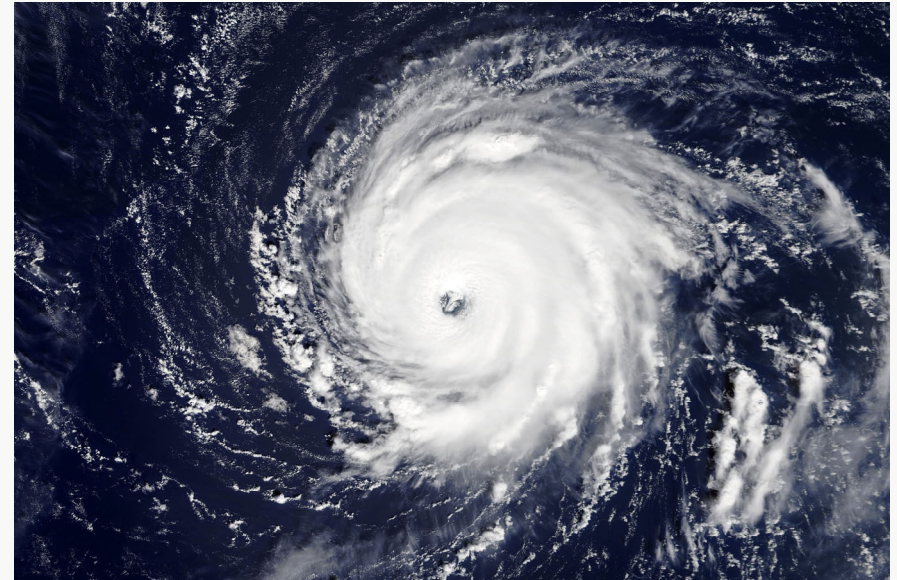
- Sampling methodologies;
- Generalized calibration/validation approaches;

1 U.S. Environmental Protection Agency  
Office of Research and Development

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# Ongoing EPA projects



# EPA's message:



**WE WANT YOU!**



# Takeaways

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1. Not all data is created equal from a legal and regulatory perspective
2. Upcoming battles over data quality
3. Significant expert/*Daubert* implications in litigation
4. Increased permit challenges
5. Increased public outreach and stakeholder engagement
6. EJ & ESG implications



# Questions?

