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EPA Tools and Resources Webinar

Citizen Science at EPA

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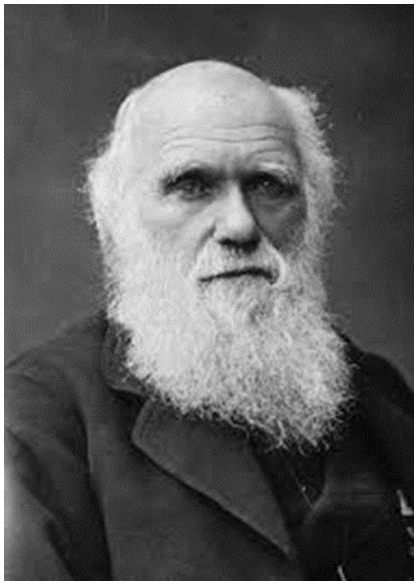
If you had 100,000 people to help you with your work, what would you do?

Citizen Science is . . .

- The involvement of the public in scientific research often in collaboration with professional scientists and scientific institutions.
- A transformational approach to environmental protection that engages volunteers, allowing large numbers people to contribute to science.

Crowdsourcing *and* Citizen Science

In **crowdsourcing**, organizations submit an open call for voluntary assistance from a large group of individuals for online, distributed problem solving.



Charles Darwin
"The Original Crowd-Sourced Scientist"

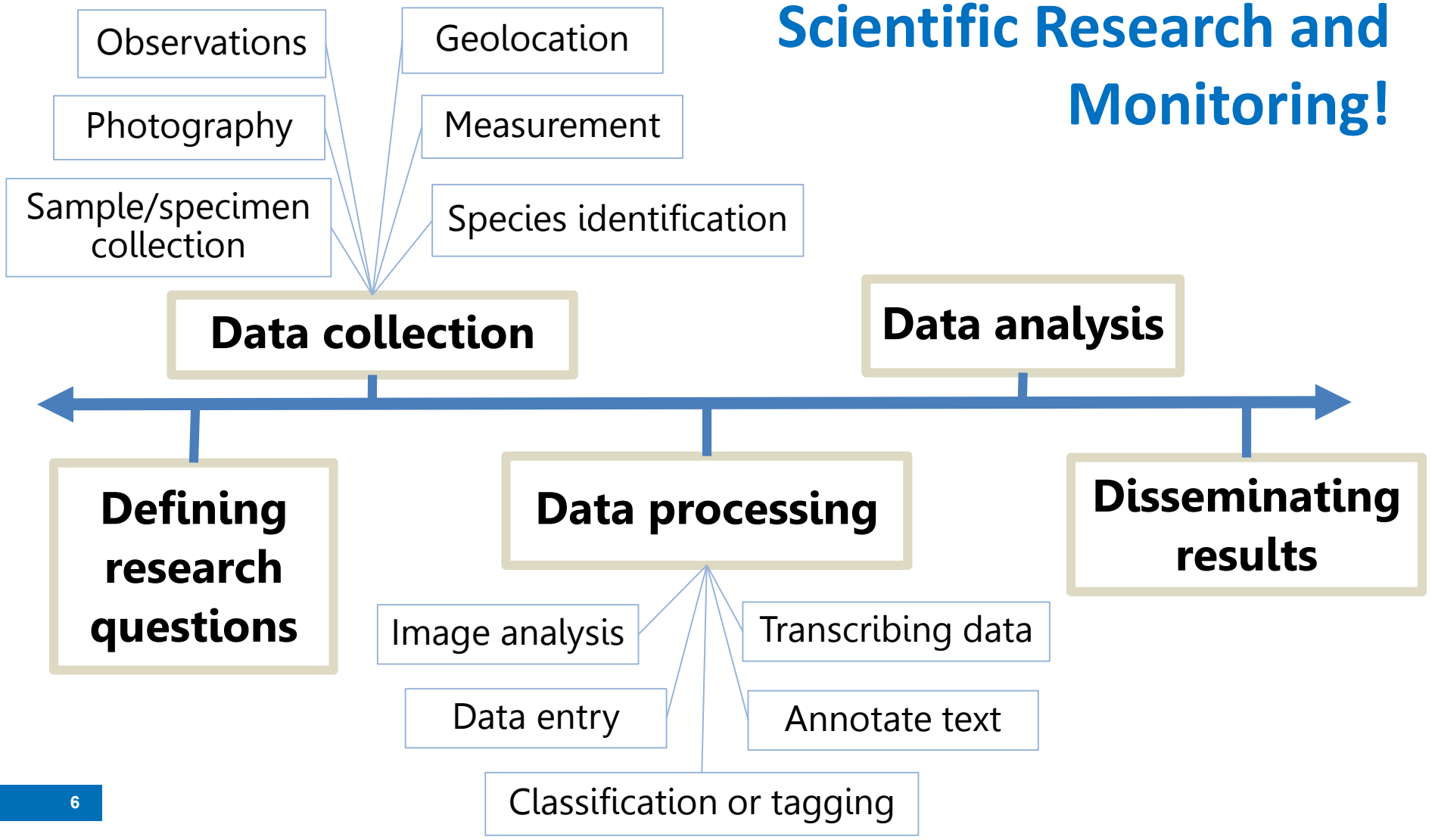
Crowdsourcing example:

"Can Smart Thermometers Track the Spread of the Coronavirus?"

- *Kinsa Health* thermometers (internet-connected) are in a million U.S. households.
- Real-time data from these thermometers can identify unusual patterns of fever clusters.
- For several years, the company's maps have accurately predicted the spread of flu about two weeks before CDC's surveillance tool.
- Crowdsourced fever data may be an early warning system for potential COVID-19 spread.

** NYTimes article by Donald McNeil Jr. , March 18, 2020*

There are Many Ways to Involve Volunteers in Scientific Research and Monitoring!



citizenscience.gov

Helping federal agencies accelerate innovation through public participation.

Citizenscience.gov is an official government website designed to accelerate the use of crowdsourcing and citizen science across the U.S. government. The site provides a portal to three key assets for federal practitioners: a searchable **catalog** of federally supported citizen science projects, a **toolkit** to assist with designing and maintaining projects, and a gateway to a federal **community** of practice to share best practices.

Explore Projects

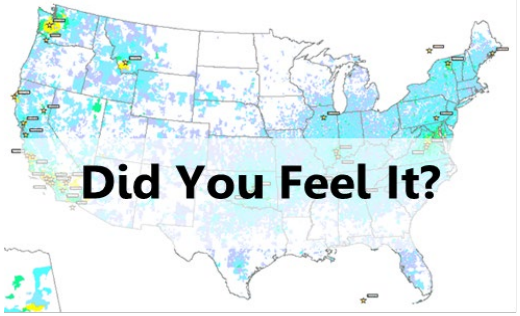
catalog

Plan Your Projects

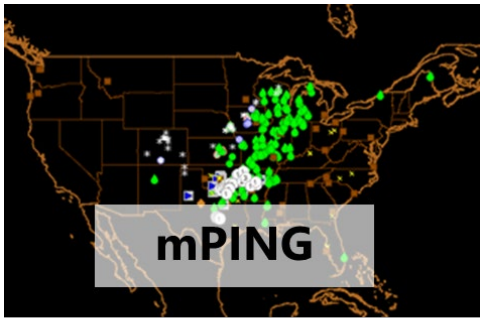
toolkit

Join Our Community

community



USGS science for a changing world



NOAA

Volunteer Water Monitoring

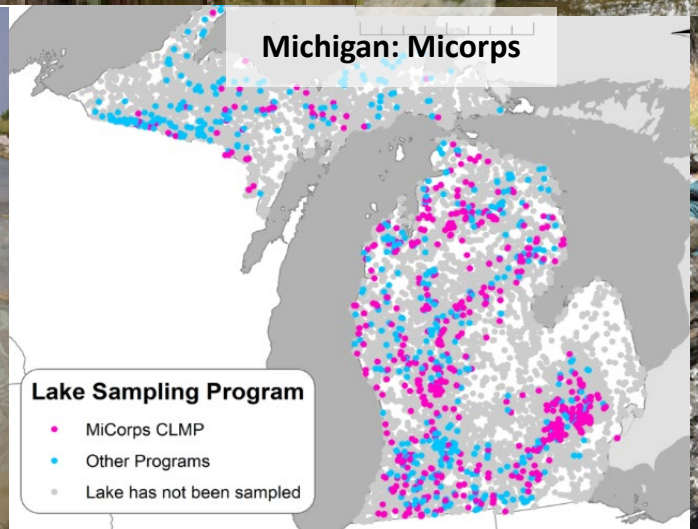
Thousands of groups across the US monitor the condition of their local streams, lakes, estuaries, wetlands, and groundwater resources.

States & Tribal Leadership in Water Citizen Science


Georgia Adopt a Stream

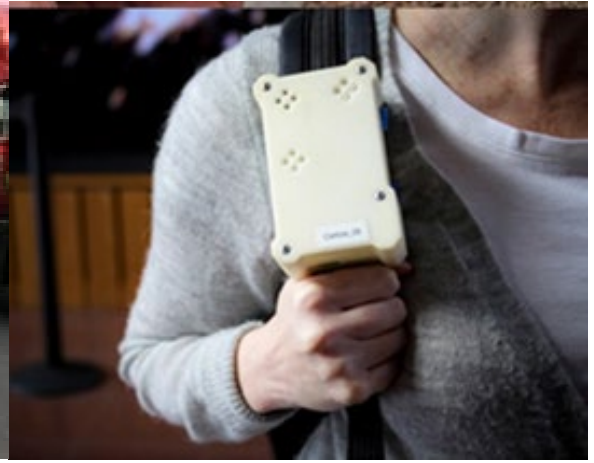

Sitka Tribe in Alaska Shellfish and Toxins


Utah: Harmful Algal Bloom Response



Michigan: Micorps


Colorado River Watch

Many Uses of Citizen Science at EPA

- Work with communities to understand local problems
- Monitor the environment for environmental protection
- Engage volunteers in research relevant to EPA's mission
- Educate the public about environmental issues



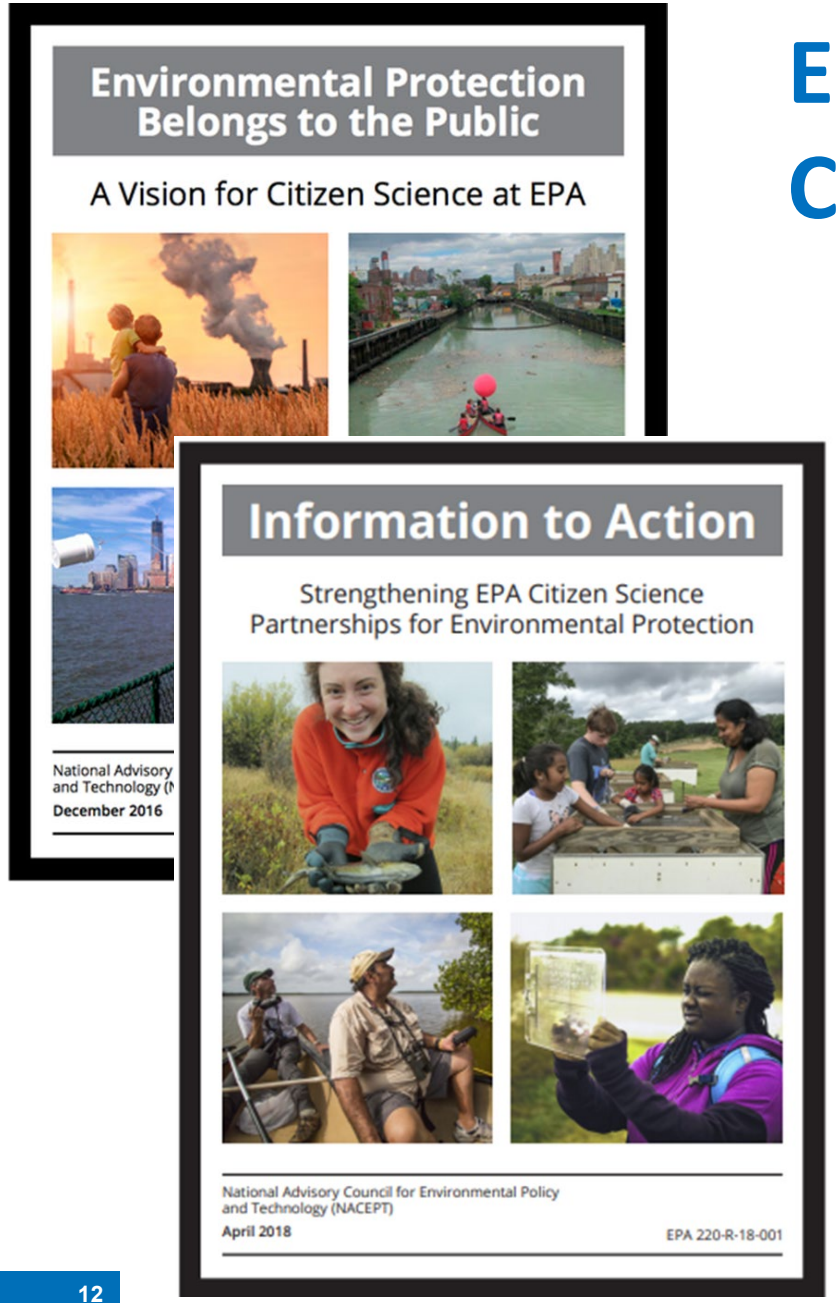
Why EPA Invests in Citizen Science

1. **Fill data gaps** and provide another means of identifying potential environmental problems.

2. **Improve public understanding** of environmental issues and actions that address them.

3. **Create inclusive, collaborative networks** of individuals and organizations dedicated to environmental problem solving.

4. **Yield cost savings and efficiency** in environmental monitoring and protection programs.



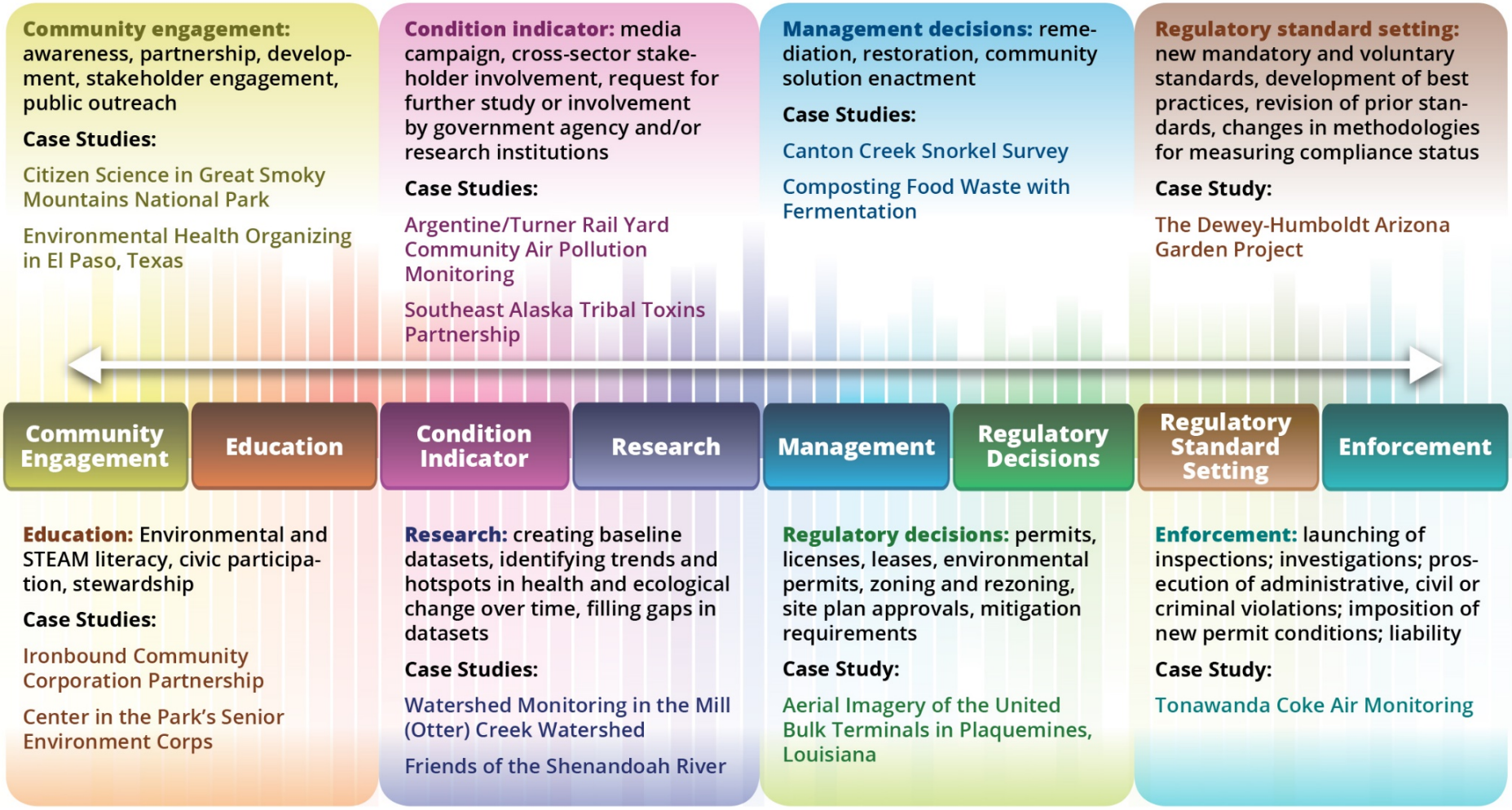
EPA Leadership in Citizen Science

Current Priorities

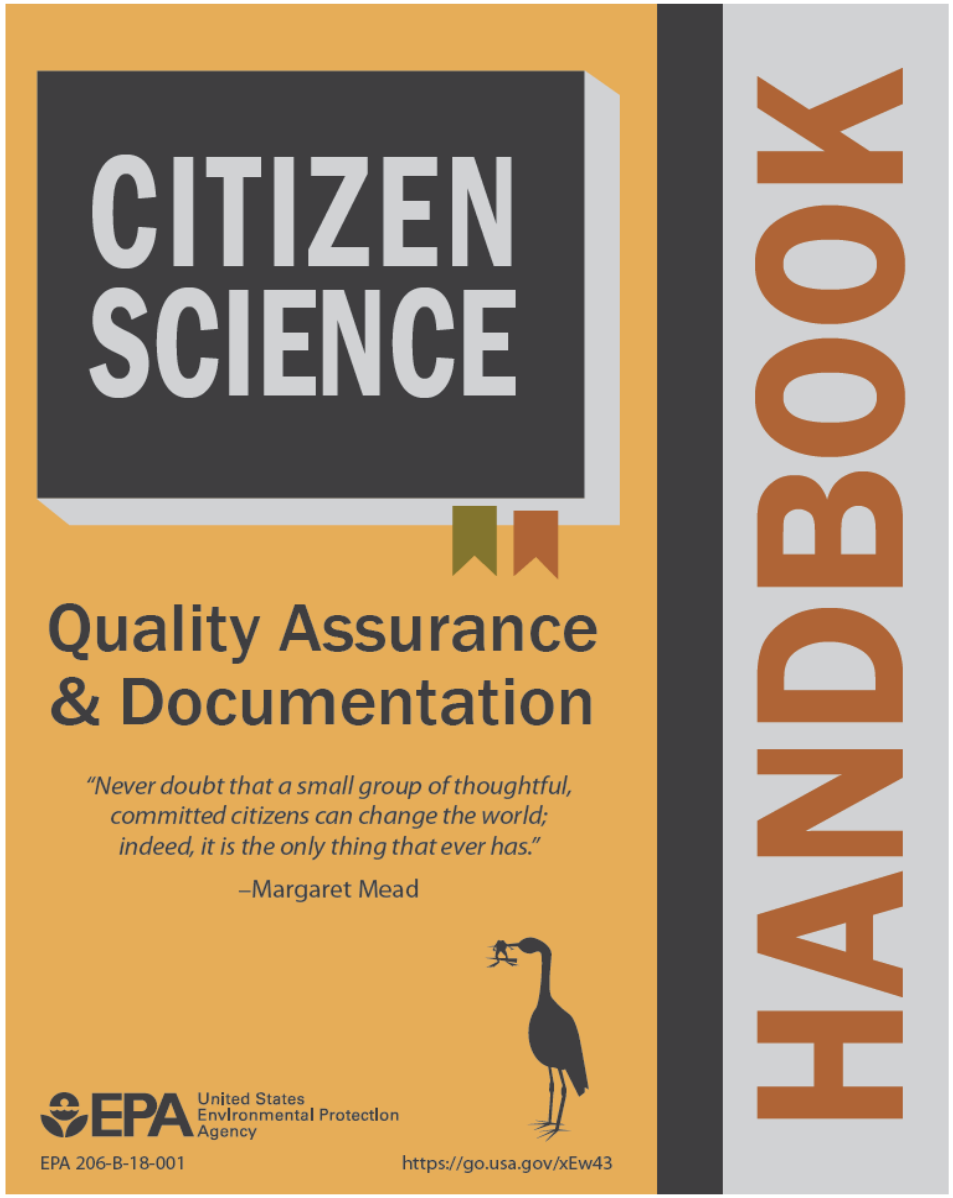
- A more comprehensive EPA vision and strategy for citizen science
- Increased institutional capacity for using citizen science in environmental programs
- Strengthening data management
- Technical support to build capacity on planning and documentation of data quality

2016 Report https://19january2017snapshot.epa.gov/sites/production/files/2016-12/documents/nacept_cs_report_final_508_0.pdf
2018 Report https://www.epa.gov/sites/production/files/2018-04/documents/nacept_2018_citizen_science_publication_eng_final_v2_508_0.pdf

Citizen Science Can Contribute to all EPA Work



Environmental Protection Belongs to the Public: A Vision for Citizen Science at EPA (PDF)



EPA QA Handbook

Purpose is to help citizen science organizations select the appropriate level of QA and documentation to fit the intended use of the data.

Encourages preparation of a *Quality Assurance Project Plan (QAPP)* that provides information for data users to evaluate the quality of data collected by citizen scientists.

Recommends contacting federal, state, local, tribal or other organizations for more assistance or guidance.

https://www.epa.gov/sites/production/files/201903/documents/508_csqapphandbook_3_5_19_mmedits.pdf

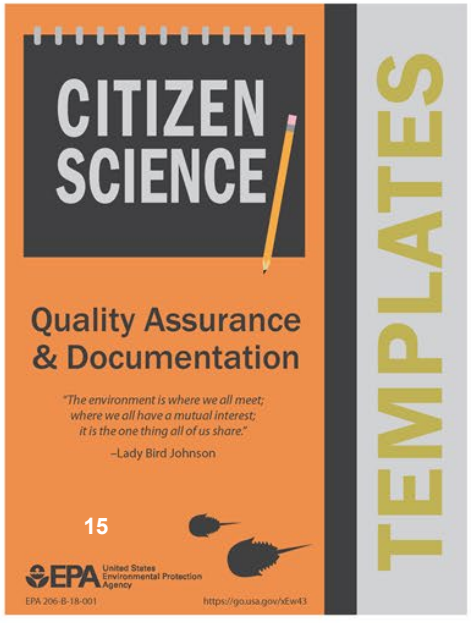
How to Use the QA Handbook

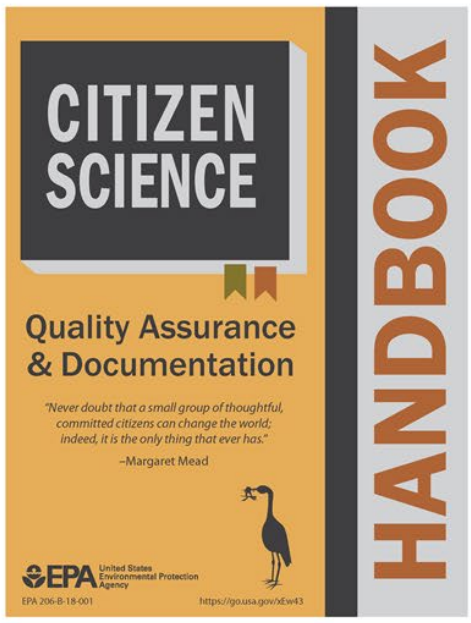
Three parts

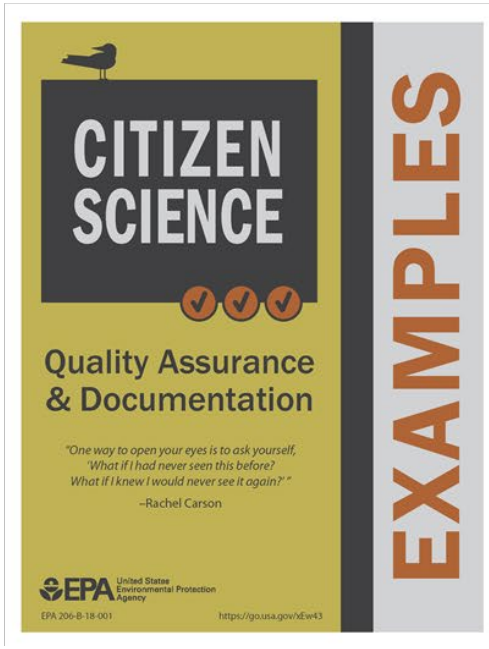
Handbook – Explains the purpose of each template

Template – Provides instructions, tables and questions

Examples – Specific examples of QA documentation

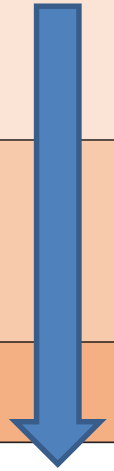






Key Idea: Plan for Intended Data Uses

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



Increasing levels of QA and documentation

QA Templates

EPA QAPP elements and QA templates recommended for citizen science projects.

Templates organized into 4 major QAPP elements listed in EPA guidance documents.

A. Managing the Project
B. Collecting the Data
C. Assessing the Data
D. Reviewing the Data

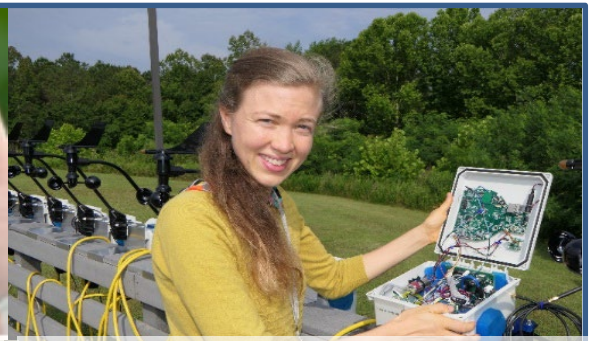
Template	Increase Public Understanding	Science/Research	Legal/Policy
A. Managing the Project			
1. Title and Preparer Page	X	X	X
2. Table of Contents		X	X
3. Problem Definition, Background and Project Description	X	X	X
4. Data Quality Objectives and Indicators	X	X	X
5. Project Schedule		X	X
6. Training and Specialized Experience	X	X	X
7. Documents and Records	X	X	X
B. Collecting the Data			
8. Existing Data		X	X
9. Sampling Design and Data Collection Methods	X	X	X
10. Sample Handling and Custody		X	X
11. Equipment/Instrument Maintenance, Testing Inspection and Calibration		X	X
12. Analytical Methods	X	X	X
13. Field and Laboratory Quality Control	X	X	X
14. Data Management		X	X
C. Assessing the Data			
15. Reporting, Oversight and Assessments	X	X	X
D. Reviewing the Data			
16. Data Review and Usability	X	X	X
Managing the Project (continued)			
17. Organization Chart		X	X
18. Project/Task Organization		X	X
19. Project Distribution List		X	X

EPA Citizen Science Activities

Some Examples

CyanoScope

Air Sensor Toolbox



Air Sensor Loan Program

Real-time Water Quality Monitoring

Video Image Analysis

Radon Crowd-Mapping

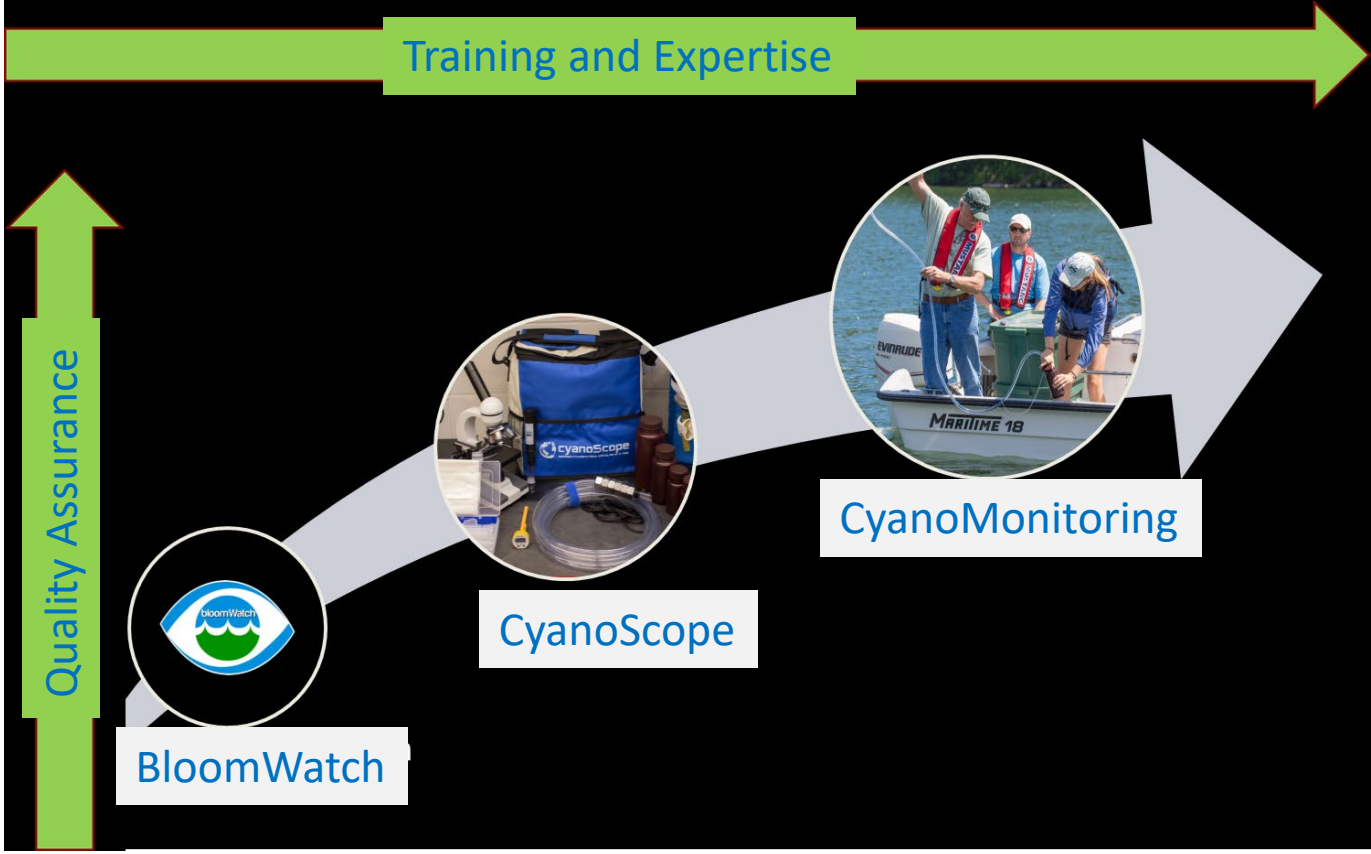
Smoke Sense

Cyanobacteria Monitoring Collaborative

An Approach for Education, Monitoring and Management of Harmful Cyanobacteria

EPA United States Environmental Protection Agency

Locating and Understanding Harmful Cyanobacteria



Three Coordinated Monitoring Projects

1. **BloomWatch App** – Crowdsourcing to find and report potential cyanobacteria blooms
2. **CyanoScope** – Mapping cyanobacteria one slide at a time
3. **Cyano Monitoring** – Professionals and trained citizen scientists monitor freshwater for cyanobacteria to determine environmental factors that cause blooms

CyanoScope

Mapping Cyanobacteria

First Steps

1. Join cyanoScope project at iNaturalist.org
2. Obtain sample collection and microscopy kit
3. Get training

How Volunteers contribute observations

1. **Collect Cyanobacteria** – Take a water sample with a net tow, prepare a microscope slide, and identify cyanobacteria in the sample.
2. **Submit the Images** – Take a photo of the Cyanobacteria found in the sample, and upload images and info on iNaturalist platform.
3. **Interact Online** – iNaturalist community can confirm type of cyanobacteria, you can view images from other volunteers, and everyone can explore the geospatial patterns of cyanobacteria.

http://cyanos.org/cyanoscope

iNaturalist Website Helps Identify the Type (Genus) of Cyanobacteria

cyanoScope

Print

The inaturalist cyanoscope project https://www.inaturalist.org/projects/cyanoscope is a citizen science based program to photograph and identify cyanobacteria and other phytoplankton. This guide is a work in progress. ...more ↓

All 16

TAGS

- BMAA 1
- Cyanobacteria 1
- Microcystin 1
- toxin 1

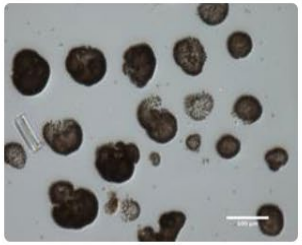
TAXONOMY

- Class Cyanophyceae 15
- Order Synechococcales 1

Search Search

Sort ▾ Grid Card

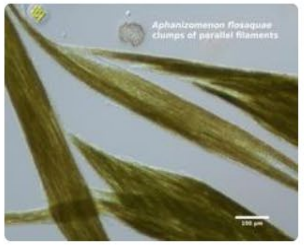
Microcystis [1]



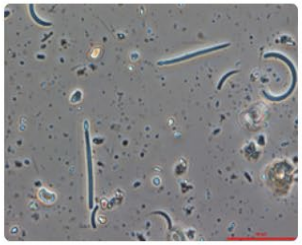
Woronichinia [1]

Anabaena [1]

Dolichospermum [1]



Aphanizomenon [1]



Cylindrospermopsis [2]

Planktothrix [1]

Nostoc [1]

https://www.inaturalist.org/projects/cyanoscope

EPA United States Environmental Protection Agency

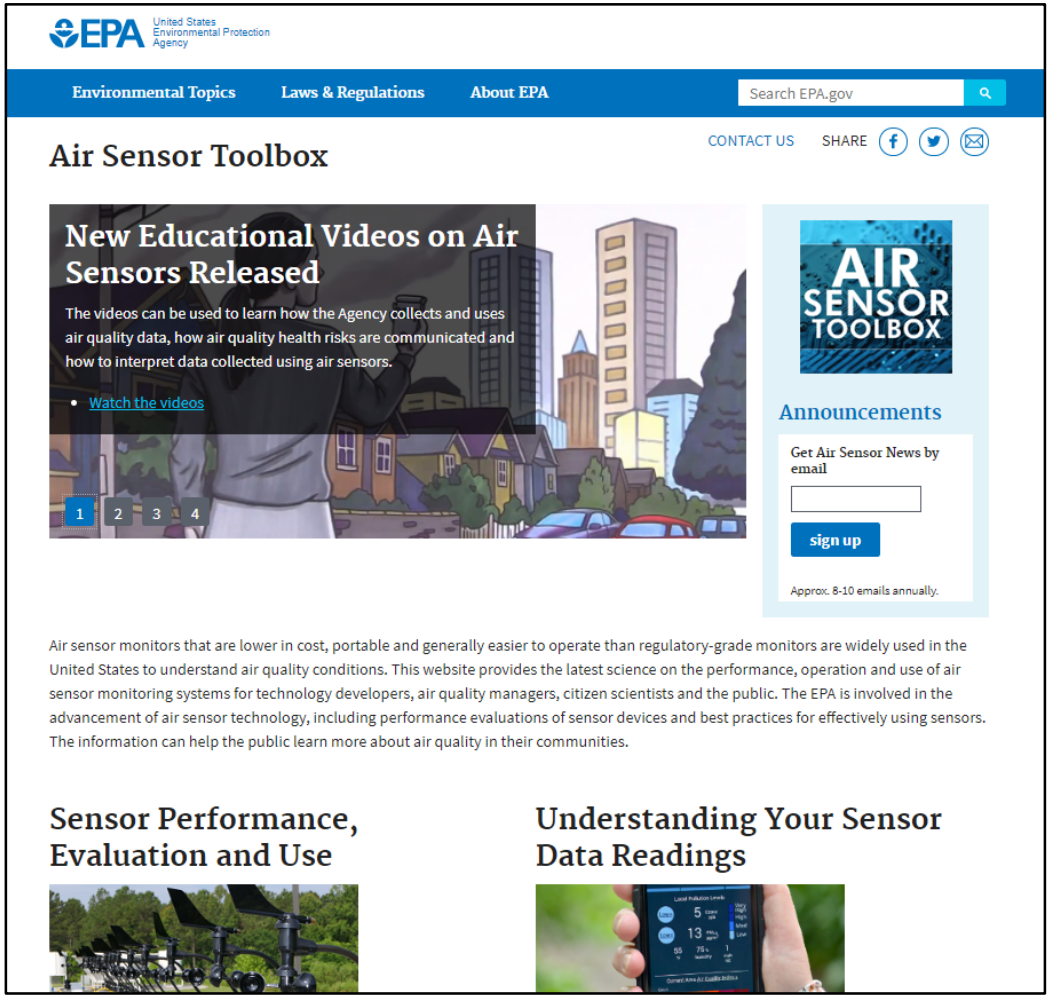
AIR SENSOR TOOLBOX

Audience:

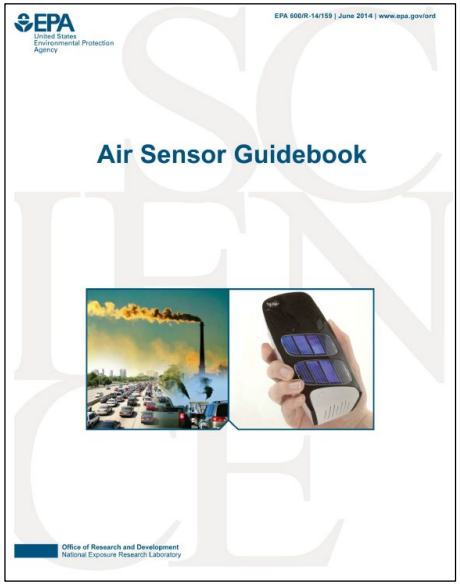
- Citizen scientists
- Technology developers
- Researchers
- State/local/tribal agencies
- General public

http://www.epa.gov/heasd/airsensortoolbox

Information on Performance, Operation and Use of Air Sensors



Air Sensor Guidebook (2014) – guide for using air sensors to collect air quality measurements

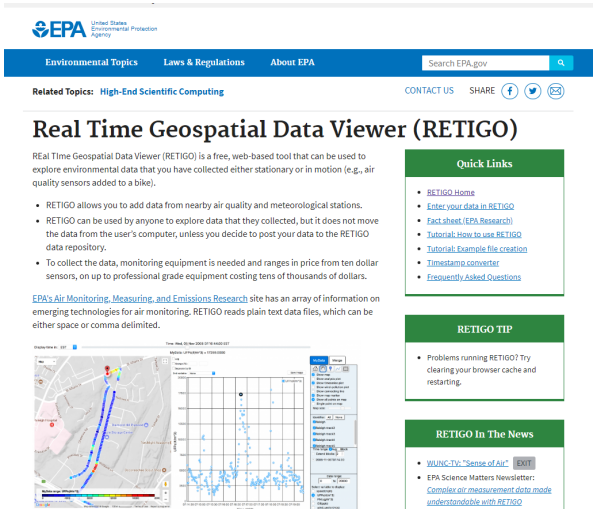


The Air Sensor Guidebook is currently being updated!

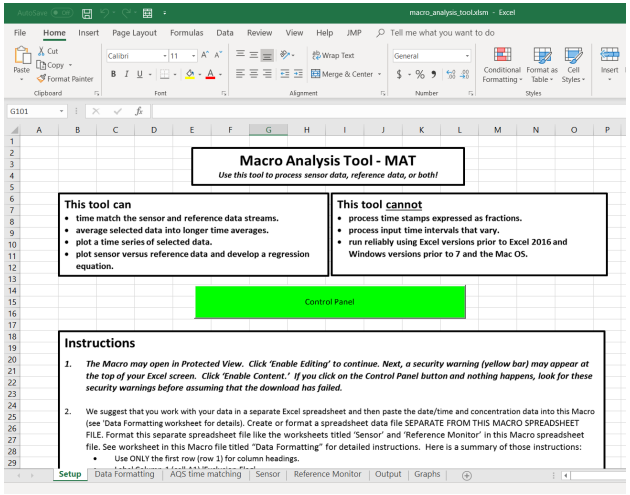
https://www.epa.gov/air-sensor-toolbox

Helpful Tools for Data Analysis, Visualization and Communication

RETIGO – Free web-based tool to explore environmental data



Macro Analysis Tool – Free excel-based tool to compare air sensor and reference monitor data



Educational Videos – Address how to use and communicate data from air sensors

Just released on Feb 18th!

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Understanding Sensor Data Readings

Potential for improved environmental awareness about local pollution levels through citizen-based monitoring

- Data Collection
- Analysis and Interpretation
- Communication

https://www.epa.gov/air-sensor-toolbox

Los Angeles Public Library Air Sensor Loan Program

- Air quality in the Los Angeles area has improved over the last 4 decades, but the area still struggles with air pollution.
- To meet requirements of the Clean Air Act, criteria air pollutants are monitored at a limited number of stations.
- **New, lower cost air sensor technologies allow** the public to measure air quality in more locations at the neighborhood or street level.

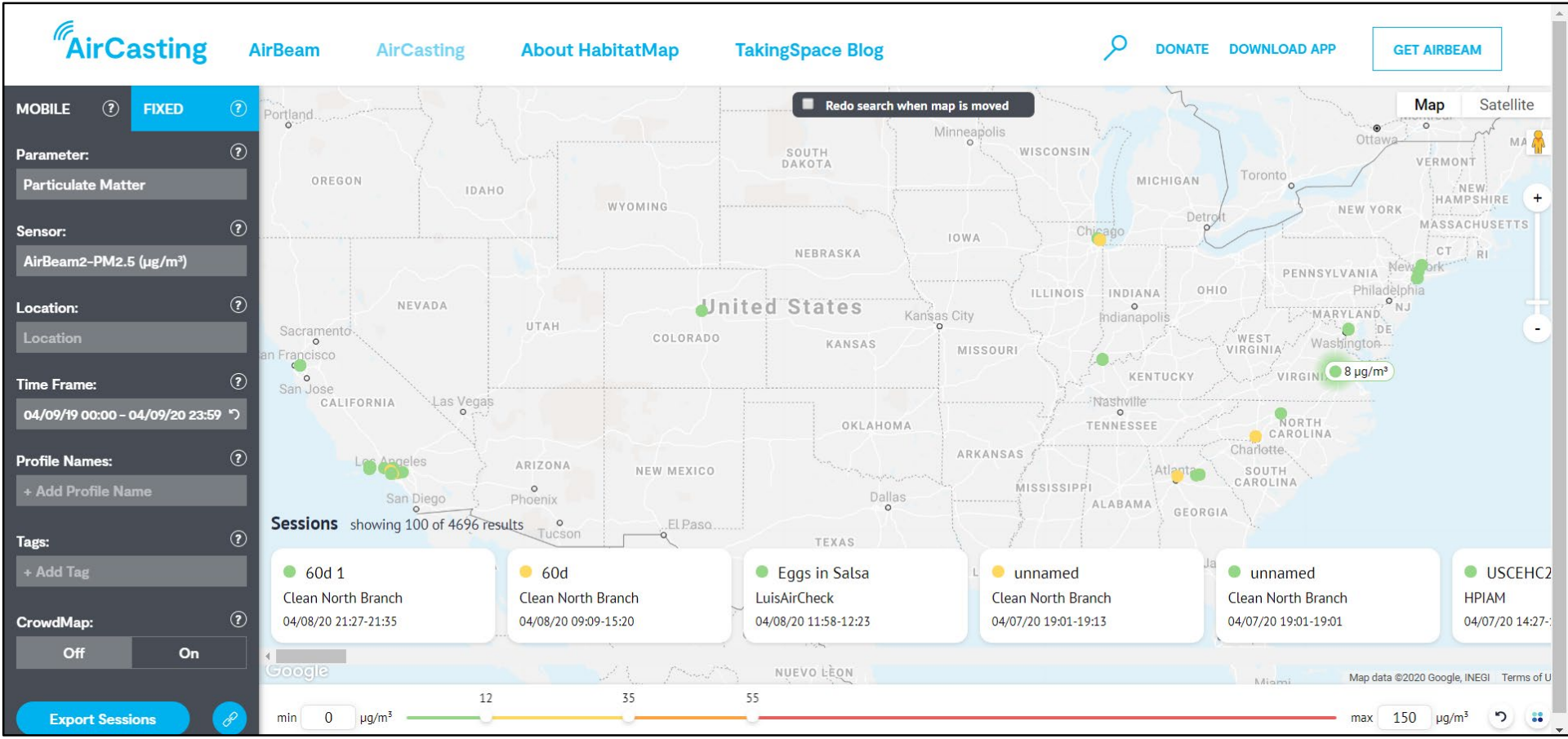
https://www.epa.gov/innovation/los-angeles-public-library-air-sensor-loan-program

Collaborative Project

Approach:

- Air sensors that measure fine particles ($PM_{2.5}$) will be available for checkout at select branches of the Los Angeles Public Library system.
- Three lesson plans with hands-on activities based on the sensor will be used.
- Libraries will host workshops on how to use the sensor using the lesson plan.
- Loan program will use the *AirBeam2 Sensor* which measures PM2.5, humidity & temperature.

https://www.habitatmap.org/airbeam



Anticipated Impacts

- Increase air quality awareness
- Educate and engage the community
- Help the public take actions to protect their health
- Develop transferable resources including air quality lesson plans for classroom instruction

Program will launch in Summer/Fall 2020!

http://aircasting.habitatmap.org/map

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Goal of LA Library Loan Program: **Demonstration and Replication**

- **Learning** – How to train staff on use of air sensor equipment as part of an environmental education curriculum
- **Practical logistics** – Challenges for community equipment loan programs (maintenance, calibration etc.)
- **Knowledge Transfer** – "Best Practices" guide with lessons learned for implementing similar programs in other parts of the country

For more information: www.epa.gov/air-sensor-toolbox

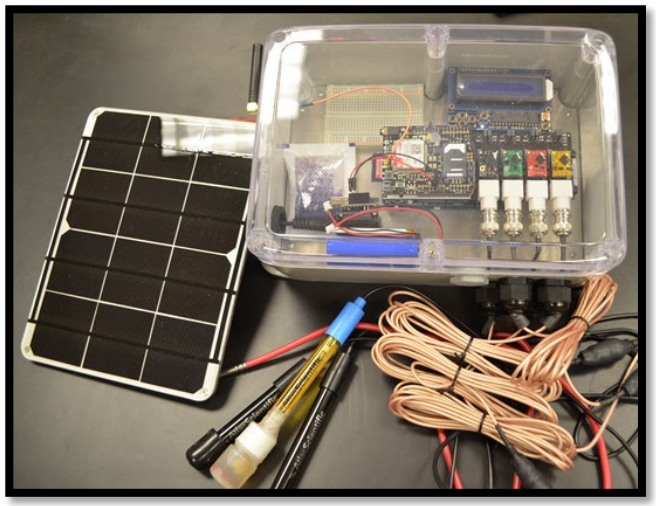
New Technology for Water Quality Monitoring

Demonstration Project in Georgia
Low Cost Sensors for Real-Time Continuous Monitoring

Cooperative Project with Georgia's Adopt-A-Stream Program

- Two day workshop trained 15 volunteer organizations to build and operate low-cost water quality sensors
- Built, programmed, and deployed 20 open source/low-cost sensor units
- Used publicly available sensors for key parameters (temperature, pH, dissolved oxygen, and specific conductance)
- 3-month field evaluation completed in June 2018 (collected 90 days of data)

https://www.epa.gov/innovation/low-cost-sensors-real-time-continuous-water-quality-monitoring



Results from Evaluation Study

Findings inform shift to advanced water quality monitoring

Low-cost sensors compared well to industry standard equipment under controlled laboratory conditions

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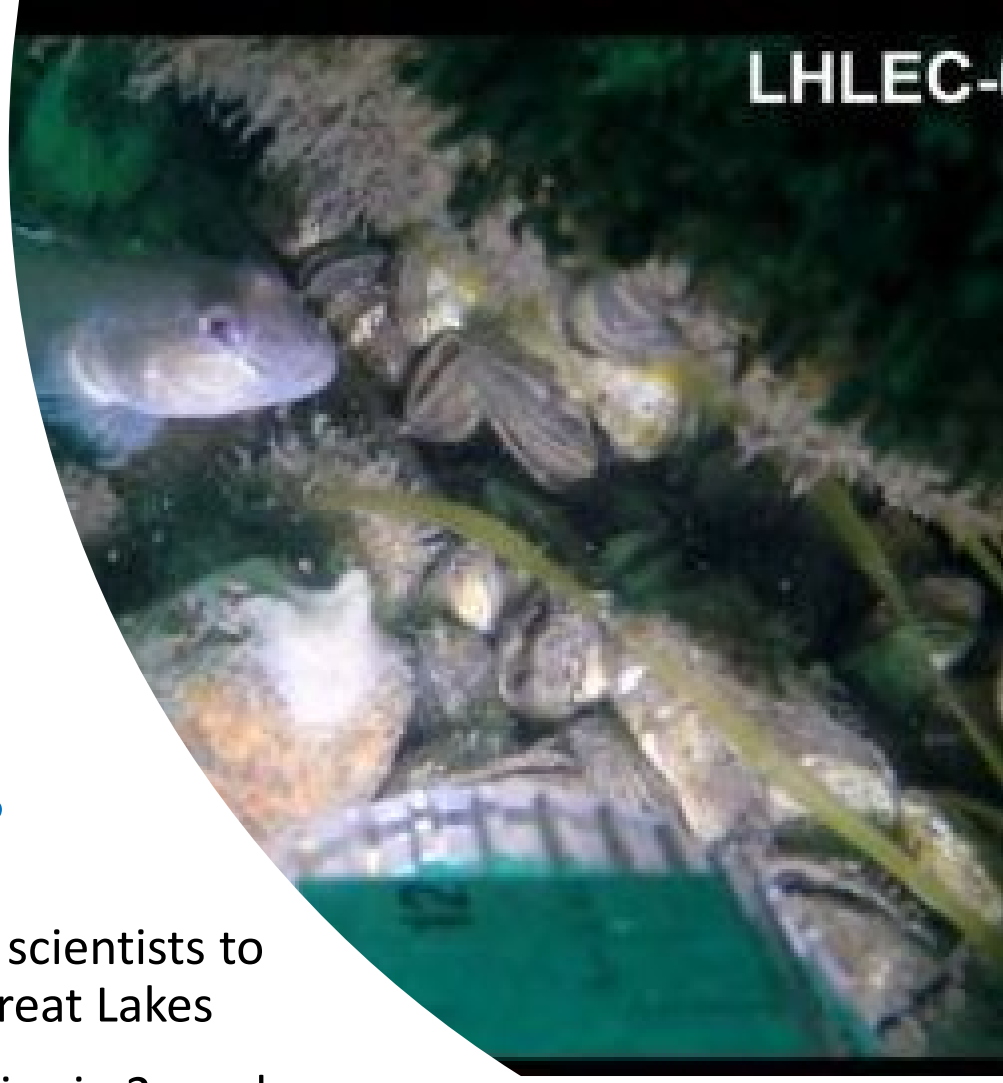
Challenges with sensor systems deployed at field sites

- Frequent calibration drift
- Decreased life expectancy (pH probe)
- High power demand
- Susceptibility to damage

Lessons for future projects that utilize open source/low-cost sensor technology

- Field ruggedness
- Maintenance/calibration demand
- Technical learning curve
- Data quality objectives

EPA United States Environmental Protection Agency



Deep Lake Explorer:
Using Citizen Science to Analyze Underwater Video in the Great Lakes

- Created a web application for citizen scientists to evaluate underwater videos of the Great Lakes
- 531 volunteers analyzed 746 video clips in 2 weeks for *habitat characteristics* and *invasive species*

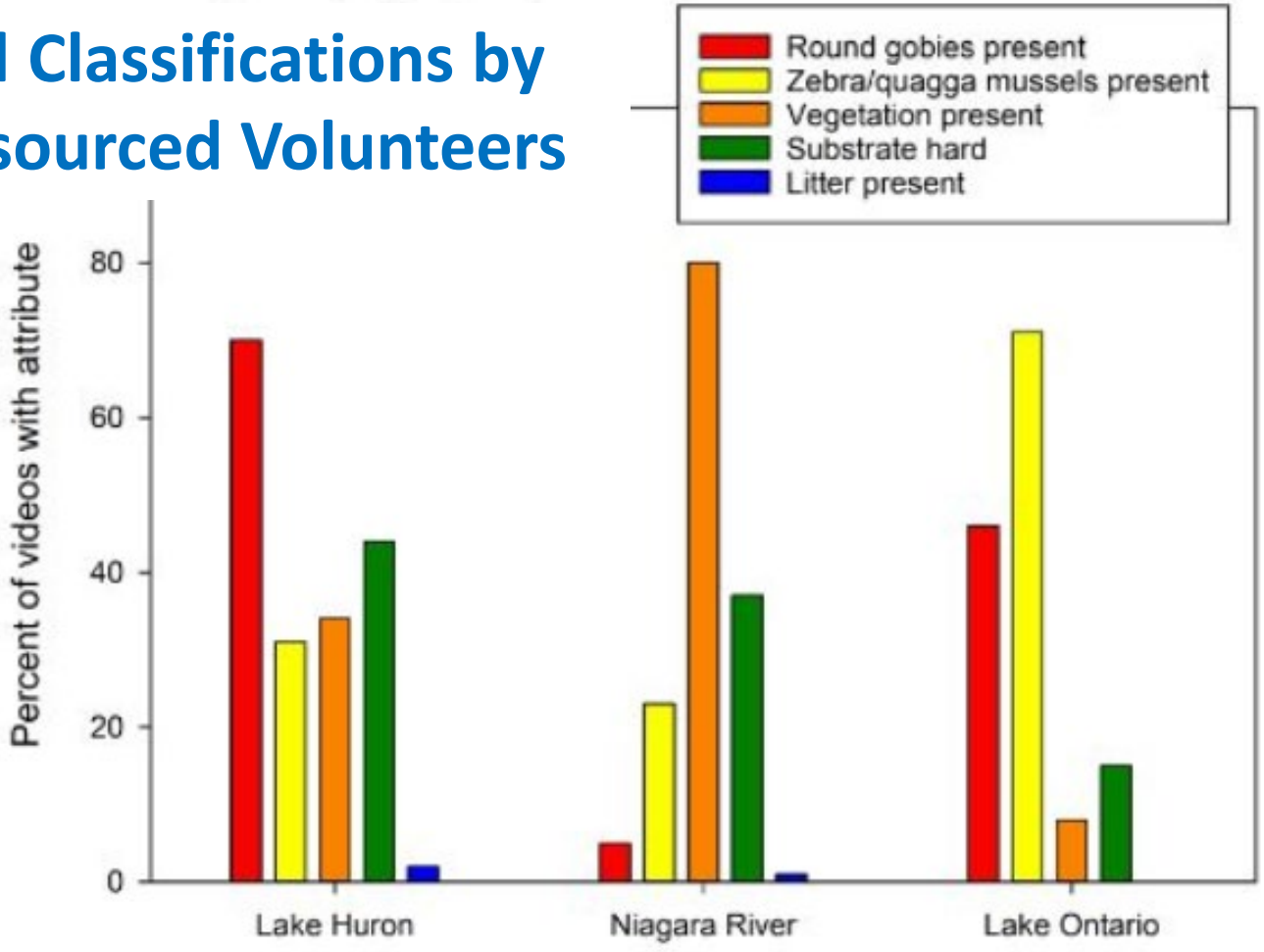
https://www.zooniverse.org/projects/usepa/deep-lake-explorer


Video Camera set up


Underwater Image

Project Compared Classifications by Experts vs Crowdsourced Volunteers

Video Images

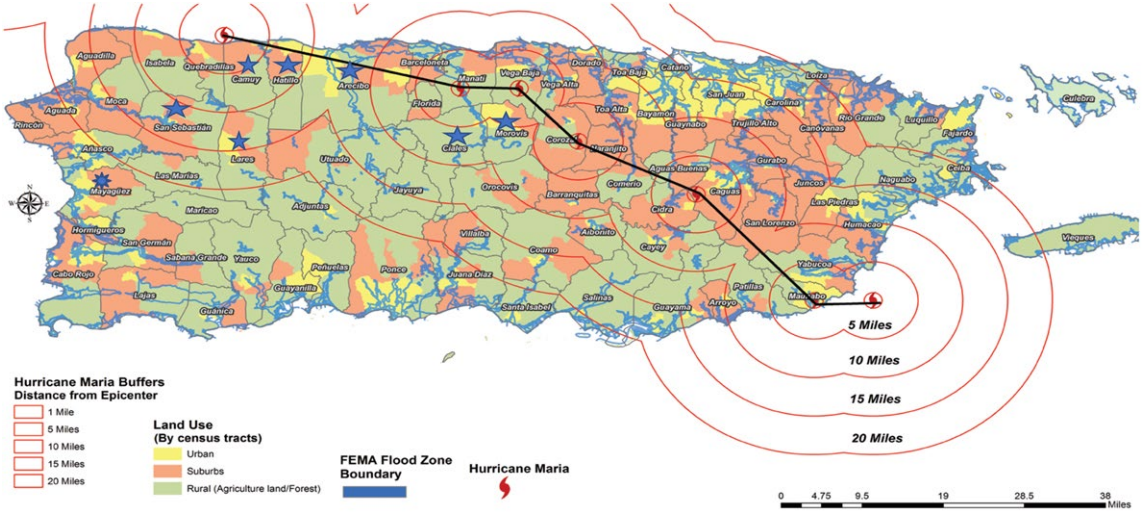


Types of Questions Asked

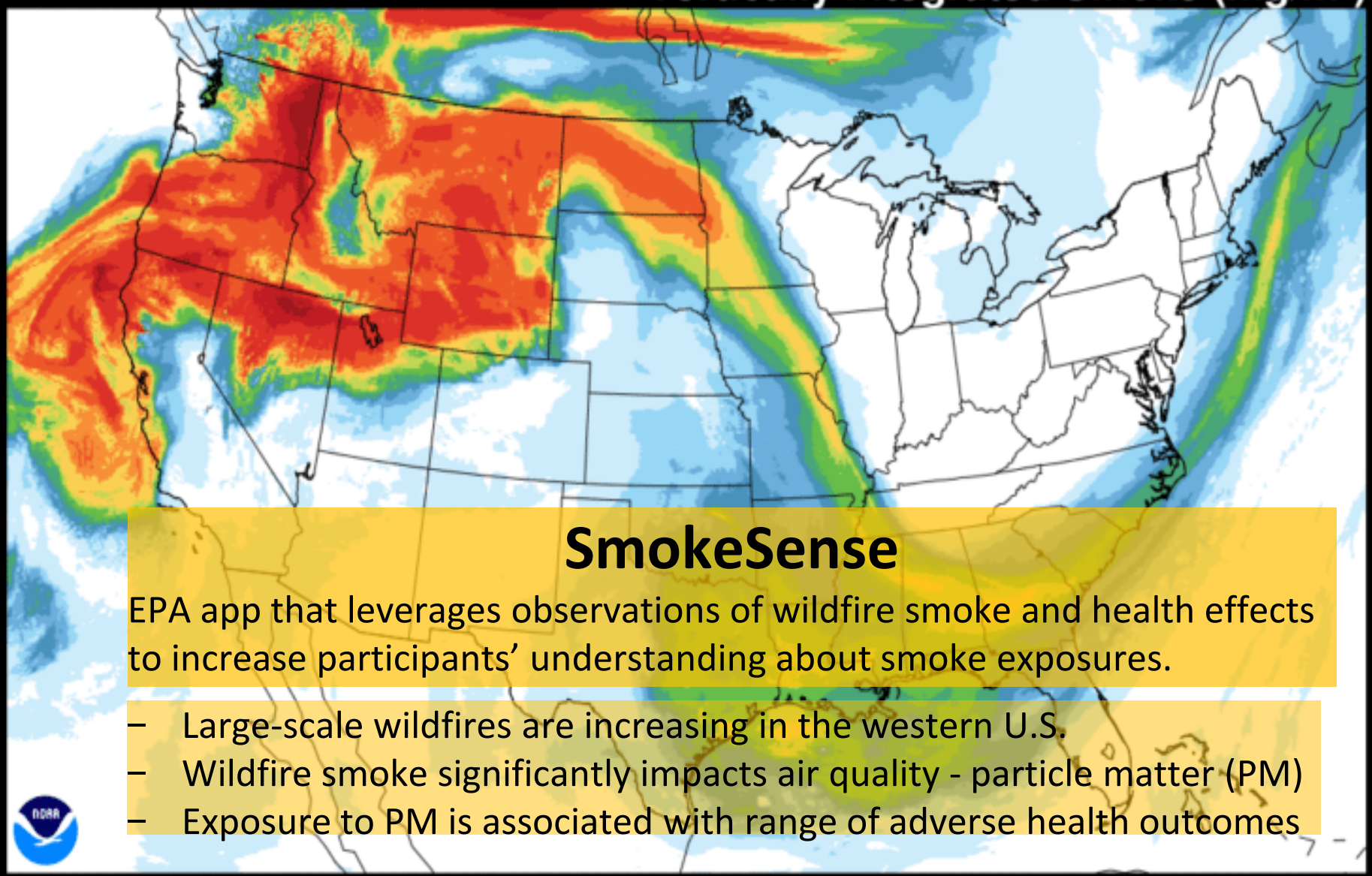
1. Is substrate mostly hard, soft, or mixed?
2. Is vegetation present?

1. Do you see fish?
2. If so, are they round gobies?
3. Do you see invasive mussels?

New Test Method for Community Mapping of Radon in Puerto Rico



https://www.epa.gov/innovation/region-2-new-test-method-community-mapping-radon-puerto-rico



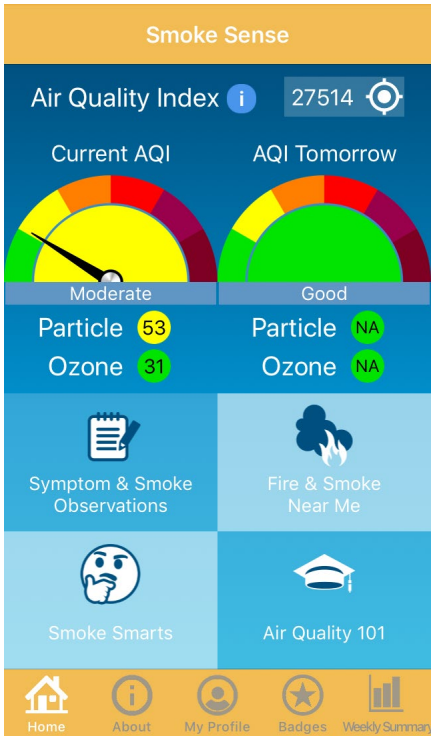
SmokeSense

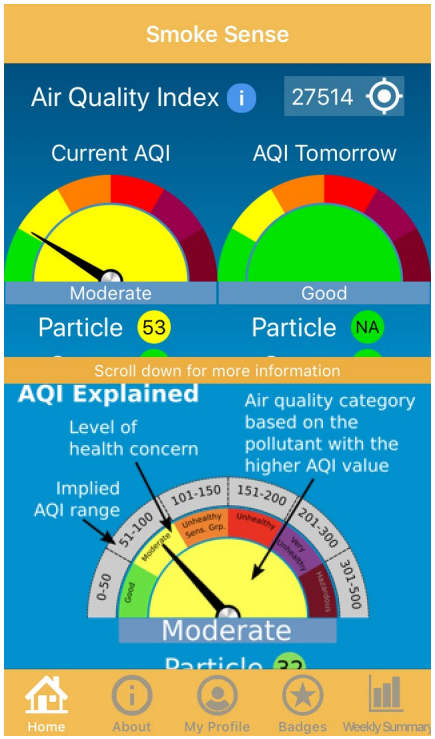
EPA app that leverages observations of wildfire smoke and health effects to increase participants' understanding about smoke exposures.

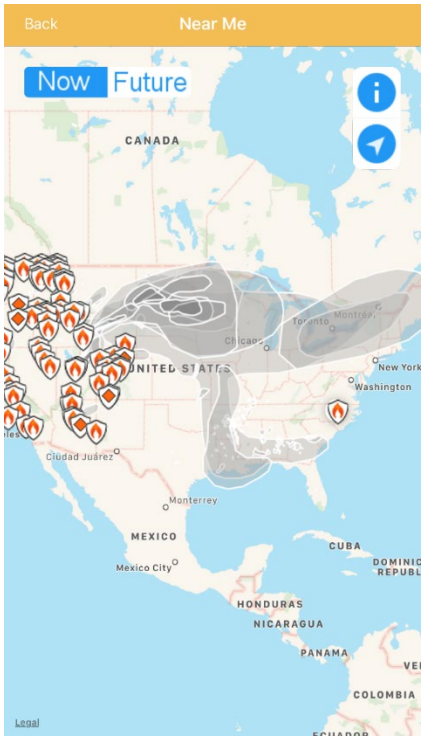
- Large-scale wildfires are increasing in the western U.S.
- Wildfire smoke significantly impacts air quality - particle matter (PM)
- Exposure to PM is associated with range of adverse health outcomes

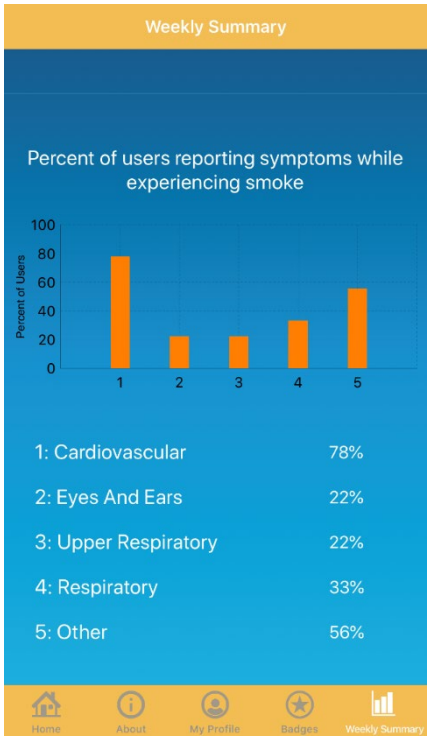
Smoke Sense App

Innovative method for communication and data collection









Smoke Sense App has over 30,000 users!

https://www.epa.gov/air-research/smoke-sense-study-citizen-science-project-using-mobile-app

Citizen Science Contribution to EPA's mission

Enhanced scientific research and environmental monitoring

STEM education

Community-scale problem solving

Stronger links to the public

Image: CROWD & CLOUD

Want to learn more?

Websites

- citizenscience.gov and epa.gov/citizen-science
- Citizen Science Association
- SciStarter – to find projects

Helpful reports and documents

- NACEPT reports about EPA's citizen science
- Recent article in Nature magazine
- NAS report on Learning through Citizen Science
- Report to Congress on Citizen Science

Contacts

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For more information about specific EPA citizen science projects:

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Air Sensors Toolbox	Andrea Clements	clements.andrea@epa.gov
Library Sensor Loan Program	Rachelle Duvall	duvall.rachelle@epa.gov
Real-time Water Monitoring	Derek Little	little.derek@epa.gov
Underwater Video Analysis	Mari Nord	nord.mari@epa.gov
Community Radon Mapping	Ameesha Mehta-Sampath	mehta-sampath.ameesha@epa.gov
Smoke Sense	Mary Clare Hano	hano.maryclare@epa.gov