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EPA Tools & Resources Webinar:
Community and Citizen Science—Making Your Data Count!

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Kim Cobb, Georgia Institute of Technology

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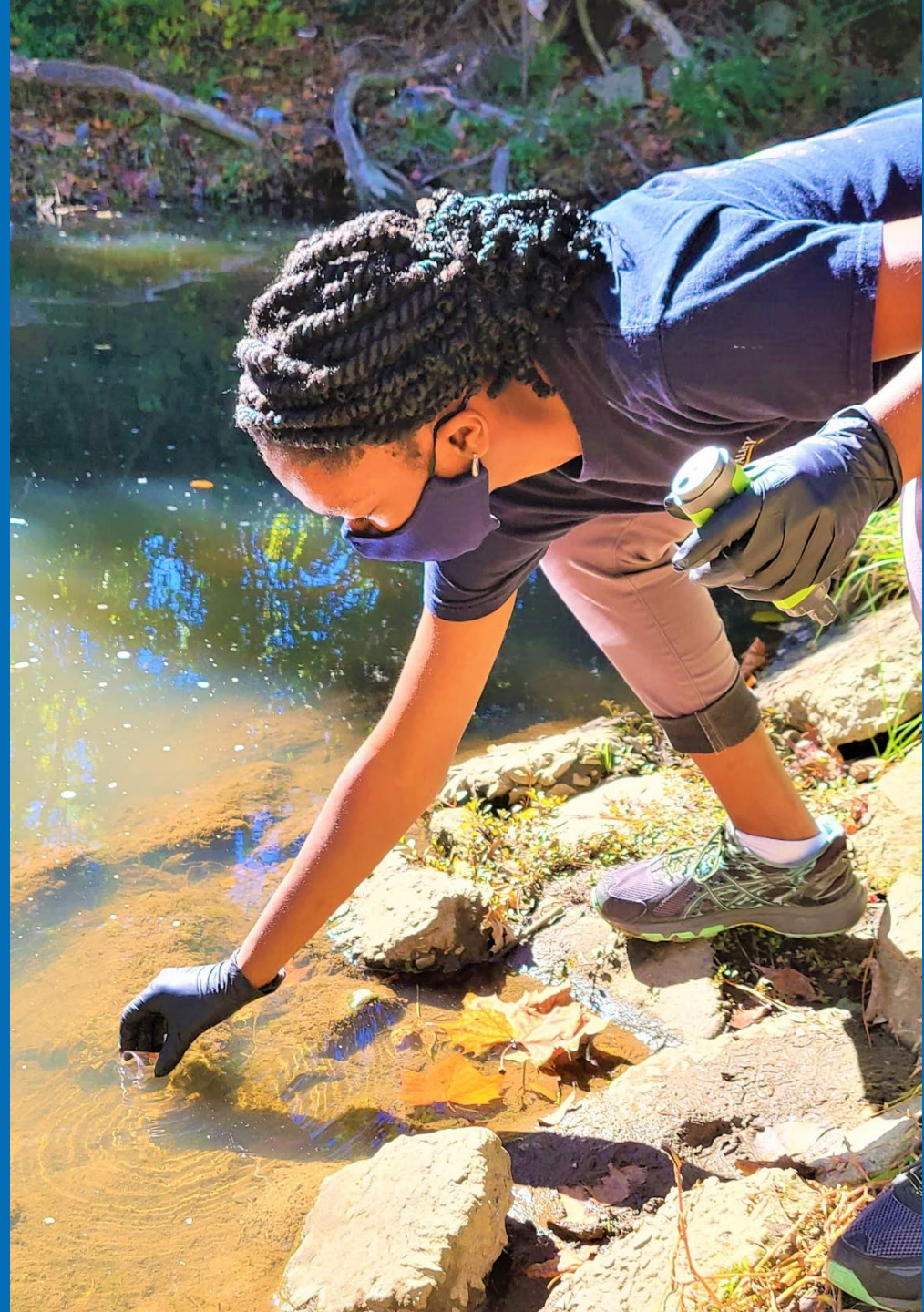
Meghan Smart, Arizona Department of Environmental Quality

December 15, 2021



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Today's Agenda

1. **Background on Community & Citizen Science (CCS)**
2. **Brief overview of New CCS Tools**
3. **Highlighted Case Studies on Data Management**
   - Urban Heat ATL (Atlanta)
   - Love My Air (Denver)
   - Eastern Shale Gas Monitoring Program (WV, PA, VA)
   - Arizona Water Watch
4. **Ideas from Data Management Workshop**

The Promise of Community and Citizen Science

Benefits of connecting people to environmental protection

Technology makes it easy to contribute information (measurements, observations, samples, photographs, etc.)

More data for environmental decision-making will improve outcomes (from environmental justice to climate change)

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Emerging EPA Vision

Community & Citizen Science

EPA envisions a future where **all parts of society are increasingly engaged and empowered** to help advance scientific knowledge that informs environmental protection actions on local, regional, and national scales.

In this vision, community and citizen science projects will provide **accessible, actionable data** that improves environmental awareness and decision-making.

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Good Science

Increase Scientific Understanding

Plan and document data quality

Use innovation, experimentation and evaluation

Community Involvement

Create equity in community projects

Build capacity for place-based problem-solving

Support collaborative partnership networks

Informed Decisions

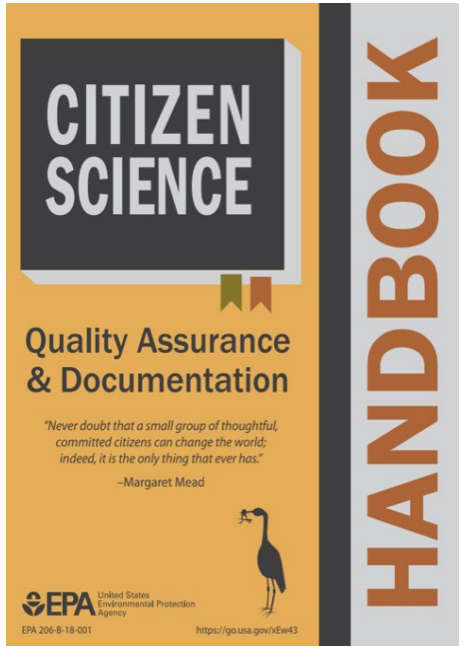
Strengthen shared governance with states and tribes

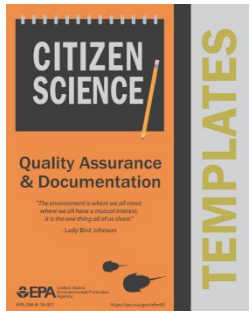
Maximize transparency and accessibility

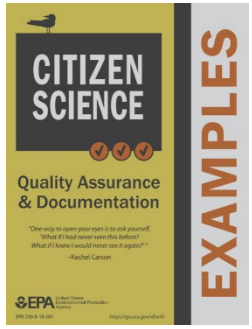
Encourage diverse project approaches

Integrate into the full range of EPA's work

DRAFT EPA PRINCIPLES







1. PSA (0:51) EXIT

2. Overview EXIT (3:00)

3. 6 Key Questions EXIT (5:12)

QA Video Series

4. Developing Your Team EXIT (2:23)

5. Documenting Data EXIT (2:25)

6. Developing a Project Plan EXIT (4:23)

Data Quality Planning and Documentation

New EPA Tools & Resources

- **Quality Assurance Handbook** – Guides organizations that are starting or growing a citizen science project, and where collecting sound data is central to the project.
- **QA Video Series –** Walks citizen scientists through the Handbook to help develop a project plan & produce quality data that can inform decisions.
- **Orientation Guide & Fact Sheets** – Can be used alongside the video series to help provide agencies, laboratories and citizen science groups with information, strategies and resources to collaboratively develop a project plan using the EPA QA Handbook.

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EPA Air Sensor Toolbox

- Air sensors are increasingly being used by the public, giving citizen scientists the opportunity to collect air quality data in their communities
- EPA's Air Sensors Toolbox website provides the latest science on the performance, operation, and use of air sensors for technology developers, air quality managers, citizen scientists and the public
- The Toolbox provides guidance and instructions to allow people to effectively use air sensors and to collect, analyze, interpret, and communicate air quality data

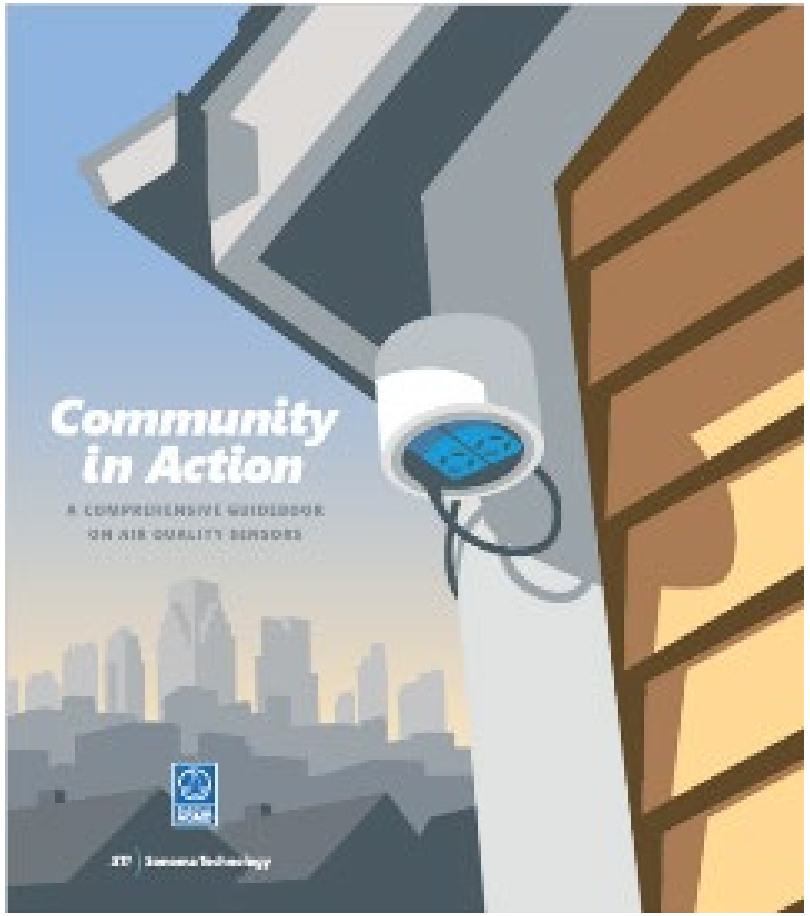
Webpage provides a wealth of resources on air sensors

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

Select resources available in Spanish:
https://espanol.epa.gov/espanol/caja-de-herramientas-de-sensores-de-aire

Toolkit for Community Use of Air Quality Sensors

- California's South Coast Air Quality Management District (AQMD) issued the guidebook and toolkit (Sept 2021)
- Toolkit based on collaborative efforts with 14 CA communities over the past five years
- Draws on experience of deploying nearly 400 air quality sensors under an EPA research grant
- Contains sections on air quality project planning, operating air quality sensors and understanding the data
- Includes training videos



Check out the toolkit here

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EPA Collaborative Projects with States & Tribes

Hot Spot Air Monitoring Project with New Jersey

- Collaborative project with New Jersey DEP and Rider University to assess the efficacy of an air sensor network to monitor ozone, nitrogen oxides, and fine PM using low-cost air sensors
- Serves as a real-world test of a standardized process for communities to collect screening-level data on hot spots

Demonstration of a Tribal Air Sensor Loan Program*

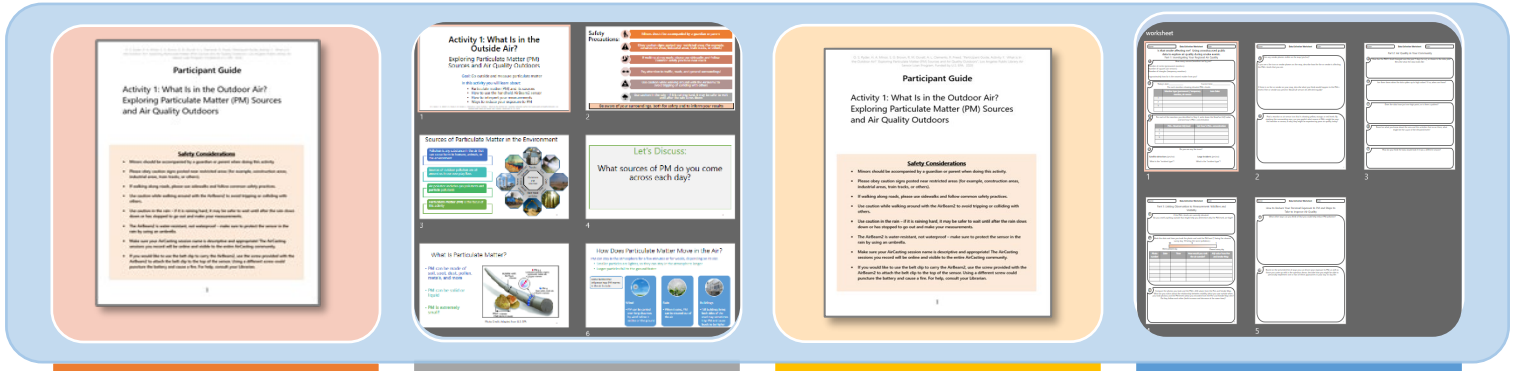
- Ongoing project increases availability of low-cost air sensors for tribal community monitoring
- Sensor loan program at 9 rural libraries help tribal members learn about air quality science, understand PM pollution, and learn how to interpret air quality data

*with the Nez Perce Tribe, Heritage University (located on the Yakama Reservation), & the Institute of Tribal Environmental Professionals (ITEP)

Sensor Loan Support Resources

1. Hands-On Lesson Plans (check out the resources here)

- Exploring Particulate Matter Sources and Air Quality Outdoors
- Hidden Particulate Matter Indoors! Explore Your Environment
- My Pollution Bubble! Exploring My Personal Particulate Matter Exposure
- The Power of Plants! How Vegetation Can Help Protect Us from Air Pollution (coming soon)
- Is That Smoke Affecting Me? Using Crowdsourced Public Data to Explore Air Quality During Smoke Events (coming soon)



Instructor Guide/Answer Key

- information to help instructors lead the lesson
- Answers to questions
- Additional tips for participants

Introductory Slide Set

- Instructors can use slides to introduce lesson & concepts
- Participants can also review on their own or prior to the lesson

Participant Guide

- Introductory material and instructions for participants

Participant Worksheet

- Printable pages with space for participants to fill in their answers to questions

2. Technology Resources

AirBeam2 and PurpleAir Quick Start Guides

- Step-by-step instructions on how to set up and run a borrowed sensor.

AirBeam2 and PurpleAir Quick Start Guide Presentations

- Slides on how to set up and run a borrowed sensor.
- A video on the AirBeam2.

FAQ Document

- Supplemental information with answers to common questions related to air sensors, data collection, and air quality.

3. Additional Resources

Resource Guide

- Supplemental information on air sensors, air quality, and air pollution. Other educational materials are included.

Air Quality 101 Presentation

- Background information on air pollution, air quality, and air sensors.

Advanced Topics in Air Sensor Use

- Slides on interpreting evaluation results, collocation, data quality control, and data analysis.

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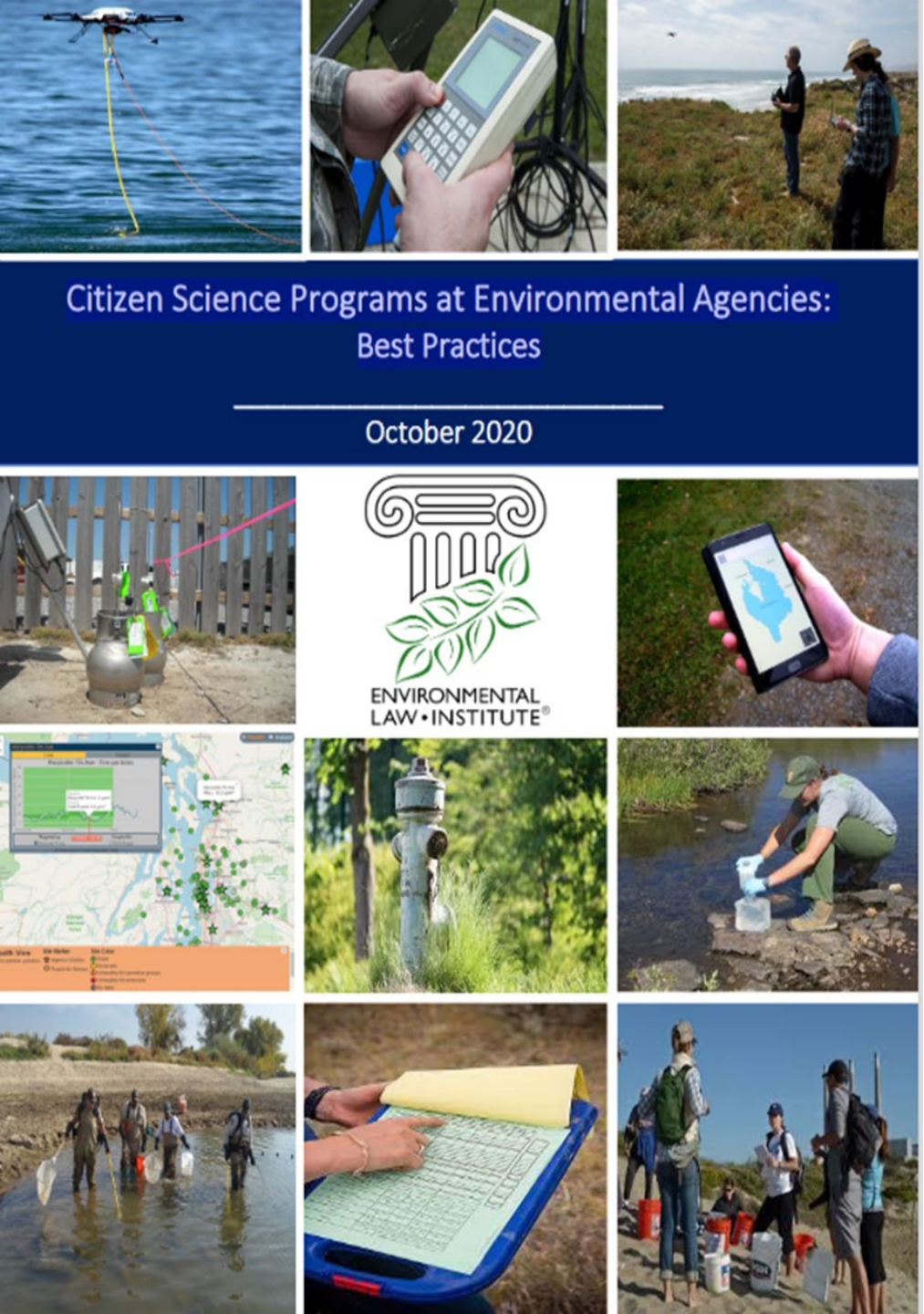
Understanding the Use of Citizen Science in State, Tribal & Local Gov't Environmental Programs

Assessment by the **Environmental Law Institute**

- 15 Case studies
- Best practices report
- Interactive webinars
- Final report and recommendations



Best Practices
of Successful Agency Programs

Focus on Data

- Define data needs and whether the public can help
- Create and communicate data quality protocols
- Use new tools for data collection, display

Build Partnerships and Networks

- Frequent communication with volunteers
- Provide training and technical resources
- Partner with others, involve them in program design

Document Results to Sustain Funding

- Measure outcomes to demonstrate value
- Invest in building support for long term sustainability

Understanding Tribal Citizen Science
Case Studies

• Microplastics in Subsistence Foods	Sitka Tribe of Alaska
• Radon Monitoring	Leech Lake/Band of Ojibwe
• Microbial Source Tracking	Shinnecock
• Watershed Watch	RiverSource, Southwest Tribes
• Climate Change Research	Menominee Nation
• Preventing Invasive Aquatic Species	Blackfeet Nation
• Climate Resilience on Tribal Lands	Great Basin & Southwest Tribes
• Watershed Monitoring	Fond du Lac Tribal & Community College

"Tribal Citizen Science: Investigating Current Activities and Future Aspirations" (Feb 2021)

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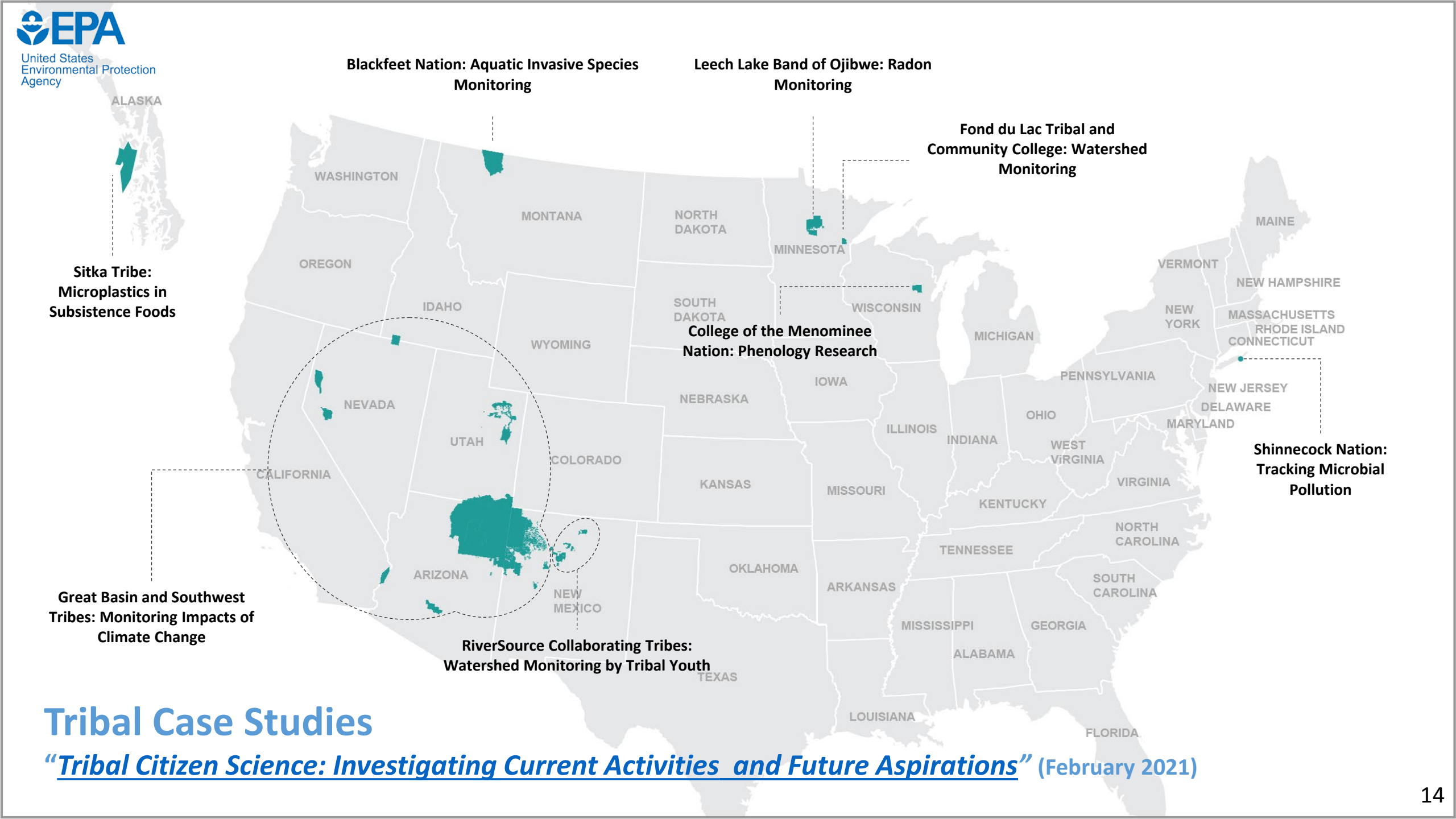
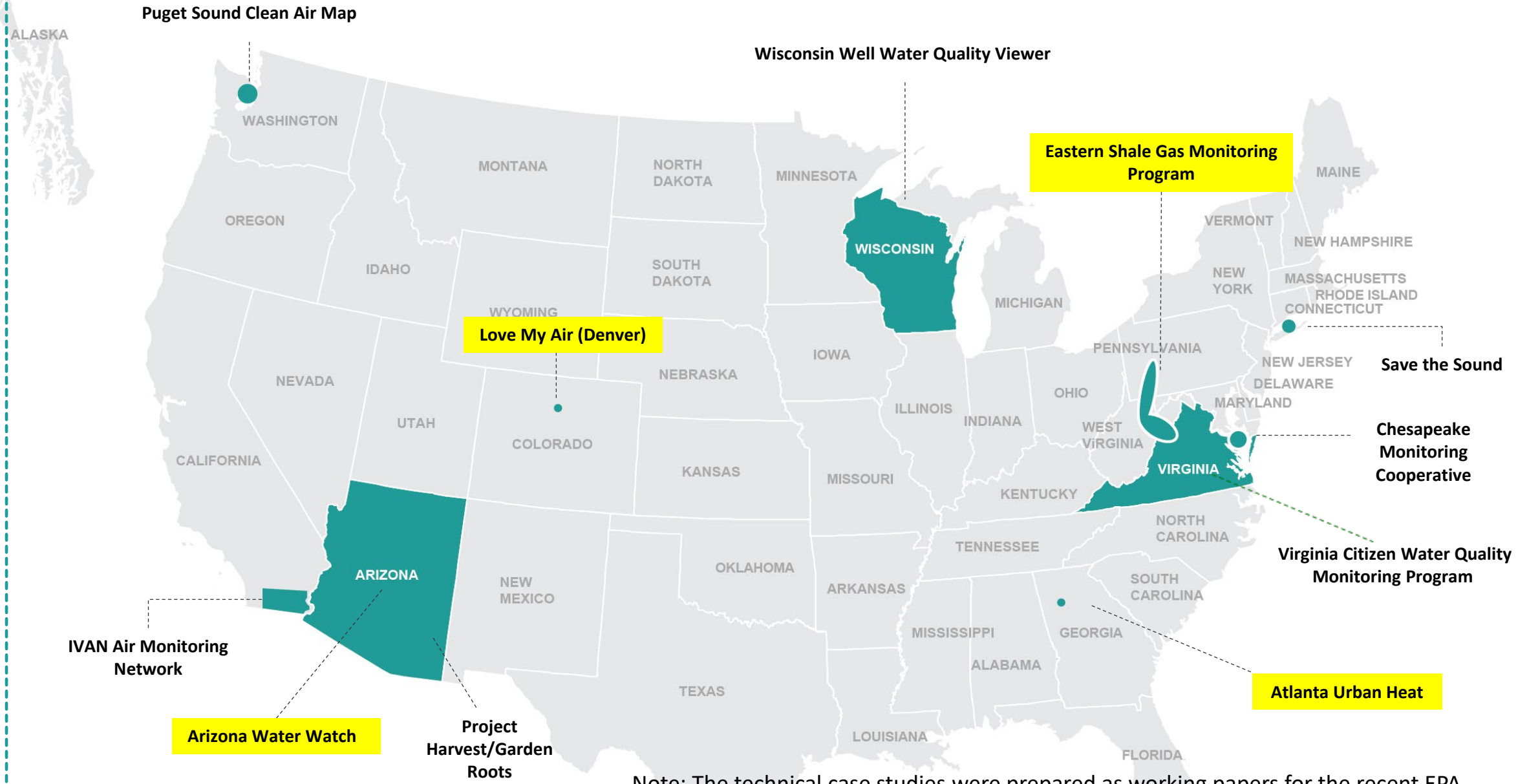


Tribal Case Studies

"Tribal Citizen Science: Investigating Current Activities and Future Aspirations" (February 2021)

12 New Case Studies on Data Management Practices for CCS Projects



Note: The technical case studies were prepared as working papers for the recent EPA Data Management Workshop and will be posted soon on the [EPA citizen science website.]

Case Studies for Today's Discussion

1. **Atlanta Urban Heat** – Community scientists help map temperature profiles that link to climate change, and the role of urban greenspace, city planning, and energy burden

2. **Love My Air (Denver**) – School-based air quality monitoring network provides real-time AQ data using low-cost technology

3. **Arizona Water Watch** – State program uses a mobile app to accept water data, observations and photographs from volunteers

4. **Eastern Shale Gas Monitoring Program** – Trout Unlimited supports stream surveillance for water quality impacts in PA, WV, and VA

UrbanHeatATL

Na'Taki Osborne Jelks, Spelman College
Kim Cobb, Georgia Institute of Technology

Extreme heat is the leading cause of weather-related deaths in the US.

Heat extremes are particularly deadly in densely populated urban centers and disproportionately affect the most vulnerable community members.

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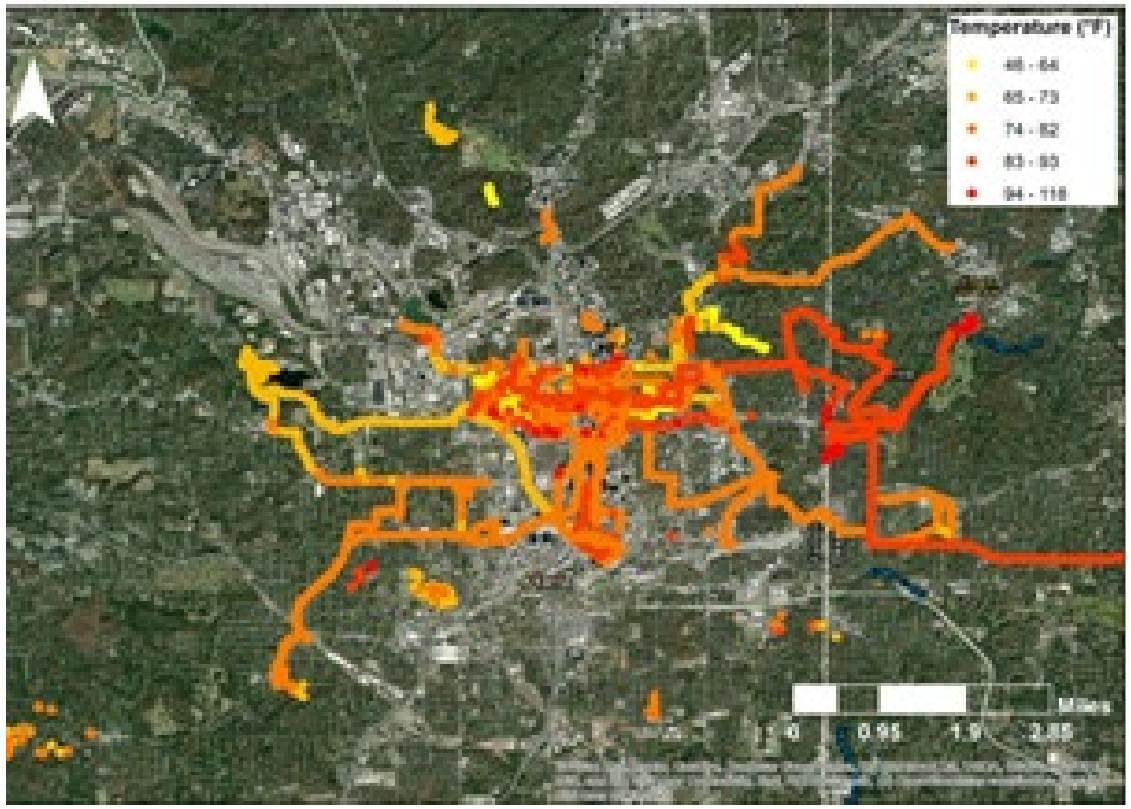
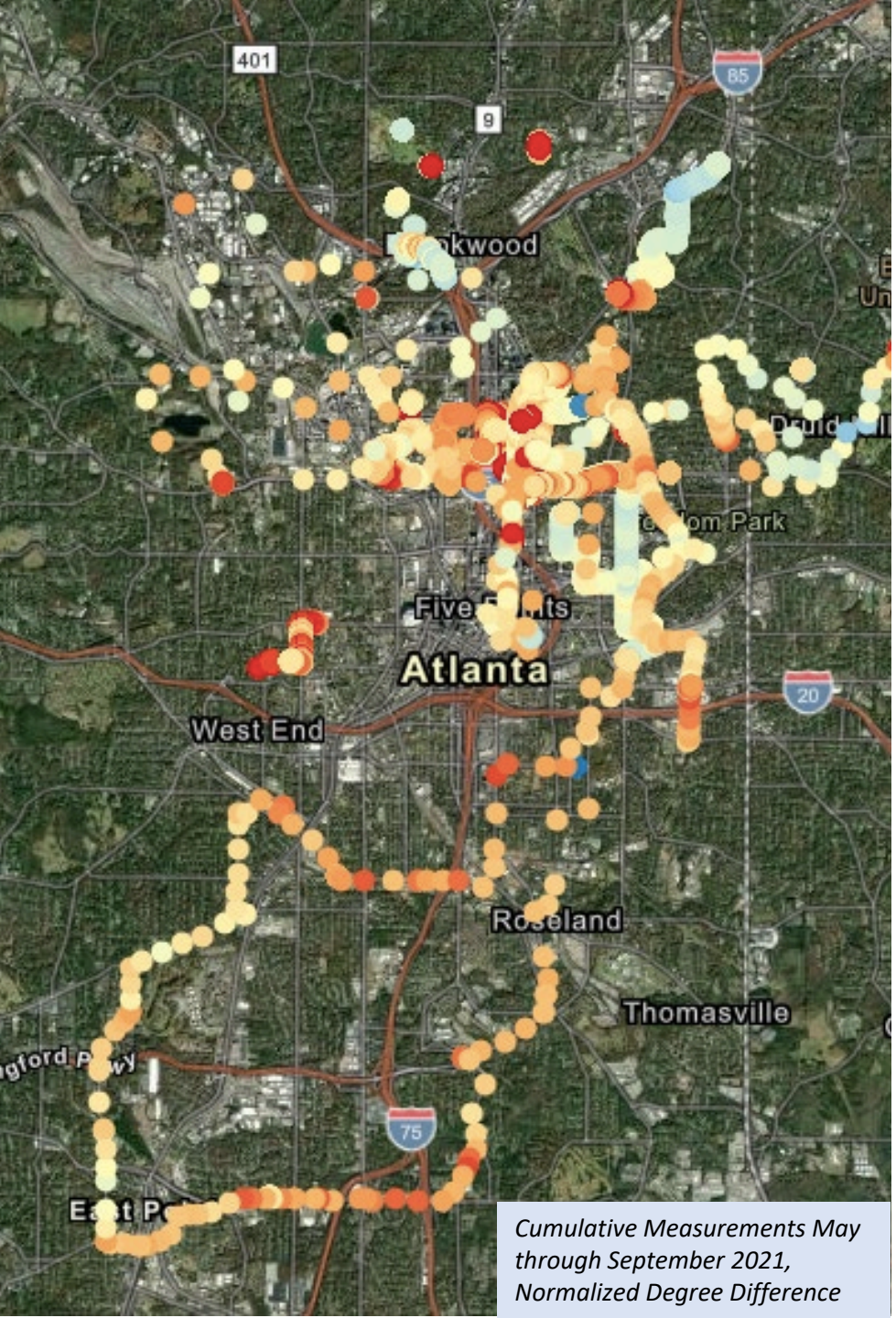
Urban Heat ATL

- Community-driven project collects temperature data in Atlanta to map urban heat hotspots
- Project data support community-based recommendations for mitigating hotspot impacts
- Enhances storytelling by adding facts to community narratives
- Supports citizen claim-making with decision makers



** a collaboration with **Spelman College Environmental and Health Sciences Program**, the **West Atlanta Watershed Alliance**, the **Partnership for Southern Equity**, the Georgia Tech **Center for Serve-Learn-Sustain**, the **Urban Climate Lab** and the Georgia Tech **Global Change Program** and the **City of Atlanta***



Cumulative Measurements May through September 2021, Normalized Degree Difference

Urban Heat ATL (Data Collected)

- More than 1 million air temperature data points in over 280 hours since the project began in March
- Volunteers email or upload sensor data via smartphone to a server at GA Tech
- Data undergoes a QC process to detect erroneous data
- Project data combined with temperature data from stationary sensors and high-powered mobile sensors (part of NOAA heat island project in 20 cities across the US)
- Following processing by a series of scripts, the data are stored in a repository as a CSV without a database
- Project produces urban heat maps that allow overlay of health, demographic and economic data with temperature data

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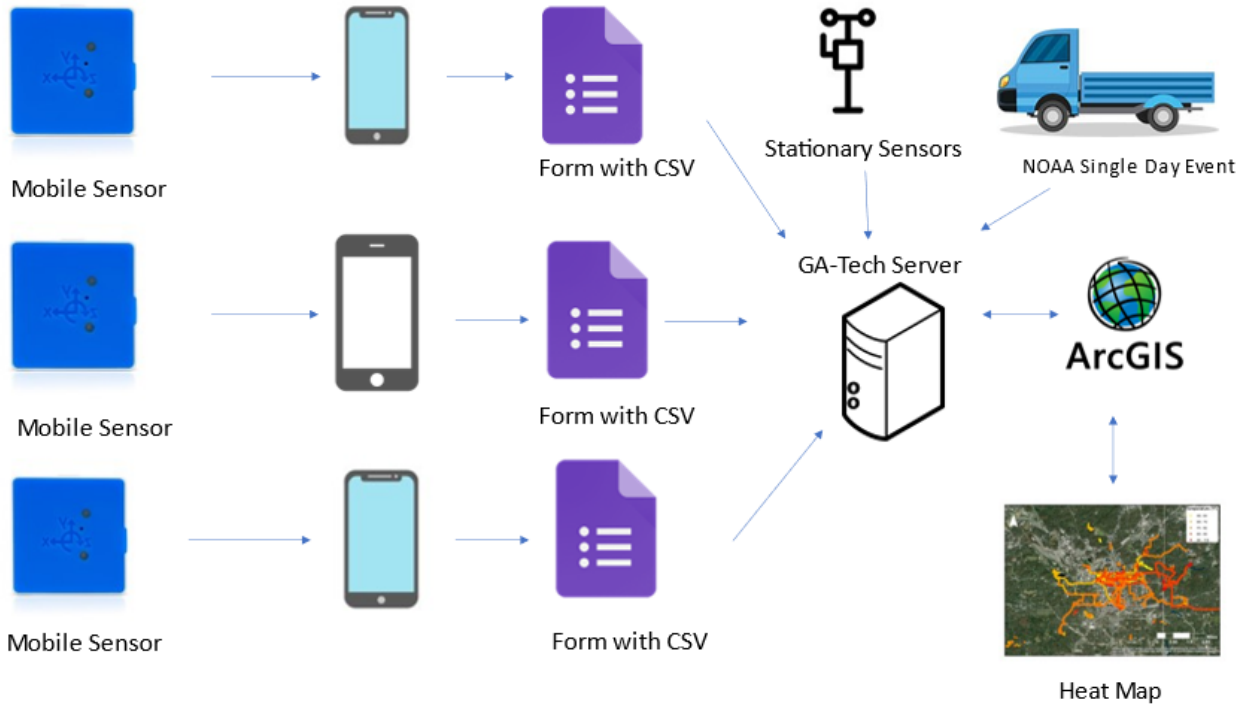

Urban Heat ATL Tools Used

- Mobile Sensors
- Smart Phones
- Conversion from CSV
- Equipment loan programs
- ARC GIS
- Build Heat Maps

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Lessons Learned and Impact

Lessons Learned

- Earlier attention to user experience on mobile sensors would have allowed the project to scale up faster
- Project Leaders surprised by the degree of student and community engagement, media interest, and support
- Investigators worked hard to find modest funding for paid interns; now working toward larger federal grants

Outcomes and Success Factors

- Collection of relevant data lends credibility to anecdotes regarding impact of urban heat in Atlanta
- Decision makers and trusted community partners at the table from the beginning
- Atlanta chosen to participate in NOAA's Urban Heat Watch Day (one of 20 cities) – based on initial project results

love my air mission

Aubrey Burgess
Denver Department of Public Health and Environment

Empower communities to live better, longer by reducing air pollution and limiting exposure through behavior change, advocacy, and community engagement.

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Love My Air Project

Empowers Denver Community with Hyper-Local Air Quality Data

Problem: Denver families spend an average of $3,100 a year on asthma-related medical costs, resulting in more than $30 million spent annually

- Lost wages for parents
- Academic performance suffers

Solution: The City of Denver will work to improve air quality by installing cutting-edge air pollution sensors around schools that will provide data to inform the city's approach to making air safer for all

Funding: 2018 Bloomberg Mayors Challenge

- $1 million dollar grant funding the program through 2021

Health & Fitness

Denver's Air Quality Among Worst In Nation, Report Finds

The American Lung Association has released its annual "State of the Air" report. See what they found for the Denver area.

Daniel Hampton, Patch Staff

Posted Wed, Apr 24, 2019 at 12:21 pm MT | Updated Wed, Apr 24, 2019 at 12:30 pm MT

Like 112 Share Reply

The American Lung Association has released its annual "State of the Air" report. (Doug Pensinger/Getty Images)

love my air network

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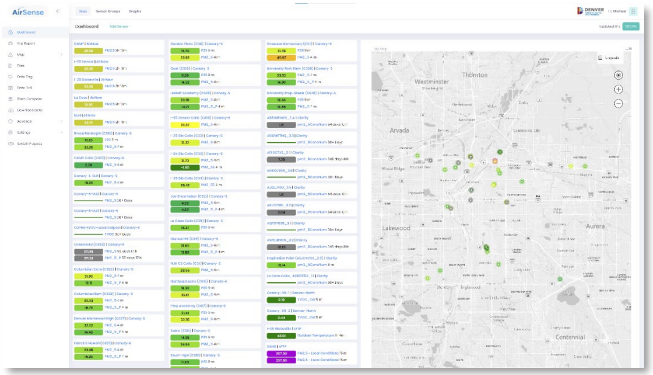
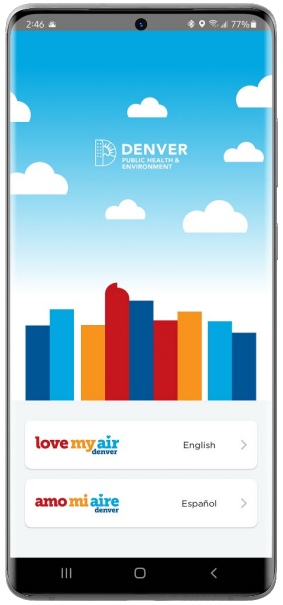
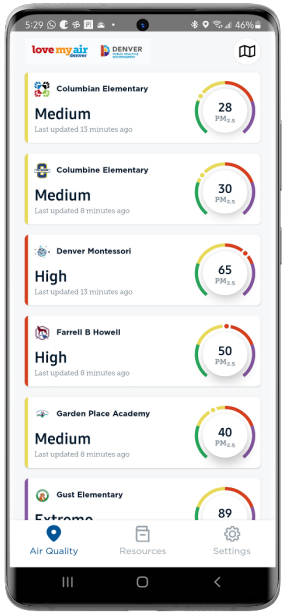
Tools Used

PM2.5,
Clarity, Lunar Outpost, 2B Tech

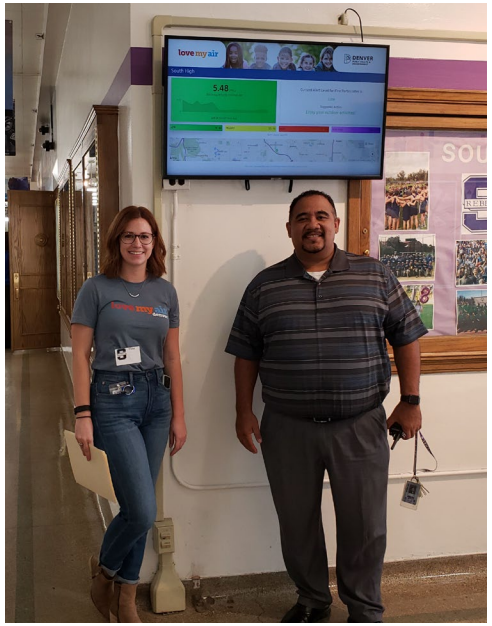


Custom data platform
QA/QC
Correction algorithm



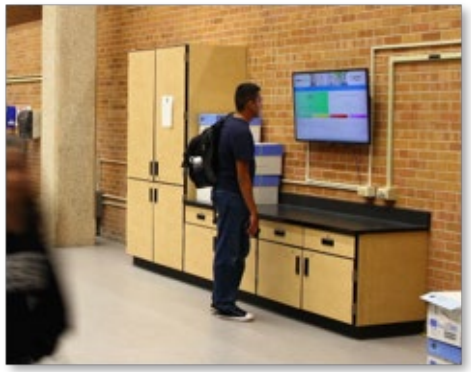


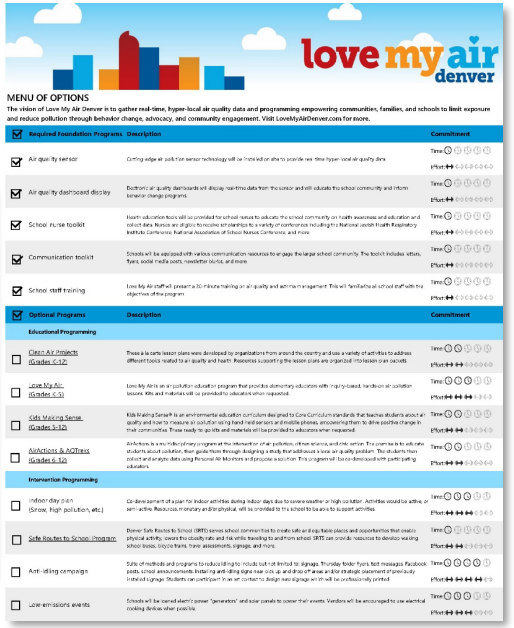
English & Spanish
Regional & local alerting
Health messaging



Education & behavior-change programs

In- school dashboards





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Lessons Learned and Impact

Challenges and Lessons Learned:

- Siting, power and WiFi limitations
- Data reliability of low-cost sensors
- Staff turn-over and competing priorities as schools
- Defining clear success metrics

Outcomes:

- Community buy-in created through early stakeholder engagement
- Real-time, publicly accessible air quality monitoring information
- More authentic connection with the community around air quality issues
- A brand and suite of tools that can be adapted for other communities
- Peer-reviewed paper on data correction algorithm

love my air network

Eastern Shale Gas Monitoring Program

Jake Lemon, Trout Unlimited

Program monitors potential impacts of shale gas development in Central Appalachia

"Anglers gathering scientific information about the fish and the places they love."

Shale Gas Monitoring Program

- Began in 2010 in PA to address local concerns about environmental impact of shale gas extraction
- Expanded to WV and VA in 2013
- Adapted protocol to address environmental impacts of pipelines in 2016
- Provides technical support for local monitoring; also can aggregate data for larger-scale uses
- Data collection – by volunteers from TU chapters and by partner organizations
- Data platform – CitSci.org, a global platform for citizen science hosted by the Natural Resource Ecology Lab at Colorado State University

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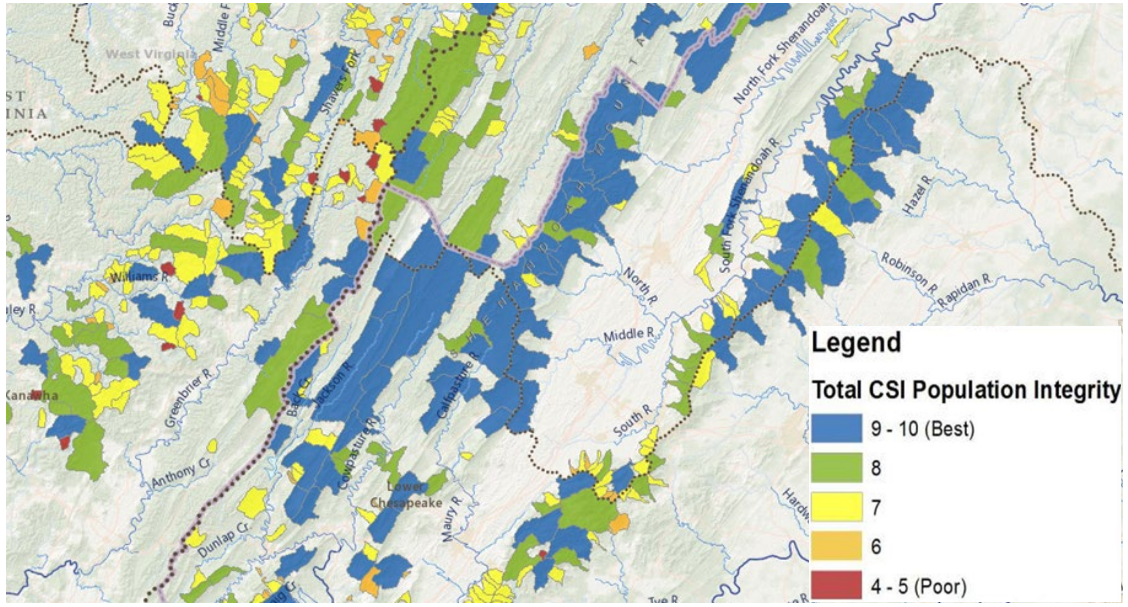
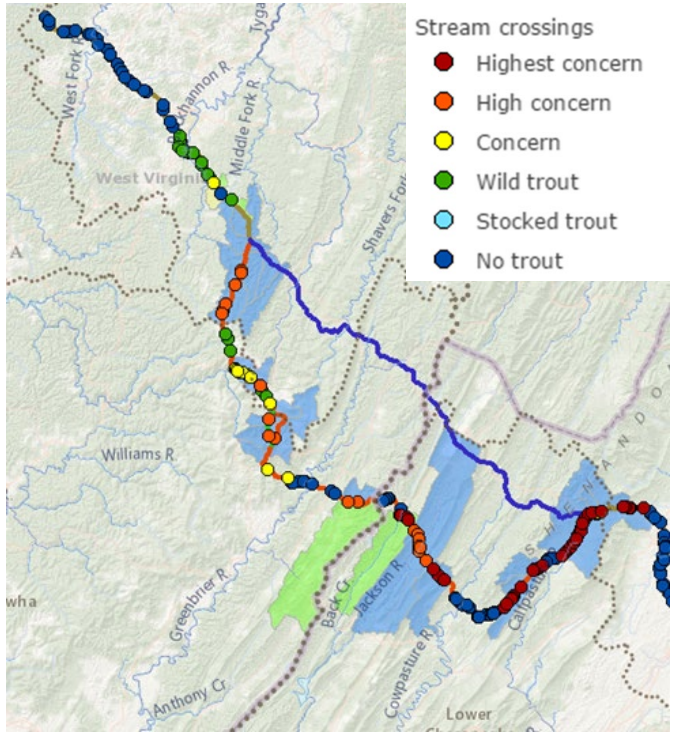
Shale Gas and Pipeline Monitoring

To better inform conservation strategies, Trout Unlimited has developed a Conservation Success Index (CSI) that compiles the best available information on trout species distribution, population, habitat features and future threats





Check out our newest planning tool in the region, the [Eastern Brook Trout Conservation Portfolio]

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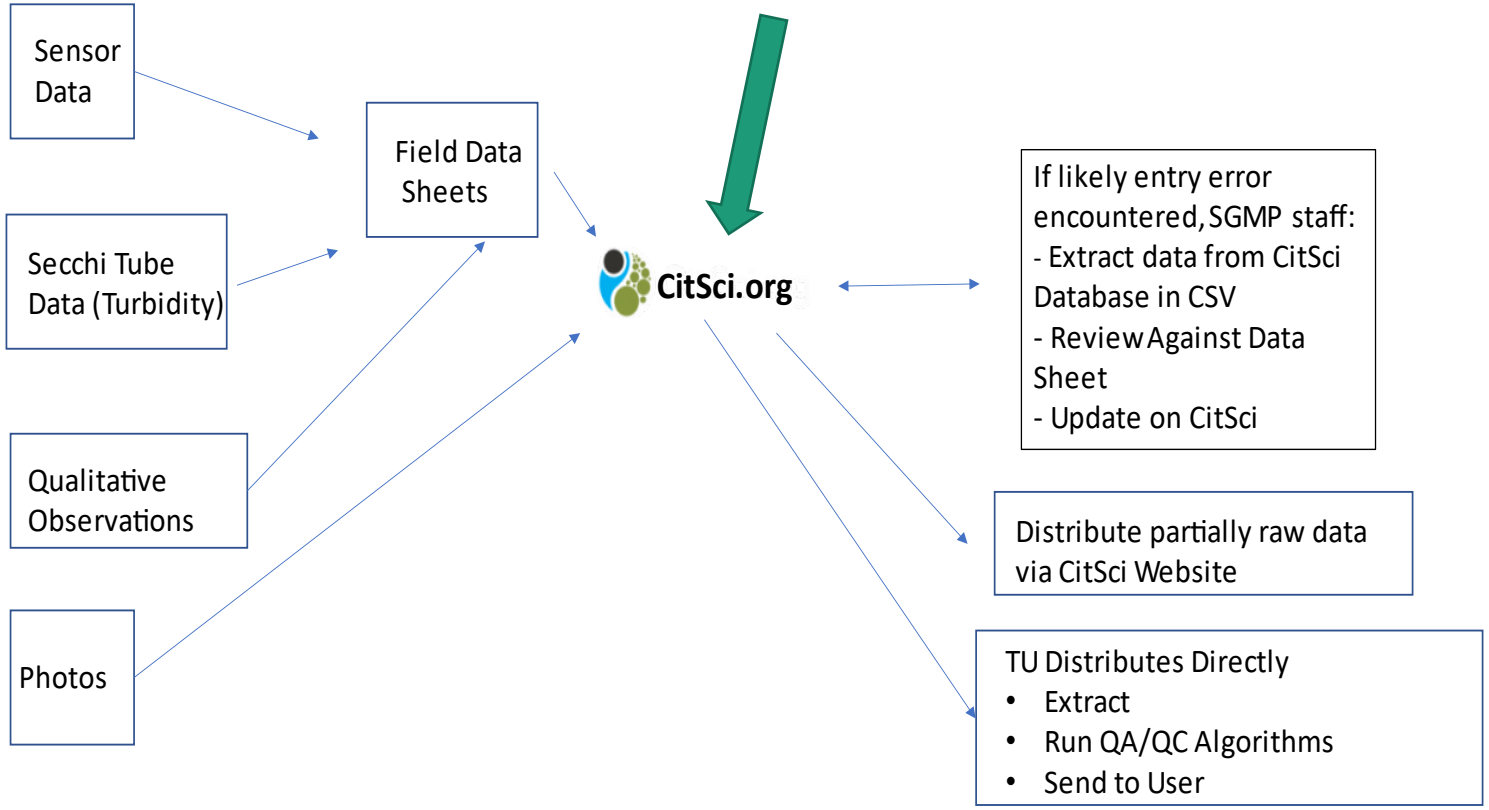
Data Management

- Uses traditional data collection techniques
- Paper field data sheets and then data transferred to templates via CitS
- The primary parameters use sensors and other equipment
- Water samples are taken periodically for parameters such as contaminant concentration and for quality control
- Also include visual observation and documentation

Role of TU monitoring group

- Enter data on CitSci templates
- Perform optional QC using CitSci Visualizations



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Lessons Learned and Impact

- Technical issues for equipment and calibration
- Streamline data entry process builds on the more traditional approach
- Proactive engagement and responsive technical support are key to engaging and retaining volunteers
- Single-day "Snapshot" events help gather a lot of data quickly in a particular location
- Active technical support important for data quality and volunteer retention

Meghan Smart
Arizona Department of Environmental Quality

As a desert state, water is one of Arizona's most precious resources that people and animals rely on to live.

Through AZ DEQ, Arizona Water Watch engages community volunteers (age 10+) to help monitor the health of their waters.

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Arizona Water Watch

- Community groups gather water quality data that support state assessments, identify pollution sources, & assess the effectiveness of Best Management Practices
- Initiated by Arizona Department of Environmental Quality (ADEQ) in 2017

Role of Community Scientists

- Project provides training and micro-videos that comply with Clean Water Act requirements
- Volunteers are given sensors and lab kits and later process samples, upload photos, and report results using ESRI's ArcGIS Survey123
- Based on Arizona's Credible Data Rule, sample plans are developed each year by ADEQ

2020

ARIZONA WATER WATCH

7,000
water data records

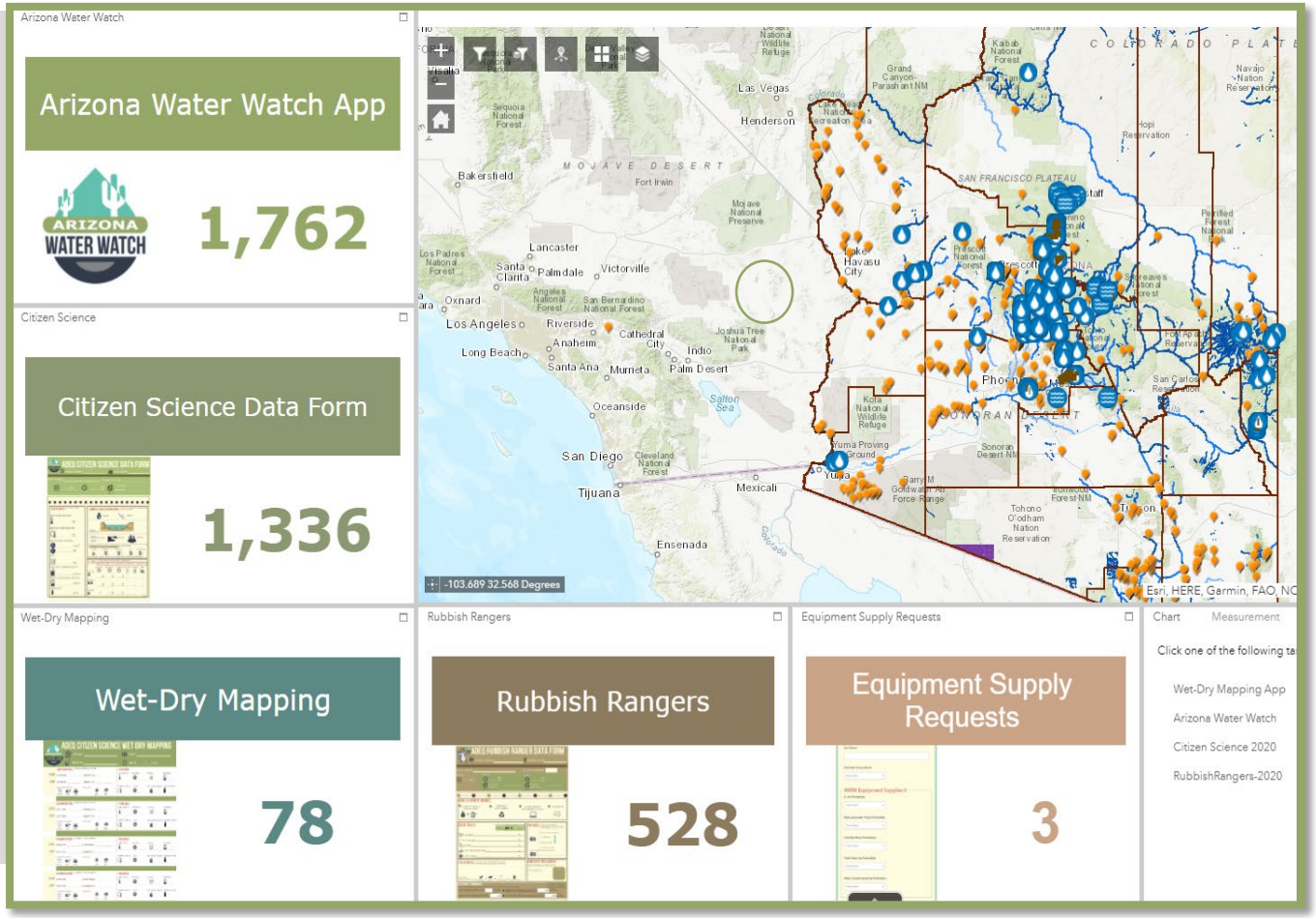
25
citizen science groups

33
wet dry mapping app submissions

8,000
pounds of trash cleaned up

1,687
flow regime app submissions

DATA MANAGEMENT & USE



Data Management

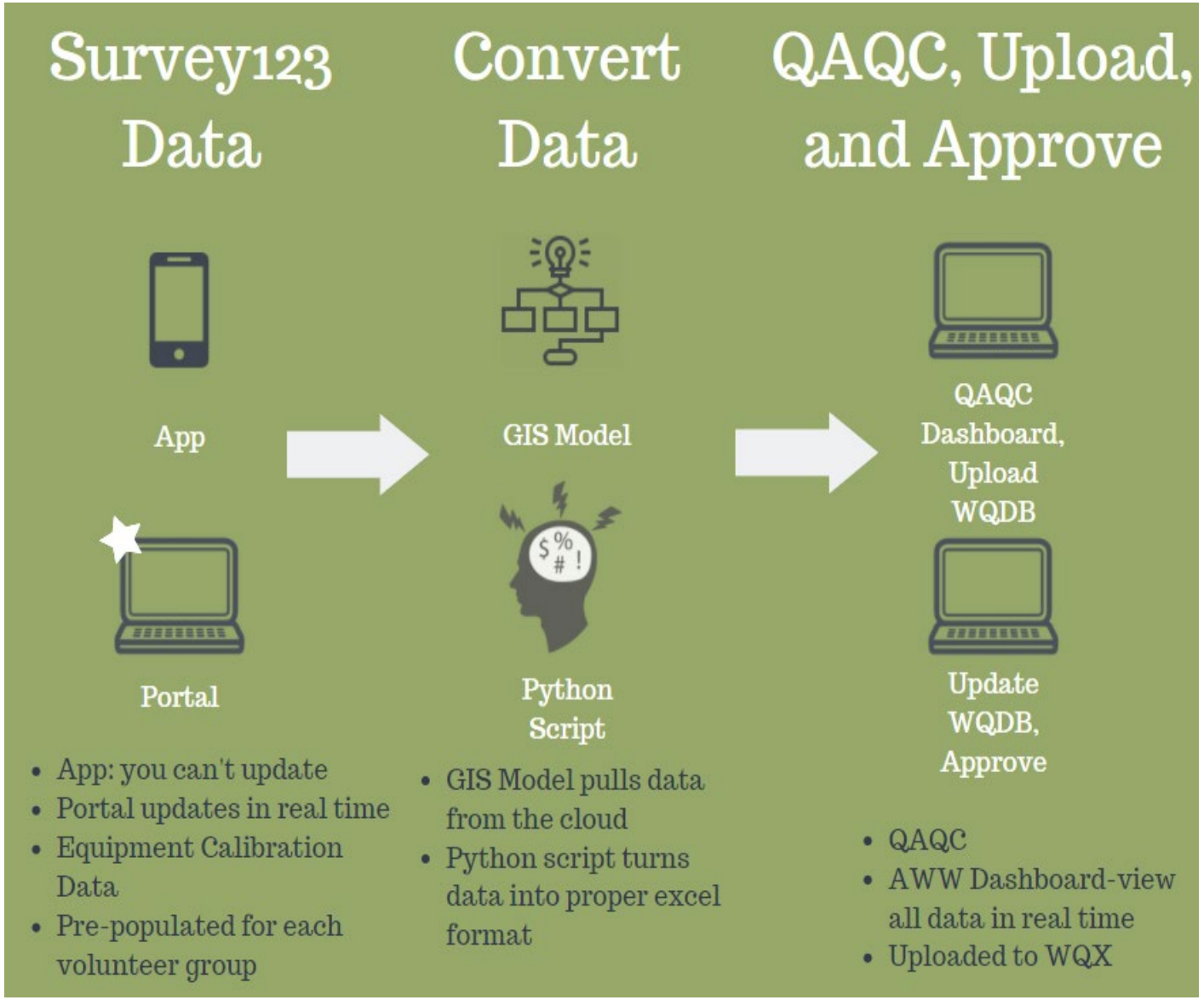
- Data stored and validated on ESRI's ArcGIS Data Cloud before entering the ADEQ Database
- Sensors calibrated quarterly and adherence to protocols is audited
- R program & dashboard provide real-time information during the state assessment reporting cycle

Data Use

- AZWW data informs state assessments that target resources for clean-up & identify at-risk water bodies
- Data submitted to EPA's Water Quality Exchange (WQX) where it informs national water quality and supports decision-making
- Data also helps water resource managers know where pollution problems exist, where to focus pollution control energies and where progress has been made

Tools Used

- The Survey123 app (Water Quality Data, Wet Dry mapping and observations on HABS/fish kill, trash cleanup's).
- Data stored in ArcGIS Online data cloud
- Data pulled from ArcGIS weekly via a python script, manipulated into a specific excel format
- Data placed on internal ADEQ drives for QA/QC review and then uploaded to the ADEQ Water Quality Database



Lessons Learned and Outcomes

- Success is all about relationships and community engagement
- Standardization of equipment reduces technical support issues
- Paid Volunteer Coordinator strengthens relationships with volunteer groups
- Need to provide alternatives to the mobile app, including paper form options due to the range of volunteers' technical and physical capabilities
- Use of Survey123 (mobile and computer app), R program, and dashboard improves data quality and significantly reduces manual data entry
- Committed volunteers, a strong training program, and an equipment loaner library allow for standardization and improved technical support

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CITIZEN SCIENCE:
THEORY AND PRACTICE

Bowser, A, et al. 2020. Still in Need of Norms: The State of the Data in Citizen Science. *Citizen Science: Theory and Practice*, 5(1): 18, pp. 1–16. DOI: https://doi.org/10.5334/cstp.303

RESEARCH PAPER

Still in Need of Norms: The State of the Data in Citizen Science

Anne Bowser*, Caren Cooper†, Alex de Sherbinin‡, Andrea Wiggins§, Peter Brenton‖, Tyng-Ruey Chuang¶, Elaine Faustman**, Mordechai (Muki) Haklay†† and Metis Meloche*

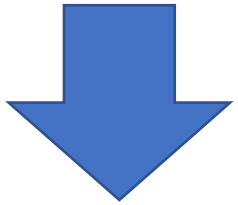
This article offers an assessment of current data practices in the citizen science, community science, and crowdsourcing communities. We begin by reviewing current trends in scientific data relevant to citizen science before presenting the results of our qualitative research. Following a purposive sampling scheme designed to capture data management practices from a wide range of initiatives through a landscape sampling methodology (Bos et al. 2007), we sampled 36 projects from English-speaking countries. The authors used a semi-structured protocol to interview project proponents (either scientific leads or data managers) to better understand how projects are addressing key aspects of the data lifecycle, reporting results through descriptive statistics and other analyses. Findings suggest that citizen science projects are doing well in terms of data quality assessment and governance, but are sometimes lacking in providing open access to data outputs, documenting data, ensuring interoperability through data standards, or building robust and sustainable infrastructure. Based on this assessment, the paper presents a number of recommendations for the citizen science community related to data quality, data infrastructure, data governance, data documentation, and data access.

Data Management Workshop (Nov 16-18, 2021)

Sponsored by EPA & E-Enterprise Leadership Council (EELC)

Workshop Approach: Convene experts to identify gaps and needed actions to improve data management

Workshop Discussion: What are your best ideas on how to better integrate and use community and citizen science data?



Workshop Outputs:

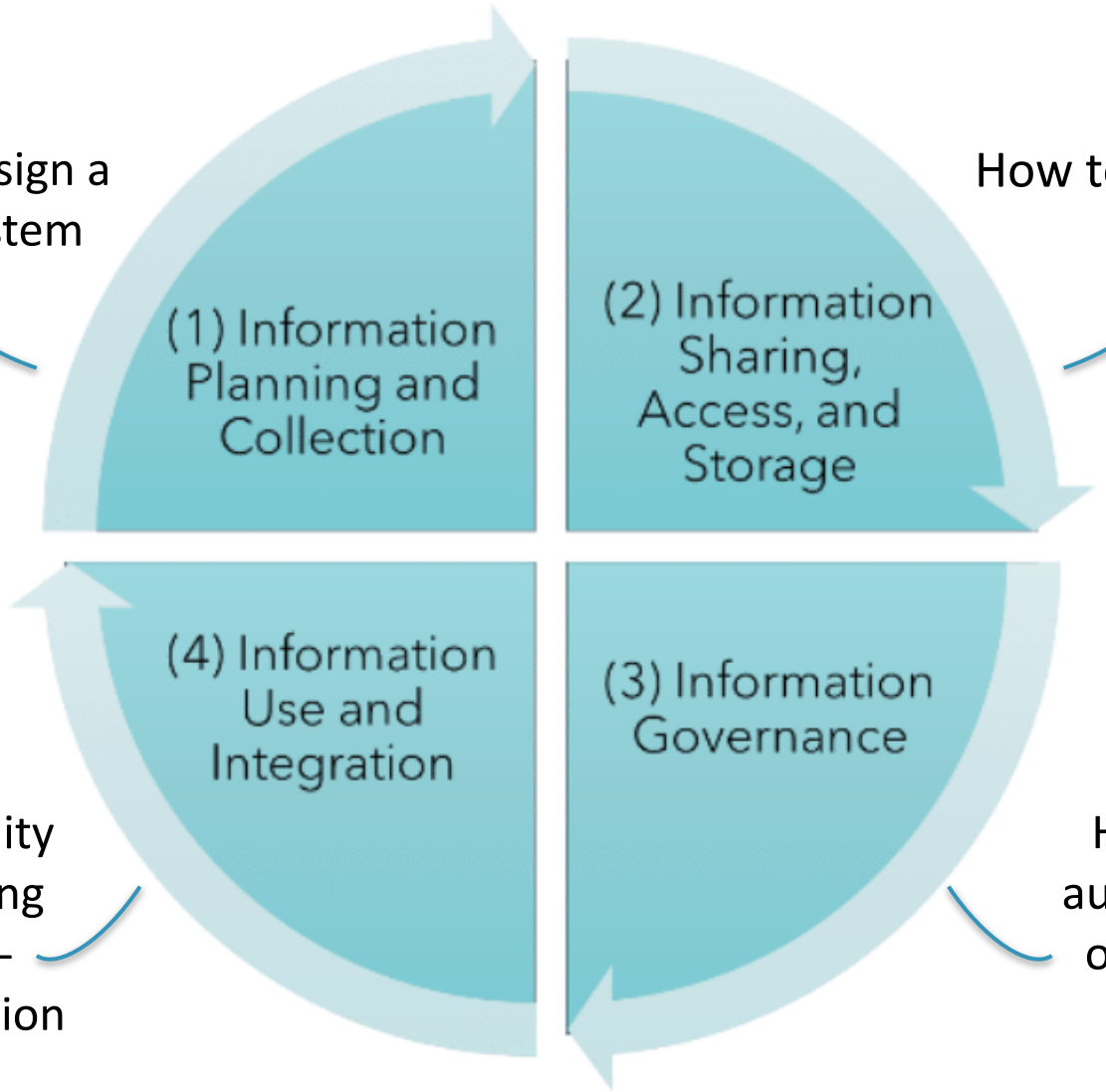
1. A **multi-stakeholder roadmap** that outlines how partners can work together
2. An **EPA strategic plan** for improving how community and citizen science data is managed and used

DATA LIFECYCLE FRAMEWORK USED AT WORKSHOP

HOW DATA FLOWS FROM PRODUCTION TO USE

How to identify a problem, design a project, and set up a data system

How to use data management technology



How data can advance community understanding, provide screening information, support decision-making, or inform regulatory action

How to set up processes for authority, security, and control of collected information and data

EPA United States Environmental Protection Agency

Issues in Current Data Management Practices

- QA practices
- Data platforms
- Data interoperability and compatibility
- Data accessibility
- Transition from paper to digital
- Technical support
- Secondary use of data
- Relationships with government (EPA, State, Tribal, local)
- Use of data in decision making
- Peer to peer sharing and learning

Workshop Outcome -
Multi-Stakeholder Roadmap

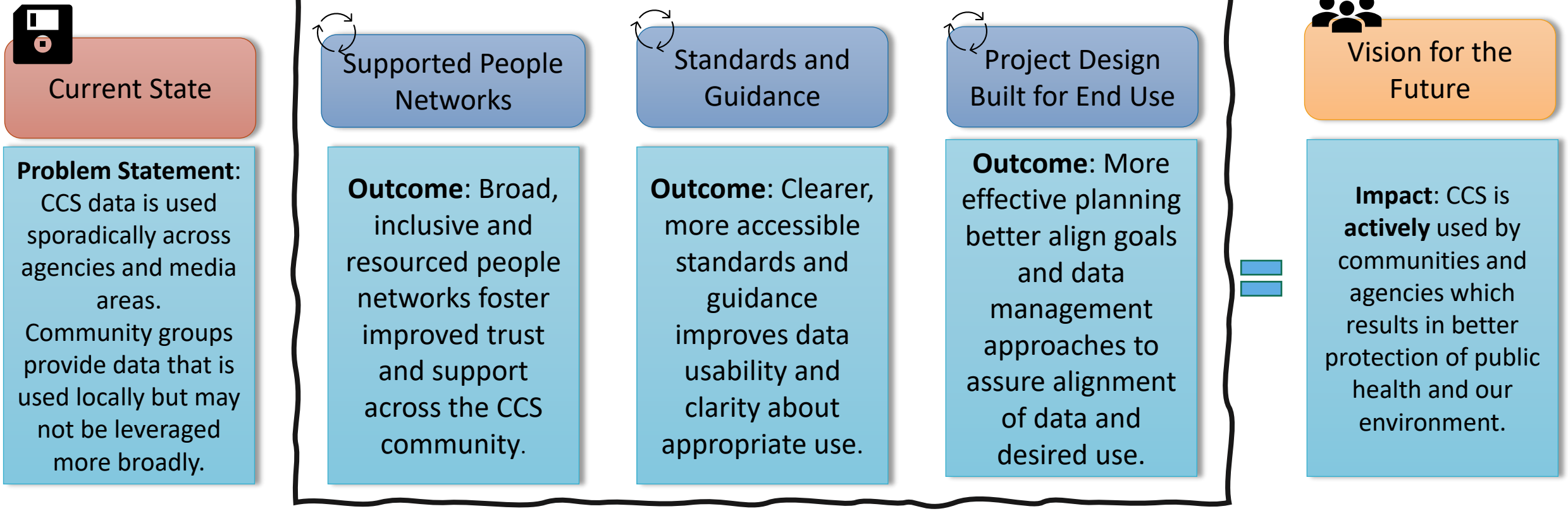
OUTCOMES

STRATEGIES

ACTIONS

Draft roadmap will be available in January 2022

Community and Citizen Science Theory of Change



Future Opportunities – *Ideas from the Workshop*

People Networks

- **Document data management gaps** – Inventory existing networks to identify needs
- **Build/support regional networks** – Provide connections for education, technical support, and knowledge sharing
- **Multi-stakeholder collaborative workshops** – Convene regular meetings to increase communication and sharing across communities
- **Awareness training and conferences** – Build understanding about CCS data use; special outreach to regulatory agency staff

Standards & Guidance

- **Metadata standards** – Continue to develop standards for different data tiers; develop guidance/principles that encourage their adoption
- **Data Tiers** – Build on existing and adopted approaches; develop a data tier framework for EPA
- **CCS Data Management Handbook** – Convene a multi-stakeholder data group to develop content and help with training/outreach

Future Opportunities – *Ideas from the Workshop (Cont.)*

Project Design & Planning

- **CCS Data Academy** – training, networking, and knowledge transfer by media area
- **Project design toolkit** – references EPA QA Handbook for CCS; make more inclusive, easier to use, and available in multiple languages and formats (better accessibility)
- **Update existing CCS guidance on project design** – to be inclusive of how project planning impacts the ability for data to be used more broadly (e.g., connect to data tiers)

Innovative Funding Approaches

- **Define funding opportunities (existing & emerging)** – provide CCS connections and guidance (e.g., ARP funding directed towards community groups)
- **Grant guidelines** – for agencies to use in grant guidance; amplify the value and usability of CCS data
- **Data visualization hack-a-thon** – leverage innovation and resource sharing across community groups (e.g., how to reduce costs)
- **Best practices for acquiring funding** – for CCS projects that collect, analyze, and use data

Workshop Ideas for EPA Actions

EPA role

- Serve as a catalyst and convener
- Support kick-off activities
- Integrate CCS into EPA programs and activities

Example activities

- **Catalog CCS guidance materials** – To aid discovery, learning, sharing
- **Data tier framework** – Work with community groups, and state and local agencies to get buy-in; build off existing tiering examples
- **Guidelines for encouraging CCS data in EPA grant programs** – Work across EPA program offices and regions; performance requirements
- **Pilot projects** – Support demonstrations that better define "return on investment" on CCS projects (i.e., how and why CCS is an effective way to increase overall environmental protection and community engagement)

Want to Learn More?

Websites

- EPA's Citizen Science Homepage –
  - Includes links to our *QA Handbook, the data management case studies,* & an *interactive storymap* on EPA's community & citizen science work
- Citizenscience.gov
- Citizen Science Association
- SciStarter – to find projects

Helpful reports and documents

- Best Practices for Citizen Science (Environmental Law Institute)
- Inclusion in Citizen Science: The Conundrum of Rebranding
- The Promise of Community-Driven Science

Contacts

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