National Aeronautics and Space Administration

Connecting Citizen Science with Remote Sensing

Amber McCullum, Juan L. Torres-Pérez, Britnay Beaudry

Jan 24, 2023

Course Structure and Information

- Three, 1.5-hour sessions on January 24, 26, and 31
  - **English:** at 11:00am - 12:30pm EST (UTC-5:00)
  - **Spanish:** at 2:00 – 3:30pm EST (UTC-5:00)

- Each session will feature lecture and a Q&A session where instructors will be online to answer questions.

- Webinar recordings and PowerPoint presentations can be found after each session at: https://appliedsciences.nasa.gov/join-mission/training/english/arset-connecting-citizen-science-remote-sensing

- For additional questions please email:
  - Juan L. Torres-Pérez (juan.l.torresperez@nasa.gov)
  - Amber McCullum (amberjean.mccullum@nasa.gov)
  - Britnay Beaudry (britnay.beaudry@nasa.gov)

ARSET Introductory Webinar:

Connecting Citizen Science with Remote Sensing

Jan 24 - Jan 31

Eng: 11:00 - 12:30 EST (UTC-5)
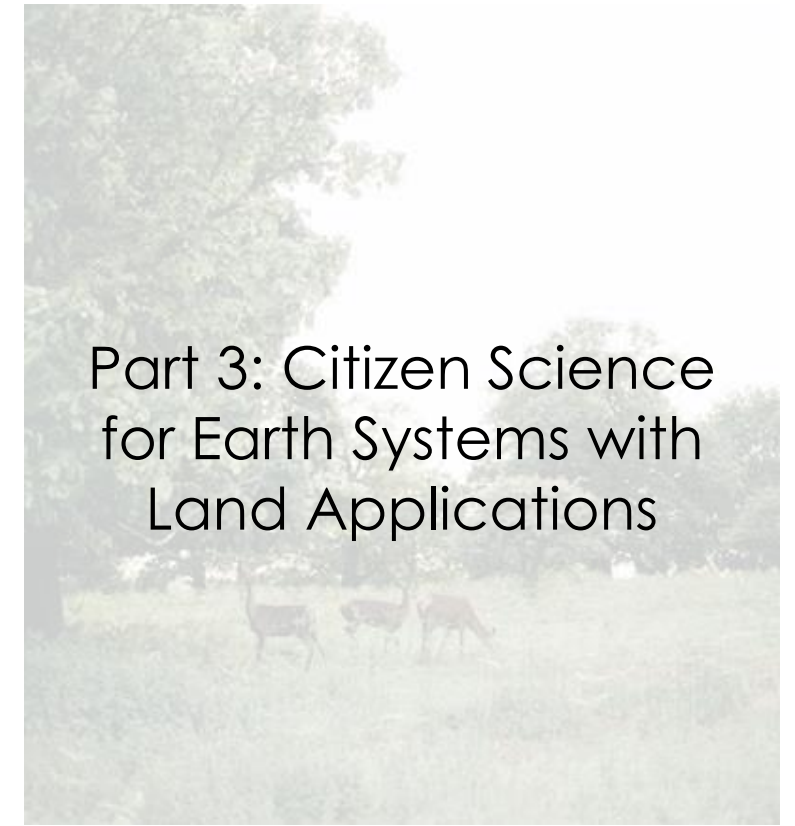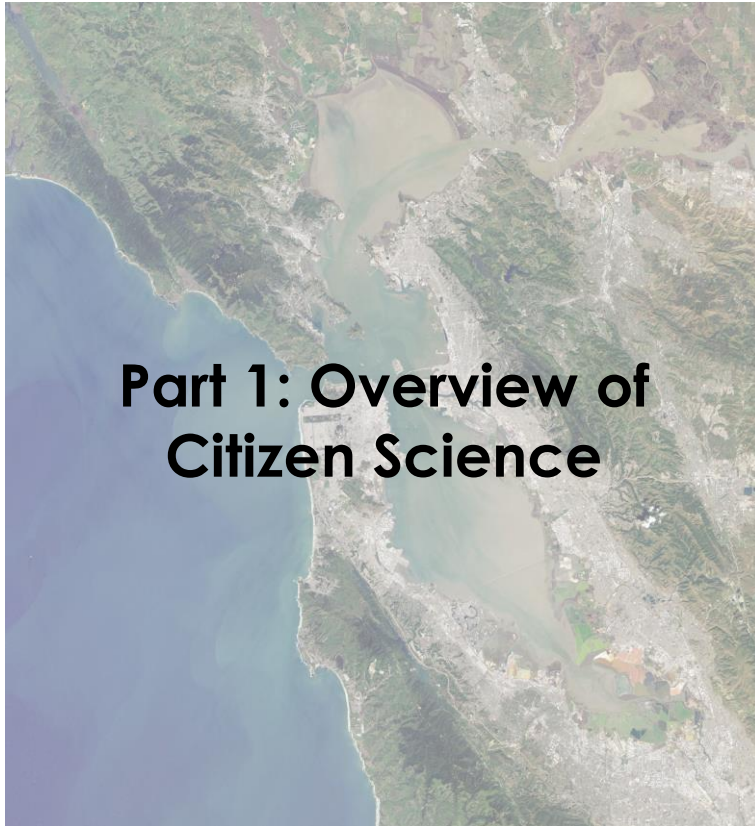Esp: 14:00 - 15:30 EST (UTC-5)

Homework and Certificates

- **Homework:**
  - One homework assignment (available at the end of Session three of this webinar series)
  - Answers must be submitted via Google Forms
  - **HW deadline: February 14th**
- **Certificate of Completion:**
  - Attend all three live webinars
  - Complete the homework assignment by the deadline (access from ARSET website)
  - You will receive certificates approximately two months after the completion of the course from: marines.martins@ssaihq.com

Course Outline

Part 1: Overview of Citizen Science

Part 2: Citizen Science for Earth Systems with Coastal/Ocean Applications

Part 3: Citizen Science for Earth Systems with Land Applications

Learning Objectives

By the end of this training, attendees will be able to:

- Outline key aspects of citizen science projects including:

  - Community engagement and effective communication

  - Motivations, ethics and policies

  - Data quality assurance and accessibility

- Summarize applications of Earth Observations for citizen science

- Discover case study examples of the use of Earth Observations for citizen science

Part 1 Agenda

- What is Citizen Science?

  - Benefits and limitations

  - Types of citizen science applications

- Motivations, ethics, and policies

- Data collection, management, usability, and accessibility

- Tools and platforms

- Q&A
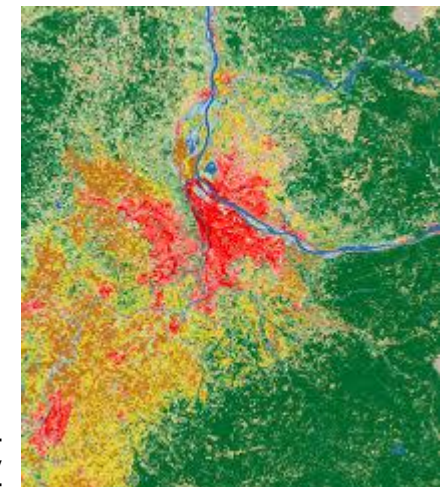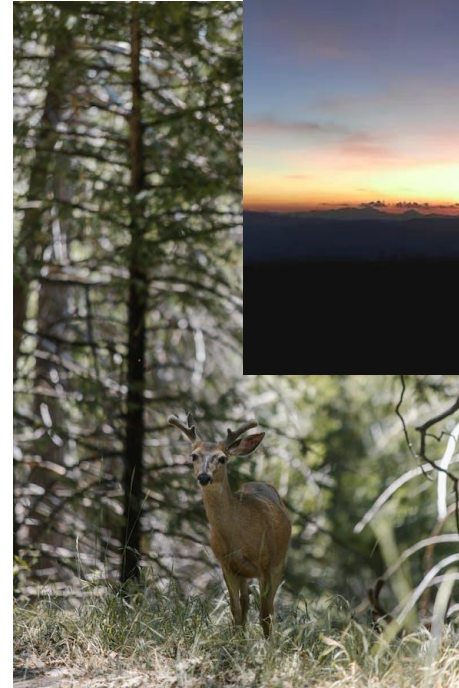
NASA Earth Observatory

NASA's Capacity Building Program

ARSET

ARSET offers trainings (virtual and in-person) on a variety of satellite remote sensing topics to build skills for integrating Earth observations into decision-making activities around the world.

DEVELOP

DEVELOP addresses decision-makers' needs through interdisciplinary 10-week feasibility studies that apply the lens of NASA Earth observations to environmental issues around the globe.

SERVIR

A partnership between NASA and USAID, SERVIR connects space to village by helping developing countries use satellite data to address critical challenges and develop innovative solutions to improve livelihoods and foster self-reliance.

Capacity Building: Community Action

Indigenous Peoples

Builds relationships across NASA and Indigenous communities through place-based remote sensing training, community engagement, and co-production of knowledge.

Equity and Environmental Justice

Builds connections with communities to advance equity and environmental justice – co-development in uses of Earth and social science. Initial work is engagement, feasibility projects, data fusion activities, and DEVELOP projects.

Prizes & Challenges

Builds partnerships with other federal agencies, international space agencies, and private organizations to host competitions, "challenges", and hackathons aimed at open innovation and public participation.

NASA Applied Remote Sensing Training (ARSET)

https://appliedsciences.nasa.gov/arset

- ***ARSET provides accessible, relevant, and cost-free training on remote sensing satellites, sensors, methods, and tools.***

- Our trainings are:
  - Online and in-person
  - Open to everyone
  - Live, instructor-led, or self-guided
  - Provided at no cost, with materials and recordings available from our website
  - Often multi-lingual
  - Tailored to those with a range of experience in remote sensing, from **introductory** to **advanced**

- ARSET offers trainings for:
  - Disasters
  - Health & Air Quality
  - Land Management
  - Water Resources
  - Climate

ARSET now offers climate trainings, our newest thematic area

Introductory Webinar

Introduction to NASA Resources for Climate Change Applications

Sep 29 – Oct 06

Session A: 11:00 - 13:00 EDT
Session B: 15:00 - 17:00 EDT

NASA's Citizen Science for Earth Systems Program (CSESP)

https://www.earthdata.nasa.gov/esds/competitive-programs/csesp

- Advancing citizen science by supporting citizen science activities and developing technology to further involvement in research

- Compliments NASA's ability to observed Earth from space, air, land, and water

Mountain Rain or Snow

Mountain Rain or Snow

Go to Project Website

A 2020-funded CSESP project will develop and deploy a mobile application for collecting precipitation phase observations (rain, snow, and mixed precipitation) across the mountainous Western U.S. to help improve satellite estimates of precipitation type. Image: Keith Jennings/Lynker Technologies LLC

Citizen Science Projects at NASA

https://science.nasa.gov/citizenscience

Floating Forests

Fjord Phyto

Soundscapes to Landscapes

GLOBE Observer: Clouds, Land Cover, Mosquito...

NeMO-Net

Lake Observations by Citizen Scientists...

Fresh Eyes on Ice

Go to Project Website

Overview of Citizen Science

What is Citizen Science?

- The involvement of the public in scientific research
  - *A form of open collaboration in which individuals or organizations participate voluntarily in the scientific process in various ways*

- Engagement and participation can be varied and wide-ranging

- There are many terms used in these types of projects
  - C*Science: contributory, collaborative, co-created

- This training aims to highlight citizen science and connections to remote sensing data

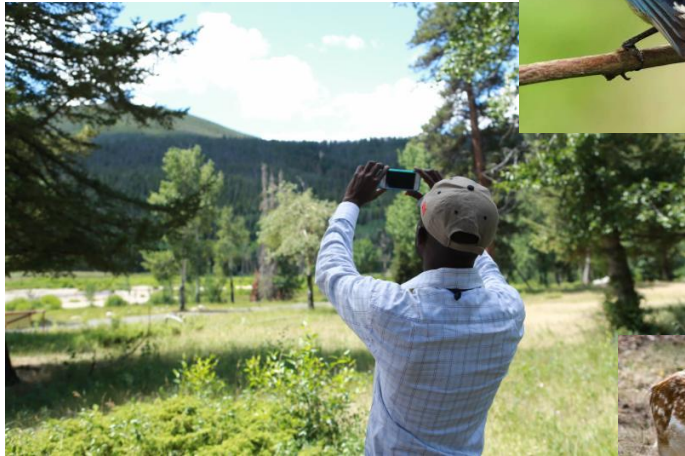*Image Credit: NPS/Renata Harrison*

Image Credit: Smithsonian

Image Credit: Cal Academy of Sciences

Citizen Science is Diverse

Accessible, Relevant, and Meaningful.

Integrity in research
Integrity in engagement

Citizen Science

citizenscience.org

Benefits of Citizen Science

- Increased participation in research and applications

  - Diversity of people and perspectives

  - Increased transparency in research

  - Sustained monitoring with committed participants

- Cost-effective and high-quality data

  - Data gathering on large spatial and temporal scales – including rare events

  - Training participants to follow data protocols

- Assistance with hazards warnings – floods, earthquakes, sea ice, etc.

Image Credit: NPS

Limitations of Citizen Science

- Resources needed for
  - Training
  - Recruitment
  - Sustained engagement

- Barriers to entry
  - Education level, language, access to reliable internet, time, income, gender

- Data collection outside of researchers' direct control
  - Validation and accuracy must be addressed

- Community engagement principles must be followed
  - Mutual understanding and respect
  - Transparency of data collection and data use

Choosing and Using Citizen Science

Clarity of aim/question	Importance of engagement	Resources available	Scale of sampling	Complexity of protocol	Motivation of participants
Clear aim/ question	Engagement is important	Plenty of resources	Large-scale sampling	Simple protocol	Good reasons to participate
Vague aim/ question	No engagement or only one-way communication	No resources	Small-scale sampling	Complex protocol	Reasons to participate are not clear

Increasing suitability for a citizen science approach

Image Credit: Pocoke, et al., 2014, SEPA and CEH

Many Forms of Citizen Science

Image Credit: *Haklay, et al, 2018*

Long-running citizen science

- Examples: weather observations, seasonal changes in phenology and bird migration, archelogy

- American Ornithologists Union and the North American Bird Phenology Program


Screenshot of the transcription webpage for the North American Bird Phenology Program. Credit: U.S. Geological Survey.

https://www.usgs.gov/centers/eesc/science/north-american-bird-phenology-program?qt-science_center_objects=0#overview

**Reddish Egret (**Egretta rufescens), Image Credit: Audubon

Citizen Cyberscience

- Utilizes the computational and sensing power of billions of connected personal computing devices to be used as scientific instruments
  – desktop computers, games consoles, and smartphones
- Volunteered computing
- Volunteered thinking
- Passive sensing

https://www.zooniverse.org

https://www.openstreetmap.org
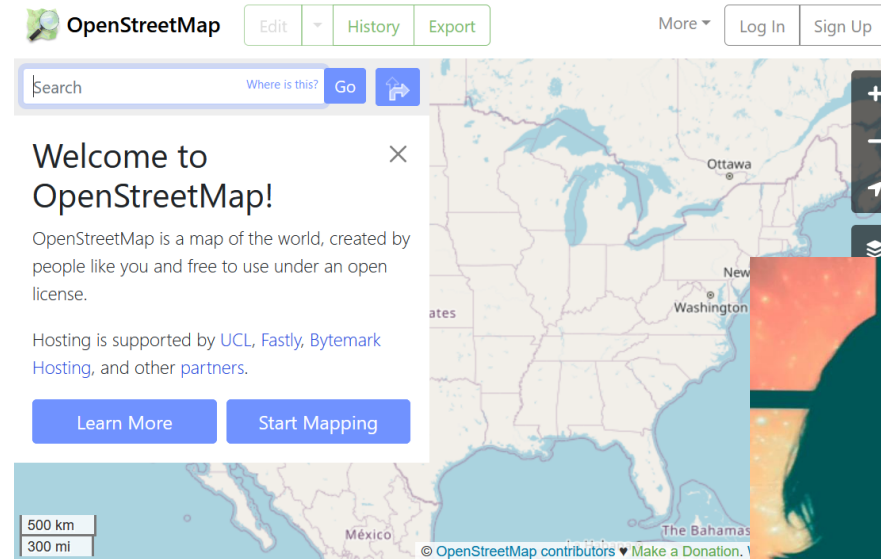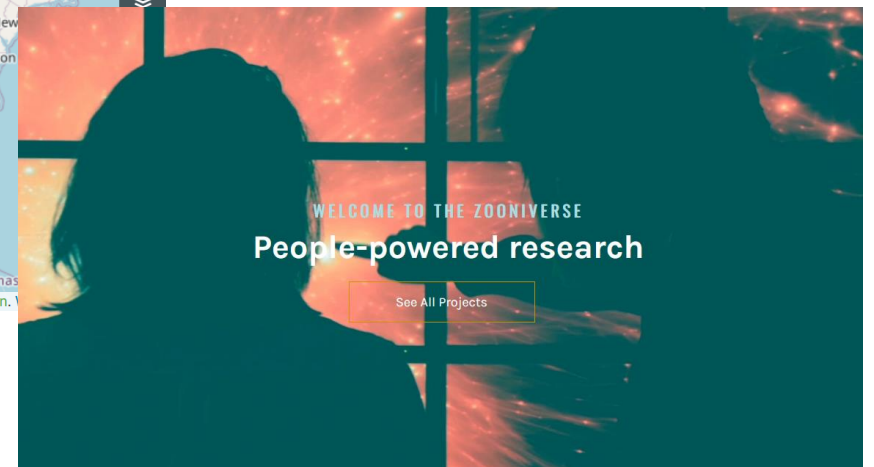
Community Science

- Activities are initiated and driven by group of participants
    - To address a particular community concern using scientific methods and tools
- Participatory: participants take major role in shaping the project, collecting, and analyzing data.
- DIY science: participants develop instruments, methodologies, and analyses.
    - Requires deep engagement and knowledge
- Civic science: community goals

Public Lab

Public Lab is a community and a non-profit, democratizing science to address environmental issues that affect people.

Public Lab was formed in the wake of the BP oil disaster. Learn more about our roots and 10th anniversary.

https://publiclab.org

Citizen Science and Earth Observations

- Expanded access to the internet/bandwidth including scientific information

- Engagement of thousands or millions of participants performing small tasks

- Volunteered Geographic Information via GPS in smartphones

- Provide data where satellite EO have gaps
  - Rain or snow – mountainous regions
  - Critical information during emergencies
    - where EO temporal resolution is limited
  - Information integration
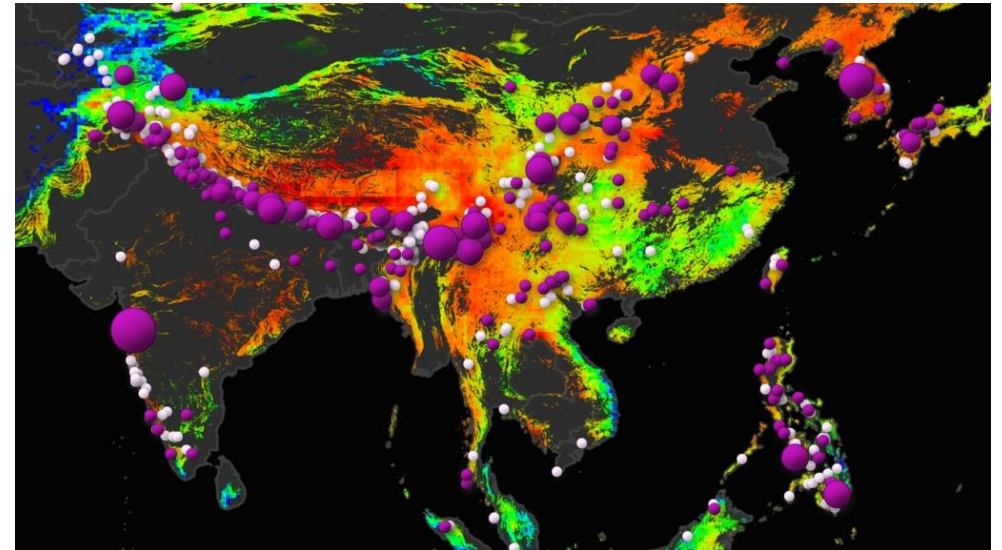
Potential landslide activity during July in Southeast Asia as evaluated by NASA's Landslide Hazard Assessment model for Situational Awareness.

Motivations, Ethics, and Policies

Motivations of Citizen Scientists

- Voluntary participation

- Excitement and genuine concern for their environment

- Sustained engagement – could require multiple forms of recognition

- Mutual benefit

Ethical Considerations

- Informed consent
    - Full understanding of research objectives and data uses
    - Continued education
    - Ability to opt in/out
- Mutually beneficial
    - Ensure participants (or community's) goals align with that of the project
- Participant feedback
- Time and resource considerations for the participant
- Acknowledgement for contributions

Policies and Guidelines

- Terms of Use agreements
- Creative Commons licenses
  - NASA follows the Open Data Policy
- Media Release agreements
  - NASA also adheres to NASA's Privacy Policy
- Federal, state, local, institutional guidelines
- Privacy considerations
  - Mobile apps and protection of Personal Identifiable Information (PII) or sensitive content.
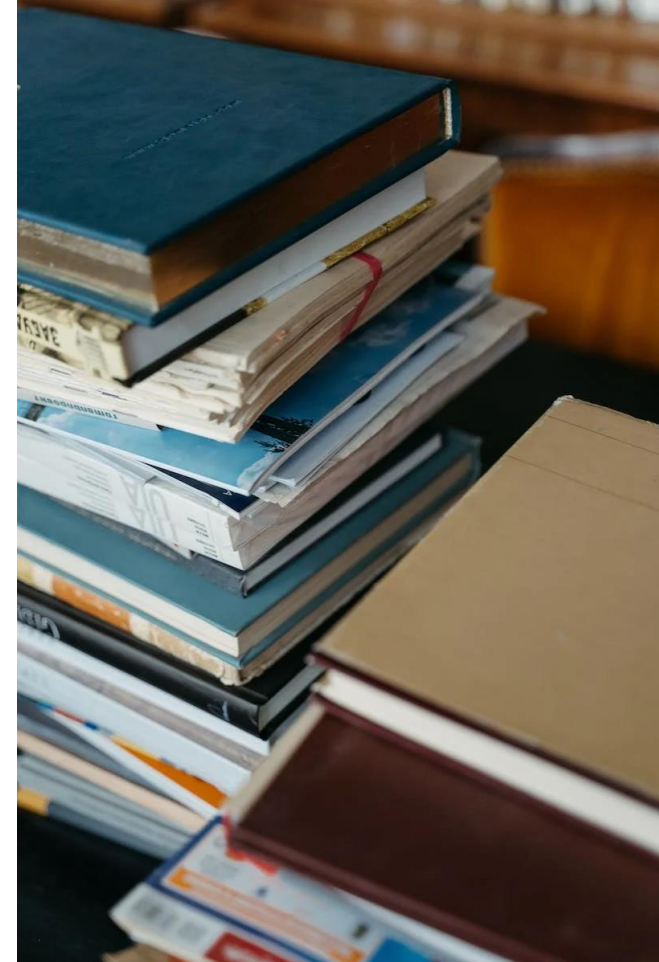
Data Collection, Management, Usability, and Accessibility

Data Quality Assurance

- Increased volume of data ≠ presence of more useful data

- Data collected may be lacking in metadata, may be incomplete, or obtained at a time/place that is not appropriate

- Need for standards and validation mechanisms
    - Rely on instruments for quality, precision, and accuracy
    - Formal participant training

Images from Lake Observations by Citizen Scientists & Satellites Project

Documentation Standards

Data Quality
- – Sampling design
- – Sample handling and custody
- – Equipment/instrument maintenance
- – Testing, inspection, and calibration
- – Field and laboratory quality control: verification and validation

Measurements Protocols
- – Permitting
- – Measurement location
- – Repeatability
- – Device calibration
- – Sample handling
- – Recording data (date, time, location identifier, participant identifier, coordinates, etc.)

Documentation Standards

Data archival

- Metadata
  - Common standard: ISO 19115-1
- File format (PDF, PNG, etc.)
- Data format (Feet, inches, Fahrenheit, Celsius, etc.)

Acknowledgement

- For citizen science efforts set a standard for what level of effort warrants a "significant contribution".
- Transparency in Author Contributions in Science (TACS) Website
- McNutt et al., 2018

Usability Considerations

Who will be using the data, and can they understand it?

- **Metadata:** who, what, when, where, why, and how

- **Data Quality:** regularly assessed and maintained

- **Documentation:** adhere to data standards, modify as needed

- **Policy Considerations:** consider national and international policies when distributing data and code, as well as ownership and licensing agreements.
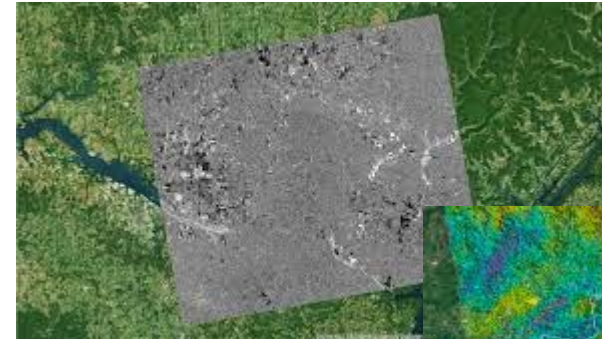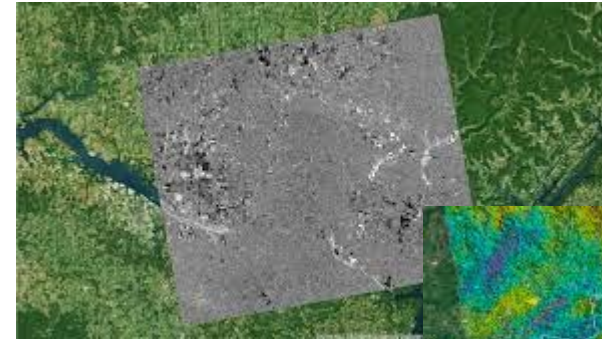

NASA Earthdata
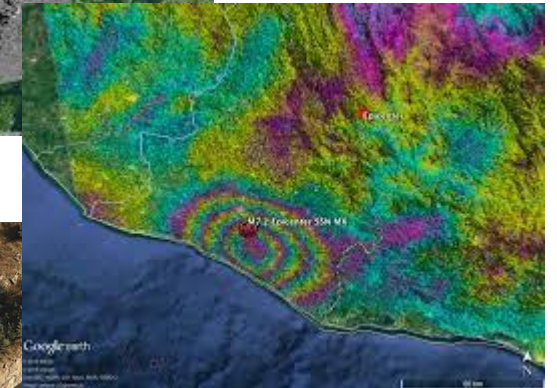
NASA Earthdata SAR

Usability Considerations

Who will be using the data, and can they understand it?

- **Identifiers:** e.g., a Digital Object Identifier (DOI)

- **Outreach:** promote usability through publications, newsletters, brochures, and online/social media.

- **Notifications:** provide a way for users to cite your data or sections of your data.

- **Data archival**

NASA Earthdata


NASA Earthdata SAR

Preventing Common Sources of Error

- Smart capture mechanisms

  - Smartphone app with location and built-in intelligence

- Allow flexibility in data collection responses
  - Participants to include responses like "I'm not sure" or indicate a level of uncertainty
  - Ability to correct or delete contributed data

- Documentation and trainings accessible during every phase of the project

- Provide a point of contact for questions and/or include a "FAQ" section on the app or website
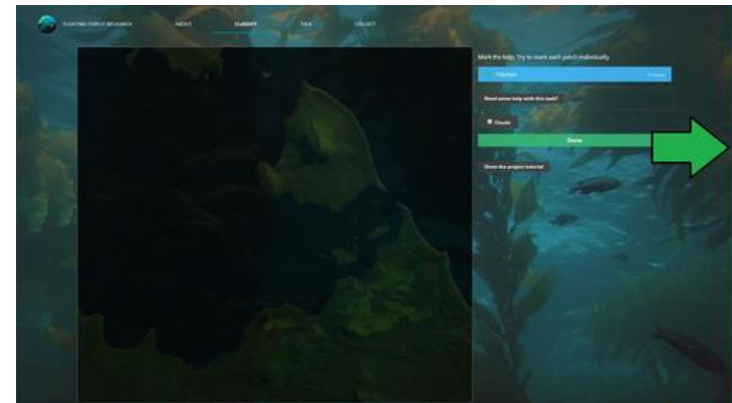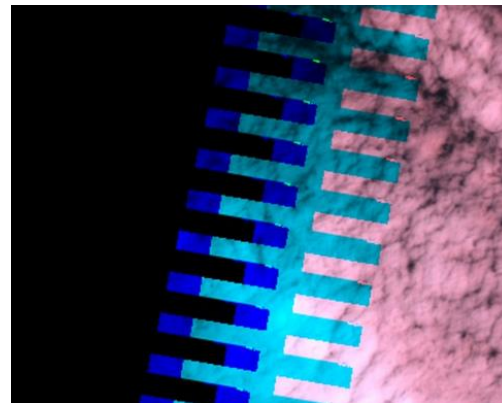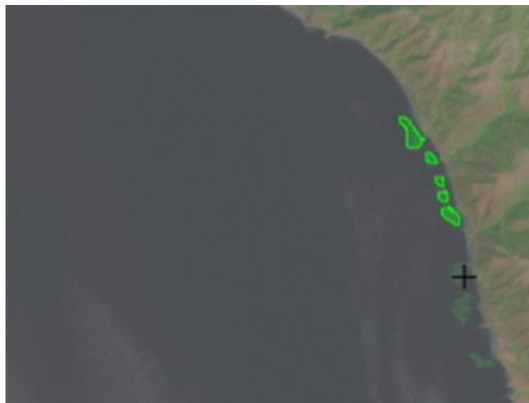
Images from Floating Forests Project

Data Availability and Accessibility

Ensure data are available and accessible after project completion

- Plan ahead for data archiving

  - Permanent and searchable

- Consider the data and file formats – current and future interoperability

- Consider open science publishing and publicly available data access

  - Exception of private data and intermediate pre-processed data

- Use community-appropriate archives and distribute to community-appropriate aggregators
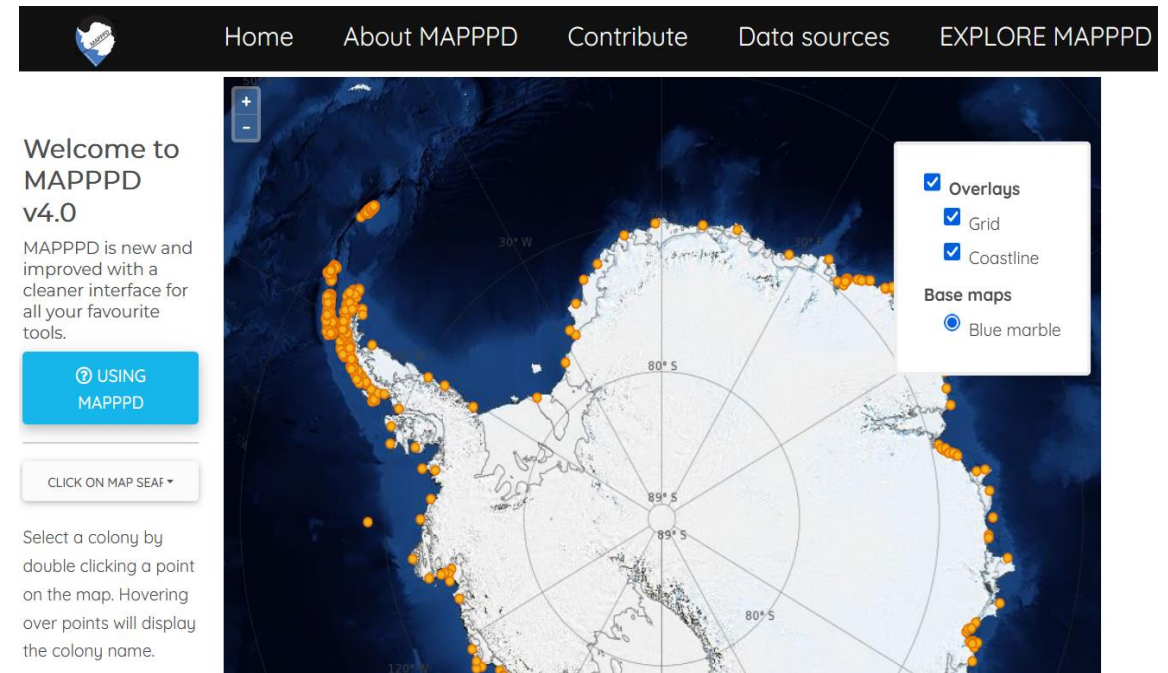
MAPPPD (Mapping Application for Penguin Populations and Projected Dynamics)

Tools and Platforms for Citizen Science

Federal Crowdsourcing and Citizen Science Toolkit
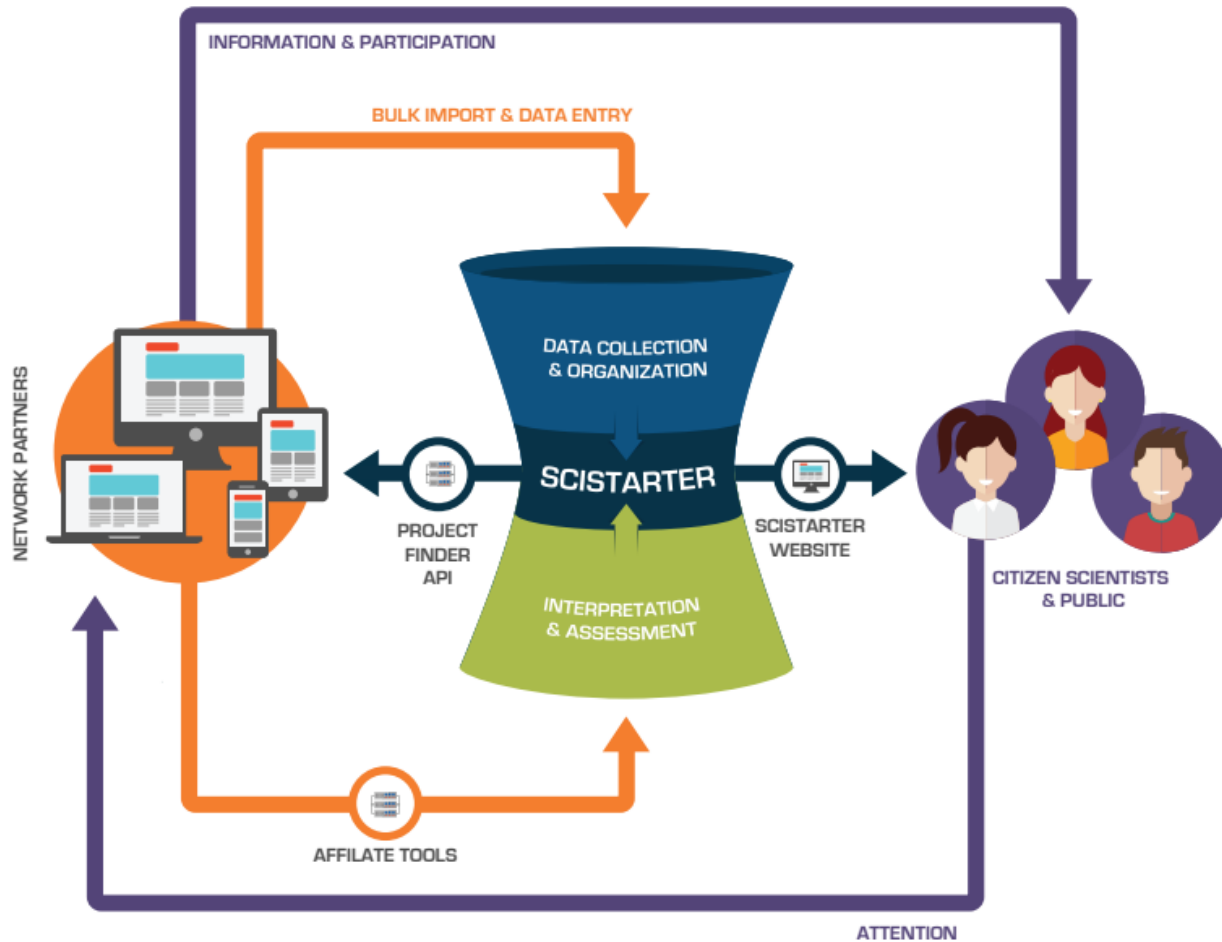

Getting Started

Case Study Overview

Resource Library

https://www.citizencience.gov/toolkit/#

Scistarter

https://scistarter.org

Zooniverse

https://www.zooniverse.org/

Summary

- Citizen Science - A form of open collaboration in which individuals or organizations participate voluntarily in the scientific process in various ways.

- Citizen scientists must be informed and properly trained, motivated, and respected throughout the process.

- Considerations must be given to data collection, management, usability, and accessibility.

- There are many resources, tools, and platforms available for conducting citizen science projects.

Resources

- https://science.nasa.gov/citizenscience

- https://www.citizenscience.gov/

- https://citizenscience.org/

- NASA ESDS Citizen Science Data Working Group White Paper

- https://www.earthdata.nasa.gov/esds/competitive-programs/csesp

- Penn State Department of Agricultural Economics, Sociology, and Education: Engagement Toolbox

Contacts

- Trainers:
  - Juan L. Torres-Pérez: juan.l.torresperez@nasa.gov
  - Amber McCullum: amberjean.mccullum@nasa.gov
  - Britnay Beaudry: britnay.beaudry@nasa.gov

- Training Webpage: https://appliedsciences.nasa.gov/join-mission/training/english/arset-connecting-citizen-science-remote-sensing

- ARSET Webpage: https://appliedsciences.nasa.gov/what-we-do/capacity-building/arset
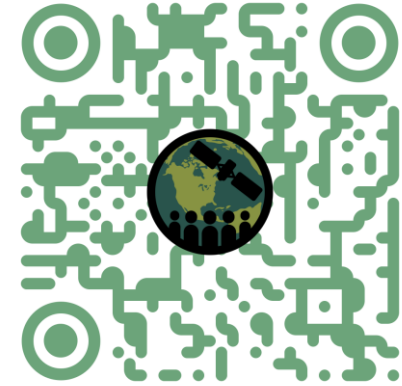
Consult Our Sister Programs:

Follow Us on Twitter
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Thank You!