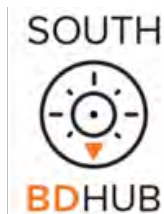# Open Science and Society: Citizen Science Addressing National and International Priorities

Forum Agenda

10:30 AM Welcome and Introductions
Jenn Loder, ACSA management committee, Reef Citizen Science Alliance
Dr. Erin Roger, ACSA Chair & NSW Office of Environment & Heritage

10:40 Successful Implementation of Citizen Science in US National Government
Dr. Lea Shanley, US NSF South Big Data Innovation Hub
Dr. Amy Kaminski, NASA

11:00 Emerging Trends in Citizen Science
Libby Hepburn, Atlas of Life
Dr. Lea Shanley, US NSF South Big Data Innovation Hub

11:10 Framework for Citizen science in Public Policy
Stephanie von Gavel, ACSA Vice Chair & Business Development Manager CSIRO

11:15 Roundtable Discussion

Noon Adjourn

2018 conference

Plenary with
Dr Alan Finkel

250 conference
delegates

Diverse talks from
local, state, national,
international projects

Trended #1 on
Australian Twitter

Launched 3 new
State chapters

Workshops on policy
& social impact

STRATEGIC PLAN
Overview

**Australian Citizen Science Association**

VISION	*A community that supports, informs and develops citizen science.*
MISSION	*To advance citizen science through sharing of knowledge, collaboration, capacity building & advocacy for citizen science.*
VALUES	*Inclusive ● Inspiring ● Empowering ● Collaborative ● Dynamic*

GOALS	Participation	Partnerships	Practice	Impact	Platform
Message *"ACSA's Strategic Goals are to…*	*Encourage broad and meaningful participation in citizen science*	*through facilitating inclusive and collaborative partnerships*	*and a community of best practice, knowledge and tools*	*to ensure the value and impact of citizen science and its outputs are realised*	*enabled by ACSA as an effective, trusted and well recognised organisation and hub for citizen science in Australia."*
Outcome	*Individual & Community outcomes*	*Network outcomes*	*Capacity outcomes*	*Science & Education outcomes*	*Institutional outcomes*
Detail	Encourage & promote broad and meaningful participation of society in citizen science so people become partners in creating science & increasing science literacy.	Facilitate inclusive and collaborative relationships and networks with members and key community, science, education, government, and business partners, nationally and internationally, to deliver against common goals.	Support the development of tools, methods, infrastructure, and resources to strengthen the practice, use and study of citizen science.	Support & promote citizen science as an effective and innovative approach in undertaking and delivering research, and supporting science outcomes, including education and policy outcomes.	Establish ACSA as a well functioning hub and network for discussion, coordination, initiatives and advocacy, for members and to promote and deliver the goals of ACSA

ACTIONS	Participation	Partnerships	Practice	Impact	Platform
Year 1 (2015/16) Plan, Initiate *continued and built on by…*	• Develop communication & promote outreach activities via website & social media, building profile and awareness • Support national citizen science projects	• Develop membership framework & business model to grow a sustainable funding stream for ACSA • Identify strategic partnerships & networks and grow interactions	• Develop information management protocols and structures for information sharing • Create online project database and portal	• Hold a national conference • Support and promote strategic citizen science activities/projects on local, regional and national scales	• Incorporation • Governance - AGM & MC & working groups • Administration - host organisation & secretariat • Website & branding • Organisational plans
Year 2 (2016/17) Build, Grow	• Target key sectors to increase participation in citizen science • Build awareness of citizen science through practitioner involvement in diverse fora	• Grow membership base & interaction • Build external partnerships • grow international collaborations	• Recognise citizen science activities, including awards • Support the development of ACSA publications & reports	• Review and communicate broad impacts of citizen science	• Increase internal participation • Deliver citizen science advocacy at all levels e.g. champions • Increase visibility of ACSA
Year 3 (2017/18) Deliver, Evaluate	• Ongoing activities, including national conference • Evaluation of activities, including identification of gaps. • Review of plans, approach, strategy and improve as appropriate				

How I Learned to Stop Worrying and love Citizen Science (in the US Federal Government)

Lea Shanley, Co-Executive Director, South Big Data Hub, and
Former Co-Chair, US Federal Community of Practice on Crowdsourcing and Citizen Science
Canberra, Australia, 12 Feb 2018
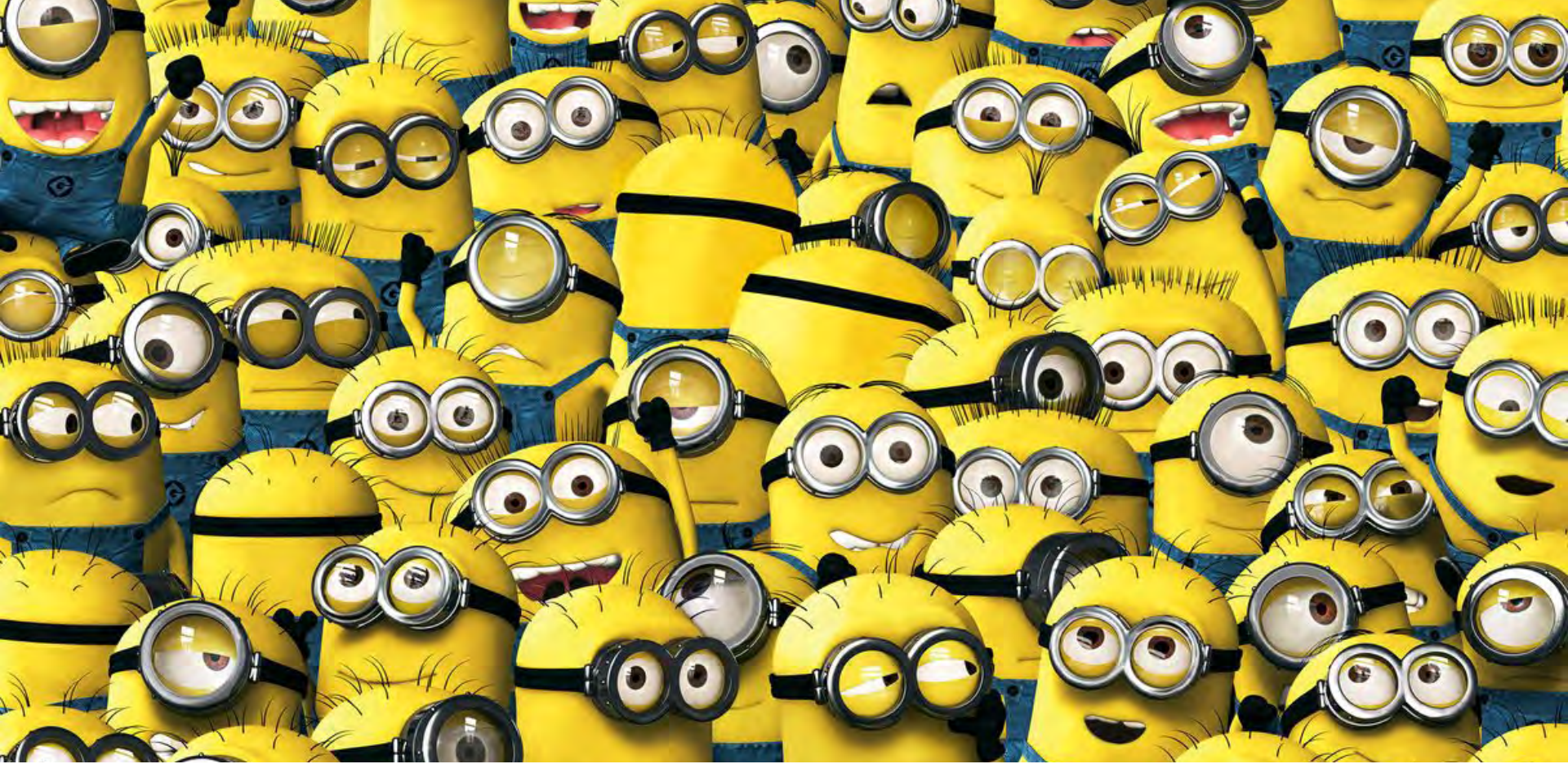
If you had 100,000 people to help you with your work, what would you do?

What is Citizen Science?

US Federal Government: "Contributions of the public to the advancement of *scientific* and *engineering research* and *monitoring* in ways that may include:

- Identifying research questions
- Designing/conducting investigations
- Designing/building/testing low cost sensors
- Collecting and analyzing data
- Developing data applications
- Developing technologies for science
- Solving complex problems"

Samples/specimen collection

Observations

Geo-location

Photography

Measurement

Sensors

Sample identification

Many ways to involve the public in scientific research, engineering, and monitoring.

Data collection

Data analysis

Defining research questions

Data processing

Problem Solving

Image analysis

Data entry

Transcribing data

Annotate text

Classification or tagging

Why Consider Citizen Science?

- Citizen science provides hands-on STEM learning outside of the classroom, and increases scientific literacy and awareness.

"In supporting science, developing science policies and carrying out science-related activities and decisions, the government will...ensure that opportunities for all Australians to engage with all aspects of the science process are maximised."

-- *Australia's National Science Statement 2017*

Why consider citizen science?

- Augment and enhance traditional scientific research and monitoring approaches:

    - Increase spatial or temporal frequency

    - Increase geographic extent or temporal scale (e.g., long-term monitoring)

    - Eye can be better than the algorithm

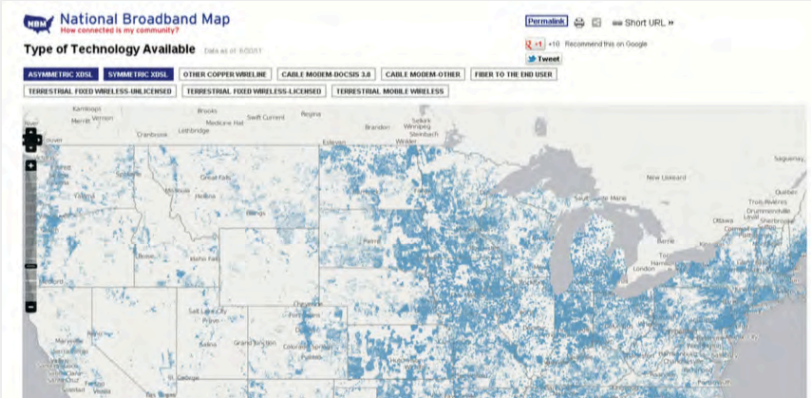   - Reduce time and labor costs
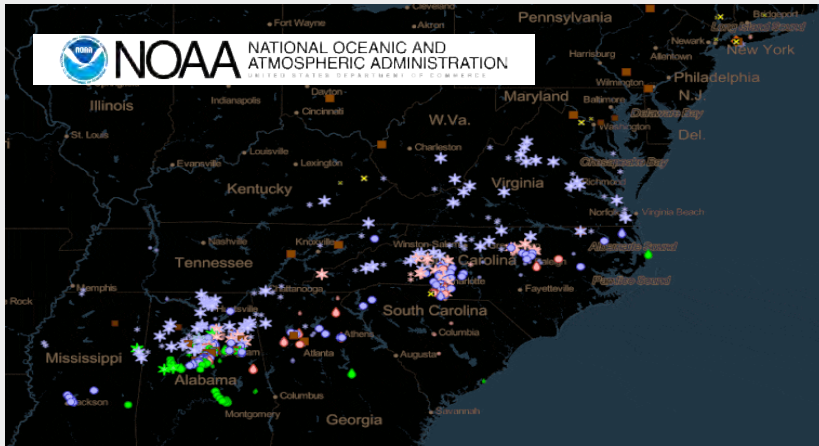
mPING mobile app has collected a million ground-based observations that help to verify weather models.
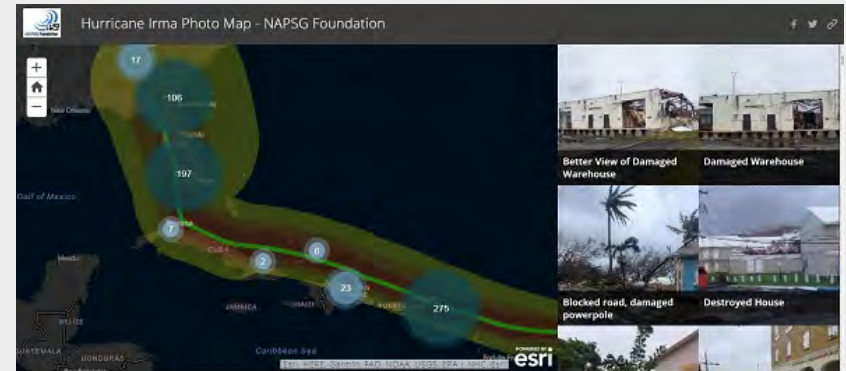
In 2017, 150 volunteers from **GIS Corps** and **HOTOSM** contributed 1300+ hours to help US FEMA map areas impacted by natural disasters.

Foldit's 240,000 players outperform algorithmically computed solutions.


2 million people used mobile app to generate the
National Broadband Map

Why consider citizen science?

- Theobald et al. (2014) analyzed 388 English-language biodiversity citizen science projects from around the world, estimating that **1.3 to 2.3 million people volunteered each year and made in-kind contributions worth up to US$2.5 billion/year.**

- Mackechnie et al. (2011) reported that terrestrial biodiversity in the United Kingdom involved more than 30 different organizations to which **volunteer contributions had an estimated value of £20million (2007-08) for a government investment of £7 million.**

Why consider citizen science?
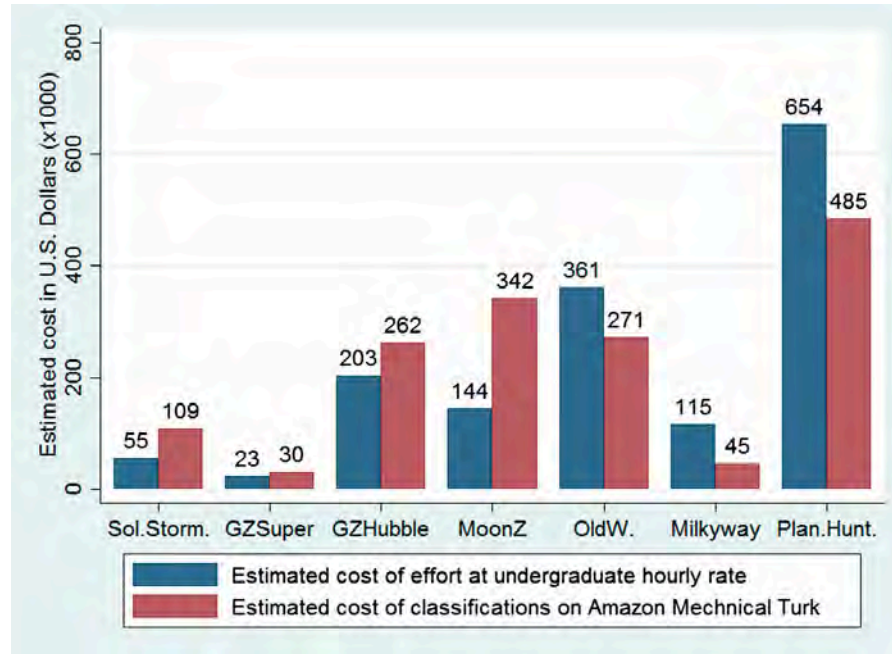
- Saurermann et al (2014) estimated that the total value of volunteer in-kind contributions over the first 6 months for a group of seven Zooniverse projects amounted to **$1,554,474.**

How We Did It

- **Serve as a bridge:** Hosted monthly meetings, connecting government with researchers, practitioners, industry, and volunteers. Established federal listserv for direct exchange of expertise, resources, information.

- Identify and encourage agency champions/evangelists.

- Highlight best practices case studies.

How We Did It

- **Encourage High Level Support ("top cover")**: Sought written/public endorsements for citizen science by government officials and chief scientists, and executives.

- **Align with National Priorities:** Aligned citizen science and crowdsourcing projects with **Open Government, Open Data,** and **Open Science** government initiatives.

What is Open Science?

- Open Access (e.g., articles, lab notebooks)
- Open Data
- Open Source Software
- Open Source Technology (e.g., Makers)
- **Open Collaboration (e.g., Citizen Science)**
- Open Funding (e.g., crowdfunding)

OECD (2015), "Making Open Science a Reality", OECD Science, Technology and Industry Policy Papers, No. 25, OECD Publishing, Paris. http://dx.doi.org/10.1787/5jrs2f963zs1-en

US Federal Citizen Science Toolkit

How To: Step by Step

This toolkit shows five basic process steps for planning, designing and carrying out a crowdsourcing or citizen science project. At each step, you'll find a list of tips you can use to keep your project on track. See the process steps

Case Study Overview

Case studies in this toolkit serve as models and provide success stories and challenges to consider while planning a project. You can browse through agency case studies to get ideas for a project of your own. Browse case studies

Resource Library

The resource library provides a list of all resources in this toolkit which you can browse through by category. You can also find resources within each of the process steps in the "How To" section of the View resources

Citizenscience.gov

Developed by the US Federal Community of Practice on Crowdsourcing and Citizen Science

White House Memorandum

- Collaborated closely with Obama White House to shape the memo *Addressing Societal and Scientific Challenges through Citizen Science* and **Crowdsourcing**, issued by the President's Science Advisor Dr. John Holdren on Sept 30, 2015.

- **Three Core Principals:**
  – Data Quality and Fitness for Purpose
  – Openness and Transparency
  – Meaningful Public Participation

- Requirements:

  – Agency Citizen Science Coordinators

  – **Catalog** of Federal Citizen Science and Crowdsourcing Projects

How We Did It

- **Increased Competitive Funding Opportunities in Citizen Science**
  - NSF Core Priority Area for 2016
  - NASA, Nat'l Atmospheric & Oceanic Administration, Nat'l Institutes of Health, etc, established new grant programs
  - FY'17 White House Budget Memo for R&D

- **Incorporated into Federal Policies**
  - Open Government National Action Plans II, III
  - President's Strategy for American Innovation
  - National Climate Assessment & USGCRP Strategy
  - National Civil Earth Observation Strategy and Implementation Plan

Citizen Science and Emerging Trends

How do we ensure data quality?

- Quality Assurance Project Plan
- Repeated sample/tasks
- Participant tasks involving control items
- Uniform or calibrated equipment
- Personal knowledge of participant skills/expertise
- Participant training
- Participant testing
- Rating participant performance
- Filtering of unusual reports
- Contacting participants about unusual reports

- Automatic recognition techniques
- Expert Review
- Paper data sheets submitted in addition to online entry
- Digital vouchers
- Data triangulation
- Data normalization
- Data mining
- Data quality documentation

Wiggins et al, 2013, Mechanisms for Data Quality and Validation in Citizen Science

Citizens' Observatories

"Community-based environmental monitoring and information systems that build on innovative and novel Earth observation applications" (EU)
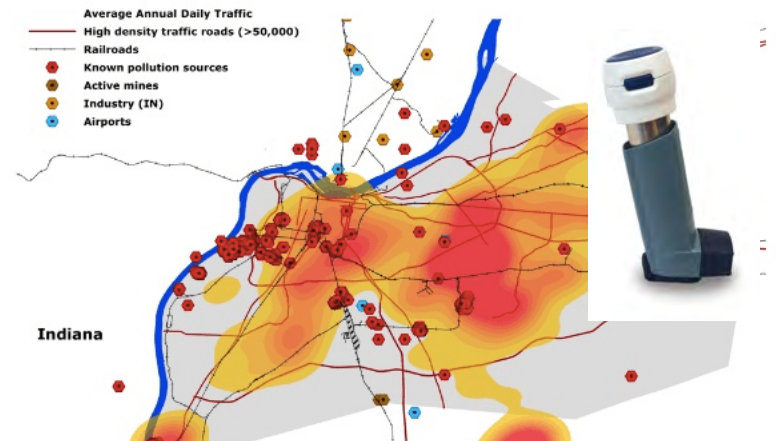
- Fuses sensor data with "citizen as sensor".

- Provides consistent architectures that allow sharing of data, code, tools and algorithms *(a la Open Data Cube).*

- Supports 2-way data sharing between scientists, citizens and policy makers.
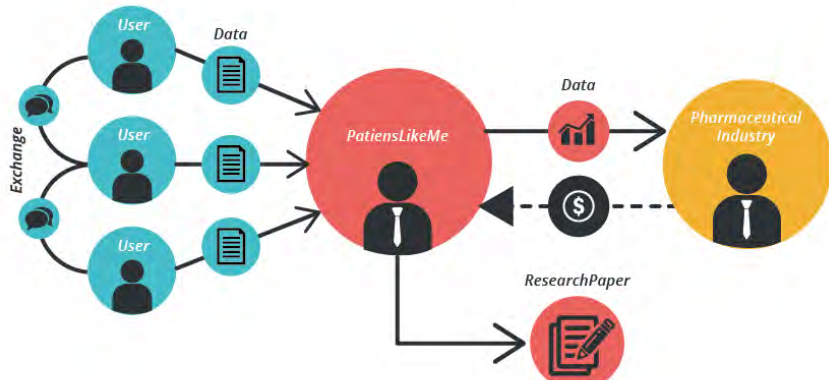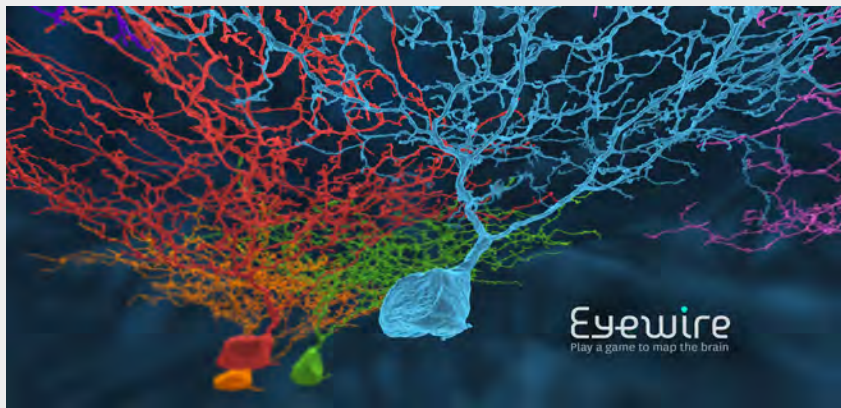
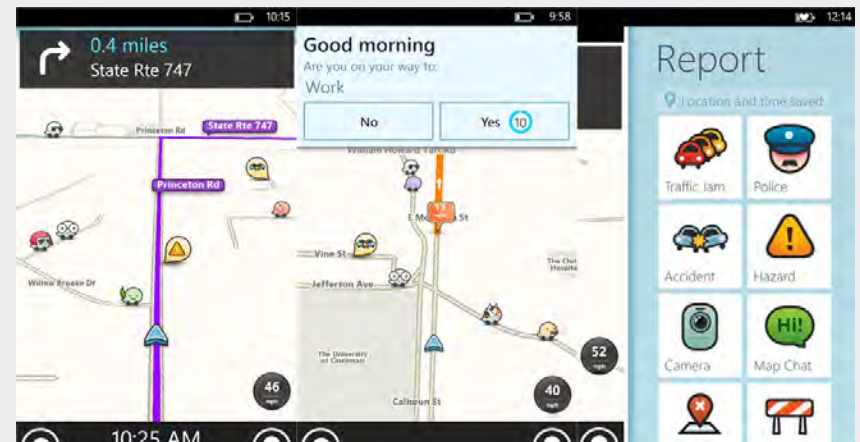PatientsLikeMe provides platform for 200,000+ patients with life-changing diseases to share data

Propeller Health provides low cost sensor and app for asthma inhaler

Eyewire engaged over 200,000 volunteers from 150 countries to map neurons in a retina.

WAZE crowdsources and provides real-time traffic data and road info

Adaptation of J.M. Flagg's 1917 poster by Kathy Butterfield and Lea Shanley, Wilson Center (2013)
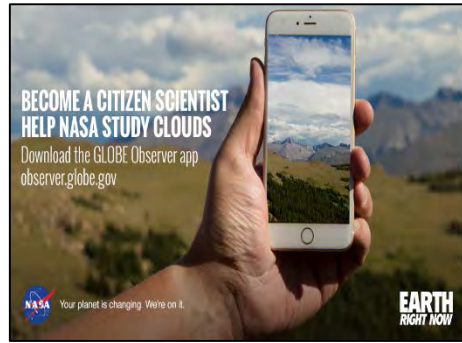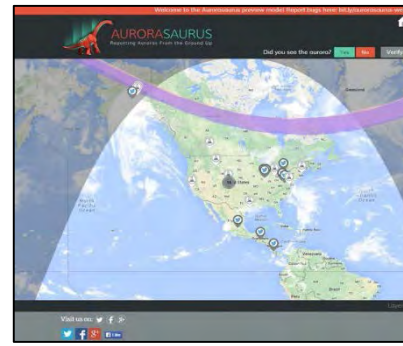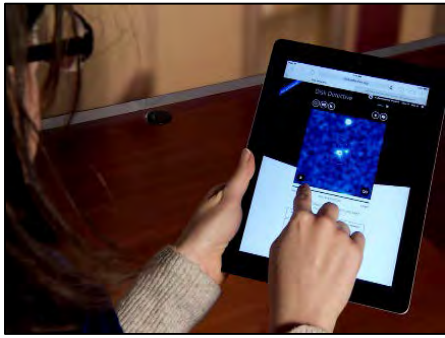
Dr. Lea Shanley

co-Executive Director

South Big Data Innovation Hub, Renaissance Computing Institute, University of North Carolina at Chapel Hill
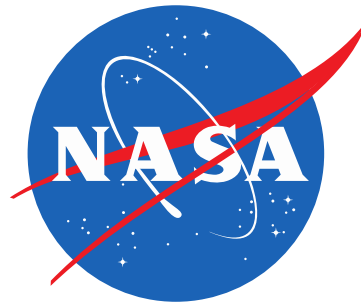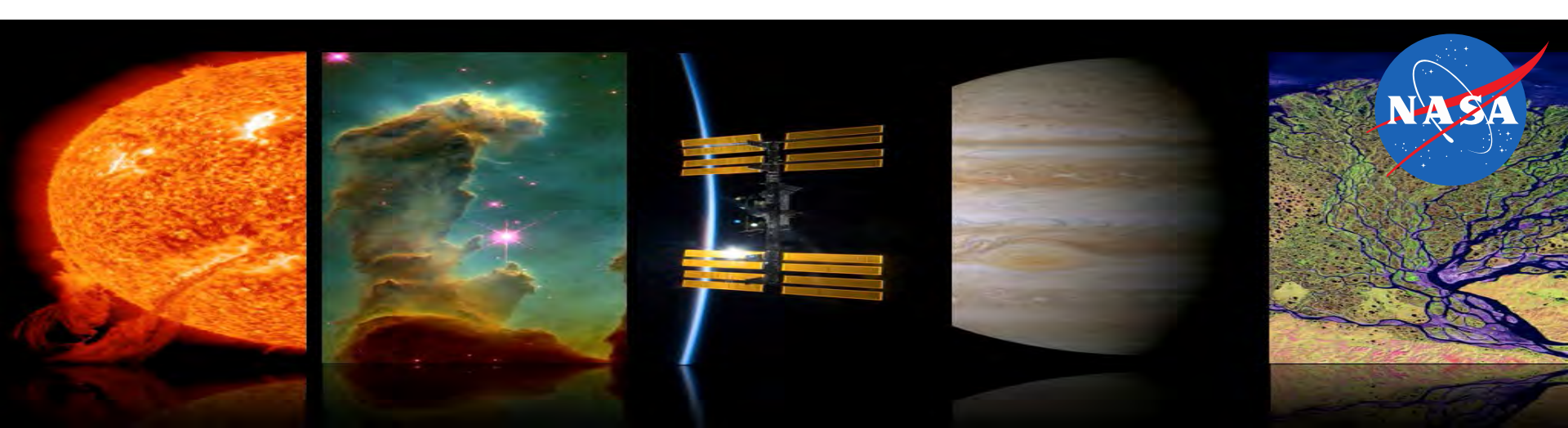
LShanley@renci.org

@Lea_Shanley

The NSF South Big Data Innovation Hub builds public-private partnerships that advance and apply data science to real world challenges.

Citizen Science as a Tool for Scientific Research and Societal Benefit at NASA

Dr. Amy Kaminski
NASA Headquarters, USA
February 12, 2018

- NASA's **strategic goals** include advancing knowledge and opportunity in space and improving life on Earth.

- We support these goals through extensive programs in **space and Earth science research** accomplished via **space-based missions** and **research funding**.

- NASA's "system" is configured to conduct science using (1) **in-house personnel** and (2) **grants**, **contracts**, and **agreements** with **external entities** (academia, industry, international space agencies).

NASA's Citizen Science Universe

+ NASA-funded
^ Uses NASA data/assets
* Completed/defunct
# Challenge/prize competition

Disk Detective
Planet 9: Backyard Worlds
+Planet Hunters
^Galaxy Zoo
^Radio Galaxy Zoo
^Exoplanet Explorers

JunoCam

+Target Asteroids
+Asteroid Mappers
*#Asteroid Data Hunter Challenge
Citizen science Asteroid Data,
    Education, and Tools (CADET)
    projects

*#Cassini Rings Challenge

+Stardust@home

Aurorasaurus
Meteor Counter

+Moon Mappers
^Moon Zoo

^Student Spaceflight
Experiments Program

+Mercury Mappers

*#Open NASA Earth Exchange Challenges
NASA S'COOL
NASA/USGS Adopt-a-Pixel
GLOBE/GLOBE Observer (Clouds; Mosquito Habitat Mapper)
^I See Change
Ecological forecasting using crowdsourcing (10 projects)
*#Climate Resilience Data Challenge
*General Aviation Study of Harmful Algal Blooms
Citizen Science for Earth Systems Programs (multiple projects)

+Mars Mappers
*Clickworkers
^Planet Four
^Planet Four: Terrains
Planet Four: Ridges
*# Mars Balance Mass Challenge

*Astrobiology Citizen Science
*MAPPER

Extending Astrophysics Research Capabilities:
Disk Detective

- WISE/other telescope image analysis to search for circumstellar debris disks

- ~30,000 volunteers have classified 2.5 million images since 2014

- 1000s of "objects of interest" identified, including new disk types

- "Super users" become part of research team – named on published papers

- Available in 14 languages

DISK ⊕ DETECTIVE

Finding planetary systems with help from 28,000 new colleagues.
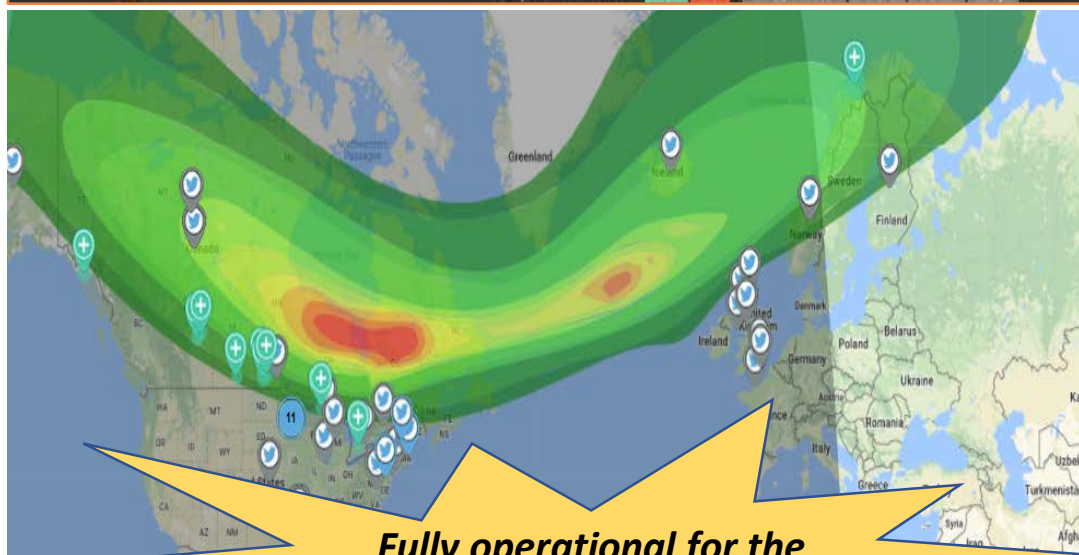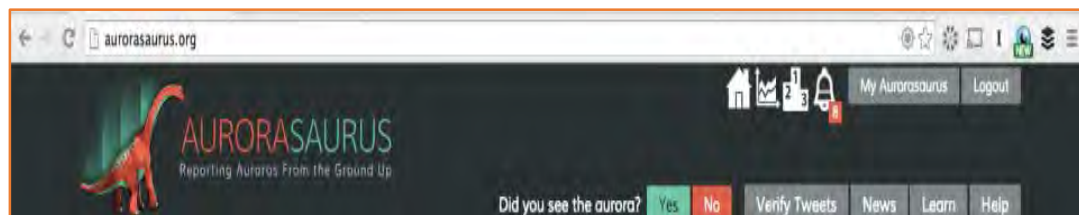
ZOONIVERSE
REAL SCIENCE ONLINE

Refining Models of Auroral Activity: *Aurorasaurus*

- Has collected 6000+ reports of aurora sightings, plus monitored 370,000+ Tweets mentioning aurora

- Accessible by computer and app

- Helps refine predictive models of aurora to support scientific and observer interests; helps to characterize new types of aurora


Fully operational for the Southern hemisphere too - More participants needed!

www.aurorasaurus.org

Wildlife Monitoring and Management Project: *Snapshot Wisconsin + NASA satellite data*

- Merged citizen science and NASA remote sensing data to understand animal populations for wildlife management

- Citizen data from Snapshot WI: 800+ citizens set up ~1000 trail cams; 17M+ images taken; analyzed on Zooniverse

- Mapping species patterns at greater spatial resolutions has improved population and management models that the Wisconsin DNR currently uses for decision making

- Public engaged through training, communication of results, volunteer recognition
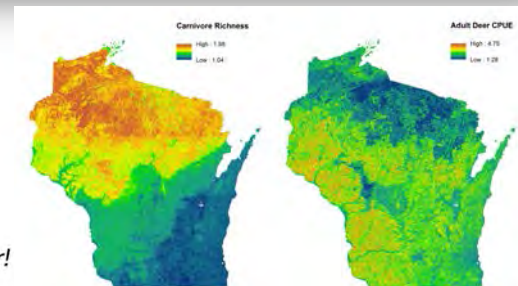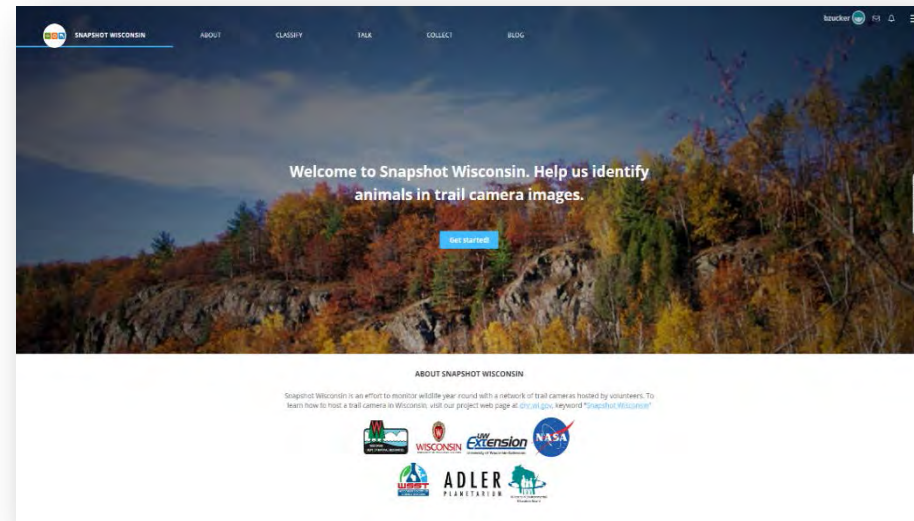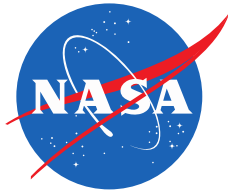
Much work remains to expand NASA's use of citizen science

- Science community's lack of familiarity with citizen science methods

- "Isn't it E/PO?"

- Volunteer data quality concerns

- Facing the review panel
  - Lack of expertise or guidance to review CS projects properly
  - Conservatism in selecting projects

Encouraging the use of citizen science within NASA
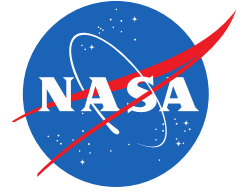
- Policy statements
- Dedicated funding opportunities
- Individual champions
- Community of practice
- Meetings/events to familiarize NASA workforce with citizen science and its applicability to their work
- Workshops involving the science and open innovation communities to develop ideas for new projects
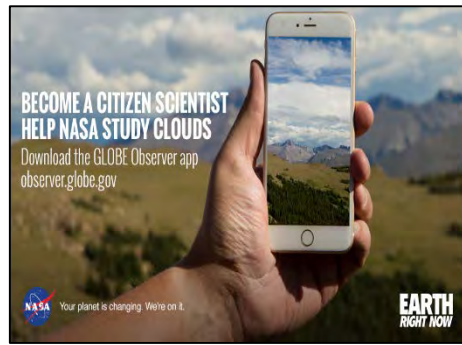
Questions?

Amy Kaminski
amy.p.kaminski@nasa.gov

Emerging Trends in Citizen Science
Libby Hepburn, Atlas of Life,
Global Mosquito Alert Consortium

Lea Shanley, Co-Executive Director,
US NSF South Big Data Innovation Hub

- **Global Mosquito Citizen Science Programme**

  - Growing concern at expanding range of 20 'ish disease vector mosquito species – a global Health **&** Environment problem

  – Multiple CS Mosquito programmes in the EU and US, interest in joint development of a common programme

  – interest from Australia, Central & Southern America, Africa and the Far East

  – A willing partner in UNEP and use of UNEP Environment LIVE

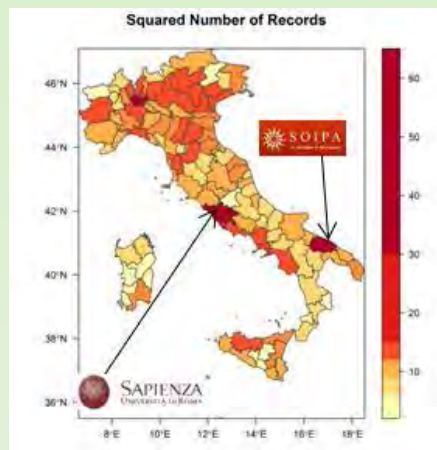 – 2015 -2018 UNEP business/policy/science forum Global project presented

GLOBAL MOSQUITO ALERT

Data

Each project collects and stores **local** data.

Select information from each project is pushed to the UN's
Environment Live data portal.
Data is accessible via APIs, downloads, or visualizations.

Data and Metadata Standards

Data and metadata standards support a set of **core protocols** for monitoring activities. Projects may augment core protocols to fit local needs. Each protocol is supported by 1+ open source data collection technologies.

Protocol 1
Real time adult vector mosquitos

Projects: Mosquito Alert, iNaturalist, Muggen Radar, Abuzz

Protocol 2
Larvae and breeding sites

Projects: GLOBE Mosquito Habitat Mapper

Protocol 3
Bites and nuisance

Projects: Zanzamapp

Protocol 4
Biodiversity specimens/ DNA

Projects: Mueckenatlas, Invasive Mosquito Project

Protocol 5+
Additional Protocols

Projects: Protocols may be added as research needs and technologies evolve

A Common Community and Supporting Platform

Global Mosquito Alert is a community of scientists, policymakers, vector control agents, educators, and public volunteers interested in leveraging citizen science to track and combat mosquito-vector disease. Participating projects contribute resources to a platform and secretariat supporting (1) a toolkit of good practices for working with diverse stakeholders; (2) standardized protocols and processes for data collection and validation; (3) a directory of participating projects; and, (4) a director of individual experts.

Citizen Science in policy for the big issues on the world stage

On September 25th 2015, countries adopted a set of goals to **end poverty**, **protect the planet** and **ensure prosperity for all** as part of a [new sustainable development agenda](). Each goal has specific targets to be achieved over the next 15 years.

…"in the last 12 months there has been such a shift in opinion, led by Peter Glipman? and the whole **International Government Chief Scientific Advisory network** who have opened the door to citizen science and it's on the basis of a lot of support at that level that now you see pretty much every member state thinking about what kind of citizen science they already have and they have made a call to IGCSA specifically to identify areas where citizen science can play a proactive role in giving advice to governments.

 The shift is phenomenal and the speed at which this has happened is very encouraging." from GMAC minutes Jan 14th

Prof. Jacquie McGlade, until recently Chief Scientist at UNEP

Citizen Science contribution to …

to policy CYCLE
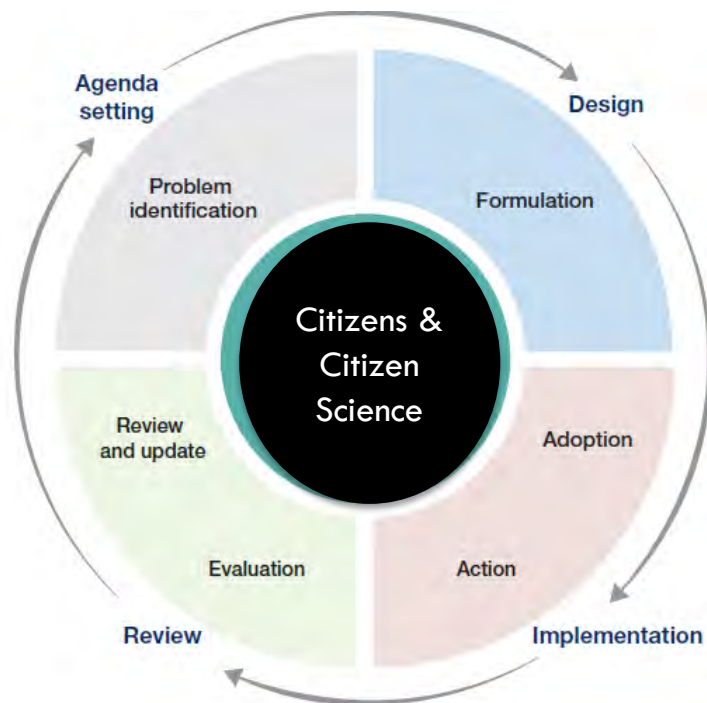
ENABLING "INFRASTRUCTURES" for citizen science

ACSA/IA	Digital platforms	Value/Impact assessment

to policy AGENDAS

examples at federal level:

- National Innovation & Science Agenda
- Developing Northern Australia
- Digital Transformation
- Closing the Gap
- Public Health
- Reef 2050
- ….

Citizen Science role in the Information Supply Chain

COLLECT	AGGREGATE	ANALYSE	IMPACT

DATA   Data-Science Interface   **SCIENCE**   Science-Policy Interface   **POLICY**

| Surveys
Research
Collections
Collection tools &
devices
Sensors
Remote sensing | social architecture | Information Aggregators / Platforms | social architecture | Assessments

Indicators Measures

Models & Analytics

Research
ecological
conservation
human health
climate change | social architecture | CBD Aichi, SDGs

Env accounts, SOE

National priorities
eg climate, health, Indigenous...

Investment
Compliance
Intervention | **Impact** – social, environmental, economic |

Identify the following … and their application in a citizen science context:

ACTORS	DRIVERS	CHALLENGES	COSTS & VALUE