Ecosystem Services 2.0

Enabling Civic Ecology through Participatory Science and Open Innovation

Lunch Town Hall

ACES 2016

December 8, 2016

U.S. Department of the Interior

USGS
science for a changing world

Sophia B Liu, Ph.D.
Innovation Specialist
Science and Decisions Center
U.S. Geological Survey (USGS)

Elizabeth Tyson
Co-Director & Program Associate
Science & Technology Innovation Program
Wilson Center

Clayton Cox, Ph.D.
AAAS S&T Policy Fellow
Office of Research and Development
U.S. Environmental Protection Agency

Joe Morrison
Product Specialist
OpenTreeMap
Azavea

Imagine having thousands or even millions of volunteers…

University of Washington analyzed

338 citizen science biodiversity projects

estimating in-kind contributions of

1.3 – 2.3 million citizen science volunteers have an economic value of up to $2.5 billion per year.

E.J. Theobald, A.K. Ettinger, H.K. Burgess, L.B. DeBey, N.R. Schmidt, H.E. Froehlich, C. Wagner, J. HilleRisLambers, J. Tewksbury, M.A. Harsch, J.K. Parrish. "**Global change and local solutions: Tapping the unrealized potential of citizen science for biodiversity research**." *Biological Conservation*, Volume 181, January 2015, Pages 236-244.

Citizen Science Misconceptions

- Data quality sucks
- Free labor
- New concept
- Just public outreach
- Always nature observations
- Only engaging with scientists

Adapted from Caren Cooper

Engaging the Public

- **OPEN INNOVATION** is a paradigm that suggests that organizations can and should solicit contributions from **external volunteers**.

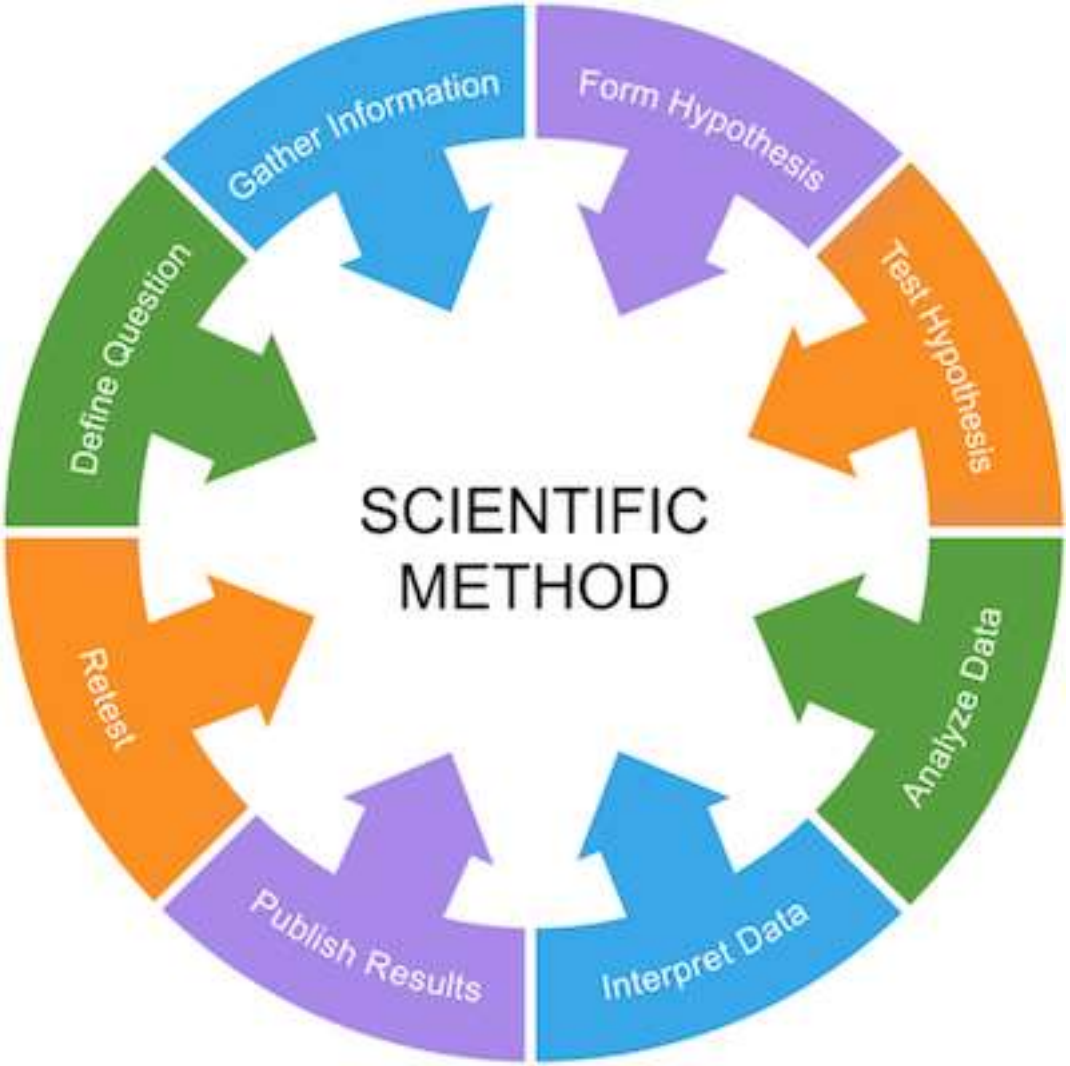
- **CITIZEN SCIENCE** is a form of open collaboration where members of the public **participate in the scientific process** in ways that may include identifying research questions, making new discoveries, collecting and analyzing data, **interpreting results, developing technologies & applications**, or problem solving.

- **CROWDSOURCING** is a process where individuals or organizations submit an **open call** for voluntary contributions from a large group of **unknown** individuals ("the crowd") or, in some cases, a bounded group of **trusted** individuals or **experts**.

- **CROWDMAPPING** is a process where individuals or organizations submit an open call for **volunteered geographic information** (VGI) or information with an associated geographic location from volunteers to **produce collaborative maps**.

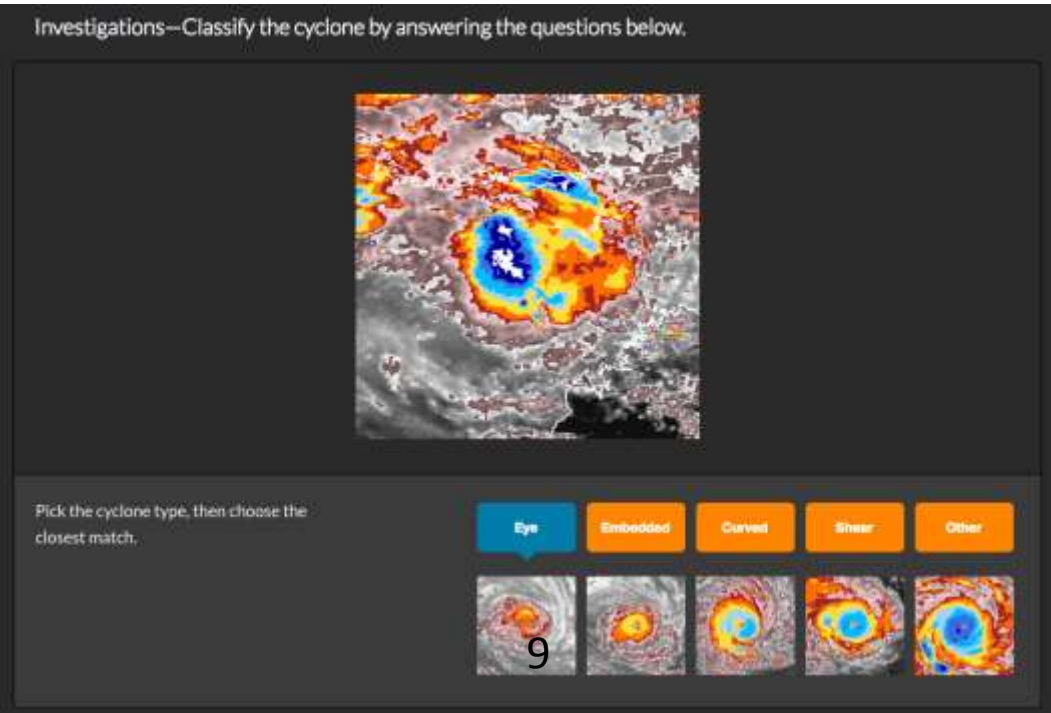
(Definitions from Federal Community of Practice for Crowdsourcing and Citizen Science)

Engaging at Any Part of the Scientific Cycle



Field-based Tasks & Low-Cost Sensors

Mobile & Web Tasks Gamification



INTERNATIONAL OPEN DATA HACKATHON

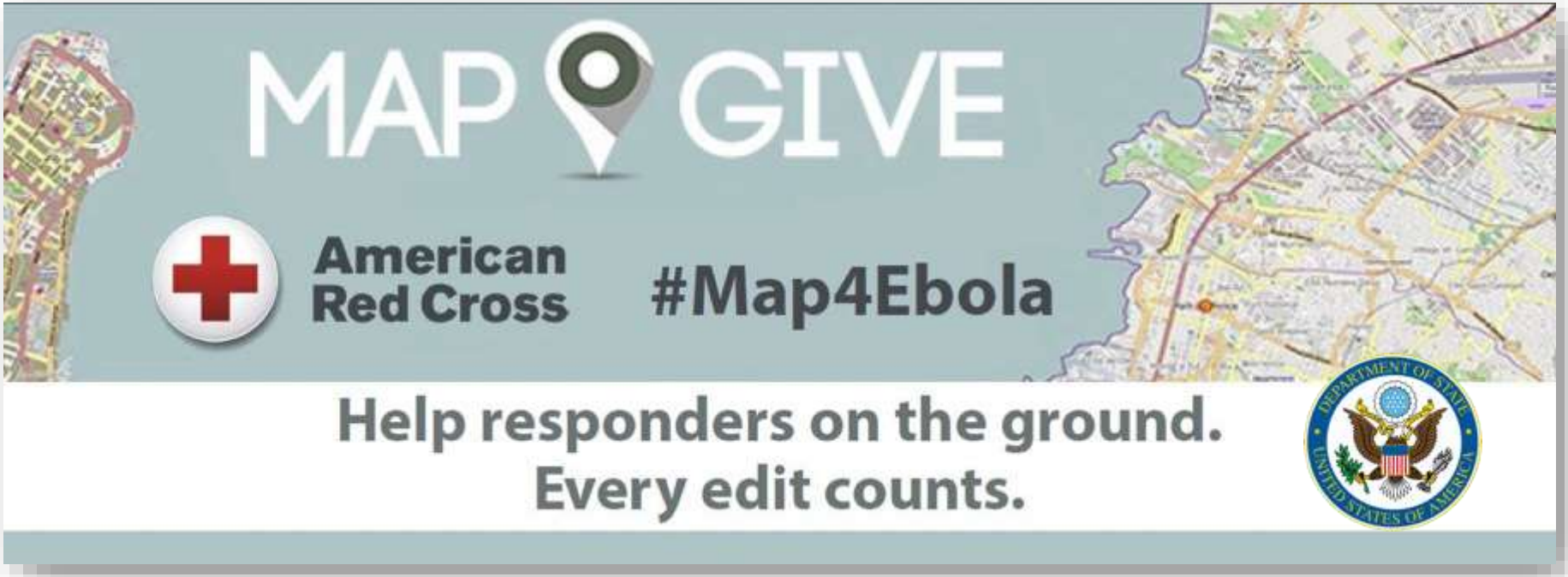
Prizes and Challenges Hackathons & Makers

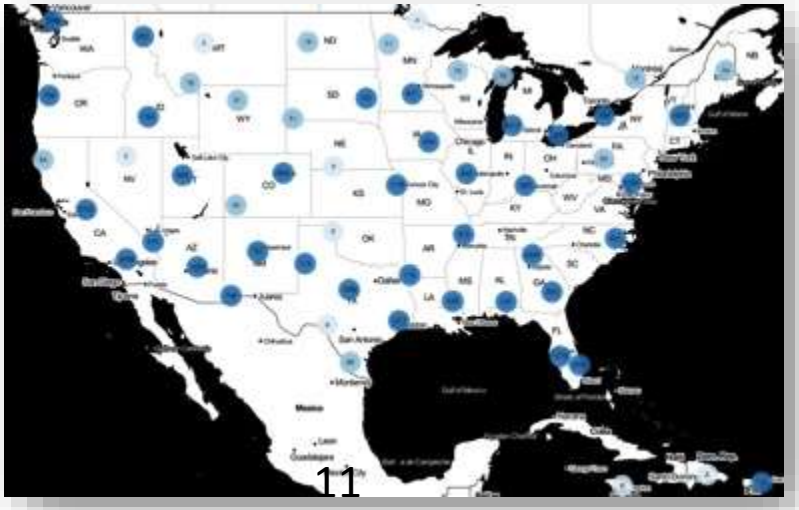
Challenge.gov
Government Challenges, Your Solutions

Industrial Arts
Artists
Chemistry "Magic"
Hands-on Science
Engineering
Makers
Musicians
Green Tech
we are all
DIY
Recycling
Tinkerers
MAKERS
S.T.E.A.M.
Alternative Energy
Young Makers
Robotics
Digi-tech
Crafts

INTERNATIONAL SPACE APPS CHALLENGE

Impact Beyond Science

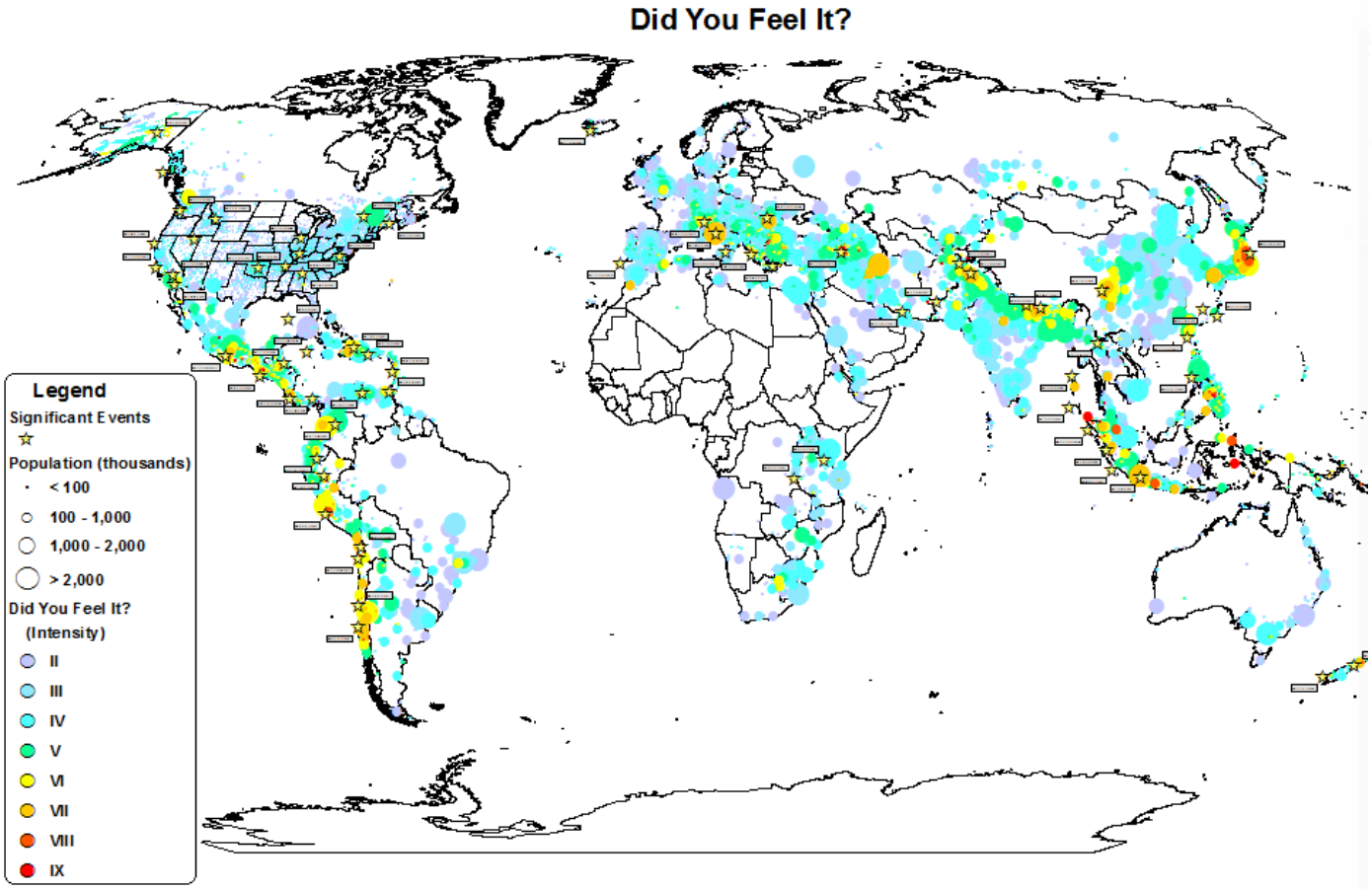


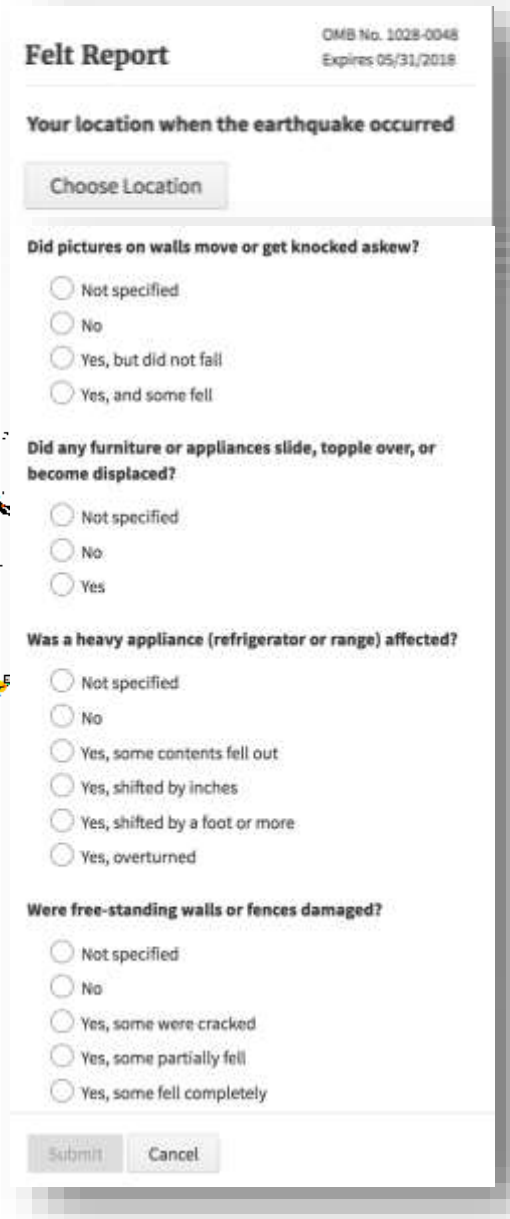


USGS Projects

Did You Feel It?

http://earthquake.usgs.gov/data/dyfi



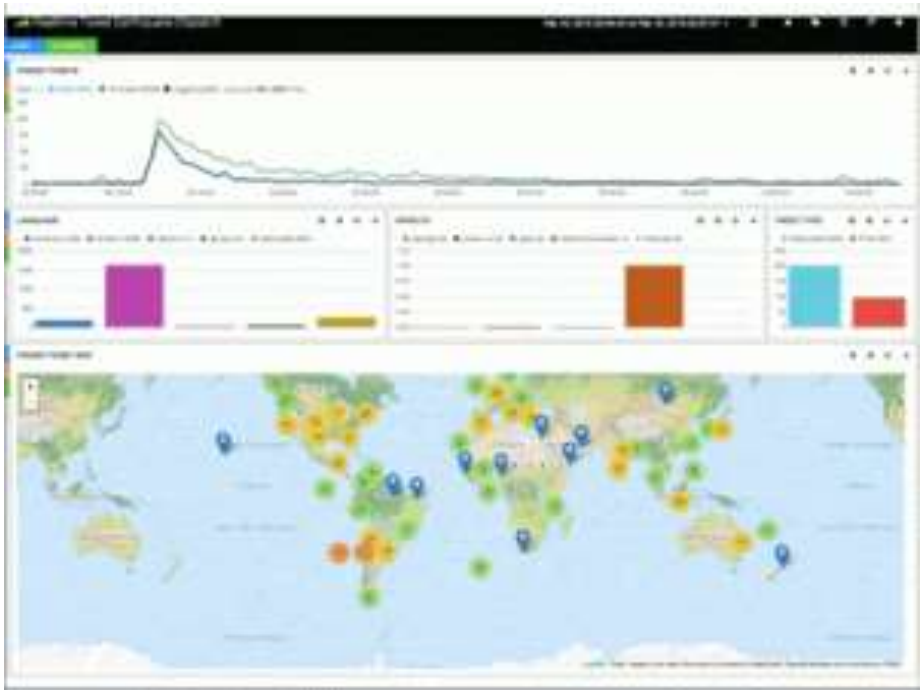


~ 3 million DYFI reports since 1997

USGS
science for a changing world

Tweet Earthquake Dispatch (TED)

http://earthquake.usgs.gov/earthquakes/ted



① **Internal alert system to seismologists that detects felt earthquakes by harvesting Twitter data**

② **Broadcast @USGSted public Tweet alerts with frequency of earthquake tweets and official USGS seismic data**

USGS TED TWEET EARTHQUAKE DISPATCH

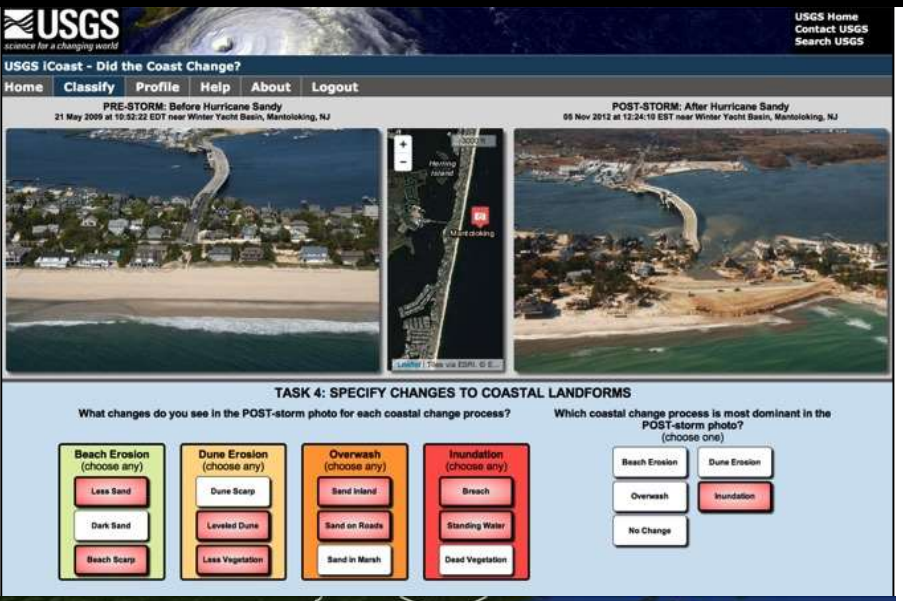
USGSted @USGSted · Aug 23

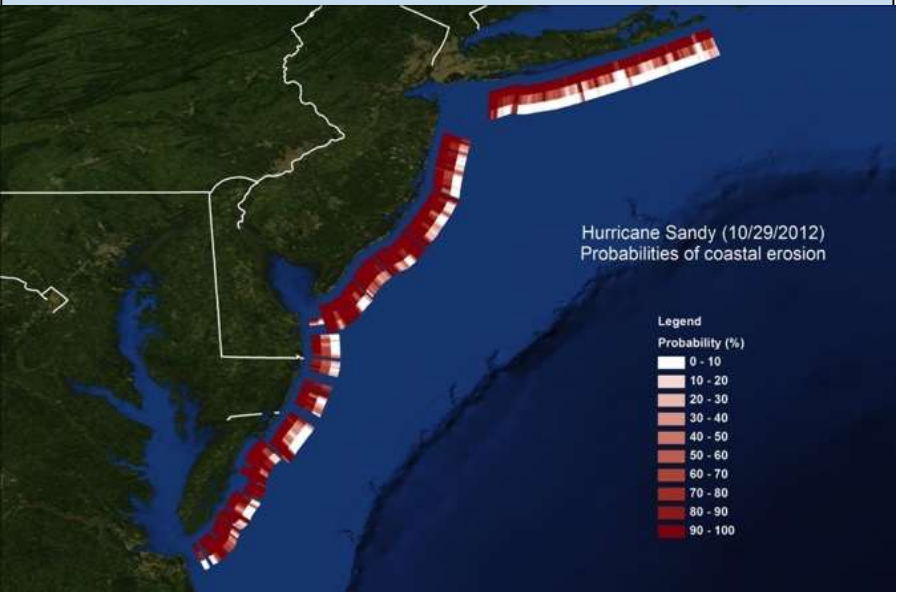
Prelim M5.5 earthquake OFFSHORE COQUIMBO, CHILE Aug-23 23:10 UTC, updates on.doi.gov/1V38YIh, 82 #temblor tweets/min

21 11

iCoast – Did the Coast Change?

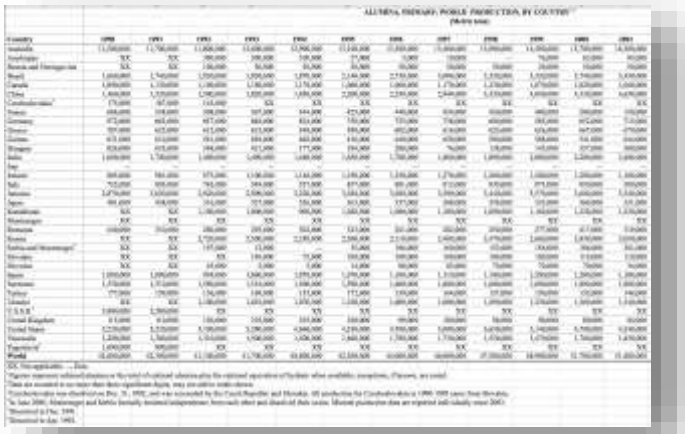
http://icoast.us

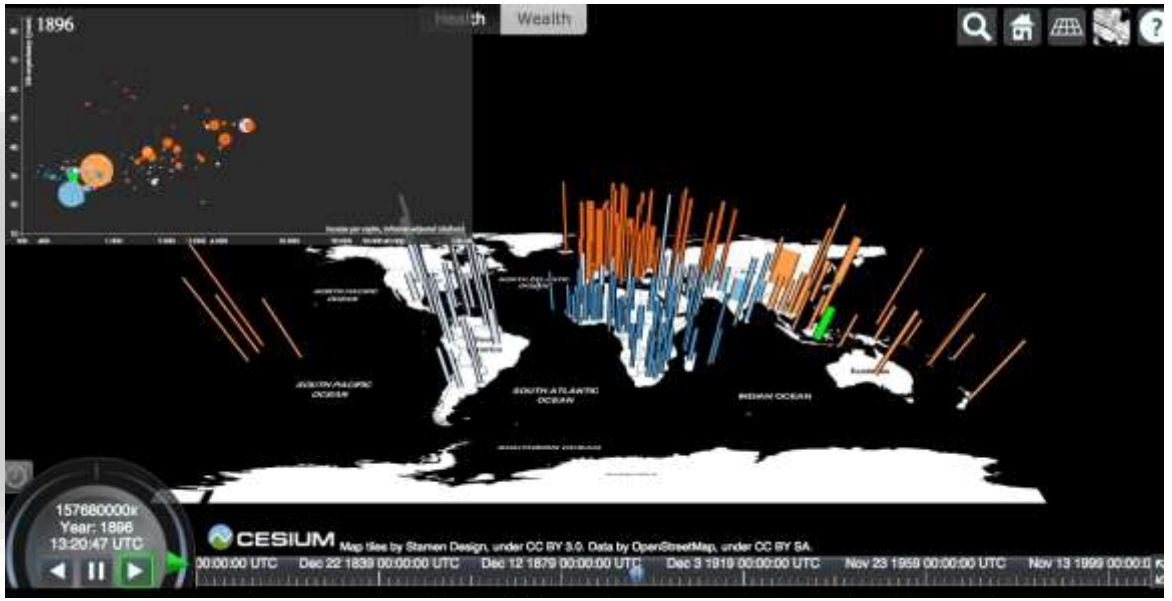




- **Compare & classify aerial photos of the coast before and after extreme storms (Hurricane Sandy and Joaquin)**
- **Educate the public about coastal vulnerability from extreme storms**
- **Ground truth and enhance USGS coastal change prediction model**

Visualizing Critical Minerals



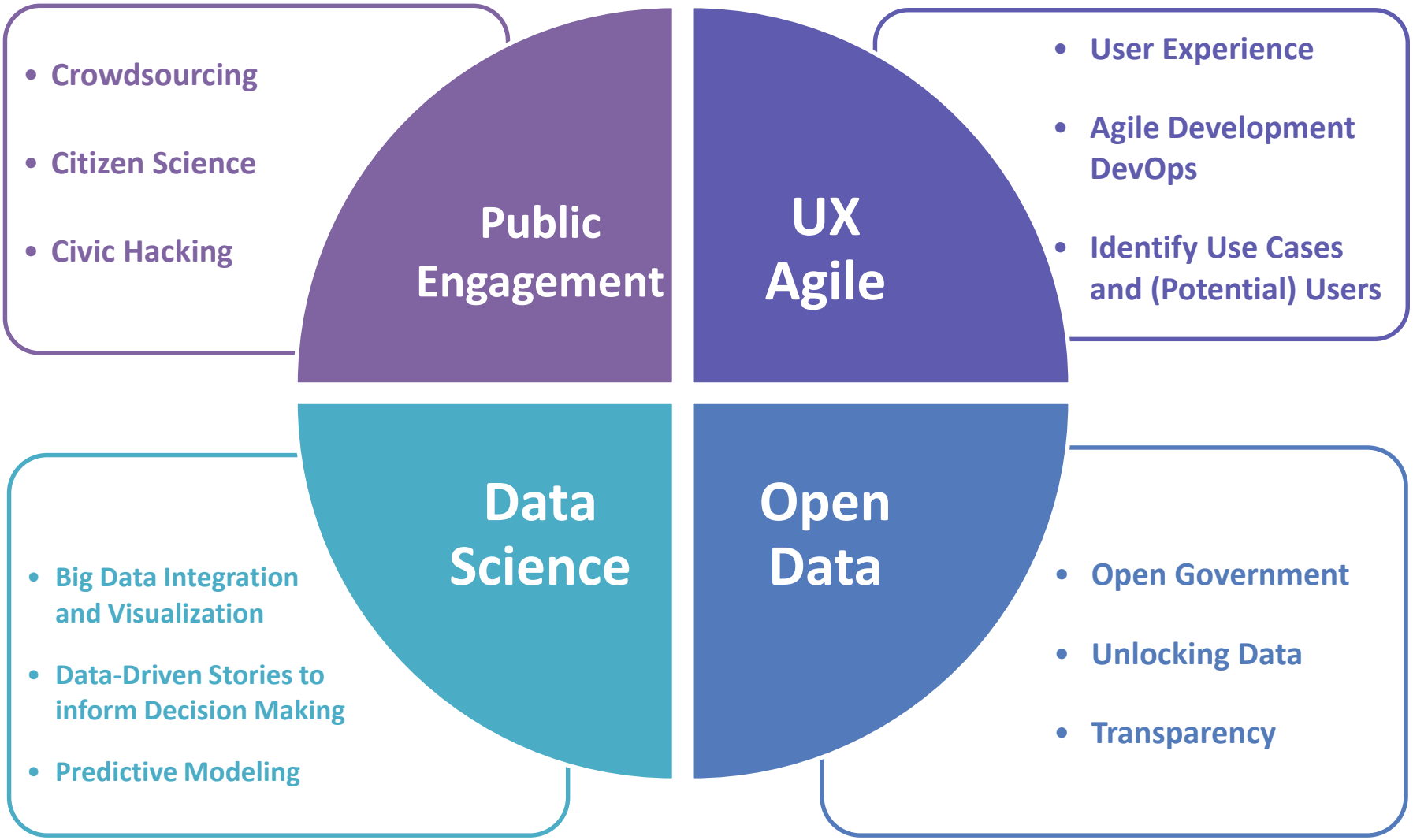


- **Data wrangling spatiotemporal spreadsheets into interactive visualizations**
- **Make the data more open, accessible, and machine-readable**
- **Leverage data science approaches and civic hacking opportunities**

Civic Hacking

- New idea, technology, or methodology to improve existing processes or systems
- Collaborating with others to create, build, and invent open source solutions using publicly-released data, code, technology

Open Innovation Trends

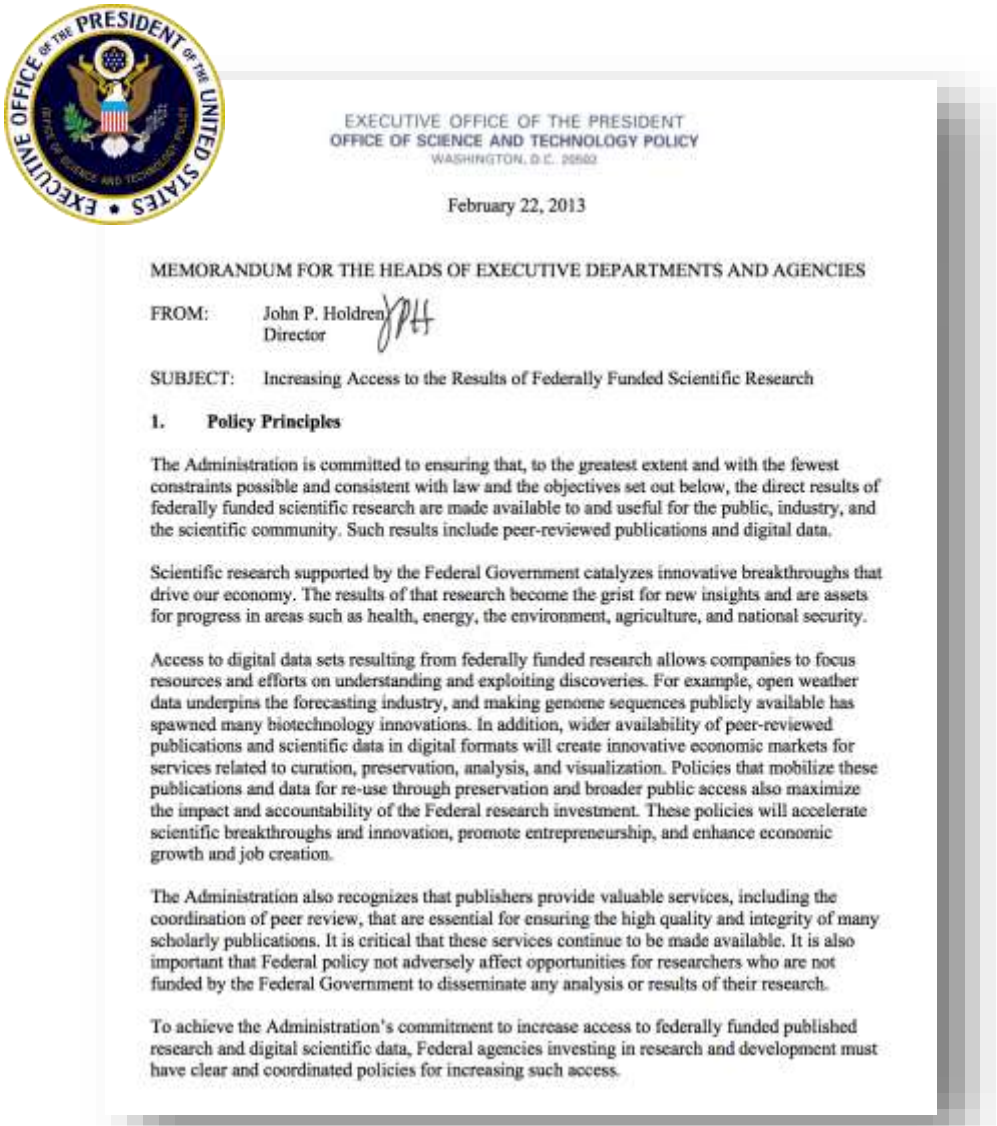


@sophiabliu

sophialiu@usgs.gov

Federal Open Innovation Policies

2013 OSTP Memo – Public Access



EXECUTIVE OFFICE OF THE PRESIDENT
OFFICE OF SCIENCE AND TECHNOLOGY POLICY
WASHINGTON, D.C. 20502

February 22, 2013

MEMORANDUM FOR THE HEADS OF EXECUTIVE DEPARTMENTS AND AGENCIES

FROM: John P. Holdren
Director

SUBJECT: Increasing Access to the Results of Federally Funded Scientific Research

1. Policy Principles

The Administration is committed to ensuring that, to the greatest extent and with the fewest constraints possible and consistent with law and the objectives set out below, the direct results of federally funded scientific research are made available to and useful for the public, industry, and the scientific community. Such results include peer-reviewed publications and digital data.

Scientific research supported by the Federal Government catalyzes innovative breakthroughs that drive our economy. The results of that research become the grist for new insights and are assets for progress in areas such as health, energy, the environment, agriculture, and national security.

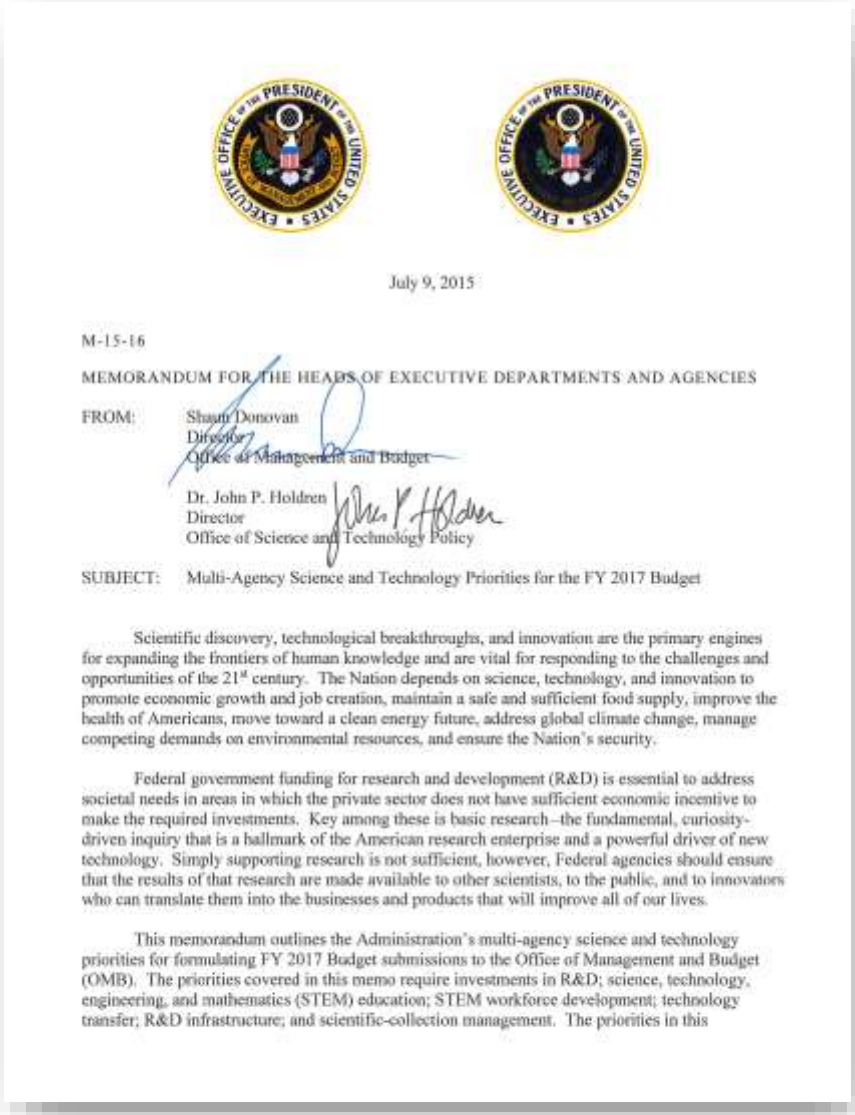
Access to digital data sets resulting from federally funded research allows companies to focus resources and efforts on understanding and exploiting discoveries. For example, open weather data underpins the forecasting industry, and making genome sequences publicly available has spawned many biotechnology innovations. In addition, wider availability of peer-reviewed publications and scientific data in digital formats will create innovative economic markets for services related to curation, preservation, analysis, and visualization. Policies that mobilize these publications and data for re-use through preservation and broader public access also maximize the impact and accountability of the Federal research investment. These policies will accelerate scientific breakthroughs and innovation, promote entrepreneurship, and enhance economic growth and job creation.

The Administration also recognizes that publishers provide valuable services, including the coordination of peer review, that are essential for ensuring the high quality and integrity of many scholarly publications. It is critical that these services continue to be made available. It is also important that Federal policy not adversely affect opportunities for researchers who are not funded by the Federal Government to disseminate any analysis or results of their research.

To achieve the Administration's commitment to increase access to federally funded published research and digital scientific data, Federal agencies investing in research and development must have clear and coordinated policies for increasing such access.

"…develop plans to make the published results of federally funded research freely available to the public within one year of publication and requiring researchers to better account for and manage the digital data resulting from federally funded scientific research."

2015 OMB and OSTP Memo



July 9, 2015

M-15-16

MEMORANDUM FOR THE HEADS OF EXECUTIVE DEPARTMENTS AND AGENCIES

FROM: Shaun Donovan
Director
Office of Management and Budget

Dr. John P. Holdren
Director
Office of Science and Technology Policy

SUBJECT: Multi-Agency Science and Technology Priorities for the FY 2017 Budget

Scientific discovery, technological breakthroughs, and innovation are the primary engines for expanding the frontiers of human knowledge and are vital for responding to the challenges and opportunities of the 21st century. The Nation depends on science, technology, and innovation to promote economic growth and job creation, maintain a safe and sufficient food supply, improve the health of Americans, move toward a clean energy future, address global climate change, manage competing demands on environmental resources, and ensure the Nation's security.

Federal government funding for research and development (R&D) is essential to address societal needs in areas in which the private sector does not have sufficient economic incentive to make the required investments. Key among these is basic research–the fundamental, curiosity-driven inquiry that is a hallmark of the American research enterprise and a powerful driver of new technology. Simply supporting research is not sufficient, however, Federal agencies should ensure that the results of that research are made available to other scientists, to the public, and to innovators who can translate them into the businesses and products that will improve all of our lives.

This memorandum outlines the Administration's multi-agency science and technology priorities for formulating FY 2017 Budget submissions to the Office of Management and Budget (OMB). The priorities covered in this memo require investments in R&D; science, technology, engineering, and mathematics (STEM) education; STEM workforce development; technology transfer; R&D infrastructure; and scientific-collection management. The priorities in this

"Agencies are encouraged to use approaches to foster innovation such as Grand Challenges, incentive prizes, citizen science, and collaboration with members of the Maker Movement."

"Preserving and improving access to scientific collections, research data, other results of Federally-funded research, open datasets, and open educational resources should be a priority for agencies."

2015 COMPETES Act

EXECUTIVE OFFICE OF THE PRESIDENT
OFFICE OF SCIENCE AND TECHNOLOGY POLICY
WASHINGTON, D.C. 20502

Guidance to Federal Departments and Agencies for Fiscal Year 2015 Report on Use of Prize Authority in the America COMPETES Reauthorization Act

October 28, 2015

By no later than **December 31, 2015**, using the format below, please report to the White House Office of Science and Technology Policy (OSTP) all activities your agency carried out during fiscal year 2014 under Section 24 of the Stevenson-Wydler Technology Innovation Act of 1980.

SUBMISSION DETAILS

• **Submit reports by email to**: prizes@ostp.gov **by:** COB December 31, 2015.

• **Requirements:** Section 24(p) of the Stevenson-Wydler Act requires a report on all prize competitions conducted under Section 2. Agencies should use the template below to report to OSTP all activities under section 24.

In addition, Agencies are also *encouraged* to:

1. Report to OSTP on prize competitions conducted under *other* legal authorities, including why the competition was conducted under that authority. OSTP will report selectively on non-COMPETES challenges.
2. Provide updated results of prize competitions conducted in prior fiscal years, including particularly compelling outcomes that were not previously reported. OSTP will report selectively on challenges conducted in prior fiscal years.
3. Provide updates on steps your Agency has taken to build infrastructure to support prizes and challenges (e.g. dedicated personnel, policies, funds, processes, contracts with vendors).

• **Clearance:** In your submission, please confirm that appropriate agency leadership has approved the report.

STYLE, TONE, GRAMMAR, AND PUNCTUATION

All submitted reports should follow a few basic style, tone, grammar and punctuation rules:

- Except in lists, use full sentences.
- Be clear, concise, and direct.
- Get to the point, focusing on information of interest to the user.
- Respond to the questions asked in the template.
- Use active voice.
- Use simple language. Avoid acronyms and clarify technical terms.

EXECUTIVE OFFICE OF THE PRESIDENT
OFFICE OF MANAGEMENT AND BUDGET
WASHINGTON, D.C. 20503

MEMORANDUM FOR GENERAL COUNSELS AND CHIEF INFORMATION OFFICERS FOR EXECUTIVE DEPARTMENTS AND AGENCIES

FROM: **Boris Bershteyn**
General Counsel

Steven VanRoekel
Federal Chief Information Officer

SUBJECT: **Prize Authority in the America COMPETES Reauthorization Act**

On January 4, 2011, President Obama signed Public Law 111-358, the America COMPETES Reauthorization Act. Section 105 of this Act added section 24 (Prize Competitions) to the Stevenson-Wydler Technology Innovation Act of 1980, to provide agencies with authority to conduct prize competitions in order to spur innovation, solve tough problems, and advance their core mission, as called for in the President's Strategy for American Innovation and the 2010 OMB "Guidance on the Use of Challenges and Prizes to Promote Open Government"(OMB Memorandum M-10-11 of March 8, 2010).

As noted below, this new prize authority is designed to expand the authority of Federal agencies to conduct prize competitions to further their goals. It does not affect any existing prize authority already provided by any other law. Prize competitions under this new statute may be funded jointly by more than one agency and by the private sector, and may be judged by committees exempt from the requirements of the Federal Advisory Committee Act. The requirements under this new authority with respect to eligibility to win a prize, conduct the competition, liability, insurance, intellectual property rights, funding, and prize amounts are described below.

To permit the Office of Science and Technology Policy (OSTP) to file the required annual reports to Congress, agencies conducting prize competitions under this new authority should complete the attached report to OSTP by December 30 each year. Agencies are also encouraged to include in such reports information about prize competitions conducted under other authority. There is no need to report if an agency has not conducted any prize competitions during the course of the year.

The following Fact Sheet and Frequently Asked Questions were developed jointly by policy and legal staff in the Office of Science and Technology Policy (OSTP) and the Office of Management and Budget (OMB) to provide informal guidance to agencies in their implementation of the prize authority in section 24 of the Stevenson-Wydler Act, as added by the America COMPETES Reauthorization Act.

FACT SHEET

New section 24 of the Stevenson-Wydler Technology Innovation Act of 1980, 15 U.S.C. § 3719, as enacted by the America COMPETES Reauthorization Act, includes the following authorities and requirements.

Authorities

- **In General.** Section 24 permits any agency head to "carry out a program to award prizes competitively to stimulate innovation that has the potential to advance the mission of the respective

2015 OSTP Memo

EXECUTIVE OFFICE OF THE PRESIDENT
OFFICE OF SCIENCE AND TECHNOLOGY POLICY
WASHINGTON, D.C. 20502

September 30, 2015

MEMORANDUM TO THE HEADS OF EXECUTIVE DEPARTMENTS AND AGENCIES

FROM: John P. Holdren
Assistant to the President for Science and Technology and
Director of the Office of Science and Technology Policy

SUBJECT: Addressing Societal and Scientific Challenges through Citizen Science and Crowdsourcing

Overview

Through citizen science and crowdsourcing, the Federal Government and nongovernmental organizations engage the American public in addressing societal needs and accelerating science, technology, and innovation. In ***citizen science,*** the public participates voluntarily[1] in the scientific process, addressing real-world problems in ways that may include formulating research questions, conducting scientific experiments, collecting and analyzing data, interpreting results, making new discoveries, developing technologies and applications, and solving complex problems.[2] In ***crowdsourcing***, organizations submit an open call for voluntary assistance from a large group of individuals for online, distributed problem solving.

Citizen science and crowdsourcing projects can enhance scientific research and address societal needs, while drawing on previously underutilized resources. For example, after analyzing 338 citizen science biodiversity projects around the world, researchers at the University of Washington estimated that the in-kind contributions of 1.3–2.3 million citizen science volunteers to biodiversity research have an economic value of up to $2.5 billion per year.[3] Other benefits include providing hands-on learning in science, technology, engineering, and mathematics (STEM), and connecting members of the public directly to Federal agency missions and to each other. In recognition of these potential benefits, this memorandum encourages the use, where appropriate, of citizen science and crowdsourcing by Federal agencies.

Specifically, this memorandum:

i. Outlines principles that agencies should apply in order to ensure future use of citizen science and crowdsourcing in a way that is appropriate and leads to greatest value and impact;
ii. Directs agencies to take two specific steps to advance appropriate application of these methods:

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[1] In both citizen science and crowdsourcing, voluntary participation can be active or passive depending on the nature of the project.
[2] This definition should not be interpreted to imply that research projects that incorporate volunteers as "subjects" of the research are citizen science projects.
[3] Theobald, E.J., A.K. Ettinger, H.K. Burgess, L.B. DeBey, N.R. Schmidt, H.E. Froehlich, C. Wagner, J. HilleRisLambers, J. Tewksbury, M.A. Harsch, and J.K. Parrish. 2014. Global change and local solutions: Tapping the unrealized potential of citizen science for biodiversity research. Biological Conservation 181: 236-244. doi:10.1016/j.biocon.2014.10.021

2015 CCS Act

114TH CONGRESS
1ST SESSION

S. _____

To harness the expertise, ingenuity, and creativity of all people to contribute to innovation in the United States and to help solve problems or scientific questions by encouraging and increasing the use of crowdsourcing and citizen science methods within the Federal Government, as appropriate, and for other purposes.

IN THE SENATE OF THE UNITED STATES

Mr. COONS introduced the following bill; which was read twice and referred to the Committee on _____

A BILL

To harness the expertise, ingenuity, and creativity of all people to contribute to innovation in the United States and to help solve problems or scientific questions by encouraging and increasing the use of crowdsourcing and citizen science methods within the Federal Government, as appropriate, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,

SECTION 1. SHORT TITLE.

This Act may be cited as the "Crowdsourcing and Citizen Science Act of 2015".

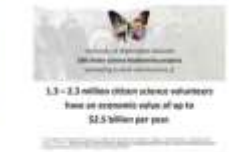
ACS Chemistry for Life®

Citizen Science: Empowering a Robust National Effort

June 7, 2016: American Chemical Society Science & the Congress Project, co-organized by the Consortium for Science, Policy & Outcomes at Arizona State University. Honorary Co-Hosts Sen. Steve Daines (R-MT) and Sen. Chris Coons (D-DE).

vimeo


Jamie Vernon, Sigma Xi and American Scien...


Sophia B. Liu, US Geological Survey


Andrew Torelli, Bowling Green State Univers...


Darlene Cavalier, Arizona State University


David Ribkin, Museum of Science Boston


Citizen Science, Question & Answer

CitizenScience.gov

catalog

@FedCitSci

300+ projects from 25 agencies

toolkit

Learn how to create a CCS project

community
citizenscience.gov

Community of Practice & Agency Coordinators

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

See What's Happening in Federal Citizen Science

Appointed by their federal agencies, a new team of coordinators is helping to manage, validate and grow citizen science and crowdsourcing initiatives across government.

Follow Us on Twitter

CitizenScienceGov @FedCitSci
Dreamy for dragonflies: New report tracks their migration with #citizenscience data, tech: ow.ly/4nb28f @forestservice @USGS

CitizenScienceGov @FedCitSci
High-seas #citizenscience: See how @AquariumPacific and the public are helping agencies study aquatic life: ow.ly/4na6L0 @NatGeo

https://ccsinventory.wilsoncenter.org

CitizenScience.gov | Add A Project | About The Catalog

catalog citizenscience.gov

Federal Crowdsourcing and Citizen Science Catalog

FIND PROJECTS:

Search for...

FILTER BY:

- Project Topic
- Agency Sponsor
- Agency Partner
- Participant Age
- Intended Outcomes

PROJECTS	AGENCIES
301	25

IDAH2O Master Water Stewards
by U.S. Environmental Protection Agency (EPA)

2016 National Parks BioBlitz - Acadia Lepidoptera BioBlitz
by National Park Service (NPS)

2016 National Parks BioBlitz - American Samoa
by National Park Service (NPS)

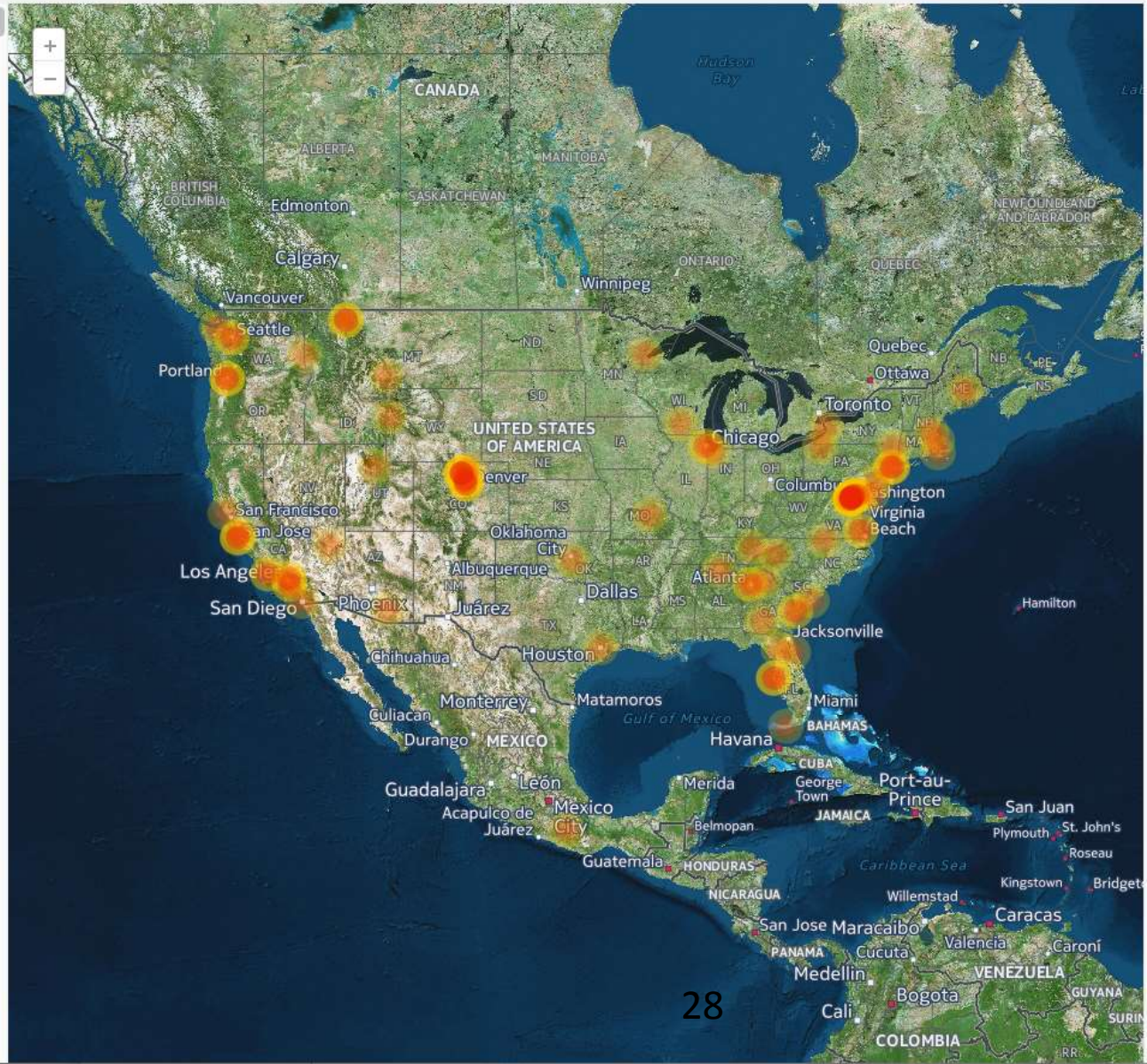
2016 National Parks BioBlitz - Antietam: Grassland Birds
by National Park Service (NPS)

2016 National Parks BioBlitz - Assateague Island
by National Park Service (NPS)

2016 National Parks BioBlitz - Aztec Ruins
by National Park Service (NPS)

2016 National Parks BioBlitz - Bandelier
by National Park Service (NPS)

2016 National Parks BioBlitz - Bering Land Bridge
by National Park Service (NPS)



https://crowdsourcing-toolkit.sites.usa.gov

enter search terms search

toolkit citizenscience.gov Federal Crowdsourcing and Citizen Science Toolkit

HOME HOW TO CASE STUDIES RESOURCE LIBRARY LAW AND POLICY CITIZENSCIENCE.GOV

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 toolkit. View resources

The Project Catalog: Find Federally Sponsored Projects

Catalog of federally sponsored projects via the Commons Lab.

Federal Crowdsourcing and Citizen Science Community

The Federal Community of Practice on Crowdsourcing and Citizen Science (CCS) meets monthly to share lessons learned and develop best practices for designing, implementing, and evaluating crowdsourcing and citizen science initiatives. Learn more about the CCS

Other Innovation Communities

- Challenges and Prizes
- OpenGov
- Ideation CoP
- DigitalGov
- Data.gov
- SocialMedia CoP

Learn about these communities

citizenscience.gov

Helping federal agencies accelerate innovation through public participation.

Welcome to Our Community!

The White House Office of Science and Technology Policy (OSTP), U.S. General Services Administration (GSA), a number of external partners, and federal agencies are undertaking a series of initiatives to support and grow the momentum of citizen science and crowdsourcing projects across the federal government. There are two primary groups within the federal government currently working to advance crowdsourcing and citizen science use and practice. These are:

- **The Federal Community of Practice for Crowdsourcing and Citizen Science**: a grassroots community open to all federal practitioners working on, funding, or just interested in learning more about crowdsourcing and citizen science.
- **Agency Citizen Science and Crowdsourcing Coordinators**: a group of federal employees designated by federal agency leaders to be responsible for implementing various tasks outlined in a September 2015 memo from OSTP to the heads of federal departments and agencies.

If you have questions, please email citizenscience@gsa.gov.

Federal Community of Practice for Crowdsourcing and Citizen Science

The Federal Community of Practice for Crowdsourcing and Citizen Science (CCS) works across the government to share lessons learned and develop best practices for designing, implementing, and evaluating crowdsourcing and citizen science initiatives.

Related Articles

- GSA Unveils New Hub for Federal Citizen Science & Crowdsourcing
  Do you have a scientific issue to address? Wish you had dozens, hundreds, even thousands more people helping you out? There's help out there, and now that help is easier than ever to find. The General Services Administration (GSA) yesterday launched CitizenScience.gov, a new central hub for citizen science and crowdsourcing projects across the federal […]
- How FEMA Delivers Anytime, Anywhere Information During Disasters
  No one wants to feel helpless in an emergency situation. To provide tips and assistance anytime, anywhere, the Federal Emergency Management Agency (FEMA) stepped up thei
  mobile game. FEMA developed

Key Federal Open Innovation Communities

Federal Community of Practice on Crowdsourcing and Citizen Science (CCS) - a grassroots community open to all federal practitioners working on, funding, or just interested in learning more about crowdsourcing and citizen science. This community created a citizenscience.gov Toolkit, which outlines the steps to take when establishing a new project, offers case studies that document the process of successful federal projects or programs, and hosts other resources.

Agency Coordinators - a group of federal employees designated by federal agency leaders to be responsible for implementing various tasks within their agency as outlined in a September 2015 memo from OSTP to the heads of federal departments and agencies.

Prizes and Challenges –Challenge.gov hosts a listing of challenge and prize competitions, all of which are run by more than 80 agencies across thefederal government. These include technical, scientific, ideation, and creative competitions where the U.S. Government seeks innovative solutions from the public, bringing the best ideas and talent together to solve mission-centric problems.

Federal Games Guild, a group of federal employees interested in or actively using video game technologies to address various societal challenges and Federal agency missions (such as education, workforce development, healthcare, and citizen science) by connecting with leaders in the field and sharing experience, strategies, and opportunities.

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Citizen Science

1776 - 1816

Thomas Jefferson makes unbroken line of weather observations.

1776

1890 -1900

Cooperative Observer Program Established

The National Weather Service's Cooperative Observer Program (COOP) is established by an act of Congress. COOP sets up stations around the U.S., where volunteers contribute observations.

1890

1800
1820
1840
1860
1880
1900

1995

Term "Citizen Science" is Coined

Alan Irwin, a University of London Professor, coins the term citizen science to describe the contributions of lay people to environmental monitoring as complementary to scientific initiatives. At the Cornell Lab of Ornithology, Rick Bonney also begins using the term citizen science during a similar timeframe.

1995

CHRISTMAS BIRD COUNT

The Audubon Society establishes the Christmas Bird Count, where volunteers count the number of birds they see during the weeks surrounding Christmas. Considered one of the longest running citizen science programs.

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20,000
volunteers
in all 50 States, D.C., Puerto Rico, the U.S. Virgin Islands and Canada are collecting real-time rain, hail and snow data

59
government organizations
300 federal employees from 59 different government organizations are participating in the Federal Community of Practice on Citizen Science and Crowdsourcing

303
federally funded citizen science & crowdsourcing projects being supported by 25 different agencies

1,600
volunteer groups
in the United States are engaged in water quality monitoring

$2.5 billion
economic value
Researchers at the University of Washington estimate that the in-kind contributions of 1.3–2.3 million citizen science volunteers to biodiversity research have an economic value of up to $2.5 billion per year.

116
BioBlitzes
were held across the U.S. to monitor species in our National Parks in 2016, with an estimated 80,000 volunteers

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Estimated U.S. Federal Agency **Annual Investment**

National Science Foundation
$44,271,721

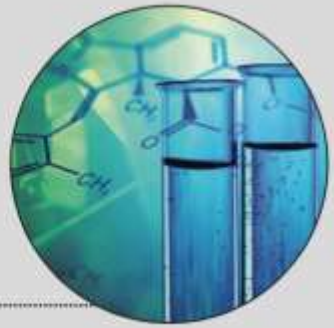
Department of Defense
$2,955,317

Department of Agriculture
$68,471

National Parks Service
$198,375

Environmental Protection Agency
$5,353,140

Health and Human Services
$1,244,106



National Oceanic and Atmospheric Administration
$10,836,046

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Applications in Ecosystem Services

Related Citizen Science Projects for Ecosystem Services

USA npn
National Phenology Network
Taking the Pulse of Our Planet

The North American Breeding Bird Survey

Biodiversity Information Serving Our Nation - (BISON)

iNaturalist

Transforming Participatory Science into Socioecological Praxis

Valuing Marginalized Environmental Knowledges in the Face of the Neoliberalization of Nature and Science

Brian J. Burke and Nik Heynen

The Coweeta Listening Project (CLP) is an action-research collective that seeks to listen to residents of Southern Appalachia, integrate their concerns and experiential knowledge with ecological and political ecological research, and build useful and meaningful connections between scientists and the public.

Ecology, 94(11), 2013, pp. 2645–2652

Using citizen scientists to measure an ecosystem service nationwide

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Ecosystem Services

Volume 7, March 2014, Pages 177–186

Civic ecology practices: Participatory approaches to generating and measuring ecosystem services in cities

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frontiers in
EARTH SCIENCE

REVIEW ARTICLE
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Citizen science in hydrology and water resources: opportunities for knowledge generation, ecosystem service management, and sustainable development

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Ecological Indicators

Volume 64, May 2016, Pages 237–248

Crowdsourcing indicators for cultural ecosystem services: A geographically weighted approach for mountain landscapes

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Environmental Modelling & Software

Volume 88, February 2017, Pages 58–73

User-driven design of decision support systems for polycentric environmental resources management

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Discussion Questions

- **How can participatory science enable the identification, measurement, and analysis of ecosystem services?**
- **When is it appropriate and inappropriate to apply these participatory methods to the ecosystem services approach?**
- **What challenges in the ecosystem services approach could be explored at an Ecosystem Services Hackathon?**
- **What systems are necessary for mitigating conflict of interest when the ecosystem providers are also the ones monitoring and evaluating the provisioning?**


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