NASA Earth Science Education Collaborative (NESEC)

IGES - Goddard – Langley – Jet Propulsion Laboratory

Presentation to National Academies Assessment Committee

Theresa Schwerin, NESEC PI
Vice President, Education
Institute for Global Environmental Strategies (IGES)

NESEC Vision

NESEC is enhancing STEM teaching and learning by creating engaging, meaningful, and **authentic STEM experiences and resources** that are based on **NASA Earth science,** tailored to specific **audiences based on their needs**; as a whole reach **diverse learners throughout their lifetimes**; and delivered broadly through **strategic partnerships**.

NESEC Operational Model: Develop – Disseminate - Supp

Enable STEM Education in all 50 States– Document benefits/improvement of including NASA SMEs, content, and authentic experiences to learners of all ages	Improve US Scientific Literacy	Advance National Educational Goals- Supporting Co-STEM goal achievement by 2020	Leverage Through Partnerships – Document benefits/improvement of including NASA Science and collaborative approach
Expand participation in NESEC offerings to all 50 states from 2016 to 2020. These include GLOBE Observer, GLOBE field campaigns, and NASA Science Investigations (using GLOBE and NASA Earth system science content)	**Increase the number of individuals who have the opportunity to actively engage in scientific processes.** Achieve 100,000 citizen scientists participating in GLOBE Observer with users in all states, from 2017 baseline (U.S.).	Increase and sustain youth and public engagement in authentic STEM experiences by **increasing the number of authentic STEM experiences available for participation from 3 in 2016 to >9 in 2020.** (Experiences include student research campaigns, GLOBE Observer protocols, data challenges, etc.)	Increase the number of **Sustained external partners** from 0 in 2016 to 2 sustained partnerships in 2020 (signed letters of agreement).
Improve access to resources that support NASA authentic STEM experiences a) increased number of online resources available with NASA Earth science content and SMEs from 10 in 2016 to 50 in 2020; b) expanded use of these resources to all 50 states from 2016-2020.	**Percentage of repeat users** of GLOBE Observer relative to all users increases by 10% in 2020 over 2017 baseline.	Increase number of U.S. student research projects based on NESEC offerings from 2017 Baseline of 31. 2018, this was increased to 179 student research projects. (GLOBE U.S. student research projects, Girl Scout Journeys, Clouds Junior Researchers)	Efforts are underway and will expand in year 4 to identify and engage additional external partners with mutually-beneficial goals that will help further NESEC impact and reach.
Increase engagement of NASA SMEs with participants (# and contact hours) compared to 2017 baseline			
Document indicators of scientific research and applications that utilize GLOBE			

Team, Partners and Evaluator

Team

Institute for Global Environmental Strategies
Theresa Schwerin, PI

NASA Goddard Space Flight Center
Dr. Trena Ferrell, Co-I
Holli Kohl, GLOBE Observer Coordinator

NASA Jet Propulsion Laboratory
Susan Callery, Co-I

NASA Langley Research Center
Jessica Taylor, Co-I

Partners and Collaborators

- The GLOBE Program
- GLOBE Implementation Office and DIS
- Association of Science-Technology Centers (ASTC)
- 4-H
- Odyssey of the Mind (OoTM)
- SciStarter/Girl Scouts
- Smithsonian Educator Resource Center
- Cross-Collaborations with the SciAct collective

Evaluator

Oregon State University –Dr. Heather Fischer, Dr. Martin Storksdieck
With thanks to Dr. Ann Martin (original evaluator)

NESEC Activities: Three Interrelated Areas

GLOBE Observer

Citizen Scientist Observations of

- Clouds
- Mosquito Habitats
- Land Cover
- Trees
- Eclipse (2017, 2019)
- Fire Fuels (coming summer 2019)

The GLOBE Program

NASA Investigations with GLOBE

- U.S. Air Quality
- Trees Around the GLOBE
- GLOBE Mission Mosquito
- Clouds/Contrails Jr Researchers
- Girl Scouts Journey: Think Like a Citizen Scientist
- ENSO (ended 2018)

Strategic Partnerships & Collaborations

Strategic Partnerships

Extend NESEC offerings to strategic audiences (e.g., SciStarter, Girl Scouts, 4-H, ASTC, ACA, Smithsonian, Oscher LifeLong Learning Institute)

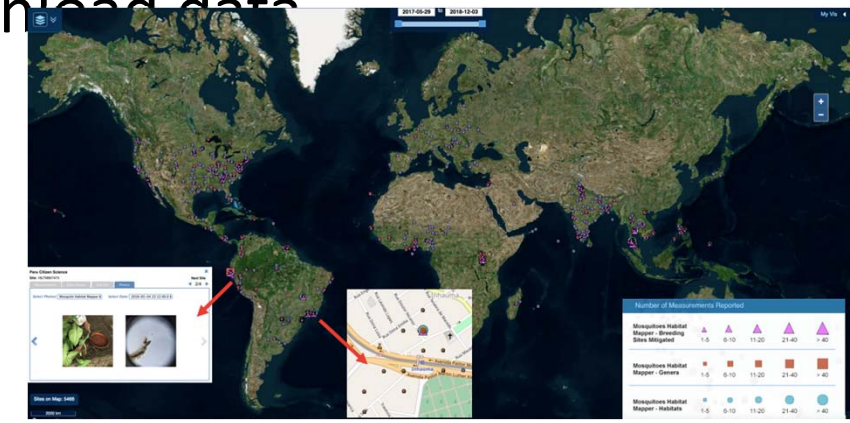
Collaborations within SciAct

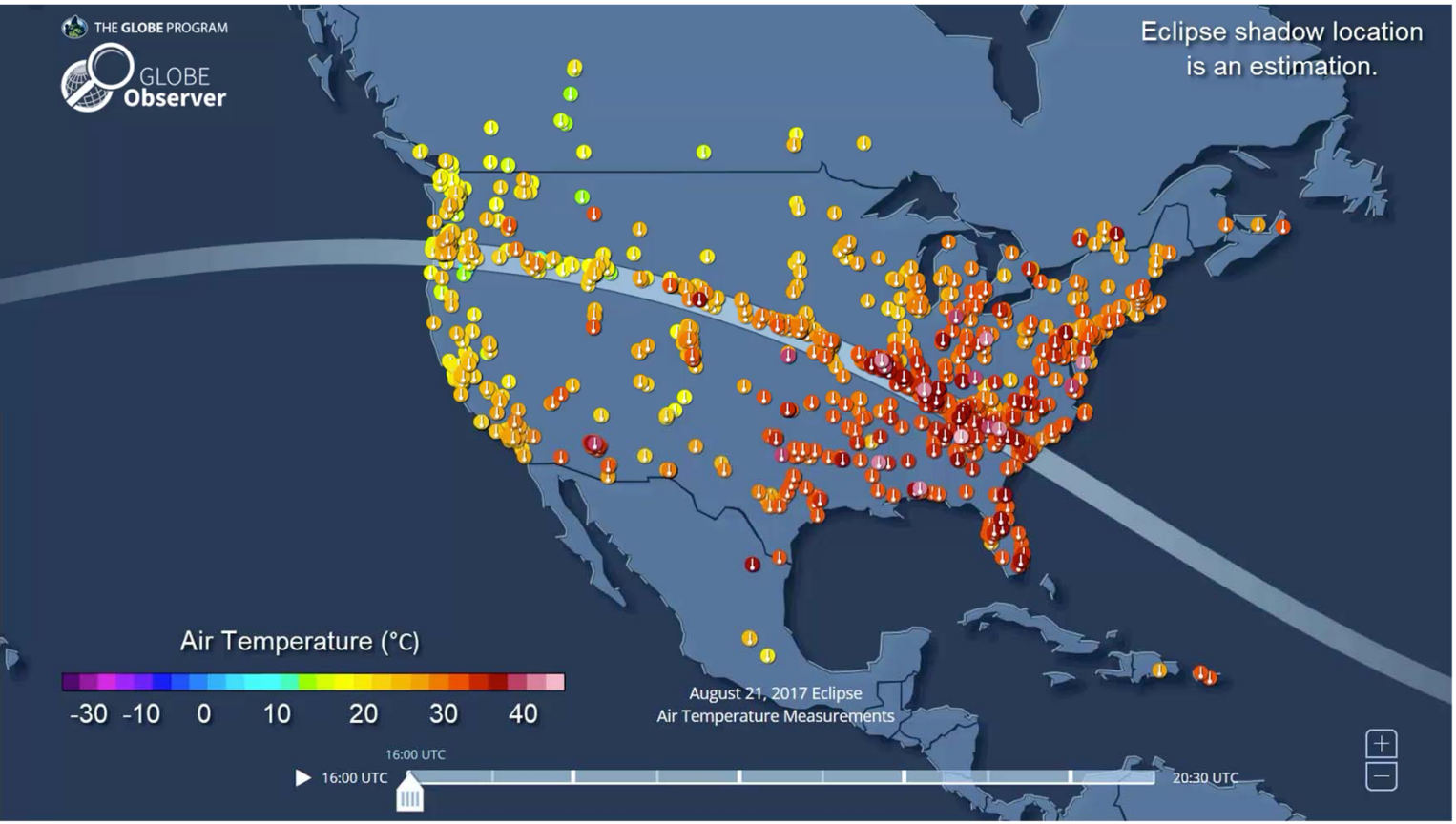
Connect to NASA Earth Assets; Leverage SciAct networks/expertise; Contribute to SciAct Working Groups

GLOBE Observer Citizen Science

- Protocols support NASA Science
- Free mobile app
- Email address registration
- In-app training
- Guided protocol or expert mode
- Visualize and download data

Coming Summer 2019 Fire Fuels





>100,000 observations of sky conditions and air temperature using GLOBE Observer throughout the day.

Related Research:

Dodson, J. B., M. Colón Robles, J. E. Taylor, C. C. DeFontes, and K. L. Weaver (2019). ***Eclipse Across America: Citizen Science Observations of the 21 August 2017 Total Solar Eclipse.*** Submitted to J. Applied Meteorology and Climatology.

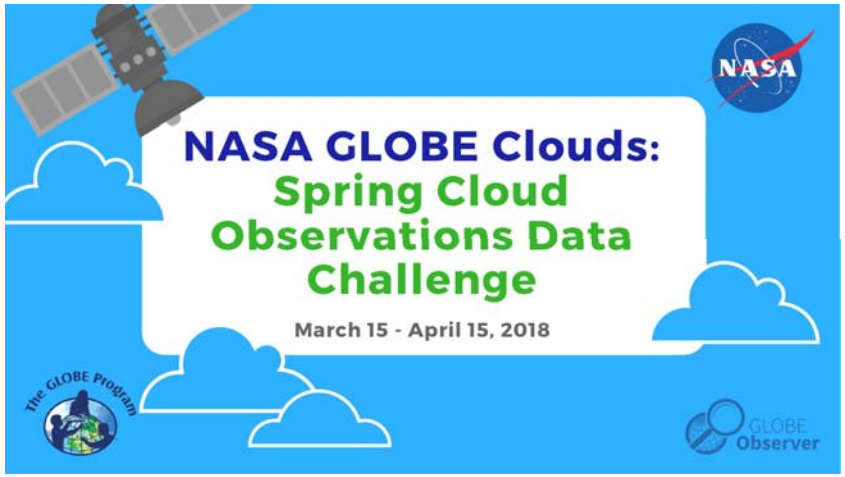
Rahman, I., Czaijkowsi, k., Jiang, Y., and Weaver, K. ***Effect of The Great American Solar Eclipse on Local Weather: A Study on The GLOBE Citizen Science Data Set,*** presented at American Association of Geographers Annual Meeting, April 3, 2019

Research by Rahman, et al is also a chapter in the Astronomical Society of the Pacific Conference Series book "Celebrating the 2017 Great American Eclipse: Lessons Learned from the Path of Totality."

Effects of the Great American Eclipse on Surface Temperatures, Huntington High School, GLOBE Student Research

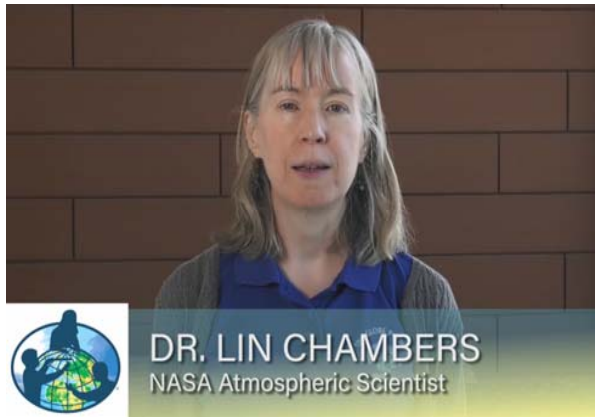
Analysis of Data Collected During the 2017 Solar Eclipse at Eighty Percent Totality, Crestwood High School, GLOBE Student Research

The Power of Data Challenges



2018 Spring Clouds Data Challenge (Mar 15-Apr 15)

- 56,500 submissions, with >120,000 cloud photos
- 15,000 locations in 99 countries, including every continent
- Over 33,700 of the observations were matched to satellite data by the NASA Langley team.
- A news feature on nasa.gov received over 41,000 views and produced over 130 news articles



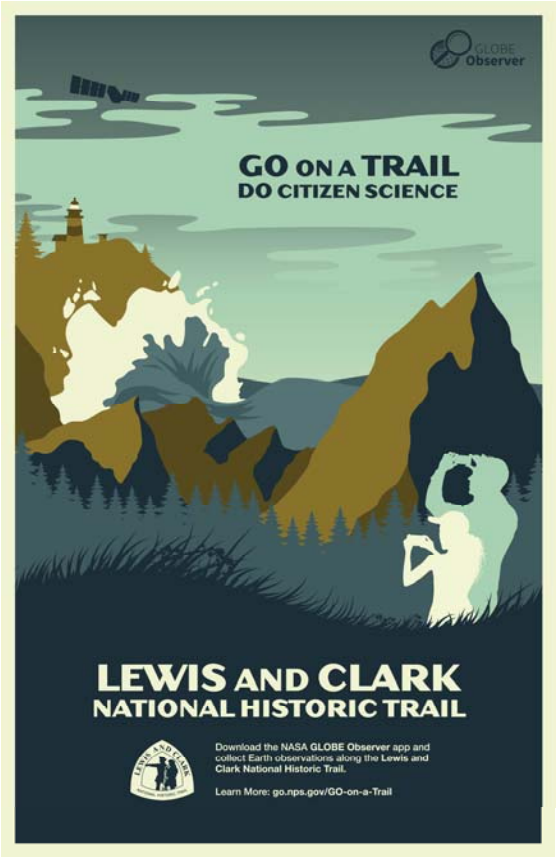
https://www.nasa.gov/feature/langley/nasa-to-cloud-gazing-citizen-scientists-job-well-done

Current Data Challenges

Mosquito Blitz Week April 7-13, 2019

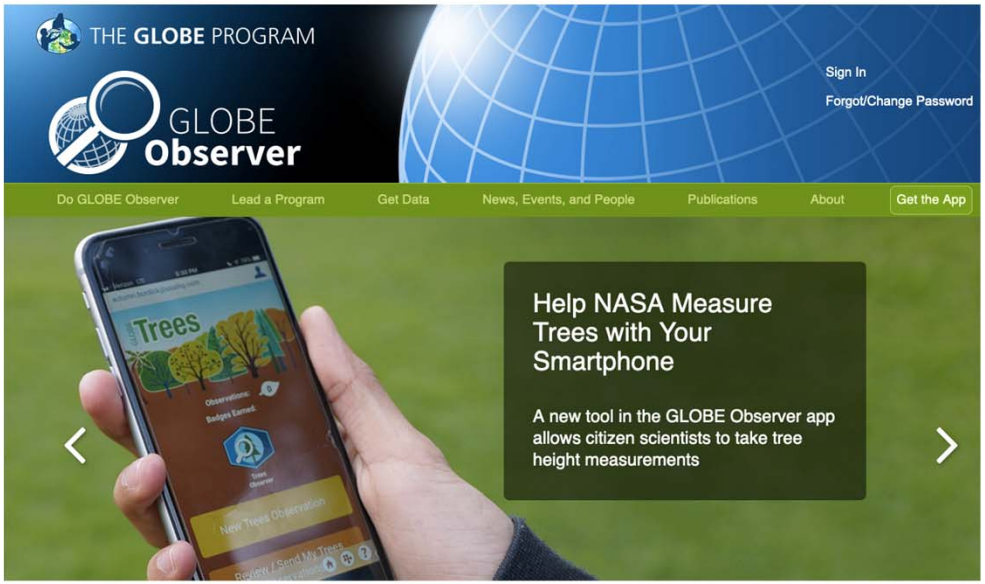
- Find Places water has collected
- Photograph and note if larvae present
- Eliminate the water
- Upload observations

GO on a Trail
June 1 – Sept 2



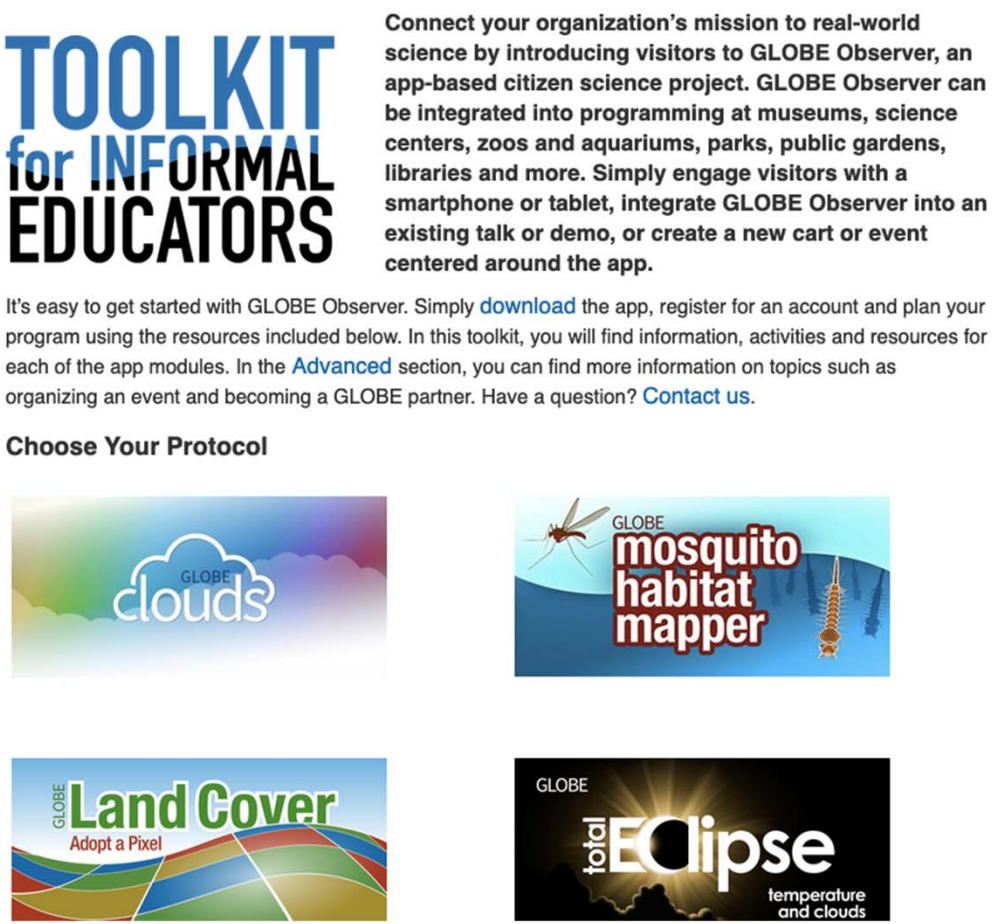
https://observer.globe.gov/do-globe-observer/challenges

GLOBE Observer Website and Toolkits for Informal Educators



Resources for citizen scientists, informal educators, and professional scientists

Toolkits are being field tested with libraries, camps, museums. Case studies and programming resources for specific settings are being planned.



Extending reach and featuring NASA scientists through Social: Examples from Trees Rollout March 25, 2019

SnapChat/Instagram/Facebook Story (left) **Reached over 2.1 million people** with Tuesday's (3/26/19) Trees featured **7 NASA subject matter experts**

YouTube (below): Trees video demonstrating how to use the app has over **5k views on Youtube**, over **8K on Facebook**, and over **4K on Twitter** (and building).

Facebook Live on March 26 reached over 84.8K and featured
5 subject matter experts for trees research at NASA

NASA Investigations with GLOBE

These GLOBE Campaigns engage educators and students through webinars and direct interactions with NASA scientists, educator resources, intensive observing periods, technical support and mentoring for student research.

U.S. Air Quality Observations
Scientist: Dr. Margaret Pippin, LaRC

Mentors teachers and students collecting aerosol data that Pippin uses in her research and students use for research projects.

Started 2016

K-12 Student Research Campaign
Coordinator: Brian Campbell, GSFC
Scientist: Peder Nelson, OSU

Observations support NASA ICESat and GEDI Missions
Started September 15, 2018

GLOBE Mission Mosquito

K-12, Informal Ed, and Citizen Scientists
Coordinator: Dorian Janney, GSFC
Scientist: Dr. Rusty Low, IGES

Contributing to updated phenology map of N. America;
Observations will support NASA applications/numerical models, potential application for public health
Started Oct. 2, 2018

NASA Investigations with GLOBE

GLOBE Observer Clouds and Mosquito Habitat Mapper are two of seven projects that **Brownie Scouts (K-5)** can select for their **Think Like a Citizen Scientist Journey**.

GSA completed testing of K-5 Journey, have started professional development with Councils. Plans are to begin **piloting with older scouts later in 2019.**

Above: Rusty Low, IGES, video for Girl Scouts Journey explaining what they will do and why their observation are needed

GLOBE Clouds Junior Research Team: Contrails Investigation

Student teams collect contrail data for NASA LaRC scientists starting fall 2018.

Junior Researchers are asked to make observations during the fall and develop a research project in the spring GLOBE Student Regional Symposia or International Virtual Student Symposia.

Five U.S. teams, one Thailand team.

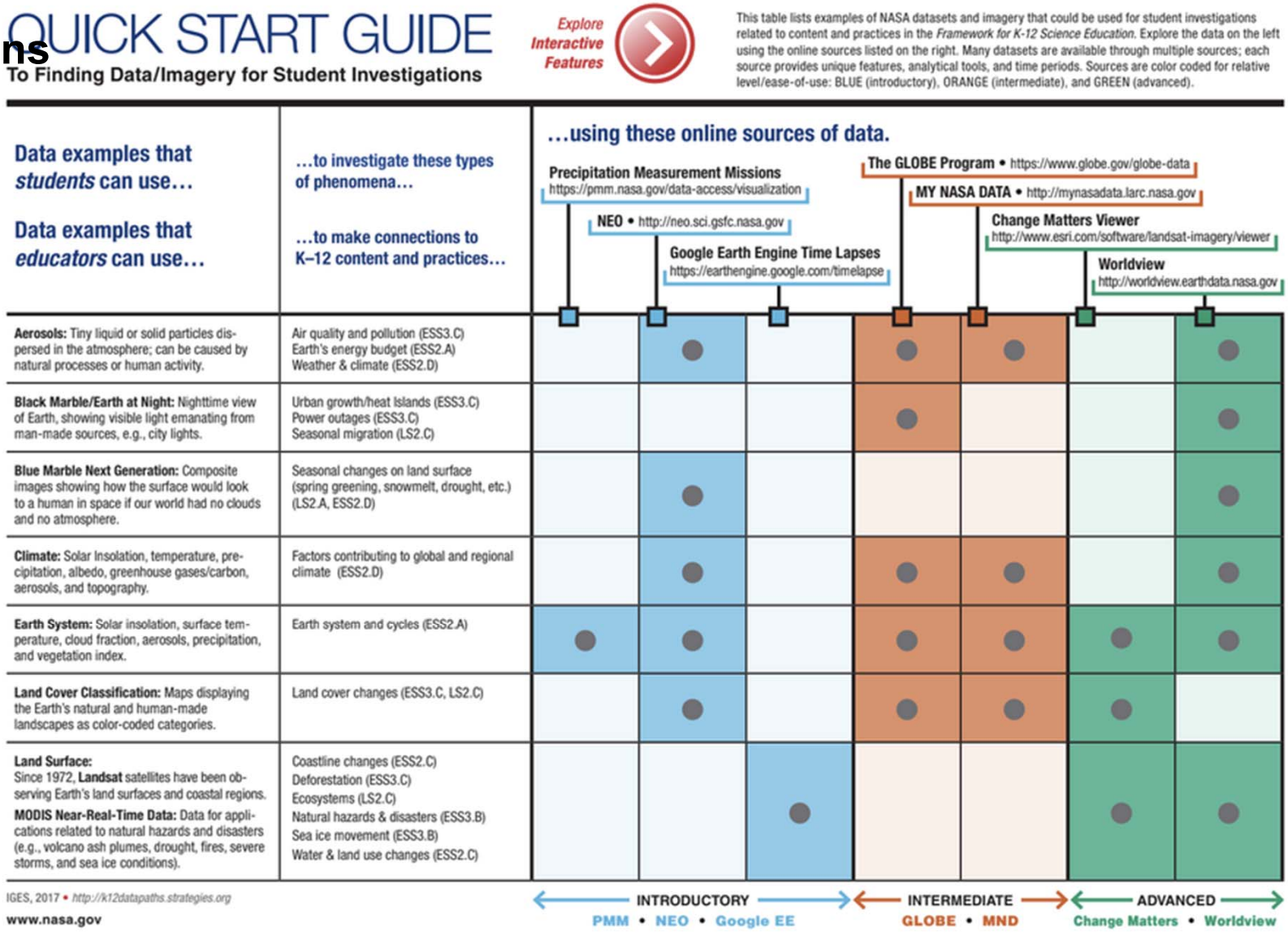
*"Technology as a tool is incredibly motivating. Having NASA as a learning partner is also a strong motivator. My students rotate through their science investigation teams daily to make sure their cloud and contrail observations are completed with accuracy and that NASA receives the data in a timely manner…. **In our second quarter the county assessment testing showed a 76.83% mastery of the objective that we just could not seem to meet before our participation in GLOBE."***

Caryn Long, Teacher, Treadway Elementary

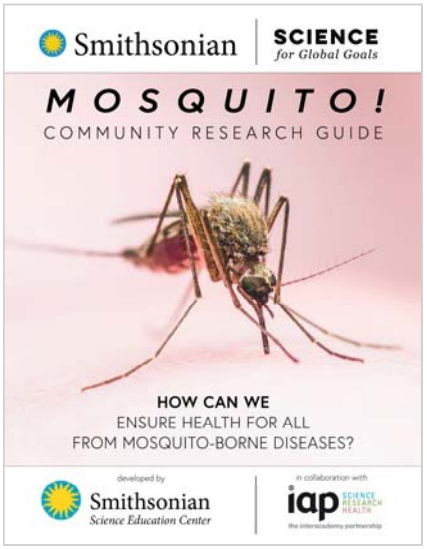
Right: Marilé Colón Robles "Zooms" with students at Treadway Elementary

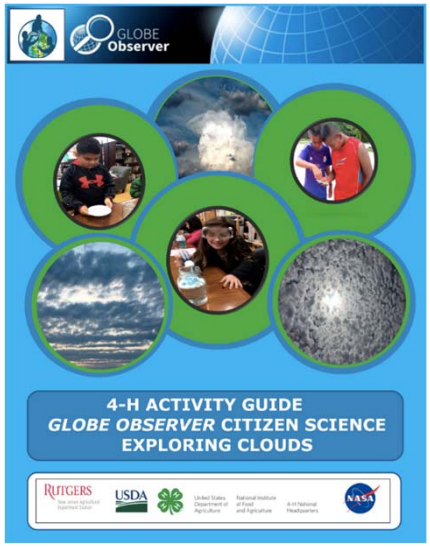
NASA Investigations

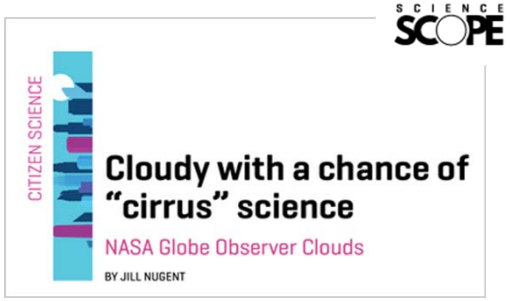
Supporting student investigations of phenomena with NASA data



Partnerships and Collaborations: Examples and Produc







Odyssey of the Mind

Thousands of students, coaches and parents meet NASA subject matter experts at NASA sessions at Odyssey of the Mind World Finals organized by NESEC. NESEC has also developed a NASA collection of creativity and problem solving resources for OoTMers. These include NASA practice problems and a collection of resources featuring NASA people and resources pointing to how NASA scientists and engineers jumpstart the engineering process

Partnerships and Cross Collaborations

NESEC Supports the NASA SciAct ⟷ NASA SciAct Supports NESEC

NESEC is often in an active advisory role with respect to SciAct partners, providing subject matter expertise, review, content alignment to NASA Earth Science assets and priorities, and content co-creation.

Rich, ongoing collaborations with:

- NISE Net
- NASA@ My Library
- Arctic and Earth SIGNS
- GLOBE Mission Earth
- AREN
- SEES/UT-Austin
- NASA eClips
- Earth to Sky

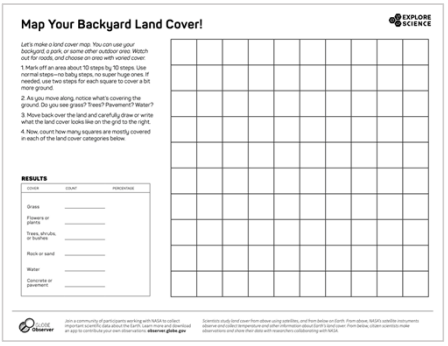
NESEC Supported WGBH Earth System Science Modules

The collective is a powerful dissemination network to connect our content to audiences

Monthly tagups, workspace (smdepo.org) enable to learn about SMD-wide activities, opportunities, others work, and to share our work

NESEC Team members participate fully on all SciAct Working Groups (Girls & STEM, Native American, Ed Tech, Visualizations)

Right – Example from NISE Net 2019 Toolkits



Evaluation: Oregon State University

- Provide strategic guidance to the NESEC team on project focus and productive connection to external partners;
- Provide support for product and program development based on conceptual and empirical evidence; and
- Provide evidence for project reach and impact, focused on goals and metrics that align with key goals that are guiding the overall NASA SMD Science Activation program.

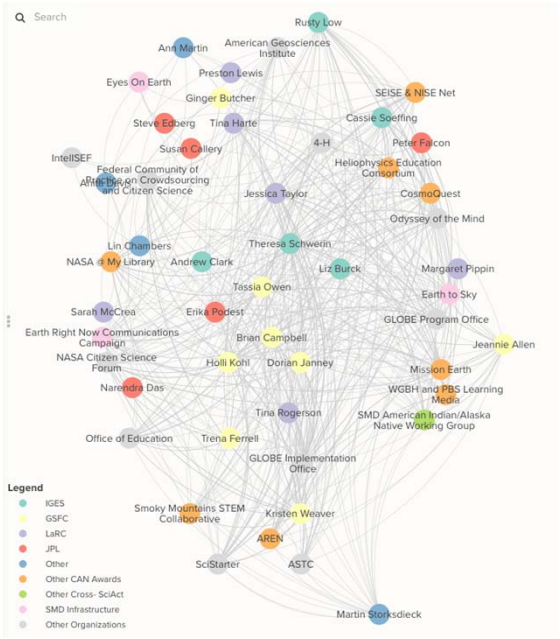
Note: Evaluation in years 1-2 focused on front end-user needs assessments and formative evaluation activities.

OSU Evaluation Studies

Understanding Participation

1. Social Network Analysis of NESEC Team and Partners

Creating a Connected System of Partners



"The connections recommended by [NESEC] have improved our products and have provided richer STEM stories for our learners."

2. Volunteer Survey: "Nibble and Drop"

Understanding volunteer motivations, participation, and user experience.

Random, stratified sample of 4,000 (75,000 N. American)

>1,000 responses (Jan 31-March 31) OSU is analyzing data for peer reviewed publication.

3. Scientist Engagement Framework

Developing and testing framework for scientist data discovery boot camps

Understanding and Documenting Effectiveness

4. Scientific Value Added

Using published framework on research productivity via Citizen Science to assess GO contribution to science. *(A Science Products Inventory for Citizen-Science Planning and Evaluation, Wiggins, et al, 2018)*

5. Embedded Assessments

Embedded Assessments based on performance measures; Test data quality while measuring outcomes.

NASA Earth Science Education Collaborative (NESEC)

PI and Institutional Co-Is: IGES: Theresa Schwerin, PI; **GSFC**: Dr. Trena Ferrell, Co-I; **LaRC:** Jessica Taylor, Co-I; and **JPL:** Susan Callery, Co-I

GLOBE Observer (GO)
H. Kohl, GO Coordinator, GSFC
K. Weaver, GO Deputy Coordinator, GSFC

Science Outreach *(Dr. H. Amos, GSFC)*

Protocol Science Leads
- Clouds *(M. Robles, LaRC)*
- Mosquitoes *(Dr. R. Low, IGES)*
- Land Cover *(P. Nelson, M.S., OSU)*
- Trees (B. Campbell, GSFC)

Communications and Social Media
(A. Burdick, SSAI)

App Development Team *(D. Overoye, SSAI)*

Toolkit Teams
Clouds *(M. Robles, LaRC)*
Land Cover *(J. Allen, GSFC)*
Mosquitoes *(C. Soeffing, IGES)*
Designer *(H. Mortimer, GSFC)*

Note:
This chart shows activity leads and does not include all team members

NASA Investigations with GLOBE

- **U.S. Air Quality** (*Dr. M. Pippin, LaRC*)
- **Clouds/Contrails** (*M. Robles, LARC)*
- **Trees Around the GLOBE** (*B. Campbell, GSFC lead and P. Nelson, M.S., OSU, co-lead)*
- **GLOBE Mission Mosquito** *(D. Janney, GSFC lead, and Dr. R. Low, IGES co-lead)*
- **Girl Scouts Citizen Science Journey** *(T. Owen, GSFC)*

NESEC Strategic Partnerships/ SciAct Cross-Collaborations
T. Schwerin, IGES

NASA Center SME Engagement
Dr. T. Ferrell GSFC
J. Taylor, LaRC
R. Zimmerman Brachman, JPL

NASA SciAct Working Groups
Women and STEM (Lead: J Taylor, LaRC)
Education Technology (Dr. H. Fischer, OSU)
Native American/America Indian (J. Allen, GSFC, Dr. R. Low, IGES)
Visualization (T. Schwerin, IGES)

Leveraging Partners *(Not funded under NESEC)*

GLOBE Implementation Office *(Dr. T. Murphy and K. Wegner)*
GLOBE DIS *(L. Dallas)*
Earth to Sky *(A. Davis, lead, and J. Giddens, co-lead)*
Odyssey of the Mind *(S. Micklus)*
Association of Science-Technology Centers *(W. Staveloz)*
Smithsonian Science Education Center (A. Radloff)

NESEC Evaluation
Dr. H. Fischer
Dr. M. Storksdieck
Oregon State University

Backup Slides

THE GLOBE PROGRAM

An International Science and Education

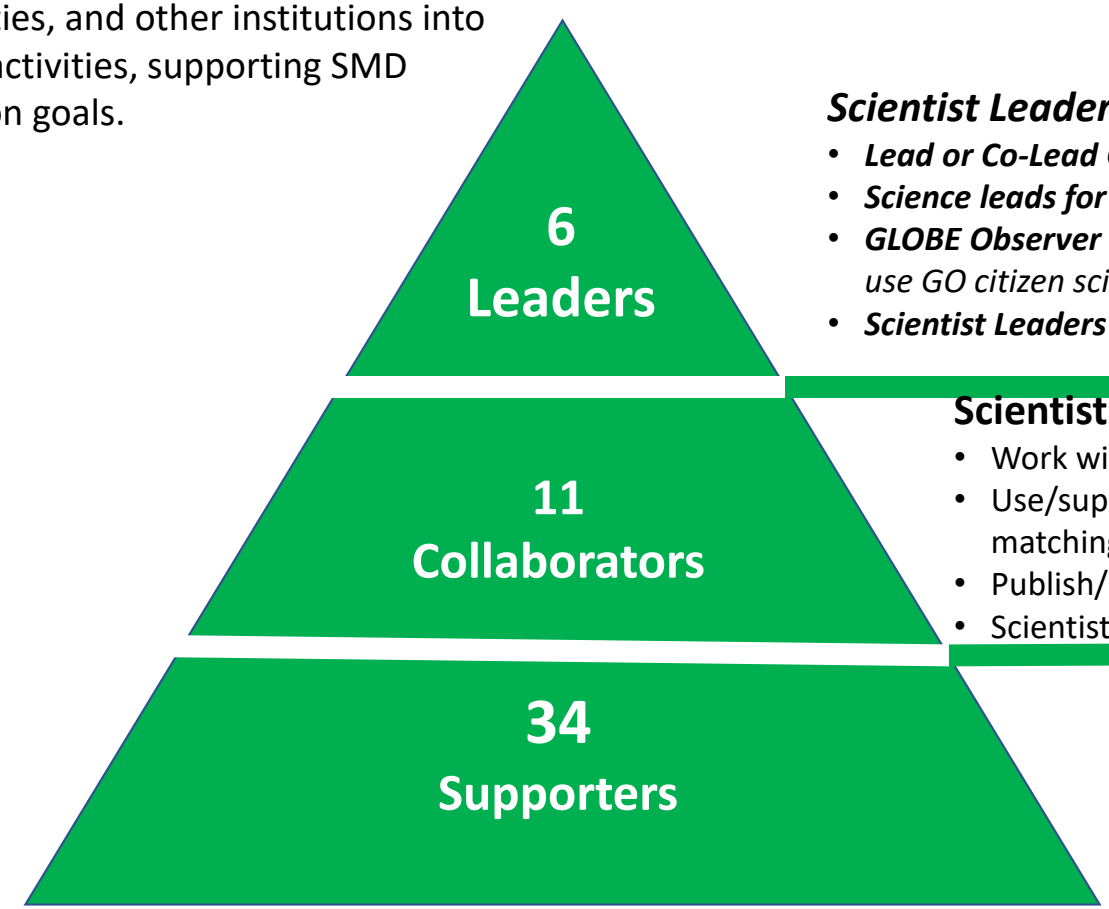
121	Countries
33,904	Schools
35,534	Teachers
130,481	GLOBE Observers
164,795,911	Measurements
114,425	Measurements this month

2018 Scientist Engagement

Unique to NESEC is integration of NASA Subject Matter Experts at Centers, universities, and other institutions into project activities, supporting SMD education goals.

FY 2018, **51 NASA-funded scientists** participated in NESEC activities

(100% increase from 2017)



***Scientist Leaders** participate as team members*

- ***Lead or Co-Lead GLOBE Field Campaigns***
- ***Science leads for GLOBE Observer** Protocols*
- ***GLOBE Observer Scientist Outreach Lead:** Engaging scientists to use GO citizen science data and conduct research*
- ***Scientist Leaders also participate in collaborations and outreach***

Scientists Collaborators

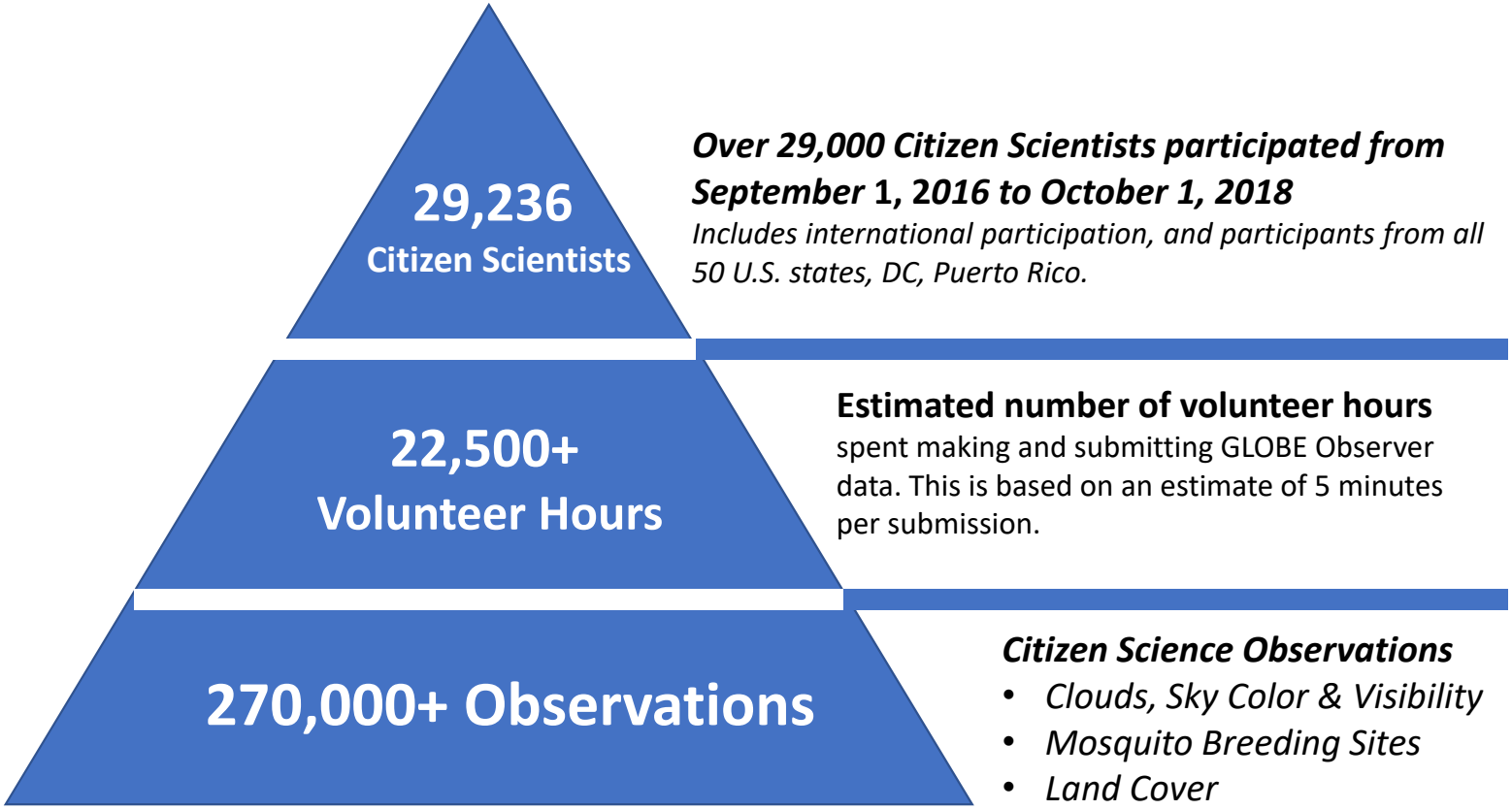
- Work with NESEC team on projects
- Use/support GLOBE Observer citizen science (e.g., satellite matching, use data in research)
- Publish/present at professional meetings
- Scientist Collaborators also participate in public outreach

Supporter scientists (ad hoc participation)

- *Featured in social media and online*
- *Present NASA science at events*
- *Review materials*
- *Answer SciAct Hotline Questions*

GLOBE Observer Citizen Science

FY 2016-2018, >29,000 people had an authentic STEM Experience with GLOBE Observer



Over 29,000 Citizen Scientists participated from September 1, 2016 to October 1, 2018

Includes international participation, and participants from all 50 U.S. states, DC, Puerto Rico.

Estimated number of volunteer hours spent making and submitting GLOBE Observer data. This is based on an estimate of 5 minutes per submission.

Citizen Science Observations

- *Clouds, Sky Color & Visibility*
- *Mosquito Breeding Sites*
- *Land Cover*