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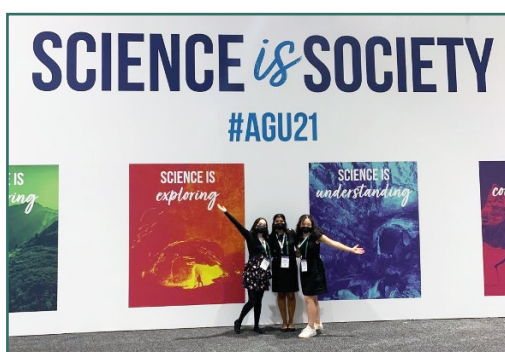
2021 Annual Report

A Year of Data, Discovery, and Decisions



IGES • 2021

A Year of Data, Discovery, and Decisions



Above 3 images: IGES sponsored and presented at the May 2021 Citizen Science Association CitSciVirtual online conference; SEES Earth System Explorer interns presented their research at the American Geophysical Union annual fall conference; GLOBE Mission Mosquito offered monthly webinars for educators and learners throughout 2021, including this one on using Big Data.

It is hard to believe that we have spent another year working remotely with limited social interaction, all the result of the continued global COVID-19 pandemic. But, as my IGES team-mates demonstrate each day, it is not how we work, but what we accomplish. And, as you read this 2021 Annual Report, I hope that you will agree that we have accomplished a great deal.

Whether strengthening citizen science, advancing science through data literacy, developing the next generation of Earth scientists, or establishing new partnerships, IGES enjoyed a vibrant and productive year.

If one theme emerged through 2021, it was connecting data, discovery, and decisions. On a personal level, the daily reporting and data showing the rise or trends in COVID cases guided our decisions regarding how we work, whether to travel, and, of course, when and where to mask. On a professional level, we also found new ways to explore and visualize citizen science data through our newly launched geospatial portal. In addition, we had the exciting opportunity to research private sector applications of Earth observations data that impact the decisions of hundreds of millions of people globally. Therefore, the role of data in our world was front and center.

As always, our team is grateful for the contributions and guidance of our Board of Directors. We also extend our thanks to our clients who provided us with exceptional opportunities to contribute to new knowledge and action for a healthier planet.

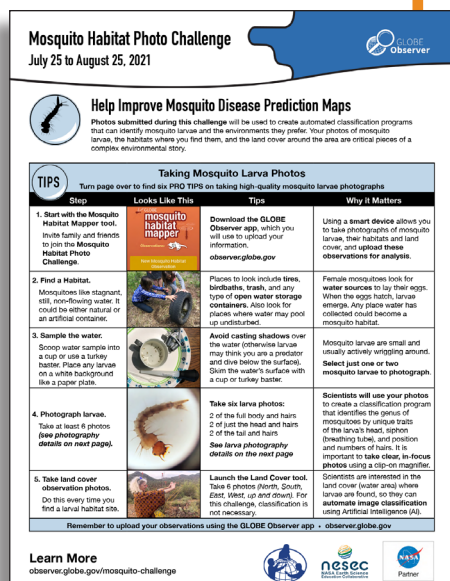
Nancy Colleton

President

IGES: Institute for Global Environmental Strategies



Our work takes on many shapes and sizes. From our largest project, the NASA Earth Science Education Collaborative (NESEC), to mosquito research with the University of South Florida, to an analysis of the environmental intelligence marketplace — IGES enjoyed many accomplishments.



2021 HIGHLIGHTS

Increased Observations of the World's Deadliest Animal – the Mosquito!

The 2021 Mosquito Habitat Photo Challenge asked volunteers to collect concurrent observations (same place, same time) of mosquito habitats and land cover to generate data to support newly funded work in artificial intelligence and machine learning. <https://observer.globe.gov/mosquito-challenge>

The one-month challenge not only resulted in an increased rate of data collection, but engaged new citizen scientists. Over 1,800 observations—including more than 6,200 photographs—were submitted from 31 countries. Thailand (62%), the United States (27%), and India (3%) topped the list of the most observations.

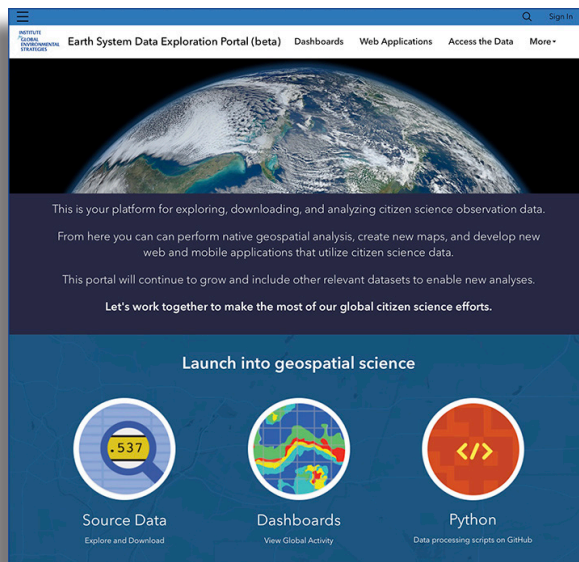
Data collected during the challenge and beyond are being used by five science teams: IGES is collaborating with the NASA Goddard AI Center for Excellence to support four teams through NASA's Established Program to Stimulate Competitive Research (EPSCoR). Teams from the University of Vermont, University of Wyoming, New Mexico State University, and the University of Puerto Rico are using photos submitted of land cover and mosquito habitats to develop automated image recognition systems.

National Science Foundation funded research, at the University of South Florida, is focusing on the development of automated image recognition systems to identify and track deadly and invasive mosquito species (<http://mosquitoAI.org>). Dr. Rusty Low, IGES, is Co-PI with USF researchers, Dr. Ryan Carney, PI, and Dr. Sriram Chellappan, Co-PI, and Ann Bowser, Co-PI, Wilson Center. Three

citizen science projects are providing data needed for AI recognition of mosquitos: GLOBE Mosquito Habitat Mapper, iNaturalist, and Global Mosquito Alert.

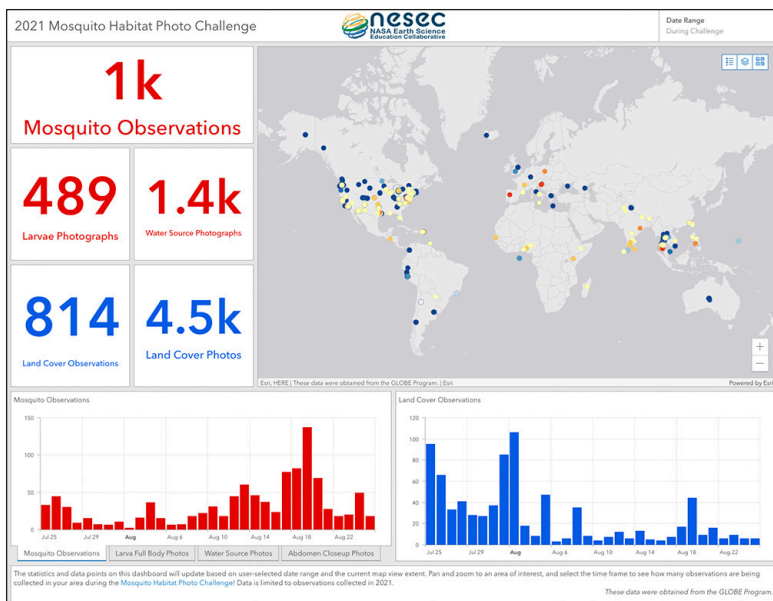
Contributing to this success, IGES made a concerted effort to engage partners who could support community volunteers' participation in the challenge and in the future. IGES created a new handout showing how to photograph mosquito larvae, presented several webinars for participants and partners, and distributed clip-on cell phone microscopes to 15 partner organizations.

These partners also held events or other activities to support volunteers. For example, the Los Angeles Public Library translated the challenge activity tracker into Spanish and Chinese to better engage their communities and hosted a public webinar. Australia's National Science Agency (CSIRO), Alabama Water Watch, the Earth Science Information Partners (ESIP), the Midwest Center for Vector-Borne Disease, and NASA's Science Activation Program all hosted webinars about the challenge. The San Gabriel Valley Mosquito and Vector Control District held an Instagram Live event. The Smoky Mountain STEM Collaborative included the challenge as part of an event called GLOBE in the Park. The La Salle Public Library in Illinois recruited and trained a small number of very active volunteers, and the NASA STEM Enhancement in Earth Science (SEES) interns were among the top data contributors. IGES will continue to cultivate these partnerships to enable ongoing community-based citizen science.



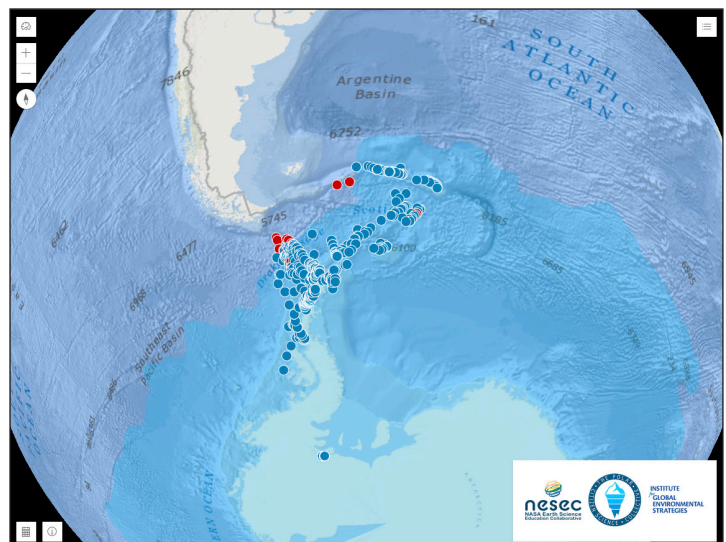
New Geospatial Tools Advance Science through Data Literacy

IGES is continuing to identify and develop new ways to support a wider audience of learners through the open data hub, The Earth System Data Exploration Portal (<https://geospatial.strategies.org>). The hub provides access and visualization tools. These include data dashboards, curated datasets, Jupyter notebooks, and code products for use in data exploration analysis. In June, a web map displaying the dataset used in the Adopt a Pixel 3km paper was added to the hub (<https://bit.ly/AdoptAPixel>).



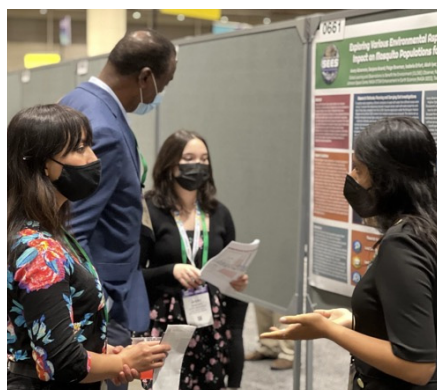
In July, a new dashboard interface was released for the GLOBE Observer Mosquito Habitat Mapper Photo Challenge (<https://bit.ly/MosquitoPhoto>). The interface enhanced engagement of citizen scientists with the data being collected and offered a supplementary tool for partnering organizations to create their own custom views of the data.

In October, a new web app (<https://nsec.strategies.org/PolarCollective.html>) was developed to assist cruise operators of The Polar Citizen Science Collective (<https://polarcollective.org>) by streamlining the process of showcasing to their clientele the extent, timing, and location of data collected on prior cruises.





The Earth System Explorers virtual internship connects students with the exciting science of applying NASA Earth observations to examine topics such as land cover change and the global health threat of vector borne disease. The virtual format enables students to conduct their internship from their home. This internship is part of the larger NASA SEES Summer High School Intern Program (Summer Enhancement in Earth Science) managed by the Texas Space Grant Consortium.



Interns Embrace the Role of Next Generation Earth Scientists



Few of IGES's 2021 accomplishments are as exciting as the results of the NESEC-led SEES Earth System Explorers, which include:

- 93 students.
- 28 completed projects.
- 23 submissions to 2021 AGU's Bright STaRS poster session.
- 28 submissions to The GLOBE International Virtual Science Symposium.
- Out of over 3,500 applicants, one 2021 SEES intern was selected as a 2022 finalist of the Award for Aspirations in Computing (AiC).

Another SEES intern was awarded 6th place and an \$80,000 award in the Regeneron Science Talent Search 2022, the nation's oldest and most prestigious science and math competition for high school seniors. Aseel Rawashdeh's (upper right photo) SEES internship was built on previous research. In her blog, she says "I am incredibly grateful to now be a part of the Mosquito Habitat Mappers team in the STEM Enhancement in Earth Systems (SEES) program. Within just the first three weeks, I have learned so much about many innovative research projects using AI, environmental satellite data, disease data, and more to accurately track and predict mosquito populations. I am excited for our individual projects, where we will be able to work with peers and mentors to further contribute to our understanding of mosquito habitats!"

PHOTOS • Above, left to right: Matteo Kimura and Prachi Ingle, AGU 2021 Outstanding Student Presentation Award; Aseel Rawashdeh, Finalist in the Regeneron Science Talent Search 2022. Left: SEES Earth System Explorer Interns present their research as part of the Bright Students Training as Research Scientists (Bright STaRS) program at the AGU 2021 Fall Meeting. The program provides a dedicated forum for students to present their own research results to the scientific community.



Dr. Russanne Low Named Fulbright Scholar

Senior IGES scientist Dr. Russanne Low ("Rusty") was named a Fulbright Scholar for 2021-2022. The Fulbright Program is an international academic program designed to foster intercultural relations, cultural diplomacy, and intercultural competence between the American people of the United States and other countries, through the exchange of persons, knowledge, and skills. It is considered to be one of the most widely recognized and prestigious scholarships in the world. Russanne is working with colleagues at the Brazilian Space Agency (AEB) and the Federal University of Paraná (UFPR) on projects to foster student data literacy through the analysis of remote sensing and citizen science data.



2021 PROJECT NEWS

Delivering Authentic Earth STEM Experiences through NESEC

IGES continues to lead the NASA Earth Science Education Collaborative (NESEC), concluding year six of the ten-year cooperative agreement working in strong partnership with the world class Earth science programs at NASA's Goddard Space Flight Center (GSFC), Jet Propulsion Laboratory (JPL), and Langley Research Center (LaRC).

NESEC is part of NASA's Science Activation (SciAct) program. SciAct is a cooperative network of thirty-three competitively-selected teams from across the nation that work with NASA infrastructure teams to connect NASA science experts, real content, and experiences with community leaders to do science in ways that activate minds and promote deeper understanding of our world and beyond. The program is informed by a 2019 assessment from the National Academies of Sciences, Engineering and Medicine.

Theresa Schwerin is Principal Investigator for NESEC, and IGES team members include Liz Burck, Andrew Clark, Russanne Low, and Cassie Soeffing.

*NESEC includes three interconnected areas that the cross-organizational team conducts: **Citizen Science** with GLOBE Observer; **Student Science Investigations** with NASA content and data; and **Strategic Collaborations** that enable us to broaden our reach to audiences across the United States.*



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Goddard
Space Flight Center

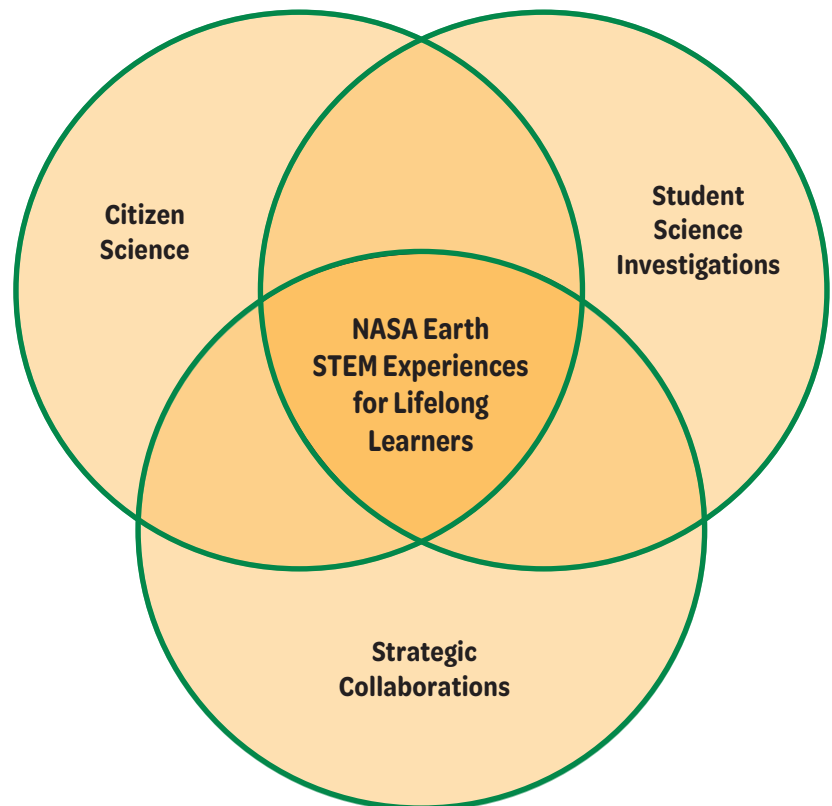
JPL
Jet Propulsion Laboratory
California Institute of Technology

Langley
Research
Center

Evaluation Team



Oregon State University
STEM Research Center



nsec.strategies.org

Following are specific, interconnected activities conducted in 2021 by the cross-organizational NESEC team.



CITIZEN SCIENCE

Engage the public to track changes in the environment in support of Earth system science research and help interpret NASA and other satellite data.

Earth System Observations

- Data collection challenges
- Open data access

Online Resources

- Science background information
- Hands-on activities and resources



STUDENT SCIENCE INVESTIGATIONS

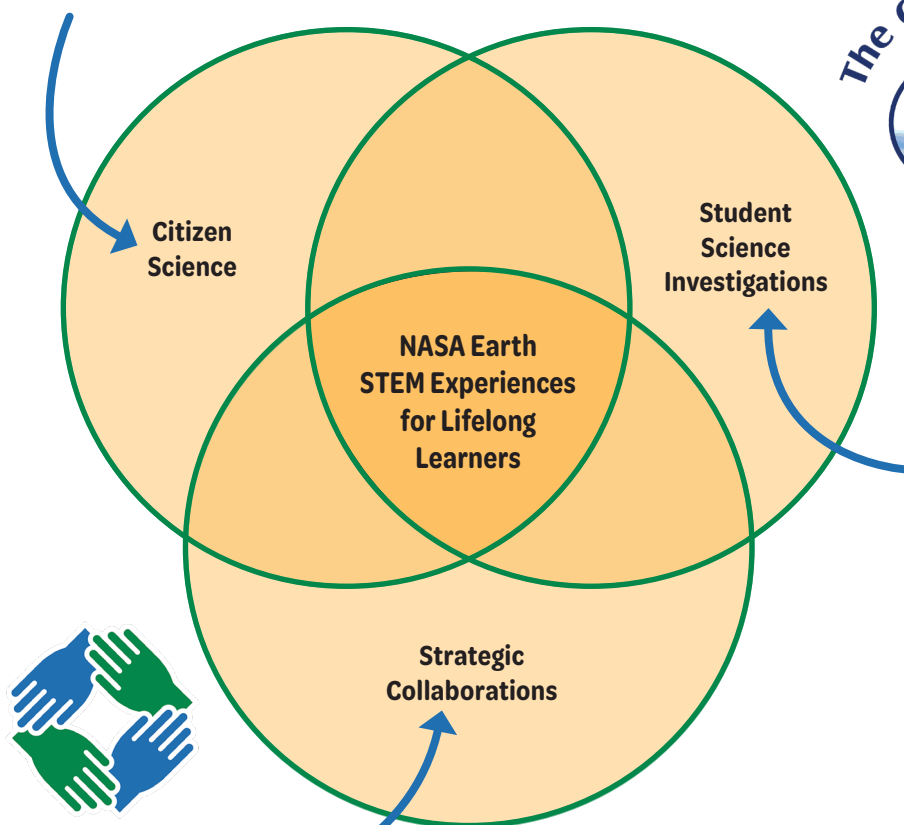
Provide facilitated opportunities that target students and youth, including GLOBE student research and field campaigns related to NASA science and satellite missions.

Student Research & Experiences

- GLOBE Mission Mosquito Campaign
- SEES Earth System Explorers Internship
- EPSCoR: AI for image recognition
- Girl Scouts Citizen Scientist Journey
- NASA GLOBE Goes to Camp Activities
- Trees Around the GLOBE Student Research Campaign
- U.S. Air Quality Student Research Campaign

Educator Support

- Webinars
- Mission Mosquito Larvae Hunters Field Guide
- GLOBE Pacing Guides



STRATEGIC COLLABORATIONS

Deliver NASA Earth STEM to greater audiences. Our collaborators range from large international networks to local community partners. Some of our collaborators include:

- SciStarter
- Citizen Science Association
- Los Angeles Public Library Neighborhood Science Program
- STARnet Libraries
- University of South Florida
- Centers for Disease Control and Prevention (CDC)
- President's Malaria Initiative
- Wilson Center
- Goddard Center for Excellence in AI
- Earth Science Information Partners
- Osher Lifelong Learning Institute at University of Hawaii at Manoa
- America View
- American Camp Association
- Earth to Sky Partnership: NASA-National Park Service-U.S. Fish and Wildlife Service
- Girl Scouts
- National Institute for Aerospace
- University of Alaska, Fairbanks
- University of Texas, Austin
- University of Toledo
- University of Wyoming



Closeup of the invasive *Aedes scapularis* mosquito • <https://www.inaturalist.org/photos/172451997>



Tracking Invasive Mosquitos with the University of South Florida

Russanne Low received research funding from the National Science Foundation (NSF) to investigate the use of artificial intelligence (AI) to track deadly and invasive mosquitos. Low will co-author a paper with the University of South Florida, the Wilson Center, and the CDC to be submitted in March 2022 to *Insects* (international, peer-reviewed, open access journal of entomology) for a special issue on “Citizen Science Approaches to Vector Surveillance.” Three citizen science projects are providing data needed for AI recognition of mosquitos: GLOBE Mosquito Habitat Mapper, iNaturalist, and Global Mosquito Alert. A first sighting of a new invasive mosquito (*A. scapularis*) in the United States was by a citizen science iNaturalist participant in Texas in December.

Amplifying Environmental Intelligence

Much of 2021 was devoted to examining new and exciting applications of environmental information and intelligence. On behalf of the Earthrise Alliance in support of the Earth Genome, IGES co-authors, Nancy Colleton and Rachel Plescha, profiled 12 companies leveraging government-collected data for innovative products and services. IGES also started working with one of those companies, BreezoMeter, to assess how their air quality, pollen reporting, and wildfire tracking intelligence could be further leveraged.



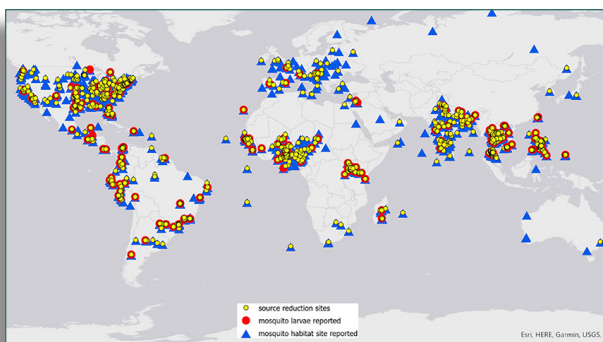
In addition, Nancy Colleton and Russanne Low mentored two students as part of the Middlebury College’s Global Partnerships for Sustainability (GPS) program. In support of the Research Center for Alpine Ecosystems (CREA Mont Blanc), the students translated into English a booklet describing the rapid climate warming in the European Alps. Colleton and Low then worked with the students to adopt best practices for communicating science information to share this important story.

Two photos taken 125 years apart (1890 and 2015) show how much of its glacier the Mont-Blanc Massif has lost over that period of time. Source: CREA/Mont Blanc.

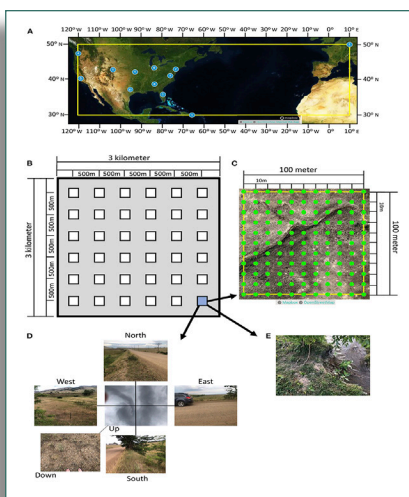
The Environmental Intelligence Marketplace: 12 Companies Innovating the Application of USG Earth Observations Data



A Report Prepared for the
Earthrise Alliance in support of The Earth Genome



Geolocated GLOBE Mosquito Habitat Mapper data displayed using the GLOBE Visualization System, 5/29/17 to 5/29/20. **Locations Legend:** Blue triangles: Reported mosquito larval habitats. Red circles: Reported mosquito genera. Yellow circles: Breeding sites were mitigated.



Adopt a Pixel 3 km. (A) Location of 49 Areas of Interest (AOI). (B) In each AOI are 36 Primary Sample Units. (C) Very high res satellite imagery uses a dot grid to get 121 samples. In each AOI: (D) GLOBE Observer Land Cover tool collects ground reference images; and (E) GLOBE Observer Mosquito Habitat Mapper collects mosquito habitat data.

Notable Publications

Colleton, N. (2021, March 30). **“NASA Earth Science to ‘Meet the Moment’.”** Op-ed prepared for the Institute for Global Environmental Strategies. Retrieved from <https://spacenews.com/op-ed-nasa-earth-science-to-meet-the-moment>

Colleton, N., and Miglarese, A. H. (2021, April 30). **“Are we there Yet? A journey to more clearly see the changing planet.”** Op-ed prepared for SpaceNews. Institute for Global Environmental Strategies. Retrieved from <https://spacenews.com/op-ed-are-we-there-yet-a-journey-to-more-clearly-see-the-changing-planet>

Colleton, N., and Plescha, R. (2021, December). **“The Environmental Intelligence Marketplace: 12 Companies Innovating the Application of USG Earth Observations Data.”** Report prepared for the Earthrise Alliance in support of The Earth Genome. Arlington, VA: Institute for Global Environmental Strategies. <https://strategies.org/products/environmental-intelligence-marketplace-report>




Low, R., Boger, R., Nelson, P., and Kimura, M. (2021, August 19). **“GLOBE Mosquito Habitat Mapper Citizen Science Data 2017-2020.”** GeoHealth, 5, e2021GH000436. <https://agupubs.onlinelibrary.wiley.com/doi/10.1029/2021GH000436>

Low, R., Nelson, P., Soeffing, C., and Clark, A., SEES 2020 Mosquito Mappers Research Team. (2021, November 18). **“Adopt a Pixel 3 km: A Multiscale Data Set Linking Remotely Sensed Land Cover Imagery with Field Based Citizen Science Observation.”** Frontiers in Climate, 18. <https://doi.org/10.3389/fclim.2021.658063>

Cho, H., Low, R., et al (2021, August 31). **“The STEM Enhancement in Earth Science ‘Mosquito Mappers’ Virtual Internship: Evaluating Place-Based Engagement with Citizen Science.”** Frontiers in Environmental Science. DOI: 10.3389/fenvs.2021.682669. <https://doi.org/10.3389/fenvs.2021.682669>



From “New Meets Old–Mosquito Habitat Mappers.”
GLOBE Observer class at Osher Lifelong Learning
Institute, University of Hawaii, Manoa.

	Dakar		Thilmakha		Touba		
	count	%	count	%	Count	%	
Aedes	55	40	135	29	70	39	
Anopheles	16	11	201	44	86	47	
Culex	67	49	122	27	26	14	

Mosquito genera reported by raw count and percent of total identified specimens for 3 Senegal cities, Dakar, Thilmakha and Touba. Representative images submitted by Senegalese citizen scientists for each of genera collected by the GLOBE Observer Mosquito Habitat Mapper are pictured above.



Co-author and GLOBE Observer scientist Dr. Rusty Low (right) with co-author, Anita Schiller (left), Director, Biological Control Initiative, Harris County, TX, Precinct 4. From “Blogging from the Field: Mosquito Habitat Hunting in the Sky Islands, Southern AZ.”

Blog Posts

“Mosquitos: Sentinels of our Changing Climate.”

11/30/2021. <https://observer.globe.gov/es/news-events-and-people/news/-/obsnewsdetail/19589576/mosquitoes-sentinels-of-our-changing-climate>

“Where does your data go?” A new publication about Mosquito Habitat Mapper data in GeoHealth. 08/27/2021. <https://observer.globe.gov/news-events-and-people/news/-/obsnewsdetail/19589576/where-does-your-data-go-a-new-publication-about-mosquito-habitat-mapper-data-in-geohealth>

“Blogging from the Field: Mosquito Habitat Hunting in the Sky Islands, Southern AZ” (with Anita Schiller). 08/19/2021. <https://observer.globe.gov/de/news-events-and-people/news/-/obsnewsdetail/19589576/blogging-from-the-field-mosquito-habitat-hunting-in-the-sky-islands-southern-az>

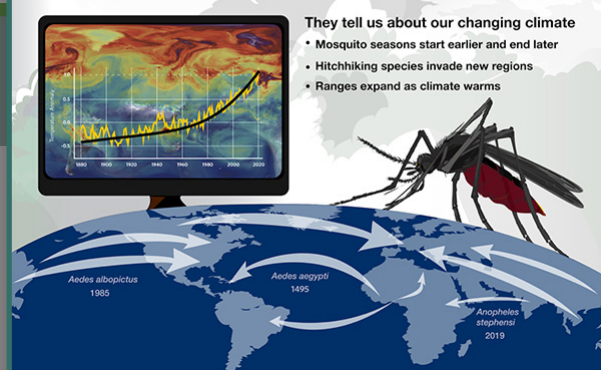
“Machine Learning and Your Citizen Science Data” (with Dr. Ryan Carney). 06/22/2021. <https://observer.globe.gov/de/news-events-and-people/news/-/obsnewsdetail/19589576/machine-learning-and-your-citizen-science-data>

Press Release: “Using Citizen Science and AI to Track Deadly and Invasive Mosquitoes” (co-written with Carney Lab team). 05/08/2021. <https://observer.globe.gov/de/news-events-and-people/news/-/obsnewsdetail/19589576/press-release-using-citizen-science-and-ai-to-track-deadly-and-invasive-mosquitoes>

“Scientists are asking for your Mosquito Habitat Mapper data!” (with Dr. Russanne Low). 04/12/2021. <https://tinyurl.com/Mosquito-Habitat-Mapper-Data>

“New Meets Old – Mosquito Habitat Mappers” (with Dr. Russanne Low). 02/22/2021. <https://observer.globe.gov/es/news-events-and-people/news/-/obsnewsdetail/19589576/new-meets-old-mosquito-habitat-mappers>

Mosquito Avatars of Climate Change



Notable Presentations

Cassie Soeffing presented a workshop for teachers, **“Connecting the Dots: Mosquitos, Land Cover, Community Engagement, and Citizen Science”** at the National Science Teachers Association regional conference. November 11, 2021.

Nancy Colleton participated in the Symposium 365 session entitled **“Cause and Effect of Climate Change”** (Part 1 of 3). Moderated by Geoff Hemplemann, Government Relations Director, Maxar. Other panelists included Dr. Karen St. Germain, Earth Science Division Director, NASA, and David Herring, Director of Communication and Education, NOAA. November 17, 2021.

As part of the U.S. launch of **We Don't Have Time**, Nancy Colleton moderated a panel on the **“Role of Government”**— which included The Honorable Sherri Goodman, Secretary General of the International Military Council on Climate and Security, and The Honorable Monica Medina, Assistant Secretary of State for the Bureau of Oceans and International Environmental and Scientific Affairs. December 3, 2021.

Theresa Schwerin and Russanne Low presented a professional development webinar for the National Network of the Library of Medicine on **“Connecting Climate Change, Mosquitoes, and Community Health.”** Participants received Medical Library Association (MLA) continuing education credits. December 8, 2021. <https://nnlm.gov/training/class/connecting-climate-change-mosquitoes-and-community-health>

For the Brazilian Space Agency, Russanne Low and Brazilian-American high school student Matteo Kimura co-presented the educator workshop **“Using GLOBE Observer Citizen Science App to Collect and Analyze Data”** (4 hour-long presentations in English and Portuguese). September 27-October 8, 2021.

Theresa Schwerin participated in a fireside chat, **“Everyone Can Be a Citizen Scientist,”** on April 15 at the AILA Los Angeles Earth Summit 2021 with Caroline Nickerson (SciStarter) and Vivienne Byrd (Los Angeles Public Library).

Russanne Low was invited to present to community entomologists participating in the Ethiopian Malaria Vector Surveillance initiative — led by the U.S. President's Malaria Initiative VectorLink Ethiopia Project and Dr. Sarah Zohny, CDC. Russanne shared **“How to Use the GLOBE Observer Mosquito Habitat Mapper Tool.”** March 23-31 and April 1-9, 2021.

Theresa Schwerin and Vivienne Byrd, Los Angeles Public Library, presented **“Citizen Science at Home: Public Libraries and Family Science”** at CitSciVirtual, the conference of the Citizen Science Association. May 2021. https://bit.ly/CitSci_PublicLibraries

CitSciVirtual



LOCAL, GLOBAL, CONNECTED

Notable Presentations (cont.)

Russanne Low, Peder Nelson. **“An Examination of Mosquito Oviposition Sites and Land Cover Heterogeneity, Using GLOBE Observer Mosquito Habitat Mapper.”** Entomology Society of America Annual Meeting, Denver. October-November 2021.

Russanne Low. **“GLOBE Observer Mosquito Habitat Mapper: A Free Citizen Science Mobile App for Larvae Surveillance, Identification, and Habitat Mitigation.”** Entomology Society of America Annual Meeting, Denver. October-November 2021.

Russanne Low, Cassie Soeffing, Theresa Schwerin, and Peder Nelson. **“Supporting Equitable Access to Robust High School Research Experiences: the Role of NASA Investments in Citizen Science.”** CitSci Virtual, Citizen Science Association. May 6-27, 2021. <https://connect.citizenscience.org/posts/supporting-equitable-access-to-robust-high-school-research-experiences-the-role-of-nasa-investments-in-citizen-science>

Several presentations at the AGU 2021 Fall Conference included:

- Bright STaRS: **“Bright Students Training as Research Scientists”** poster session. Included 23 posters by 93 students from 2021 SEES Virtual Internship.
- Russanne Low, Peder Nelson, Cassie Soeffing, Rebecca Boger, Erika Podest, Faguni Gupta, Theresa Schwerin, Margaret Baguio; ED15A-0520 – **“Broadening Access to High School Science Research Enrichment Experiences Using Cloud-Based Data Tools, Handheld Mobile Devices, and Virtual Communication Technologies.”** <https://agu.confex.com/agu/fm21/meetingapp.cgi/Paper/959265>
- Cassie Soeffing, Elizabeth Burck, Russanne Low, Theresa Schwerin; ED55D-0316 – **“Real Science Investigations from the Classroom to Home.”** <https://agu.confex.com/agu/fm21/meetingapp.cgi/Paper/974019>

GLOBE 2021 Virtual Conference presentations:

- Cassie Soeffing, Russanne Low, Liz Burck, and Theresa Schwerin, IGES, with Trena Ferrell and Dorian Janney, NASA GSFC: **“GLOBE Mission Mosquito Adaptations to a Changing Climate.”**
- Cassie Soeffing: **“Experienced Protocol Training – Mosquito Habitat Mapper.”**
- Theresa Schwerin: **“NASA Earth Science Education Collaborative.”**

GLOBE 2021 Virtual NARM (North American Regional Meeting) presentation: Cassie Soeffing and Liz Burck: **“GLOBE Mission Mosquito Science Notebook.”**



AGU FALL MEETING

New Orleans, LA & Online Everywhere
13–17 December 2021



CITIZEN SCIENCE
ASSOCIATION
CitizenScience.org | @CitSciAssoc

IGES Team Members and Affiliations



IGES team members.

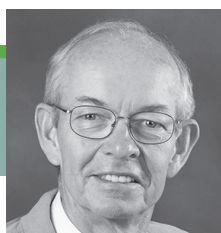
Columns 1, 2, 3: Left to right, top to bottom –

Column 1: Theresa Schwerin, Cassie Soeffing, Rachel Plescha.

Column 2: Nancy Colleton, Andrew Clark, Liz Burck.

Column 3: Rusanne Low, Nikki Rogers.

- AGU Voices for Science
- Alaska Science Teachers Association
- Albert Einstein Distinguished Educator Fellow and Alumni
- American Association for the Advancement of Science (AAAS)
- American Astronautical Society (AAS), International Programs Committee
- American Geophysical Union (AGU)
- American Library Association (ALA)
- American Meteorological Society (AMS)
- American Mosquito Control Association
- Association of Presidential Awardees in Science Teaching
- Citizen Science Association
- Climate and Security Advisory Group (CSAG)
- Entomological Society of America
- International Union for Conservation of Nature (IUCN)
- Kaleidoscope School of Arts and Science
- Maryland Space Business Roundtable
- National Earth Science Teachers Association (NESTA)
- National Science Teachers Association (NSTA)
- Nevada State Science Teachers Association
- South Dakota State Science Teachers Association



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Former Governor of Wyoming (1995-2003)



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President
Institute for Global Environmental Strategies



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