THEGLOBEPROGRAM

Annual Review

2021–2022

Sponsored by: NASA Supported by: NSF NOAA

THE GLOBE PROGRAM

GLOBE Milestones

1994	Earth Day, U.S. Government announces The GLOBE Program as a multiagency effort.
1995	Earth Day, The GLOBE Program launches (with 11 protocols); 33 countries join the program.
1998	Finland hosts the first GLOBE Learning Expedition (GLE) in Helsinki.
2000	USA hosts the second GLE in Fayetteville, Arkansas.
2003	Croatia hosts third GLE held in Sibenik.
2004	GLOBE receives the Goldman Sachs Award for being an "outstanding program that makes use of media/technology to educate students or teachers about other world regions and cultures, or international issues."
2005	Earth Day; GLOBE celebrates its 10th birthday, with 15,000 schools in 106 countries.
2008	South Africa hosts the fourth GLE in Cape Town.
2009	GLOBE establishes Regional Offices in Africa, Asia and Pacific, Europe, Latin America and the Caribbean (LAC), and North Africa and the Near East (NENA) to support professional development workshops, capacity building, and regional sustainability efforts; GLOBE database reaches 20 million.
2011	GLOBE launches concept of Student Research Campaigns.
2014	India hosts fifth GLE in New Delhi.
2015	Earth Day, GLOBE celebrates its 20th birthday; offers 51 protocols; data reaches 128 million measurements.
2016	GLOBE provides online eTraining; hosts International Virtual Science Fair and six regional U.S. science fairs and various student scientific campaigns; launches a new mobile data entry app, called GLOBE Observer.
2017	Data reaches over 140 million measurements; International Virtual Science Symposium increases in number of submitted projects and worldwide representation; new mosquito protocol launched.
2018	Ireland hosts the sixth GLE in Killarney, Ireland; data reaches over 150 million measurements; U.S. Department of State initiative on mosquito education launched; all six GLOBE regions entered over one million measurements into the GLOBE database
2019	GLOBE (via the GLOBE Zika Education and Prevention Project) connects with Google Voyager to highlight a GLOBE story, "Stopping the Spread of Zika."
2020	The GLOBE Program celebrates its 25th Anniversary! For the first time, the GLOBE Annual Meeting goes "virtual."
2021	GLOBE a new milestone with over 200 million measurements in the database; GLOBE receives THE American Geophysical Union (AGU) Excellence in Earth and Space Science Education Award.
2022	First cohort of GLOBE Student Vloggers completes a successful first year!

About The GLOBE Program

The GLOBE Program (GLOBE) is an international science and education program sponsored by the National Aeronautics and Space Administration (NASA); supported by the National Science Foundation (NSF), the National Oceanic and Atmospheric Administration (NOAA), and the United States Department of State (DoS). GLOBE is implemented by the University Corporation for Atmospheric Research (UCAR) in Boulder, Colorado, USA. For more than 25 years, GLOBE has connected students, teachers, and professional and citizen scientists from around the world to conduct hands-on science within their local environment to enhance their awareness of—and their scientific contribution to—the global environment.

Cover photos are scenes from the 2021–2022 GLOBE Agents of Change documentary films, which can be found on the GLOBE YouTube channel.

The GLOBE Implementation Office is supported under NASA Grant and Cooperative Agreement 80NSSC19M0120, awarded to the University Corporation for Atmospheric Research.

A Message from Dr. Tony Murphy

GLOBE Implementation Office Director

The past couple of years have left us in a strange state. When we pictured a post-Covid world, we might have imagined getting our old lives back. In 2022 we are, in fact, returning to some normality—albeit a new normal—but we have not gotten our old lives back. And while some aspects of our lives have only changed slightly many have been permanently altered:

- The GLOBE Implementation Office (GIO) looks different, with many staff electing to work from home entirely or in part. The new work-from-home option has allowed us to hire new staff from outside the normal commuting area. We currently have staff working permanently from New York, Chicago and the Washington, D.C. area. The majority of our staff meetings continue to be online. (I encourage you to learn about the team on the GLOBE website.)
- Our students experience learning differently. "Remote learning" required a refinement of practices for the shift to more of a student-centered learning approach. In the best situations, students were empowered to drive their learning and to remain connected to their community of peers, mentors and teachers. The pandemic sparked an endless amount of teacher-student-parent creativity around learner-centered experiences. So while many students were successful, some were not. There exists an immediate need to address the magnified learning gaps and inequities, as well as the social stress, students face today.
- Technology helped teachers survive and sustain classroom continuity, and that technology has become permanently embedded in our educational methods. Technology also helped sustain and even grow our community. And while technology has been critical, so has an emphasis on learning out in nature—to balance the increased screen time with the benefits of hands-on learning.

The GLOBE Program remained surprisingly robust, and in many ways strengthened, throughout the pandemic. I think this was specifically due to GLOBE's guiding principles encouraging everyone to be keen observers, to be creative, and do more learning and research outdoors, in the fresh air. All this while using the best characteristics of technology—the ability to connect and stay connected. The International Virtual Science Symposia experienced no diminished numbers. In fact, the event grew in the number of participants and countries involved.

We have proven we can be agile, but we are forever changed by the global pandemic. I believe there are new opportunities in the post-pandemic world that can reshape the educational space, but only if we examine what was learned about the educational and social-emotional needs of students and the teachers who have answered the call to work with them. The future of education, and GLOBE's place in it, lies on our focus, not in going back to where we were before, but solely on moving forward.

In closing, I would like to express my appreciation for your continued commitment to The GLOBE Program. We would not be the wonderful community that we are without you, all of you! A huge thank you to our sponsors at NASA, NOAA, NSF and the U.S. Department of State; to our global community, including the

Regional Coordination Offices (RCOs), the U.S. GLOBE Office; Country Coordinators, U.S. Partners and Working Groups; to the various ministries supporting efforts around the world; to our teachers, learners and student vloggers; to our collaborators from various organizations and agencies, and private funders (YLACES for example); to our Data Information Systems (DIS) team; to the GLOBE Observer staff; and to the team from the GIO.

Our community is strong. We thrive on our diversity and on creating a culture of inclusion for all who want to join our efforts. Our growing influence and leadership in data collection and its use in student research, in fostering data literacy, in science education diplomacy, and in creating an extensive global network of individuals committed to raising the next generation of STEM professionals and Earth stewards means that we have a lot to be proud of....and more to do!

As everyone who participates in this program knows, The GLOBE Program is unique in its ability to create a very committed global community, a dedicated community, imbued with a sense of responsibility to respect and protect each other and the life-supporting planet we all share.

Sincerely,

Dr. Tony Murphy

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1 The GLOBE Program

A Community Engaged in Authentic Scientific Education and Exploration

Since its creation in 1995, The GLOBE Program has been dedicated to the vision of *"a worldwide community of students, teachers, scientists, and citizens working together to better understand, sustain, and improve Earth's environment at local, regional, and global scales"* and to the mission *"to increase awareness of individuals throughout the world about the global environment, contribute to increased scientific understanding of the Earth, and support improved student achievement in science and mathematics."*

Through interdisciplinary, and inquiry-based, activities that delve into the various Earth spheres, GLOBE gives students from around the world a hands-on way to experience the journey that is science—from data collection to analysis and research. GLOBE's protocols are developed by the scientific community and validated by teachers in classrooms—whether inside (with students creating data visualizations) or outside (with students sifting, sorting, and exploring the layers of Earth's soils).

For over 25 years now, GLOBE has invited students, educators, and professional and citizen scientists, from around the world to join together to create an international community of practice. In its day-to-day efforts, GLOBE has offered a unique opportunity for community members to engage in authentic scientific exploration using the same language: science.

Expanding personal comprehension and increasing precise data measurements, the people of GLOBE engage in hands-on investigations to deepen their comprehension of, and commitment to, our interconnected planet. GLOBE now consists of dedicated and engaged community members from over 126 countries and over 100 U.S. partnerships.

GLOBE's international framework includes:

- **GLOBE Regions**: GLOBE administration is divided into six regions: Africa, Asia and Pacific, Europe and Eurasia, Latin America and Caribbean (LAC), Near East and North Africa (NENA), and North America (which consists of Canada and the United States). GLOBE partners (Country Coordinators and U.S. Partners) facilitate the implementation of GLOBE in their country or within their service area.
- **GLOBE Working Groups**: GLOBE's five Working

Groups (Diversity, Equity, and Inclusion; Education; Evaluation; Science; and Technology) are dedicated to enhancing the role of the program's diverse community members in shaping the future of GLOBE, and in supporting the development and implementation of GLOBE worldwide.

- **U.S. Partner Forum:** The U.S. Partner Forum (USPF), which represents six regions (Midwest, Northeast and Mid-Atlantic, Northwest, Pacific, Southeast, and Southwest) works to enhance the contribution of GLOBE toward improving STEM (Science, Technology, Engineering, Mathematics) education in the United States.
- **The GLOBE International STEM Network (GISN)**: The GISN is an international network of STEM professionals. These experts mentor teachers; explore national and international components of science and research; design and create unique field campaigns; and inspire students to engage in the hands-on exploration of cutting-edge STEM and research.

Whether in-person or virtual, GLOBE Annual Meetings, GLOBE Learning Expeditions (GLEs), and regional meetings bring the GLOBE community together as one. The goal of these efforts is to share best practices and solutions to common issues; engage in collaborative data-collection adventures and horizon-expanding expeditions; consider challenges and opportunities; and work together to chart the course of The GLOBE Program.

GLOBE: Receiving the AGU 2021 Excellence in Earth and Space Science Education Award

In 2021, The GLOBE Program was awarded the prestigious American Geophysical Union (AGU) 2021 Excellence in Earth and Space Science Education Award. GIO Director Dr. Tony Murphy, and NASA Program Manager Dr. Allison Leidner, accepted the award at the AGU Honors Ceremony and Honors Banquet in New Orleans, Louisiana, USA.

The award is given annually in recognition of long-lasting, positive impacts in Earth and space science education. Award winners are those who have made long-lasting, positive impacts in the Earth and space sciences at any education level from kindergarten through postgraduate studies. More frequently given to individuals, the award

Left to right: AGU President Dr. Susan Lozier, NASA Program Manager Dr. Allison Leidner, and GIO Director Dr. Tony Murphy

is sometimes given to groups or organizations. This year's award goes to The GLOBE Program and everyone at the GIO as well as throughout the GLOBE international community feels a sense of pride in the achievement!

"The GLOBE Program has made outstanding achievements and contributions by pushing the frontiers of our science forward," said AGU President Susan Lozier, on behalf of the AGU Earth and space science community. "GLOBE has also embodied AGU's shared vision of a thriving, sustainable, and equitable future for all powered by discovery, innovation, and action. And you did this with integrity, respect, diversity, and collaboration while creating deep engagement in education and outreach."

GLOBE Implementation Office: Building, Training, Sustaining, and Supporting

The primary goal of the GLOBE Implementation Office (GIO)—hosted by the University Corporation for Atmospheric Research (UCAR) in Boulder, Colorado, USA—is to put in the work necessary to ensure the continued success of the program's educational and scientific endeavors. This includes building and nurturing an ever-growing network of informed and inspired people, and the invaluable and implementable science and technology that they need at their fingertips to achieve their data and research goals; as well as the training framework necessary to sustain the ever-expanding health and viability of the program.

GIO works to provide informed support for the common elements of science, communication, education and evaluation, technology/website, and overall community development—all with a focus on diversity, equity, and inclusion. These common elements, along with the NASA-hosted Data Information System (DIS)—which is focused on database and website infrastructure—are instrumental to enabling the worldwide implementation of GLOBE.

GIO staff provide cutting-edge technical support services; initiate and sustain activities that encourage and promote diverse community involvement and expansion; provide up-to-date training and mentoring; coordinate and facilitate campaigns, Intensive Observation Periods (IOPS), projects, and meetings; engage with other groups, such as the DIS team, the GLOBE Observer team, and the NASA-funded Science Activation (SciAct) projects (managed by GLOBE partners); and generate high-quality education and science materials and resources.

In accordance with "The GLOBE Program Strategic Plan 2018–2023," GIO's strategic priorities are "to improve student understanding of environmental and Earth system science across the curriculum; contribute to scientific understanding of Earth as a system; build and sustain a global community of students, teachers, scientists and citizens; and engage the next generation of scientists and global citizens in activities to benefit the environment."

GLOBE: Collecting Field-focused Data for Ground-breaking Research

The GLOBE Program is based on science—from data collection and data entry to analysis, research, and collaborative scientific studies. GLOBE offers field-focused opportunities for community members to collect and submit data that can be used in ground-breaking scientific research efforts. The table below shines a light on some of the critical results of the community's ongoing data measurement efforts during 2021-2022.

By mid-2022, more than 43,000 teachers from over 38,000 schools contributed over 230 million measurements to the GLOBE database for use in their inquirybased science projects. In addition, citizen scientists using The GLOBE Program's app, GLOBE Observer, had contributed over 800,000 measurements.

Given that, in 2021–2022, the world was still in the midst of a global pandemic, it was an incredible show of focus and dedication that the community (while adhering to health and safety regulations in their areas) continued to develop new and creative ways to achieve their scientific and research goals—even using their "backyards" for data collection—showing the ingenuity and passion of the community for the program and what it stands for!

Region	Total number of countries entering data from 01 May 2021 through 31 May 2022	Total number of measurements entered by 31 May 2022	Total number of measurements entered between 01 May 2019 and 31 May 2022	Total measurements entered by Citizen Scientist organizations between 01 May 2019 and 31 May 2022
Africa	16	1,499,737	11,885	579
Asia and Pacific	15	4,150,983	729,740	24,814
Europe and Eurasia	42	83,041,936	3,715,034	19,403
Latin America and Caribbean	18	1,800,904	155,434	8,665
Near East and North Africa	12	2,896,671	394,657	818
North America	02	167,743,833	20,310,336	93,440
TOTAL	**105**	**261,134,064**	**25,317,086**	**147,719**

2 Science in Action

Ground-truthing NASA Missions through Field Measurement Campaigns/IOPS

A critical focus of The GLOBE Program is to support NASA's satellite missions through handson, and ongoing, field measurement campaigns and Intensive Observation Periods (IOPs). GLOBE campaigns/IOPs are regional and worldwide projects that provide students with the opportunity to step out into the field and question, research, explore, measure, and collect data that NASA can then use to validate and "ground truth" its scientific data.

The current campaigns are:

- **The Trees Around the GLOBE Student Research Campaign:** This campaign, launched in 2018 in conjunction with NASA's Ice, Cloud, and Land Elevation Satellite 2 (ICESat-2) launch, is a student research campaign focusing on tree height, land cover, and "greenings". From May 2021 through May 2022, the campaign had 1,000+ participants from 58 countries. In early 2022, data counts included: tree height (11,000+ from 4,000+ global sites; land cover (6,500+ from 4,500+ global sites); and greenings (6,700+ from 350+ global sites). From May 2021 to May 2022, there were 17 webinars and one half-day workshop, with 950+ live participants from 51 countries.
- **The GLOBE Mission Mosquito Campaign:** This campaign, which began in 2018, is creating an organized citizen science community who conduct and report local observations using The GLOBE Program's App, GLOBE Observer/Mosquito Habitat Mapper Tool. Through this effort, citizen scientists identify potential mosquito breeding sites, sample and count mosquito larvae, and (with optional equipment) examine and photograph specimens to identify genus. They are also requested to eliminate the breeding grounds, if possible; for example, emptying tires, plant pot holders, etc.
- **The Urban Heat Island Effect (UHIE)-Surface Temperature Student Research IOP:** This ongoing campaign, which is now an IOP, takes place in October, December, and March. It is focused on examining the impact urbanization has on the Earth's surface temperature and how the surface temperature changes the dynamics of the Earth's atmosphere. In 2020–2021, the IOP conducted virtual presentations in Greece, Malta, Qatar, and the

United States to promote the study of the urban heat island by K–12 students. During the campaign, 4,938 surface temperature observations were taken at 117 schools.

Supporting GLOBE/NASA Science Activation Projects

GIO provides support for four innovative NASA-funded Earth Science Activation (SciAct) projects (through STEM agreements with GLOBE U.S. Partners). In 2021–2022, this work included:

- **GLOBE Mission EARTH (GME):** GME focuses on bringing together scientists, science educators, and other experts to develop a K-12 "Earth as a System" curriculum progression, embedding NASA assets and GLOBE resources into the classroom. Overall, approximately 4,100 K-12 students, and 99 undergraduate students, were involved; 70 student research projects were completed; 62 teachers attended GLOBE-related professional development sessions, with 69 teachers attending virtually; and 21 subject matter experts (SMEs) connected to classrooms.
- **AEROKATS and ROVER Education Network (AREN):** The goal of AREN is to train the next generation of scientists, engineers, and other professionals to observe and understand Earth through experiential learning using NASA technology and data in realworld settings. In 2021-2022, AREN conducted a range of professional development activities for educators, including GLOBE trainings at the University level, various AREN workshops, and the AREN Remote Sensing Summer Institute. Most of these events included a GLOBE component, either training teachers or providing the opportunity for eTraining.
- **Impacts and Feedbacks of a Warming Arctic:** Engaging Learners in STEM using NASA and GLOBE Assets (Arctic and Earth SIGNs): This project connects youth and adults to climate issues and Earth science learning through inquiry-based GLOBE investigations and community stewardship activities. In 2021–2022, the project used the learning model that braids Indigenous and western science in curriculum development, professional development workshops, and climate change related courses and stewardship projects to meet the needs of diverse audiences.
- **NASA Earth Science Education Collaborative (NESEC):** NESEC is a partnership between four organizations that are GLOBE partners: Institute for Global Environmental Strategies (IGES), and the Earth sciences at three NASA Centers (Goddard Space Flight Center, Jet Propulsion Laboratory, and Langley Research Center). By early 2022, a total of more than 226,000 citizen scientists had downloaded (and registered with) the GLOBE Observer app, with more than 800,000 observations submitted by citizen scientists. In 2021–2022, more NESEC hosted more than 200 activities (via webinars and online presentations).

In 2021–2022, all these endeavors engaged audiences in science-driven events—all geared toward educating and energizing the GLOBE community.

Mobilizing The GLOBE Program's App through GLOBE Observer Challenges

The GLOBE Program's mobile app, GLOBE Observer, extends the reach of GLOBE by providing a way for all community members—those who have been dedicated to this expansive effort for years or those who have just joined in—to take and submit observations. These "citizen scientist" observations help professional scientists track changes in clouds, plants, trees, land cover, and other life in support of Earth system science research. As of early 2021, over 194,500 (up from 166,000 in early 2020) citizen scientists had downloaded the program's app, and over 507,693 (up from 373,000) data were entered by GLOBE Observers.

2 Science in Action

Below are a few of the challenges charged to inspire the community in 2021–2022.

- **2021 Mosquito Habitat/Land Cover Photo Challenge:** The 2021 Mosquito Habitat/Land Cover Photo Challenge took place from July through August During this month-long challenge, more than 6,200 new mosquito and land cover photos were added to the GLOBE database to support new research in artificial intelligence. Data submissions came from 516 teachers, students, and volunteer scientists in 31 different countries. The top contributing countries by data count were (in rank order): Thailand, the United States, India, Argentina, Colombia, and the Taiwan Partnership.

- **2022 NASA GLOBE Clouds Challenge:** Clouds in a Changing Climate: The 2022 NASA GLOBE Clouds Challenge took place from January through February. During this month-long challenge, more than 42,000 (from 89 countries and seven continents), with 108,214 images were added to the GLOBE database. Cloud Challenge participants surpassed the satellite match goal set at the beginning of the challenge (which was 20,000 matches) with nearly 50,000 satellite matches. The challenge also incorporated NASA GLOBE CLOUD GAZE, through which participants made over 300,000 classifications.

Growing the GLOBE International STEM Network

The GLOBE International STEM Network (GISN) links STEM professionals with GLOBE teachers and schools, providing the opportunity for them to work directly with students on specific educational activities

In late 2021, to increasingly engage the GISN community, GLOBE reevaluated many aspects of the application process for GISN. This effort included: reviewing the requirements for GISN membership participation; updating the application form to emphasize participation, based on interests in activities and mentoring; and adding questions that allow potential members to share their experiences and connections with GLOBE.

As of early 2022, the GISN had 126 active members from all six regions: Africa (13); Asia and Pacific (19); Europe and Eurasia (11); LAC (8); NENA (5); and North America (70). This includes 11 early career STEM professionals from four of the six GLOBE regions.

3 Education in Action

Enhancing GLOBE's eTraining Modules

As always, GLOBE remains dedicated to inviting—and inspiring—teachers (formal and informal) and environmental observers (citizen and professional) to dive into the educational and scientific wealth of the program.

To enter GLOBE data into the ever-expanding database (through the website or through The GLOBE Program's app, GLOBE Observer) teachers with approved accounts simply need to complete the necessary training by attending a GLOBE workshop (when the program is offering in-person trainings once again) or by completing the online eTraining modules.

Once training is complete, these teachers can enter measurements—and join a community of thousands teachers and observers from around the world! There are now 48 eTraining modules available (including modules introducing The GLOBE Program and all four protocol areas: Atmosphere, Biosphere, Hydrosphere, and Pedosphere).

GLOBE has been working on a comprehensive review of the eTraining modules, and is working to update, streamline, and improve their overall functionality and accessibility.

Encouraging GLOBE Student Research Via 2022 IVSS

The GLOBE International Virtual Science Symposium (IVSS) is a way for GLOBE students (K16) to show the world what they have learned through hands-on research. In 2022, GLOBE received 220 student project submissions from 97 schools in 25 countries in all six GLOBE regions. Projects were submitted in five languages: Arabic, Croatian, English, Spanish, and Portuguese. In all, 162 judges from 36 countries (from all six regions) helped score the projects and provide feedback.

On Earth Day, 22 April, a stipend drawing was held, and seven projects were selected randomly from a group of projects that received a four-star student research badge, and at least two other optional badges, to receive a stipend for educational materials for their classrooms. The seven projects were:

- **Africa Region:** *Green Balconies and Terraces—A Solution for Climate Change* (Shree Swaminnarayan Academy/Upper Primary; Teacher: Beatrice Oyange; Students: Soraya Firth, Prayosha Budhdeo, and Jiyana Kerai; Mombasa, Kenya)
- **Asia and Pacific Region:** *A Study of Microplastic Contamination in Water and White Shrimp* (Litopenaeus Vannamei) in Shrimp Ponds in Songkhla Province, Thailand (Princess Chulabhorn Science High School; Teacher: Patchara Pongmanawut; Students: Pacharapun Odthon, Kantapong Wongpanich, and Patcharanuch Kaiman; Trang, Thailand)
- **Europe and Eurasia Region:** *Clouds Over my City* (OS Sime Budinica/Middle School; Teacher: Zrinka Klarin; Students: Petra Maruši, Bartol Cukovi, and David Pejdo; Zadar, Croatia)
- **Latin America and Caribbean Region:** *Cobertura Terrestre y Comunidades de Aves, en Bosques de Manglar, Cartagena, Colombia* (Período 2013–2021) (Colegio

3 Education in Action

Montessori de Cartagena/Secondary School; Teacher: Juan Felipe Restrepo Mesa; Students: Jimena Sánchez Ojeda, Diego Andrés Luna Vélez, Lito Porto Sanabria, and Gabriela Olmos Tejeda; Cartagena de Indias, Colombia)

- **North America Region:** *Assessing the Effects of Surface Temperature and Tree Coverage in Select Suburban Parks* (Crestwood High School; Teacher: Diana Rae Johns; Students: Yasmina Abbas, Marwa Aidibi, and Zainab Zaidan; Dearborn Heights, Michigan, USA)
- **North America Region:** *How Does the Soil Temperature in the School Prairie Compare to the Soil Temperature in the Turf Grass and the Playground?* (Dorr Elementary School; Teacher: Kristy DiSalle; Students: Katelyn Duke, Ryan Bryant, Evan Millsaps, and Rue Warner; Holland, Ohio, USA)
- **Near East and North Africa Region:** *Soil Characteristics and their Impact on Omani Garlic Plant Growt*h (Asma Bint Aomis/Middle School; Teacher: Hedaya Alfarsylbry; Students: Abrar Saif and Khalifa Alfarsi; Ibry, Oman)

GLOBE would like to acknowledge the hard work and dedication of students, teachers, GISN members, and GIO staff; without this assistance, and passion for science, this ongoing endeavor would not be possible!

Revitalizing the GLOBE Campaign Proposal Process

GLOBE campaigns and projects are highly valued components of The GLOBE Program, facilitating diverse interactions among students, teachers, and scientists. They stimulate student measurement activity and provide the opportunity for students to expand their research and science horizons—while also providing scientists with research-quality measurements.

This past year, to encourage engagement within and across the community, GLOBE began updating the campaigns and projects proposal and implementation process to provide better support for ongoing and future campaigns and projects. Relevant webpages are being revised to better facilitate knowledge sharing and interaction among GLOBE countries, regions, students, teachers, and citizen and professional scientists.

Currently, GLOBE is working through the process of ensuring that relevant webpages include tracking of all ongoing campaigns and projects; provide information on how to propose a successful campaign and project; and explain how GLOBE strives to provide the necessary support to these efforts.

Expanding GLOBE's Protocol Bundles: Advancing in Agriculture

GLOBE recognizes that agriculture is a critical source of livelihood for many people around the world. Nearly 70 percent of the world's population relies directly on agriculture as a means of livelihood.

As "Green Revolution" technologies evolved, between 1960 and 2015, worldwide agricultural production more than tripled due to these advancements, and there has been a significant expansion in the use of land, water, and other natural resources for agricultural purposes. The expansion of agriculture is required to support a growing human population, which has often resulted in negative consequences, including land degradation, salinization of irrigated areas, over-extraction of groundwater, the build-up of pest resistance, and the decline of biodiversity.

In 2021–2022, GLOBE tailored an "Agriculture Bundle" where the community can find a collection of protocols, prompts, and projects related to these issues—and their intersections with various Earth Spheres. By using this new bundle, the community can help secure agricultural resources for future generations by monitoring the changes in cultivated lands in their communities.

Subsistence agriculture

Commercial plantation

Mixed farming

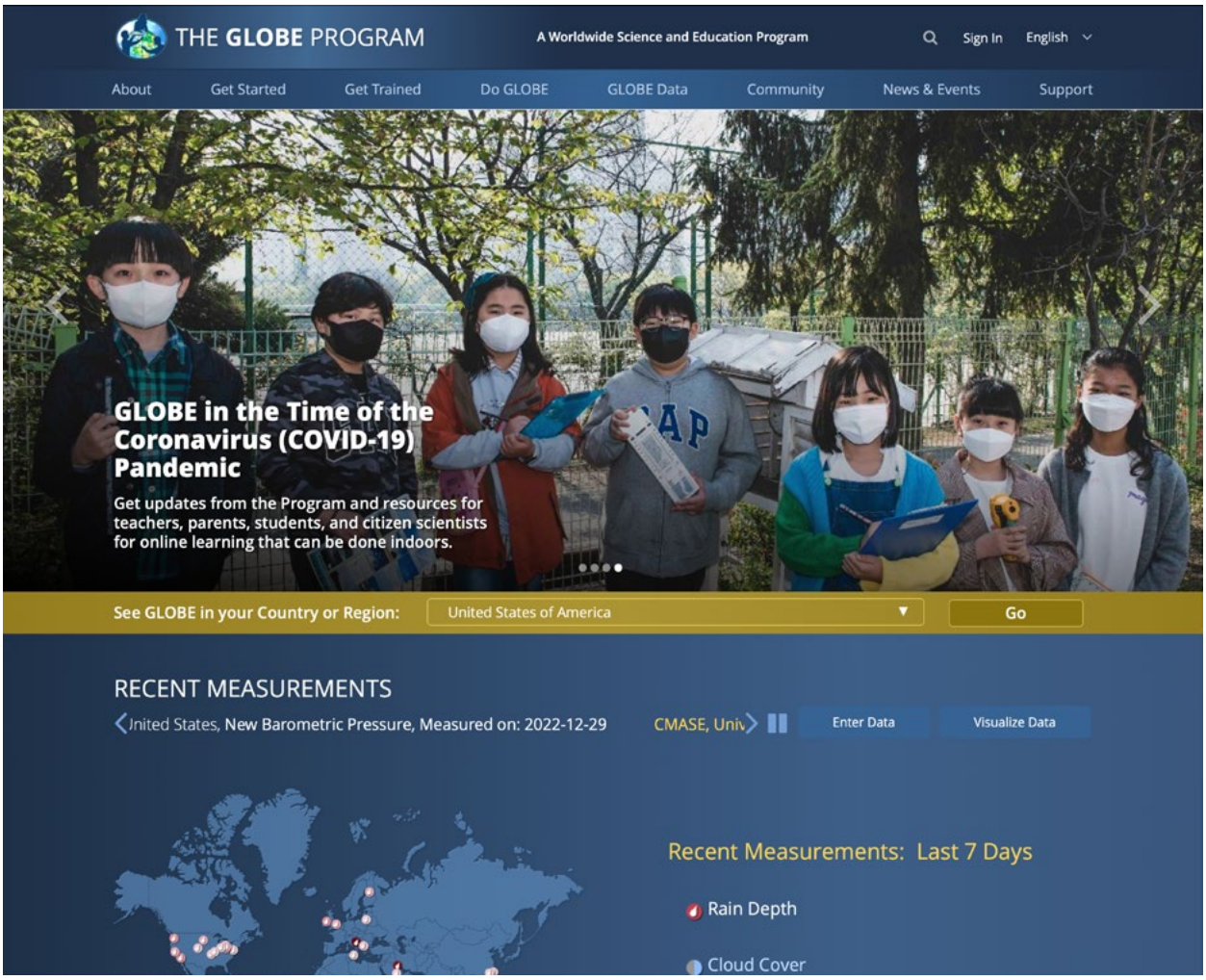
Dryland agriculture

4 Technology/Website in Action

Enhancing the GLOBE Website

GLOBE continues the behind-the-scenes upgrades to the GLOBE website. Recent work includes improvements that strive to provide enhanced ease-of-use features, including:

- **New Features for Teachers and Students:** GLOBE rolled out a set of new features to help teachers track their students' contributions to GLOBE. Teachers will see an improved student account creation process, unique names for their student accounts, and on the teacher's "MyPage" a list of all students and the total number of observations each student has made. This capability also extends to GLOBE Teams: A teacher can make their own GLOBE Team(s), assign students to the team, and see how much data each student has entered. Student accounts now have both generic and personalized naming to uniquely identify each student
- **Hydrosphere Added to The GLOBE Program's GLOBE Observer App:** All trained users can access atmosphere and hydrosphere protocols from within the app. A new simplified site setup process and improved interface makes it easy to enter data from any mobile device.
- **Site Re-architecture:** A team of representatives from across GLOBE has contributed to a concept to re-architect the GLOBE for easier navigation and to simplify the account creation process. This has been a year-long



process of surveys, discussions, and testing—resulting in an approach that GLOBE believes will help simplify the community's ability to find, and work with, content across the GLOBE site. The move into the new site architecture will be in phases and will take place over the next year.

The goal of this extensive effort is to ensure that people visiting—and using—the GLOBE website can maneuver through features and options with greater ease of use and a greater sense of hands-on accomplishment.

Assisting and Training the Community Via the Website

The Community Support Team (CST) is constantly engaged in website assistance in order to facilitate ease of its use for the overall GLOBE community.

To achieve that goal, CST has created a wide variety of customized videos to allow the community to see, stepby-step, what needs to be done to achieve success on the website. From May 2021 through May 2022, 45 custom videos, 20 graphics interchange formats (GIFs), and over 40 screenshots with illustrations were created for the community.

In addition, CST:

- provided website training for the Regional Coordination Offices (RCOs), and continued to provide additional training for all ongoing website updates;
- provided training for GLOBE U.S. partners and Country Coordinators;
- updated, maintained, and/or created pages on the website, and continued to work on maintaining the main publications pages;
- created online communities and managed new/existing measurement campaigns, and providing updates, as needed;
- created new animated images for GLOBE website tutorials to help demonstrate the step-by-step actions described in tutorials;
- provided training for new GLOBE partners, using Skype, Google Hangouts Meet, and Zoom; and
- created and maintained a list of issues reported to DIS on regular calls.

CST engaged in these efforts to ensure that the community could "walk" their way through all that the GLOBE website has to offer and to ensure that the "work" of GLOBE is a smooth journey toward resource richness!

Assisting and Informing the Community Via FAQs and Personal Attention

FAQS

As the GLOBE community explores, learns more about, and dives deeper into The GLOBE Program, there are many answers available on the website designed to provide up-to-date assistance. On an ongoing basis, CST works to provide tips and tools to make using GLOBE, and GLOBE resources, as easy as possible.

Need to know "what" it's all about? Check out the focused FAQs, including:

- GLOBE Program Overview
- GLOBE Accounts Information
- GLOBE Schools Information
- GLOBE Workshop Information
- GLOBE Website Tutorials
- GLOBE Protocols Information
- Instrument Information
- Data Entry Information

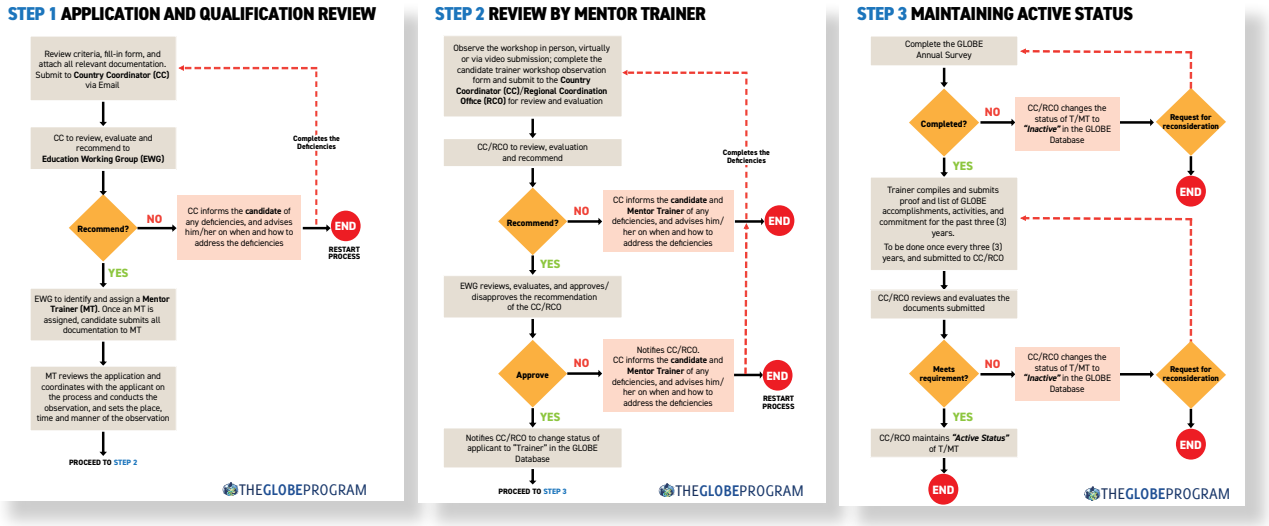
Need to know "how" to engage in the program? Check out the training tutorials, including:

- Setting up Your Data Site
- Entering Measurement Data
- Retrieve and Visualize Your Data
- Setting up Your GLOBE Account
- Creating Student Accounts
- Collaboration

PERSONAL ATTENTION

On a daily basis, CST lends a personal touch to ensuring that the community is able to fully engage in all that the program offers by answering incoming "help desk" calls. Team members answer the Help Desk Hotline to assist

4 Technology/Website in Action



users with urgent issues. To track phone calls, CST creates a Request Tracker (RT) ticket for each phone call received, which includes details of the issue. In late 2021, CST updated their outgoing voice mail messaging to introduce The GLOBE Program more succinctly to callers (and, as result, to reduce the number of non-related calls) so that time could be invested where it matters most—assisting and supporting the community.

CST responded to a variety of issues regarding the GLOBE website or regarding The GLOBE Program in general. In addition to meeting immediate community needs, all inquiries or questions were monitored and, as policy or technologies changed, responses to inquiries were revised to reflect the changes—ensuring that GLOBE remains current and responsive.

Community members can also reach out to the CST via email (globehelp@ucar.edu).

Ensuring the Success of the Trainer and Mentor Trainer Certification Process

GLOBE has a long history of building the capacity, and capability, of its community by certifying GLOBE trainers and mentor trainers. Recently, GLOBE has been engaged in refining the certification process to ensure that it is flexible, transparent, and accessible—and to guarantee the highest level of competence throughout the community.

To help ensure the success of this process, CST worked diligently over the past year to assist the Regional Coordination Offices (RCOs), Country Coordinators, Working Group members, and mentor trainers to help review, adjust, and implement the new process.

The effort included reviewing the process and providing feedback, translating the process into Arabic and Spanish, and posting the results of surveys designed to help guide the future effectiveness of the certification process. CST also updated relevant webpage contents and helped develop (including testing and troubleshooting) website tools designed to streamline the overall process.

Through this ever-evolving effort, GLOBE is achieving the goal of adding informed, qualified, and dedicated GLOBE trainers and mentor trainers to the list of community members ready, willing, and more than able to move the program forward to even higher levels of scientific achievement.

5 Communications in Action

Informing Via News and Events

A daily goal of the GIO is to inform, educate, inspire, and engage GLOBE community members. To achieve this, GIO scours the globe for what's new, what's happening (and when, where, and why it's happening), as well as all other pertinent information about what other community members are up to—then works to announce this "news" to the community. In alignment with the *GLOBE Strategic Plan: 2018–2023*, the goal of these efforts is to improve communication pathways among the GLOBE community; improve communication of GLOBE events, activities, and national and international achievements; and increase the promotion of GLOBE to new audiences.

GIO also invites community members, sponsors, partners, and collaborating organizations and programs to provide the information necessary to ensure that the website is constantly being updated with vital information regarding GLOBE-related news and events. In 2021–2022, more than 1,000 GLOBE-related news and events were posted to the website!

In addition to "printed" news and events listings on the website (as well as those shared in the monthly News Brief and mass mailings), GIO created and produced a number of vital, informative, and personalized video presentations to help ensure that all community members realized their invaluable significance to the enduring and expanding success of The GLOBE Program.

Impacting Via "Agents of Change" Videos

The power behind The GLOBE Program is the passion, the purpose, and the people—GLOBE community members. The GLOBE Program values the level of daily dedication to, and ongoing support of, the program, as well as the enduring quality of the educational, environmental, and scientific contributions of our community members.

From March through May 2022, GIO embarked on Phase 2 of the "Agents of Change" documentary series, which is designed to create a video portrait of The GLOBE Program throughout all six regions. Phase 2 videos focus on the primary themes of the program, including: "Girls in Science

and Leadership" (Oman); "Creating a More Diverse and Inclusive Learning Community" (United States); and "The Importance of Leadership in Raising a Generation of Scientists" (Croatia).

Inspiring via GLOBE Student Vloggers

A new "cohort" of twelve GLOBE Student Vloggers (GSVs)—selected from all six GLOBE regions—were welcomed aboard on Earth Day 2022. These GSVs (or "video bloggers") are creatively crafting "selfie-style" videos designed to invite the community into their unique culture and local environment—into what they are doing, learning, and discovering. In line with the Strategic Plan for communications, these vlogs are vibrantly crafted in a manner designed to increase the use of new communication networks among different GLOBE community groups; to increase the awareness of the achievements of GLOBE community members; and to increase the promotion of The GLOBE Program to new audiences!

The new cohort of GSVs:

GLOBE Near East and North Africa Region

- Alreem, age 19 (Oman)

GLOBE Latin America and Caribbean Region

- Andrea, age 13 (Guatemalan)
- Coral, age 10 (Argentina)

GLOBE Europe and Eurasia Region

- Benjamin, age 12 (Malta)
- Regina, age 18– now 19 (Estonia)

GLOBE Asia and Pacific Region

- Haranindan, age 14 (India)
- Llyn, age 15 (The Philippines)
- Wannachol, age 10 (Thailand)

GLOBE Africa Region

- Idowu Faith, age 17 (Nigerian)
- Nuwaira, age 15 (Nigeria)

GLOBE North America Region

- Royce, age 17 (United States of America)

Simply subscribe to GLOBE's YouTube channel to keep up with these vibrantly unique weekly journeys.

Sharing Via Social Media

Reaching out to community members around the world through social media outlets continues to be a central, and critical, way to keep people up-to-date on news, events, trainings, meetings, science symposia, and all GLOBE-related activities and opportunities.

GLOBE's efforts on Facebook continue to promote greater interaction with the program, cultural sharing, and professional and citizen science across the world. As of early 2022, the GLOBE Facebook account gained nearly 3,000 new followers! Thanks to an enhanced strategy of sharing, GLOBE also began posting four times per day, reaching 464,152 people, and "engaging" 24,489 (on average).

GLOBE's efforts on Twitter strive to keep the community up-to-date (up-to-the-minute) on GLOBE. The team shared a combination of program-related, community-related, science-related, and sponsor-related content. By early 2022, GLOBE had nearly 9,500 followers! The team tweeted four tweets per week, with additional retweeting on any given day (in relation to news, updates, challenges, etc.), and "impressed" over 826,100 people.

GLOBE's efforts on Instagram continue to promote upcoming events and opportunities, social media focuses (clouds, mosquitoes, etc.), and intriguing aspects of our planet. Over the last year, the team began to release weekly "Reels." These short (taking a minute or less) vertical-format videos cover a variety of topics and have the potential for greater reach than other forms of content currently on the platform. Through use of reels, the team saw increased reach numbers, interactions, and "likes" on the account. Reels were a key piece of outreach during the 2022 Cloud Challenge. GLOBE reached over 60,000 people (on average) with one-to-two photos (per week) and two-to-three Instagram stories (per week).

And, as always, the team coordinated with larger NASA social media accounts to achieve strategic cross-promotion. For example, during the Community Trees Challenge 2021: Science is Better Together (April–May 2021), combined efforts reached 3,211,465 people; and during the GLOBE Mosquito Habitat Mapper Challenge (July–August 2021), combined efforts reached 2,535,685 people.

6 The GLOBE Community

Gathering Virtually at the 2021 GLOBE Annual Meeting

The theme of the 2021 GLOBE Annual Meeting, which was held from July 12–16, was "Adapting to a Changing GLOBE." In all, 352 registrants from 51 countries engaged in this virtual community endeavor. Participants could select from 55 sessions with a total of 114 speakers. Sessions were hosted live, and "on-demand" recordings were made available after they were completed.

"As GIO's second foray into virtual meetings, the meeting was successful and certainly met the goals that we had developed for it." GIO Director Dr. Tony Murphy said. "One of the aspects that we planned for here was that the meeting would be far more interactive than it was in 2020."

"What excited most people, I believe, was the number of community presentations that took place as part of the meeting," Dr. Murphy said. "It again solidifies for me the great work that you all do wherever you are in a GLOBE country, and sharing your good work only makes the program and us all stronger. This is even more amazing given that we continue to face challenges, both personal and professional, with this ongoing pandemic."

GLOBE would like to thank everyone who participated in the 2021 GLOBE Annual Meeting. The continued dedicated participation of the community is the key to GLOBE's enduring educational and scientific success.

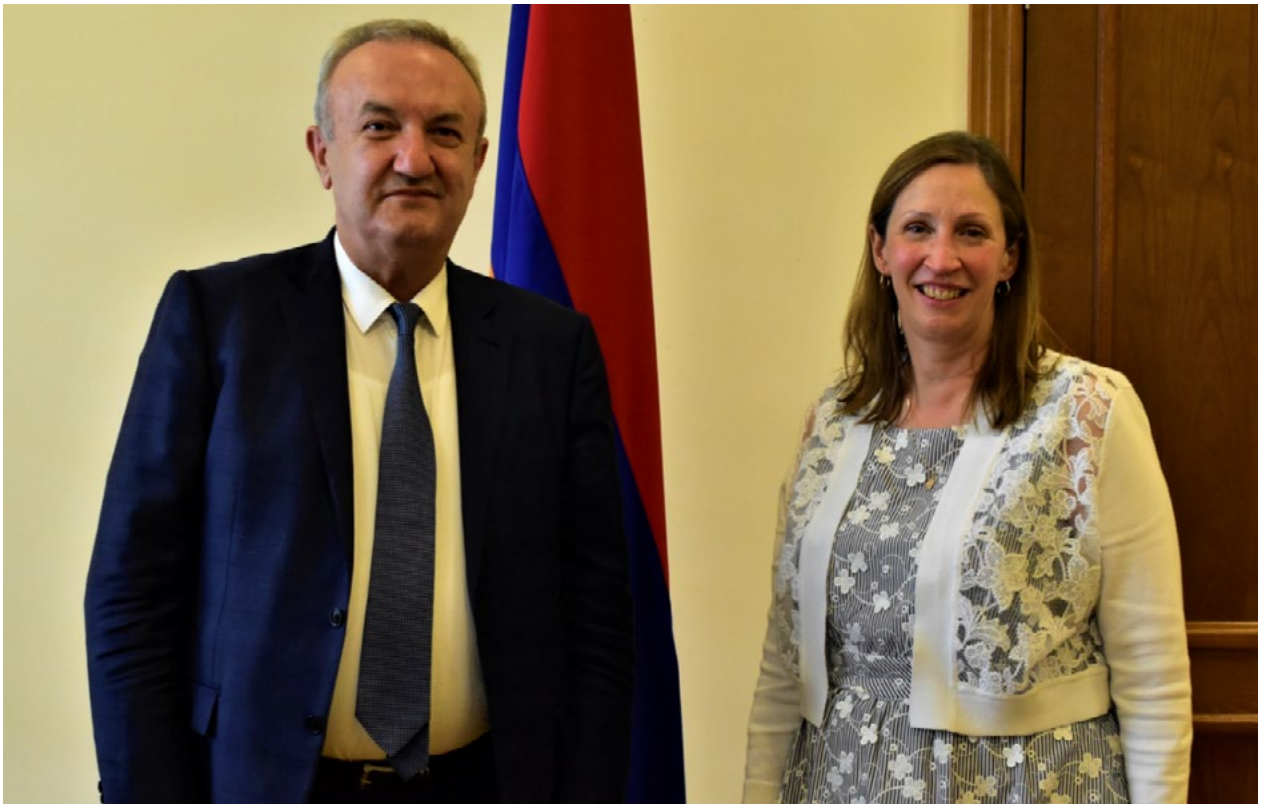
Seeking Information Via the GLOBE Annual Survey

The GLOBE Annual Survey is one of the GIO's primary data-collection tools for monitoring progress toward the goals outlined in the GLOBE Strategic Plan. It is administered to GLOBE teachers, partners, Country Coordinators and GISN members.

GLOBE has created a set of one-page infographics that summarize the survey results in each of the five goal areas of the Strategic Plan. These infographics (covering communications, community, education, science, and technology) serve to communicate a subset of highlights more succinctly from the broader survey and to replace more cumbersome PowerPoint presentations.

The GLOBE community plays a vital role in ensuring that the program stays on track in terms of meeting goals, but also in ensuring that GLOBE's Mission: *"To promote the teaching*

Taiwanese teachers and students work on an investigation about the marine ecosystem and pastics pollution and to enhance awareness of the hydrological environment.



Acting Minister of Education, Science, Culture and Sports Vahram Dumanyan and U.S. Ambassador Lynne Tracy congratulate Armenia for joining the GLOBE family of nations.

*and learning of science, enhance environmental literacy and stewardship, and promote scientific discovery" i*s carried out every single day!

Welcoming New GLOBE Country: Republic of Armenia

In June 2021, U.S. Ambassador to the Republic of Armenia Lynne Tracy met with the Acting Minister of Education, Science, Culture and Sports (ESCS) Vahram Dumanyan; ESCS Deputy Minister Arthur Martirosyan; the newly appointed United States Agency for International Development (USAID) Armenia Mission Director John Allelo; and Officer of the U.S. Embassy in Armenia on political and economic issues Oleg Sokola in order to welcome the Republic of Armenia to the GLOBE community.

In an announcement issued by the Ministry of Education, Science, Culture and Sports of the Republic of Armenia, the Acting Minister expressed confidence that GLOBE, being an international scientific and educational environmental program, will encourage Armenian students and scientists to study the world environment and that this agreement will contribute to the implementation of new joint initiatives, thereby contributing to the development of technological education in the Republic of Armenia.

Ambassador Tracy, confirming her willingness to continue and advance multilateral cooperation, highlighted the engagement of Armenia in The GLOBE Program. "Given the multiple climate challenges facing the world, the innovative and interactive methods of recognizing and protecting the environment offered by The GLOBE Program are more relevant today than ever," Ambassador Tracy said.

The Republic of Armenia is the 126th country to participate in The GLOBE Program. "We look forward to Armenia building a strong program in science and education, with the support of the GLOBE Implementation Office (GIO)

here in the United States and GLOBE's Europe and Eurasia Regional Coordination Office in the Czech Republic," GIO Director Dr. Tony Murphy said. "A big welcome from the GLOBE family of nations, Armenia!"

Nurturing GLOBE Collaborative Endeavors

GLOBE's ongoing collaborative efforts continue to focus on expanding and enhancing the work of the program. In 2021–2022, collaborative efforts included:

- **Peace Corps:** Since 1995, GLOBE and Peace Corps share a common commitment to the environment, education, youth development and empowerment, capacity building, and cultural understanding. In 2021–2022, Peace Corps volunteers were pulled back due to the pandemic; Peace Corps announcements for volunteers indicated that postings would occur no earlier than sometime during the spring-to-fall 2022 timeframe (depending on the location).
- **United Nations Environmental Programme (UNEP):** GLOBE and UNEP share a common commitment to the environment, capacity building, and cultural understanding. Through this partnership, GLOBE and UNEP cooperate on environmental education and training, citizen science, and the collection and distribution of environmental data. In 2021-2022, GLOBE worked with UNEP/GRID Warsaw Centre (which serves as the Poland Country Coordinator) to support the development of a collaborative activity to highlight the 50th Anniversary of UNEP and the 25th Anniversary of GLOBE Poland.
- **National Wildlife Federation Eco-Schools International Collaboration:** GLOBE and Eco-Schools are working together to integrate high-quality, STEM-focused, and environment-based programs. In 2021–2022, GLOBE continued discussions with the National Wildlife Federation GLOBE Point of Contact on several countries where there is no current GLOBE country coordinator, including Iceland, Portugal, and the United Kingdom. This partnership contributed to Slovenia signing the GLOBE agreement (the Eco-Schools National Operator in Slovenia promoted GLOBE to the government and offered to play a leading role in its implementation).

Photos from Around the Regions

Africa Region Highlights

2022 REGIONAL MEETING

In March, the 2022 Africa Regional Meeting was conducted virtually. The meeting was attended by Country Coordinators, Deputy Country Coordinators, teachers, students, and scientists from 14 countries. The primary topics of discussion (which were updated via a regional Padlet), included: current challenges to active and sustained participation, waterbodies research, and invasive plant species. There was also a daily live (virtual) panel discussion session, focusing on discussion, input, and feedback.

Meeting participants were encouraged to participate and contribute. (A portion of the session was allocated to French and English, and consisted of speakers from the region.) The panel monitored the contributions and summarized the input; discussions centered on presentations from regional representatives who spoke to the input gathered during the day. An electronic participation certificate was generated at the end of the meeting and was provided to each participant.

TOPICAL HIGHLIGHTS FROM THE REGION

As always, the Regional Coordination Office (RCO) encouraged, supported, and hosted (virtually) numerous events (meetings, training, activities, field studies, and research efforts) during 2021–2022. The items listed below are only to serve as "highlights" of the region's ongoing, dedicated, work.

SCIENCE

A variety of science activities, meetings, and events occurred in various forms throughout the region, including the 2022 Waterbodies Intensive Observation Period (IOP), which took place in May. The event covered stories about local waterbodies (including a focus on indigenous knowledge systems); presentation of pictures and location information on waterbodies; hands-on involvement with GLOBE's hydrology protocol (participants were able to decide on the specifics of what they wanted to measure, and then were able to data to the GLOBE database). Overall, 10 countries participated in these efforts, with a follow-up virtual session taking place to help the community discuss the experience.

EDUCATION

A variety of education activities, meetings, and events occurred in various forms throughout the region, including:

- **Online Training:** In March 2022, an online teacher training workshop took place that covered eTraining modules (atmosphere, biosphere, hydrosphere, and pedosphere). Ninety-four teachers from 11 countries participated in the event.

- **Geography Training Session:** In February 2022, a training session took place in Yaounde (Cameroon) for geography teachers. The training covered atmosphere protocols, with a focus on projects that included building a thermometer, constructing an ozone station, contour mapping, resetting and calibrating thermometers with ice, and working with geographic data.

COMMUNITY

A variety of community activities, meetings, and events occurred in various forms throughout the region, including an "introductory" training session in May of 2022 that covered basic website administration. Twenty-two people from five countries participated in the event; they learned how to set up their GLOBE account and how to locate and print participation certificates.

Asia and Pacific Region Highlights

2022 REGIONAL MEETING

In January, the 2022 Asia and Pacific Regional Meeting was conducted virtually. The meeting was attended by Country Coordinators, Deputy Country Coordinators, teachers, students, and scientists from 12 countries. The first day of the meeting focused on student research, with ten student teams participating (from India, the Philippines, Nepal, the Republic of Korea, Taiwan, and Thailand).

The rest of the three-day meeting focused on the theme: "We Learn, We Do, With GLOBE." The goal of this was for Country Coordinators in the region to showcase their best practices; to exchange ideas related to their experiences with digital learning, distance learning, and online cooperative/collaborative efforts; and to share "lessons learned" as a result of the partial (or total) shut-down of schools during the pandemic. Participating Country Coordinators spent time discussing the presentations from their peers—finding similarities, asking questions, and contributing ideas and experiences.

Protocol training in Bhutan.

TOPICAL HIGHLIGHTS FROM THE REGION

As always, the Regional Coordination Office (RCO) encouraged, supported, and hosted (virtually) numerous events (meetings, training, activities, field studies, and research efforts) during 2021-2022. The items listed below are only to serve as "highlights" of the region's ongoing, dedicated, work.

SCIENCE

A variety of science activities, meetings, and events occurred in various forms throughout the region, including:

- **Soil in Schools:** In May 2022, the RCO hosted a webinar for Country Coordinators, GLOBE trainers, teachers, and students. The goal was to encourage participants to develop skills in using the GLOBE Soil Protocol. Ninety-eight people (including 43 students from Nepal and ten students from Bhutan) from nine countries participated in the event.
- **Tree Challenge Awareness Webinar:** In September 2021, the RCO hosted a "Tree Challenge Awareness" webinar that focused on sharing student research on biosphere with the community and training participates on the GLOBE Biosphere Protocol. Ninety-three people from throughout the region participated in the event.

- **GLOBE Scientist Story:** In October 2021, the RCO hosted a special webinar focusing on Yashraj Patil, a GISN member and mentor for the American Geophysical Union (AGU) Mentoring365 Program. During the event, Patil shared his scientific experience resulting from his expedition to the Himalayan region (Ladakh). He credited The GLOBE Program—and his experiences learning and growing within the program—with helping him achieve a personal and professional dream.
- **Awareness on Microplastic in Ocean Water:** In May 2021, the RCO hosted an "Awareness on Microplastics in Ocean Water" webinar for Country Coordinators, GLOBE trainers, and teachers. Forty-seven people participated in the event.

EDUCATION

A variety of educational activities, meetings, and events occurred in various forms throughout the region, including:

- **Initial Teacher Training (GLOBE Bhutan):** In January 2022, the RCO (in collaboration with GIO, and in association with the Ugyen Wangchuck Institute for Conservation and Environment Research) hosted the first teacher training workshop in Bhutan, which was presented to 12 schools.
- **Second Teacher Training (GLOBE Bhutan):** In April 2022, the RCO (in collaboration with GIO, and in association with the Ugyen Wangchuck Institute for Conservation and Environment Research) hosted the second teacher training workshop in Bhutan, which was presented to ten of the twelve schools that had participated in the first training, and three new schools.

COMMUNITY

A variety of community activities, meetings, and events occurred in various forms throughout the region, including:

- **Air Quality Campaign:** In November 2021, the RCO hosted a webinar designed to inspire participation in the campaign (which ran from November 2021 through January 2022). This was an educational project designed to raise awareness about air pollution and showcase the potential of citizen science to gather unique datasets and insights into the environment. Thirty-five people from seven countries participated in the event.
- **Training on The GLOBE Program's app, GLOBE Observer:** In December 2021, the RCO hosted a training for teachers and students. Ninety-five people from countries throughout the region participated in the event (including 28 students from Nepal).
- **Mosquito Awareness Campaign:** In July-August 2021, 12 school teams from eight countries participated in the Mosquito Awareness Campaign; they collaborated on projects designed to help them prepare research reports, and to exchange data and experiences. The RCO hosted ongoing webinars with scientists and online "meet-ups" to keep the community motivated.

Europe and Eurasia Region Highlights

2021 REGIONAL MEETING

In October, the 2021 Europe and Eurasia Regional Meeting was conducted virtually. The meeting was attended by Country Coordinators, Deputy Country Coordinators, students, trainers, and scientists from 29 countries. The primary topics of discussion focused on adding an environmental aspect to student research and highlighting GLOBE's impact on the local community.

There was extensive community involvement in the meeting, with 40 presentations and videos submitted by teachers and students. The most popular sessions were the ones that highlighted student presentations and videos. There was also a significant amount of time during the meeting dedicated to scientists providing feedback to the students for their contributions to The GLOBE Program.

GLOBE Games in Croatia.

TOPICAL HIGHLIGHTS FROM THE REGION

As always, the Regional Coordination Office (RCO) encouraged, supported, and hosted (virtually) numerous events (meetings, training, activities, field studies, and research efforts) during 2021–2022. The items listed below are only to serve as "highlights" of the region's ongoing, dedicated, work.

SCIENCE

Various forms of science activities, meetings, and events occurred throughout the region, including:

- **Tree Observations/2021–2022 European Phenology Campaign:** The RCO organized several webinars and online "meet-ups" to keep the community involved in this endeavor where teachers and students cross borders and language barriers to collaborate. Participants exchanged observations of trees changing color (in autumn) and greening-up (in spring); they tracked the date when buds opened and took pictures and shared results at the discussion forum. In all, 151 schools from 19 countries joined the autumn portion of the campaign; 188 schools from 21 countries joined the spring portion. More than 6,000 students were involved in the campaign.
- **National GLOBE Contest (GLOBE Switzerland):** In the summer of 2021, with the support of the U.S. Embassy and numerous partners, GLOBE research teams from all Swiss regions conducted research projects based on various GLOBE areas of investigation, and conducted poster presentations. More than 775 students (256 research teams) from all Swiss regions participated.
- **Air Quality Campaign (GLOBE Ireland):** In 2021–2022, over 300 teachers registered to participate in the GLOBE Air Quality Campaign, which runs twice a year in Ireland. The focus of this endeavor is on monitoring nitrogen dioxide, a traffic-related pollutant at schools. The campaign raised awareness around the value of meaningful school-based citizen science and promoted action-based solutions to reducing traffic around schools. At a final virtual event, five Irish schools presented their air quality stories, along with one school from Malta. A project submitted to IVSS (a collaborative effort with two schools

from Ireland and two schools from Malta) was also presented.

- **Air Quality Campaign Re-launched (GLOBE France):** In March 2022, GLOBE France invited other members of the GLOBE community to attend their Air Quality webinar, which was organized with scientists from French Space Agency (CNES) and NASA. The goal of the event was to launch the 2022 edition of the campaign and to expand the list of countries that engage GLOBE schools in air quality-related monitoring and research.
- **Israel Urban Heat Island Campaign (GLOBE Israel):** Students in the Kfar Saba Municipality investigated the phenomenon of urban heat island effect. Students explored school yards, as well as community gardens, and prepared an urban GIS map. They also monitored environmental data according to GLOBE protocols, shared the results of their monitoring, and contributed to NASA's global research on climate change. High school students prepared lesson plans for teaching the subject to elementary school students.
- **Microplastics in Water Project:** Students from the region were invited to join a second year of the pilot project on microplastics in water. (The initiative was started by Deakin University in Geelong, Australia and the GLOBE Italy team.) The schools used this opportunity to expand their GLOBE hydrosphere research. A second round of an online training was organized in 2021 to motivate teachers to test the method and provide feedback to the scientist.
- **2022 GLOBE Science Fair (GLOBE Netherlands):** In April, at the annual GLOBE Science Fair, organized by the GLOBE Foundation Netherlands, students presented the results of their environmental GLOBE research to a scientific jury and to their peers. The winning team received funding from the U.S. Embassy in Hague to travel to the GLOBE Games in Czech Republic to present their findings at the international level.

EDUCATION

A variety of educational activities, meetings, and events occurred in various forms throughout the region, including:

- **The GLOBE Program (GLOBE Slovak Republic): I**n June 2021, the Slovak GLOBE community celebrated the first year of the program in Slovakia at an online student conference. During the event, students presented their activities and held discussions with scientists. Coordinators from the Daphne Institute of Applied Ecology assisted students from disadvantaged communities with a project designed to motivate underprivileged children to learn via GLOBE's hands-on approach, materials, tools, and outdoor activities.
- **Live Observation Sessions from Xrobb l-Ggagin Nature Park (GLOBE Malta):** GLOBE Malta and Xrobb l-Ghagin Nature Park teamed up and offered online live sessions. A total of 932 students joined live sessions on cloud types and sky conditions, air temperature, air humidity, air pressure, wind, the urban heat island effect, and global warming. An additional 219 students participated in live sessions for the European Spring Phenology Campaign, Urban Heat Island Effect Campaign, and the Trees Around the GLOBE Student Research Campaign.
- **GLOBE Games (Czech Republic):** In December 2021, student teams were invited to the National Student Conference (organized online by Czech GLOBE), where scientists provided feedback on all projects. More than 200 students and teachers from 30 Czech schools attended the conference and field workshops. This year´s edition of GLOBE Games also attracted GLOBE guests from the Netherlands, Slovakia, and Ukraine, as well as U.S. Embassy representatives in Prague, and the Minister of Education.
- **First GLOBE Teacher Training (GLOBE Georgia):** Georgia successfully began their efforts with The GLOBE Program—with schools selected and GLOBE materials translated; a "kick-off" training was organized online in October 2021. With the assistance of trainers from Croatia, Czech Republic, and Malta, 20 teachers were

Students at GLOBE Games in Croatia.

Students and teachers at the GLOBE Games in Czech Republic, May 2022.

introduced to the program, and were trained in the use of the GLOBE cloud protocol, and data entry and visualization.

- **GLOBE Games (Croatia):** In May, after a two-year break, the national competition for GLOBE schools, Croatian GLOBE Games, was organized in Cakovec and Sveti Martin na Muri, and by GLOBE Croatia and the Education and Teacher Training Agency. The event showcased the best student research project presentations selected for the final round, and gave students the opportunity to prove their GLOBE

expertise during a field survey competition. Over 120 participants from 39 of the most active GLOBE schools met face-to-face to learn about the most recent GLOBE achievements.

- **The GLOBE Program (GLOBE Slovenia):** Since Slovenia joined the program in 2020-2021, the Centre for School and Outdoor Education (which serves to implement the program in the country, along with Eco-Schools) prepared a plan to launch the program in the country and engaged in their first GLOBE-related activities. The GLOBE Teachers Guide was translated to Slovenian, and the first teachers training was carried out in August 2021 (with an additional round of training organized in May 2022).

COMMUNITY

A variety of community activities, meetings, and events occurred in various forms throughout the region, including:

- **Science Communication Award (GLOBE Estonia):** The GLOBE Program in Estonia received the Estonian Science Communication Award. The aim of the award is to acknowledge, and draw attention to, individuals who promote science. The prize is awarded in cooperation with the Estonian Academy of Sciences and funded by the Ministry of Education and Research. GLOBE Estonia received five additional awards in 2021 for involving and educating youth in science. This was one of five awards GLOBE Estonia received this year.
- **Tree Reporters Challenge:** In the fall of 2021, the RCO invited students and teachers to participate in the Tree Reporters Challenge. The aim was to demonstrate the importance of trees to local communities. Students from eight GLOBE countries participated in the effort. Twenty videos and 21 posters from Croatia, Lithuania, Malta, North Macedonia, Poland, Slovakia, Taiwan, and Ukraine were presented through "Tree TV" and "Tree Magazine" to the international community at the online show "Our Autumn with Trees," which served as the culmination of the 2021 European Phenology Campaign.
- **Cloud Exploration (GLOBE Israel):** To encourage ongoing activities, even in times of quarantine and social distance, GLOBE Israel decided to focus on the protocol of cloud exploration. They created a curriculum for cooperation between different schools in Israel (Jews and Arabs) to deepen the relationship between the two sectors. Approximately 60 schools participated, engaging in the collaborative spirit of GLOBE by partnering with students and teachers from the other communities.
- **Waterbodies Challenge:** From March through May 2022, students from throughout the region took part in observing their local waterbodies as part of the Waterbodies Challenge that was launched by the RCO. The students were able to choose from nine challenges while observing their local lake, river, stream, spring, seashore (or any other) waterbody. Students collected GLOBE data, organized a "Clean-Up Day," prepared videos, and enjoyed dipping their feet into the water. In all, 46 student teams from nine countries in the region participated.
- **World Water Day (GLOBE Italy):** In March, GLOBE Italy organized a community event called "Rivers in Spring: World Water Day" in Mantova. The event took place virtually, and involved numerous schools, science institutions, local authorities, and environmental agencies in a day-long streaming event. Presentations and videos from several GLOBE schools, as well as a presentation by a NASA scientist, were also part of the event.
- **The GLOBE Program (GLOBE Armenia):** In 2021, the European GLOBE network was enriched by yet another partner country: Armenia. The program is being implemented by the Ministry of Education, Science, Culture and Sports, National Academy of Science and the Center for Ecological-Noosphere Studies.

Latin America and Caribbean Region Highlights

2021 REGIONAL MEETING

In November, the 2021 Latin America and Caribbean Regional Meeting was conducted virtually. The meeting was attended by Country Coordinators, Deputy Country Coordinators, teachers, students, trainers, and scientists from 14 countries. The primary topics of discussion included: GLOBE biosphere, carbon cycle, and pedosphere protocol training; new program content translations; the program's app, GLOBE Observer (in relation to land cover and tree height measurements); and local and regional "best practices."

During the meeting, there was also an interactive data literacy workshop, an "overview" presentation covering participation in the GLOBE IVSS, and a summary of future actions and events.

TOPICAL HIGHLIGHTS FROM THE REGION

As always, the Regional Coordination Office (RCO) encouraged, supported, and hosted (virtually) numerous events (meetings, training, activities, field studies, and research efforts) during 2021–2022. The items listed below are only to serve as "highlights" of the region's ongoing, dedicated, work.

SCIENCE

Various forms of science activities, meetings, and events occurred throughout the region, including:

- **Virtual Science Fair:** In May 2021, the RCO hosted the first Virtual Science Fair in the region. During the two-day event, 11 groups of students and teachers from Argentina, Brazil, Colombia, Peru, and Uruguay presented research papers submitted to the 2021 IVSS. At the event, there was a rich exchange of questions, ideas, and proposals for collaboration between schools from different countries. Over 180 people participated in the fair.
- **Citizen Science Latin American Congress:** In June 2021, the RCO (in collaboration with the National University of La Rioja, the National University of Comahue, the University of the Americas, and members of the La Molina National Agrarian University in Peru) hosted the virtual Citizen Science Latin American Congress. The event had 1,306 registrants, 80 Zoom participants, and 1,200 "YouTube Live" participants.
- **Butterfly Observation IOP:** In September–November 2021, the RCO (in collaboration with GLOBE Argentina, GLOBE Peru, and GLOBE Uruguay) organized the observation campaign "Butterflies and Environmental Variables." The campaign was aimed at GLOBE primary, secondary, and university teachers who wished to investigate atmospheric and biosphere variables, as well as the appearance and behavior of butterflies found in their environment.
- **The GLOBE Program (GLOBE Uruguay):** In September–October, the RCO supported GLOBE Uruguay's effort to resume in-person field activities in multiple schools. To achieve this goal, eight visits were made to schools, colleges, and a secondary school to carry out learning activities and data collection efforts focused on atmosphere protocols and butterfly observations. Twelve new teachers were certified as GLOBE teachers; 198 students from six different schools participated in field activities and data collection.
- **"Mosquito Alert" Contest (GLOBE Argentina):** In September–October 2021, the GLOBE Argentina Country Coordinator (along with the U.S. Embassy) organized the webinar (and related contest) "Mosquito Alert," which focused on mosquito habitats, vector-borne diseases, and the use of the program's app, GLOBE Observer Mosquito Habitat Mapper tool.

- **"How I became a NASA Scientist" Series:** In October–November 2021, the RCO hosted the webinar series "Women in STEM: How I Became a NASA Scientist." The goal of these events was to encourage young women to consider STEM careers and to become scientists.
- **GLOBE Pedosphere Field Workshop (GLOBE Uruguay):** In March–April 2022, GLOBE Uruguay organized a virtual pedosphere virtual course. There were 80 participants registered from Argentina, Perú, and Uruguay. Participants learned how to extract a soil sample/profile; what constituted a soil characterization; and the protocols associated with soil infiltration, pH, humidity, temperature, and fertility.
- **Science Fair to Celebrate Earth Day (GLOBE Dominican Republic):** In April 2022, GLOBE Dominican Republic held its 25th Science Fair at Notre Dame School. During the event, preschool, elementary, and high school students made their presentations in alignment with the 2022 IVSS theme "Engineering Solutions for a Changing Climate."
- **GLOBE LAC Virtual Science Fair (Second Edition):** In May 2022, the RCO hosted the "Second Edition" of the virtual science fair for the region. During the two-day event, students and teachers from Argentina, Brazil, Chile, Colombia, Guatemala, and Uruguay presented the research work they had conducted for the 2022 IVSS. During the event, there was a rich exchange of questions, ideas, and proposals for collaboration between schools from other countries.

EDUCATION

A variety of educational activities, meetings, and events occurred in various forms throughout the region, including:

- **Translation of GLOBE materials into Spanish:** In May 2021, with the goal of improving the quality of education in the region, the RCO translated GLOBE materials, including 31 presentation modules, six datasheet files, 74 evaluation tests, and three bonus material files (posters and graphics).
- "**Citizen Science and Butterfly Monitoring" Training:** In June–July 2021, GLOBE Argentina and GLOBE Peru organized an online training for teachers in the region, which was promoted by the RCO. Out of the 108 participants, 40 were certified as GLOBE teachers

- **Virtual Environmental Congress for Educators:** "How to Create Learning Opportunities in Environmental Education:" In October 2021, GLOBE Dominican Republic, together with the Ministry of Education of the Dominican Republic, participated in a virtual environmental congress for educators. This consisted of a series of conferences and presentations covering The GLOBE Program to train teachers, students, and citizen scientists.
- **"Trainer and Mentor Trainer Certification Process" Webinar:** In October 2021, the RCO and GLOBE Argentina organized a presentation. The goal was to inform the community about the new training process for trainers and mentor trainers, and to promote community participation in the training. There were participants from Argentina, Bahamas, Brazil, Colombia, Dominican Republic, Ecuador, Guatemala, Mexico, Panama, Paraguay, Peru, Uruguay, and Trinidad and Tobago.
- **"Escola Virtual" Trainings:** In September–November 2021, GLOBE Brazil, with the help of the RCO, created an online platform called "Escola Virtual" to offer online training for teachers. GLOBE Brazil hosted "Workshop GLOBE Brazil 2021," a workshop for teachers that focused on the program's app, GLOBE Observer. The goal was to encourage teachers to participate in the GLOBE IVSS. On 08 October, the RCO gave a presentation on the international scope of GLOBE, including how to carry out collaborative projects, how to contact GISN members, and how to submit projects to the 2022 IVSS.
- **Online Teacher Training (GLOBE Argentina):** GLOBE Argentina, with the help of the RCO, hosted an online training for teachers. During the training, 37 teachers learned about the application of the GLOBE protocols.
- **"Climate Change: Innovative Teaching" Contest (GLOBE Argentina):** In September–November 2021, GLOBE Argentina, in collaboration with the U.S. Embassy, organized a contest aimed at Argentine primary and secondary teachers. The goal of the contest was to promote the teaching of climate change by presenting an innovative plan for teaching the subject.
- **Pedosphere Workshop (GLOBE Uruguay):** In March–April 2022, GLOBE organized an online and a face-to-face workshop on pedosphere protocols. Seventy people participated in the online event. The workshop was accompanied by a face-to-face session, which was attended by 30 participants.
- **Atmosphere Workshops (GLOBE Peru):** In March–April 2022, GLOBE Peru hosted two workshops for teachers. During the training, 80 teachers learned about GLOBE's atmosphere protocols.

COMMUNITY

A variety of community activities, meetings, and events occurred in various forms throughout the region, including:

- **"Learning Together the What, How, and Why of The GLOBE Program" Workshop:** In February 2022, GLOBE Costa Rica, with the assistance of the U.S. Embassy, hosted a regional workshop presenting GLOBE as an effective public diplomacy platform to combat dengue, Zika, and other vector-borne diseases. The RCO hosted a presentation on the GLOBE Zika Education Project; the program's app, GLOBE Observer; and related planning for 2022. The webinar was attended by 45 participants, all from the U.S. Embassies in the region and regional Country Coordinators.
- **"Team Seas" Global Campaign (GLOBE Dominican Republic):** In October 2021, students from GLOBE Dominican Republic participated as volunteers in the "Team Seas" campaign, with Fundación Vida Azul. The goal was to collaborate in the elimination of 30 million pounds of garbage in the ocean to reduce the effects of climate change. During the campaign, GLOBE hydrology protocols were covered to inform participants, and the press, about the quality of the water both before the cleanup and for two weeks after the event.
- **"Science with a Positive Cause is the Way to Go!" (GLOBE Brazil):** In December 2021, GLOBE Brazil participated in the National Week of Science and Technology, which is an annual Science Exposition promoted by the Ministry of Science, Technology, and Innovation. Approximately 300 students and teachers from schools all over the country participated in the event. During the week, GLOBE workshops were held, which focused on teaching the students how to use the program's app, GLOBE Observer, to collect data.
- **Zika Bus (GLOBE Brazil):** In February 2022, GLOBE Brazil participated in the "Zika Bus" project, which is hosted by the Federal University of Paraná with the support of the Brazilian Space Agency. The "Zika Bus" is a lab that travels to Paraná's coastal schools, through which students are able to learn about mosquitoes and mosquito protocols. Approximately 200 students participated in Zika Bus activities.
- **Earth Day Celebration (GLOBE Colombia):** In April 2022, GLOBE Colombia hosted an event for schools throughout the country. During the celebration, students connected virtually through social media to celebrate the planet together, exchange ideas, and learn about the role of water in the Earth system.

Near East and North Africa Region Highlights

2021 REGIONAL MEETING

In November, the 2021 Near East and North Africa Regional Meeting was conducted virtually. The meeting was attended by Country Coordinators, Deputy Country Coordinators, teachers, students, trainers, and scientists from nine countries. Primary topics of discussion included: an overview of The GLOBE Program; updates from the region; training on the GLOBE website and on the program's app, GLOBE Observer; and training on the trainer and mentor training process. On the final day of the meeting, scientists and teachers from the region presented research and work related to The GLOBE Program, as well as to environmental progress in general.

During the meeting, students from around the region presented research and GLOBE-related activities completed during the year. There was a strong focus on collaborative projects conducted with teachers and students from throughout the region. In addition, outside "field day" activities took place in the countries participating in the meeting. Within the countries, students went outside and took GLOBE measurements and collected data, which were later entered into the GLOBE database. Students documented their trips with notes and videos, which were shown during the meeting.

TOPICAL HIGHLIGHTS FROM THE REGION

As always, the Regional Coordination Office (RCO) encouraged, supported, and hosted (virtually) numerous events (meetings, training, activities, field studies, and research efforts) during 2020–2021. The items listed below are only to serve as "highlights" of the region's ongoing, dedicated, work.

SCIENCE

Various forms of science activities, meetings, and events occurred throughout the region, including:

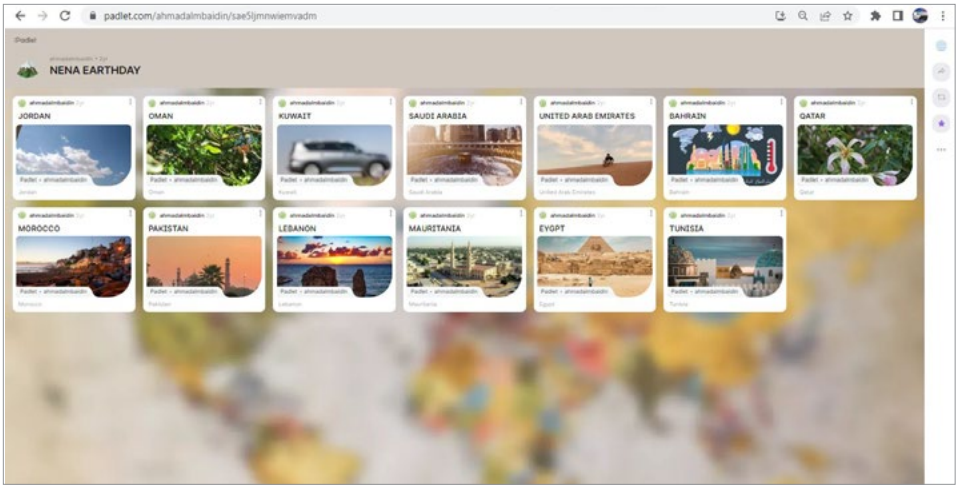
- **Environmental Games (GLOBE Jordan):** In April 2022, GLOBE Jordan hosted an online event focusing on learning/experiencing and using GLOBE protocols at the Al Chouf School. Several schools from the country gave presentations on their GLOBE-related environmental science activities. Discussions were held about future endeavors related to research and GLOBE protocols.
- **GLOBE Science Fair:** In April 2022, countries throughout the region participated in an Earth Day GLOBE Science Fair. There were interactive discussions (along with science and art activities related to science) focused on GLOBE-related science activities within the region. The goal was to foster a deeper understanding of climate change and research to help avoid the challenges resulting from climate change.

EDUCATION

A variety of educational activities, meetings, and events occurred in various forms throughout the region, including a "Clean Up the World" Day in September 2022. During this event, 30 students from King Abdullah II School for Excellence (GLOBE Jordan) visited the city of Aqaba to clean the beaches. The event, which was covered in area television stations, newspapers, and in social media, focused on GLOBE hydrology protocols. The GLOBE students served as representatives of the program in the region during the event, which gathered together 22 international institutions focused on the larger goal of environmental stewardship of Red Sea waters.

COMMUNITY

A variety of community activities, meetings, and events occurred in various forms throughout the region, including Earth Day 2022 celebrations. For this celebration of the Earth, and The GLOBE Program's anniversary, the RCO coordinated with all the countries of the region to host an interactive online event. Teachers, students, scientists, and Country Coordinators from Bahrain, Jordan, Kuwait, Lebanon, Qatar, Saudi Arabia, and the United Arab Emirates engaged in the celebrations. Preparations for the event were made with the Jordanian Ministry of Environment and the Ministry of Education. There were discussions and presentations from the countries in the region throughout the day.



North America Region Highlights

2021 REGIONAL MEETING

In October, the 2021 North American Regional Meeting (NARM) took place virtually, via Zoom. The theme of NARM was "Adapting to a Changing GLOBE," which is a continuation of the theme from the 2021 GLOBE Annual Meeting. Partners, sponsors, RCOs, and GIO staff registered for this event from across the United States and Canada, with a total of 71 participants. The NARM featured eight unique sessions, including working sessions on partner onboarding and affinity groups. In addition, 10 lightning talks were presented, and 14 Partners introduced their partnership and collaboration goals in a GLOBE Exchange session.

During the meeting, working sessions, facilitated by the U.S. Partner Forum and others, focused on the onboarding process for new partners and providing affinity group breakout sessions. A total of 39 speakers and facilitators contributed to the success of this event.

TOPICAL HIGHLIGHTS FROM THE REGION—UNITED STATES

As always, the United States GLOBE Office, encouraged, supported, and hosted (virtually) numerous events (meetings, training, activities, field studies, and research efforts) during 2021–2022. The items listed below are only to serve as "highlights" of the region's ongoing, dedicated, work.

SCIENCE

A variety of science activities, meetings, and events occurred in various forms throughout the region, including work by the GLOBE U.S. Coordination Office to increase the participation level of STEM professionals. In 2021, the GLOBE U.S. Coordination Office focused on mentorship provided by U.S. members of the GLOBE International STEM Network (GISN) North America region. North American GISN members volunteered for this mentorship program by filling out a survey about the types of interactions they would like to have with students and other (optional) details to better match them with students, including research areas, life experiences, and demographic data. A pilot program was launched in the fall of 2021 with a registration survey for educators seeking to be matched with GISN U.S. STEM professionals that collected information about grades and subjects taught, learner populations, educator demographics, and expectations of the mentoring program. All educators who responded to the registration survey were matched with one or more GISN mentors.

EDUCATION

A variety of educational activities, meetings, and events occurred in various forms throughout the region, including:

- **Materials and Resources/Natural Inquirer and GLOBE Project:** The GLOBE U.S. Office is coordinating a crosswalk between issues of the Natural Inquirer and The GLOBE Program protocols and learning activities. The products are created by educators and partners and are posted to the GLOBE website and social media accounts.

- **Professional Development:** In April 2022, the U.S. GLOBE Office provided in-person GLOBE training for approximately 70 specialists (trainers) in Alabama. A group of four GLOBE partners/trainers from across the country provided the Earth systems-themed, two-day workshop. This was a follow-up workshop from a virtual two-day training provided to the same specialists in April 2021
- **2022 Student Research Symposia (SRS):** The U.S. GLOBE Office managed the regional SRS, which give students and educators an opportunity to share the results of their GLOBE scientific research projects, get feedback from knowledgeable reviewers, engage in peer review, and participate in experiential learning activities. Due to the ongoing pandemic, the 2022 SRS in-person regional events were cancelled. In April–May 2022, the U.S. Coordination Office instead supported local, in-person, one-day SRS. During these, 210 students presented 68 GLOBE research projects at seven different events. In addition to in-person SRS, the Midwest Earth System Science Collaborative held a Virtual Science Symposium in May 2022 that was attended by 60 students (Grade 3–12).
- **Student Investigations:** Along with the combined 270 students that participated in SRS or the Midwest Virtual Science Symposium, 185 students submitted a total of 63 research projects to the 2022 IVSS.
- **Evaluation—Publications and Communications:** In 2022, 13 news stories were published about GLOBE partnerships and the local SRS; in addition, there were articles featuring U.S. GLOBE community members, including teachers, partners, and STEM professionals. Forty-nine GLOBE presentations were presented at the American Geophysical Union Fall Meeting. A total of five videos were submitted to the "2022 STEM for All Showcase" that highlighted GLOBE.

COMMUNITY

A variety of community activities, meetings, and events occurred in various forms throughout the region, including:

- **Community Growth:** The Southern Louisiana Partnership became a new GLOBE Partnership.
- **Interactions and Collaboration:** In 2021–2022, the U.S. GLOBE Office held 22 virtual Watercooler meet-ups. The goal of the Watercoolers is to provide an informal opportunity for GLOBE teachers, partners, and community members to connect and share ideas. Over the course of the year, there were 97 unique participants, with between six and 19 participants attending each event. Watercoolers covered a broad range of topics from partnership/project updates to student-centered opportunities and networking. The highest attended events fell into the categories of virtual trainings, facilitated work sessions, and accessibility.
- **U.S. GLOBE Partnership Yearbook:** The U.S. GLOBE Office created an annual Yearbook, with one page for each partnership, to share their annual GLOBE accomplishments. The final products are available on the United States webpage.
- **U.S. Regional Newsletters:** U.S. Partner Forum members worked with the U.S. GLOBE Office to create six versions of a regional newsletter (one for each region), plus a NASA-focused version by the NASA representative. These are emailed quarterly to the GLOBE partnerships in the geographic regions of the United States. Each newsletter features one or more regional highlights and a "Partner of the Month" item.

TOPICAL HIGHLIGHTS FROM THE REGION—CANADA

As always, the Canada GLOBE Office, encouraged, supported, and hosted (virtually) events (meetings, training, activities, field studies, and research efforts) during 2021–2022. The items listed below are only to serve as "highlights" of the region's ongoing, dedicated, work.

SCIENCE

Various forms of science activities, meetings, and events occurred throughout the region, including:

- **Forestry Course/Carbon Sequestering:** Liard First Nations (Yukon) developed a forestry training program for community members. The program involved understanding the amount of carbon stored in trees, which included sampling a number of trees within a representative sample of the stand. The species of tree was identified; the diameter at breast height (DBH) was recorded; and the height was measured, along with the age of the tree. The Canadian Forest Services web site provides the above ground mass of a tree using this data. Throughout these field activities, students learned several different forestry assessment skills. On the first day they selected sample plots near their community. On the second day a different ecosystem was sampled. Collectively, the knowledge and skills acquired throughout the exercise provided students with a greater understanding of the role of forests as carbon sinks.
- **Community Science Liaison (CSL) Program:** A variety of science activities, meetings, and events occurred in various forms throughout the region, including work on the Community Science Liaison (CSL) Program. The goal of the CSL research collaboration program (proposed by scientists in the

pan-Canadian Earth-System Observing Network—Réseau d'Observation du Système terrestrE) is to increase community engagement in the sciences. Scientists work with the CSL teams to design hands-on, experiential, place- and curriculum-based citizen science projects for kindergarten to grade 12 (K-12) classrooms parallel to the scientific programs, such as GLOBE and EON-ROSE.

EDUCATION

A variety of educational and community-focused activities, meetings, and events occurred in various forms throughout the region, including:

- **Yukon First Nations Education Directorate Training:** This year, the Yukon Territory, in recognizing the 49th anniversary of "Together Today for Our Children Tomorrow," announced the official establishment of the Yukon's First Nation School Board. The Yukon First Nation School Board Agreement was signed by 10 Yukon First Nations in June 2021; it allows for the creation of a First Nation School Board using the processes outlined in the Education Act. Although there is still much work ahead, this is an exciting and important educational system model that allows Indigenous and non-Indigenous partners to continue to work together to advance reconciliation and make meaningful changes for the betterment of all students throughout the territory.
- **GLOBE Training:** GLOBE educator Bob Sharp provided extensive professional development and teacher training regarding a number of GLOBE protocols, measurements, and learning activities that represented GLOBE Canada's commitment to integrating Indigenous and Western knowledge through place and land-based teaching and learning.

COMMUNITY

A variety of community activities, meetings, and events occurred in various forms throughout the region, including participation in local and regional meetings, including the NARM, with GLOBE community members to provide, and receive, GLOBE Canada, GLOBE program, and GIO updates.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- Cameroon
- Cape Verde
- Chad
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- Ethiopia
- Gabon
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- Ghana
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- Kenya
- Liberia
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- Micronesia
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- Sri Lanka
- Taiwan Partnership
- Thailand
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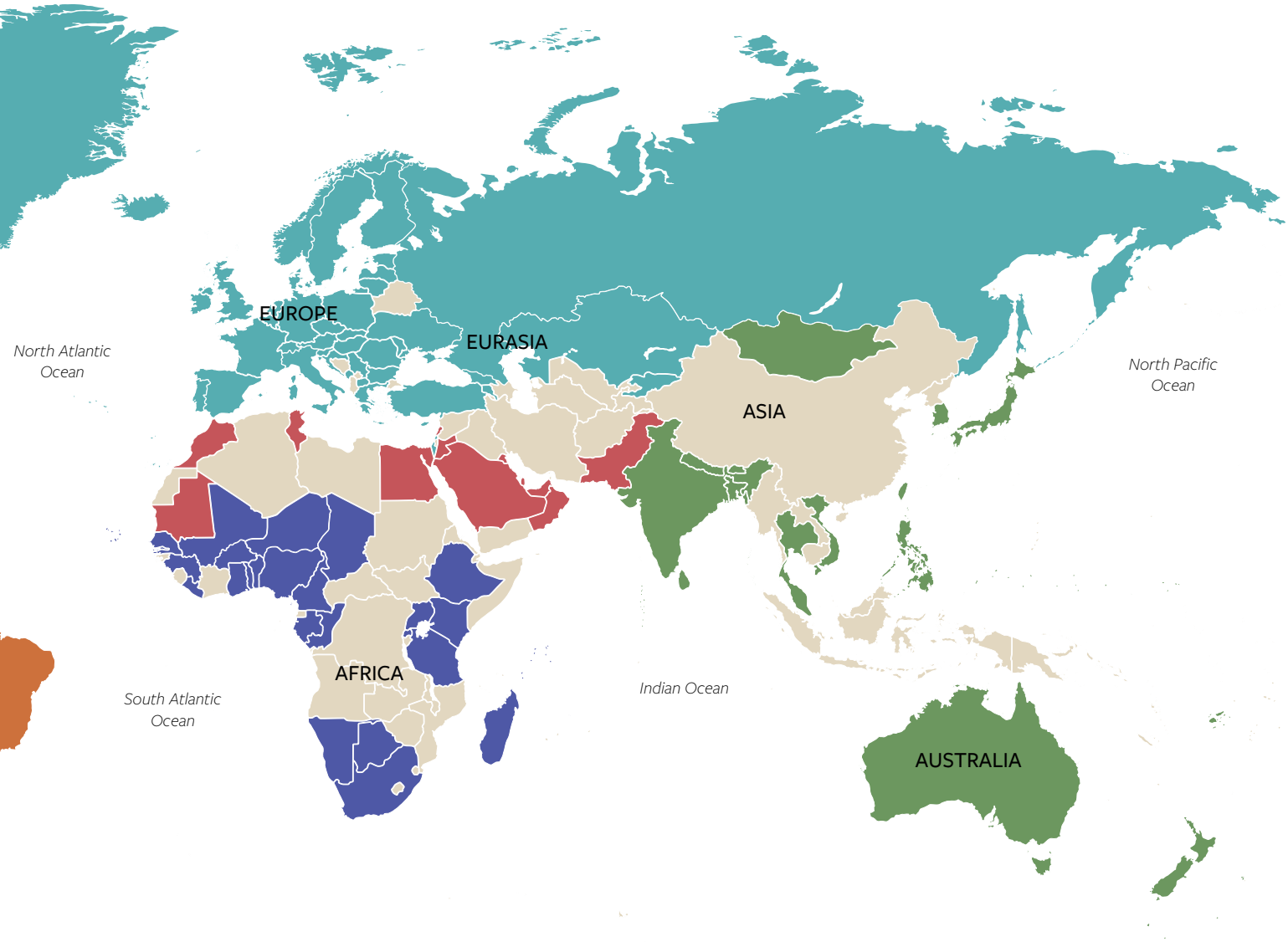

The Annual Review can be found online at www.globe.gov/about/annual-reviews

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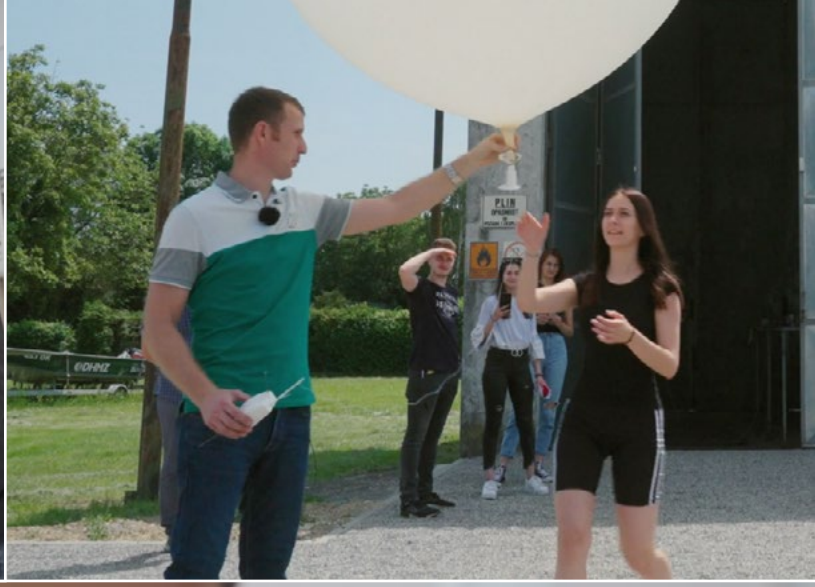
- Bahamas
- Bermuda
- Bolivia
- Brazil
- Chile
- Colombia
- Costa Rica
- Dominican Republic
- Ecuador
- El Salvador
- Guatemala
- Honduras
- Mexico
- Panama
- Paraguay
- Peru
- Suriname
- Trinidad and Tobago
- Uruguay

NEAR EAST AND NORTH AFRICA

- Bahrain
- Egypt
- Jordan
- Kuwait
- Lebanon
- Mauritania
- Morocco
- Oman
- Pakistan
- Qatar
- Saudi Arabia
- Tunisia
- United Arab Emirates

NORTH AMERICA

- Canada
- United States of America



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