



The **GLOBE** Program

Framework and Roadmap for Inspiring the Next Generation of Explorers

FY 2004 - FY 2008 & Beyond



July 20, 2004



Foreward: New Horizons

GLOBE is a remarkable and unprecedented collaboration of thousands of individuals worldwide – primary, secondary, and tertiary students, teachers and teacher educators, scientists, government officials, and others – to improve education and reach a more complete understanding of the Earth System.

We are at a watershed in the history of GLOBE. October 1, 2003, the University Corporation for Atmospheric Research (UCAR) signed a Cooperative Agreement with the National Aeronautics and Space Administration (NASA) to take over administration of the Program in partnership with Colorado State University (CSU). As we enter this next phase, we must all strive to retain the best ideas, practices, and models from GLOBE's long and successful history, but we must also seize the opportunity this transition offers to collectively rethink how best to conduct GLOBE.

This document presents a framework and roadmap to achieve measurable and meaningful enhancement and expansion of GLOBE toward that vision over the next 3 to 5 years and beyond. This plan sets an agenda for wise investment of finite resources through the achievement of goals in four interrelated areas – Education, Partnerships/Outreach, Science, and Systems, with sustainability weaving together these areas to ensure the long-term future of GLOBE.

Throughout this plan, we have emphasized quality over quantity. We believe that GLOBE has reached a period in its history in which consolidation of past efforts is necessary to build for the future. We will shift from recruiting and training large numbers of new Partners, teachers, and schools toward providing greater support services and resources in order to improve retention and long-term participation. We will also work hard to reengage inactive GLOBE Partners, teachers and schools. Likewise, we will emphasize building stronger relationships within the scientific community, generating more scientific use of GLOBE data, and strengthening existing protocols rather than further promoting the creation of new protocols. Our focus will also shift to those protocols that have the highest degree of scientific and classroom utility while still providing support and networking opportunities to GLOBE schools implementing the full range of protocols.

I thank all of the GLOBE community members who helped shape this document and who will be essential to the achievement of its goals. The UCAR/CSU GLOBE Team is proud to be working with you, our United States and International Partners, and with NASA, NSF, the Department of State and other GLOBE sponsors and friends. With your help, we will successfully chart the future of GLOBE as we voyage to new horizons. We look forward to your continued participation in this process, and your ongoing contributions to the Program.

Craig Blurton, Ph.D.
Executive Director

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I. Introduction

GLOBE is an on-going international science and education program that unites students, teachers, and scientists in the study of the Earth System. Students participating in GLOBE engage in hands-on activities, including the collection and analysis of research quality scientific data. They interact with members of the science community who use the data collected from locations around the world in their



research – data that would often not be available otherwise. Students benefit from GLOBE by gaining a better understanding and appreciation of Earth System science and improve their achievement in science, technology, engineering, and mathematics. GLOBE also provides teachers with important professional development opportunities and a context for applying inquiry in science education. As of July 2004, over 25,000 teachers in more than 15,000 schools from 106 countries have participated in GLOBE workshops. GLOBE students enter their measurements via the Internet into an openly available database that is accessible not only by GLOBE students, but also by scientists and educators worldwide. To date, students have reported data from over 11 million GLOBE measurements from around the world.

The purpose of this Plan is to capture and communicate our vision and planning for GLOBE for the next 3 to 5 years and beyond. The document begins with a review of GLOBE's history and a statement of our Vision, Mission, Goals, and Objectives. Then specific plans in the areas of Partner Support, Education, and Science are outlined, followed by a brief discussion of program evaluation. This plan, like the program it describes, is dynamic in nature. We will continuously strive to incorporate the best ideas and adapt to best serve the community.

II. Background and History

The GLOBE Program began operations in April 1995. At that time, the program was supported by a group of U.S. Government agencies including the National Oceanic and Atmospheric Administration (NOAA), the National Aeronautics and Space Administration (NASA), the National Science Foundation (NSF), the Environmental Protection Agency (EPA), and the Departments of State and Education. The GLOBE Program developed and provided the measurement protocols and science research teams, the educational and training materials including a Teacher's Guide, and the GLOBE database and Web site. Other countries were invited to participate in GLOBE and those that were interested agreed to be responsible for the funding, implementation, and operation of the GLOBE Program in their country under the leadership of a designated Country Coordinator. GLOBE provided training for GLOBE Trainers in the partner countries as well as access to the GLOBE-developed materials and Web site, but the countries themselves were and are still responsible for adapting and delivering the program in the most appropriate way for their schools.

GLOBE initially provided training and support directly to teachers in the U.S. As the number of GLOBE schools in the U.S. began to grow, it became clear that it was not possible for the Program to continue this model for direct teacher training and support. The Program sought to develop agreements with groups to give them responsibility for the recruiting, training, and ongoing support of teachers in their area, similar to the role of international Country Coordinators. These groups, originally referred to as franchises and now known as GLOBE U.S. Partners, function in a way similar to that of our international partners. They are responsible for the schools in their area and GLOBE provides them with training, inquiry-based materials, and other Partner support. This model, in which a centralized GLOBE Program Office provides the program content to partners who in turn adapt and deliver the program to schools and communities, is now a fundamental aspect of GLOBE's organization, and is illustrated in Figure 1.

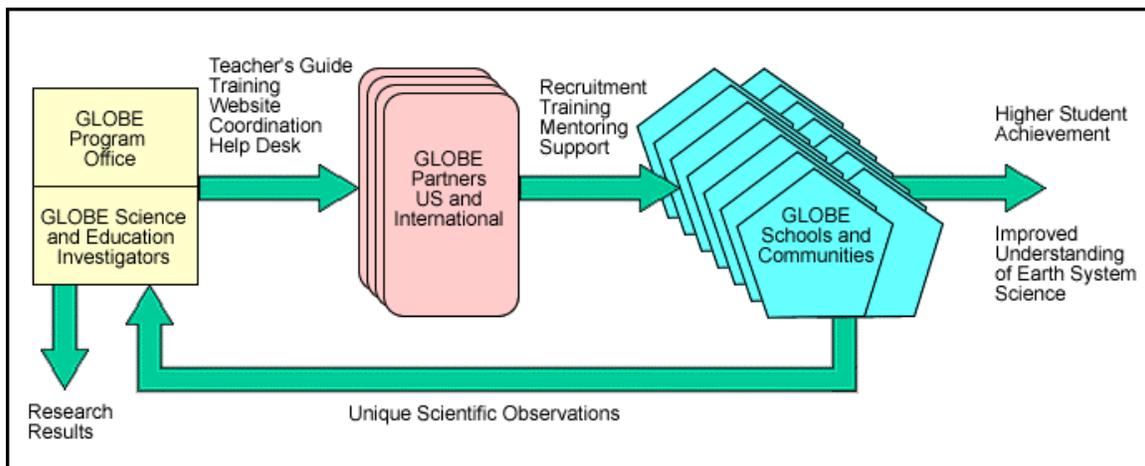


Figure 1 - GLOBE Reaches Schools and Communities Through its Partners

In 2002, NASA assumed the role of lead agency for GLOBE. Soon after assuming that role, NASA chose to select an outside organization to take responsibility for the management of the GLOBE Program. The intent of this action was to generate competition for and innovation in the operation of the Program and to provide a structure where GLOBE could over time develop into a self-sustaining activity, independent of NASA funds. After a competitive selection process, NASA entered into a Cooperative Agreement with the University Corporation for Atmospheric Research (UCAR) and Colorado State University (CSU), who took over the management of the GLOBE Program effective October 1, 2003. GLOBE Science and Education investigations continue to receive funding from the U.S. National Science Foundation. Significant assistance in developing and maintaining relations with our International Partners is also provided by the U.S. Department of State.

Throughout its evolution, GLOBE has consistently provided value to its various stakeholders: students, teachers, educators, scientists, U.S. and International Partners, and supporting organizations. The UCAR/CSU team will build on the success of the GLOBE Program and develop new innovative approaches to strengthen our network of schools and communities, produce more quality scientific data and research results, and ensure the long-term operation and sustainability of the Program.

III. Strategy Elements

Vision and Mission

The heart of our Vision for the GLOBE Program is an integration of education and scientific research where everyone contributes and everyone benefits. Students, teachers, and scientists work together in the community to understand and appreciate the world around them. GLOBE supports scientific research, promoting our understanding of the Earth as a system and building our knowledge to address and solve important societal problems. GLOBE students from different countries and cultural backgrounds learn to work closely and effectively together in the field and classroom. GLOBE enriches these students, giving them the knowledge and skills that they will need to become informed citizens and responsible decision-makers in an increasingly complex world.

Vision:

GLOBE students, educators, scientists and communities around the world work together to improve education, achieve a more complete understanding of the Earth System, and enhance environmental awareness.

The Mission of the GLOBE Program is to realize this Vision through an international network of scientists, educators, students, and community members. GLOBE is at its heart a creator and supporter of learning communities. GLOBE provides an infrastructure that has spawned a worldwide network of Partners and other affiliated organizations. These learning communities come in many forms, but they are common in their commitment to the enhancement of scientific understanding and educational opportunities in both formal and informal settings. What sets GLOBE apart from many other programs is its strong tie to the science community and the direct participation of schools in the collection of quality, long-term datasets.

Mission:

GLOBE is an international science and education program that brings together students, teachers, and scientists:

- To support improved student achievement in science, technology, engineering, and mathematics
- To gather important data for the global Earth Science community

Goals and Objectives

Our concept of GLOBE's future is supported by the following four interrelated goals and their objectives.

GOAL 1 [The Partner Support Goal]: SUPPORT AND EXPAND THE EXISTING NETWORK OF SUCCESSFUL GLOBE PARTNERS

- **Objective A:** Continue the development and support of mutually beneficial partnerships with organizations and institutions implementing GLOBE
- **Objective B:** Promote the development of local, regional, and international collaborations that bring together GLOBE Partners, GLOBE Schools, businesses, universities, government agencies, scientists, parents, and other community members to explore areas of common interest and concern

- **Objective C:** Work with existing and new partners on initiatives to support traditionally underrepresented students in science, technology, engineering, and mathematics education.

GLOBE achieves its goals through partnerships with over 100 countries and more than 150 U.S. entities, including multiple research partnerships with universities. We will continue to promote a concept of GLOBE Learning Communities as a sustainable model for implementation for our Partners and positive impacts for our communities. Support for U.S. and International Partners will now be handled under one single Partner Support Team. We will use a matrix approach to partner support and encourage our Partners to work directly with the individual staff members that can best address their unique needs. We will improve our online tools to track partner requests and ensure that they are receiving the help and recognition they need. GLOBE is proud of its history of supporting diverse partner, school, and student communities, and we will continue our efforts to target underrepresented groups.

GOAL 2 [The Education Goal]: DEVELOP AND PROVIDE EDUCATIONAL MATERIALS AND WORKSHOPS THAT HELP PARTNERS AND TEACHERS EFFECTIVELY IMPLEMENT GLOBE

- **Objective A:** Develop a high quality GLOBE Trainer Certification Program merging the strengths of face-to-face workshops and online courses.
- **Objective B:** Provide opportunities for professional development for GLOBE Partners, trainers, and teachers through additional online courses.
- **Objective C:** Develop and maintain educational resources, including the GLOBE Web site and Teacher's Guide, that can be adapted by partners to local needs in areas such as program implementation, curriculum integration, alignment to standards, and classroom logistics.

GLOBE In Action

The GLOBE students and teacher from Louis Armstrong Middle School transformed a trash-strewn vacant lot into a viable GLOBE study site. They cleaned up the area and, with the help of the New York City Parks Department, planted native trees and shrubs, set up their weather station and are now designing and building a pond. With help from Consolidated Edison Company of New York, which helps fund New York City GLOBE training and activities, and KeySpan Foundation, which helps fund activities and training in Nassau and Suffolk counties, the Queens College GLOBE-New York Metro Partnership is working hard to get the word out about GLOBE and to train and support more teachers in the New York Metropolitan Area.

"We know how important it is for students to experience the scientific process and to engage in authentic scientific investigations," New York City Department of Education official Greg Borman said. "GLOBE provides exactly that. The students are generating their own data, which are really going to be used or analyzed by scientists. They are doing something that is important, and which may have a strong impact on environmental planning. The students see the connection between data and generating questions to explore, drawing conclusions, and making predictions. They begin to understand the need for standardization and the use of accepted protocols."

A young student put it another way: "I now see pictures in textbooks and can say, 'I saw that outside,' whereas before, the picture didn't mean anything to me."

A new model for certifying GLOBE trainers being piloted in the U.S. will feature a combination of extensive online distance learning materials and focused face-to-face workshops. This will provide continuing support and guidance to trainers throughout their participation in the Program. We also recognize that teachers won't continue to use GLOBE unless it helps them meet their classroom objectives. We will work with our Partners, teachers, and educators to make GLOBE easier to integrate into classroom activities and the curriculum. We will also work with our Partners to find ways to reengage inactive GLOBE teachers and schools. Ultimately, we strive to improve the quality of education for all children and to create new opportunities for all members of our diverse student population to develop a lifelong interest in science through first-hand experience.

GOAL 3 [The Science Goal]: PROMOTE WIDESPREAD USE OF GLOBE DATA IN BOTH SCIENCE AND EDUCATION

- **Objective A**: Improve GLOBE data quality and coverage.
- **Objective B**: Promote GLOBE data use in both scientific research and classroom investigations.

The uniqueness of GLOBE lies in the collaborations that have arisen in which students, educators, and scientists work together to contribute to our scientific understanding of the Earth. We will encourage scientists to use GLOBE data and emphasize strengthening existing protocols over the creation of new protocols. We will focus our efforts on providing greater support to protocols that have the highest degree of scientific and classroom utility, while still providing support and networking opportunities to GLOBE schools that may have particular affinity to less frequently used protocols due to their alignment with their unique weather, geographical location, or local environmental conditions. GLOBE data quality will be enhanced through a combination of improved online data checking, Principal Investigator and science team review of datasets, increased classroom use of data and visualizations, and improvements in training and training materials. A strong priority will continue to be community-based projects that use GLOBE data to better understand the local, regional, or global environment. The GLOBE One field campaign will be a model for this and should result in multiple refereed journal publications.

GOAL 4 [The Sustainability Goal]: DEVELOP A BROAD BASE OF PUBLIC, NON-PROFIT, AND PRIVATE PARTNERSHIPS THAT ENSURES THE SUSTAINED LONG-TERM OPERATION OF THE PROGRAM

- **Objective A**: Develop relationships with private and non-profit organizations aimed at sponsorship for GLOBE materials, events, and infrastructure.
- **Objective B**: Continue to work with government agencies in the U.S. and abroad with common interests in educational outreach and reform and scientific research and advancement.

Sustainability is an overarching component of the GLOBE Program. It is of paramount importance that we continue to provide a high quality program infrastructure, against which U.S. and International Partners can leverage local and regional investments to

support their own implementation activities. The highest priority for initial GLOBE sustainability efforts is thus to secure additional partnerships to ensure the success of current GLOBE program infrastructure activities. A plan to address long-term program sustainability will be developed during 2004 with input from the GLOBE Advisory Board, the Sustainability Working Group, and other key constituents within and external to the program. Again, we will look to local, regional, and global communities to build the relationships required to achieve sustainable programs at all levels.

Detailed plans for Sustainability will be outlined in a separate Sustainability Strategic Plan.

IV. Partner Support

GLOBE International and U.S. Partners are the primary customers of the GLOBE Program Office's products and services. It is through our Partners that the GLOBE Program is delivered, and as such it is only through the success of our Partners that we are successful. The overall intent of the Partner Support activities is to help Partners become more effective in their recruiting, training, and supporting of GLOBE schools and in building community support for their local GLOBE efforts.

Developing and Supporting Partners

Creating and maintaining mutually beneficial Partnerships with organizations that implement GLOBE are the central functions of the Partner Support team. GLOBE will improve the recruiting and orientation process for new Partners to better help them build successful Partnerships and to establish agreed-upon expectations for what both GLOBE and the Partner will do. GLOBE Partnership agreements will be reviewed on a yearly basis to ensure that both sides of the agreement continue to benefit.

Support for International and U.S. Partners will now be handled under one single Partner Support Team consisting of a Director for both International and U.S. Partnerships, a Deputy Director, and Regional Directors serving as the desk officers for the countries in their respective regions. The regions have been divided into the following categories: Africa; the Middle East; the Caribbean, Latin America, and Mexico; Russia and the Commonwealth of Independent States; Asia and the Pacific; Eastern, Central and Western Europe; Canada; and the United States of America. In addition to serving the Partners in their regions, the entire Partner Support Team will be involved in specific crosscutting outreach programs to meet the needs of our diverse partners. GLOBE will continue to organize annual Partner conferences for U.S. and International Partners, and will work with our partners on future GLOBE Learning Expeditions.

A new support model is being implemented to support our U.S. Partners. This model includes providing our U.S. Partners with direct access to the expertise of the entire GLOBE team at UCAR and CSU, consisting of a diverse group of scientists, educators, and technology specialists. Instead of working through a Partner Liaison, U.S. Partners can now work directly with over 30 different specialists to obtain assistance with their programmatic needs. After a pilot phase, we will work with our International Partners to evaluate the effectiveness of this approach and determine whether it is applicable and beneficial to them. In the mean-time, support to our International Partners will continue to be handled through the Regional Directors, drawing on the same expertise within the program.

A Partner Support Accountability System is being created to ensure that Partner's needs are being met with respect to both substance and timeliness of responses to their questions. The Partner Support Accountability System will consist of a database that will track Partner requests for support and the status of our responses to these requests. The Director for Partnerships will monitor the status of all open requests and ensure timely

response. Other planned improvements include the restructuring of the Partner Support pages of the GLOBE Web site to provide better access to support materials, the creation of a Partner Administration Manual for the online Administration pages, and the development of an Auto-Generated Response System to support Help Desk efforts. The Partner Support team will also work with our Partners to develop cost-effective strategies for the translation of GLOBE materials into the six U.N. languages.

Promoting the Development of Local, Regional, and International Collaborations

GLOBE LEARNING COMMUNITIES

The GLOBE Learning Community (GLC) concept is an extension of the Partner model that supports and encourages the participation of a broad range of community members in the implementation of GLOBE. A GLC is a group of diverse elements, with broad expertise and resources, who share a common commitment to supporting teachers and students in the implementation of GLOBE in their community for the benefit of their community. For example, a GLC might begin as a GLOBE Partner based at a university working with teachers and students from primary and secondary schools in the local school district, and then branch out to include parents, youth clubs, scientists, senior citizens, other colleges and universities, daycare centers, museums, businesses, government agencies and more. GLCs make learning and science relevant by focusing on the local and regional environment. GLCs also form an infrastructure that can help schools make a scientific contribution to the community by consistently collecting and reporting high-quality GLOBE data.

GLC development efforts will be focused on evolving current active Partners into more dynamic collaborations that perform a variety of activities including rich teacher support and follow-up, involvement of community volunteers, and outreach to business,

GLOBE In Action

Eight GLOBE students from four high schools in the Merced Union School District in California and their teachers spent an extraordinary two weeks of living, learning and gathering GLOBE data in a regional park in Mantova, Italy. The entire town was involved in an example of how GLOBE can help bring together a community. Ten Italian students and their teachers from Istituto Tecnico Industriale Fermi then returned with the Californians for two weeks to learn about life in America and to conduct GLOBE protocols in Yosemite National Park.

In Mantova, a semi rural town of elegant old buildings in the south of Italy, Italian and American GLOBE students used GLOBE protocols to study the local environment. "They really got to analyze the river and how it changes as it passes through," said Sandro Sutti, Italy's GLOBE country Co-ordinator and a high school science teacher. "For us it was also a social experience because we had so many acquaintances and local boards and volunteers. It involved the major institutions in the town and the parents."

In California, the students working together conducted GLOBE hydrology protocols in the San Francisco Bay and the Merced River. They used GLOBE land cover and soil protocols to help gauge the effects of prescribed fires on the carbon levels of the soil in Yosemite National Park and collected GLOBE basic and advanced data on atmosphere.

In both places, the GLOBE students studied the environmental impact of urban and industrial development on parks. Three years in the making, the exchange was a cooperative effort between the Environmental Science Academy's International Exchange with the University of California --a GLOBE Partnership, the GLOBE Program in Italy and a long list of public and private agencies in Italy and the US.

government and media. The first year of the project will concentrate on studying existing successful GLC models and developing products that will help Partners develop GLCs. A combination of site visits and telephone and e-mail interviews with 5-10 Partners will be conducted to collect information on current GLCs. Based on this and other research, we will develop and publish a GLC Toolkit to be disseminated broadly among Partners and other interested parties to help foster the evolution of Partners into the GLC model. In addition, we will provide updates through the Partner listserv alerting Partners to new ideas, collaborations, and funding opportunities. A Funding Toolkit will also be developed. In addition to these materials, we will develop and offer GLC Networking Workshops and Regional Workshops. GLC Networking Workshops will be focused on sharing ideas between Partners and delivering information on topics of common interest. Regional Workshops will be focused on local community building, discovering and nurturing regional resources, and developing common goals and objectives to form a GLC in a specific location.

GLOBE PRESERVICE EDUCATION

GLOBE seeks to strengthen existing Partner preservice institutions and initiate networks to expand GLOBE preservice education in science, technology, engineering, and mathematics, as well as social studies and language arts. GLOBE will promote GLOBE preservice education at institutions nationally and internationally, including at UCAR member universities. By engaging university faculty involved in teacher preparation, GLOBE has the opportunity to systematically impact large numbers of practicing teachers in the field. Research indicates teachers teach as they were taught. Preservice programs provide an avenue for long-term training and development of future teachers.

A Preservice Resource Guide, containing a compilation of currently utilized models of preservice education focused around GLOBE, will be developed. This document will also contain statistics on existing teachers who attended preservice GLOBE training regarding their current implementation of GLOBE in their classrooms and a summary of best and promising practices for GLOBE implementation in preservice education programs. The intent of this document is to show how GLOBE can provide an interdisciplinary preservice model that is replicable in many states. We will gather baseline information on successful established GLOBE preservice programs in the U.S. We will also seek to understand our International Partners' experience with preservice activities, share U.S. experiences in preservice activities, and support our International Partners' efforts in this area. Data collection for this guide will include phone and e-mail interviews, travel to selected partnerships, and follow-up surveys as needed to address additional questions. The guide will also incorporate data on GLOBE Program implementation documented by institutions of higher education participating in NASA Opportunities for Visionary Academics (NOVA).

Serving Traditionally Underrepresented Students In Science, Mathematics, and Technology Education

As a result of the international participation in the program, GLOBE naturally brings together a diverse group of students and professionals from around the world and

GLOBE is being used in thousands of schools serving diverse populations of students in the U.S.

In its role as U.S. Country Coordinator, GLOBE has entered into partnerships with several organizations serving underrepresented individuals (HBCUs, Native American Tribes and Tribal Colleges, MESA—Mathematics, Engineering, Science Achievement, and schools for the deaf). A Diversity Strategic Plan will be created to focus GLOBE activities to better serve these individuals. The plan will address retention of current U.S. Partners, recruitment of new U.S. Partners, development of GLOBE Learning Communities, outreach to preservice institutions, and support of our nation's growing number of English Language Learners (ELLs). The Diversity Strategic Plan will be geared to reach out to more organizations for under-represented groups such as the Women in Science and Engineering (WISE), the Society for the Advancement of Chicanos and Native Americans in Science (SACNAS), American Indian Science and Engineering Society (AISES), as well as TESOL (Teachers of English to Speakers of Other Languages) and ACTFL (the American Council on the Teaching of Foreign Language), the two U.S. global education associations predominately serving as the only assistance networks for students of diverse language backgrounds found in the U.S. GLOBE could serve as the link for both organizations to facilitate ELLs to participate and excel in content areas of science, technology, engineering, and mathematics, as well as social studies, geography, and language arts in the K-12 curriculum.

GLOBE In Action

Preservice elementary education majors at the University of Idaho spend a semester studying the Paradise Creek watershed, utilizing GLOBE as part of their science preparation. Integrated Science (INTR 103) is designed for future teachers to expose them to inquiry-based science and provide an instructional model that is replicable when they become teachers.

The preservice teachers conduct a study of the local watershed from its source on top of Moscow Mountain to its confluence with the Palouse River (approximately 25 km). The students collect hydrology and landcover data and utilize historical GLOBE data from previous classes and other sources to monitor and record changes in the creek. Students create a scientific poster as their final class project and present them as if they were attending a scientific meeting. Students leave the course with a better understanding of the science enterprise and improved measurement and communication skills.

V. Education

The Education Team oversees GLOBE education activities including GLOBE trainer certification, development of online courses, and development of instructional materials, and provides educational expertise where needed throughout the program. The overall strategy of the Education Team is to provide high quality instruction, materials, and support that will enable GLOBE Partners, Trainers, and Teachers to convey the intent and the integrity of GLOBE as a science and education program to a variety of audiences with a special emphasis on enhancing the knowledge and skills of classroom teachers. A number of common themes will be woven throughout activities, including viewing the Earth as a System, protocol implementation, classroom integration, standards alignment, and inquiry based instruction.

To better meet the evolving needs of GLOBE Partners and Trainers, the GLOBE Professional Development Institute (GPDI) has been formed. The GPDI is responsible for the U.S. GLOBE trainer certification process and the development of face-to-face and online instruction. In the context of the GPDI, the term ‘professional development’ goes beyond the traditional reference to classroom teachers to also encompass the continued knowledge and skills enhancement of GLOBE trainers, and where appropriate, GLOBE partners. This expanded view of professional development allows and encourages on-going learning and professional growth by diverse members of the GLOBE community. In addition, the Education team will provide critical input on the development of GLOBE educational materials such as the GLOBE Teacher’s Guide and GLOBE Web site and share educational perspectives and experience as appropriate with Partners and internal staff.

GLOBE Trainer Certification Program

A major component of the Education activities will be the GLOBE U.S. Trainer Certification Program (TCP). The TCP will certify new GLOBE Trainers through a three-part sequence that includes a prerequisite online Orientation course, a face-to-face workshop, and a post-requisite online Practicum course. The goal of the TCP model is to maximize the limited face-to-face time and provide critical follow-up support to new trainers. With the addition of a robust distance education component, a portion of the background material and protocol coverage will be shifted to the online Orientation, freeing up time in the face-to-face workshops to share essential information that is not as practical to teach online. Face-to-face workshops will emphasize practicing GLOBE protocols, learning how to facilitate inquiry-based student research that focuses on the Earth as a System, learning ways to teach data entry, data analysis, and the GLOBE visualization tools, and practicing leading a teacher training to refine presentation skills.

Individuals completing the TCP will have a solid understanding of both the value that GLOBE offers to their community and of their expected commitments to the GLOBE Program. Full participation in the TCP will contribute to meeting the educational and science goals of GLOBE.

Evaluation will be an integral and ongoing component of all aspects of the TCP. This will be especially important in the early stages of the TCP to identify and address barriers to successful implementation. An initial survey will be conducted prior to the deployment of the online courses to obtain base-level information on the participants. Formative evaluations will take place at each step of the way in the form of surveys, interviews, and observations of the learners and instructors. Summative evaluations will also be done at the completion of each stage of the TCP course to inform revisions and continual development.

While the TCP described here has been developed specifically to meet the needs of GLOBE Trainers and Partners in the U.S., it is the intent of the Education team to work with the GLOBE Partner Support team on the possible adaptation and/or adoption of all newly developed educational materials and methods for an international audience. Similarly, effective international educational materials and methods will be explored to promote the ongoing evolution of best practices within GLOBE in the U.S. In the meantime, the current successful model for international Train the Trainer workshops and international Trainer and Master Trainer certification will continue to be used.

GLOBE Professional Development Online Courses

GLOBE Professional Development Online Courses will be another significant effort within the Education group. The initial focus will be on the design, development and delivery of four different kinds of distance learning courses; the Orientation and Practicum Courses for the TCP, a Refresher Course for teachers and trainers, and Topic Specific Courses that may explore specific protocol areas, their possible environmental contexts, and the analysis of data using visualization and GIS tools. It is anticipated that by working with the other GLOBE teams and GLOBE Partners, additional needs and opportunities will be identified that lend themselves to the utilization of online courses. Input from the GLOBE Science PIs will be solicited on the portions of the online courses that directly cover protocol content or implementation.

GLOBE In Action

Successful GLOBE Students from Jefferson Middle School in Winston-Salem, NC, USA, are working with GLOBE Soil scientists from the NASA Goddard Space Flight Center on GAPS, a simulation model that investigates the soil-plant-atmosphere system. Teacher John Cardarelli's use of GLOBE Soils activities also provides benefits closer to home. Soil characterization is part of North Carolina's requirements for sixth-grade science, and Cardarelli finds GLOBE the perfect teaching vehicle.

In addition to his sixth-grade classes, Cardarelli uses GLOBE soil, hydrology and atmosphere protocols with his extra-curricular science club and with his "Envirothon" teams. The annual Envirothon is a national multiple-choice competition on soil, water, forestry, wildlife and "current environmental issues." Cardarelli's teams - made up of five students from the 6th, 7th, and 8th grades - made it to the state-level competition.

A \$1,000 grant from the John Muir Foundation got Cardarelli and his students the equipment they needed for their GLOBE protocols. Now he can envision expanding his students' work.

"The science in GLOBE is real and down-to-earth at the same time. It's a far cry from textbook learning and in brings the concepts to life," Cardarelli said. "It's great when it matches your curriculum. And we're happy that the scientists [at Goddard] are finding our data helpful."

The refresher course will incorporate much of the scope and sequence of the TCP. The refresher course will be open to GLOBE trainers, partners, and teachers. In addition to reviewing procedures for taking GLOBE measurements and entering data, the course will also provide practical information on classroom integration and implementation, designing age-appropriate research projects, standards alignment, assessment tools, and implementing GLOBE in non-classroom settings. GLOBE trainers will be encouraged to take an online refresher course every two years to maintain their GLOBE skills.

Topic specific courses will emerge in years two through five of the funding period. Tentatively, a focus group comprised of GLOBE partners, trainers, teachers, and science and education PIs, will be convened during the summer of 2004 to explore online opportunities. Topic selection will be guided by requests for follow-up enrichment courses by GLOBE trainers, partners, teachers, and scientists, identification of protocols that are in greatest use, and opportunities to extend new science content and technology. The contact hours and length of time course is offered will vary depending on topic being addressed.

The GLOBE online courses will be designed to take advantage of the web-medium, which works well for in-depth, thoughtful discussions of scientific concepts as well as teaching and assessment strategies. The online courses will include a combination of effective instructional strategies adapted for distance education, including specified content text and images, streaming or downloadable video clips, audio narrations, visualizations, and both asynchronous and synchronous communication tools such as email, discussion forums and chat rooms. The course design will be based on the most recent standards for best practices in distance learning education and professional development, and will take advantage of lessons learned from prior GLOBE and Partner distance learning activities. All online courses will undergo a rigorous review and evaluation process.

General Education Support

As GLOBE continues to grow to meet the needs of partners, scientists, and educators, it is likely that many opportunities will arise that require input and guidance from GLOBE education staff. Currently, education staff members are collaborating with GLOBE One to develop instructional materials and trainings for teachers associated with that project.

We will always work with our Partners to ensure that our materials are meeting their educational goals and meeting the needs of their teachers, students, and community. Classroom teachers will be sought to serve as consultants throughout the material development process. Education staff will work in concert with the rest of the staff to ensure that all print and on-line materials intended for educators are responsive to their needs. This includes such products as the Teacher's Guide and the GLOBE Web site. Working with the Systems group, we will ensure that appropriate technologies are used to enable and enhance the effective electronic delivery of GLOBE and related NASA data and information.

GLOBE Framework and Roadmap for Inspiring the Next Generation of Explorers

As GLOBE evolves, there is tremendous opportunity to conduct research that will benefit the science education community. This is a new direction for GLOBE and the Education staff will oversee education research projects to make certain high standards and appropriate methodologies are in place.

VI. Science

GLOBE has identified the following two science objectives: to improve GLOBE data quality and coverage and to promote GLOBE data use in both scientific research and classroom investigations. To address the first objective, we present means of improving the GLOBE dataset and making it more useful to the science community. Addressing the second objective involves identifying and developing opportunities for science-student-teacher collaborations that result in scientific publications, and advertising the data and opportunities in scientific venues. Both objectives will be addressed by efforts to firm up scientist-teacher-student collaborations. In many cases, responding to these challenges involves all groups in GLOBE, and we invite our Partners to join in the effort.

Maintaining And Enhancing Data Quality, Quantity And Continuity

The GLOBE Program Office Science Team will continue to follow the procedures developed by GLOBE to develop and oversee the GLOBE protocols. In addition, we will continue to act as an interface between the science Principal Investigators (PIs) overseeing the protocols and the rest of GLOBE in the development of the Teacher's Guide and other materials, removing sources of confusion, answering science-related Help Desk questions, and making sure that the materials are accurate and up to date. We will keep an inventory of instruments for training, ship instruments to TTT workshops as needed, assess new instruments, and work with vendors and Partners on instrument issues. The Chief Scientist Honor Roll will continue; but the reward structure will be reviewed to account for automatic data loggers.

In addition, the Science team will address the large number of protocols using a number of strategies. We will work with the Education Team to identify subsets of protocols that can be combined scientifically, by grade level, by geographic location, or according to cost, in efforts varying from trainings to data collection. We will promote the idea of GLCs providing a full suite of measurements by having different schools and community groups focusing on subsets of measurements. We will review our methods for accepting new protocols and look for ways to make their implementation more efficient.

Improving quality control and spatial and temporal coverage of GLOBE data increases the likelihood of its being useful to scientists and students. This objective will be addressed on several fronts. First, the CSU GLOBE PI team is examining and refining data quality checks and documenting error patterns. The Science Team will make error messages more student-friendly. The Science Team will continue work to ensure that the trainer certification process provides trainers and teachers with both the science and pedagogy skills necessary to implement GLOBE effectively and correctly in the classroom. Several means will be adopted to encourage students to see their data in context and to use it – including providing a popup map or graph for students see their data in context after a successful submission, developing or providing access to more print and on-line training modules on data analysis, and providing additional links to useful supplementary data. We will work with Partner Support to collect and disseminate

information on finding local scientists, weather services, etc. as mentors. We will continue to find opportunities to recruit schools and Partners in data-void regions.

Other supplementary activities include ensuring that information on how to obtain and share good observational sites be made available to schools, and examining the reward system to encourage good data collection and the use of automatically recorded data.

Promoting GLOBE data in Scientific Research

Our overall strategy to increase the use of GLOBE data in scientific research will include creating opportunities for GLOBE PIs and other scientists to work with GLOBE to use or collect needed data, and to seek GLOBE-related funding through normal science channels. In many cases, these efforts will involve collaborations between GLOBE PIs and other PIs, or new PIs seeking funding for GLOBE as the educational part of their proposal or to meet a scientific need.

While we wish to promote collaborations that produce publications in the reviewed science literature, the collaborations must still be designed to benefit the students and teachers as well as the scientists. Such collaborations will vary, but there are certain common needs – to obtain funding, engage local partners and schools, set up training, engage the community, etc. Science, with input from Partners and Education needs to produce a set of “how to” documents for scientists desiring to collaborate with GLOBE Partners or schools.

The Science Team will continue current efforts to expand the use of GLOBE data in scientific research. We will increase the pool of scientists using GLOBE data through

GLOBE In Action

Students and teachers from the Edmund Burke School in Washington, D.C. and the Realschule Cuxhaven in Cuxhaven, Germany, partnered with GLOBE Principal Investigator David Brooks on a research project to compare space-based data with ground-based data to assess the performance of aerosol retrievals. Their paper, entitled "Scientist-Teacher-Student Partnerships for Aerosol Optical Thickness Measurements in Support of Ground Validation Programs for Remote Sensing Spacecraft," is now a formally recognized publication of the International Astronautical Federation.

The students collected data using handheld sun photometers developed for GLOBE. They tried, whenever possible, to time their measurements to coincide with overflights of the NASA Terra and Aqua spacecraft which monitor how Earth's atmosphere, lands, oceans, solar radiation and life influence each other. Both of these spacecraft carry the Moderate Resolution Imaging Spectroradiometer (MODIS), an instrument that uses light reflected from the Earth/atmosphere system to infer aerosol optical thickness.

The Aerosol Robotic Network (AERONET) site at NASA's Goddard Space Flight Center provided professional measurements against which to compare student measurements taken by the students at Edmund Burke school. The German school site in Cuxhaven, a port at the mouth of the Elbe River on the North Sea, provided an opportunity to assess MODIS performance along coastlines.

Comparison of Burke data with AERONET showed no significant differences among those data sources. "This project demonstrated that the AOT values obtained from GLOBE sun photometers compare favorably with professional ground monitoring such as provided by AERONET," said Dr. Brooks. Data from Cuxhaven showed the same small positive bias in MODIS aerosol retrievals that has been observed at other coastal sites. "Thus, this work has demonstrated that GLOBE aerosol measurements can be used to help in the validation of MODIS measurements at sites where AERONET instruments are not available," said Dr. Brooks.

continued data improvements, advertising the data in scientific venues, and recruiting scientists through U.S. and international Partners. We will continue to foster ongoing efforts and look for new opportunities. Some of the ways in which scientists are beginning to use GLOBE data are through GLOBE PIs working locally with schools on a problem of local interest, GLOBE PIs teaming up to address the earth system at a specific location, as currently being done in GLOBE ONE, working as part of already existing field campaigns (e.g., the African Multiscale Multidisciplinary Analysis), and using GLOBE data to evaluate satellite data.

As time permits, we will explore and implement new strategies. A Rapid Reaction Science Team, as proposed by GLOBE PI Forrest Mims, would use the GLOBE Web site to ask students to take observations of specific environmental events, and then report the results. Also, we will encourage the use of GLOBE data by government agencies where appropriate, and look for opportunities to use GLOBE data to evaluate weather and climate models. We are receptive to new ideas from all members of the GLOBE community.

Firming up Scientist-Teacher-Student Collaborations

The efforts outlined above will require the efforts not only of the GLOBE Program Office, but help from GLOBE science PIs, Partners, teachers, and students. We will continue to meet with the GLOBE PIs at least once a year, and will begin to communicate more frequently with them regarding opportunities and our current efforts. We are working closely with the PIs on GLOBE ONE. We will continue to involve the PIs in evaluating new materials and trainer certification. Through field campaigns, we will provide opportunities for Partners to obtain instrumentation for their schools, and a cadre of scientists willing to work with schools and share field measurements with the students internationally. We will work with the rest of GLOBE to help find scientist mentors.

We will continue to provide incentives for teachers and students for their GLOBE efforts, and will expand efforts to let them know how their data are used. We will continue to develop opportunities for PI contact with schools through field programs, Web chats, and web-based publications. We will not only continue to encourage GLOBE students to analyze their data, but will promote GLOBE student participation in science fairs, through providing some science project ideas and offering awards. Partner Support should obtain information from Partners on GLOBE-related field days so that the practice can be used more widely.

It would be mutually beneficial for GLOBE and GLOBE Partners to team up with programs with complementary efforts. We are already actively exploring better collaborations with S'COOL and Space Grant schools. The Science Team will continue to explore these and form collaborations as time and resources permit.

VII. Evaluation

GLOBE is committed to enhancing and expanding the value that we provide to our Partners, teachers, students, and learning communities that implement GLOBE. We are also committed to providing value to our funding and supporting organizations, particularly NASA, who provides the largest single source of operating funds for GLOBE. To ensure that we are satisfying the needs of these various stakeholders, GLOBE will work with them to define specific metrics and use these metrics to quantify our performance and effectiveness.

Since the beginning of the GLOBE Program, SRI International has been funded to perform an annual independent review of the GLOBE Program. These reports have studied a variety of different aspects of the program including data reporting trends, classroom impact, and the impacts of various levels of Partner Support. We will continue to work with SRI to define appropriate assessment areas and to align their evaluations with the needs our customers.

As the main source of funding for GLOBE operations, NASA has a significant interest and stake in the GLOBE program. GLOBE represents an important part of the NASA Earth Science Enterprise's educational activities. We are pleased to be able to play such an important and visible role and will work hard to help NASA meet its goals in education and public outreach as outlined in the NASA Agency, Education, and Earth Science Enterprise Strategic Plans. These goals are well aligned to GLOBE's own goals and reinforce the natural fit and complementary relationship between NASA and GLOBE. We will continue to participate in annual NASA education program reviews and will use the 6 NASA Education Program Operating Principles in our ongoing internal review and assessment of the Program. We will provide GLOBE developed materials to the NASA Educational Product Review Process.