P1.7 **Incorporating Real-Time Data into the Classroom**
The Digital GLOBE Project: Visualizing a Sustainable Future

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1.1 ABSTRACT

This project has introduced participants to the GLOBE Program, an international K-12 environmental/science education program. Students and teachers throughout the world have been working since 1995 with Global Change Scientists in making scientific observations following strict protocols and sharing a database on the Internet. Data from these geo-referenced schools, which includes atmosphere, hydrology, soils, land cover and more, has been incorporated into this project. The Digital GLOBE Project grew out of a response to a national effort known as the Digital Earth Initiative, first introduced in 1998 as a possible user scenario. The Digital Earth-GIS Project can be viewed on GLOBE's Web page at www.globe.gov, under "School Collaborations." With nearly 50 U.S. and international schools participating, the Digital GLOBE Project has developed a true international K-12 learning community that can share and exchange data and ideas, which can be displayed through GIS. It is the intent of this project to have representation from at least one school from every country, so that GIS can be used as a common language and tool for the understanding, conservation, and preservation of Planet Earth. More recently, ground truthing data from the NASA S'COOL Project, an international atmospheric science project, has been incorporated into the dataset adding another layer of observations, but also can be used in conjunction with the GLOBE atmospheric observations. The sharing of data is of utmost concern to the science community, and collaborative inquiry-based learning with real-life applications is the current accepted practice in the science education community. This project represents how the educational goals of the science, technology, and environmental educational communities can be explored together in a real and practical way while introducing GIS to the next generation of learners.

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2.1 BACKGROUND

Over the past four decades information and data collected from satellites in space and other remote sensors, have presented volumes of information, satellite imagery and now computer visualizations that, for the first time in the history of Planet Earth, allows for scientists and educators alike to gain a new and unique perspective of our planet. The advantage of using remotely sensed data and imagery is that much can be learned about geographic locations, many which cannot be easily accessed, if at all. For the first time in human history, the entire surface of Planet Earth can be viewed, analyzed and interpreted. Scientists and educators have therefore, the capability of looking at the planet as a total global system, a sum of integrated systems, physically interacting in a constantly changing fluid and dynamic state. Students can begin to observe the Earth from both outside and *inside* the classroom. Using these new technologies, students can begin to *visualize* the future. An integration of well-established academic and scientific disciplines such as Meteorology, Oceanography, Geology and Biology can now be viewed in a systems approach that will lead to a deeper understanding of our planet and the impact of human activity on environmental processes rather then fragmented or reductionist approach This approach to science is called "Earth Systems Science' and is supported in most NASA and NOAA educational materials. While looking at the planet as an integrated system is not new for the environmental scientist, it did provide a new paradigm for many other scientific disciplines. Due to the ever-increasing availability of satellite data, a new role has emerged for students, that is "ground truth verification." Essentially the GLOBE Program is providing Global Change Scientists with valuable data that is not available through any other means. Another example for

the NASA community is the "S'COOL" project. In this project, students from around the world make daily cloud observations that aid in verifying satellite data and imagery. These observations are "geo-referenced", therefore making them importable into a GIS format.

"Science education itself is in the midst of a wide ranging reform movement in the United States. The geosciences are well suited to lead in this reform beginning in the pre-college phase, because the geosciences provide a natural window on the world of science... a strong pre-college component provides a crucial foundation for geoscience education at all subsequent levels: undergraduate, graduate, and postdoctoral, as well as for the general public." (Geoscience Education: A Recommended Strategy", NSF 97).

Recent pedagogical research recommends that effective learning occurs when students: a) are engaged in learning that they view as relevant to their lives, b) use inquiry-based strategies to seek solutions to science problems that are realistic and pertinent, and c) employ cooperative learning approaches (Cuseo, 1992; Novak, 1993). Promotion of science - technology-society (STS) triad (Yager, 1993), constructivist strategies (Bykerk-Kauffman, Kerlinger, and Johnson, 1996; Fosnot, 1989, open-ended inquiry approaches (Lueck, 1970), higher-order thinking strategies, and computers as cognitive tools (for knowledge construction rather than knowledge consumption). (Busch, Moore, 1997)

The GLOBE Program, and the NASA S'COOL Project, are both directly linked to the National Science Standards, both in content, and in science education pedagogy. Perhaps more importantly, this project represents how many evolving educational disciplines over the past forty years, i.e. science education, environmental education, and technology education. The disciplines can unify goals and objectives and further technical careers through providing students with doing science like scientists do, in a relevant and meaningful to them, they can see the applications of what they are leaning. The AMS is actively engaged in providing teacher enhancement opportunities to not only booster content, but aid in the shift in the paradigm in educational pedagogy required for this "real-time" science and environmental interpretation.

3.1 The Digital Earth Initiative (www.digitalearth.gov)

*"Digital Earth will be a **virtual representation** of our planet that enables a person to **explore and interact** with the vast amounts of **natural and cultural information** gathered about the Earth."*

Recognizing this challenge the *National Digital Earth Initiative* was created to enable and facilitate the evolution of Digital Earth, a digital representation of the planet that will allow people to explore and interact with vast amounts of natural and cultural information. Students and teachers will be able to search the planet, requesting information on land cover distribution of planet, animal species, real-time weather, roads, political boundaries, and population. Imagine the quality of decisions that can be made by citizens, community leaders, business, and government leaders. *Digital Earth* is several things: a way to obtain information about the Earth; a framework in which to publish information; a new market for data, software and services; a set of standards; a local, national, and international collaboration a near-term " A primary goal of Digital Earth is to unlock the world's knowledge by simplifying access to geo-referenced information, which is information that relates to a particular spot or area of the earth.

3.2 The GLOBE Program (www.globe.gov)

On the 25th anniversary of Earth Day (April 22, 1995) the GLOBE Program officially began. Global Learning and Observations to Benefit the Environment (GLOBE) is a hands-on international environmental science and education program. GLOBE links students, teachers, and the scientific research community in an effort to learn more about our environment through student data collection and observation. The goals of GLOBE are to:

- enhance the environmental awareness of individuals throughout the world
- contribute to scientific understanding of the Earth
- help all students reach higher levels of achievement in science and mathematics.

GLOBE is a hands-on, minds-on K-12 project in which students will become the environmental experts for their study sites. The GLOBE Program fosters the creation of a worldwide research team, comprised of students and

teachers in collaboration with environmental scientists for generating knowledge about the Earth as an interconnected system. Learning activities are designed to promote the understanding of science using tools such as visualizations and satellite images. The inquiry process used by the GLOBE Program is an approach to learning, which parallels the scientific method used by scientists. Protocols focus on data collection and data reporting. The activities broaden from the data collection and data reporting to include other parts of the inquiry process such as formulation of hypotheses, analysis of data, and drawing of conclusions. As students achieve higher levels of scientific understanding, they are challenged to move from a specific discipline to a multi-disciplinary perspective and from a local to a global perspective. GLOBE adheres to such pedagogy as: concepts of authentic learning, student-scientist partnership, and inquiry-based. The GLOBE Program website itself is a wealth of geo-referenced information, data and educational activities. These activities present the concepts to be used in this project. Students can engage in and practice activities and various tutorials, which allow students to gain an understanding of the environmental data that they will be using to construct a GIS data-base.

Through the GLOBE Program teachers and students have the opportunity to participate with other GLOBE schools from around the world through a format called "School Collaborations". One such project is called "Digital Earth-GIS" (Moore, 1998) which has established a significant international learning community. This is an important concept because as the learning community is established, topics or special issues, such as Sustainability, can be addressed, with the common language of a GIS database. Since that time, the project has been renamed "Digital GLOBE", as to not be confused with the "Digital Earth Initiative". Current participants are (and the list continues to grow):

Moderator: Mr. John D. Moore, Burlington County Institute Of Technology, Medford, NJ United States

Participants:

- Lyn Harper, Kinard Elementary School, Clover, SC United States
- Ms. Kathleen R. Mitchell, Kimball Elementary School, Concord, NH United States
- H. Claus Roennebeck, Gymnasium Rahlstedt, Hamburg, Germany
- Mr. Patsy Cicala, Poughkeepsie High School, Poughkeepsie, NY United States
- Mr. Brian Doyle, Noble Junior High School, Berwick, ME United States
- Mr. Chuck Drake, C.D. Hylton High School, Woodbridge, VA United States
- Yan Dazheng, Shenzhen Experimental School, Shenzhen, China
- Marcia Craft, Northville Central School, Northville, NY United States
- Mr. William Dyke, East High School, West Chester, PA United States
- Mr. Gordon Davis, Walker Memorial Academy, Avon Park, FL United States
- Mr. Wayne Gilchrest, Dutchess Academy Of Environmental Studies, Poughkeepsie, NY United States
- Mr. John Caldwell, Crescent Elk School, Crescent City, CA United States
- Ewa Czupry, XI Liceum St. Konarskiego, Wroclaw, Poland
- Mika Vanhanen, Enon kirkonkylan ala-aste, Eno, Finland
- Mr. Todd E. Toth, Waynesboro Senior High School, Waynesboro, PA United States
- Ms. Toni Smith, E.L. Bouie Traditional Theme School, Lithonia, GA United States
- Mrs. Nora Ziegler, Hillsdale Elementary School, West Chester, PA United States
- Ms. Gayle Sellers, Royersford Elementary School, Royersford, PA United States
- Frank Ebiner, La Puente High School, La Puente, CA United States
- Ms. Wendy Barcroft, First Colonial High School, Virginia Beach, VA United States
- Dr. Klaus-Peter Schmitt, Kopernikus Gymnasium, Wissen, Germany
- Mr. Dave Foord, Paul F. Brandwein Institute, Dingmans Ferry, PA United States
- Aili Alatsei, Rakke Gymnasium, Laane-Virumaa, Estonia
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- Ms. Kathy Reynolds, Milken Community High School, Los Angeles, CA United States
- Ms. Marina Grcic, Sumarska Skola Karlovac, Karlovac, Croatia
- Bernd Tissler, Gymnasium Ohmoor, Hamburg, Germany
- Mr. Keith Rees, Forest Street Primary School, Wendouree, VIC Australia
- Zelimir Trlek, OS Konjscina, Konjscina, Croatia
- Mr. Evan Justin, McMurray Middle School, Vashon Island, WA United States
- Ms. Diane Duncan, Ferson Creek Elementary School, Saint Charles, IL United States
- Anne Riles, Sope Creek School, Marietta, GA United States
- Mr. Roger Skillman, Walhalla Middle School, Walhalla, SC United States
- Ms. Sanja Knezic, OS Matija Gubec, Gornja Stubica, Croatia
- José Luis Escuer Ibarz, IES "Ramón J. Sender", HUESCA, Spain
- Alenka Bujan, OS Draganici, Draganici, Croatia
- Mr. Steve Engelmann, Palisades Charter High School, Pacific Palisades, CA United States
- Vesna Brlek, OS Marija Bistrica, Marija Bistrica, Croatia
- Jiri Suchy, Zakladni Skola Banov, Banov, Czech
- G.B. Berenos, AMS, Paramaribo, Suriname
- Ioannis Orfanos, 3rd Lyceum of Aigaleo, Athens, Greece
- Ms. Marina Gojkovic, Gimnazija Matija Mesic, Slavonski Brod, Croatia
- Alev Sirikci, TED Ankara College Foundation, Ankara, Turkey
- Susan Newbury, Thurston Middle School, Springfield, OR United States
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- Ms. Betty M. Welsh, Centennial Campus Middle School, Raleigh, NC United States
- Helen M. Magee, Tylertown High School, Tylertown, MS United States
- Christer Slotte, Virkby Gymnasium, Virkby, Finla Finland
- Kay Jackson, Oak Tree Elementary, Gilbert, AZ United States
- Theodorou Neophyta, Gymnasium Yeroskipou, Pafos, Cyprus
- Silvia Gysler, Primarschule Trittenbach, Taegerwilen, Switzerland
- Nittaya Phattanamas, Banyangsung, Kanchanaburi, Thailand
- Sune Jeppson, Vannarodsskolan, Sosdala, Sweden
- Juhasz Istvan, Gábor Áron Gimnázium,Egészségügyi Szakközepiskola és Kollégium, Karcag, Hungary
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- Martin Anscombe, Hoe O Tainui, Ohinewai, Waik New Zealand
- Ms. Susan Allick, St. Croix Central High School, Christiansted, VI United States
- Giovanni Imbalzano, Liceo Scientifico Majorana, Moncalieri, TO Italy
- Roumyana Kostova, Mihail Lakatnik Primary School, Bourgas, Bulgaria
- Wade Carpenter, Sir John Franklin High School, Yellowknife, NT Canada
- Helgi Holm, Storu-Vogaskoli, 190 Vogar, Iceland
- Mr. Scott Noble, Shawnigan Lake School, Shawnigan Lake, BC Canada
- Gemma L. Calvo, Philippine Science High School Mindanao Campus, Davao City, Philippines
- Natalie Todorova, Municipal Kids Center, Balchik, Bulgaria

- Ms. Kiran Chhokkar, Centre for Environment Education, Ahmedabad, India
- M.Ngouffo Grace, Lycee Technique Industriel Et Commercial, Bafoussam, Cameroon
- Frau Pfitz, Chemisches Institut Dr. Flad, Stuttgart, Germany
- Mr. Brian Doyle, Noble Junior High School, Berwick, ME United States
- OLA EID, GERMAN SCHOOL, BEIRUT, Lebanon
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- Linda davies, Monroe Middle School, Eugene, OR United States
- Filip Petr, Gymnazium Dr. A. Hrdlicky, Humpolec, Czech Republic
- Rebecca Roach, Bolts Elementary School, Denniston, KY United States
- Abdallah Saeed Khalifa, Kintampo Secondary School, Kintarmpo, B/A, Ghana
- Dr. Esma Itir Av, Ozel Darussafaka Lisesi, Istanbul, Turkey

4.1 CONCLUSIONS

Students and teachers have begun the process of gathering data in each location. Observations and measurements from thousands of schools are available on the GLOBE website, however the Digital GLOBE schools are working specially on creating a GIS database. Other visualization tools developed by NASA are available on-line to display data for use in the classroom. Students using email can communicate with each other to ask for specific requests, or to verify data. To date, and exchange of information has occurred that includes: LandSat Imagery (supplied to each GLOBE school), photographs of environmental study sites, schools and cultural points of interest. In addition, student ground truthing observations as part of the NASA S'COOL Project can now be displayed, adding yet another layer of data/information. Datasets from the USGS website i.e. earthquake and volcanic activities, are currently in a geo-referenced format, and therefore are being incorporated into the project. American Meteorological Society teacher enhancement courses, DataStreme Atmosphere, and DataStreme Water in the Earth System both build content in the sciences and pedagogy that is Earth System Science based, and exemplify use of real time data in the classroom.

5.1 TOWARDS A SUSTAINABLE FUTURE

The topic of the World Environmental Earth Summit in September 2002 in Johannesburg South Africa was Sustainability. The use of real-time data and remotely sensed data will be instrumental in reaching global sustainability, not only in terms of developing a data base from which to work, but enables us to verify what is happening. Issues of sustainability need to occur at all levels, local to global. It is really a decision making/policy making practice. Good decisions are always based on good data/information. This implies two things, (1) the data exists, and (2) it is shared. Currently, data sharing is sometimes controversial, however the students we teach now, need to learn, particularly concerning issues of sustainability, that working collaboratively is the only way a "global" sustainable future can be insured.