

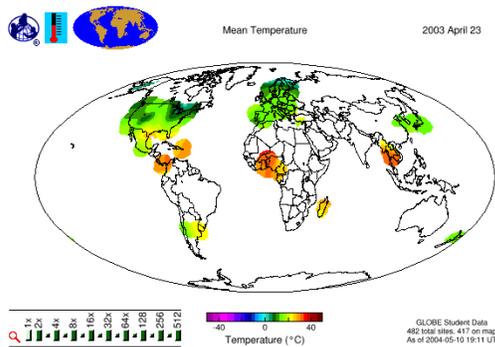
The GLOBE Program: How it Can Aid Scientific Investigations...

GLOBE is a hands-on **science** and **education** program that has students collect scientifically valid environmental measurements and report them to a publicly available database.

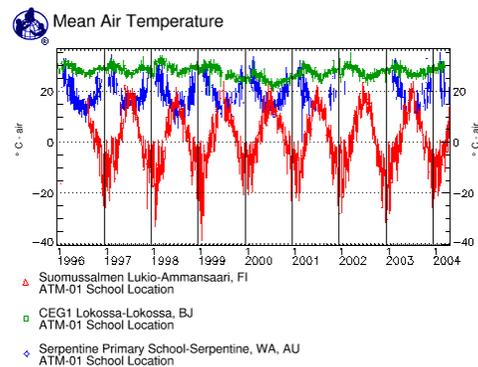
"GLOBE is the quintessentially ideal program for involving kids in science,"
- Nobel laureate Dr. Leon Lederman.

WHY USE GLOBE DATA?

Spatial and Temporal Coverage: GLOBE is a network of over 14,000 schools in 105 countries. Over 11 million environmental measurements have been collected to date, this amount grows daily.



GLOBE Student
Mean Air Temperature Data for April 23, 2003



Comparison of mean air temperature
from three different GLOBE schools

Research Quality Data: All data are collected following scientifically valid protocols, and research scientists work to ensure the accuracy of all measurements. All data reporters have undergone first-hand training.

Education and Community Outreach: The GLOBE Program offers an ideal means to partner science and education. The hands-on nature of GLOBE allows students to become involved in authentic scientific research. Since GLOBE relies on a network of partners to implement the program, it is possible to find partners eager to work with your project, or to become a partner yourself. These partnerships involve a variety of groups, such as satellite missions, university departments, zoos, science centers and museums.

Name Recognition: GLOBE is a recognized and respected program in the realm of science education. Established in 1994, the program is currently funded by the National Aeronautics and Space Administration (NASA), the National Science Foundation (NSF), and the State Department. It is operated by the University Corporation for Atmospheric Research (UCAR) in cooperation with Colorado State University (CSU).

FOR MORE INFORMATION...

Visit the GLOBE Web site at www.globe.gov, or email our Help Desk at help@globe.gov



GLOBE MEASUREMENTS

GLOBE currently offers protocols for the following environmental measurements in our five main investigation areas:

Atmosphere

- Clouds (including contrails)
- Aerosols
- Atmospheric Water Vapor
- Surface Temperature
- Relative Humidity
- Precipitation (including snow and rainfall pH)
- Maximum, Minimum, and Current Air Temperature
- Barometric Pressure
- Surface Ozone

Hydrology

- Water Transparency
- Water Temperature
- Dissolved Oxygen
- Electrical Conductivity
- Salinity
- Water pH
- Alkalinity
- Nitrate
- Freshwater Macroinvertebrates

Land Cover/Biology

- Land Cover Sampling (according to Modified UNESCO Classification System)
- Biometry
- Manual Land Cover Mapping
- Computer-aided Cover Mapping (using LandSat imagery)
- Land Cover Change Detection (compare two geo-referenced LandSat images)
- Fire Fuel Ecology

Soil

- Soil Characterization
- Soil Temperature
- Soil Moisture (using gravimetric sampling or sensors)
- Bulk Density
- Soil Particle Density
- Particle Size Distribution
- Soil pH
- Soil Fertility (Nitrogen, Phosphate, and Potassium)
- Water Infiltration

Earth as a System

- Budburst
- Green-Up
- Green-Down
- Ruby-throated Hummingbird Monitoring
- Lilac Phenology
- Phenological Gardens
- Seaweed Reproduction Phenology
- Arctic Bird Migration

WAYS TO BECOME INVOLVED IN GLOBE

1) Work with an existing partner

GLOBE has partners in 10 countries and almost all U.S. states. The complete list of these partners, including contact information, can be found on the *Countries* and *U.S. Partners* links found on the GLOBE Web site at <www.globe.gov>. The diversity of partnerships makes it possible to find partners that are appropriate for inclusion in an array of projects.

2) Become a partner

It is a straightforward process to become a partner and support schools directly. If you are interested in becoming a partner, or need help locating partners to work with, email <partnersupport@globe.gov>.

3) Include GLOBE in the outreach portion of your proposal

GLOBE would be glad to suggest ways that you could incorporate portions of our program into your project. Please email the GLOBE Science Team at <scienceteam@globe.gov> to discuss opportunities.

4) Use GLOBE data in your research project

All GLOBE data are publicly available. With data ranging from land cover classifications in Bahrain to cloud observations in the Marshall Islands, you may be able to find just what you are looking for. Powerful search tools on the GLOBE Web site allow you to narrow down the exact

data you need. Numeric data can be downloaded in a variety of formats (web-based, delineated text, or shape files), or visualized using our online mapping and graphing tools.

5) Submit a proposal to support a measurement and work as a GLOBE Scientist

There are four different measurement types in GLOBE: Basic, Advanced, Optional and Special. To be a GLOBE scientist for a Basic, Advanced or Optional science measurement requires scientists to undergo a peer-review process. For **scientists at U.S. institutions**, the National Science Foundation (NSF) has competitively selected the science teams. **For more information about upcoming opportunities, please monitor <http://www.geo.nsf.gov/adgeo/education.htm> and <http://www.nsf.gov/od/lpa/news/publicat/nsf04009/geo/edu.htm>.** For **non-U.S. scientists**, GLOBE requires an in-country or multi-national competitive process to have happened before it can acknowledge a non-U.S. group as part of the set of GLOBE science teams. To be part of the set of GLOBE science teams, however, does not require development of a new protocol. A scientist can propose to work with data from one or more existing GLOBE protocols.

GLOBE scientists supporting Basic, Advanced and Optional measurements are required to develop and edit science and education materials for the protocol(s) or participate in any changes that will be made to the current protocols, use GLOBE student data in research papers published in the peer-reviewed literature, participate in the review of all data for quality control, answer questions about the protocol and use of the data, as well as participate in science meetings and provide input for GLOBE science policy decisions. In return, GLOBE provides varying degrees of support and has different expectations for training and implementation by GLOBE schools for each of these types. The levels of support are listed on the next page.

The process for GLOBE Special Measurements is slightly different. It does not require a peer-review process. Scientists may contact the NASA Program Manager, Dr. Paula Coble, and propose a new protocol. If the new protocol makes “good sense” to GLOBE and GLOBE (under the operation of UCAR/CSU) can afford to support the development of the protocol and subsequent Web site systems implementation for the protocol, then Chief Scientist, Dr. Peggy LeMone of UCAR <lemone@ucar.edu>, will work with the scientist to develop and promote the new protocol. A formal agreement with NASA must also be concluded. Criteria for “good sense” include the likelihood of schools doing the protocol (such as ease of taking the measurement and expense of equipment to do protocol), enhancement of the overall package of GLOBE measurements through addition of a needed new feature or through reinforcement or complementing the existing set of protocols, and the ability of more than one country to take the measurement. For instance, scientists from Senegal could develop one or more protocols for students in tropical countries. Currently, Dr. Rebecca Boger is the lead contact person for development of Special Measurements <rboger@globe.gov>.

The majority of GLOBE measurements are watched over by science teams that have been selected using a peer-review process and funded by NSF. NSF releases an Announcement of Opportunity (AO) approximately every four years. Scientists interested in a) supporting an existing GLOBE measurement, b) proposing a new GLOBE measurement, c) conducting research using GLOBE data or d) assessing the quality of GLOBE data can submit proposals.

Additionally, GLOBE does occasionally add “special” measurements watched over by scientists who are not funded through these NSF grants. If you have an idea for a measurement that would fit well with GLOBE, email the GLOBE Science Team at <scienceteam@globe.gov>.



GLOBE Measurement Protocols and Levels of Support

There are four measurement types in GLOBE:

- Basic (including universal and area specific)
- Advanced
- Optional
- Special

GLOBE provides varying degrees of support and has different expectations for training and implementation by GLOBE schools for each of these types. These are given below.

Basic Measurements

Universal protocols:

Teacher training: recommended

Trainer training: offered

School implementation: highly desirable for all schools

Inclusion in Teacher's Guide: yes

Protocol Video: yes

Written & Web distribution to schools: yes

Systems support: yes

PI funding at U.S. institutions: yes

Area specific protocols:

These are basic protocols that measure phenomena that do not occur worldwide such as snow.

Teacher training: recommended where the protocol can be implemented

Trainer training: offered

School implementation: highly desirable for all schools where the protocol can be implemented

Inclusion in Teacher's Guide: yes

Protocol Video: yes

Written & Web distribution to schools: yes

Systems support: yes

PI funding at U.S. institutions: yes

Advanced Measurements

Teacher training: desirable

Trainer training: offered

School implementation: highly desirable for all schools

Inclusion in Teacher's Guide: yes

Protocol Video: yes

Web distribution to schools: yes

Written distribution to schools: no, except for schools lacking Internet connectivity

Systems support: yes

PI funding at U.S. institutions: yes

Optional Measurements

Teacher training: optional

Trainer training: not offered routinely

School implementation: optional

Inclusion in Teacher's Guide: yes

Protocol Video: case by case decision

Web distribution to schools: yes

Written distribution to schools: no except for schools lacking Internet connectivity
Systems support: yes
PI funding at U.S. institutions: yes

Special Measurements

Teacher training: optional
Trainer training: not offered routinely
School implementation: desirable particularly for schools identified by the PI
Inclusion in Teacher's Guide: yes for the 2003 GLOBE Teacher's Guide
Protocol Video: no
Web distribution to schools: yes
Written distribution to schools: no except in special situations lacking Internet connectivity
Systems support: yes
PI funding at U.S. institutions: no

Description of Support Items

Trainer training: GLOBE trainers are trained in the protocols in a train-the-trainer (TTT) workshop provided or sanctioned by GLOBE. Master trainer development is provided.

Teacher training: GLOBE teachers are trained in the protocols in a workshop or other forum. This training is person-to-person and involves hands-on conduct of the protocol by the trainee. Training is delivered by GLOBE trained instructors except in the cases where a local expert is used or an alternative trainer has been approved by GLOBE. Teacher training is the responsibility of the GLOBE partner countries.

School implementation: Schools have students take data following the measurement protocol and report the data to GLOBE, provided the protocol is grade appropriate for the students.

Inclusion in Teacher's Guide: The protocol and associated material, including science background information, learning activities or similar supports for classroom implementation, instrument specifications, and data entry sheets, are included at least in the Web version of the Teacher's Guide.

Protocol Video: GLOBE has produced and distributes a video for the protocol. The video is aimed at teachers with students as a secondary audience. The video complements the Teacher's Guide and provides an illustration of how the protocol is conducted and key pointers on how to take the measurements correctly.

Web distribution to schools: GLOBE provides the Teacher's Guide to everyone via the Web.

Distance Learning: Starting in 2004, on-line courses on the protocols will be developed. All of the protocols should be covered by on-line courses by sometime in 2006.

Written distribution to schools: GLOBE provides to all trainers and to schools in the U.S. the text and graphic material associated with the protocol as a printed GLOBE Teacher's Guide.

Systems support: GLOBE provides for the entry of data, the visualization of these data, the archival of data as part of the GLOBE Data Archive, and the distribution of these data to all who request them. Distribution is provided in formats that are compatible with easy ingest into

spreadsheets and geographic information systems software as well as in on-line images or tables of data. Off-line and FTP delivery of significant amounts of data are provided on request.

PI funding at U.S. institutions: If the Principal Investigator and research team, including an educator Co-principal Investigator, are at U.S. institution(s), they may receive funding from NSF as GLOBE investigators for the conduct of research using the data gathered following the protocol, development and maintenance of the protocol related materials, review of all data submitted for the protocol for accuracy and adequacy for use in research, interaction with students and teachers including support for training, and the provision of supporting educational materials. If the PI and team are at a non-U.S. institution, they may receive this support from a national source in their country or from a multilateral funding entity.

GLOBE Protocols

Atmosphere/Climate

Existing:

- Clouds (Basic)
- Contrails (Basic)
- Aerosol (Advanced)
- Relative Humidity (Basic)
- Precipitation (Basic)
- Max/Min/Current Air Temperature (Basic)
- Digital Multi-Day Max/Min/Current Air and Soil Temperatures (Basic)
- Surface Ozone (Advanced)
- Automated Soil and Air Temperature Monitoring (Optional)
- Barometric Pressure (Optional)
- Davis Automated Weather Stations
- AWS Automated Weather Stations

In Development:

- Column Water Vapor (Advanced)
- UV-A (Advanced)

GPS

Existing:

- GPS Measurement (Basic)

Hydrology

Existing:

- Collecting the Water Sample (Basic)
- Water Transparency (Basic)
- Water Temperature (Basic)
- Dissolved Oxygen (Basic)
- pH (Basic)
- Electrical Conductivity (Basic)
- Salinity (Basic)
- Alkalinity (Basic)
- Nitrate (Basic)
- Salinity Titration (Optional)
- Freshwater Macroinvertebrates (Optional)

Soil

Existing:

- Soil Characterization (Basic)
- Bulk Density (Basic)
- pH (Basic)
- NPK (Advanced)
- Soil Temperature (Basic)
- Soil Moisture (Basic)
- Particle Size Distribution (Advanced)
- Automated Soil and Air Temperature Monitoring (Optional)
- Soil Moisture Sensor (Optional)
- Infiltration (Optional)
- Soil Particle Density (Advanced)
- Surface Temperature (Advanced)
- Automated Soil Moisture (Optional)

Land Cover/Biology

Existing:

- Land Cover Sample Site (Basic)
- Biometry (Basic)
- Manual Interpretation Land Cover Mapping (Basic)
- Unsupervised Clustering Land Cover Mapping (Advanced)
- Accuracy Assessment (Basic/Advanced)
- Land Cover Change (Optional)

Earth as a System/Phenology

Existing:

- Budburst
- Green-up / Green-down (Basic)
- Ruby-throated Hummingbird (Optional)
- Phenology Gardens (Optional)

Special Measurements

Existing:

- Clonal and Common and Lilacs
- Fire Fuel Ecology
- Seaweed Phenology
- Arctic Bird Monitoring

In Development:

- European Phenology Network plant and animal protocols
- Marine Macroinvertebrates

