GLOBE: A Hands-On, Inquiry-Based Environmental Science and Education Program

GLOBE Initiative

- The GLOBE initiative was announced on Earth Day 1994
- The first GLOBE training workshops were conducted in 1995
- Over 15,000 schools worldwide are involved
- All US schools were invited to participate
  - Over 10,000 US schools have registered
- All nations were invited to participate
- Over 100 countries have become GLOBE partners
- The United Nations issued a resolution in 1994 which
  - Endorsed GLOBE and encouraged nations to participate
  - UN agencies were requested to support GLOBE implementation

THE GLOBE PROGRAM

GLOBE is a **hands-on** environmental science and education program involving students in primary and secondary schools throughout the world.

GLOBE Program Goals

- **Improve** students' **achievement** in science, use computer and network technology, and help teachers **meet local education standards**
- **Expand** the **pipeline** of potential future scientists and researchers for industry, academia and government
- **Increase** student **awareness** of the global environment from a scientific viewpoint, without advocacy relative to issues
- **Improve** student **understanding** of science by involving them in performing real science – taking measurements, analyzing data, and participating in collaborative research with scientists.

GLOBE Partnerships

- GLOBE is a world-wide partnership involving:
  - Science and education
  - Scientists and teachers/students
  - Teachers and students
  - Schools and communities
  - Schools and schools

GLOBE Students Learn Science While Helping Scientists

- GLOBE students learn authentic science by collecting accurate data and using the data in their investigations.

- GLOBE student collected data, in the areas of atmosphere, hydrology, soil and land cover, are used to help scientists generate new knowledge about the Earth.

GLOBE Protocols

- GLOBE protocols were chosen using the following criteria:
  - The data have research significance
  - The procedures can be done by primary and secondary school students
  - The equipment needed is inexpensive enough for schools to purchase

GLOBE Scientific Instruments

- Functional or performance specifications for GLOBE scientific instruments are provided
- Approximate cost for basic instrument kits:
  - $450 for **Primary** schools
  - $600 for **Secondary** schools

Basic Protocols

Atmosphere/Climate

- Cloud
- Temperature
- Precipitation

Land Cover / Biology

- MUC
- Qualitative Land Cover Sampling
- Quantitative Land Cover Sampling
- Manual Mapping

Hydrology

- Transparency
- Temperature
- pH
- Conductivity
- Salinity

Soil

- Field Characterization
- Bulk Density
- pH
- Temperature
- Gravimetric Moisture

Advanced Protocols

Atmosphere/Climate

- Aerosols
- Barometric Pressure
- Relative Humidity
- Surface Ozone

Hydrology

- Dissolved Oxygen
- Alkalinity
- Nitrate

Land Cover / Biology

- Unsupervised Clustering
- Accuracy Assessment

Soil

- Soil Fertility
- Particle Size Distribution

Area Specific Basic Protocols

Hydrology

- Salinity
- Conductivity

Land Cover / Biology

- Quantitative Land Cover Sampling (Forest, Woodland, Grassland)

Optional Protocols

- Salinity

- Soil Moisture Sensors
- Infiltration

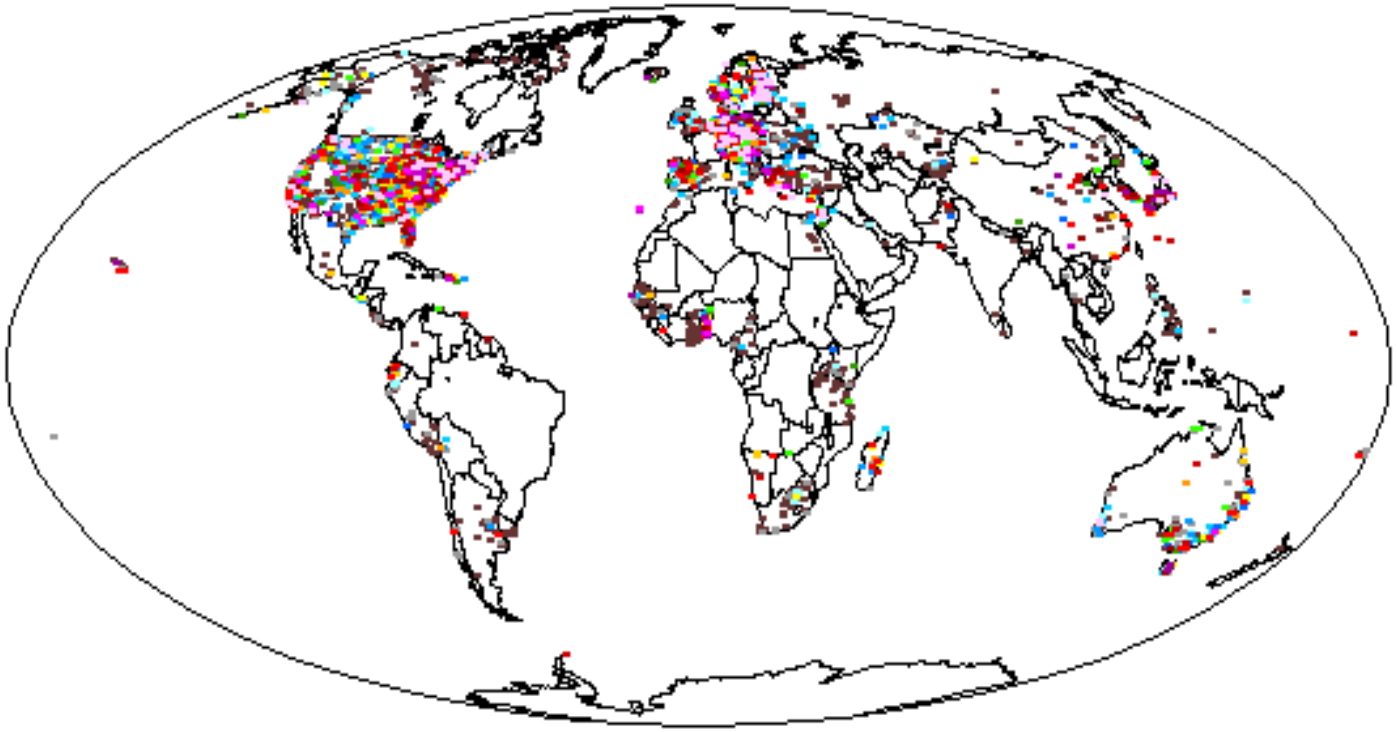
Special Protocols

- Budburst
- Snow Pack Water Equivalent

THE GLOBE PROGRAM

How Many Data Are There? Total

GLOBE Program through
18 January 2001



1 2 4 8 16 32 64 128 256 512

0 1 2000 8000
Number of Measurements

GLOBE Student Data
10129 total schools, 10129 on map
As of 2001-01-18 03:08 UT

Inquiry and Science Processes

Inquiry Process and Science Process

K-12 Teachers and Students

Learning Science

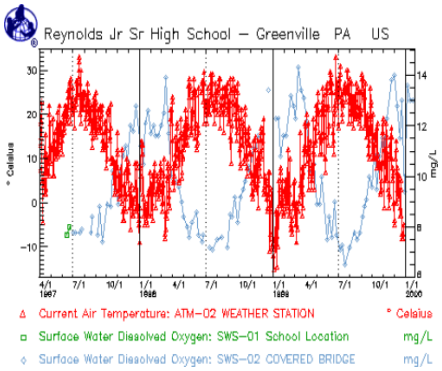
Ask Question
Hypothesis
Methodology
Data Collection
Data Reporting
Analysis
Conclusions
Report Results and Peer Review

Research Scientists

Generation of Knowledge

GLOBE Data Process and Flow in Schools

Data Collection	→	Data Recording	→	Data Entry	→	Data Use
Protocols		Data Book		Computer & Web		Student Inquiry



How Does GLOBE Support Student Inquiry?

- GLOBE provides:
  - **Training** in inquiry for teacher trainers
  - **Educational materials** that support inquiry
  - **Measurement protocols** for students to use
  - Access to **data that students are ready to use** and understand
  - Visualizations of student data as **maps and graphs**
  - Access to **reference images** of data from other sources
  - Web-based **tools for communication, collaboration, & publishing**
  - Support for computer-based **analysis tools** (spreadsheets, GIS)
  - **Satellite images** of the area around each school
  - **Access to scientists** for answers and encouragement

GLOBE Teacher Perception of the Impact of GLOBE on Student Learning

- The biggest perceived impact of GLOBE on student learning is in the following areas:
  - Observational skills (69%)
  - Measurement skills (68%)
  - Technology skills (60%)
  - Understand data (50%)
  - Work in small groups (50%)
  - Critical thinking (36%)
  - Map skills (30%)

From GLOBE Year 2 Evaluation

Comparison of GLOBE Students and Non-GLOBE Students

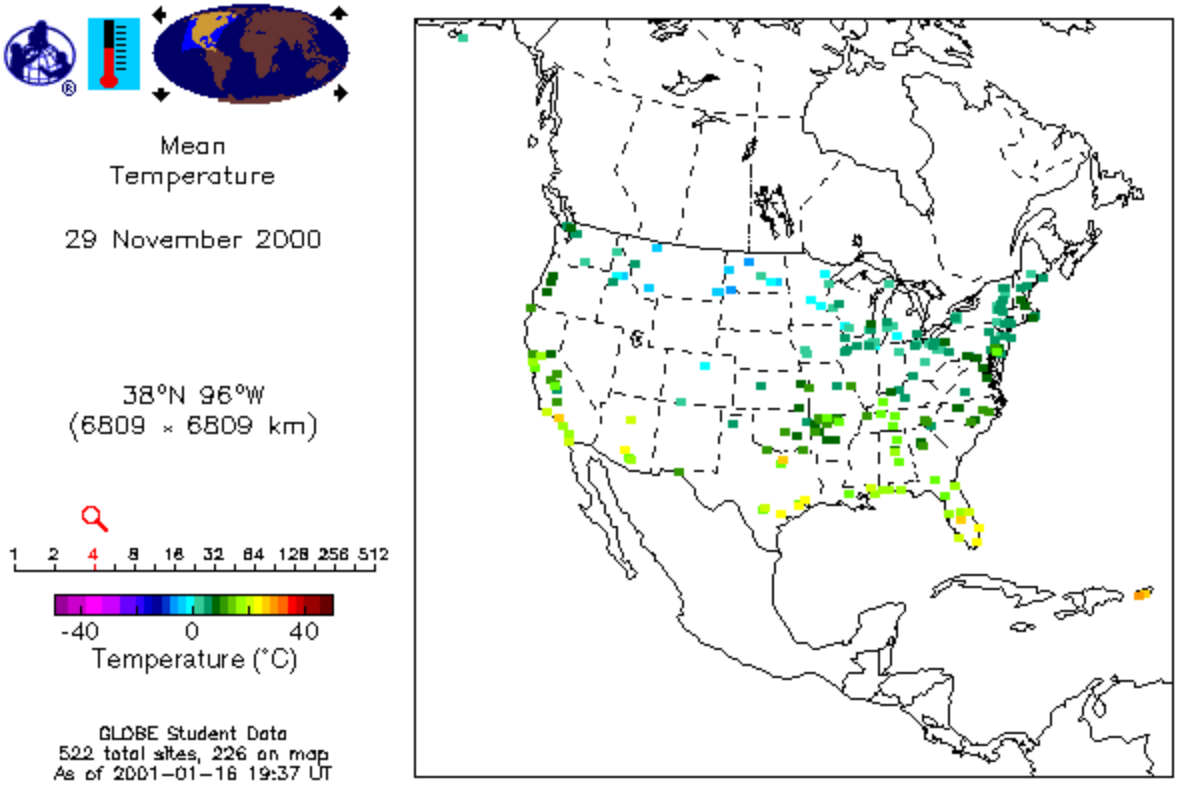
Topic	GLOBE Students	Non-GLOBE Students
Knowledge of measurement procedures	53%	36%
Sampling and measurement principles	56%	51%
Interpreting data and applying concepts	48%	42%
Interest in pursuing a career in science	34%	25%

From: GLOBE Year 2 Evaluation available on-line at: www.globe.gov

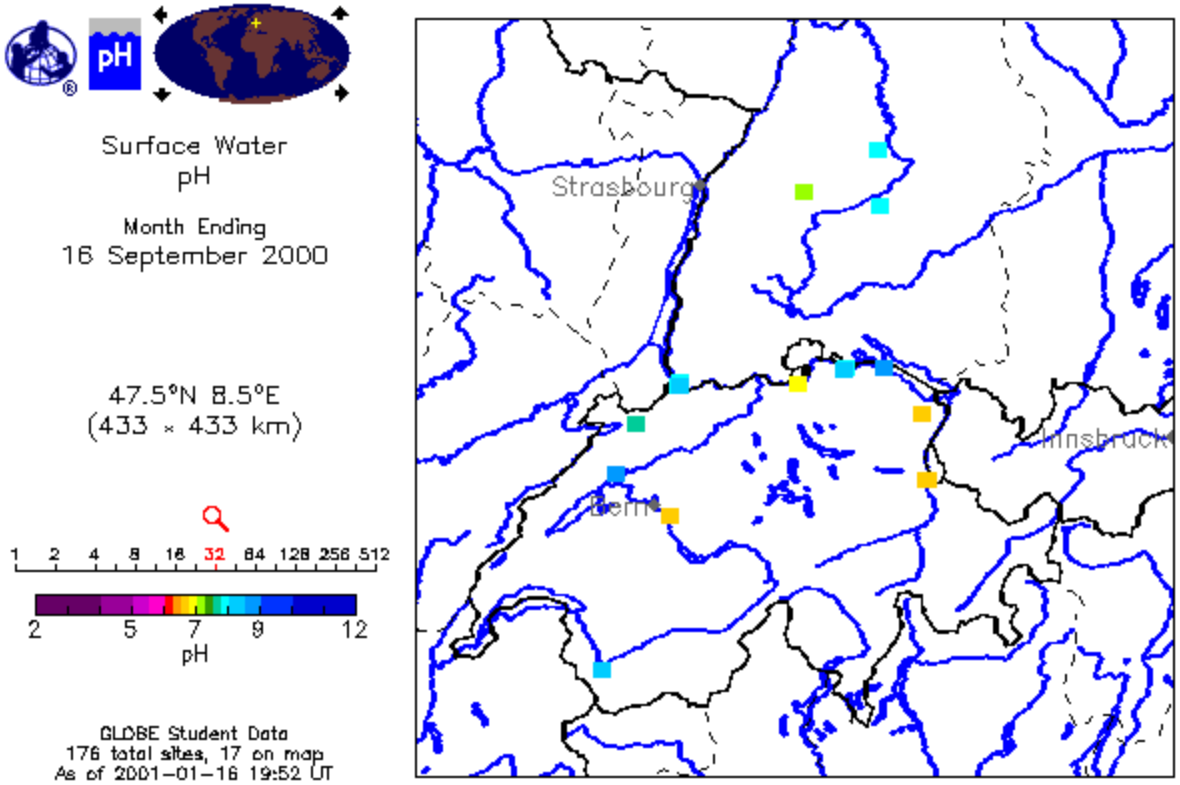
Earth System Measurements in GLOBE

- GLOBE students measure components of the Earth system and its cycles
  - Energy: temperatures of air, water, and soil; clouds; transparency
  - Water: precipitation; soil moisture, infiltration, and bulk density; land cover
  - Biogeochemicals: pH of precipitation, water, and soil; soil characterization; water chemistry; land cover and biology

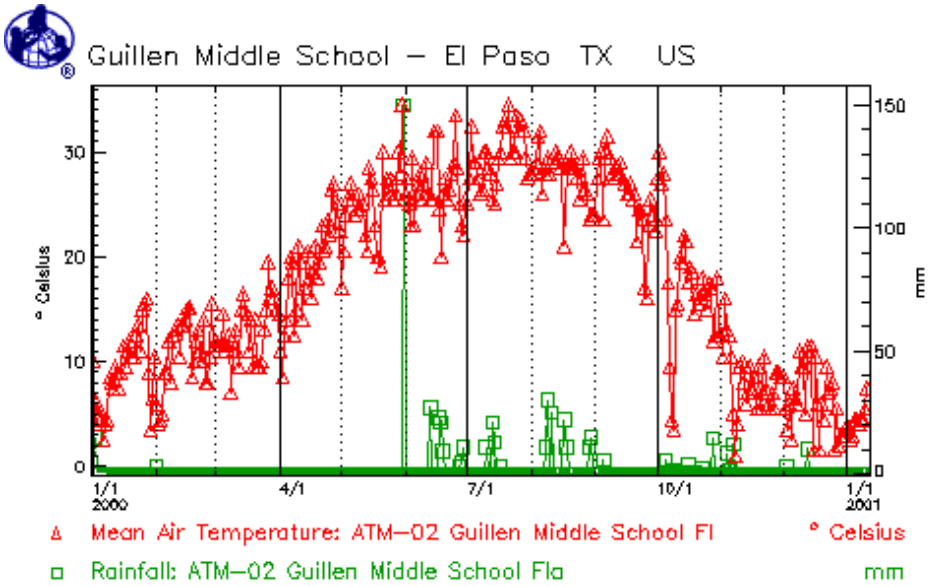
Variation Over Large Scale Geographic Areas



Variation Over Regions/Watersheds

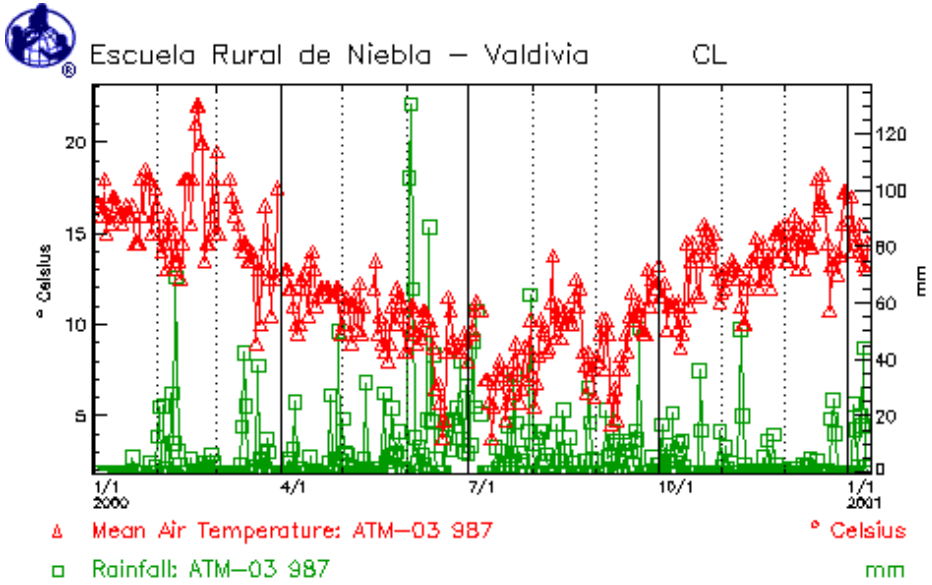


Change Over Time, Comparison

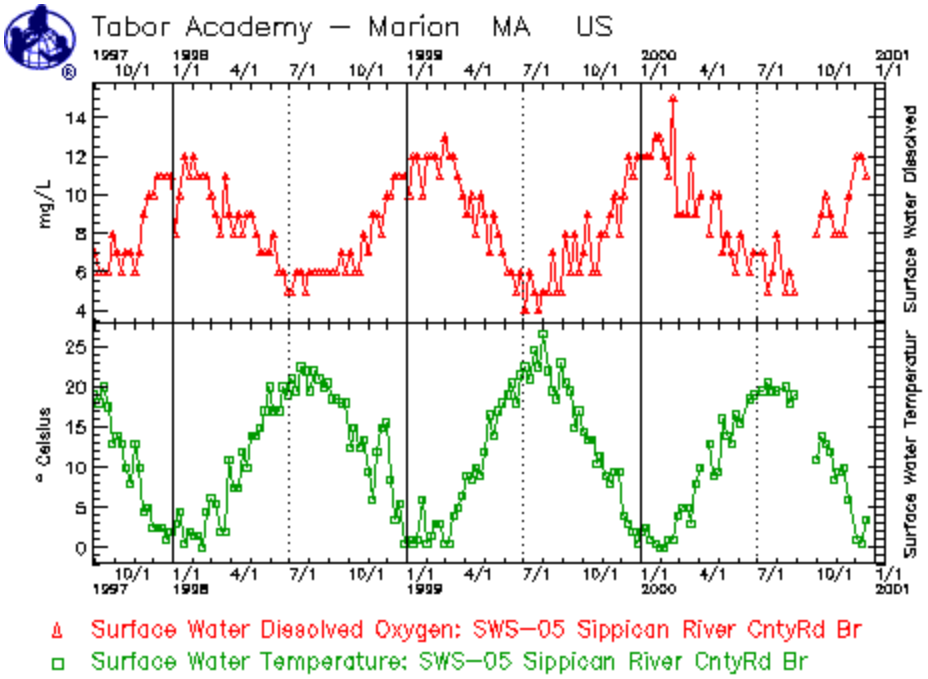


Guillen Middle School, El Paso, Texas, USA
31.7546 N, 106.4734 W, 0 m

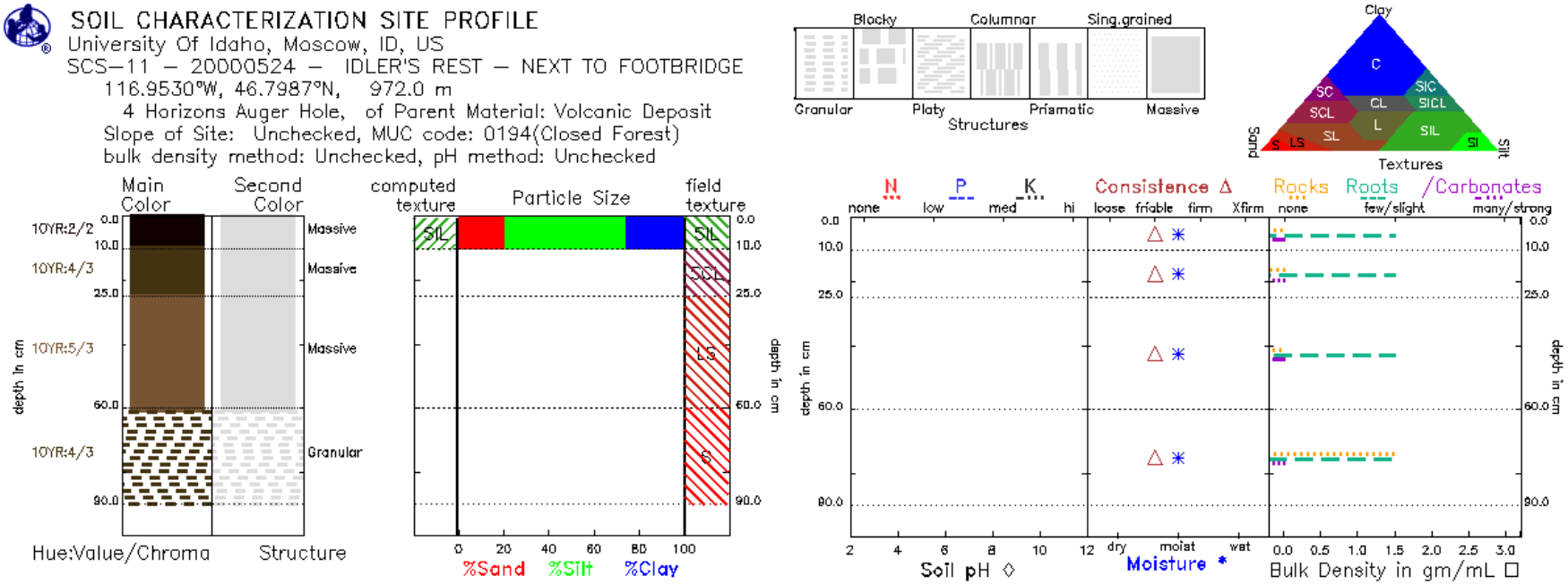
Escuela Rural de Niebla, Valdivia, Chile
33.9500 S, 71.6000 W, 16 m



Relationships Between Variables

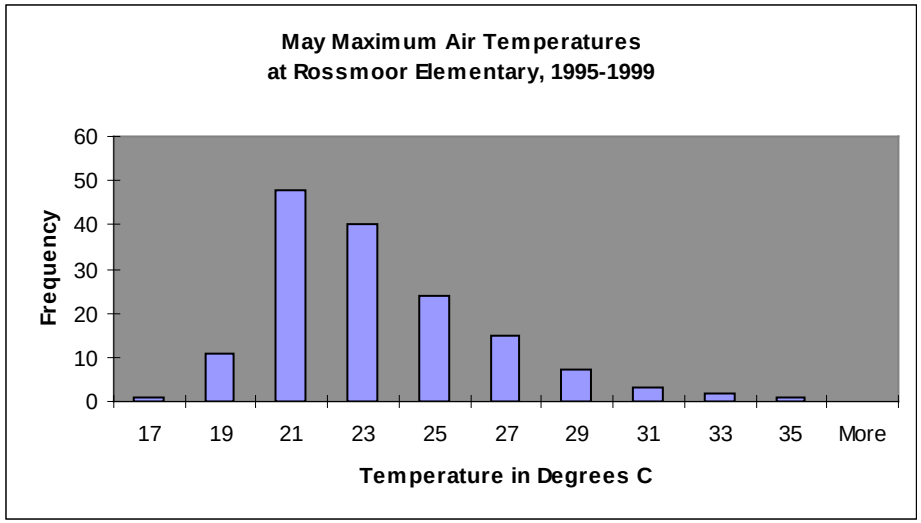


Special Visualizations: Soil Characteristics



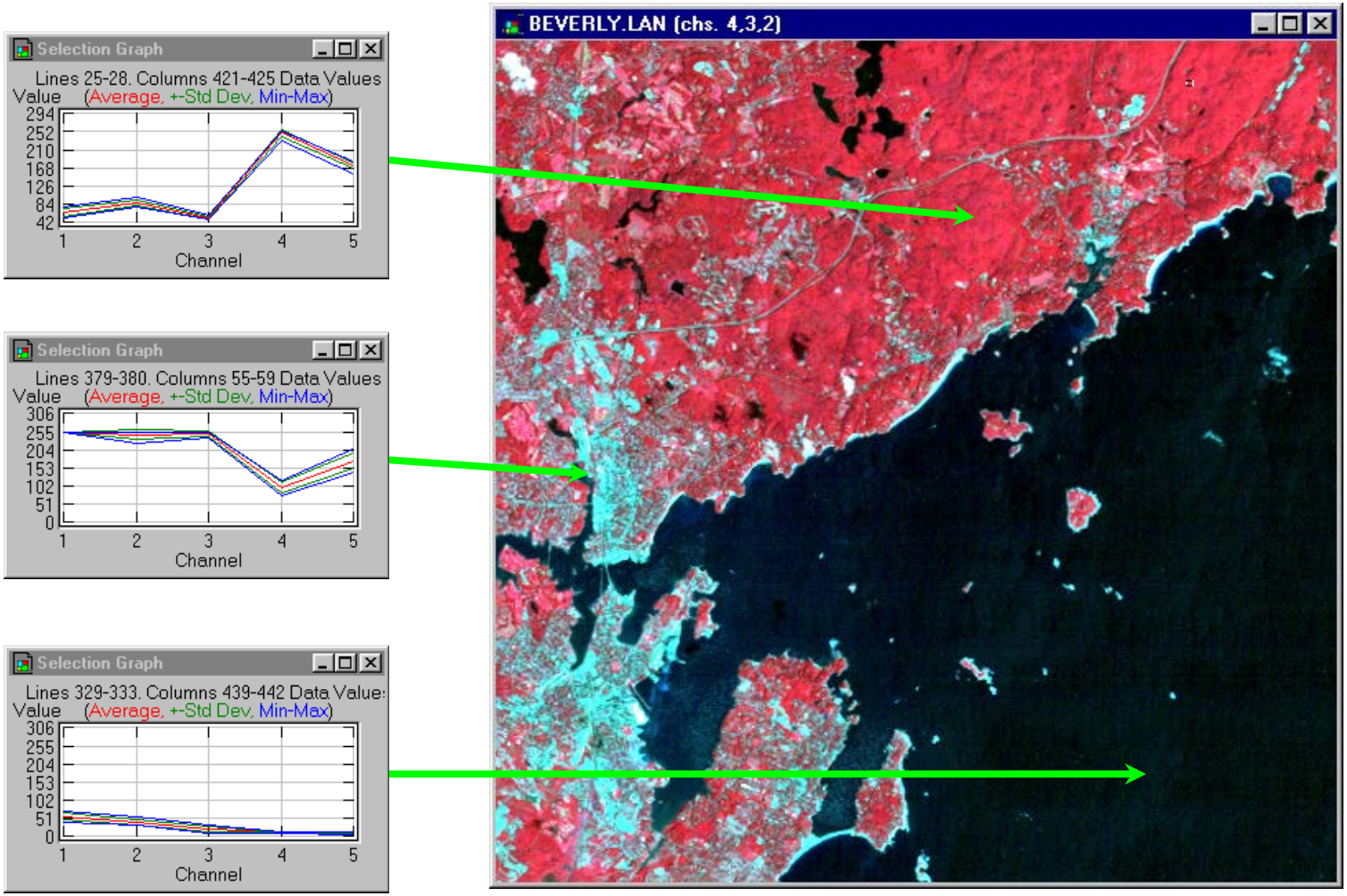
Advanced Analysis Options

	1995	1996	1997	1998	1999
5/1	22	30	22	20	19
5/2	22	26	26	21	18
5/3		24	26	22	18
5/4	21	23.5	28	22	18
5/5	18.5	22.5	28	20	21
5/6	20	25	29	22	23
5/7	17	24	28	21	27
5/8	20	23	27	20	20
5/9	21	23	26	20	18
5/10	22	25.5	27.5	21	20
5/11	22	28	24	20	21
5/12	20	32	25	19	22
5/13	20.5	27	23	18	20
5/14	20	23	24.5	20	20
5/15	20	25	27	21	19
5/16	21	25	31	22	21
5/17	20	25	26	22	23
5/18	21	26	26	25	25
5/19	24	28	23		21
5/20	22	25.5	24	22	21
5/21	20	24	25	21	20
5/22	20.5	24	24	21	18
5/23	19.5	22	25	21	20
5/24	19	22	25	21	23
5/25	21	21.5	24	22	24
5/26	21	23	25	22	22
5/27	21	23	27	20	22
5/28	21	22	32	22	23
5/29	22	23	34	21	21
5/30	25	22.5	30.5	21	21
5/31		23	26	22	22

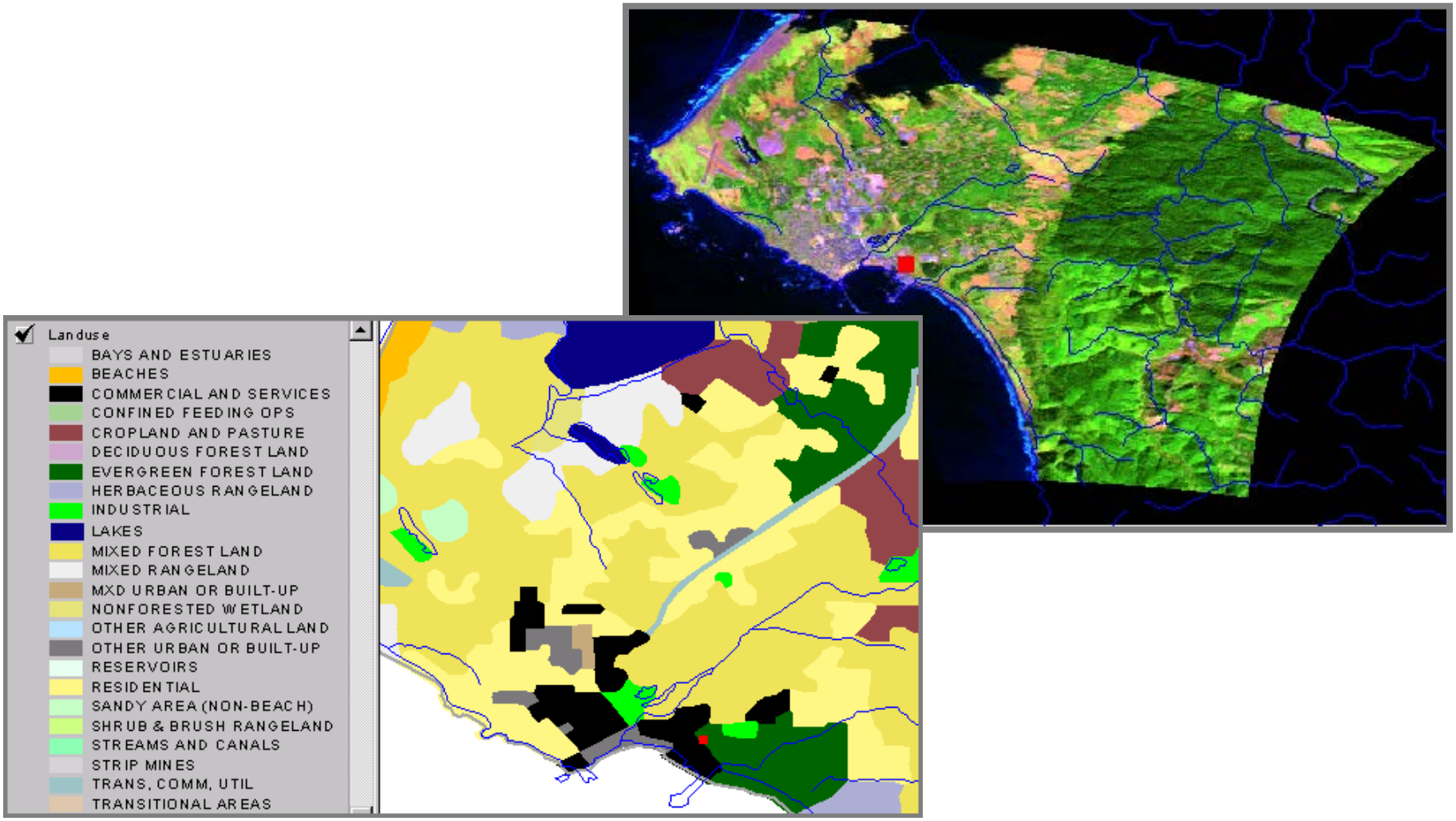


	1995	*1996*	*1997*	*1998*	*1999*
Mean	20.83	24.55	26.40	21.07	21.00
Standard Error	0.29	0.44	0.49	0.23	0.39
Median	21.00	24.00	26.00	21.00	21.00
Mode	21.00	23.00	26.00	21.00	21.00
Standard Deviatior	1.54	2.44	2.73	1.26	2.16
Sample Variance	2.36	5.94	7.46	1.58	4.67
Kurtosis	2.02	1.97	1.01	2.81	0.68
Skewness	0.35	1.37	1.00	0.42	0.66
Range	8.00	10.50	12.00	7.00	9.00
Minimum	17.00	21.50	22.00	18.00	18.00
Maximum	25.00	32.00	34.00	25.00	27.00
Sum	604.00	761.00	818.50	632.00	651.00
Count	29.00	31.00	31.00	30.00	31.00

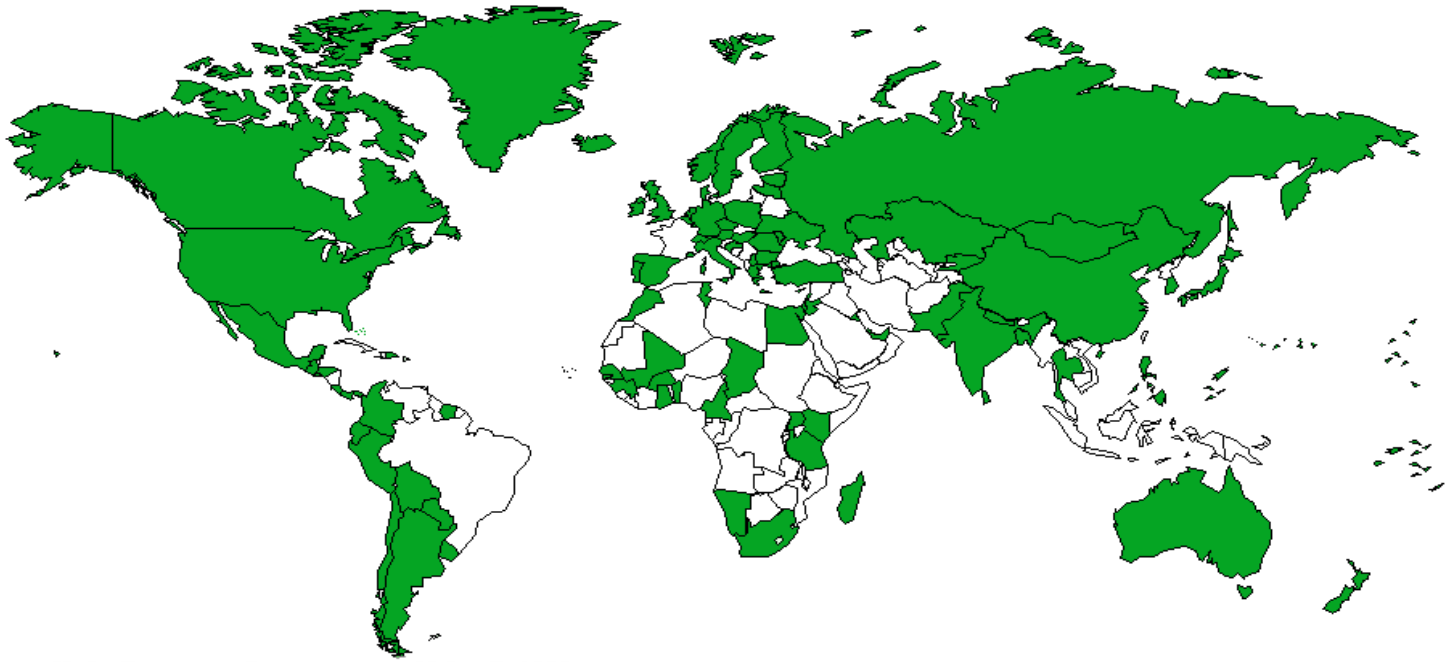
Remote Sensing: Landsat Image Analysis



GLOBE and GIS

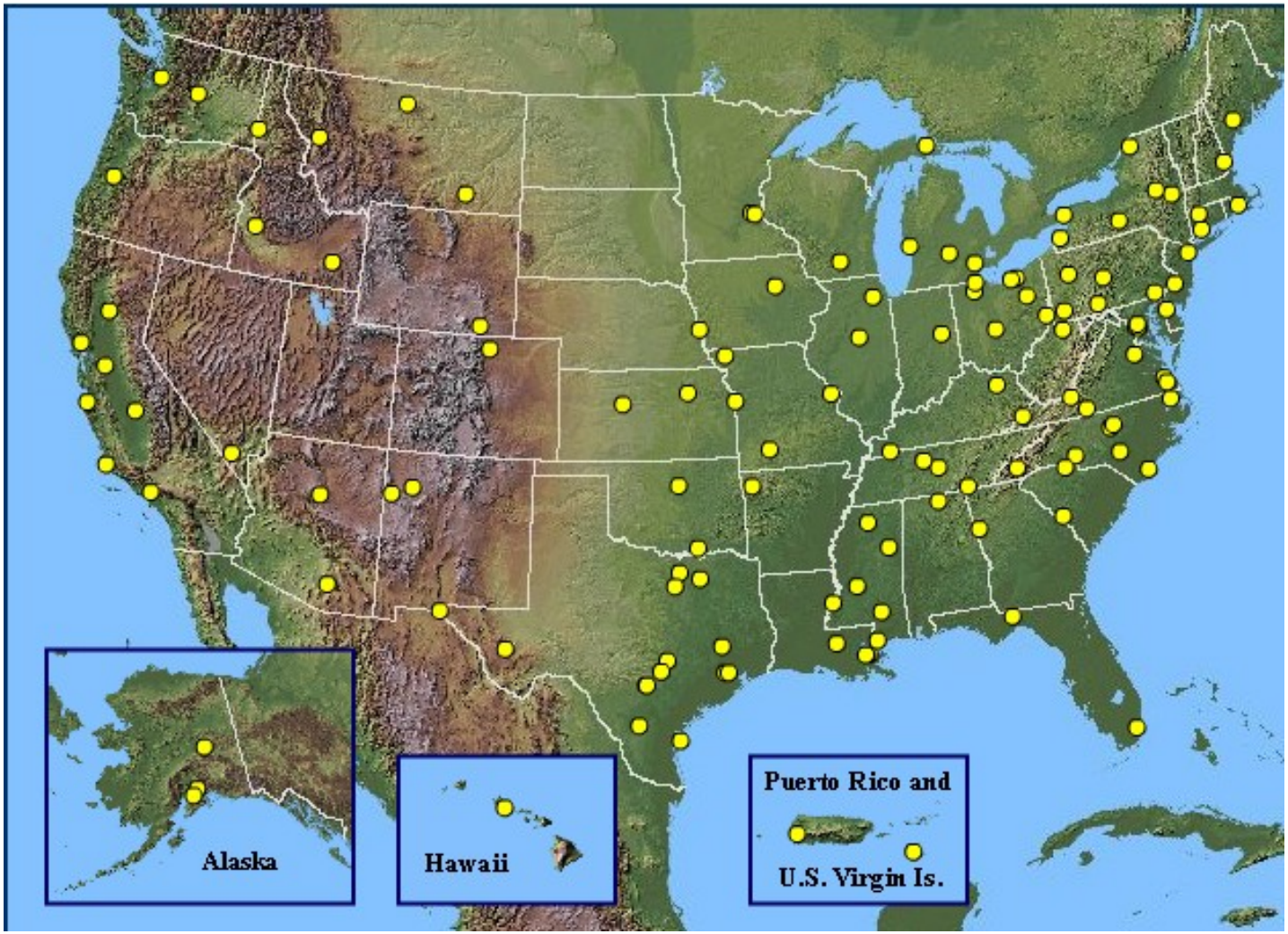


GLOBE Around the World



114 GLOBE Countries as of 2015

GLOBE US Partners



Last update: January, 2006

US Partner Roles

- Recruiting teachers
- Training teachers
- Providing follow-up and support to schools

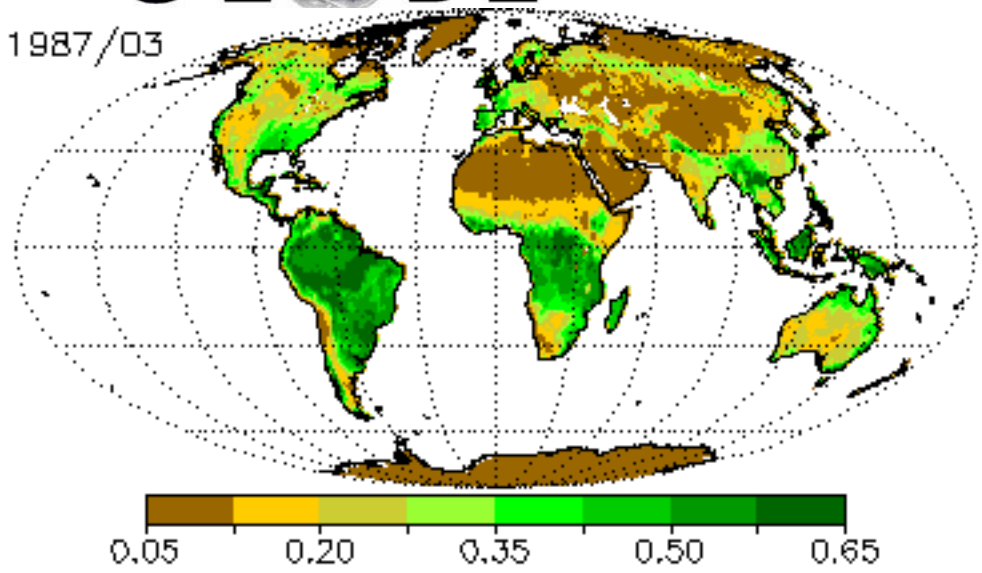
How to Become a GLOBE Teacher

- Attend a **free** GLOBE teacher training workshop
- Find a workshop by going to the GLOBE Web site at www.globe.gov and click on Teacher Workshops
- Follow prompts to register for a GLOBE workshop

- All trained teachers are GLOBE certified (e-Training)
- 25th Anniversary, GLOBE Data Entry App

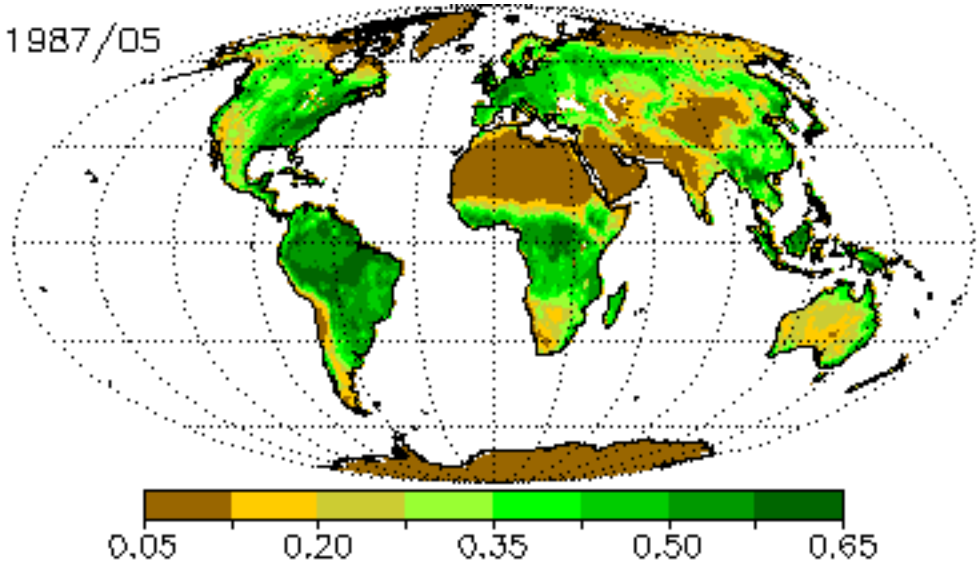
THE GLOBE PRO

March

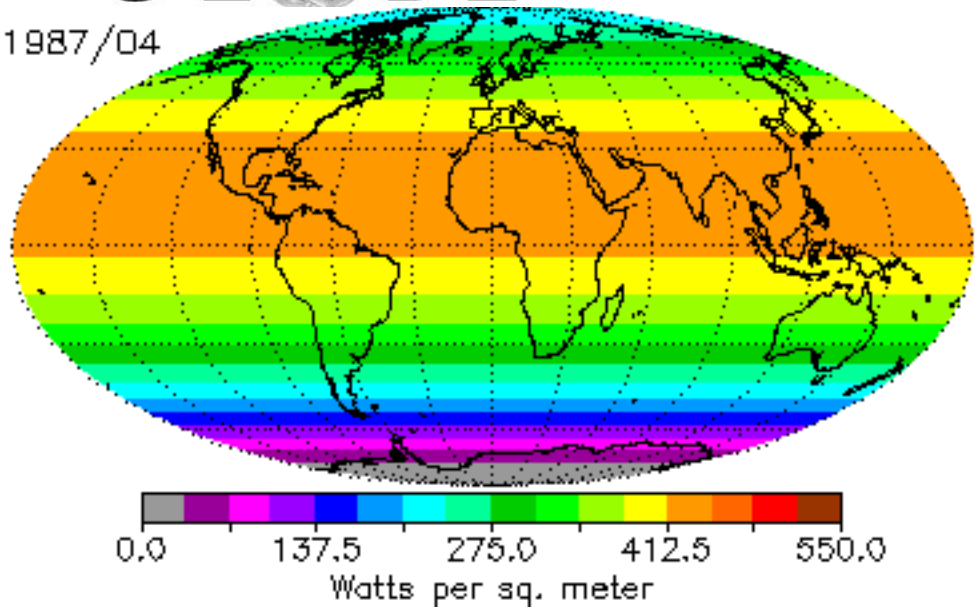


Normalized Difference Vegetation Index, 1987

May

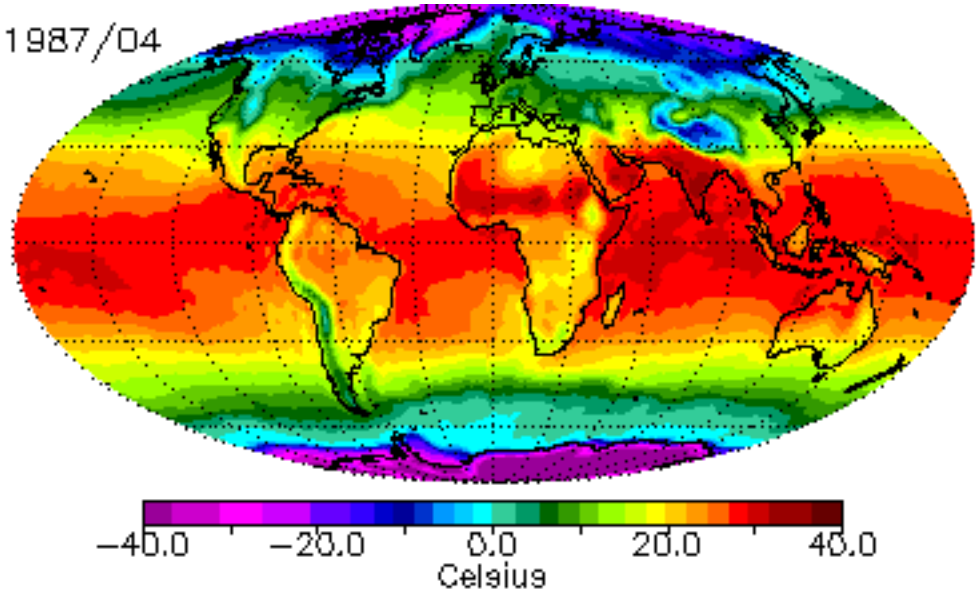


Solar Energy

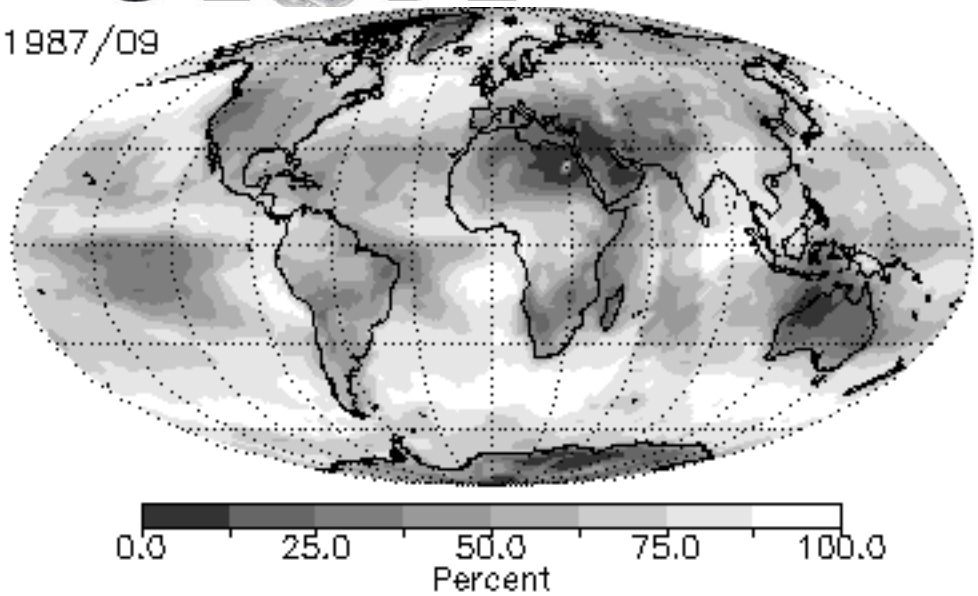


April 1987

Average Temperature

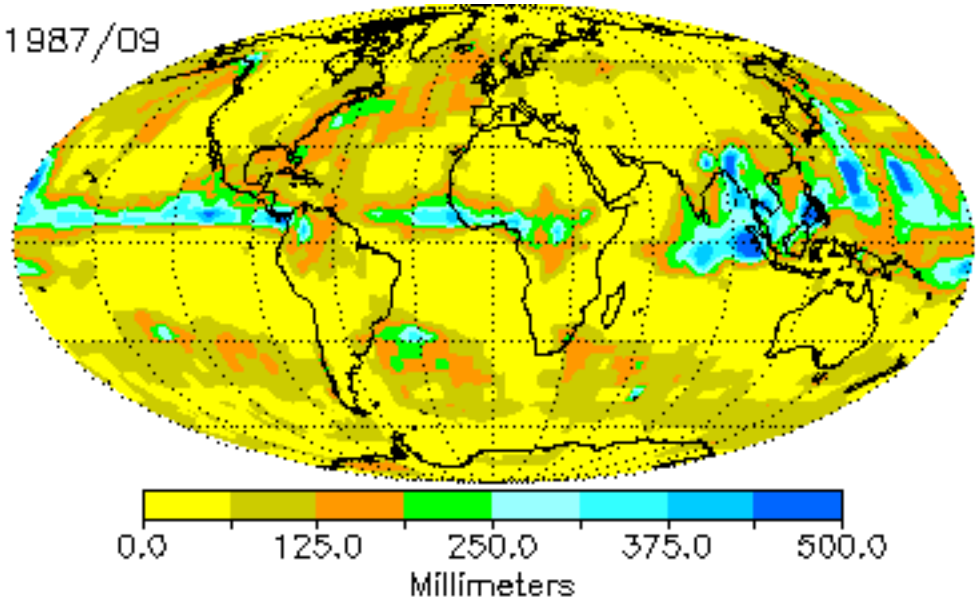


Cloud Cover



September 1987

Precipitation



NOAA GLOBE and Citizen Science

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