2015

Effective Computer Based Resources for Teaching Inquiry Based Science: The GLOBE Program

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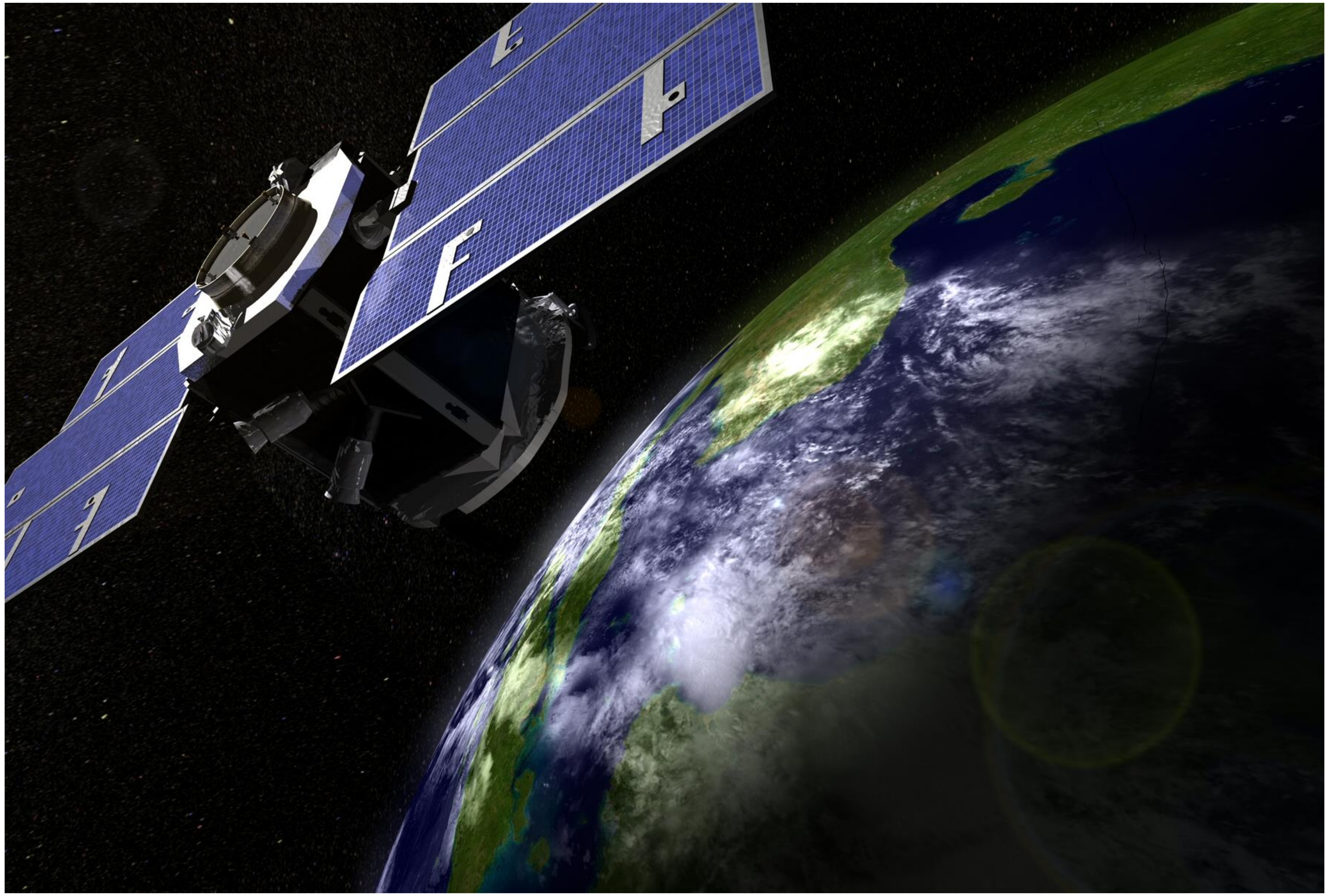
EFFECTIVE COMPUTER-BASED RESOURCES FOR TEACHING INQUIRY-BASED SCIENCE: THE GLOBE PROGRAM



University of the Philippines

National Institute for Science and Mathematics Education Development

NISMED International Conference

October 28-30, 2014

Sherry S. Herron, Ph.D.

University of Southern Mississippi

DEDICATION

My major professor and mentor, Dr. Rosalina 'Lina' Villavicencio Hairston, who first introduced me to NSTA, NARST, BSCS and GLOBE.

My Filipino family: Pia Campo, Josephine Estrera, Peter Orbita, and Miliza Romero.

COMPUTERS ARE HERE

More than half of the teachers surveyed across the U.S. reported that using digital technologies has strongly influenced the ways they teach.

~ 80% see computer use as important to the success of their professional work - for administration, communication, planning, and instruction.

Yet only 37% of the same sample reported using computers with their students daily. (p. 18).

Harris, J. (2008). One size doesn't fit all: Customizing educational technology professional development. *Learning & Leading with Technology, February 2008*, 18-23.

INQUIRY IS HERE

John Thornton, a retired biology professor who was a pioneer in the field of investigative laboratories, said:

"The general notion that you should engage students in investigations as a vehicle to teaching them science wasn't anything new 25 years ago. What was new then, and is still new now, is the idea that you can use this approach with all students".

Howard Hughes Medical Institute Report, 1997, p. 32

Math and Science Standards promote inquiry and the use of authentic data.

COMPUTER TECHNOLOGIES FACILITATE INQUIRY

PhET: University of Colorado, Boulder: **phet**.colorado.edu/

- Free online educational simulations covering a diverse topics designed by the University of Colorado Boulder available in many languages.

HHMI: Howard Hughes Medical Institute

Dolan DNA Learning Center: Cold Spring Harbor

http://www.dnalc.org/resources; http://www.dnalc.org/websites

Learn.Genetics: University of Utah

http://learn.genetics.utah.edu

Free Apple Apps, including Augmented Reality

Texas Instruments Graphing Calculators combined with sensors and probes

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION (NOAA)

Example: Digital coast "*More Than Just Data*"

How can data be collected if you can't get to far away spots? "Adopt a Drifter"!

Drop an instrument overboard and let the current take it where it will. Ground true-thing in the ocean! A class can adopt an instrument, follow its path, and record the data it is collecting.

http://www.noaa.gov/climate

www.estuaries.noaa.gov

http://dataintheclassroom.org

www.climate.gov

Global Learning and Observations to Benefit the Environment

http://www.globe.gov/

- Began on Earth Day 1995
  - 112 participating countries
  - 58,000 GLOBE-trained teachers
  - > 25,000 schools
  - > 1.5 million students
  - > 23 million measurements


THE GLOBE PROGRAM
English
Log In
Fourteen Countries Meet in Africa to Discuss GLOBE Student Research Achievements
Antananarivo, Madagascar served as the location of the 7th GLOBE Africa Regional Meeting in February 2012. Leaders from the 22 GLOBE countries in Africa met to discuss important issues related to implementation of GLOBE in their countries and to work towards greater participation,
31/74 ◄ prev | next ►
Home
Teaching & Learning
Explore Science
Community
News
Events
Media
About GLOBE
Join
Search
Welcome to GLOBE
The Global Learning and Observations to Benefit the Environment (GLOBE) program is a worldwide hands-on, primary and secondary school-based science and education program.
Learn More about GLOBE ►
GLOBE Community
See Members ►
Schools:
27,898
Teachers:
20,798
Total Measurements:
125,290,543
Enter Live Data ►
Enter Training Data ►
Collaboration Groups
Recent Postings In:
Community Feedback Forum
Thumbnail View of Documents
When I am choosing a PPT, Word doc or PDF file to download, it would be nice to
The Student ZONE
Learn how to be a student GLOBE scientist
Visualize and Retrieve Data

GLOBE Teacher's Guide

Overview

In the GLOBE Teacher's Guide, protocols and learning activities are related to the standards they address. In the United States, there is growing insistence that teaching be directed to address specific standards. Many countries in GLOBE and virtually every state in the United States have adopted standards for education, including science education. These standards vary, and it is not presently possible to provide a correspondence between GLOBE elements and every set of standards. However, there is much in common among the different sets of standards for science education.

For this Teacher's Guide, GLOBE has chosen to use the National Science Education Standards published by the US National Academy of Sciences, selected additional content standards that GLOBE scientists and educators feel might make appropriate additions to standards, and the National Geography Standards prepared by the (US) National Education Standards Project.

Teacher's Guide Introduction

English

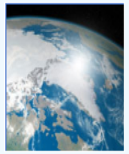
Spanish

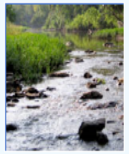
French

German

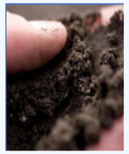
GLOBE provides five scientific investigation areas, each providing background information, measurement protocols and learning activities. Resources from the five areas can be combined in many ways, providing students and educators with many options for building meaningful scientific investigations. Also provided are data sheets and field guides to assist in the accurate collection of data.


Atmosphere


Earth as a System


Hydrology


Land Cover/Biology


Soil

THE GLOBE PROGRAM

YOU TUBE CHANNEL

GLOBE Learning Expedition held in August 2014, Delhi, India

https://www.youtube.com/watch?v=osSollSKq4o&list=PLfpnkASII_NYBUCwa0uZP53YutlHllcgf

GLOBE Salute to Teachers

https://www.youtube.com/channel/UCWSToq833hSt2meu8PWhrjQ

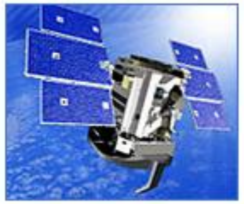
GLOBE Satellite Partnerships

Field Campaigns

Satellite Partnerships

Along with our current CloudSat and CALIPSO Missions, 2014 will be an exciting year for NASA Missions and GLOBE! Here are four opportunities to take part in GLOBE Campaigns related to NASA Missions: CloudSat, CALIPSO, Global Precipitation Measurement (GPM) and Soil Moisture Active Passive Mission (SMAP).

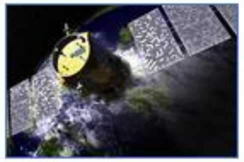
CloudSat



Clouds influence Earth's weather and climate. They bringing water from the air to the ground and from one region of the globe to another. Clouds also have a large impact on Earth's radiation budget; even small changes in cloud abundance or distribution could affect climate.

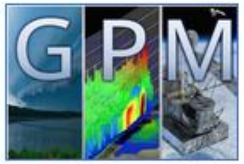
GLOBE students and teachers can collect and enter data that will be compared to CloudSat measurements. CloudSat, in turn, contributes Earth science learning opportunities to lifelong learners and shares the results of CloudSats scientific research mission to improve our understanding of clouds and global climate change.

CALIPSO



CALIPSO, a joint mission between NASA and the French Space Agency, CNES, provides new insight into the role that clouds and atmospheric aerosols (airborne particulates) play in regulating Earth's weather, climate, and air quality.

CALIPSO combines an active lidar instrument with passive infrared and visible imagers to probe the vertical structure and properties of thin clouds and aerosols over the globe.



Global Precipitation Measurement (GPM)

The Global Precipitation Measurement (GPM) satellite mission "will use multiple satellites orbiting Earth to collect rain, snow and other precipitation data worldwide every three hours." In GLOBE, students also take regular precipitation data. Updates here.

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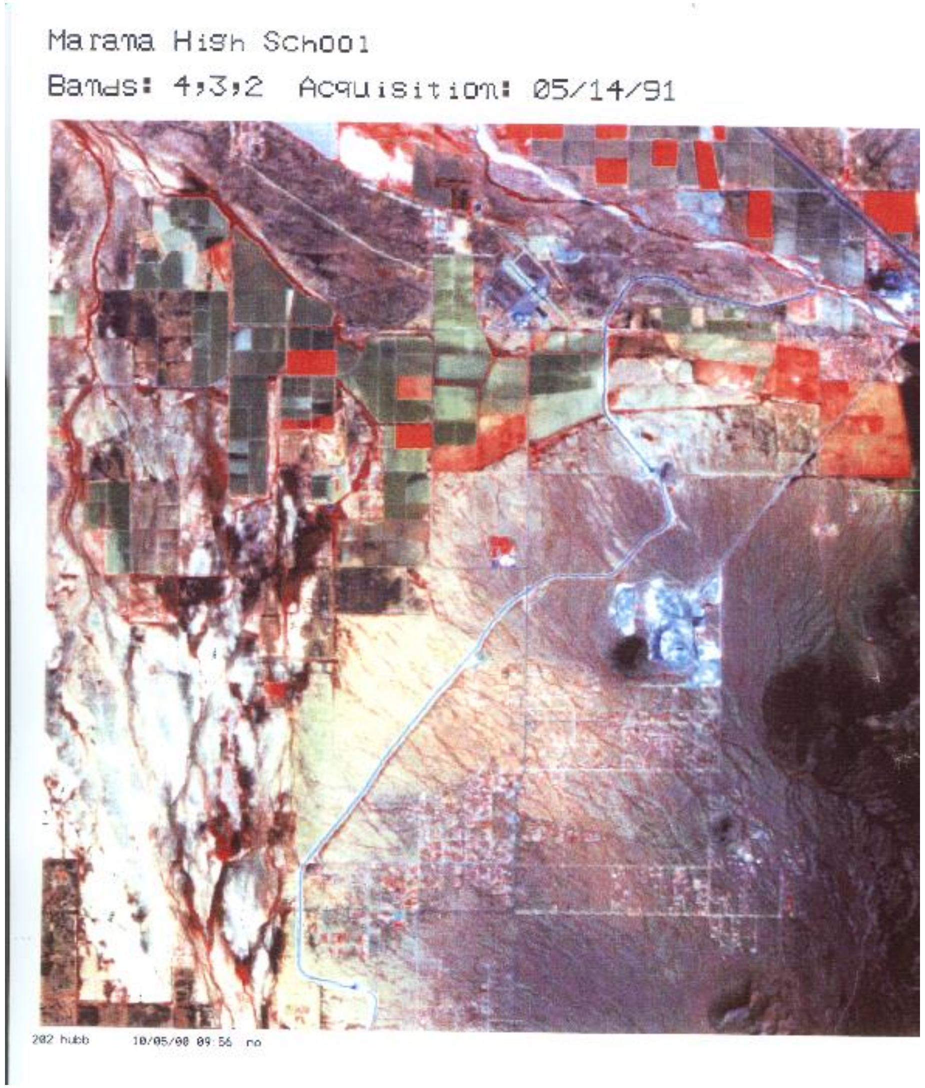
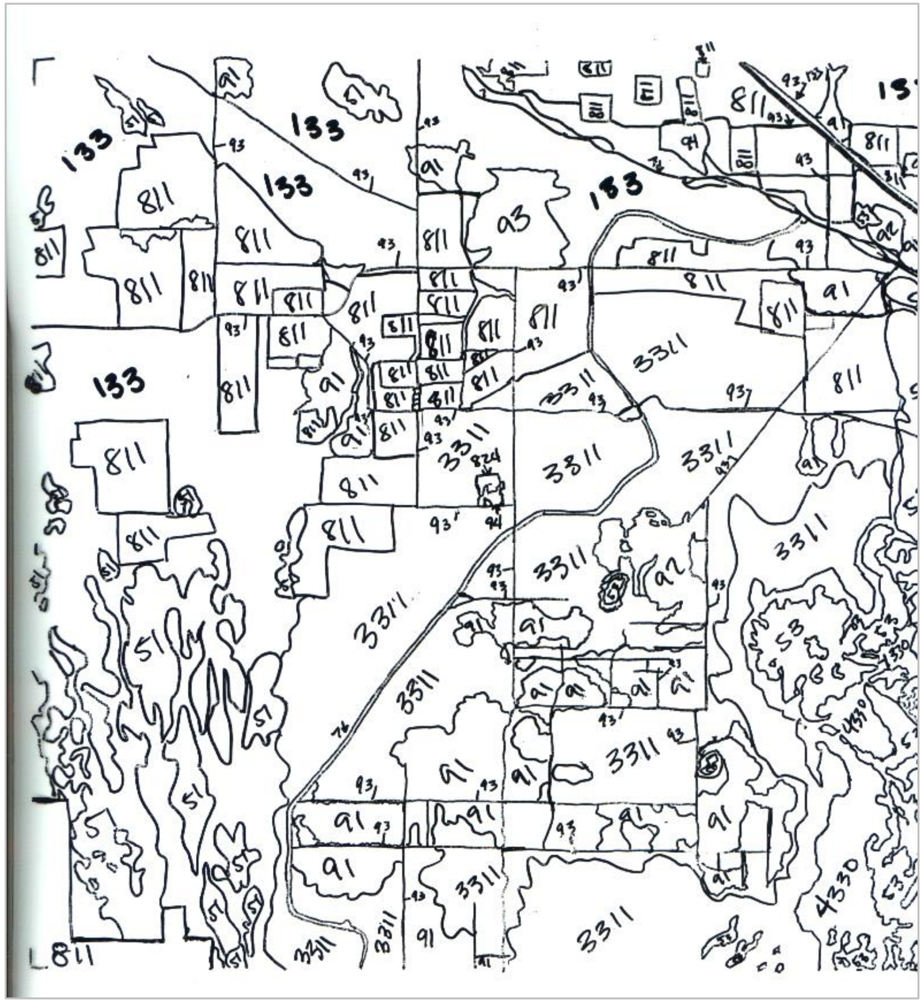
GLOBE students at Marana High School in Tuscon, AZ worked with Landsat images and data within the Land Cover investigation, conducting ground-truth measurements of land cover types.



Infrared Landsat image of Marana High School



The land cover map created by GLOBE students

GLOBE students in the U.S. and Germany did ground-truthing of the MODIS sensor flying on the Terra satellite.

This research was also a winning 2003 GLE student report

ASSESSING SATELLITE-BASED AEROSOL RETRIEVALS AND GROUND TRUTH VALIDATION FOR TERRA'S MODIS SENSOR OVER URBAN AREAS USING THE GLOBE PROGRAM'S HANDHELD SUN PHOTOMETERS

Melanie Benetato, Gianna D'Emilio, Jordan Glist, Chris Hanawalt: Students
Edmund Burke School, Washington, DC, USA

Frank Niepold, High School Science Teacher
Edmund Burke School, Washington, DC, USA

Abstract
The Edmund Burke School collected numerous GLOBE measurements from 2002 to the present. Working with David Brooks in his scientist, teacher, student partnership concept, Gianna D'Emilio, a Burke ninth grade student, expanded her 9th grade science fair project into a much larger undertaking. Gianna and three other students took aerosol measurements coinciding with the times of overflights of the Earth-observing spacecraft TERRA because "ground truth validation" is an essential component of any program that attempts to use space-based measurements to study Earth's atmosphere. The MODIS measurements collected on TERRA were used to calculate aerosol optical thickness (AOT) at several wavelengths. The team of students completed nine months of AOT measurements, refined the GLOBE *Aerosol Protocol* and has established a data analysis protocol to be used by another team of trained students as part of their long-term science education. The results presented in this paper are inconclusive due to a number of unknown variables. Although GLOBE's ground validation yielded values 0.64 - 4.08 standard deviations below the MODIS AOT values, we cannot be sure whether this is due to procedural (systematic), or random discrepancies.

Research Question

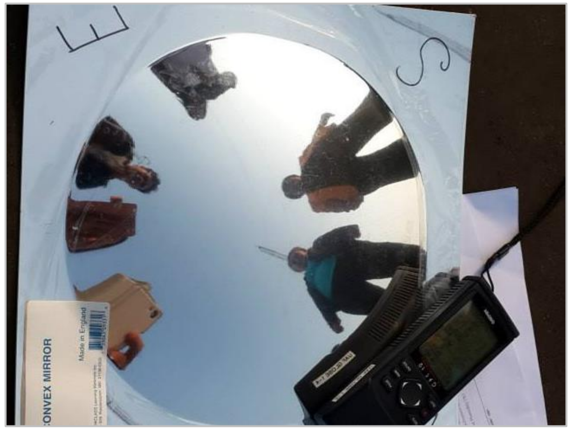
Can the accuracy of MODIS' Aerosol Optical Thickness observations be validated over urban areas by GLOBE's ground validation techniques?

Background

Aerosols have both natural and man-made sources. Volcanoes, dust storms, agricultural activity, marine spray, air pollution from industrial activity, fossil fuel burning, and forest fires all contribute, influencing both weather and climate. The details of their effect on climate (and, in particular, on models for

THE GLOBE PROGRAM

CloudSat and CALIPSO missions became satellite partnerships with GLOBE.



Students gather around a CloudSat convex mirror.

Teachers learn how to use sun photometers to collect aerosol data and observe clouds in four quadrants of the sky.

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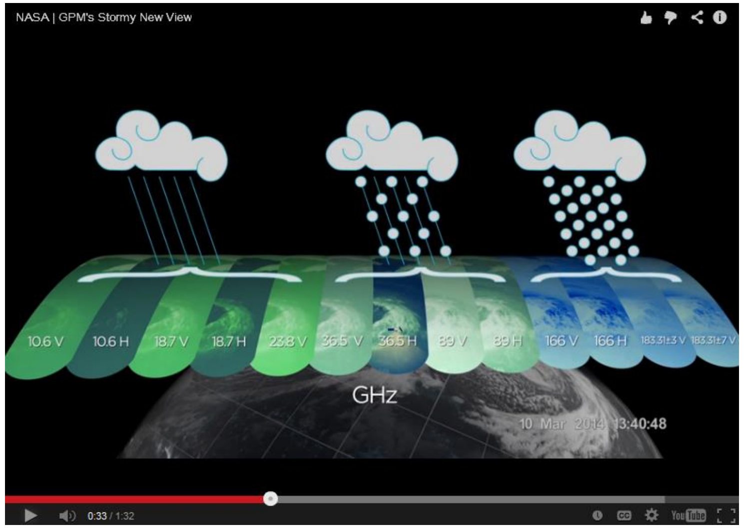
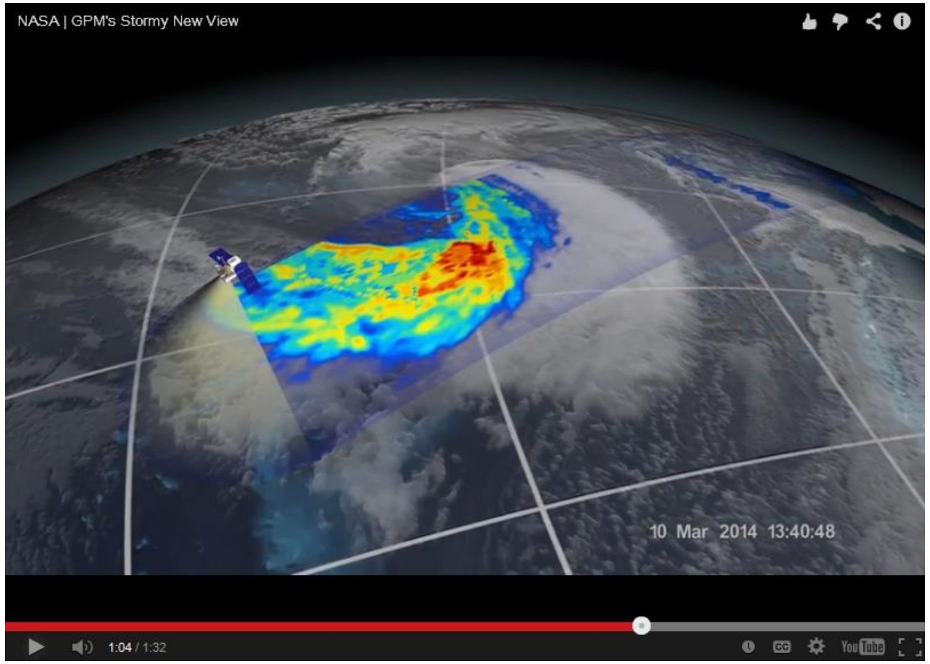


全球降水観測計画
GPM
GLOBAL PRECIPITATION MEASUREMENT

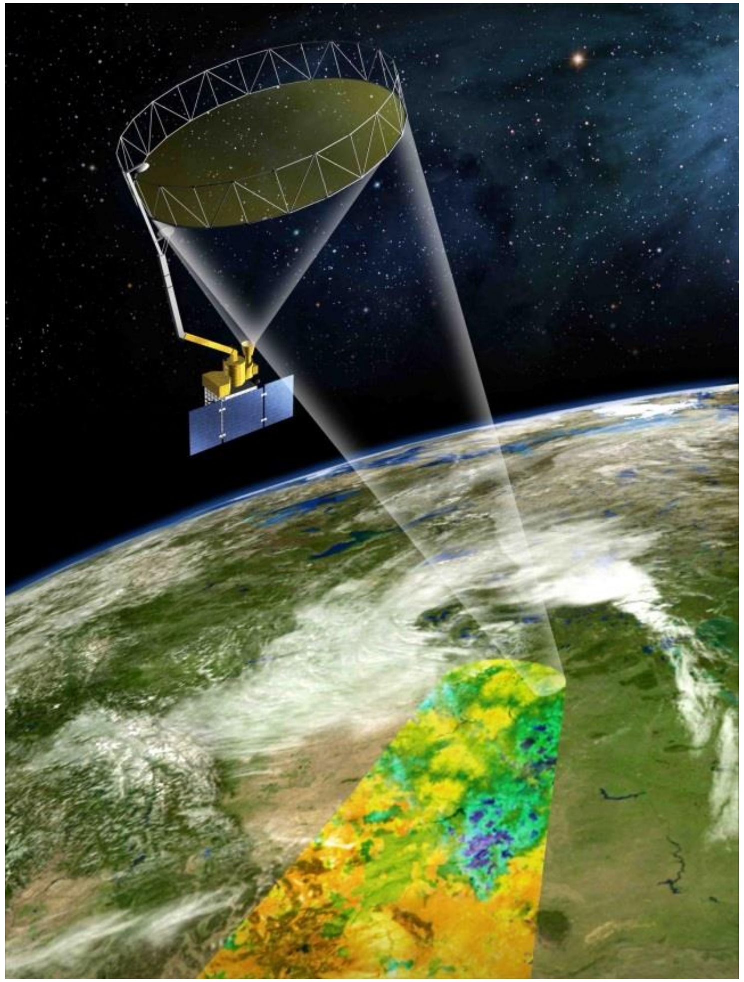


These first images show precipitation falling inside a cyclone over the northwest Pacific Ocean, 1700 km east of Japan.

SMAP: Soil Moisture Active Passive

Scheduled to launch in November 2014

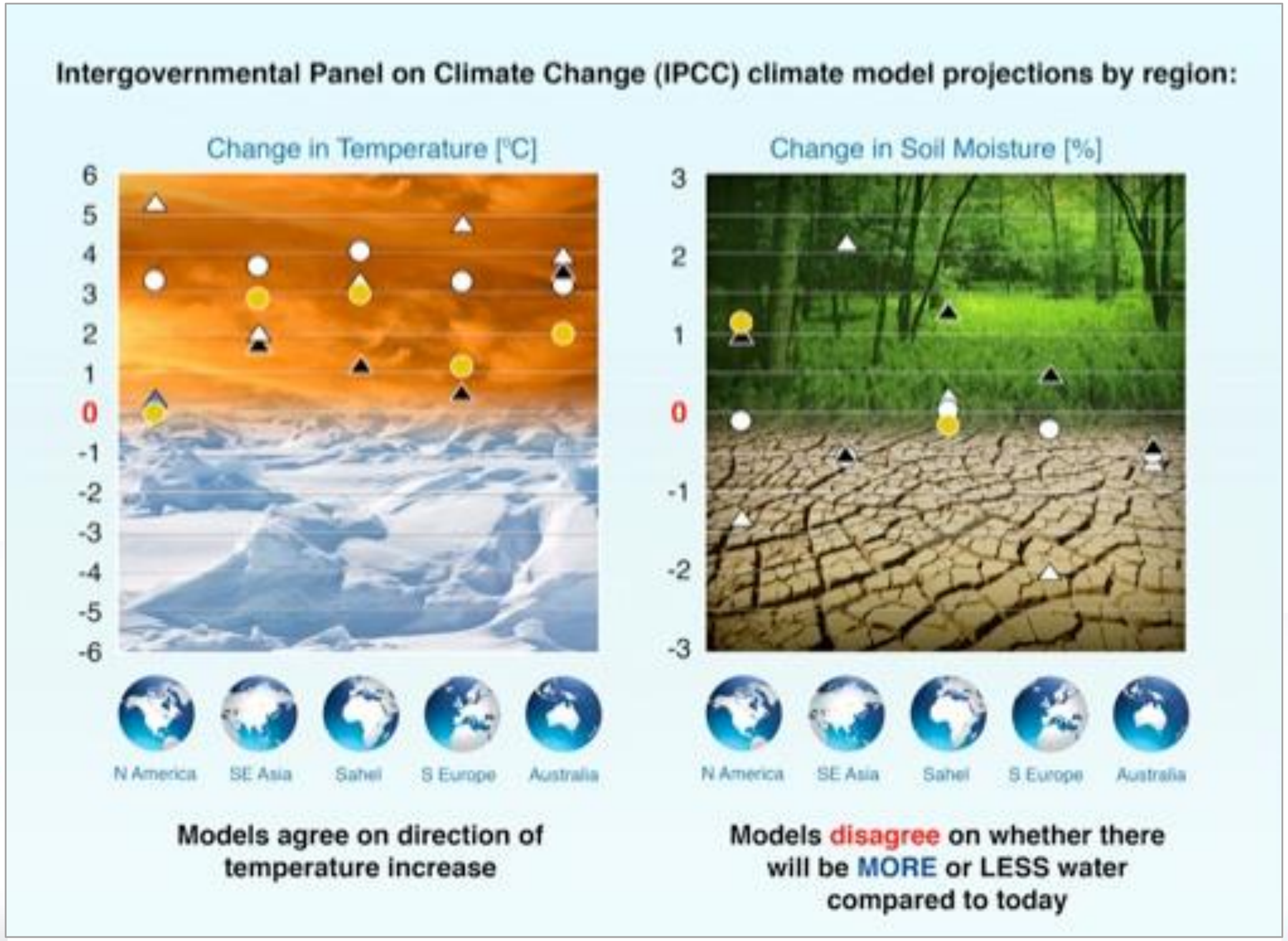
2 sensors – both in the Microwave range, will allow the satellite instruments to collect data regardless of cloud cover and light.



Active/Passive Mission:
Active (Radar) provides high **resolution** (3 km);
Passive (Radiometer) provides high **accuracy** resolution (40 km)

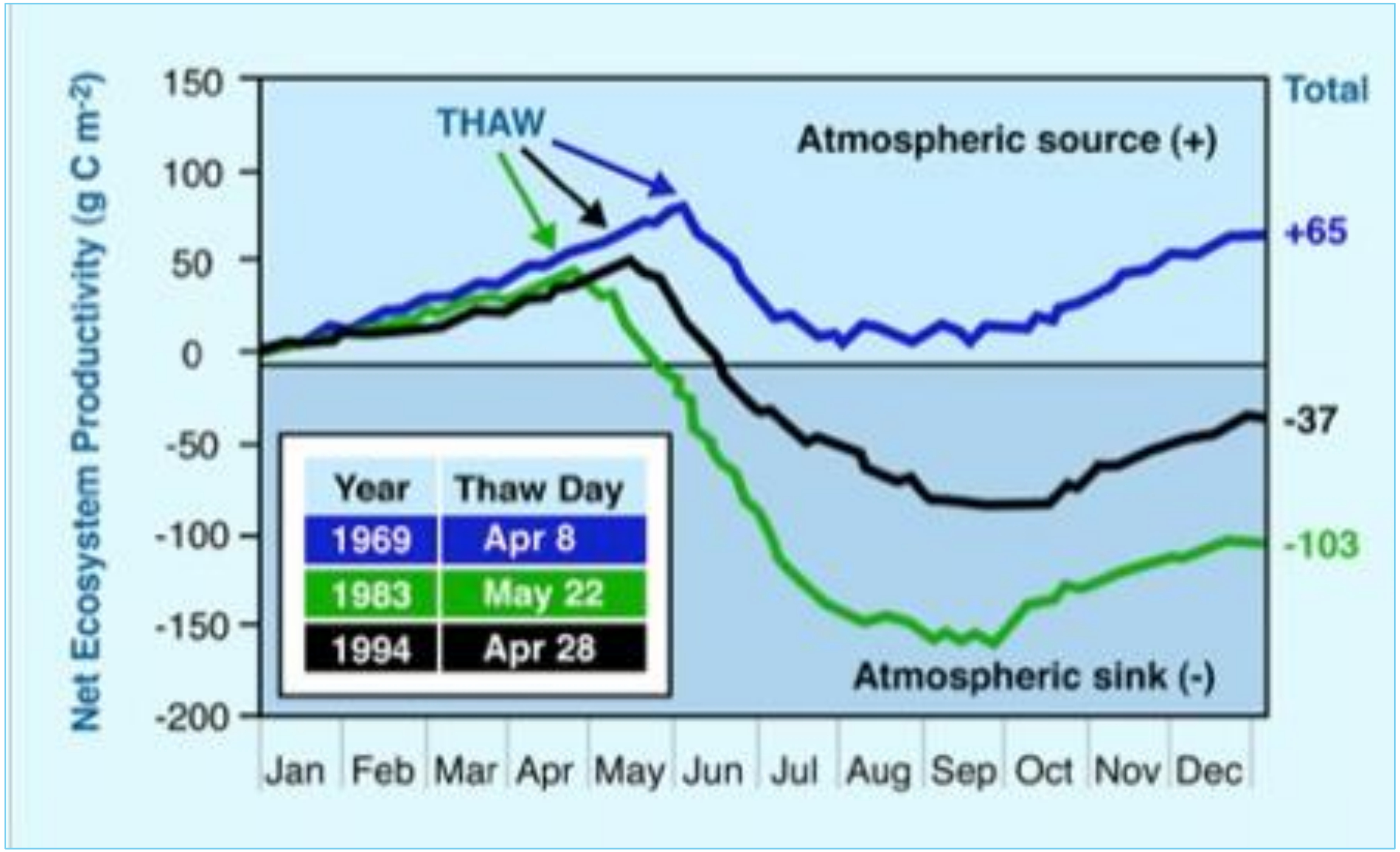
Continuous 1000 km swath allows for each site to be reimaged every 3rd day
SMAP will fly at a sun-synchronous (6am/6pm) orbit

How will global climate change affect water supply and food production?



Models disagree; in situ and remotely sensed data could bring agreement among the models.

SMAP will also quantify seasonal freeze/thaw state transitions



Why? Soil moisture plays a major role in determining the length of the growing season. Carbon uptake and release is determined by the growing season. Understanding the long-term trends is key in estimating terrestrial carbon sources and sinks.

GLOBE schools can help calibrate and validate SMAP data

SMAP Educational Resources

THE GLOBE PROGRAM

Our World (K-5)

Learn about soil and how different kinds of soil hold moisture. See how NASA plans to use measurements from the Soil Moisture Active Passive Mission, or SMAP, to make Our World a better place to live.

Real World (6-8)

What is the connection between water, soil and carbon cycles? The answer may be in the soil beneath your feet. See how NASA plans to measure soil moisture from space with the Soil Moisture Active Passive Mission, or SMAP. Learn to calculate soil moisture in your own backyard and discover the real world applications for this data.

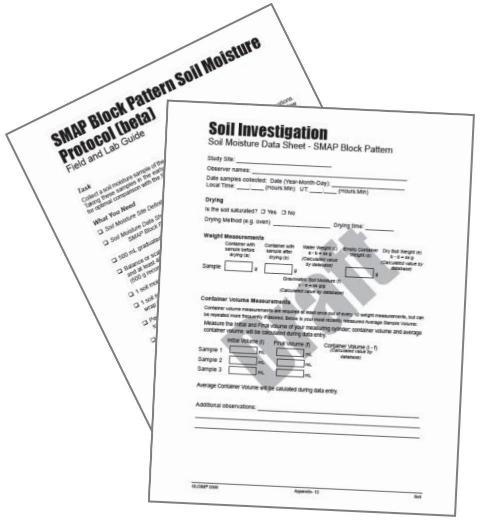
Launchpad (9-12)

Learn how NASA's Soil Moisture Active Passive Mission, or SMAP, will use new technologies to help answer questions raised in the National Research Councils' Decadal Survey. See what kind of modeling and forecasting applications the data from this mission will provide as it measures the soil moisture that cools Earth's surface and provides water to the atmosphere and plants.

https://smap.jpl.nasa.gov/educationpublicoutreach/

THE GLOBE PROGRAM

Data collection materials for the SMAP Block Pattern Soil Moisture Protocol



Data sheet and field guide

GPS Receiver

A scale (0.1 g sensitivity & 400 g capacity)

Soil sample can with lid

Trowel

Meter stick or centimeter ruler

Hammer and nail

Oven mitts or hot pads

Drying oven

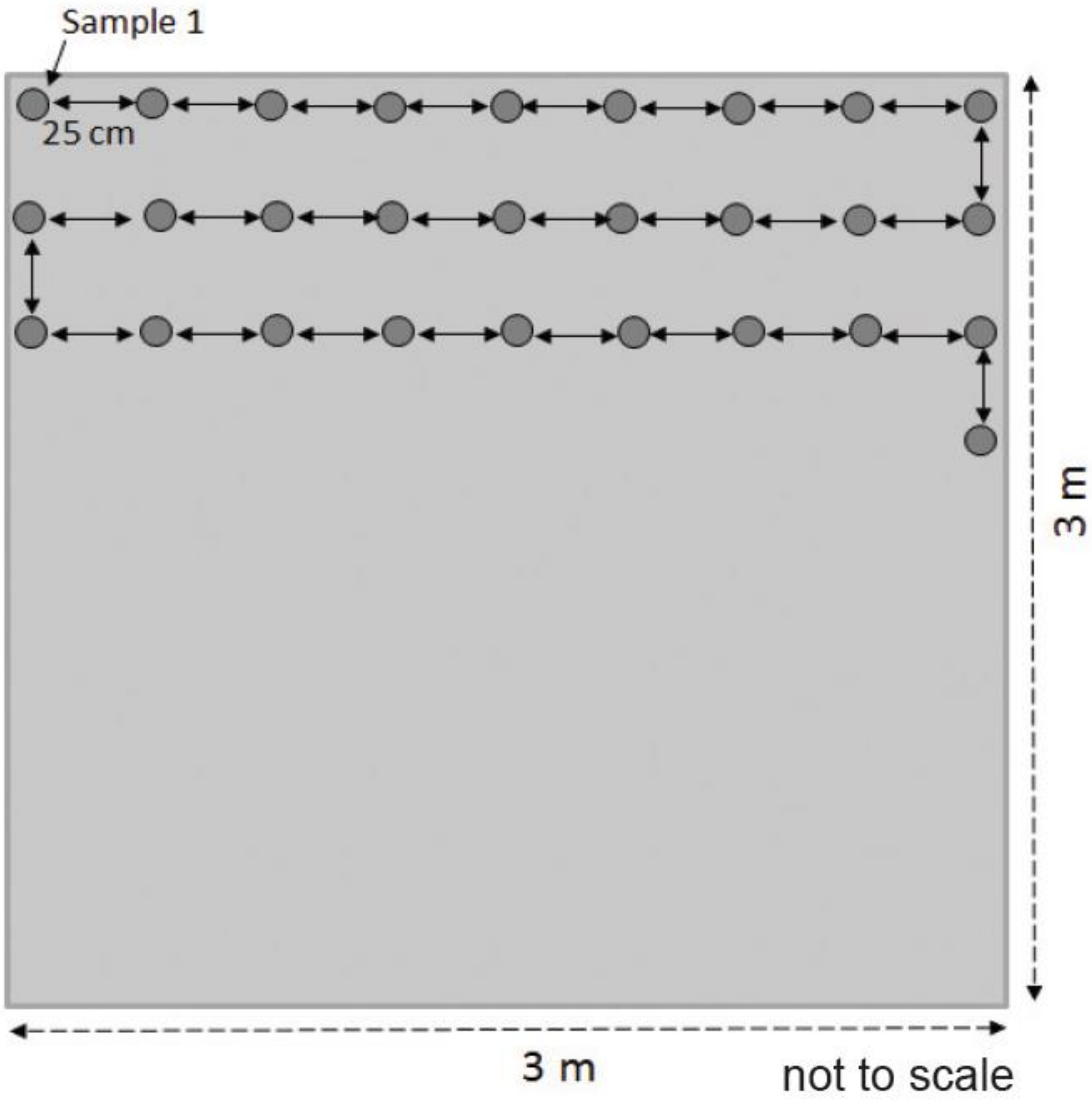
500 mL graduated cylinder

Wood block

pencil

… and soil!

SMAP Block Pattern Sample Site and Sampling Procedure



WITH FUNDING FROM NOAA AND EPA…

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STUDENT SCIENTISTS

Tupelo Middle students measure trees, collect water samples

Their data will be logged on website that scientists around e world can access.

BY CHRIS KIEFFER
Daily Journal

TUPELO – Science proved to be ore work than Tupelo Middle chool eighth-grader Kimya Jaasbi expected.

After spending a class period easuring the trees on the chool's athletic field, Kimya said he was surprised to be ducking nder branches and getting oked by limbs.

"It was a good experience," she aid, "but I didn't like climbing hrough the trees."

Kimya was among about 300 udents participating in a hands-n activity Wednesday with science educators from the Univerty of Southern Mississippi.

The students, from Holly Baiey's seventh-grade science class nd Judy Harden's eighth-grade cience class, peered at the trees hrough a tube-shaped instrument called a densiometer; used easuring tape to determine circumferences of trunks; and carried clipboards to record data.

They will log that information hroughout the year and record it n an online database that allows cientists to use the results hroughout the world.

"Hopefully they will gain an wareness of how science works nd what scientists do," said herry Herron, professor and diector of the Center for Science nd Mathematics Education at USM.

Herron joined Shelia Brown at he school Wednesday to give he students a lesson on collecting data. Brown is an educator/ biologist at Gulf Coast Research Laboratory Marine Education Center in Ocean Springs, part of USM.

Kate Wheeler and George Patterson measure and record the size of a sycamore outside of the school. Below, Shelia Brown assists Tupelo Middle School students, from left, Wyatt Herring, Marcus Lewis, Lucas Hartigan and Jason Garrett with their recording of scientific data.

The activity is part of a grant that Harden received for the Formal and Informal Environmental Education program. The two classes also aren't the only ones at Tupelo Middle working with USM educators.

Brown was also at the school on Tuesday leading a lesson for seventh-grade math teacher Connie Gusmus and art teacher Leah Patterson.

That lesson about fish, pressure waves and sharks' electromagnetic senses is part of a B-WET grant that Gusmus has received. B-WET is an acronym for Bay Watershed Education and Training.

Gusmus's classes will collect water samples throughout the year and test their pH and levels of oxygen, phosphates and nitrates.

Like Harden's and Bailey's science classes, they will log their information in GLOBE, an online

apply math and science and why scientists do different things," Gusmus said.

Harden's and Bailey's students also will record water samples to GLOBE in addition to their observations about the density of tree canopies and the height and circumferences of the trees. Scientists are able to use that data to observe conditions throughout

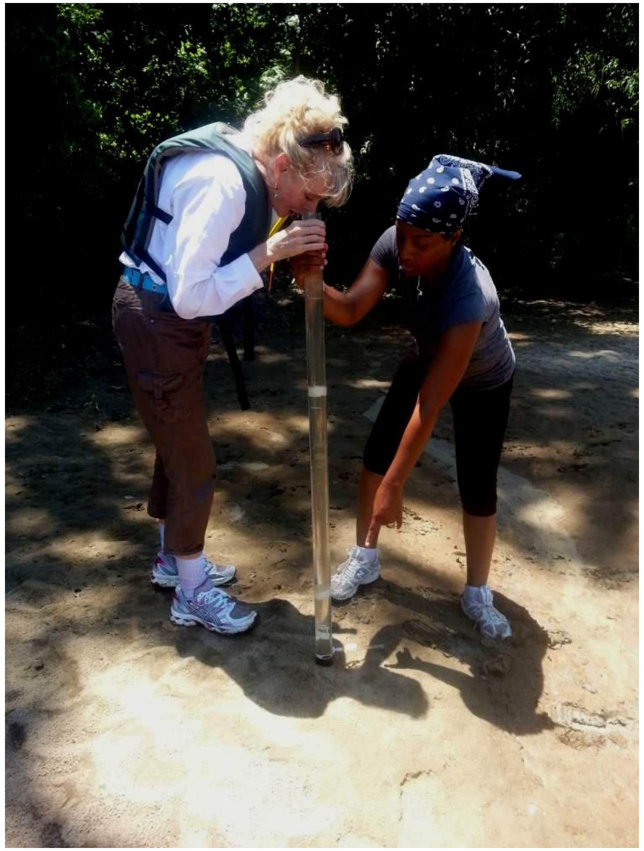
ment."

Two groups of students will also go to the Gulf Coast during the spring for even more experience in marine biology.

"It is great that the students get to work with real scientists," Harden said. "It is wonderful for them to meet and talk to people who do this for a living."

Eighth-grader Rachael Malone

MY UNDERGRADUATE AND GRADUATE STUDENTS

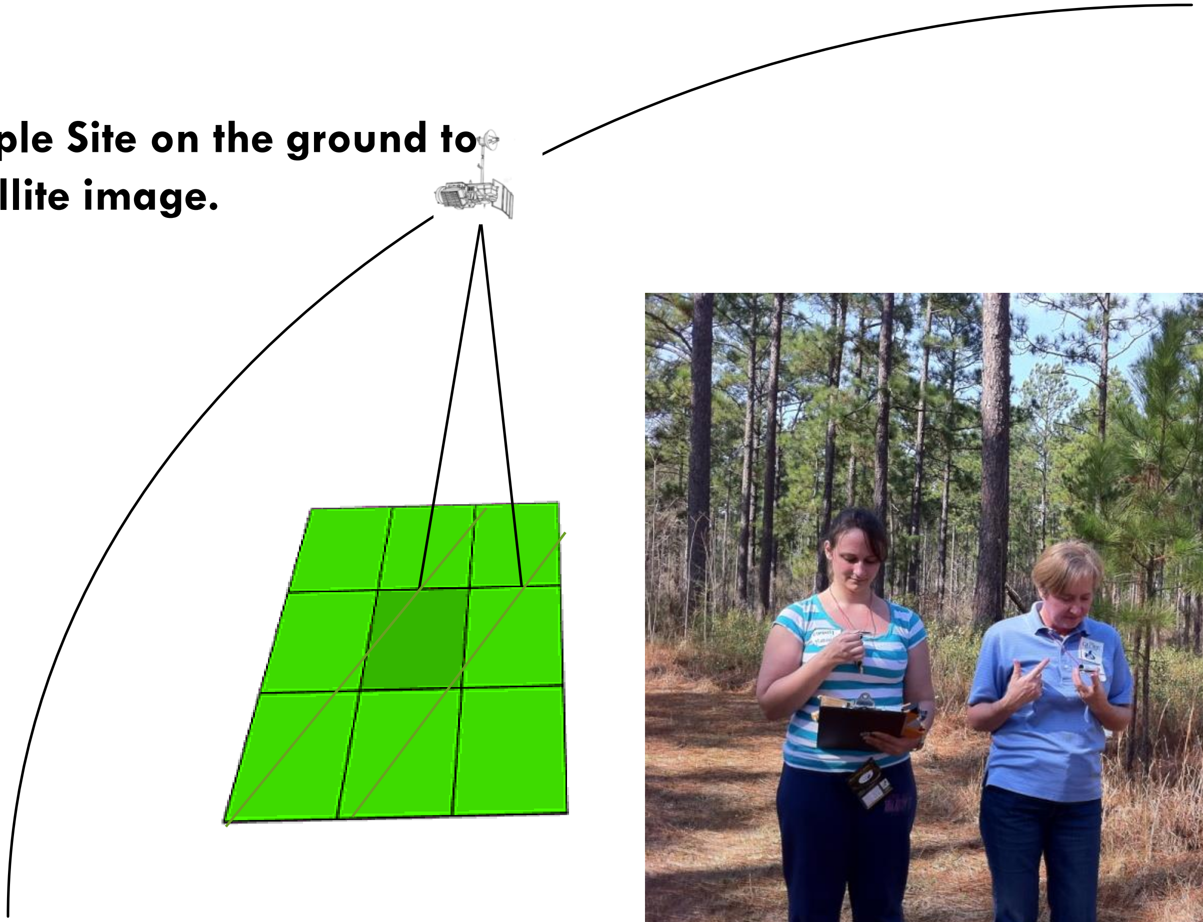


LONGLEAF PINE *PINUS PALUSTRIS*

These once dominant trees have largely been replaced by loblolly and slash pines across the southeastern U.S. My students study climate change, the effects of controlled burning in maintaining the longleaf population, compare biomass, and many other studies.

USING GPS

We compare each Land Cover Sample Site on the ground to the corresponding area on the satellite image.



MEASURING AND MARKING OFF A STUDY SITE IS HARDER THAN YOU THINK!

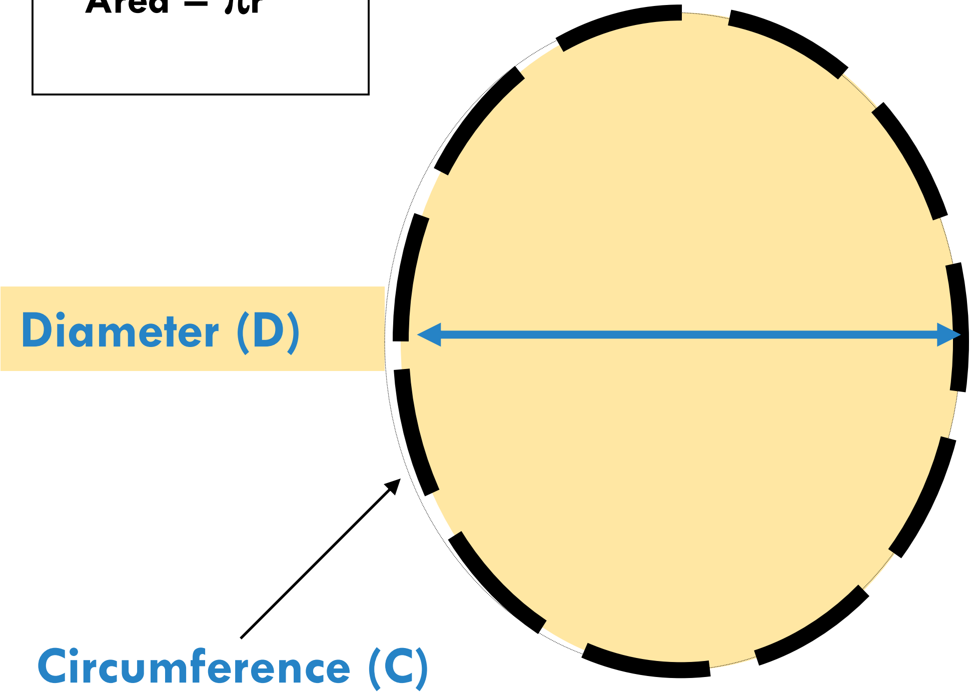
Measuring Tree Height with a Home-made Clinometer

TAPE MEASURE IS USED TO MEASURE DIAMETER AT BREAST HEIGHT (DBH)

$\pi = 3.14$

$D = C/\pi$

$Area = \pi r^2$



THE GLOBE PROGRAM

CONNECTING THE NEXT GENERATION OF SCIENTISTS

Investigating the Carbon Cycle in Terrestrial Ecosystems

Carbon Cycle

http://globecarboncycle.unh.edu/

NSF

NASA

UNIVERSITY of NEW HAMPSHIRE

EXCEL SPREADSHEET WITH PRE-LOADED FORMULAS IS USED TO CALCULATE BIOMASS

Plot Size

In order to compare your data to data collected by others, our calculation of biomass per plot will be converted to biomass per square meter. This conversion requires some information that you will enter here about your plot size. **Enter data into either 1 or 2 below in meters**:

1. If your plot is rectangular, enter the LENGTH of a SHORT and LONG side
2. If your plot is circular, enter the plot RADIUS
3. If you have an odd sized plot (for instance you've sampled your entire schoolyard, calculate the entire area in m^2, and add it here)

Calculated plot size in m^2 0

Investigating the Carbon Cycle in Terrestrial Ecosystems

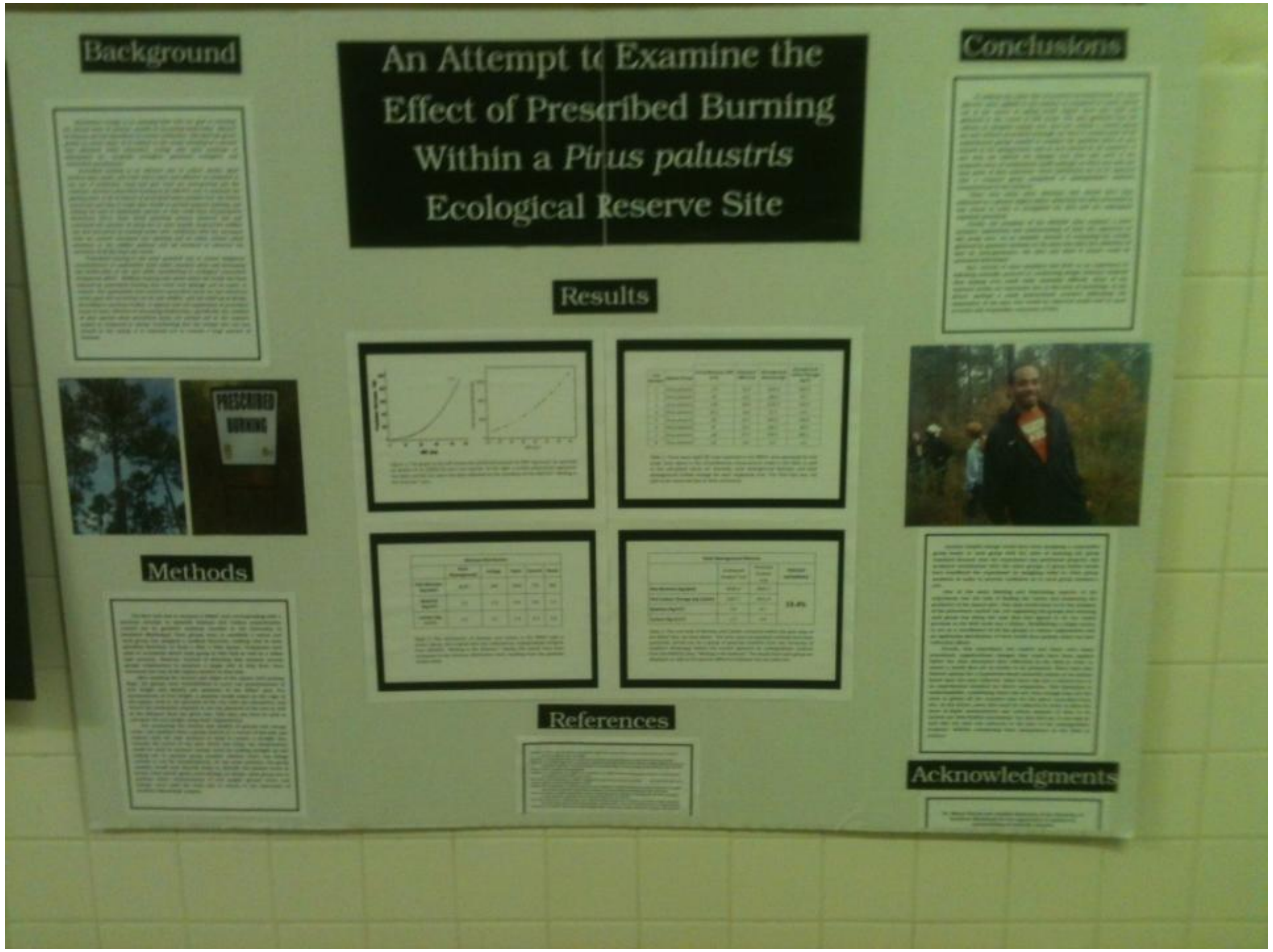
Carbon Cycle

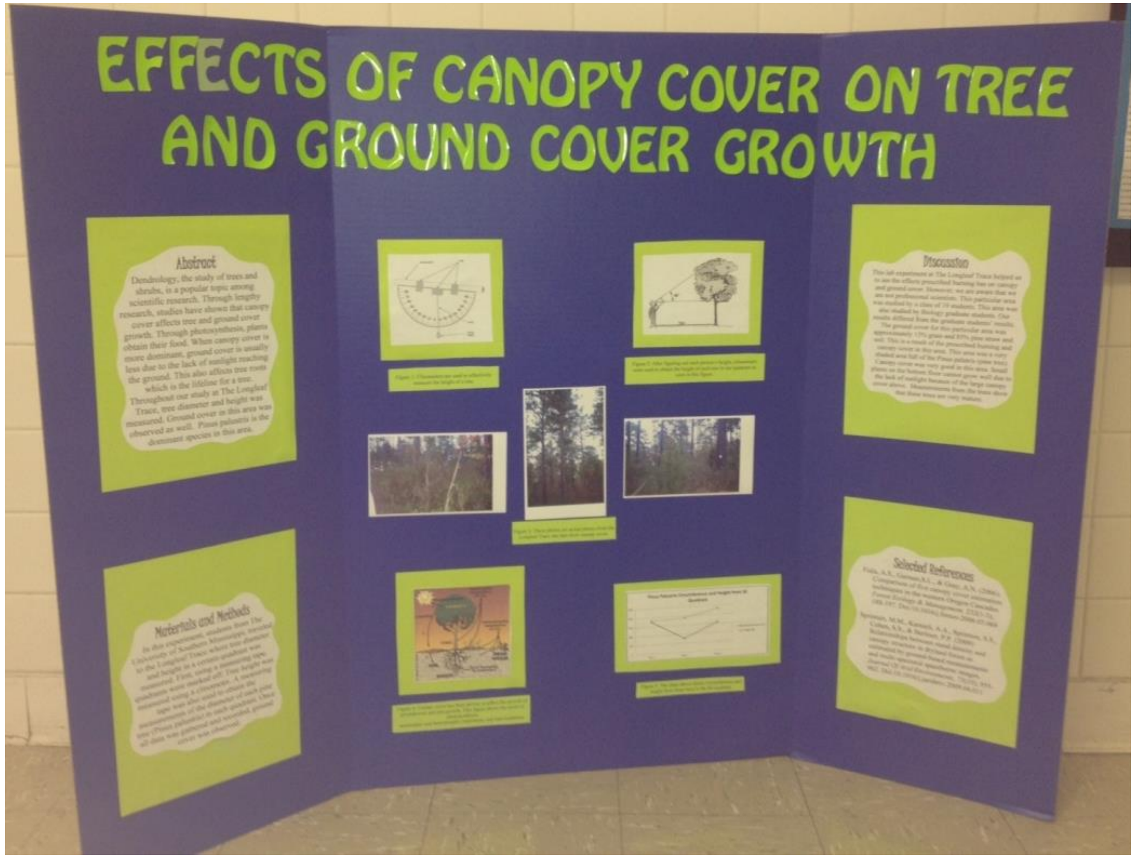
One of our examples of Biomass Calculation

Tree #	Species Group	Circumference/ CBH (cm)
1	Pinus palustris	132.91
2	Pinus palustris	138.92
3	Pinus palustris	148.84
4	Pinus palustris	159.83
5	Pinus palustris	76.93
6	Pinus palustris	159.83
7	Pinus palustris	171.76
8	Pinus palustris	127.8
9	Pinus palustris	86.98
10	Pinus palustris	70.97
11	Pinus palustris	113.04

Table summarizing the tree data					
	Total Aboveground	Foliage	Stem	Branch	Roots
Plot Biomass (kg/plot)	7843	451	6118	1274	1670
Biomass (g/m2)	8714	501	6798	1415	1855
Carbon (g C/m2)	4357	250	3399	708	928

Examples of My Students' Presentations





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