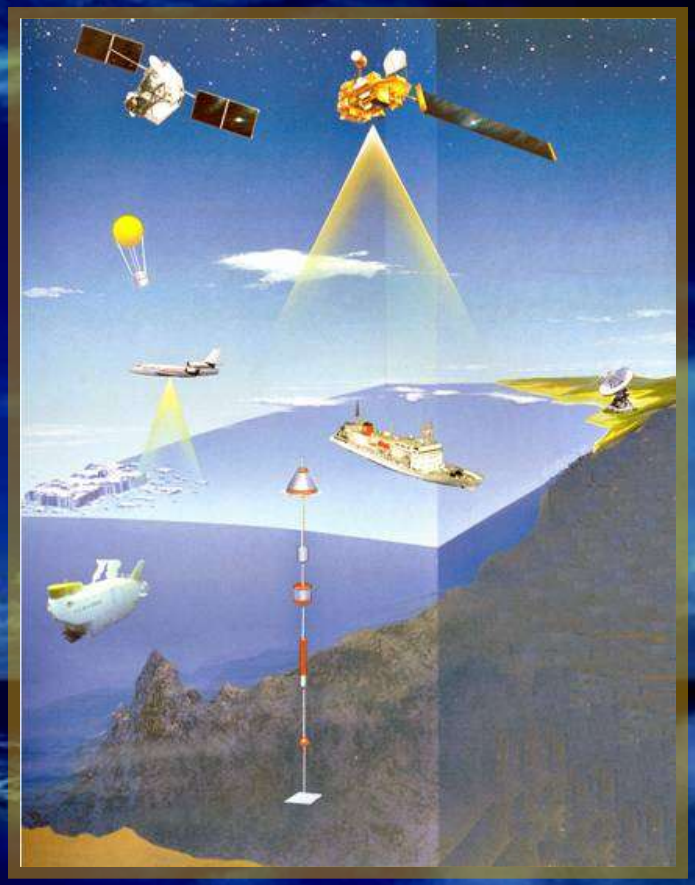


Improved Student Research with the Use of Drifting Buoy Data

Workshop to Define Student Collaborative Climate Research
Silver Spring, MD
November 17, 2010

Ruth Krumhansl

Science and Math Education Programs Development Center, Newton, MA

AND

Diane Stanitski

Adopt a Drifter Program Coordinator
NOAA, Silver Spring, MD

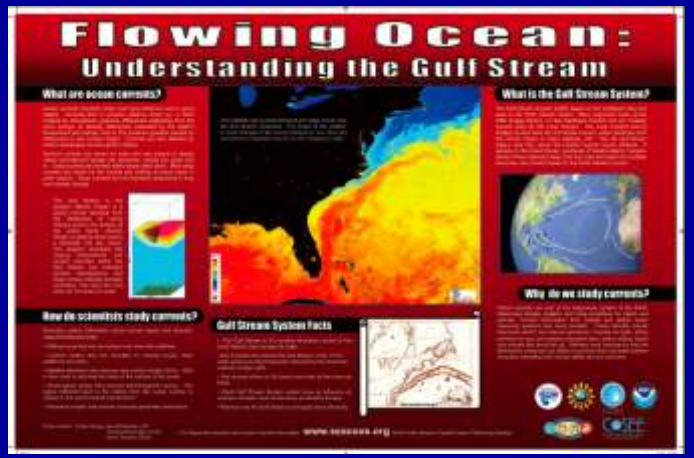
photo courtesy of MeteoFrance

Students become involved in scientific research at the data analysis stage, looking for patterns in real-time and archived scientific data available online

Image courtesy of the Center for Environmental Visualization, UW

Context for Project

Changes in the direction and velocity of ocean currents due to global warming may affect the migratory patterns of marine species. Long-term monitoring of the position of ocean currents and sea surface temperatures (SST), particularly along the northern and southern boundaries of migratory species' ranges, are necessary to identify long-term trends in environmental conditions and distinguish them from normal seasonal variability. These data, correlated with larvae retention or transport, reports of marine species strandings, and/or unusual sightings of marine species as documented by marine laboratories, will provide important insight into the potential impact of shifting ocean currents on marine organisms.



Research Objective

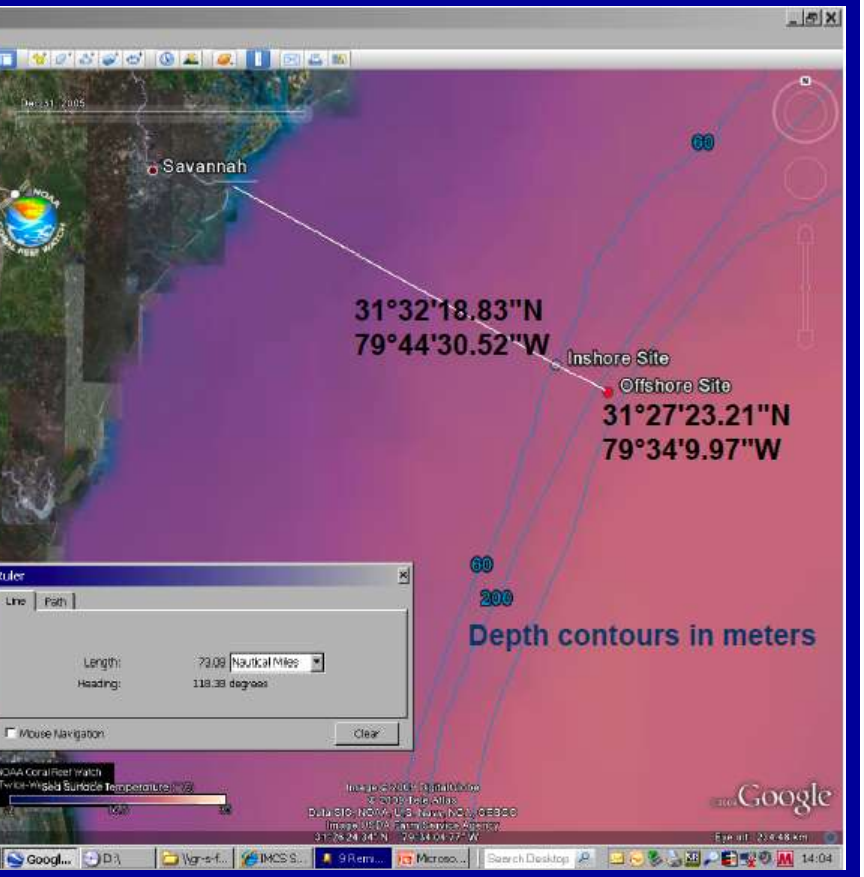
Students will search for links between ocean currents and marine species to determine if changing climate has impacted or is affecting their migration patterns.

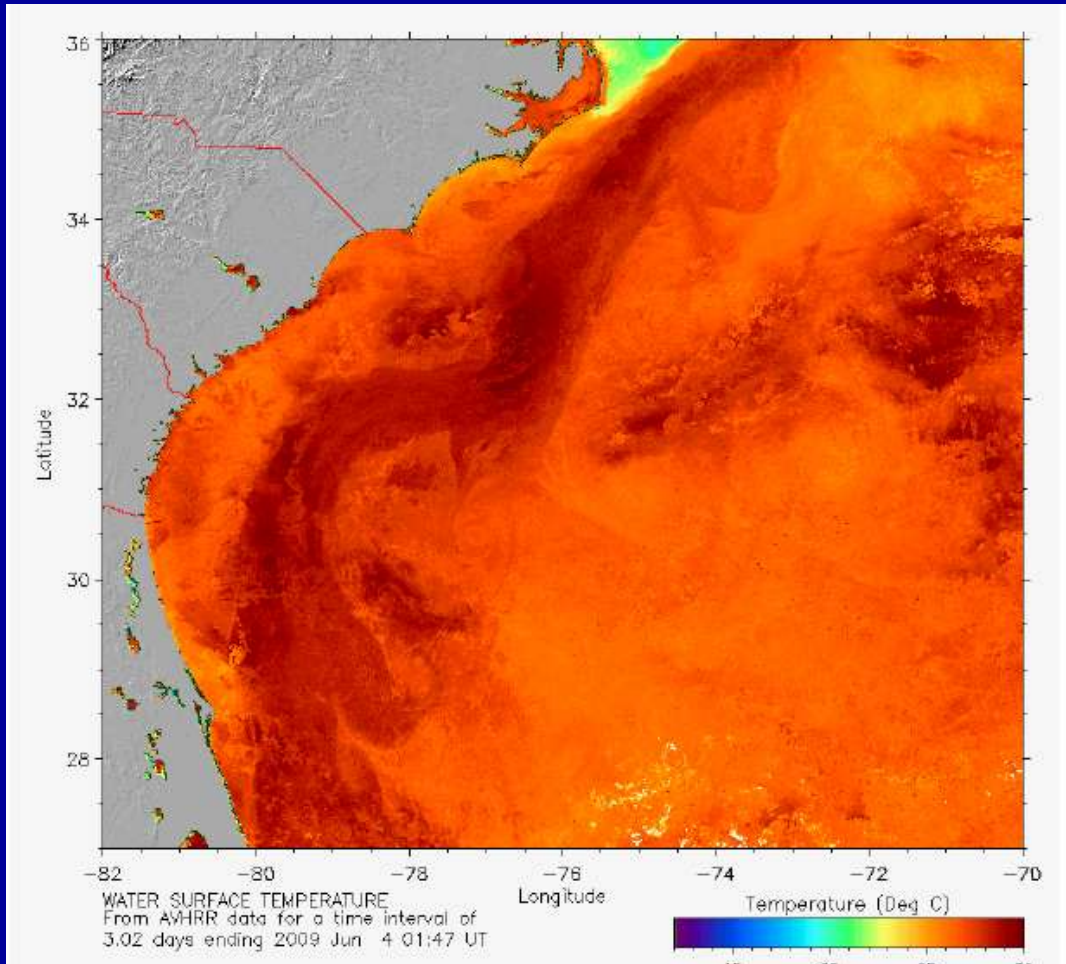
How do we measure ocean currents?

What is a Drifting Buoy?

Drifting buoys are satellite-transmitted ocean instruments that measure sea surface temperature and sea surface pressure.

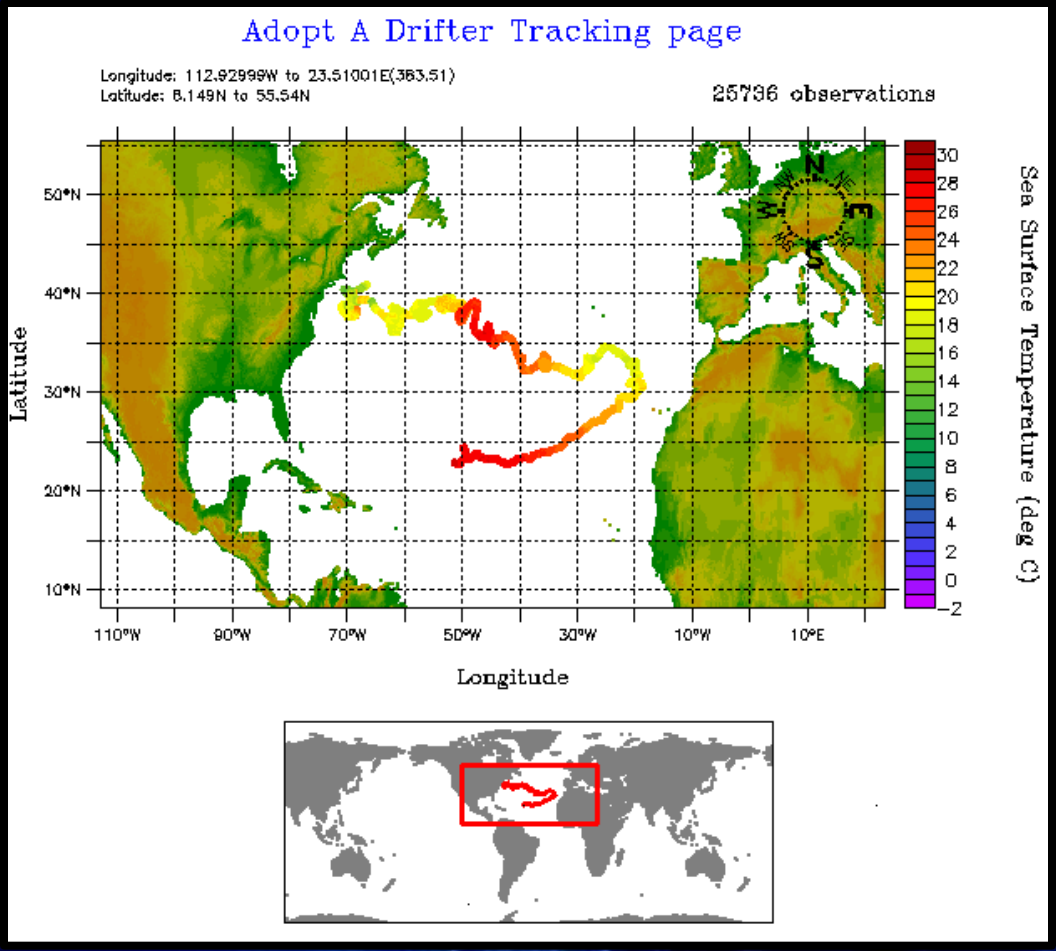
Drifting buoys are deployed in ocean currents and currently schools co-adopt drifters and analyze the data as part of the NOAA Adopt a Drifter Program.





The Global Drifting Buoy Array

The Adopt a Drifter web site allows you to Select a Buoy to Track Ocean Currents and Sea Surface Temperature in Real Time

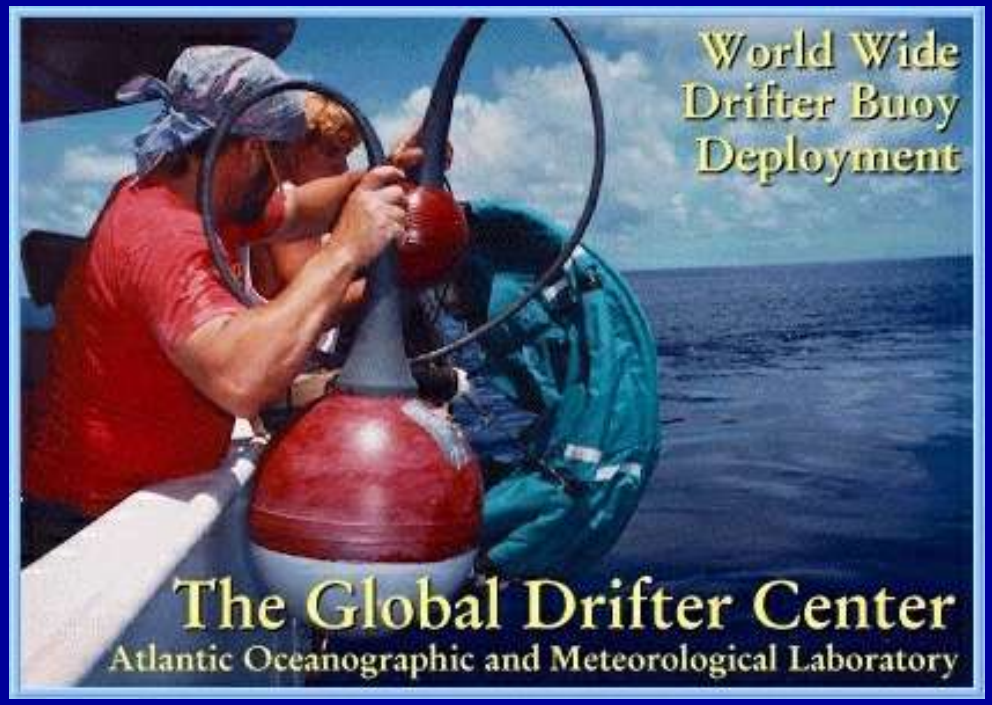


Adopt a Drifter Tracking Page

http://www.adp.noaa.gov/

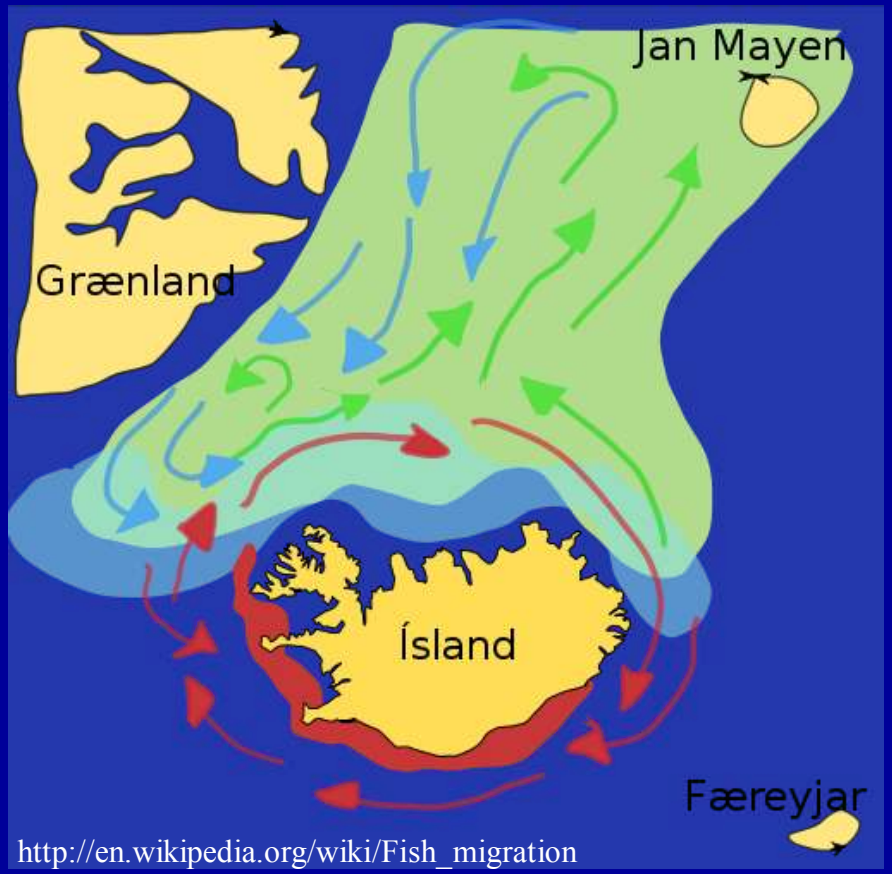
Drifter Data Are Important

- Help to Predict Path of Hurricanes
- Reveal Ocean Temperature Patterns
- Monitor Ocean Currents, Winds
- Ground truth Satellite Data
- Predict the Path of Ocean Pollutants
- Help Determine the Path of Migratory Species



http://www.aoml.noaa.gov/phod/dac/gdc.html

Important Migrations



Migration of Icelandic capelin

Example Species

Altering Migrations

Many species depend upon ocean currents to aid movement, with a number of turtle species using ocean currents to migrate. During their juvenile phase, hawksbill turtles and loggerhead turtles float on ocean currents until they mature. Turtle hatchlings instinctively swim towards local surface currents to help transport them across ocean basins. Changes in ocean circulation are likely to change the distributions and migration patterns of such species.

Lohmann K. & Lohmann C, 2003, Smithsonian, 44-62; Mortimer J.A. & Donnelly M., IUCN 2009, V2009.1; Bolten A.B., 2003. Smithsonian Books, 63-78

Climate change impacts on migrating ocean species

Global Change Biology (2009), doi: 10.1111/j.1365-2486.2009.01875.x

Climate-driven changes in abundance and distribution of larvae of oceanic fishes in the southern California region

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Abstract

We examined climatic effects on the geographic distribution and abundance of 34 dominant oceanic fishes in the southern California region using larval fish data collected from the 50-year long California Cooperative Oceanic Fisheries Investigations (CalCOFI) surveys. The oceanic species responses to environmental changes in their geographic distributions were not very pronounced, perhaps because they lived in the deep layer where temperature change was relatively small or because the environmental variation of the CalCOFI region is not strong enough (with an average temperature gradient of the upper 100 m around 91 km $^{\circ}C^{-1}$). Among the 34 taxa, 16 showed a significant distributional shift (median latitude or boundaries) in relation to environmental variables, and eight species significantly shifted their geographic distribution from the 1951–1976 cold period to the 1977–1998 warm period. Interestingly, the vertically migrating taxa more often showed a significant response to environmental variables than the nonmigrating mesopelagic taxa, reflecting the more significant increase in heat content of the upper ocean (<200 m), compared with the deeper zone (300–500 m) where the mesopelagic fishes typically remain. Climate change has significant effects on the abundances of oceanic fishes. Twenty-four taxa exhibited a significant change in

Student Data

Students will conduct this research by using:

1) drifting buoy data to track the flow patterns of ocean currents (both location and velocity), and

2) marine species data collected by marine labs to determine spawning grounds, larval retention, and migratory patterns or displacements from typical paths.

Potential Research Sites / Collaborations

1. Northeast shelf in the North Atlantic (data possibly available through the Office of Marine Ecosystem Studies, NE Fisheries Science Center)
2. Gulf of Mexico near the loop current (data possibly available through the National Marine Fisheries Center/SE Fisheries Science Center
3. Coastal California region as part of the CalCOFI investigations (data collected by Southwest Fisheries Science Center and NOAA CalCOFI survey teams)

Data Access

1. Global Drifter Program Data Assembly Center, NOAA/AOML: http://www.aoml.noaa.gov/phod/dac/dacdata.php
2. NOAA Adopt a Drifter Program, NOAA CPO: http://www.adp.noaa.gov
3. Observing System Monitoring Center: www.osmc.noaa.gov
4. CalCOFI larval fish data: https://oceaninformatics.ucsd.edu/ichthyoplankton/secure/login.php
5. Sea surface temperature and chlorophyll satellite data can be accessed at: http://gdata1.sci.gsfc.nasa.gov/daac-bin/G3/gui.cgi?instance_id=ocean_month
6. Ocean Tracking Network: http://oceantrackingnetwork.org/

Metrics for Success

A special **on-line student science fair** would highlight results of projects. The number of students participating could serve as one metric of success.

Fisheries science center **scientists who specialize in marine species and climate could serve as judges** to determine those projects satisfying criteria proposed at the start of the project and highlighted on line. Judges would rank projects based on use of appropriate methods and most accurate results.

Scientists could then follow up with additional research in those areas where climate impacts have been identified.

Results could be posted on the Adopt a Drifter Program and Global Drifter Program website, along with other sites.

Important Questions

Who?

High school students in Earth Science, Environmental Science and Biology Classes

How much?

Start up costs associated with curriculum development, website and software development and piloting of prototype.

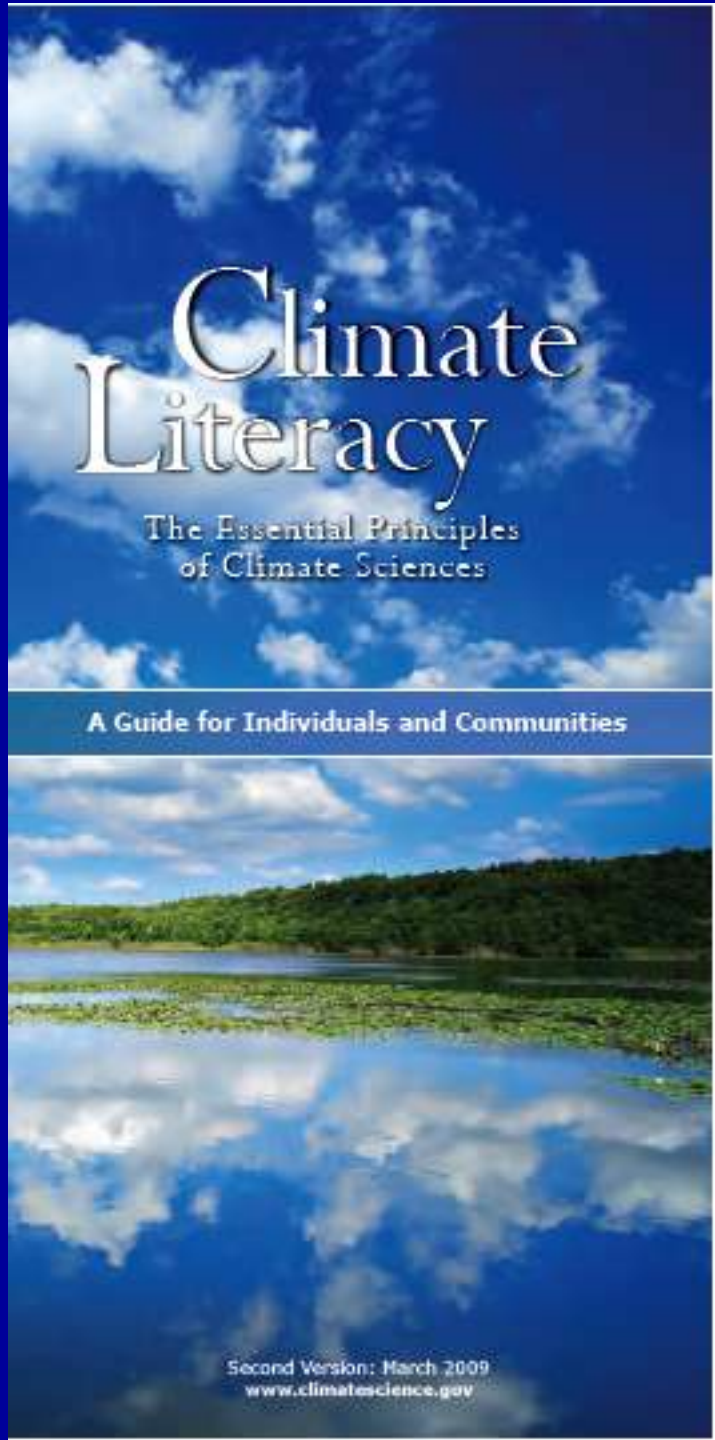
Schools would need computers and software to implement.

When?

Work with data collected over entire year, paying particular attention to seasonal patterns

Climate Literacy Principles Addressed

- Life on Earth depends on, is shaped by, and affects climate;
- Our understanding of the climate system is improved through observations, theoretical studies, and modeling; and
- Climate change will have consequences for the Earth system and human lives.



Thank You

Photo courtesy of Sweeney