

How to use NOAA data: A guide for educators



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What's today's weather?

En Español [+](#) Share | [G](#) [f](#) [t](#) [i](#) [e](#)

Current conditions at Fulton County Airport-Brown Field (KFTY)

Lat: 33.78°N Lon: 84.52°W Elev: 804ft.



A Few Clouds
59°F
15°C

Humidity 96%
Wind Speed SW 5 mph
Barometer 29.88 in (1011.2 mb)
Dewpoint 58°F (14°C)
Visibility 10.00 mi
Last update 25 Mar 9:53 am EDT

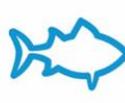
More Information:
[Local Forecast Office](#)
[More Local Wx](#)
[3 Day History](#)
[Mobile Weather](#)
[Hourly Weather Forecast](#)

Extended Forecast for Atlanta GA

Today	Tonight	Sunday	Sunday Night	Monday	Monday Night	Tuesday	Tuesday Night	Wednesday
								
Chance T-storms then Sunny	Partly Cloudy	Chance Showers	T-storms	T-storms then Showers Likely	Chance T-storms	Chance T-storms	Slight Chance T-storms then Mostly Clear	Sunny
High: 81 °F	Low: 59 °F	High: 77 °F	Low: 60 °F	High: 74 °F	Low: 58 °F	High: 70 °F	Low: 40 °F	High: 65 °F

Who am I?

- From Garibaldi, OR, ancestral lands of the Tillamook/Siletz Tribe
- NOAA Teacher at Sea Alumni Association [Fellow 2022-2023](#)
- Sailed on hydrography ([NOAA Ship Rainier](#)) and shark surveys ([NOAA Ship Oregon II](#)) as a NOAA Teacher at Sea
- Taught Second Grade (7 years) and High School Spanish and World Studies with a STEM bent for 15+ years.

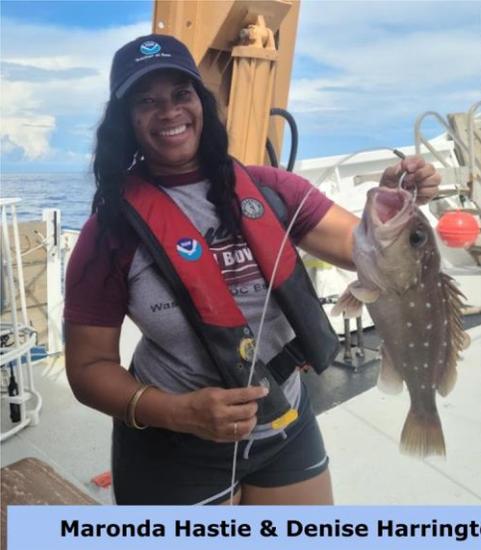


Who am I?

- From Atlanta, GA
- NOAA Teacher at Sea 2023!
- Sailed on shark survey ([NOAA Ship Oregon II](#)) as a NOAA Teacher at Sea
- Teach high school math at McNair High School in DeKalb County
- Field trips around the world since 1997
- students experience hands-on activities, lab experiments and presentations.



Collect tissue samples & the otolith from the Red Snapper



Maronda Hastie & Denise Harrington NOAA Teacher at Sea Alumni



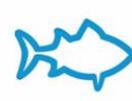
Who are you?

- What classes or subjects do you teach?
- How long have you been teaching? And where do you teach?
- Have you taught with data before?
- Are you familiar with NOAA?



Questions to answer today

- What is NOAA and what kind of data does NOAA collect?
- Where can I find NOAA data resources for my classes?
- How can my students get involved in data collection in community science projects?

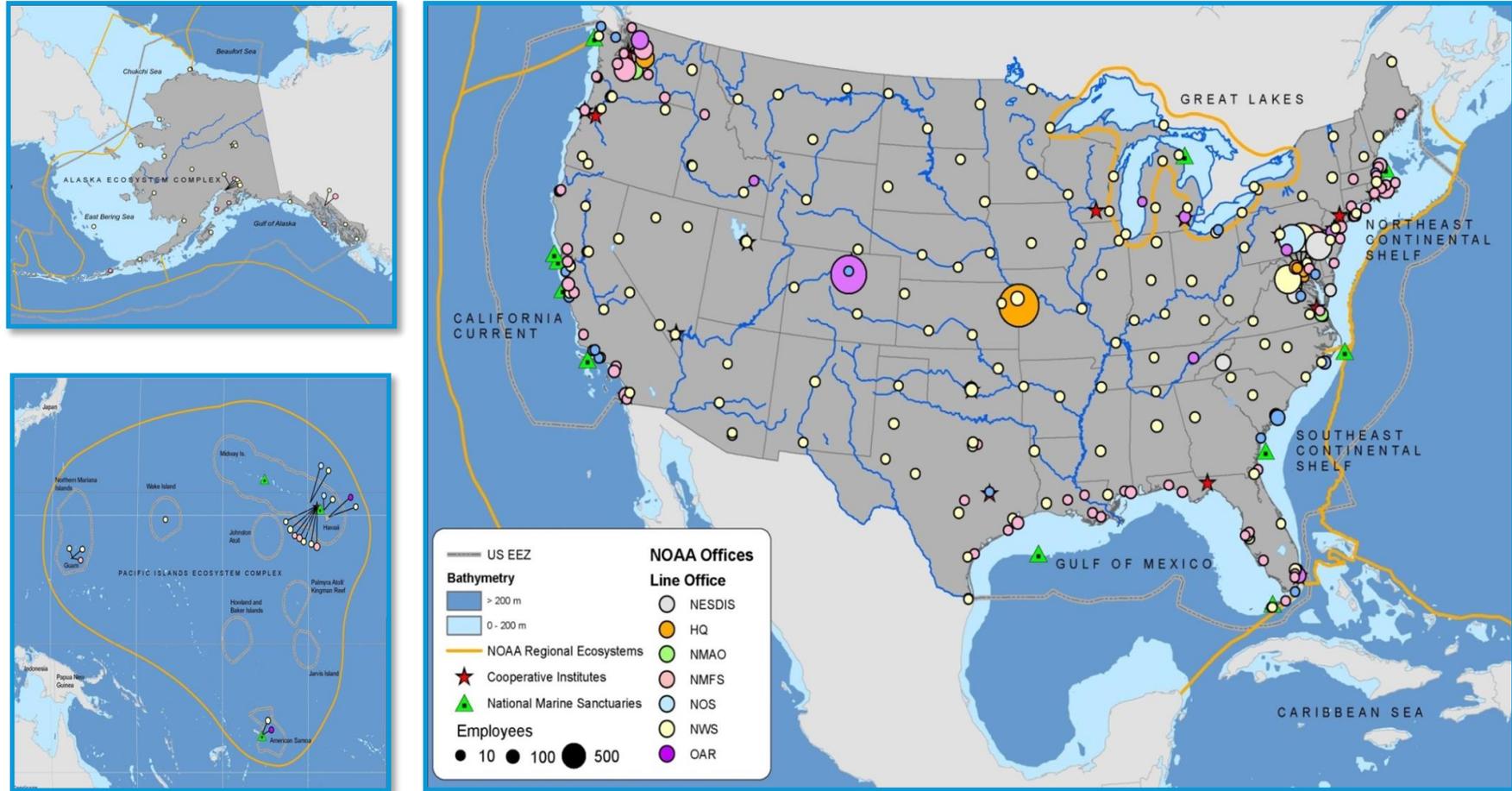


What is NOAA?

- National Oceanic and Atmospheric Administration (NOAA)
- Mission: **Science, Service, Stewardship**
- Focus areas:
 - Protects life & property from weather
 - Protecting fisheries & marine life
 - Studying and exploring the planet
 - Collecting & sharing Earth science data
 - Modeling climate data
 - Mapping our waters
 - Conserving natural resources
 - Protecting the ocean, the Great Lakes, and our coasts



Where is NOAA?



NOAA in your backyard

- <https://www.noaa.gov/education/noaa-in-your-backyard>

NOAA in your backyard

Get connected to NOAA guest speakers, field trips, and professional development in your area.

Share: [t](#) [f](#) [e](#) [p](#)

NOAA has hundreds of facilities and professional communicators across the nation. Below are links to resources in various regions of the country that would be of interest to educators:

- [Alaska region](#)
- [Caribbean region](#)
- [Central region](#)
- [Great Lakes region](#)
- [Gulf of Mexico region](#)
- [Mid-Atlantic region](#)
- [Northeast region](#)
- [Northwest region](#)
- [Pacific Island region](#)
- [Southeast region](#)
- [Southwest region](#)



NOAA in your backyard: Southeast

Educational opportunities and staff in Georgia, North Carolina, South Carolina, and eastern Florida

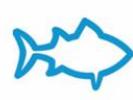
NOAA in Your State & Territory

State by state listings of NOAA facilities and programs
A summary of NOAA facilities, staff, programs, or activities based in, or focused on, your state or territory.

National Weather Service

School visits • Forecast office tours • Student and educator resources
The National Weather Service provides weather, hydrologic, and climate forecasts and warnings for the United States, its territories, adjacent waters and ocean areas.

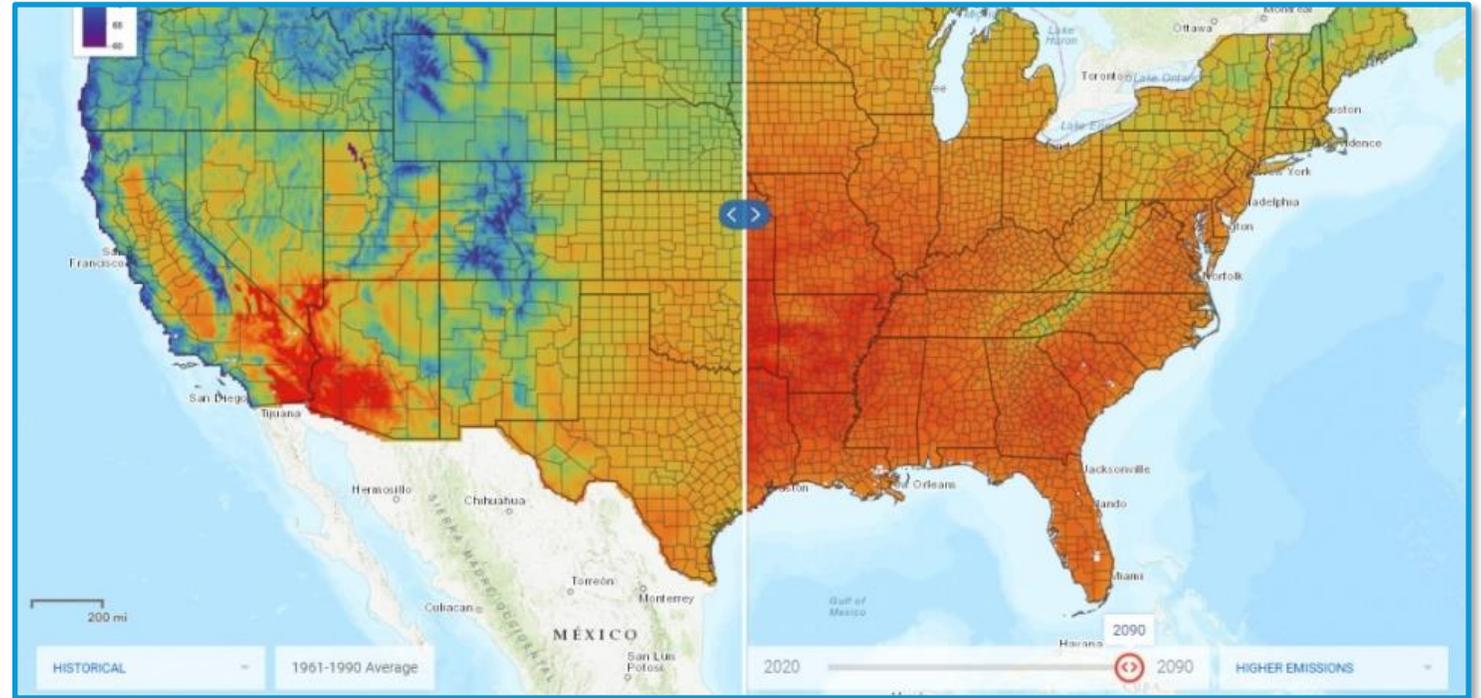
- To find your local Weather Forecast Office (WFO), visit the [National Weather Service local contact page](#) and click on your state. There will be a name, email address, and phone number for the WFO that serves your area.
- Visit [weather.gov](#) and enter your zip code to find your local WFO.



NOAA has *petabytes* of data!

One petabyte = one million gigabytes!

Real-time
Historic
GIS: shape files & Google Earth
Pictorial
Visualizations
Raw data
Analyzed data
Modeled/predicted data
Weather observations
Satellite imagery
Graphs & figures
Numerical data
Interactive maps



Where does the data come from?

- Land



- Air



- Sea

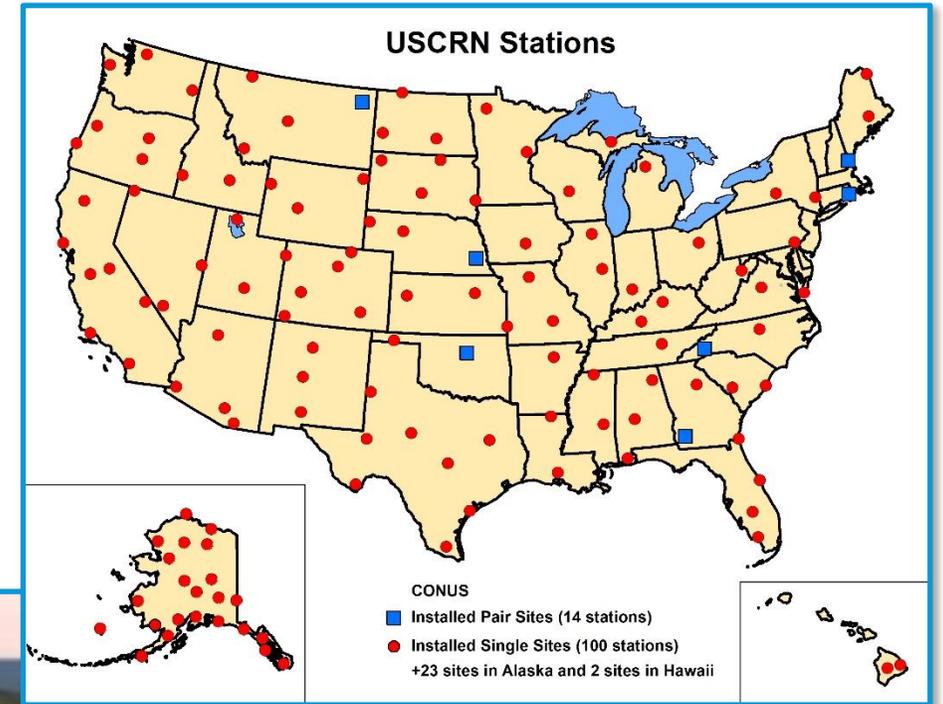
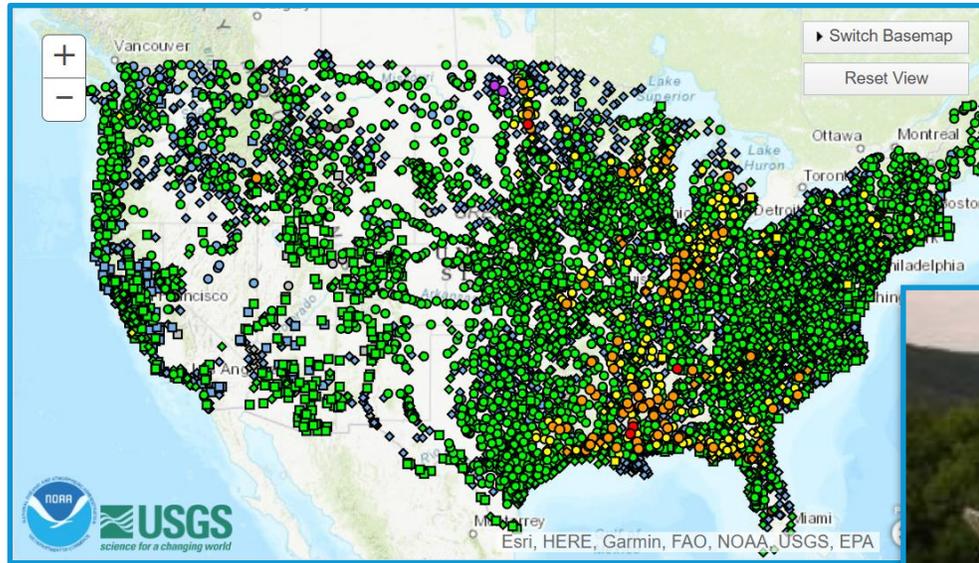


- Space



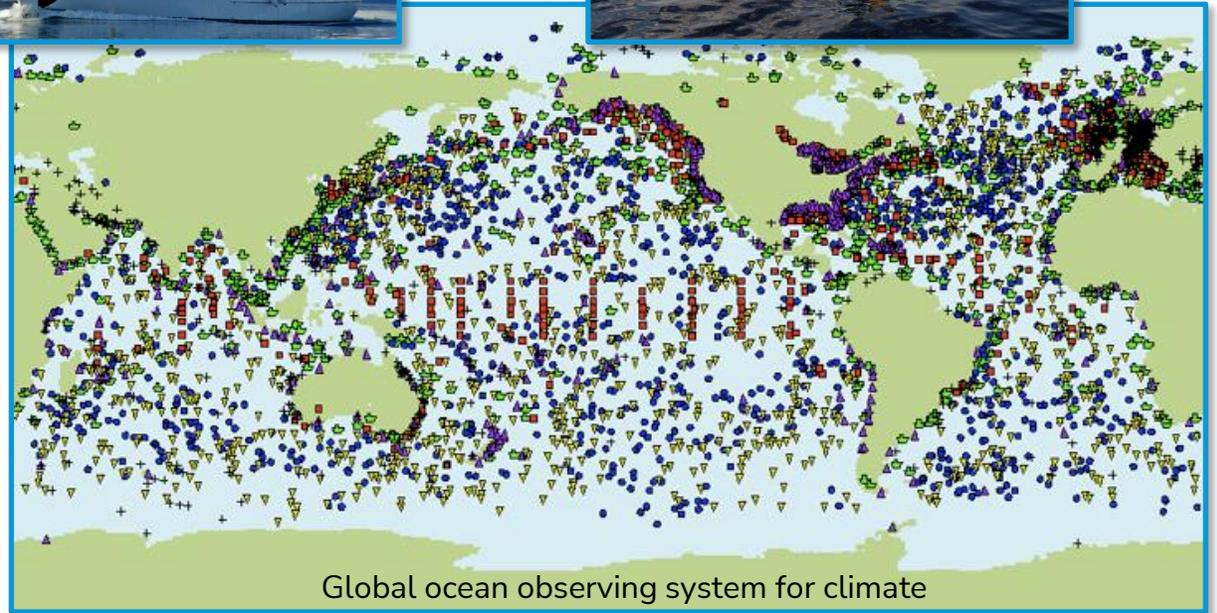
Ground-based observations

- Weather
- Climate
- Coastal
- Rivers



NOAA by sea

- 17 research vessels in fleet
 - Hydrographic
 - Fisheries
 - Oceanographic
- Buoys
 - Tsunami
 - Deep sea
 - Sea surface
 - Air



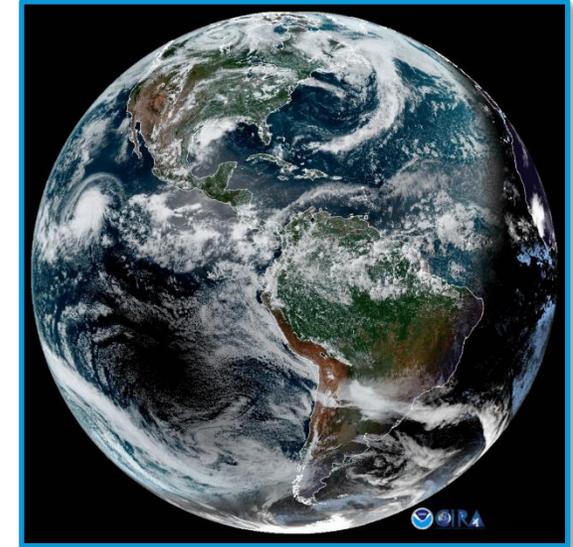
NOAA in the air

- Hurricane hunters
- Winter storm observations
- Marine mammal surveys
- Oil spill response
- Aerial snow surveys
- Visual verification of aeronautical charts
- Post-disaster aerial photography
- Autonomous unscrewed vehicles (AUVs) or drones



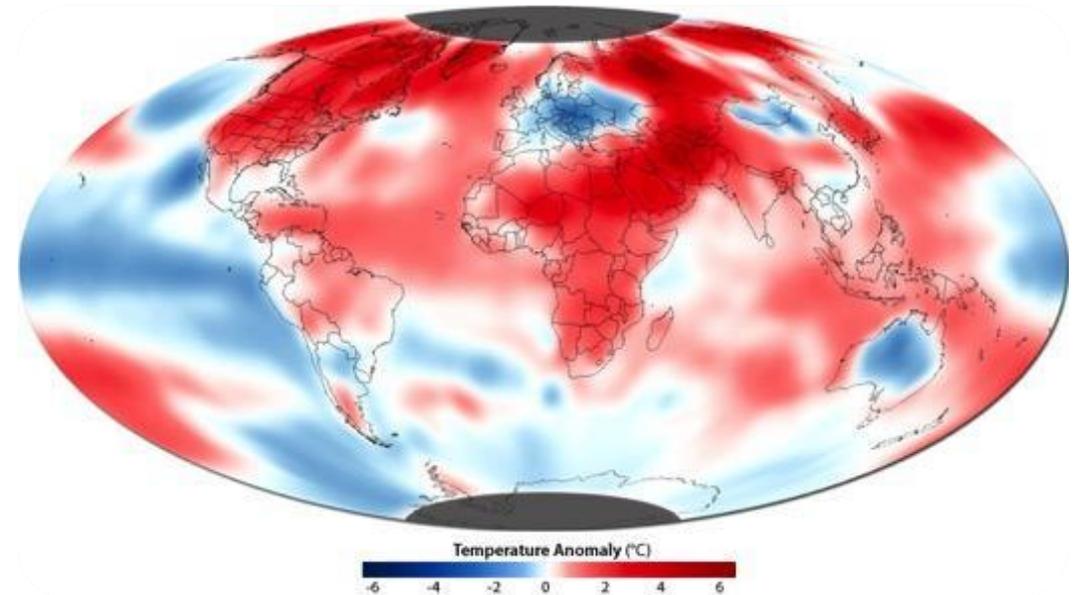
Observations from space

- Environmental satellites monitor the Earth
 - Weather data (temperature, pressure, wind, etc.)
 - Real-time events
 - True color or infrared
 - Water vapor, topography, sea level rise, corals, solar wind
- Main types:
 - Geostationary Operational Environmental Satellite (GOES)
 - “Geostationary” with Earth’s rotation
 - Takes same image of Earth from 22,240 miles away
 - Polar Operational Environmental Satellite (POES)
 - Circles Earth around the poles
 - Takes images from 540 miles away



How can use NOAA data in your classroom?

- Conceptual understanding
- Data analysis
- Data visualization
- Student research
- Remote sensing & GIS
- Career explorations
- Citizen science data collection



Does data fit into your curriculum?

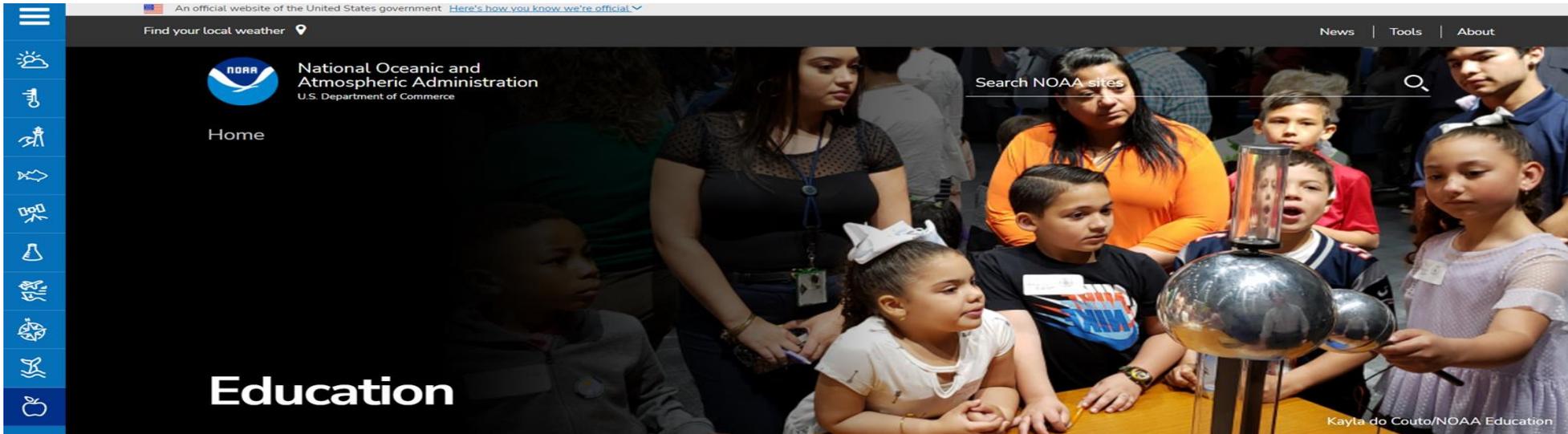
- Climate
- Weather
- Atmosphere
- Snow and ice
- Glaciers
- Space weather
- Ocean currents
- Coral reefs
- Tsunamis
- Tides
- Estuaries
- Fisheries
- Remote sensing
- Mapping
- Modeling
- Environmental issues:
 - Oil spills
 - Ozone depletion
 - Water quality
 - Animal surveys



NOAA data education resources website

<https://www.noaa.gov/education/resource-collections/data>





- Education home
- About NOAA Education
- Resource collections
- ▼ Educator opportunities
- Student opportunities
- Grants & networks

Educators, students, and curious people explore the ocean and atmosphere.

STORIES //



[View all >](#)

MULTIMEDIA //

- Resource collections
- ▼ Ocean and coasts
- ▼ Weather and atmosphere
- ▼ Climate
- ▼ Marine life
- ▼ Freshwater
- More collections
- ▲ Data resources for educators
- ▲ Classroom-ready data resources
- Climate data resources
- Historical data resources
- Ocean & freshwater data resources
- Real-time data resources
- Tiny tutorials: Get started using Earth science data in seconds
- Weather & atmosphere data resources
- ▼ Education at home
- ▼ Elementary resources

HELPFUL LINKS //

- [Office of Education >](#)
- [NOAA in your backyard: Education contacts near you! >](#)
- [Data resources for educators >](#)
- [How can we improve this website? Share your feedback with the Office of Education](#)





- Education home
- Resource collections home
- Ocean & coasts
- Weather & atmosphere
- Climate

Data resources for educators

Focus areas: Education

Did you know that NOAA collects terabytes of data every day from weather stations, radar, satellites, ships, buoys, and sensors? This information isn't just collected for our scientists to use; anyone can take the role of scientist using our publicly available resources. But with dozens of websites and hundreds of variables to choose from, it can be tricky for educators to know how to get their students started with scientific data. This collection highlights ocean and atmosphere data sources that are easy to use and appropriate for classrooms and informal learning environments.

Within each topic area, the resources are separated into categories based on level of content:

- **Classroom ready** modules are designed with educators in mind. They use NOAA data in lessons and curricula for a straightforward experience. In addition to being on each topic page, all of the classroom ready resources are organized into one separate collection.
- **Easily accessible resources** are often geared for researchers and come in a variety of formats. They are not associated with lesson plans. However, the ones we highlight here are user-friendly and usually address a single subject.
- **Looking for more?** If you haven't found what you're looking for here, try exploring these major data repositories. These sites host vast troves of data from across many different subjects and disciplines.



Showing 7 of 7 Education Resource Collections

Classroom-ready data resources

Explore NOAA data collected around the globe in formats designed just for educators. These resources take information from our atmosphere and ocean and package it in easily accessible, classroom-friendly lesson plans, activities, and curricula.

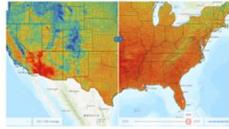
Focus areas: Education



Climate data resources

Whether you're looking into the past or predicting the future, these resources let you work directly with the data that make up our climate record on land, in the atmosphere, and at sea.

Focus areas: Education



Historical data resources

Long-term data and past events offer insights into how our planet works. Peer into observations from past decades, centuries, and beyond to see what has happened on Earth, how conditions have changed, and how they might change in the future.

Focus areas: Education



Ocean & freshwater data resources

We live on a water planet. Follow marine animals as they navigate the ocean, get your local tide and current predictions, or see what sea level rise may have in store for coastal communities. You can also explore river observations and trends in snow and ice.

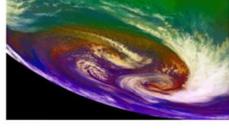
Focus areas: Education



Real-time data resources

NOAA collects real-time data from satellites, buoys, weather stations, citizen scientists, and more. See what is happening right now in this collection of ocean, freshwater, and atmospheric resources.

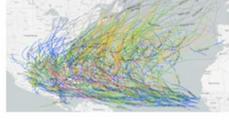
Focus areas: Education



Tiny tutorials: Get started using Earth science data in seconds

We want everyone to be able to understand and work with the data our agency collects on the ocean, atmosphere, and beyond. But we know that, when it comes to using a new online data portal, sometimes the first few clicks are the hardest.

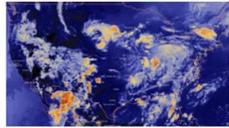
Focus areas: Education



Weather & atmosphere data resources

Go beyond your local weather forecast with these tools. Watch the Earth from a satellite's view in space, explore data collected by citizen scientists, and monitor hazards like hurricanes, wildfires, and droughts.

Focus areas: Education





Climate

Focus areas: Education

Whether you're looking for data that make up



Classroom

Classroom-minded. They're straightforward

Climate &

6th - 12th grade

This collection of data from around the world. Students can explore climate change. These resources help build data literacy from

Interactive map •

Data in the

5th - 12th grade

Data in the Classroom uses NOAA data. This tool supports complex inquiry

Interactive map •

Easily accessible

Often geared toward a variety of formats. However, they usually add

Climate.gov

Explore numerous Snapshots, Data visualizations.

Interactive map •

Looking for more?

If you haven't found what you're looking for here, try exploring our major data repositories. These sites host vast troves of data from across many different subjects and disciplines.

National Centers for Environmental Information (NCEI) [Advanced]

NCEI hosts and provides public access to one of the most significant archives for environmental data on Earth. Over 25 petabytes (25 million gigabytes) of atmospheric, coastal, oceanic, and geophysical data are available.

Interactive map • Numerical data • Satellite imagery • Graph/figure • Modeled/predicted

Digital Coast Sea Level Rise Viewer

Display potential future sea levels and view sea level rise simulations of up to 6 feet at a local landmarks on this interactive map. Overlay social and economic data to see the potential impact that sea level rise may have on vulnerable people and businesses.

Interactive map • Modeled/predicted



Searchable database in beta!

www.noaa.gov/education/resources

RESOURCE TYPE

- Activities, lessons, and units (206) +
- Arts and crafts (3)
- Background information (223)
- Career profile (85)
- Citizen science project (14)
- Collection (157)
- Coloring/activity book (29)
- Contest (4)
- Data product (161) -
 - Easy-to-use data product (71)
 - Advanced data product (24)
 - Intermediate data product (72)
- Job seeker resource (13)
- Multimedia (531) +
- Poster/brochure (24)
- Related story (135)



Major data repositories



NOAA Data Discovery Portal:

<https://data.noaa.gov/>

The screenshot displays the NOAA Data Discovery Portal interface. At the top left is the NOAA logo and the text "data.noaa.gov NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION". A blue banner reads "Welcome to the NOAA Data Discovery Portal" and contains introductory text about the search approaches. Below this are two main sections: "OneStop" and "NOAA Data Catalog". The "OneStop" section describes enhanced search capabilities for archived datasets. The "NOAA Data Catalog" section describes an inventory of all NOAA data collections with web-based and machine-to-machine search options. Below the "OneStop" section is a sub-page for the "OneStop" search platform, featuring a search bar and "Explore Popular Topics" icons for Weather, Climate, Satellites, Fisheries, Coasts, and Oceans. The "NOAA Data Catalog" section shows search results for "65,438 datasets found", listing various hydrographic survey datasets with their titles and descriptions.



National Centers for Environmental Information (NCEI): <https://www.ncei.noaa.gov/>

NOAA National Centers for Environmental Information
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

Home Products Services Resources News About **Contact**

Search NCEI

National Centers for Environmental Information

NOAA's National Centers for Environmental Information (NCEI) hosts and provides public access to one of the most significant archives for environmental data on Earth. We provide over 37 petabytes of comprehensive atmospheric, coastal, oceanic, and geophysical data.

About NCEI **Our Products**

Looking for Data? **Access Data** Archive Data



NCEI: <https://www.ncei.noaa.gov/>

Home / Products

Products

Browse by Category, Parameter, or Instrument/Method

Category

- [Climate Data Records](#)
- [Climate Monitoring](#)
- [Coastal Indicators](#)
- [Geomagnetism](#)
- [Gulf of Mexico](#)
- [Marine Biology](#)
- [Marine Geology and Geophysics](#)
- [Natural Hazards](#)
- [Ocean Chemistry](#)
- [Ocean Climate Laboratory](#)
- [Ocean Exploration](#)
- [Ocean Physics](#)
- [Paleoclimatology](#)
- [Radar Meteorology](#)
- [Regional Ocean Climatologies](#)
- [Satellite Meteorology](#)

Home / Products / Severe Weather

Severe Weather

NCEI Severe weather products provide access to data on destructive storms and other severe weather. They can be used to find detailed information about local, intense, often damaging storms such as thunderstorms, hail storms, and tornadoes, but can also describe more widespread events such as tropical systems, blizzards, nor'easters, and derechos.

Products

- [Drought and Wildfire Products](#)
- [Hurricane Satellite \(HURSAT\) Data](#)
- [International Best Track Archive for Climate Stewardship \(IBTrACS\)](#)
- [Lightning Products and Services](#)
- [Monthly Climate Reports](#)
- [National Digital Forecast Database](#)
- [National Digital Guidance Database](#)
- [Next Generation Weather Radar](#)
- [Severe Weather Data Inventory](#)
- [Storm and Wind Products](#)
- [Storm Events Database](#)
- [Terminal Doppler Weather Radar](#)

Related Content

- [Reinsurance](#)
- [Weather Service Providers](#)



Recommended data resources

Weather, climate, ocean, coasts, Great Lakes

Educational data resources



National Weather Service: <https://www.weather.gov/>

NATIONAL WEATHER SERVICE
 NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

HOME FORECAST PASTWEATHER SAFETY INFORMATION EDUCATION NEWS SEARCH

Local forecast by "City, St" or ZIP code
 Enter location... Go
[Location Help](#)

Arctic Airmass to Bring Heavy Rain to Southern Plains and Heavy Snow to Interior New England
 An Arctic-sourced airmass will sweep across the eastern two-thirds of the U.S. over the next few days. On the leading edge heavy rain is forecast from the southern Plains to the Tennessee Valley Wednesday and moderate to heavy snow is forecast interior New England Thursday. The Arctic-sourced air will support an extended stretch of below to much below normal temperatures. [Read More >](#)

10,000+
 WEATHER-READY NATION AMBASSADORS

ACTIVE ALERTS FORECAST MAPS RADAR RIVERS, LAKES, RAINFALL AIR QUALITY SATELLITE PAST WEATHER

Created: 11/06/19 at 13:40 UTC

Customize Your Weather.gov
 City, ST
 Enter Your City, ST or ZIP Code
 Remember Me
 Get Weather
 Privacy Policy

American Samoa Guam Puerto Rico/Virgin Islands

Click on the map above for detailed alerts or Warnings By State [Public Alerts in XML/CAP v1.1 and ATOM Formats](#)

NATIONAL WEATHER SERVICE
 NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

HOME FORECAST PAST WEATHER SAFETY INFORMATION EDUCATION

Local
 Graphical
 Aviation
 Marine
 Rivers and Lakes
 Hurricanes
 Severe Weather
 Fire Weather
 Sun/Moon
 Long Range Forecasts
 Climate Prediction
 Space Weather

News Headlines

- [Local Earliest Snowfall Climatology](#)
- [November Cooperative Weather Observer Award](#)
- [Regional Climate Summary - October 2019](#)
- [Frost/Freeze](#)

[Additional Headlines](#)

Airport Lunken Field (KLUK)

Humidity 96%
 Wind Speed Calm
 Barometer 30.48 in (1032.5 mb)
 Dewpoint 31°F (-1°C)
 Visibility 0.25 mi
 Last update 6 Nov 7:53 am EST

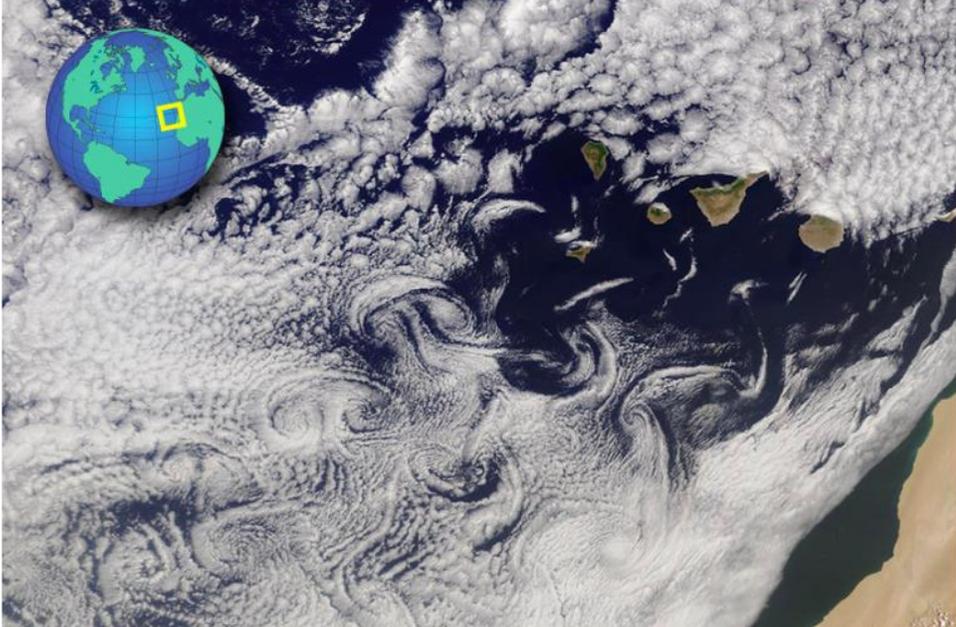


JetStream: An online school for weather

<https://www.weather.gov/jetstream/>

- Learn *about* meteorological data

JetStream - An Online School for Weather
[Become weatherwise with NOAA](#)



JetStream's Topics

- The Atmosphere
- The Ocean
- Global Weather
- Clouds
- The Upper Air
- Upper Air Charts
- Synoptic Meteorology
- Thunderstorms
- Lightning
- Derechos
- Tropical Weather
- Doppler Radar
- Satellites
- Tsunamis
- The National Weather Service
- Appendix

About JetStream

The National Weather Service understands the critical value of fast, accurate weather information. We know that information is power - the power to save your life or the lives of your loved ones. Over the last ten years... [about JetStream](#)



River forecasts:

<https://water.weather.gov/ahps/>

National Oceanic and Atmospheric Administration's
National Weather Service

Site Map News Orga

Local forecast by "City, St"
City, St Go
RSS RSS Feeds
Warnings Current
By State/Country...
UV Alerts
Observations Radar
Satellite
Snow Cover
Surface
Weather...
Observed Precip
Forecasts Local
Graphical
Aviation
Marine
Hurricanes
Severe Weather
Fire Weather
Text Messages
By State
By Message
Type National
Forecast Models Numerical
Models Statistical
Models... MOS Prod
GFS-LAMP
Prod
Climate
Past Weather
Predictions

National Observations

Warnings & Forecasts Graphical Forecasts National Maps Radar Water Air Quality Satellite Climate

River Observations River Forecasts Long-Range River Flood Risk Precipitation River Download Other Information

Auto Refresh: OFF [Refresh] [Print]

Print this map Permalink BOOKMARK [Social Media]

All Locations

Switch Basemap
Reset View

Click on the map or select one of the data views below:

United States
NWS Weather Forecast Offices
NWS River Forecast Centers
Water Resources Regions

Probability and forecasts available
 Observations only available
 Forecasts available

9264 total gauges
Show all locations in flood (68)

- 5 Gauges: Major Flooding
- 5 Gauges: Moderate Flooding
- 58 Gauges: Minor Flooding
- 101 Gauges: Near Flood Stage
- 5697 Gauges: No Flooding
- 2692 Flood Category Not Defined
- 26 At or Below Low Water Threshold
- 600 Gauges: Observations Are Not Current
- 80 Gauges: Out of Service

Show all locations

Last map update:
11/06/2019 at 08:51:17 am EST
11/06/2019 at 13:51:17 UTC

Alaska Hawaii Puerto Rico



Climate Data Online (past weather)

<https://www.ncdc.noaa.gov/cdo-web/>

The screenshot shows the NOAA Climate Data Online (CDO) website. At the top, there is the NOAA logo and the text "NATIONAL CENTERS FOR ENVIRONMENTAL INFORMATION" and "NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION". Below this is a navigation bar with links for Home, Climate Information, Data Access, Customer Support, Contact, and About, along with a search box. A secondary navigation bar includes links for Datasets, Search Tool, Mapping Tool, Data Tools, and Help. The main content area features the title "Climate Data Online" and a descriptive paragraph: "Climate Data Online (CDO) provides free access to NCDC's archive of global historical weather and climate data in addition to station history information. These data include quality controlled daily, monthly, seasonal, and yearly measurements of temperature, precipitation, wind, and degree days as well as radar data and 30-year Climate Normals. Customers can also order most of these data as certified hard copies for legal use." To the right of the text is a circular graphic depicting a landscape with a sun, clouds, mountains, and water. Below the text are four icons representing different actions: "Browse Datasets" (grid icon), "Certify Orders" (award icon), "Check Status" (info icon), and "Find Help" (question mark icon). At the bottom, there is a section titled "DISCOVER DATA BY" with three columns: "SEARCH TOOL" (blue background), "MAPPING TOOL" (orange background), and "DATA TOOLS" (dark red background). Each column contains a brief description of the tool and a link to the tool.

NOAA NATIONAL CENTERS FOR ENVIRONMENTAL INFORMATION
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

Home Climate Information Data Access Customer Support Contact About Search

Home > Climate Data Online Datasets Search Tool Mapping Tool Data Tools Help

Climate Data Online

Climate Data Online (CDO) provides free access to NCDC's archive of global historical weather and climate data in addition to station history information. These data include quality controlled daily, monthly, seasonal, and yearly measurements of temperature, precipitation, wind, and degree days as well as radar data and 30-year Climate Normals. Customers can also order most of these data as certified hard copies for legal use.

- Browse Datasets**
Browse documentation, samples, and links
- Certify Orders**
Get orders certified for legal use (requires payment)
- Check Status**
Check the status of an order that has been placed
- Find Help**
Find answers to questions about data and ordering

DISCOVER DATA BY

SEARCH TOOL	MAPPING TOOL	DATA TOOLS
Search for and access past weather and climate data by station name or identifier, ZIP code, city, county, state, or country.	Find and view past weather and climate data by station name or identifier, ZIP code, city, county, state, or country.	Access past weather and climate data using a collection of specialized tools.
Search Tool »	Mapping Tool »	Data Tools »



Climate at a Glance

<https://www.ncdc.noaa.gov/cag/>

Climate at a Glance

- Climate Monitoring
- State of the Climate
- Temp, Precip, and Drought
- Climate at a Glance
- Extremes
- Societal Impacts
- Snow and Ice
- Teleconnections
- Monitoring References

Global National Regional Statewide Divisional County City

Mapping Time Series Rankings Haywood Plots Data Information Background

Global Mapping

Select a desired date from the menu below to plot an interactive map of 5°x5° gridded temperature anomalies. Anomalies are based on the 1981-2010 mean. For more information and data access, visit Global Surface Temperature Anomalies.

Year: 2021 Month: July Plot

« June 2021

Temperature Anomalies
July 2021



Climate at a Glance tiny tutorial

NOAA Education
Tiny tutorial

Climate at a Glance: Comparing historical data



noaa.gov/education



Climate.gov maps & data

<https://climate.gov/maps-data>



[f](#)
[t](#)
[i](#)
[y](#)

Home

Maps & Data

Tools and Interactives »



Data Snapshots (Images)
Browse a range of easy-to-understand climate maps in a single interface.



Climate Data Map (Interactive)
Visualize climate data on a web map.

Event Tracker



Browse stories about the 'climate behind the

Dreaming of a Christmas?



Map of the historic probability of there being

Global Climate Dashboard

Tracking climate change and natural variability

Sort by Indicator: - Any - Apply

Greenhouse Gases



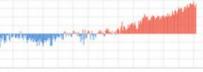
Arctic Sea Ice



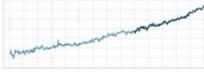
Carbon Dioxide



Ocean Heat



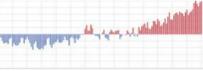
Sea Level



Spring Snow



Surface Temperature



Arctic Oscillation



North Atlantic Oscillation



Pacific-North American Pattern



Southern Oscillation Index



Home > Maps & Data

Climate Data Primer

Are you new to climate data? Ready to learn or review some of the basics?

Climate Data Primer

What environmental data are relevant to the study of infectious diseases like COVID-19?

What's the difference between climate and weather?

How do weather observations become climate data?

How do we observe today's climate?

How do we know about climate in the past?

How can we learn about future climate?

How do scientists classify different types of climate?

How can I find or make climate maps or graphs?

How do I find the climate data I want?

What questions can I answer with climate data?

Global Climate Dashboard

Tools & Interactives

Climate Data Primer

Are you new to climate data? Ready to learn or review some of the basics?

U.S. Department of Commerce
National Oceanic and Atmospheric Administration
National Environmental Science, Data, and Information Service
Current Location: 505 1st St. NE, Wash., DC 20567-19
Phone: 202-761-8400
Email: climate@noaa.gov

National Centers for Environmental Information
10170000 National
Arling, North Carolina 28507

Record of Climatological Observations

These data are quality controlled and may not be identical to other observations. Observation Time Temperature Unknown Observation Time Precipitation: 0000

Year	Month	Day	Temperature (F)		Precipitation (in)	Snow (in)	Wind Speed (mph)		Sun (hr)		Relative Humidity (%)		Barometric Pressure (in)	
			Max	Min			Max	Min	Max	Min	Max	Min	Max	Min
2015	01	01	38	28	0.00	0.0	10	10	12.0	12.0	95	95	30.00	30.00
2015	01	02	35	25	0.00	0.0	12	12	11.5	11.5	90	90	29.95	29.95
2015	01	03	32	22	0.00	0.0	15	15	11.0	11.0	85	85	29.90	29.90
2015	01	04	30	20	0.00	0.0	18	18	10.5	10.5	80	80	29.85	29.85
2015	01	05	28	18	0.00	0.0	20	20	10.0	10.0	75	75	29.80	29.80
2015	01	06	25	15	0.00	0.0	22	22	9.5	9.5	70	70	29.75	29.75
2015	01	07	22	12	0.00	0.0	25	25	9.0	9.0	65	65	29.70	29.70
2015	01	08	20	10	0.00	0.0	28	28	8.5	8.5	60	60	29.65	29.65
2015	01	09	18	8	0.00	0.0	30	30	8.0	8.0	55	55	29.60	29.60
2015	01	10	15	5	0.00	0.0	32	32	7.5	7.5	50	50	29.55	29.55
2015	01	11	12	3	0.00	0.0	35	35	7.0	7.0	45	45	29.50	29.50
2015	01	12	10	2	0.00	0.0	38	38	6.5	6.5	40	40	29.45	29.45
2015	01	13	8	0	0.00	0.0	40	40	6.0	6.0	35	35	29.40	29.40
2015	01	14	5	-2	0.00	0.0	42	42	5.5	5.5	30	30	29.35	29.35
2015	01	15	3	-5	0.00	0.0	45	45	5.0	5.0	25	25	29.30	29.30
2015	01	16	2	-8	0.00	0.0	48	48	4.5	4.5	20	20	29.25	29.25
2015	01	17	0	-10	0.00	0.0	50	50	4.0	4.0	15	15	29.20	29.20
2015	01	18	-2	-12	0.00	0.0	52	52	3.5	3.5	10	10	29.15	29.15
2015	01	19	-5	-15	0.00	0.0	55	55	3.0	3.0	5	5	29.10	29.10
2015	01	20	-8	-18	0.00	0.0	58	58	2.5	2.5	0	0	29.05	29.05
2015	01	21	-10	-20	0.00	0.0	60	60	2.0	2.0	0	0	29.00	29.00
2015	01	22	-12	-22	0.00	0.0	62	62	1.5	1.5	0	0	28.95	28.95
2015	01	23	-15	-25	0.00	0.0	65	65	1.0	1.0	0	0	28.90	28.90
2015	01	24	-18	-28	0.00	0.0	68	68	0.5	0.5	0	0	28.85	28.85
2015	01	25	-20	-30	0.00	0.0	70	70	0.0	0.0	0	0	28.80	28.80
2015	01	26	-22	-32	0.00	0.0	72	72	0.0	0.0	0	0	28.75	28.75
2015	01	27	-25	-35	0.00	0.0	75	75	0.0	0.0	0	0	28.70	28.70
2015	01	28	-28	-38	0.00	0.0	78	78	0.0	0.0	0	0	28.65	28.65
2015	01	29	-30	-40	0.00	0.0	80	80	0.0	0.0	0	0	28.60	28.60
2015	01	30	-32	-42	0.00	0.0	82	82	0.0	0.0	0	0	28.55	28.55
2015	01	31	-35	-45	0.00	0.0	85	85	0.0	0.0	0	0	28.50	28.50

Example of a climate data table showing daily maximum and minimum temperature, as well as precipitation, for a weather station near Old Faithful, Wyoming.

This site will walk you through some of the basics to help you understand and explore climate data. In the table of contents on the left, you'll find information on:

- instruments used to measure weather and climate
- how weather observations relate to climate products
- how climate scientists check the quality of observations
- tools you can use for exploring climate data

Why does climate data matter? Lots of people check climate data to help them make decisions:

- Folks who are planning outdoor events check **climate normals** data to help them



The Climate Explorer

<https://crt-climate-explorer.nemac.org/>

The Climate Explorer interface for Houston, TX. The top navigation bar includes a home icon, the title "The Climate Explorer", and links for "About the data", a share icon, and a settings icon. Below the navigation bar, the location "Houston, TX" is displayed. A section titled "Select one of the following for Harris County" offers several interactive cards:

- Climate Maps:** "Compare past and projected future conditions in your county." Includes a map of Harris County with a color-coded legend.
- Climate Graphs:** "Check past and projected values for climate variables." Shows a line graph with historical data in grey and projected data in red and blue.
- High-Tide Flooding:** "Explore the number of days per year with high-tide floods." Features a graph showing the projected increase in high-tide flooding days over time.
- Historical Weather Data:** "Compare observed daily weather to long-term climate." Displays a bar chart comparing daily weather observations to long-term climate averages.
- Historical Thresholds:** "Check how often temperature or precipitation has exceeded user-defined values." Shows a bar chart of historical data points relative to user-defined thresholds.
- Ready to plan for resilience?:** "Resources from our partners can help you identify what matters to your community and evaluate how climate change could affect it." Includes a list of bullet points: "Check your exposure to extreme events such as wildfires and flooding", "Identify social vulnerabilities across urban areas", and "Get step-by-step guidance for completing a vulnerability assessment or crafting an action plan." A link "Explore planning tools" with a right-pointing arrow is also present.

At the bottom of the interface is a navigation bar with icons and labels for: Cards Home, Climate Maps, Climate Graphs, Historical Weather Data, Historical Thresholds, High-Tide Flooding, and Take Action.



Global Monitoring Lab atmospheric data:

<https://gml.noaa.gov/dv/iadv/>

The screenshot displays the NOAA Global Monitoring Laboratory's Data Viewer interface. At the top, the NOAA logo and the text "Global Monitoring Laboratory Earth System Research Laboratories" are visible, along with a search bar labeled "Search GML...". A navigation menu includes "About", "People", "Research", "Observing Networks", "Data", "Products", and "Information".

The main content area is titled "Data Viewer >> Site Selection". It features a dropdown menu for selecting a location, currently set to "[MLO] United States, Mauna Loa, Hawaii". Below this are filters for "Programs" (set to "All Programs"), "Popup Detail" (set to "Full"), and "Active Sites" (set to "All Sites"). A map shows the globe with various monitoring sites marked by colored dots (red, yellow, blue, green). The current selection is highlighted in blue. The map includes a coordinate display: "Lat: Lon -70.75217 : 27.96311".

On the right side, the "Current selection:" is "Mauna Loa, Hawaii United States". Below this is a section for "Select Measurement Program and Plot Type" with a list of categories: "Carbon Cycle Gases", "Halocarbons and Trace Gases", "Aerosols", "Solar Radiation", "Ozone", and "Meteorology".

At the bottom of the right panel, there are links for "Site Summary of Mauna Loa, Hawaii" and "Data files for Mauna Loa, Hawaii", and a list of "Cooperating Agencies" including "NOAA Earth System Research Laboratory, Global Monitoring Division".

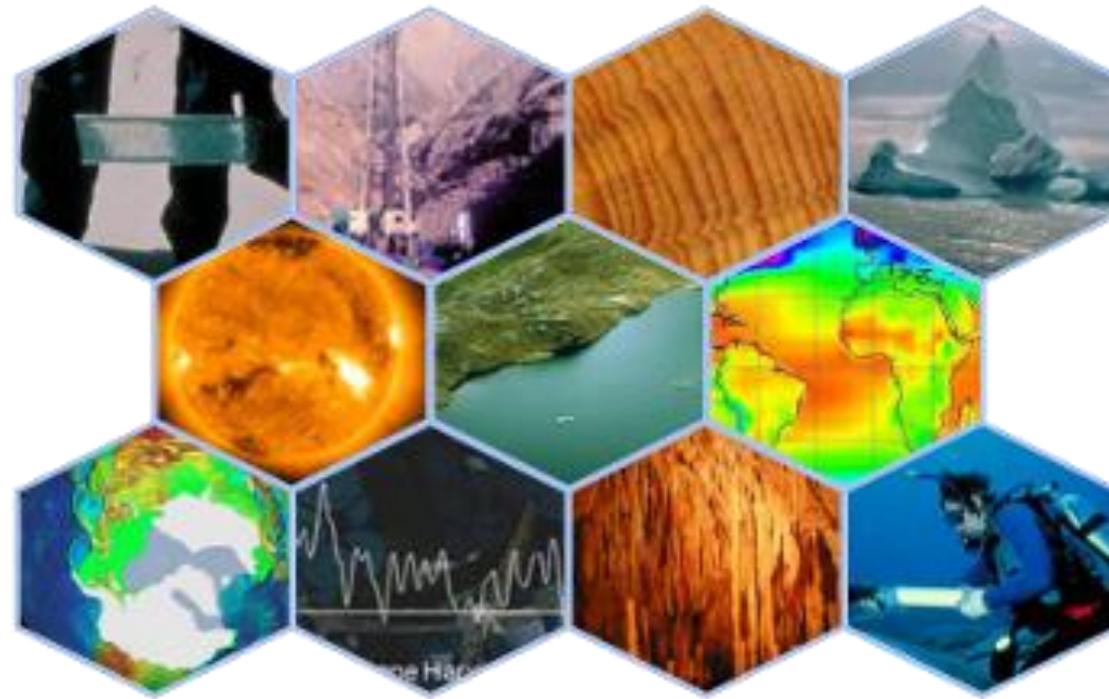
At the bottom of the map area, it says "Leaflet | Powered by Esri | USGS, NOAA". Below the map, a note states: "You can change which markers are displayed and their tooltips by using the menus in the bar above the map."



Paleoclimatology data

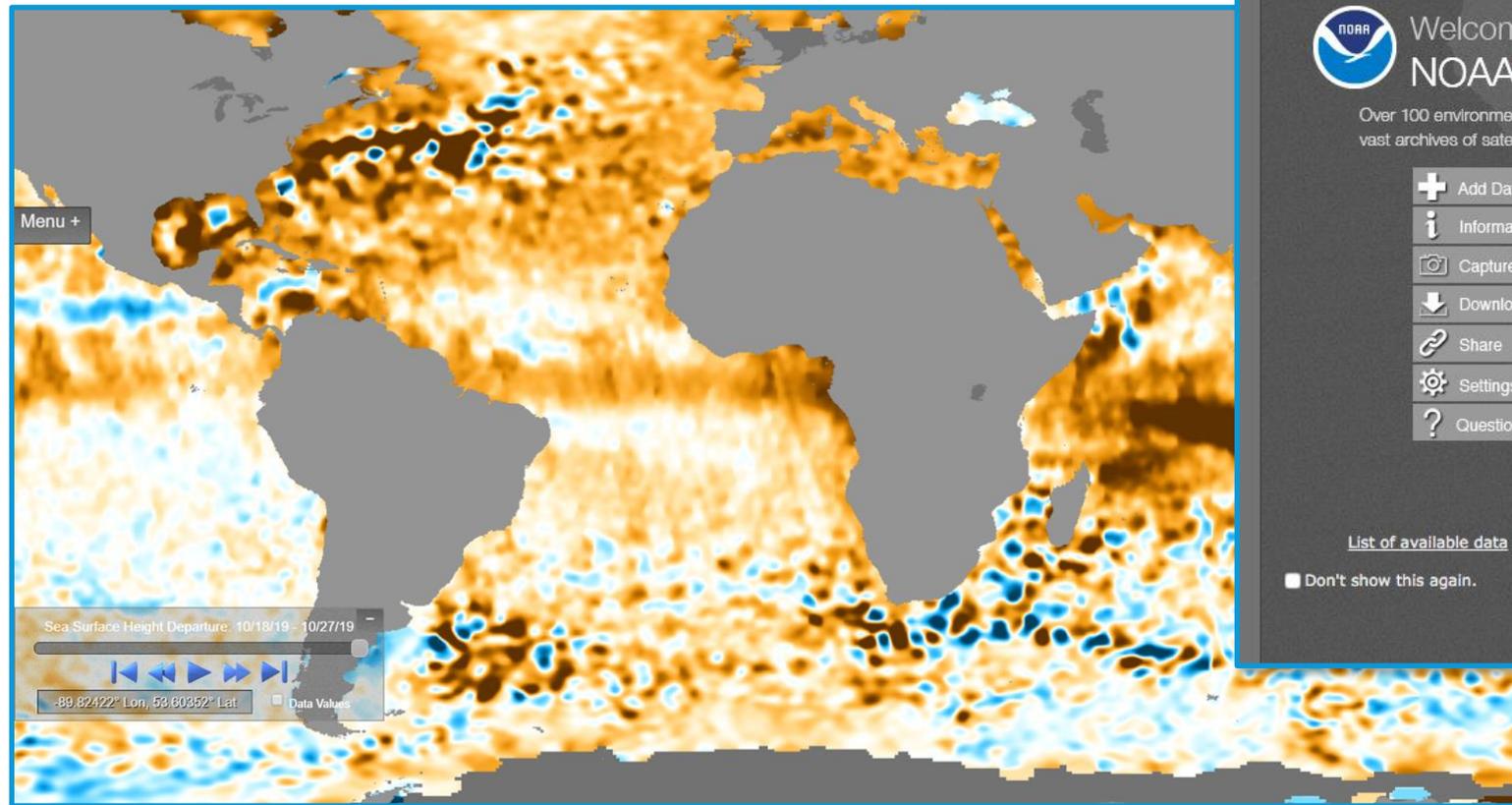
<https://www.ncei.noaa.gov/products/paleoclimatology>

- Part of NCEI
- Ice cores, coral records, tree rings, etc.



NOAA View data exploration tool:

<https://www.nnvl.noaa.gov/view/>



Welcome to the
NOAAView Data Exploration Tool

Over 100 environmental variables are available using NOAA View, using data from NOAA's vast archives of satellites, climate models, and other observation devices.

Add Data	START by using the menu to select data to view
Information	Get information about each dataset
Capture	Save full resolution images
Download	Download global images and Google Earth files
Share	Share links to datasets and interesting events
Settings	Customize the interface
Questions	Display the Help menu

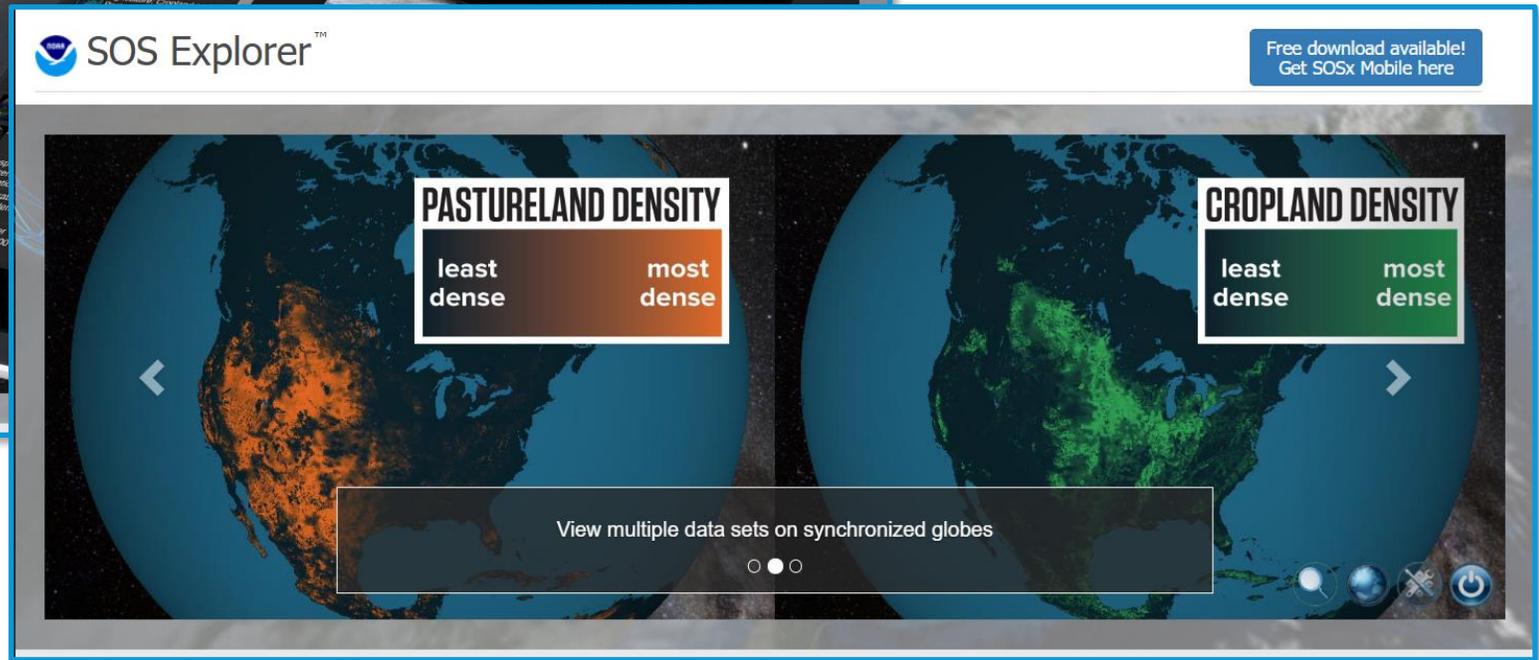
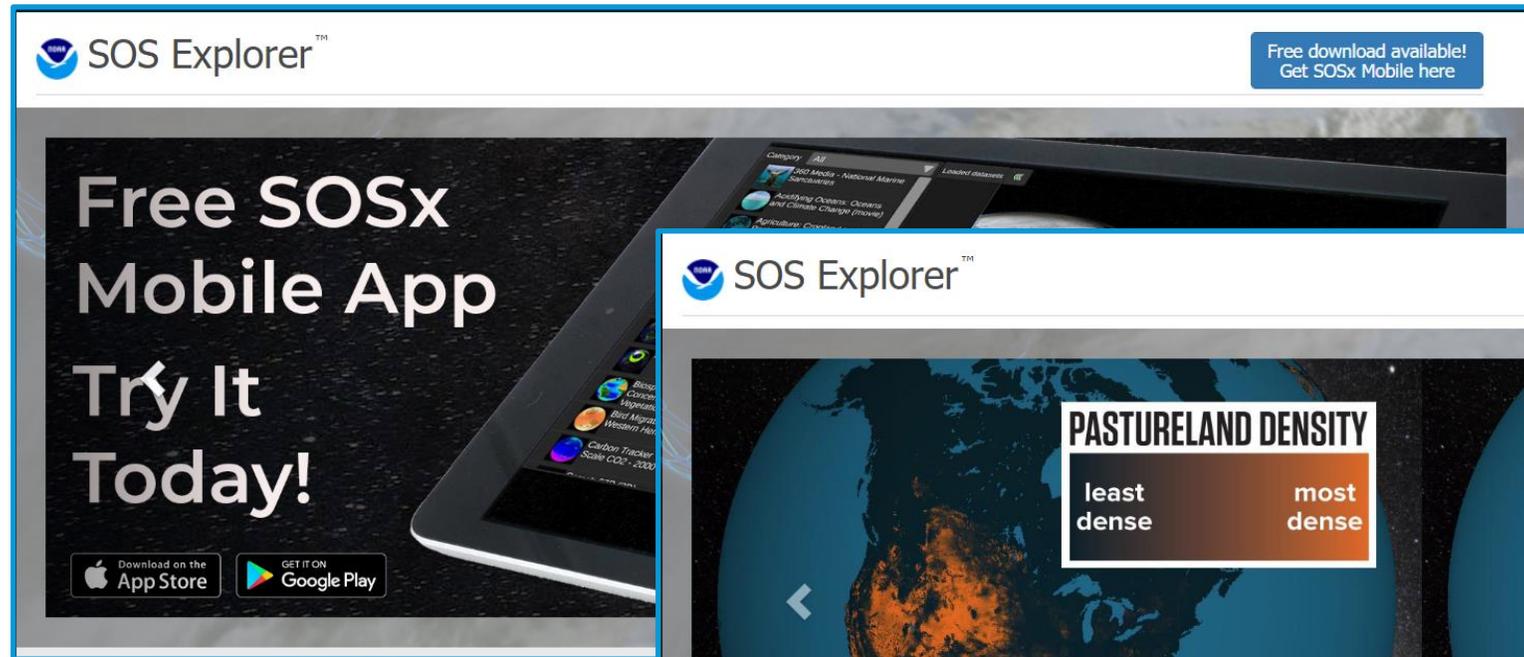
[Watch a Video Tour](#)

[List of available data](#) | [FTP access](#) | [Subscribe to Updates](#) | [Contact us](#) | [Privacy Policy](#)

Don't show this again. *Best viewed in Firefox, Chrome or Safari



Science On a Sphere (SOS) Explorer mobile app: <https://sos.noaa.gov/sos-explorer/mobile-faq/>



NOAA Satellites

<https://www.nesdis.noaa.gov/real-time-imagery/imagery-collections>

The screenshot shows the NOAA National Environmental Satellite Data and Information Service (NESDIS) website. The header includes the NOAA logo, the text "National Environmental Satellite Data and Information Service", and "DEPARTMENT OF COMMERCE". A search bar labeled "Search NESDIS" is on the right. A navigation menu below the header lists: "Real-Time Imagery", "Current Satellite Missions", "Next Generation", "Data, Research, & Services", "Our Environment", "Commercial Space", and "About". The main content area features a dark blue banner with the text "Home / Real Time Imagery" and "Imagery Collections". Below the banner, a paragraph states: "Our world is constantly changing, and our satellites help us learn more about its dynamic environment. This section is arranged so that you can browse among images and animations from NOAA's geostationary and polar satellites, and invites you to see your home planet in new ways." A section titled "Collections" contains three cards: "Earth from Orbit" (with a satellite view of Earth), "Image of the Day" (with a satellite image of a storm), and "Beautiful Places" (with a satellite image of a coastline). A vertical social media sharing bar is on the left side of the "Collections" section.



GOES East and West satellite imagery

<https://www.star.nesdis.noaa.gov/GOES/index.php>



National Snow & Ice Data Center:

<https://nsidc.org/>

1189.4 m above sea level

ICESat-2
ICESat-2 data
Distributed

Scientific Data for Research

- SNOW
- GLACIERS
- ICE SHEETS
- SEA ICE
- ICE SHELVES
- SOIL MOISTURE
- FROZEN GROUND

Daily Image Update

Sea Ice Extent, 24 Oct 2019

Sea Ice Concentration, 24 Oct 2019

Arctic Sea Ice Extent
(Area of ocean with at least 15% sea ice)

Extent (millions of square kilometers)

Jul Aug Sep Oct Nov

2019
2012
1981-2010 Median
Interdecadal Range

Click for high-resolution image. —Credit: National Snow and Ice Data Center

Antarctic daily images

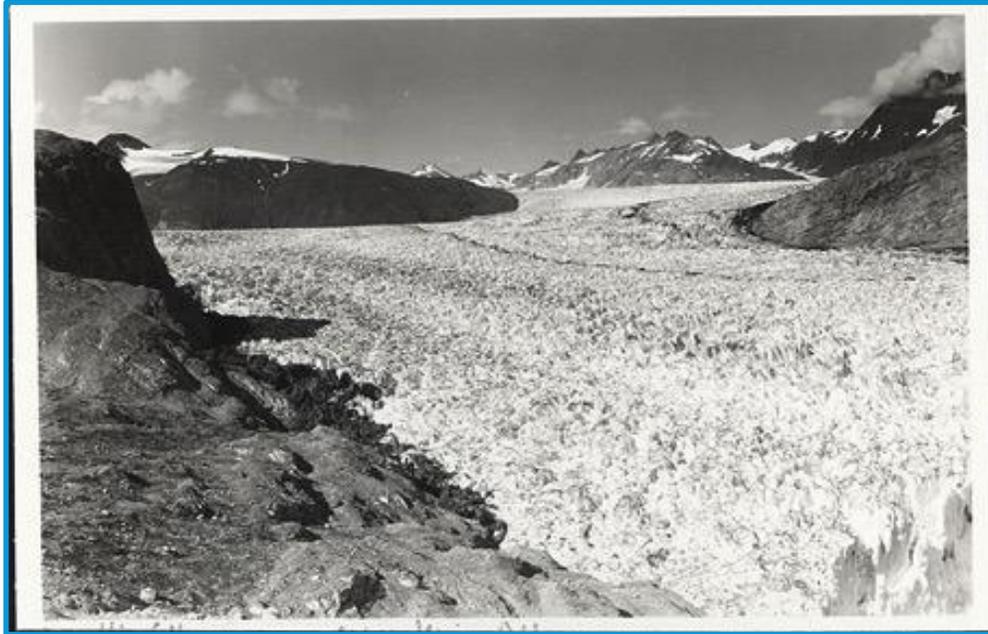
ABOUT THESE IMAGES



Repeat glacier photography

https://nsidc.org/data/glacier_photo/

Muir Glacier, Alaska



1941 (William Osgood Field)



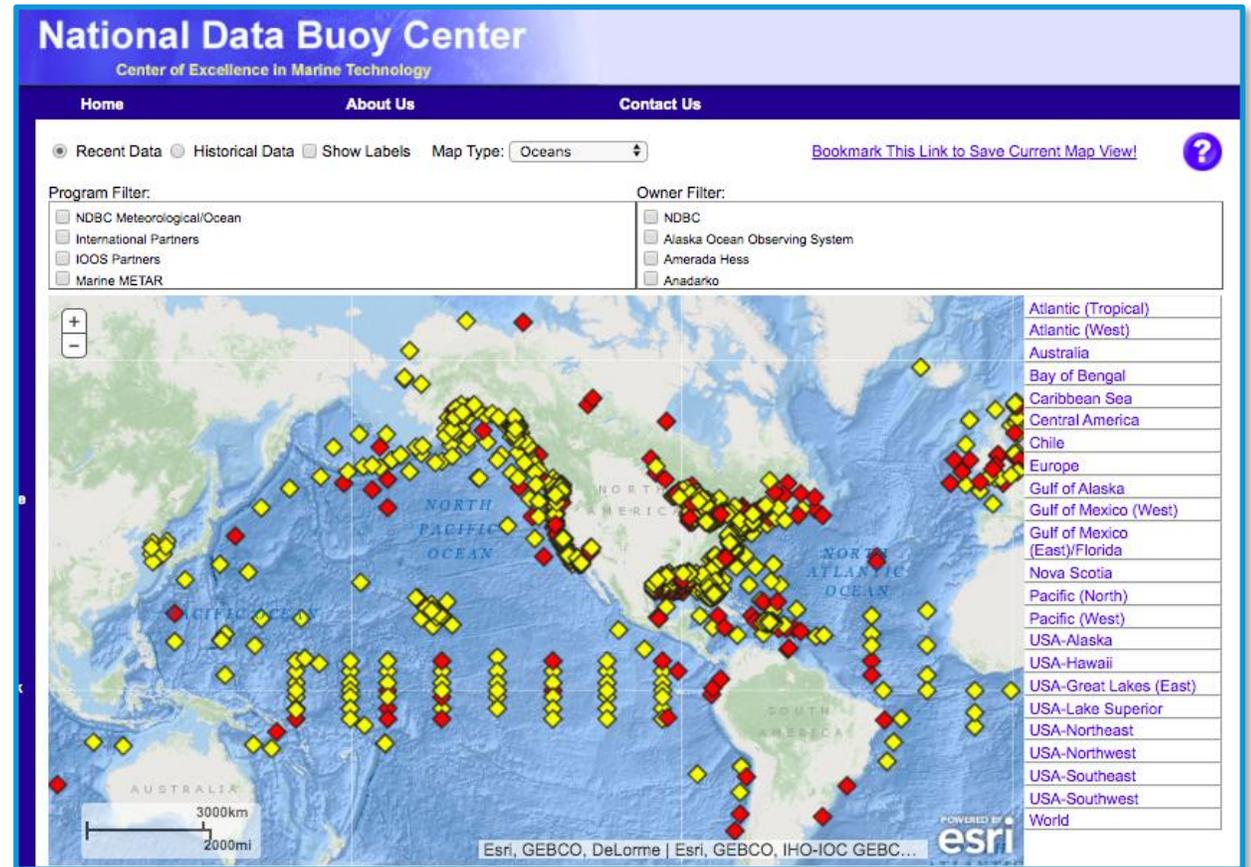
2004 (Bruce F. Molnia)



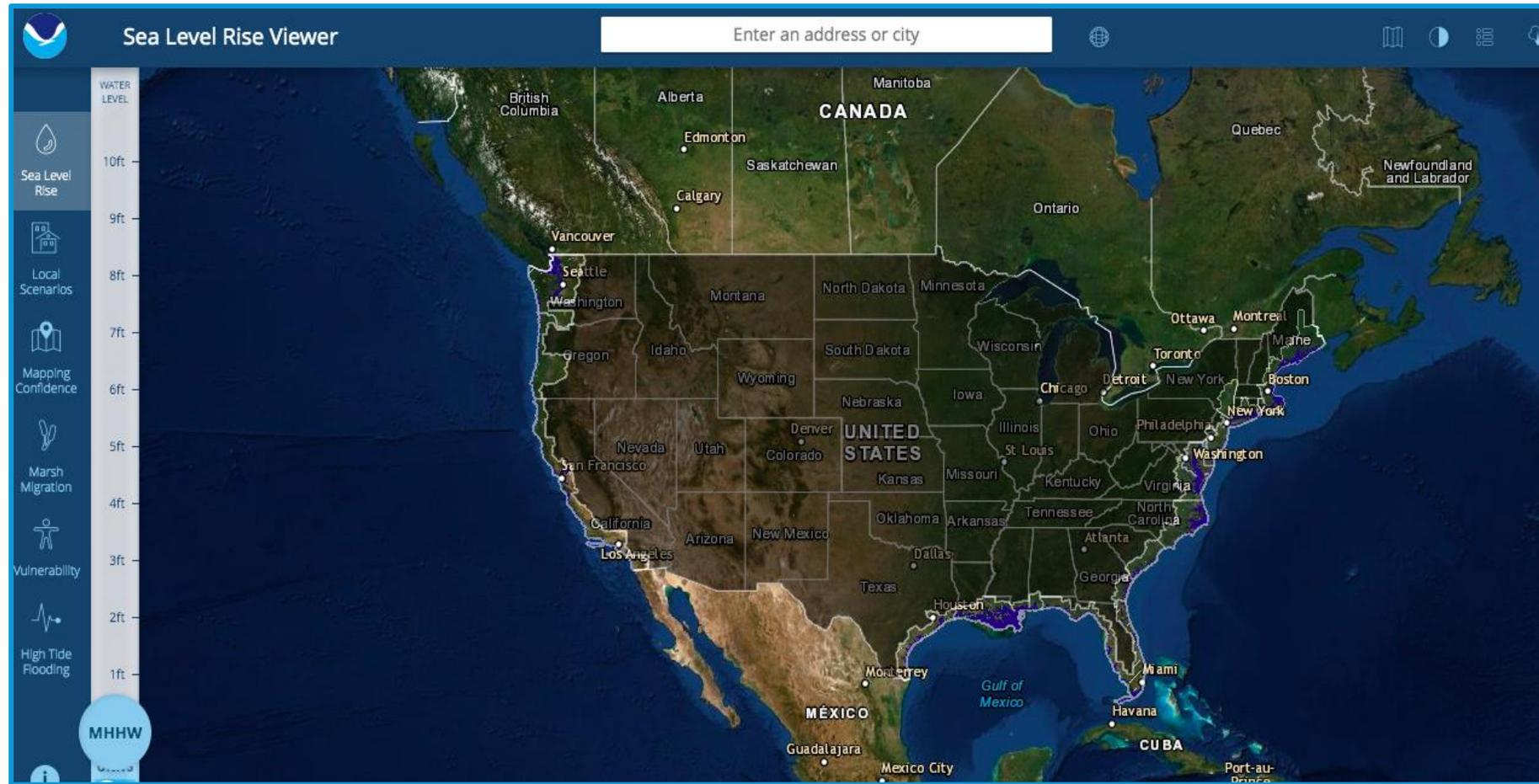
National Data Buoy Center

<https://www.ndbc.noaa.gov/>

- Hundreds of buoys
- Location, temperature, wind, humidity, pressure, sea level, tsunami, much more!



Sea level rise viewer: <https://coast.noaa.gov/slr/>



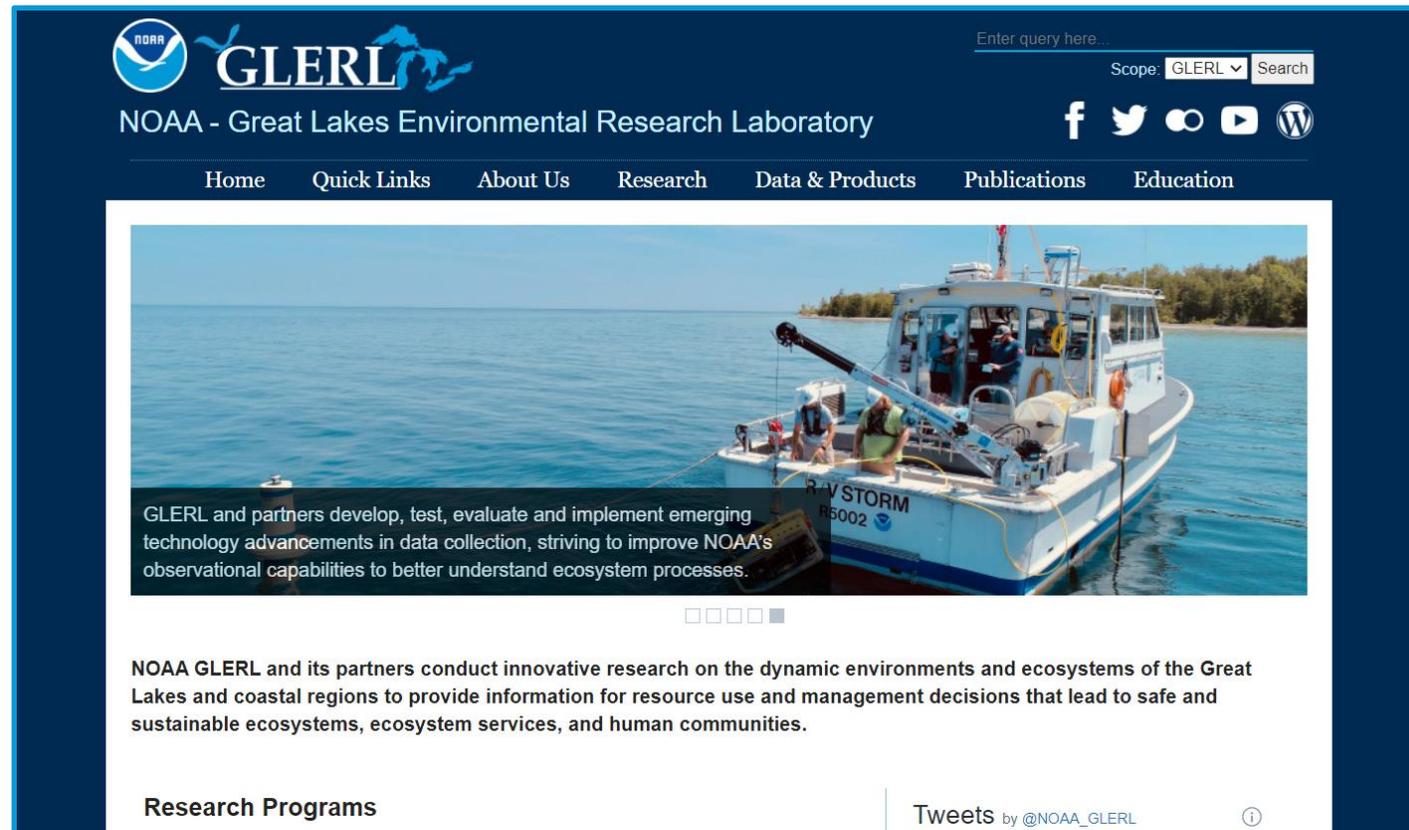
- Sea Level Rise
- Local Scenarios
- Mapping Confidence
- Marsh Migration
- Vulnerability
- High Tide Flooding



Great Lakes Environmental Research Lab

<https://www.glerl.noaa.gov/>

- Data, news, education, more



The screenshot shows the NOAA GLERL website homepage. At the top left is the NOAA logo and the GLERL logo, which includes a map of the Great Lakes. Below the logos is the text "NOAA - Great Lakes Environmental Research Laboratory". To the right of the logo is a search bar with the text "Enter query here..." and a dropdown menu set to "GLERL" with a "Search" button. Below the search bar are social media icons for Facebook, Twitter, YouTube, and WordPress. A navigation menu below the search bar includes links for "Home", "Quick Links", "About Us", "Research", "Data & Products", "Publications", and "Education". The main content area features a large image of a research boat named "R/V STORM" with the number "R5002" on its side. The boat is on a body of water with a forested shoreline in the background. Below the image is a text box that reads: "GLERL and partners develop, test, evaluate and implement emerging technology advancements in data collection, striving to improve NOAA's observational capabilities to better understand ecosystem processes." Below this text is a row of five small square icons. Further down is another text box that reads: "NOAA GLERL and its partners conduct innovative research on the dynamic environments and ecosystems of the Great Lakes and coastal regions to provide information for resource use and management decisions that lead to safe and sustainable ecosystems, ecosystem services, and human communities." At the bottom of the main content area are two sections: "Research Programs" and "Tweets by @NOAA_GLERL".



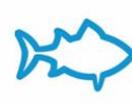
Integrated Ocean Observing System (IOOS):

<https://ioos.noaa.gov/>

The screenshot shows the IOOS website interface. At the top, the IOOS logo and name are displayed. Below is a dark blue navigation bar with links for ABOUT, COMMUNICATIONS, DATA, IOOS IN ACTION, REGIONS, and COMMUNITY, along with a search icon. A dropdown menu is open under 'REGIONS', listing various regional programs: IOOS Region Map, Alaska – ADOOS, Caribbean – CARICOOS, Central And Northern California – CaNCOOS, Great Lakes – GLOS, Gulf Of Mexico – GCCOOS, Mid-Atlantic – MARACOOS, Northeast Atlantic – NERACOOS, Pacific Islands – PacIOOS, Pacific Northwest – NANOOS, Southeast Atlantic – SECOORA, and Southern California – SCCOOS. Below the navigation is a main banner with the text: "IOOS is our eyes on the ocean, coasts, and Great Lakes. We are an integrated network observing data and developing tracking and predictive tools to benefit the economy, home, across the nation, and around the globe." Underneath the banner is a filter for "My Interests Are... All". A row of three featured content tiles is visible: "Eyes on the Ocean™ – IOOS Bi-weekly – 30 October 2019", "IOOS at OceanObs'19", and "SECOORA: Eyes on Hurricane Dorian".



Curriculum and Lessons



CLEAN climate & energy education network

<https://cleannet.org/index.html>

Explore the Collection Teaching Climate and Energy Get Involved

Teaching about Climate and Energy?

Our team of educators and scientists has reviewed and organized the best free teaching resources for K-12 through college.

Entire Collection Activities Videos Visualizations

Featured Resource

CATAN SCENARIOS GLOBAL WARMING

PRINTING AND COPYRIGHT

Printing Instructions

- This PDF version is suitable for:
- Print and use as a reference tool
- Print and use as a teaching tool
- Print and use as a student activity
- Print and use as a student activity

Catan: Global Warming

This game is an expansion on the popular board game Catan, it adapts the regular Catan game to become a game about sustainability ...

[Other](#)

Get Started Teaching Climate and Energy

Easy-to-read **explanations of science and policy**, designed to step students through the **key principles of climate and energy**

- Suggested teaching approaches, selected for various grade levels
- Spanish-language versions
- Supporting materials from the CLEAN reviewed collection
- Culturally relevant climate teaching

[Explore Teaching Climate and Energy »](#)



ACLIPSE climate and data

<https://mare.lawrencehallofscience.org/curriculum/climate-data-clipse-activities>

The screenshot shows the MARE website interface. At the top left is the MARE logo with the text "Marine Activities, Resources & Education". To the right is a search bar with a "SEARCH" button. Below the logo are navigation links: "OCEAN LITERACY", "MARE IN SCHOOLS", "PROFESSIONAL LEARNING", and "PARTNERSHIPS". Under "MARE IN SCHOOLS" are "CURRICULUM AND ACTIVITIES" and "COURSES ABOUT US". The main content area shows "CURRICULUM AND ACTIVITIES" and "Climate & Data ACLIPSE Acti". A dropdown menu is open, listing the following activities:

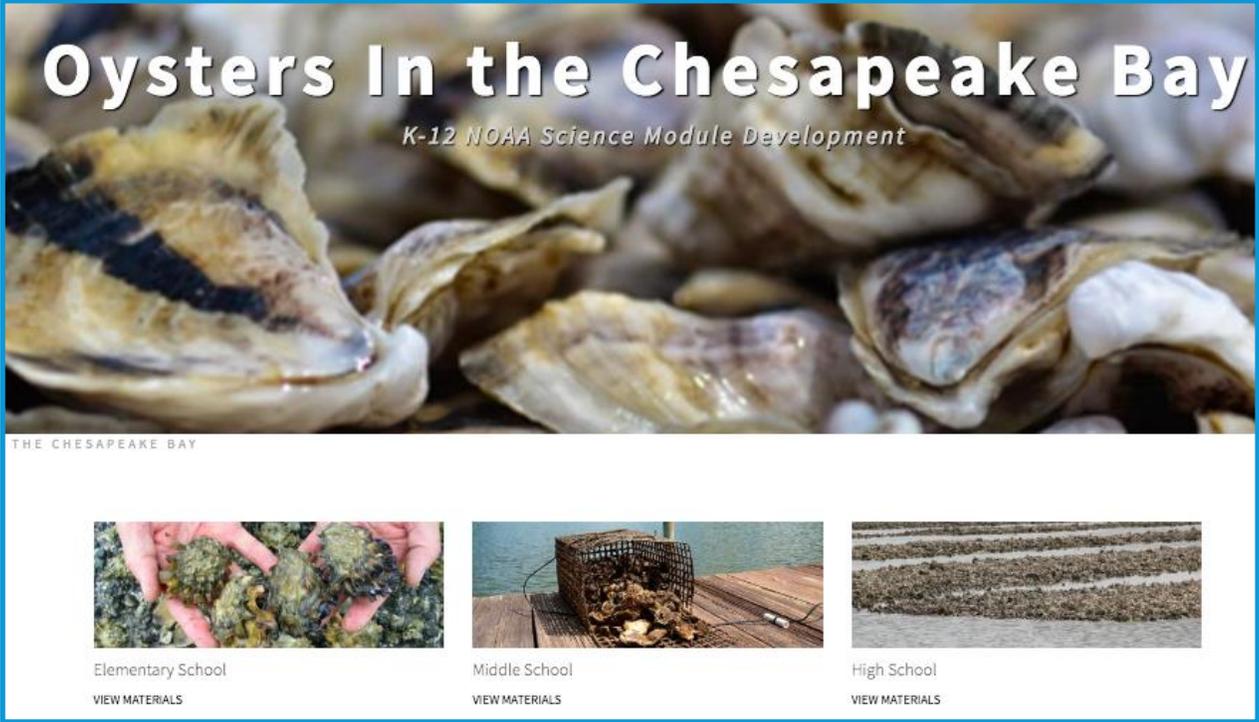
- + Data Scavenger Hunt
- + Engaging with Data Visualizations
- + Carbon Reservoirs and Global Carbon Cycling - Introduction
- + Tracking Carbon: Photosynthesis and Respiration
- + Tracking Carbon: Global Flows and Reservoirs
- + Anthropogenic Effects on Carbon Flows and Reservoirs
- + Causes and Effects of Climate Change
- + Ocean Acidification: Overview and data inquiry activities
- + Ocean Acidification: Effects on Organisms and Solving an Environmental Challenge
- + Global and Local Solutions to Climate Change



Oysters in the Chesapeake Bay

<https://oceanservice.noaa.gov/education/oysters-in-the-chesapeake-bay/welcome.html>

- Modules for elementary, middle, high school
- Historical data in middle, high



Oysters In the Chesapeake Bay
K-12 NOAA Science Module Development

THE CHESAPEAKE BAY

Elementary School
VIEW MATERIALS

Middle School
VIEW MATERIALS

High School
VIEW MATERIALS



Data in the Classroom

<https://dataintheclassroom.noaa.gov/>



The screenshot shows the NOAA Data in the Classroom website. At the top left is the NOAA logo and the text "National Oceanic and Atmospheric Administration U.S. Department of Commerce". To the right is "Satellite and Information Service". The main heading is "Data in the Classroom". Below it is a navigation menu with links for "Home", "El Niño", "Sea Level", "Water Quality", "Coral Bleaching", and "Ocean Acidification". A sub-heading reads "Put Real-Time Data to Work in Your Classroom!". The main text states: "With NOAA's Data in the Classroom, students use real-time ocean data to explore today's most pressing environmental issues, and develop problem-solving skills employed by scientists. Access online and classroom-ready curriculum activities with a scaled approach to learning and easy-to-use data exploration tools." Below this are five topic cards: "El Niño" (purple header), "Sea Level" (orange header), "Coral Bleaching" (green header), "Water Quality" (red header), and "Ocean Acidification" (yellow header). Each card contains a short introductory paragraph.

NOAA National Oceanic and Atmospheric Administration
U.S. Department of Commerce

Satellite and Information Service

Data in the Classroom

Home El Niño Sea Level Water Quality Coral Bleaching Ocean Acidification

Put Real-Time Data to Work in Your Classroom!

With NOAA's Data in the Classroom, students use real-time ocean data to explore today's most pressing environmental issues, and develop problem-solving skills employed by scientists. Access online and classroom-ready curriculum activities with a scaled approach to learning and easy-to-use data exploration tools.

El Niño

People blame El Niño for all kinds of abnormal weather. But how does El Niño really work?

Sea Level

Scientists know that global sea level is rising. But how are water levels monitored and measured to understand impacts?

Coral Bleaching

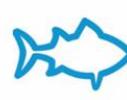
Coral reefs undergo bleaching when exposed to heat stress. But how do scientists measure and predict bleaching?

Water Quality

Changes in water quality conditions have a big impact on organisms living in estuaries. But how is water quality monitored?

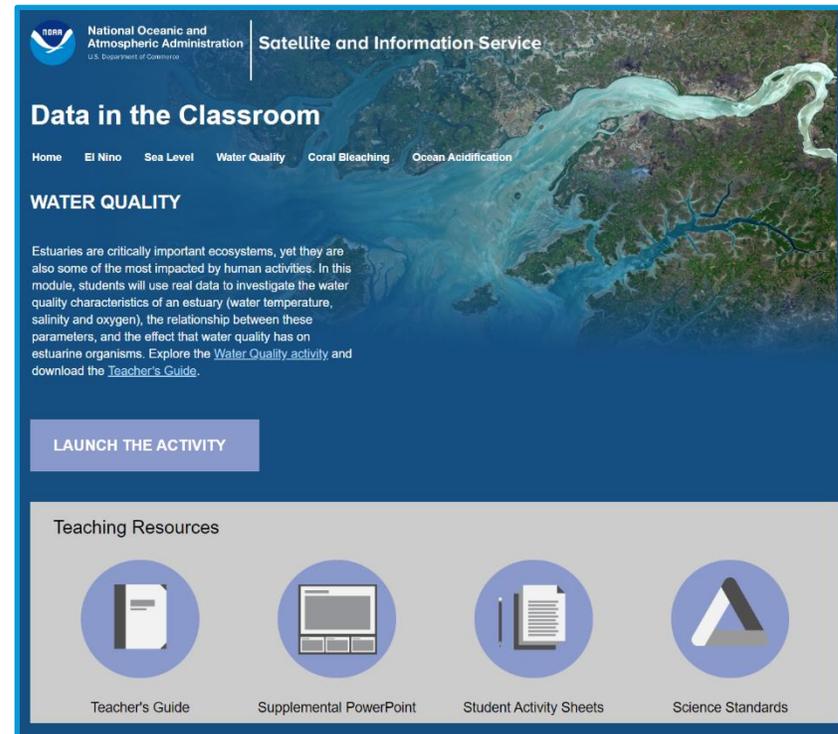
Ocean Acidification

The amount of CO₂ in the atmosphere is increasing, due to the burning of fossil fuels. How do these changes affect the chemistry of the ocean?



Data in the Classroom

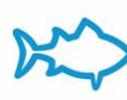
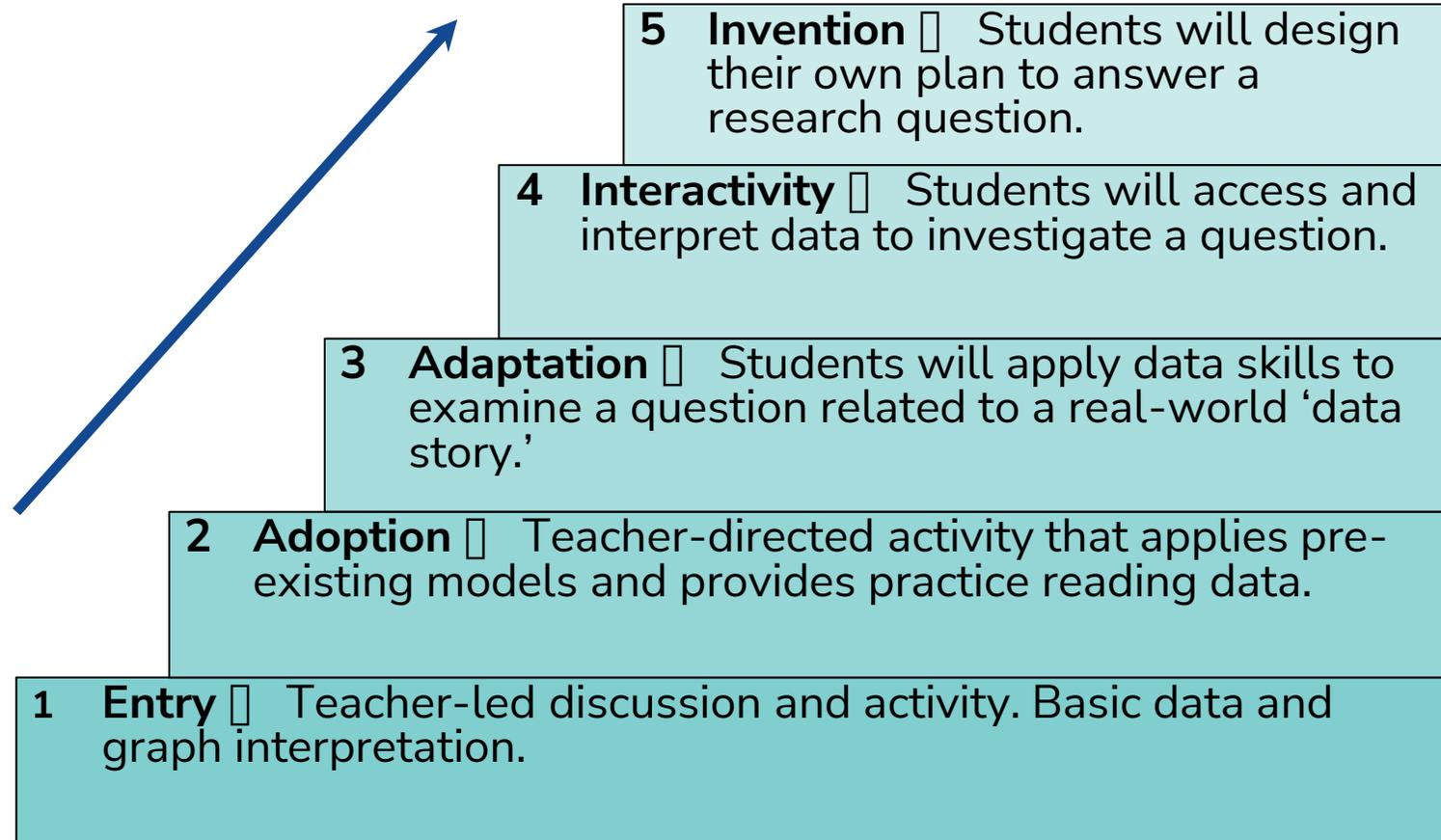
- Historic and real-time data
- Authentic research questions
- Teacher guide
- NGSS aligned
- Scaled learning:
 - Entry
 - Adoption
 - Adaptation
 - Interactivity
 - Invention



The screenshot shows the NOAA Data in the Classroom website. At the top, it features the NOAA logo and the text "National Oceanic and Atmospheric Administration | Satellite and Information Service". Below this is the title "Data in the Classroom" and a navigation menu with links for "Home", "El Nino", "Sea Level", "Water Quality", "Coral Bleaching", and "Ocean Acidification". The main content area is titled "WATER QUALITY" and includes a paragraph of text: "Estuaries are critically important ecosystems, yet they are also some of the most impacted by human activities. In this module, students will use real data to investigate the water quality characteristics of an estuary (water temperature, salinity and oxygen), the relationship between these parameters, and the effect that water quality has on estuarine organisms. Explore the [Water Quality activity](#), and download the [Teacher's Guide](#)." Below the text is a purple button labeled "LAUNCH THE ACTIVITY". At the bottom, there is a section titled "Teaching Resources" with four icons representing different resources: "Teacher's Guide" (a document icon), "Supplemental PowerPoint" (a laptop icon), "Student Activity Sheets" (a document with a pencil icon), and "Science Standards" (a triangle icon).

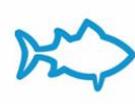
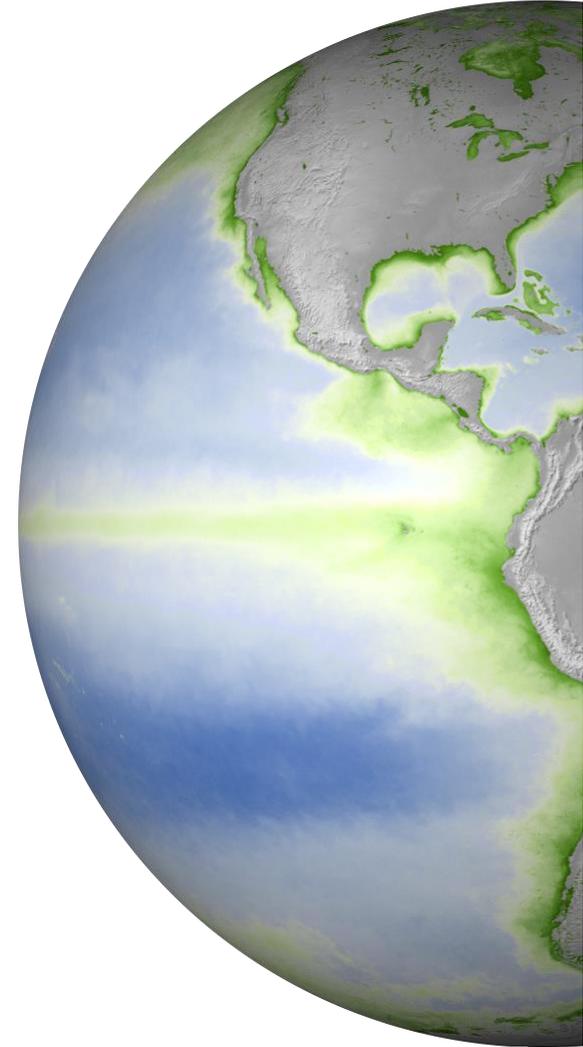


Data in the Classroom



Module demonstration

Investigating El Niño



INVESTIGATING EL NIÑO

People blame El Niño for all kinds of abnormal weather. One of the ways to detect an El Niño event is to look at sea surface temperature (SST). By observing SST through graphs and maps, you can track the growth of plant life and even begin to predict future El Niño events. Explore our [El Niño activity](#) and download our [Teacher's Guide](#).



LAUNCH THE ACTIVITY

Teaching Resources



Teacher's Guide



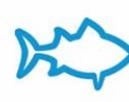
Supplemental PowerPoint



Student Activity Sheets



Science Standards





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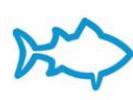
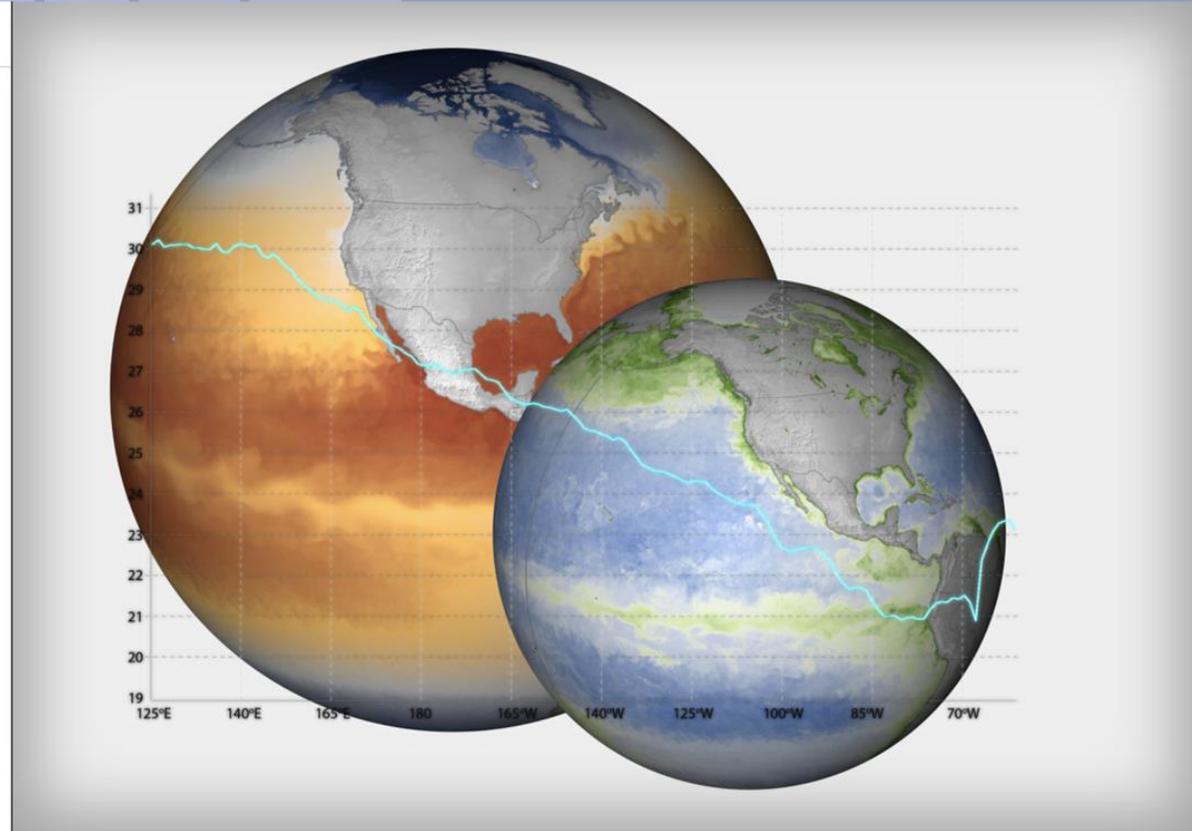
People blame El Niño for all kinds of abnormal weather. But how does El Niño really work?

This activity uses a series of interactive web maps, apps, and high resolution images to help you learn about El Niño using real data from NOAA.

Work through Levels 1-5, or explore the data on your own using the NOAA data tools.

Teachers: These online activities support an in-depth curriculum module on El Niño for middle school students and beyond. To access the full suite of curricular resources, visit the Teachers Guide tab.

In addition, [maps](#), [images](#) and [printable worksheets](#) are available for classrooms that cannot support the technologies on this website.





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Reading Sea Surface Temperature

Introduction

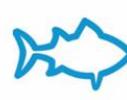
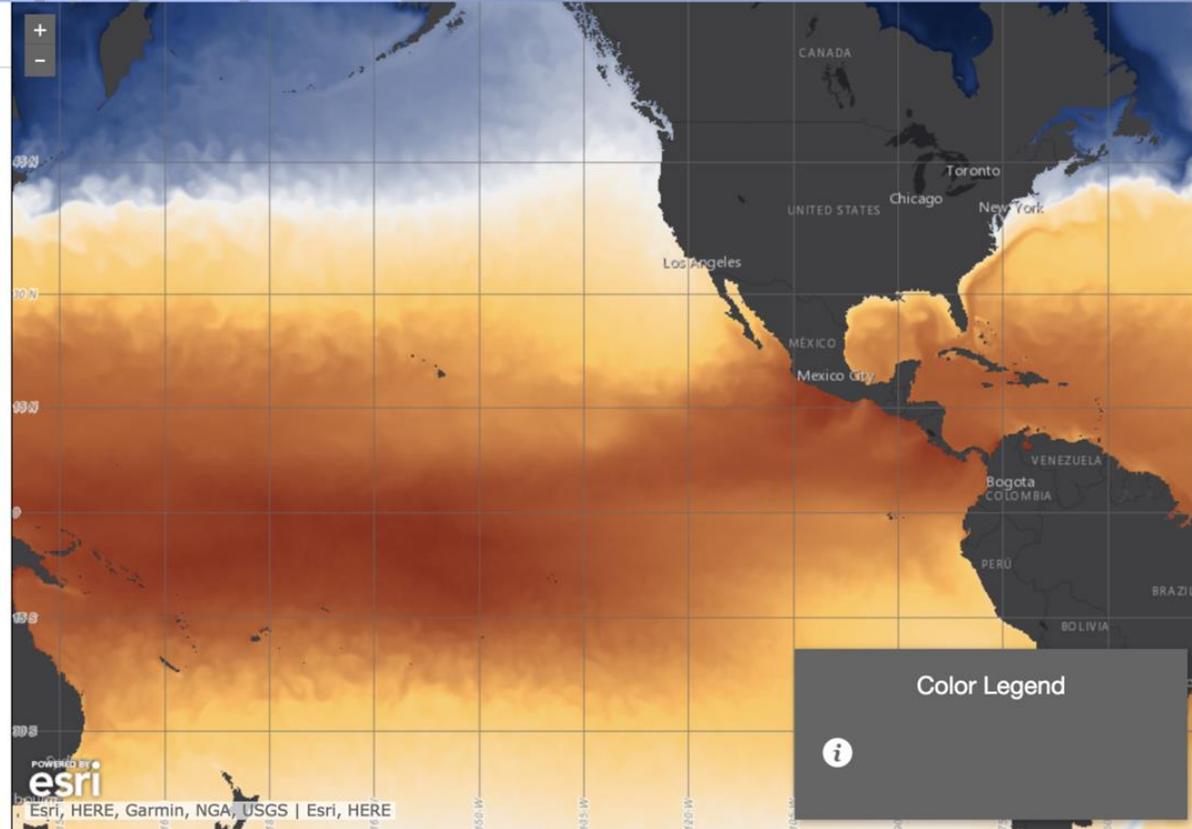
Objective

Students will learn how to read and interpret sea surface temperature maps.

Background

One of the ways to detect an El Niño event is to look at sea surface temperature (SST). SST can be recorded using instruments on satellites that measure heat from the surface of the ocean. These data can be represented on maps in different ways. One way scientists do this is to plot different temperature values with different colors, producing what is called a false-color map.

Also shown on this map are lines indicating





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Understanding False Colored Maps

Examine this SST map from December 2015 and answer the following questions.

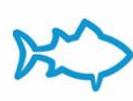
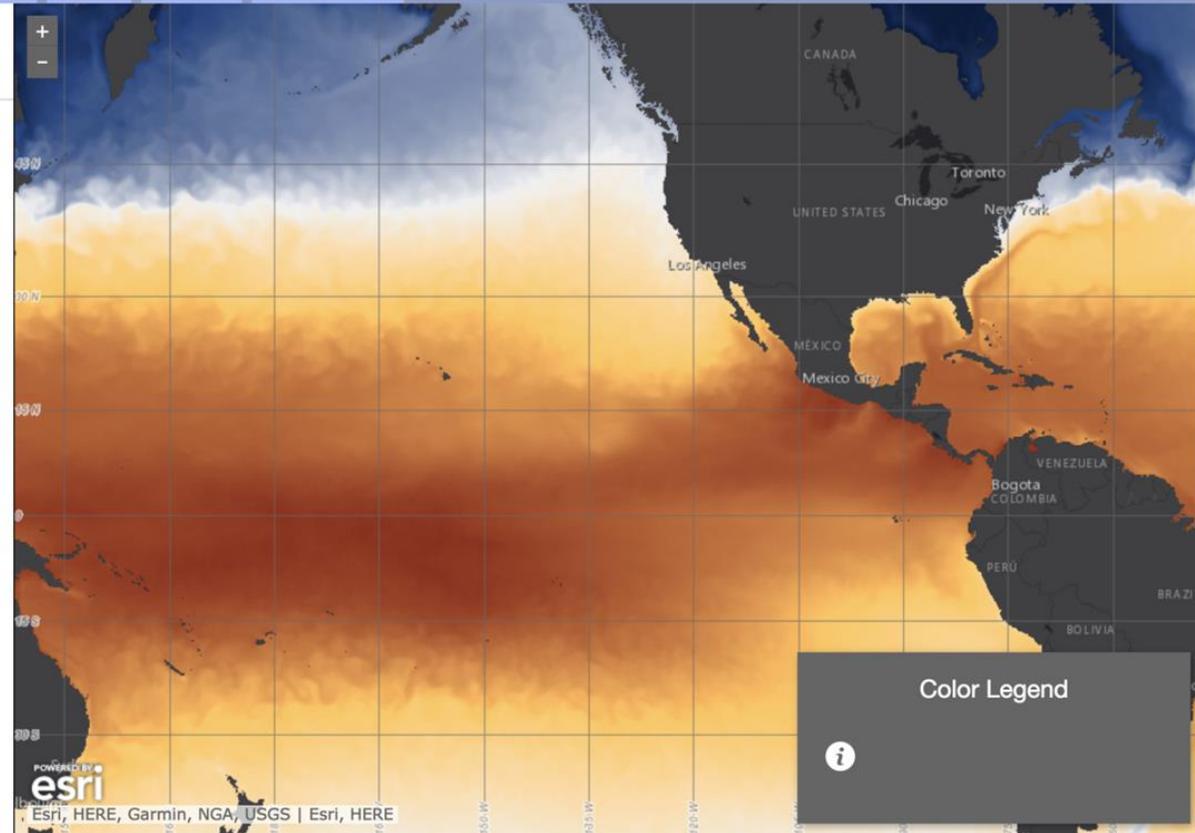
Question 1: Lines of latitude indicate?

- Degrees of temperature
- Degrees north and south of the equator
- Areas of equal temperature
- Representations of colors to indicate temperature

Question 2: According to the map, the average monthly sea surface temperature at 5° North and

Comparing Change Over Time

Look at these two maps. On the left is a map from





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Reading Sea Surface Temperature

Comparing Change Over Time

Look at these two maps. On the left is a map from December 1990, and on the right is a map from December 1991.

Discuss and compare these two maps. How are they alike and how are they different?

Question 3: Why is it important for researchers to look at data for more than one year to determine sea surface temperature change?

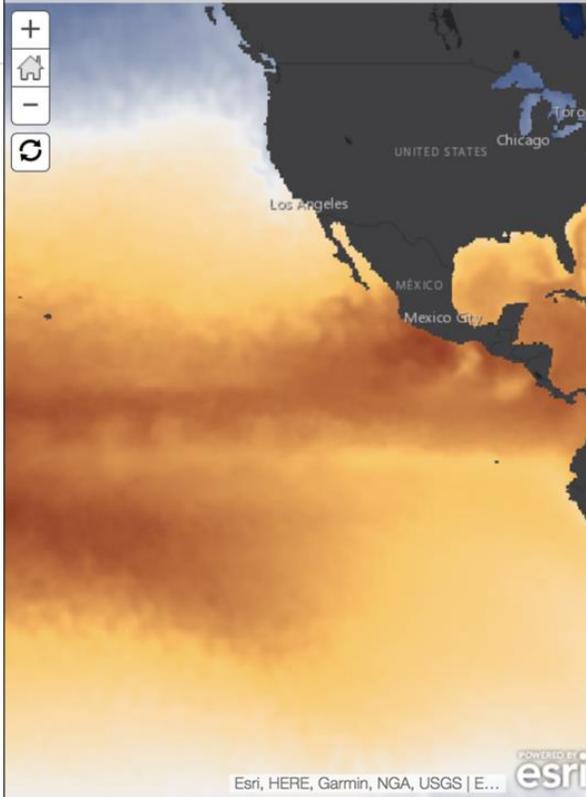
- A. From year to year, temperature patterns may be quite different
- B. Some years, data is not reliable
- C. A lot of data is needed to analyze trends
- D. Answer A and C

Sea Surface Temperature °C



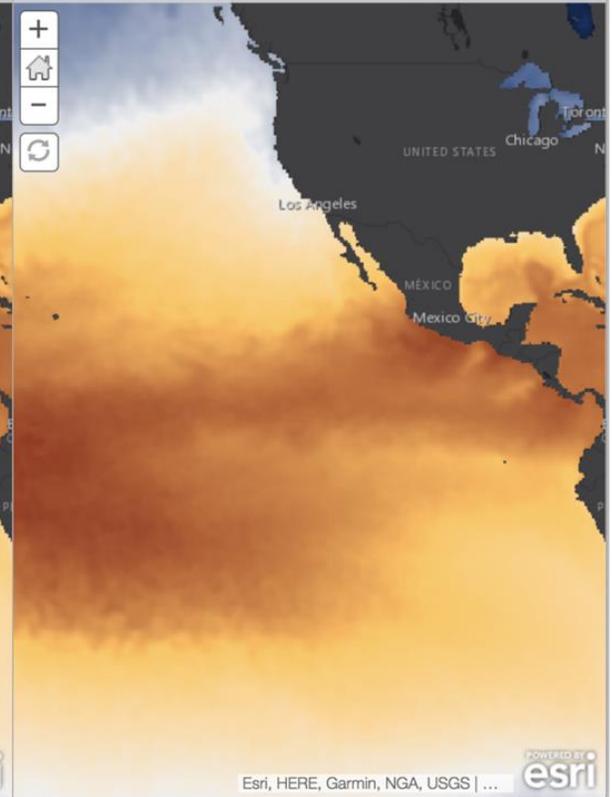
Hint: Zoom and navigate the map on the left and

Level 1 - December 1990 SST

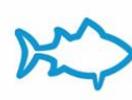


Esri, HERE, Garmin, NGA, USGS | E...

Level 1 - December 1991 SST



Esri, HERE, Garmin, NGA, USGS | ...





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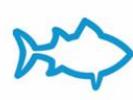
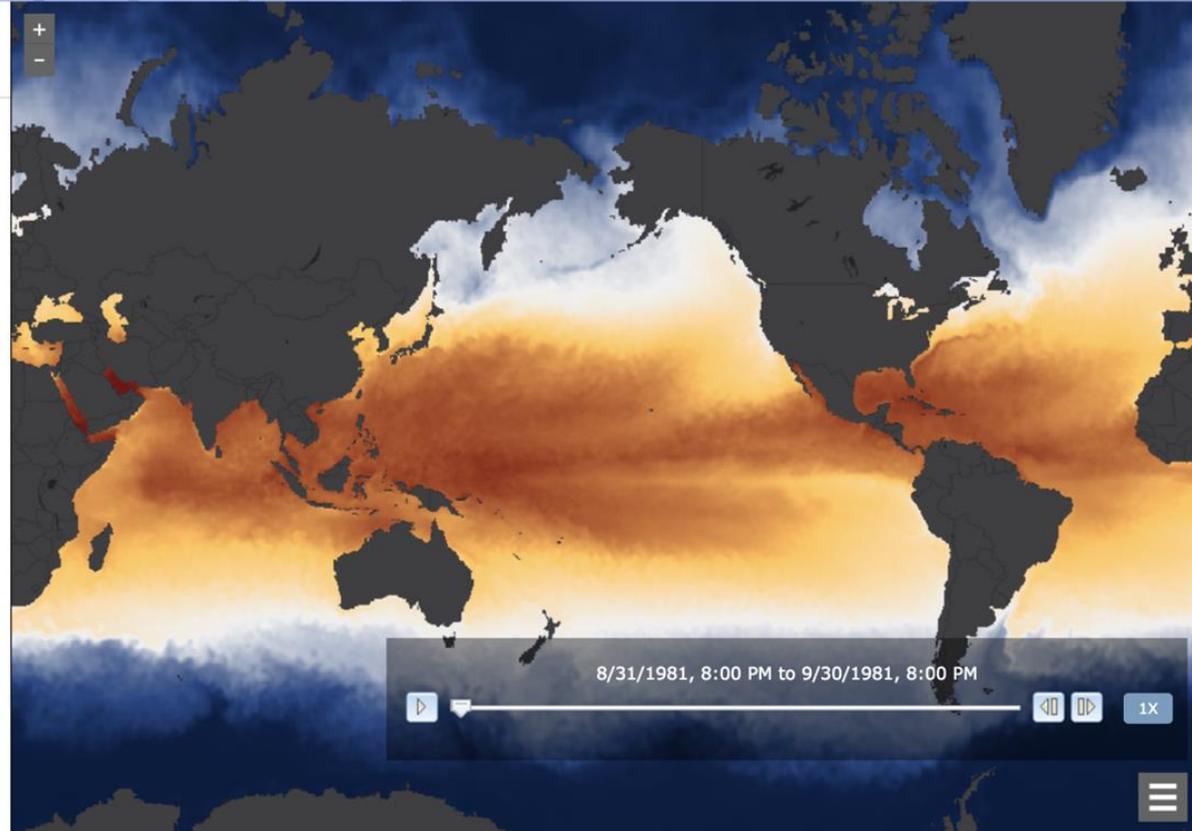
Explore More Data

After analyzing the December 1991 map above, what do you think a map from June 1992 should look like?

The data application to the right show all of the SST data since satellite measurements began in 1981.

Use the slider to scroll through time and analyze the SST data and see how SST changes from month to month.

Sea Surface Temperature °C





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Looking at SST Another Way

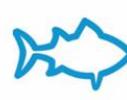
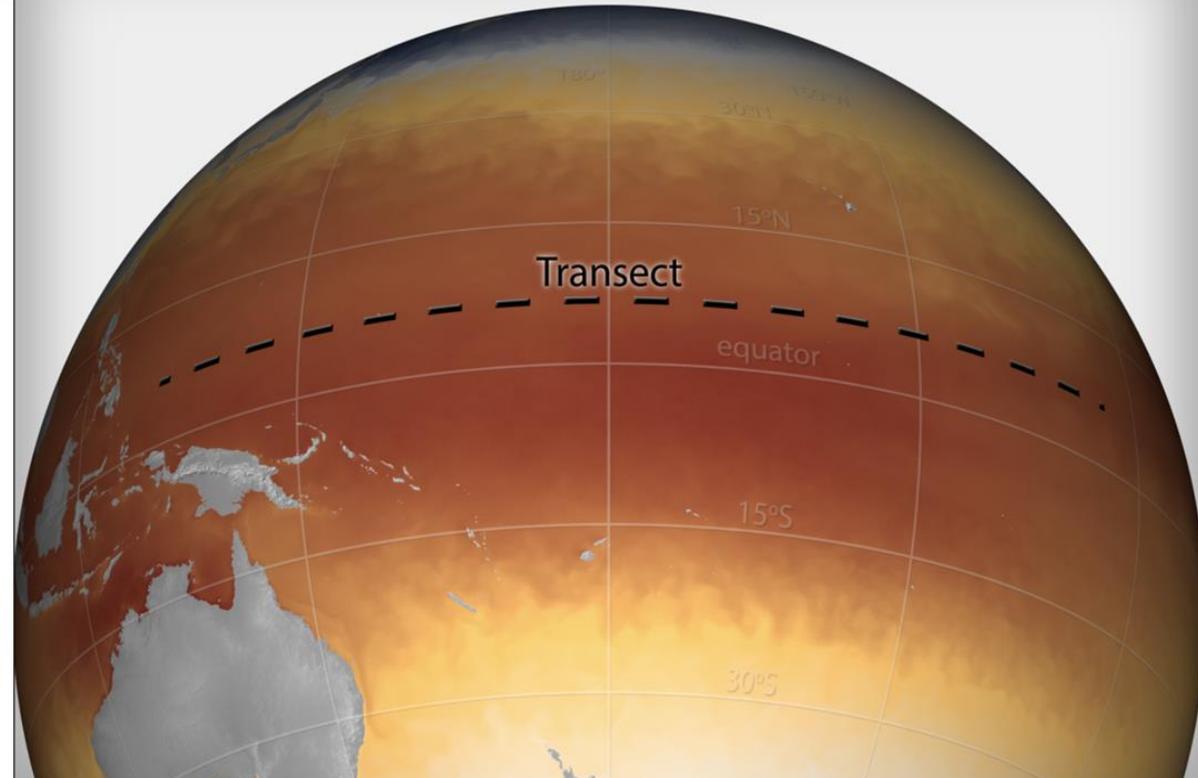
Introduction

Objective

Students will explore two different ways sea surface temperature (SST) data can be represented and describe the advantages of both displays.

Background

Researchers use satellites to collect data and provide "snapshots" of sections of the ocean. During an El Niño event, it is important to have different tools to understand how SST changes. In the last activity, students used maps displaying SST over a large surface area in the Pacific Ocean. Now students are asked to look at that same data, but this time using a graph along a single line of latitude from west to east. This kind of graph





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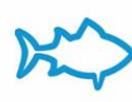
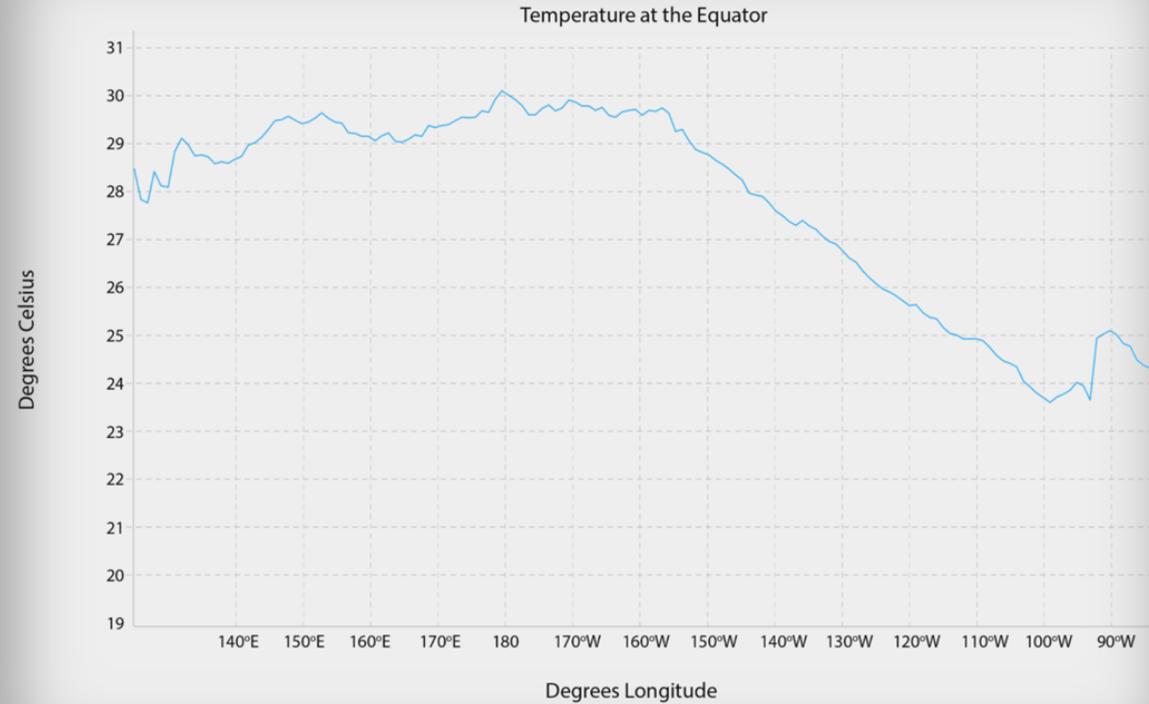
Looking at SST Another Way

Graphing SST Measurements

Examine the line graph to the right, using SST data from December 2015. Identify the units along the X and Y axis and be sure to understand the difference between degrees of temperature and degrees of latitude/longitude.

Question 1: What were the monthly average sea surface temperatures along 0° latitude at these locations? Fill in the chart below or in your Worksheets.

Longitude	SST Value
140°E	-Enter value-
180°	-Enter value-
140°W	-Enter value-
100°W	-Enter value-





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Looking at SST Another Way

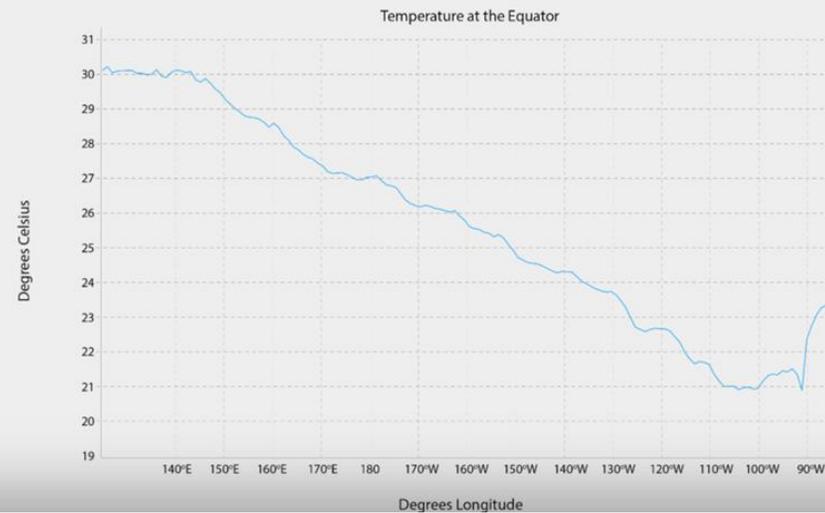
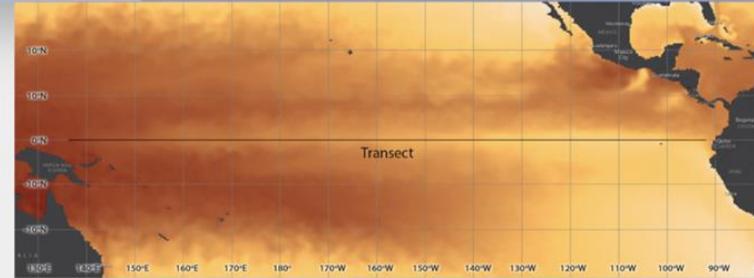
Understanding Maps and Graphs

The image on the right shows the SST map for December 2010, along with the corresponding line graph of SST.

Question 2: What was the SST at 0° latitude at these locations?

Following the transect line along the SST map, use the colorbar (below the table) to estimate the values of temperature at each line of longitude. Enter your temperature estimates in the chart below (or in the worksheet provided by your teacher) for each longitude value in the Map column. Afterwards, repeat the same process with the graph: enter each value in the Graph column below. Do they correspond?

Longitude	SST Map	SST Graph
140°E	-Enter value-	-Enter value-
180°	-Enter value-	-Enter value-





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Detecting El Niño

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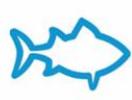
Objective

Students will apply map and graph skills learned in earlier levels to a real problem — identifying an El Niño event.

Background

During a typical year, the trade winds that blow across the Pacific Ocean push warm surface water to the west. On a typical SST map, the surface water in the western Pacific is warmer than in the eastern Pacific. But periodically, this pattern changes. The trade winds die down or even reverse, and water temperatures in the east become warmer than usual. This change in wind patterns is the beginning of an El Niño.

Upwelling and El Niño Conditions





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Detecting El Niño

Graphing El Niño

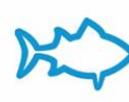
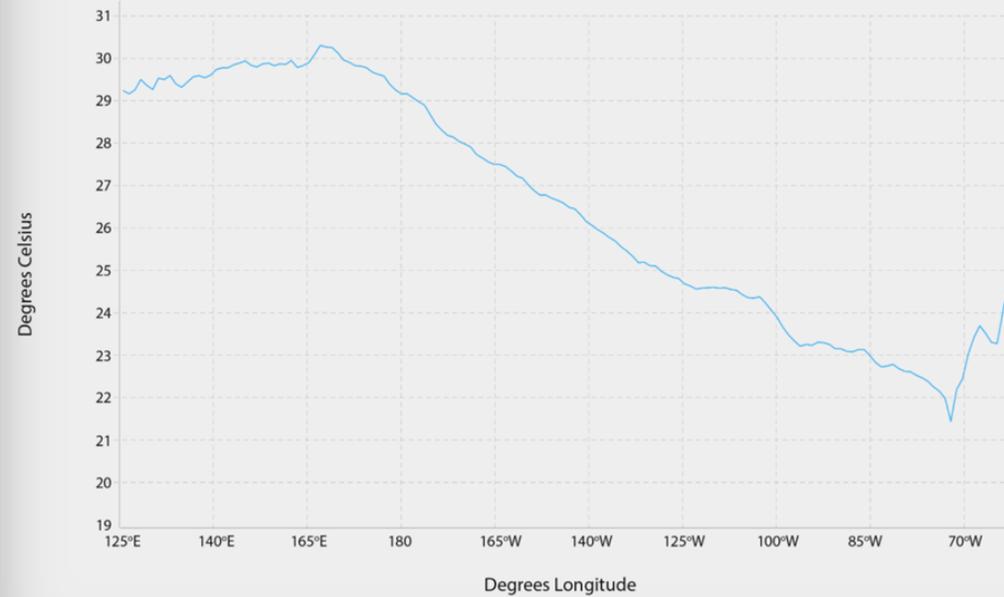
In Level 2, you examined a graph of SST data along the equator. By using similar graphs it is possible to determine if the Pacific Ocean is experiencing an El Niño.

During a [normal](#) year (click), the temperature difference between warm water in the west and cooler water in the east is evident in the slope of the line on the following temperature plot.

During an [El Niño](#) year (click), the area of high temperature can be seen extending farther to the east than in a typical year. The temperature difference from west to east may also be smaller.

After analyzing the images, scroll down to check your understanding.

Temperature at the Equator





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Detecting El Niño

Check Your Understanding

Click each **Question** to display a new image and answer the question.

[Question 1. \(click here\)](#)

Which graph is indicative of an El Niño year?

- A
- B

Check my answer

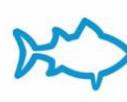
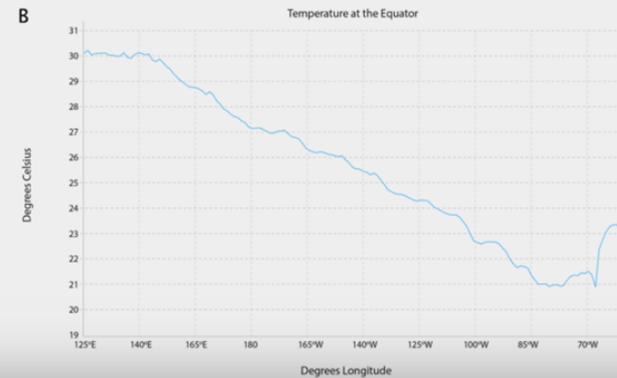
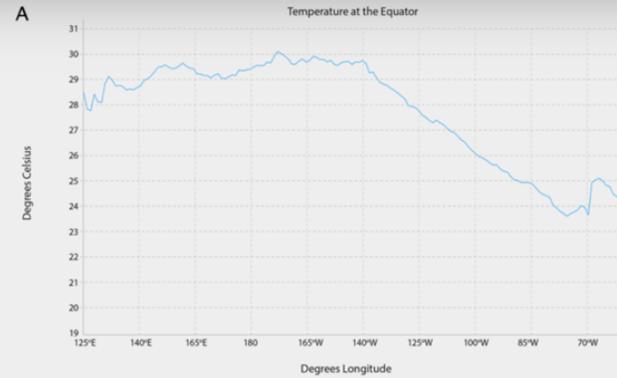
[Question 2. \(click here\)](#)

Which diagram is indicative of El Niño upwelling patterns?

- A
- B

Check my answer

[Question 3. \(click here\)](#)





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Check Your Understanding

Click each **Question** to display a new image and answer the question.

[Question 1. \(click here\)](#)

Which graph is indicative of an El Niño year?

- A
- B

Check my answer

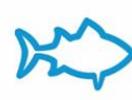
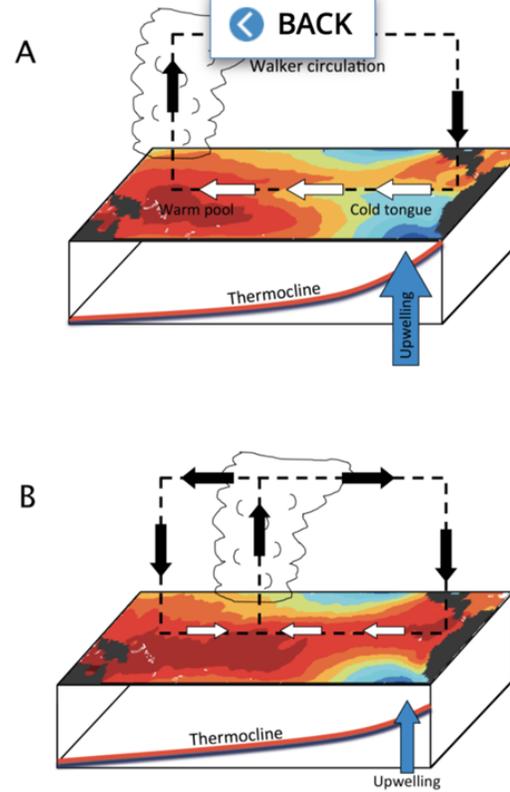
[Question 2. \(click here\)](#)

Which diagram is indicative of El Niño upwelling patterns?

- A
- B

Check my answer

[Question 3. \(click here\)](#)





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Check my answer

Question 2. [\(click here\)](#)

Which diagram is indicative of El Niño upwelling patterns?

- A
- B

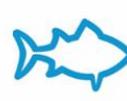
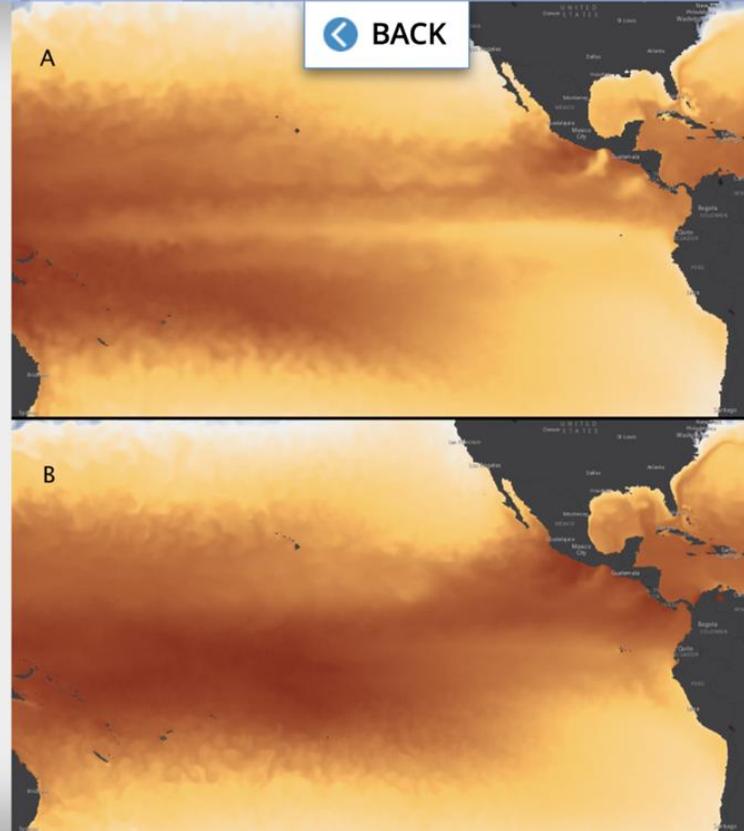
Check my answer

Question 3. [\(click here\)](#)

Which map is indicative of an El Niño year?

- A
- B

Check my answer





Detecting El Niño

Answering a Question With Data

It's December of 2015. The water along the coast of California is unusually warm. Tiny red crabs that are typically common in the warm waters of Mexico are now washing up along beaches of California. Are these observations the result of an El Niño? Your mission is to find out - using data.

1. **Your Question:** Did an El Niño event occur during the winter of 2015-2016?

2. **Get the Data:** To answer this question, use the data tool at right to access sea surface temperature data. Here's how it works:

- **Which timespan?** Select 'monthly'
- **Specify a date:** Select the desired month and year
- **Bounding Box:** Move and resize the red box on the map by clicking and dragging the edges. For example, you could resize the box to include the entire Pacific Ocean, if desired. Alternatively, you can select the exact latitude and longitude by entering the

Download Sea Surface Temperature and Chlorophyll Concentration Data

Which data?

Sea Surface Temperature

Which timespan?

- Weekly
- Monthly
- Yearly

Specify a date

1981 08/24 to 08/30

Bounding Box:

Upper-Left Latitude: 22°N
22

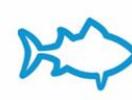
Upper-Left Longitude: 126°E
126

Lower-Right Latitude: 23°S
-23

Lower-Right Longitude: 73°W
-73

Select a region

Please use the crosshairs to select a particular region of the map





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Introduction

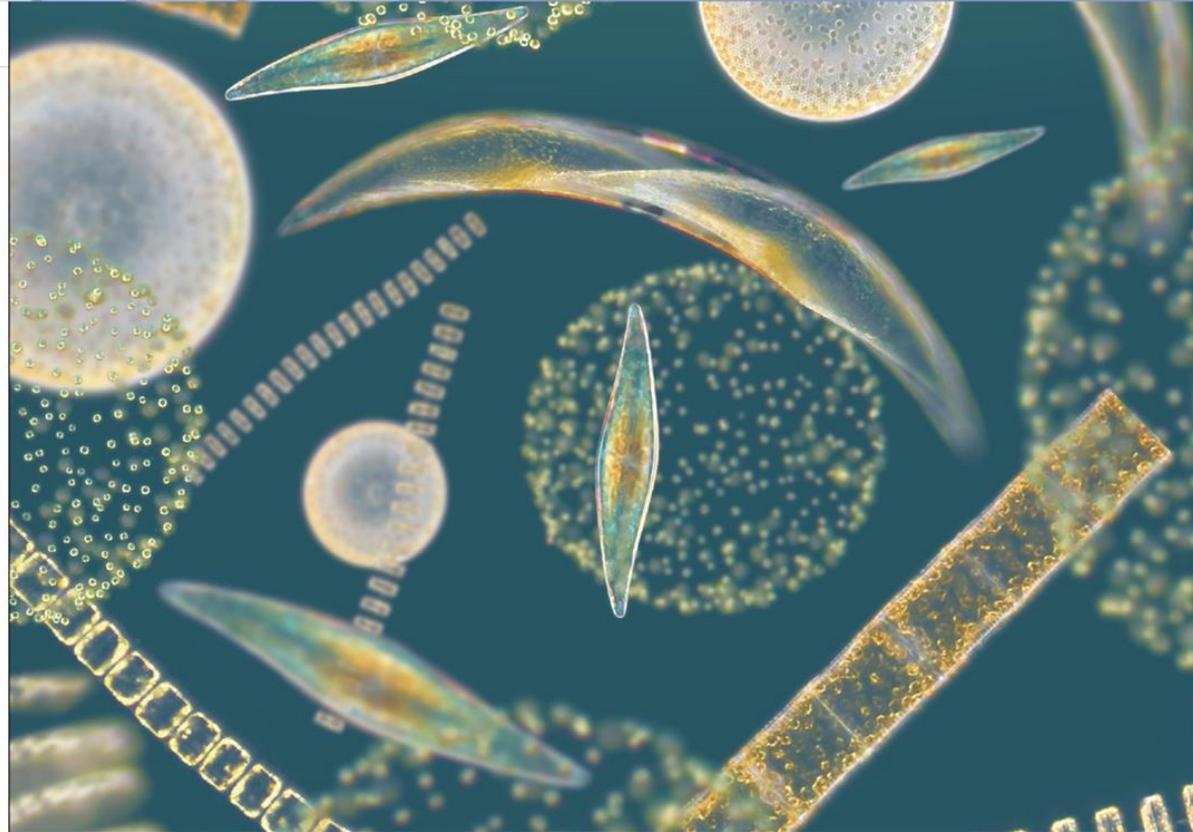
Objective

Students will examine the relationship between SST and chlorophyll a to understand how El Niño affects productivity in the ocean.

Background

Phytoplankton are microscopic plants that live near the surface of the ocean and provide food for larger organisms. They form the base of the food chain. Nutrients carried by upwelling from deeper water up to sunlit surface water encourage phytoplankton growth. This process can be compared to the addition of fertilizers to soil to encourage land plants to grow faster and larger.

Activities:





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Measuring Phytoplankton from Space

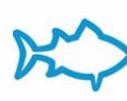
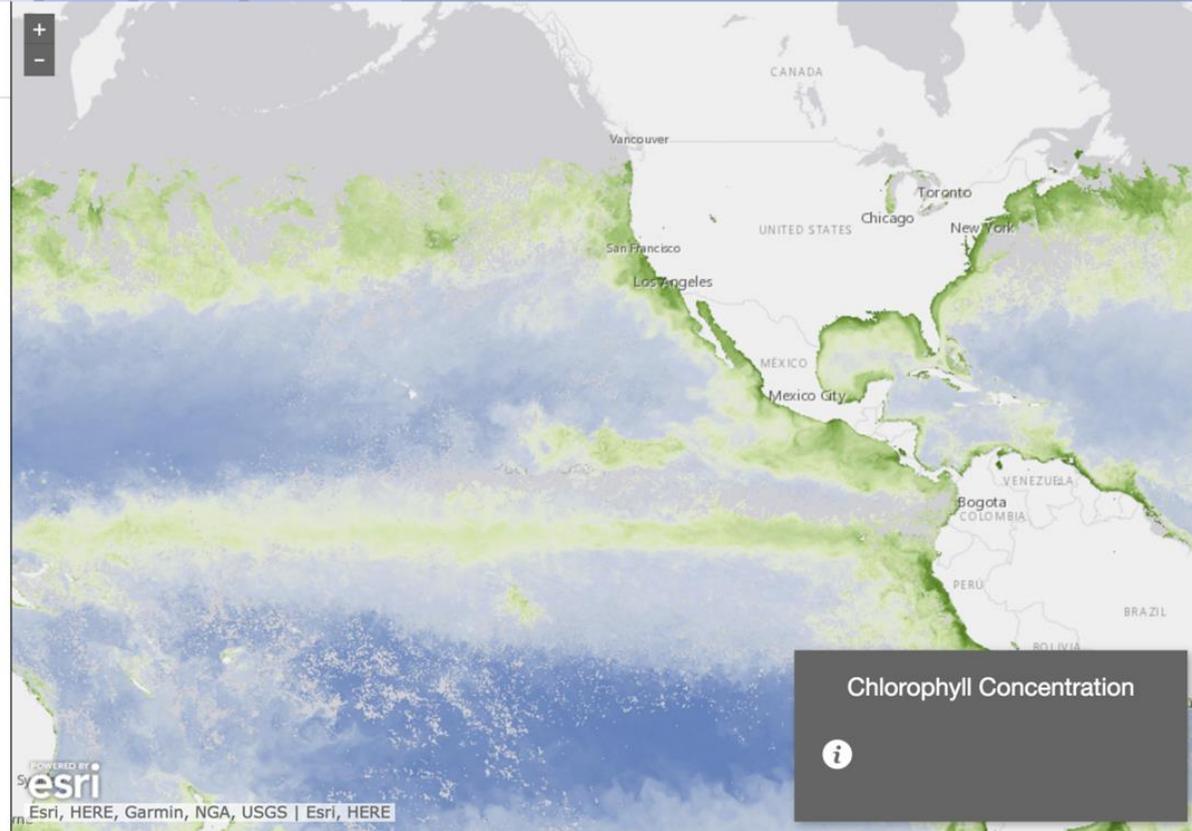
Phytoplankton also contain chlorophyll, which enables them to use photosynthesis. Scientists estimate the amount of phytoplankton in the ocean by using satellites that can detect the color of the ocean from space. Greener water means more chlorophyll and phytoplankton.

Scientists map the values of chlorophyll concentration much like what was done for SST. In this case, areas that are blue have very low chlorophyll concentration due to limited amounts of nutrients. Areas that are green have much higher chlorophyll concentration.

Question 1: The narrow green region along the coast of California indicates:

- Low levels of nutrients
- Low levels of phytoplankton
- High levels of nutrients only
- High levels of nutrients and phytoplankton

Check my answer





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Relating SST to Productivity

Disrupting Ocean Productivity

During an El Niño, when upwelling is disrupted, scientists measure a decrease in chlorophyll in areas of the eastern Pacific. This signals a decline in phytoplankton productivity.

Examine the connections between sea surface temperature, upwelling and chlorophyll concentrations by answering the questions below.

Click each **Question** to load the proper map. Click and slide the vertical bar left and right to view and compare the data.

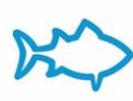
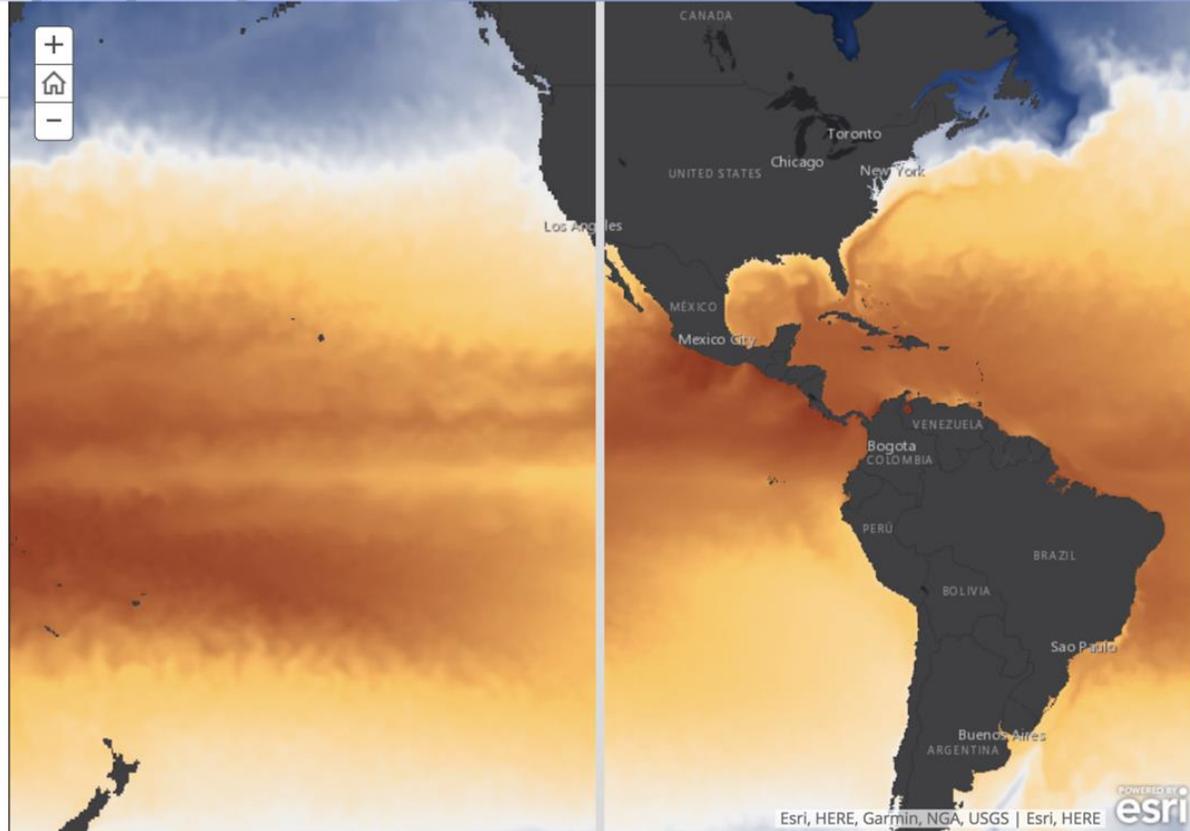
[Question 2: \(click here\)](#)

Which SST map might indicate a disruption in upwelling?

- Left map
- Right map

Check my answer

[Question 3: \(click here\)](#)





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Relating SST to Productivity

and slide the vertical bar left and right to view and compare the data.

Question 2: (click here)

Which SST map might indicate a disruption in upwelling?

- Left map
- Right map

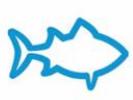
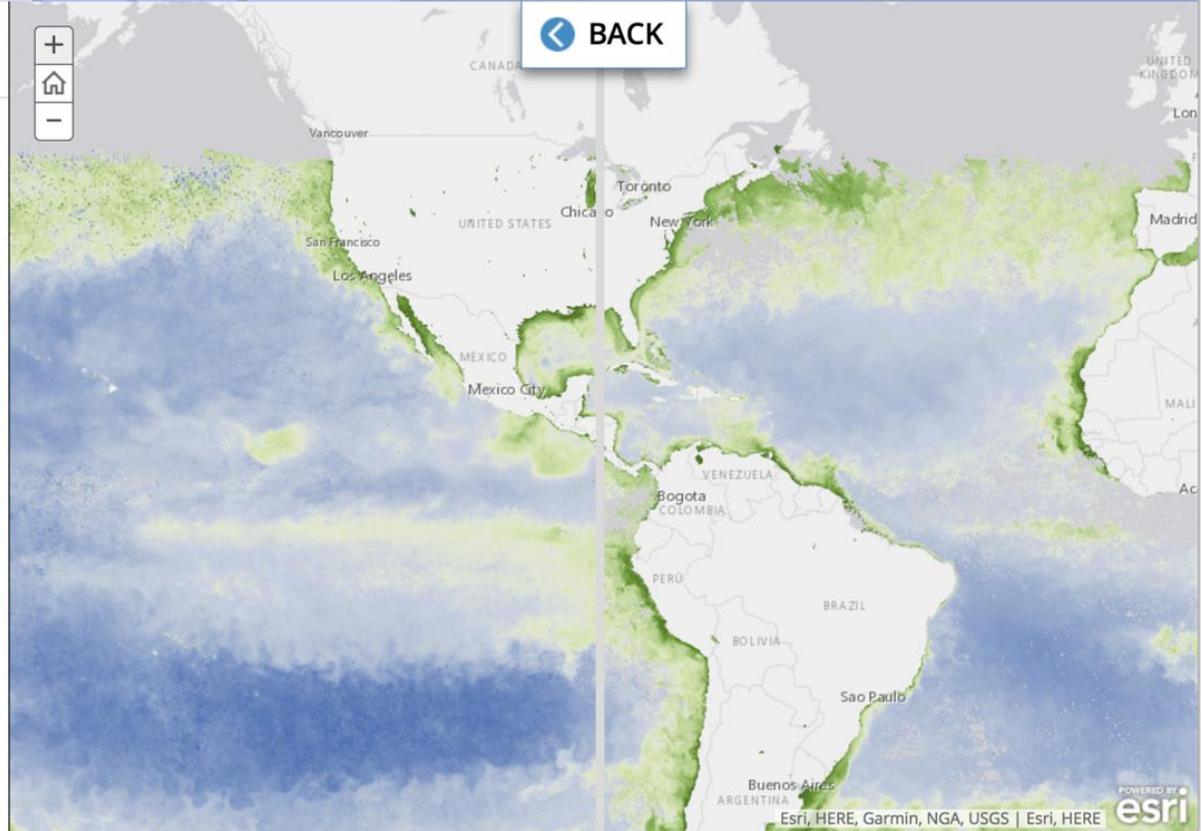
Check my answer

Question 3: (click here)

Which chlorophyll concentration map might indicate a disruption in upwelling?

- Left map
- Right map

Check my answer





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Relating SST to Productivity

Research Project: Exploring El Niño and Chlorophyll Data

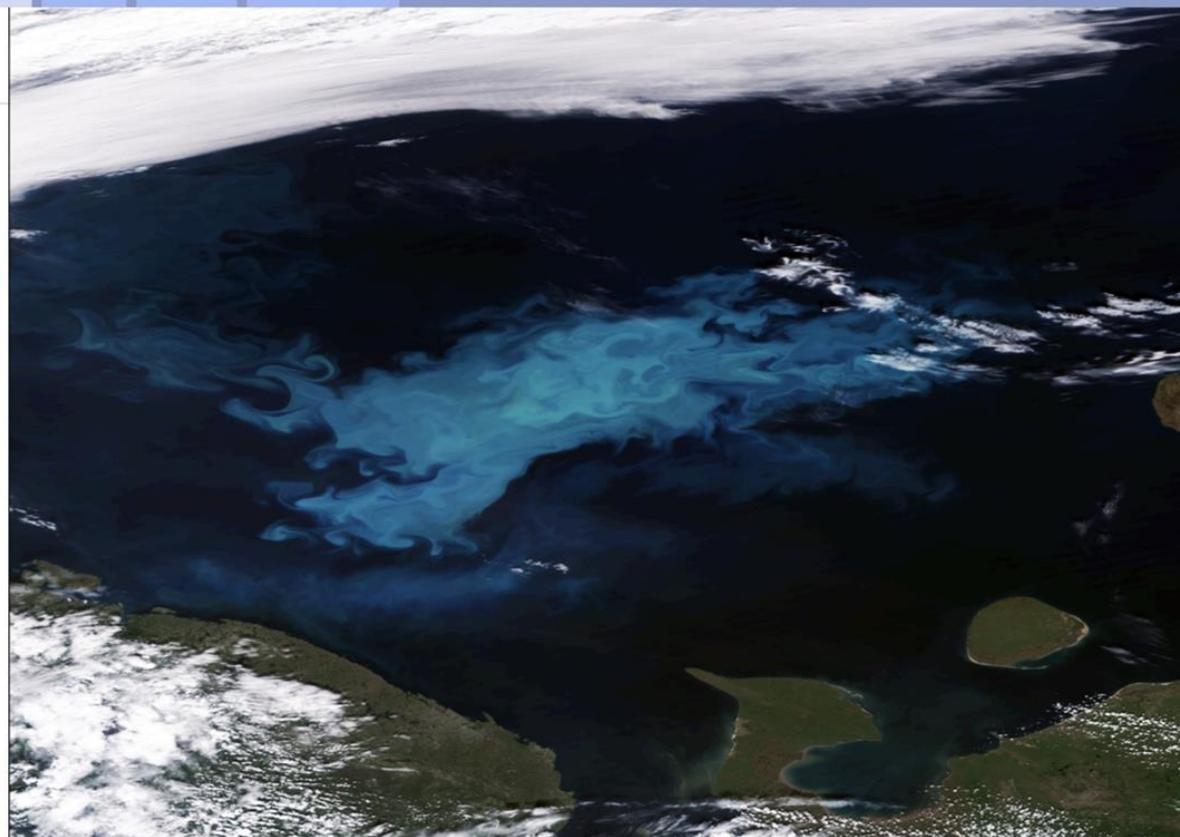
You have joined a team of scientists who are studying the effects of El Niño on biological systems in the ocean. Specifically, you are interested in the relationship between sea surface temperature (SST) and productivity, as measured by the amount of chlorophyll-a. Your task is to determine if there is a relationship between sea surface temperature and the distribution of phytoplankton, and, if so, how this relationship is impacted during El Niño.

The team has decided that you will compare two time periods: December 2009 and December 2010.

Form a hypothesis to answer the research question below.

Research Question: Is there a relationship between sea surface temperature and the distribution of phytoplankton? If so, how is this distribution impacted during El Niño?

Hypothesis: During an El Niño event, when sea surface temperatures in the eastern Pacific ocean





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Relating SST to Productivity

Testing Your Hypothesis With Data

In order to test your hypothesis, closely observe the data maps and graphs in this section. You may use the worksheet provided by your teacher to record your observations and analyze the data.

[Display data map for 2009](#)

[Display data map for 2010](#)

Sea Surface Temperature °C



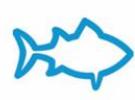
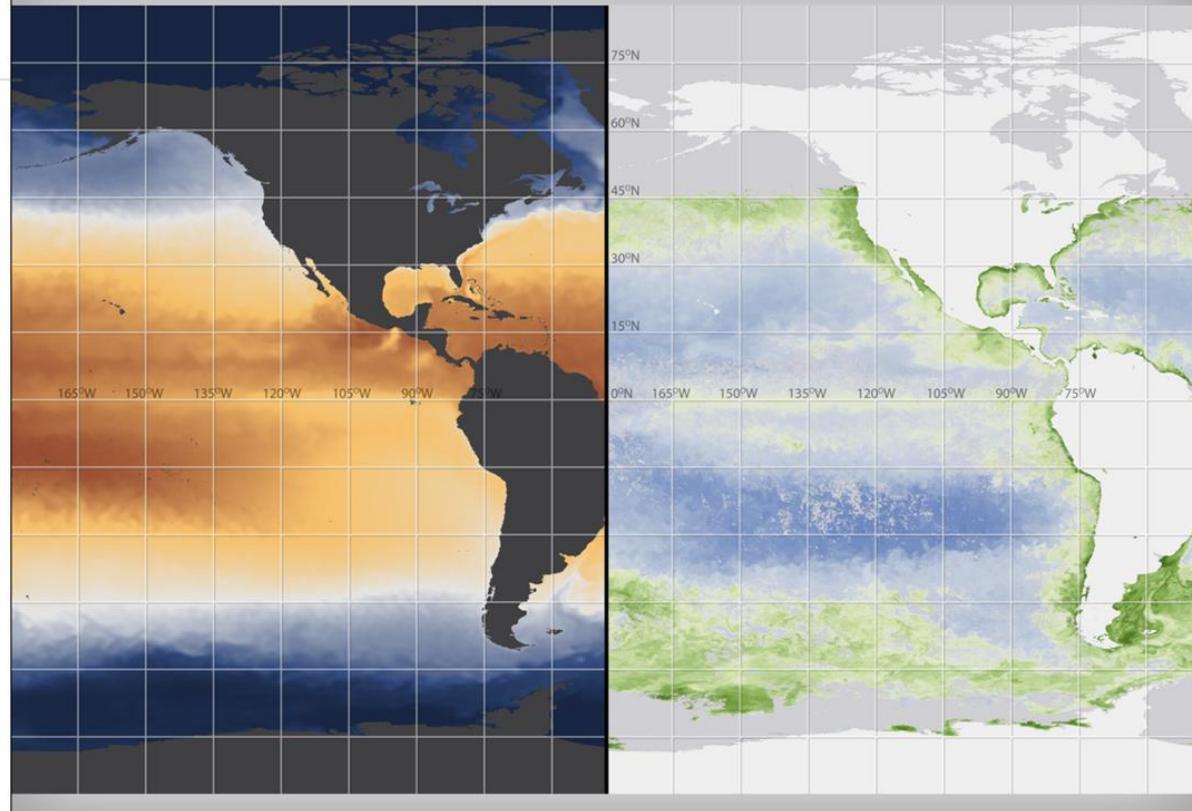
Chlorophyll Concentration (mg/m³)



[Display graphs for 2009](#)

[Display graphs for 2010](#)

After analyzing the data, answer the questions below.





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Relating SST to Productivity

Testing Your Hypothesis With Data

In order to test your hypothesis, closely observe the data maps and graphs in this section. You may use the worksheet provided by your teacher to record your observations and analyze the data.

[Display data map for 2009](#)

[Display data map for 2010](#)

Sea Surface Temperature °C



Chlorophyll Concentration (mg/m³)

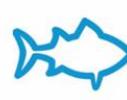
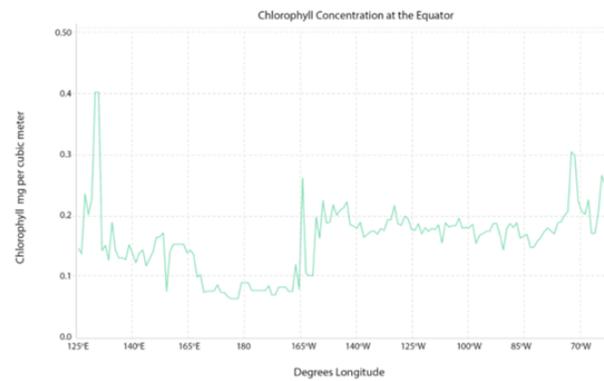
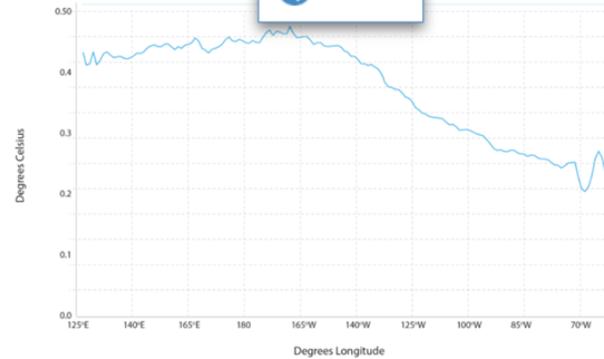


[Display graphs for 2009](#)

[Display graphs for 2010](#)

After analyzing the data, answer the questions below.

[← BACK](#)





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Introduction

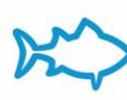
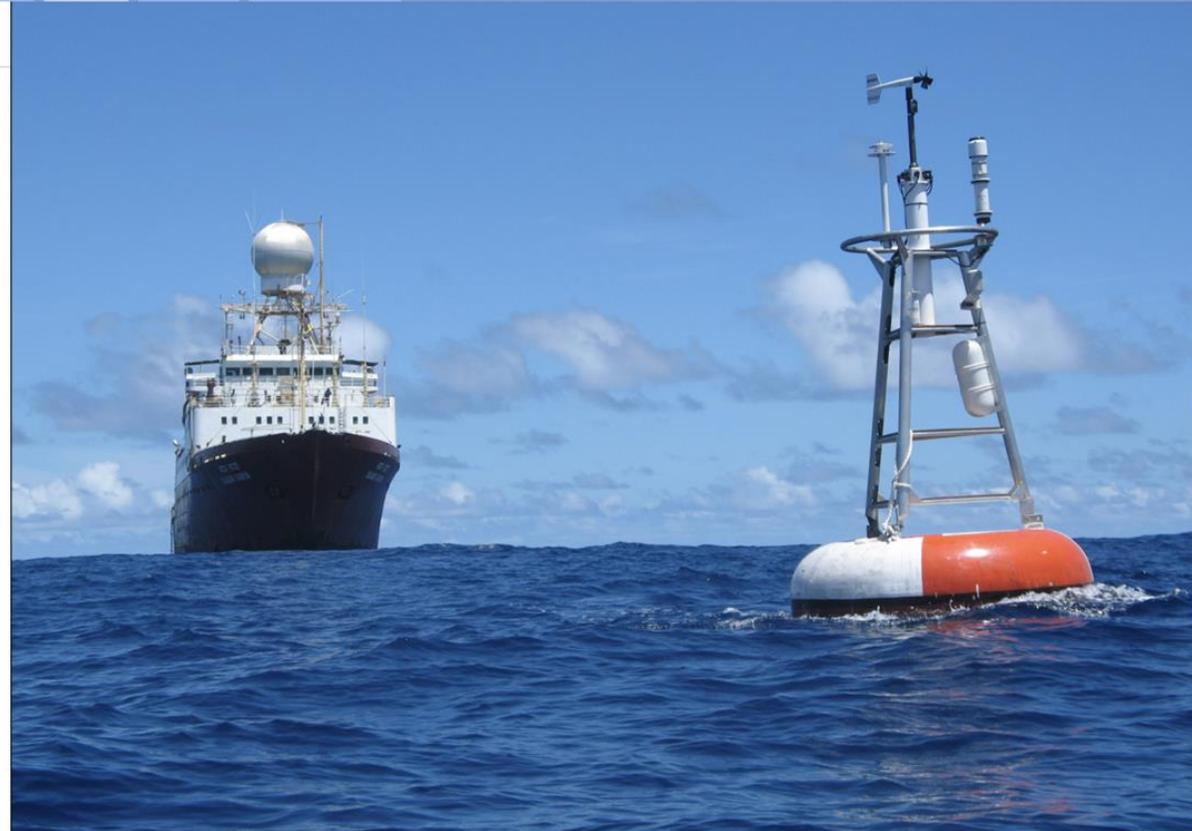
Objective

Students will design an investigation using real data on El Niño to try to answer a research question of their choosing.

Background

Students will design an investigation using real data on El Niño to try to answer a research question of their choosing. In reporting the outcome of their research, they must state what they have learned from the investigation, and use their findings to evaluate, explain, and defend the validity of their hypothesis.

For decades, satellite instruments have reliably





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Plan Your Investigation

You have used real data to begin to understand the phenomenon of El Niño, but you can learn a lot more from exploring this data over time. El Niño events last an average of 12 to 18 months and occur about once every two to seven years. Ten events happened in the last 42 years, with one of the most extreme occurring in 2015-2016.

1. Develop Your Question:

Ask a question that can be answered using the data available in this section. Two sample questions are below:

- Are El Niño events becoming stronger over time?
- Are El Niño events becoming more frequent?

2. Make a Plan:

What data will you need to answer your question? Access the data using the tools below.

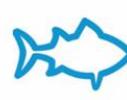
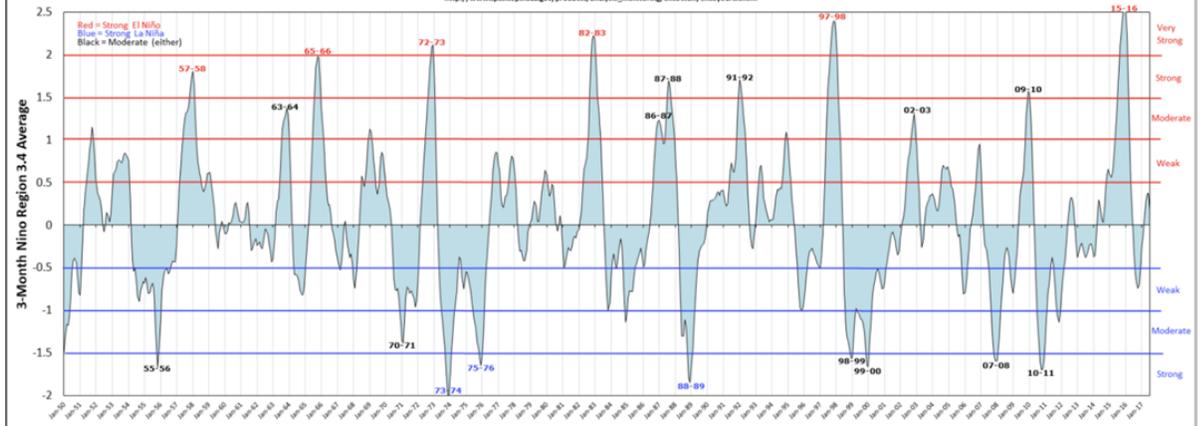
[El Niño Historical Index](#)

[SST and Chlorophyll Data Tool](#)

[NOAA View Global Data Explorer](#)

Oceanic Niño Index (ONI)

http://www.pco.ncep.noaa.gov/products/analysis_monitoring/ensostuff/ensyears.shtml





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How to Use Get Data

Select Dataset

Start by selecting one of the datasets from the pull-down menu at the upper left.

- Sea Surface Temperature
- Chlorophyll Concentration

Timespan

Next, choose the timespan of the data that you'd like to download: weekly averages, monthly averages, or yearly averages of the variable that was chosen. Levels 1-5 use monthly averages for generating the maps and graphs, but you may find other interesting connections by analyzing data from weekly or yearly time spans.

Date

Use the pull-down menu to select the desired date.

Bounding Box

This option chooses the latitude and longitude of the



Download Sea Surface Temperature and Chlorophyll Concentration Data

Which data?

Sea Surface Temperature

Which timespan?

- Weekly
- Monthly
- Yearly

Specify a date

12/1/2012

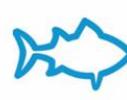
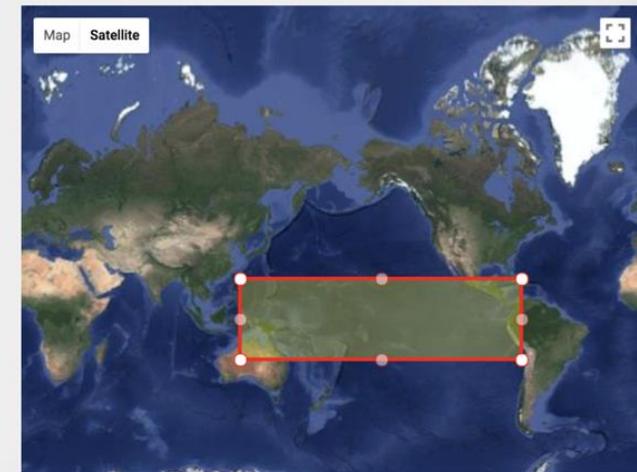
Bounding Box:

Upper-Left Latitude: 22°N
22

Upper-Left Longitude: 126°E
126

Select a region

Please use the crosshairs to select a particular region of the map



Students and professors as collectors of data: Citizen science & professional development



Citizen science

- As citizen scientists, your students can participate in the scientific process, addressing real-world problems
- They may:
 - Collect and analyze data
 - Formulate research questions
 - Conduct scientific experiments
 - Interpret results
 - Make new discoveries
 - Develop technologies and applications
 - Solve complex problems

Modified from <https://www.citizenscience.gov/>

- “Citizen science” = “community science” or “community-based science”



Citizen science at NOAA

- NOAA supports 60+ citizen science projects
- In 2019:
 - Over 550,000 participants
 - Over 16 million observations
 - Over 1.2 million volunteer hours
- Find projects at <https://www.citizenscience.gov/> and select NOAA in the “View by Agency” field
- Suggested projects: <https://www.noaa.gov/work-with-us/volunteer-opportunities-citizen-scientists>



Marine Debris MAP – Cape Lookout



① 13 total debris (2.5 cm or larger) found across 5 transect(s).

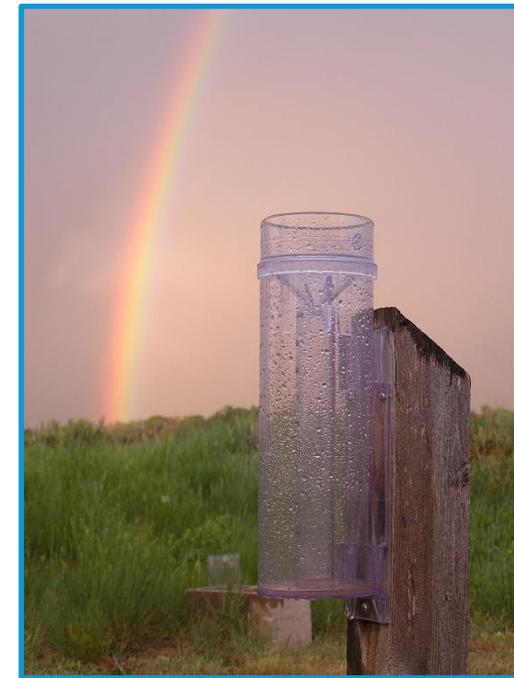
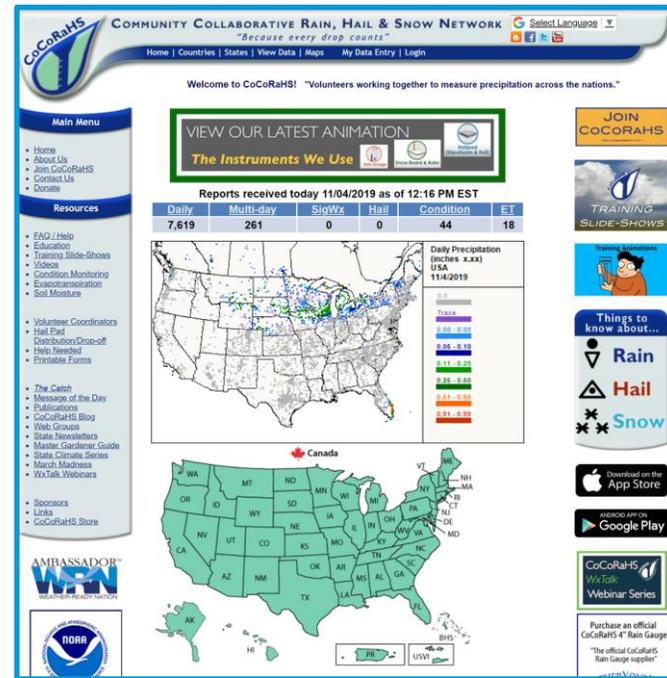
PLASTIC		Main Beach	Back Barrier
FRAGMENTS	Hard	4	0
	Foamed	0	0
	Film	1	0
SINGLE-USE	Bags	0	0
	Beverage bottles	0	0
	Bottle or container caps	0	0
	Cups (<i>incl. polystyrene/foam</i>)	0	0
	Food wrappers	0	0
	Other jugs or containers	0	0
	Straws	0	0

METAL	Main Beach	Back Barrier
Metal fragments	0	0
Aerosol cans	0	0
Aluminum/tin cans	0	0
Other metal	0	0

GLASS	Main Beach	Back Barrier
Glass fragments	0	0
Beverage bottles	0	0
Jars	0	0
Other glass	0	0

CoCoRaHS <https://www.cocorahs.org/>

- Community Collaborative Rain, Hail, & Snow Network
- Precipitation data used by NWS!



The GLOBE Program <https://www.globe.gov/>

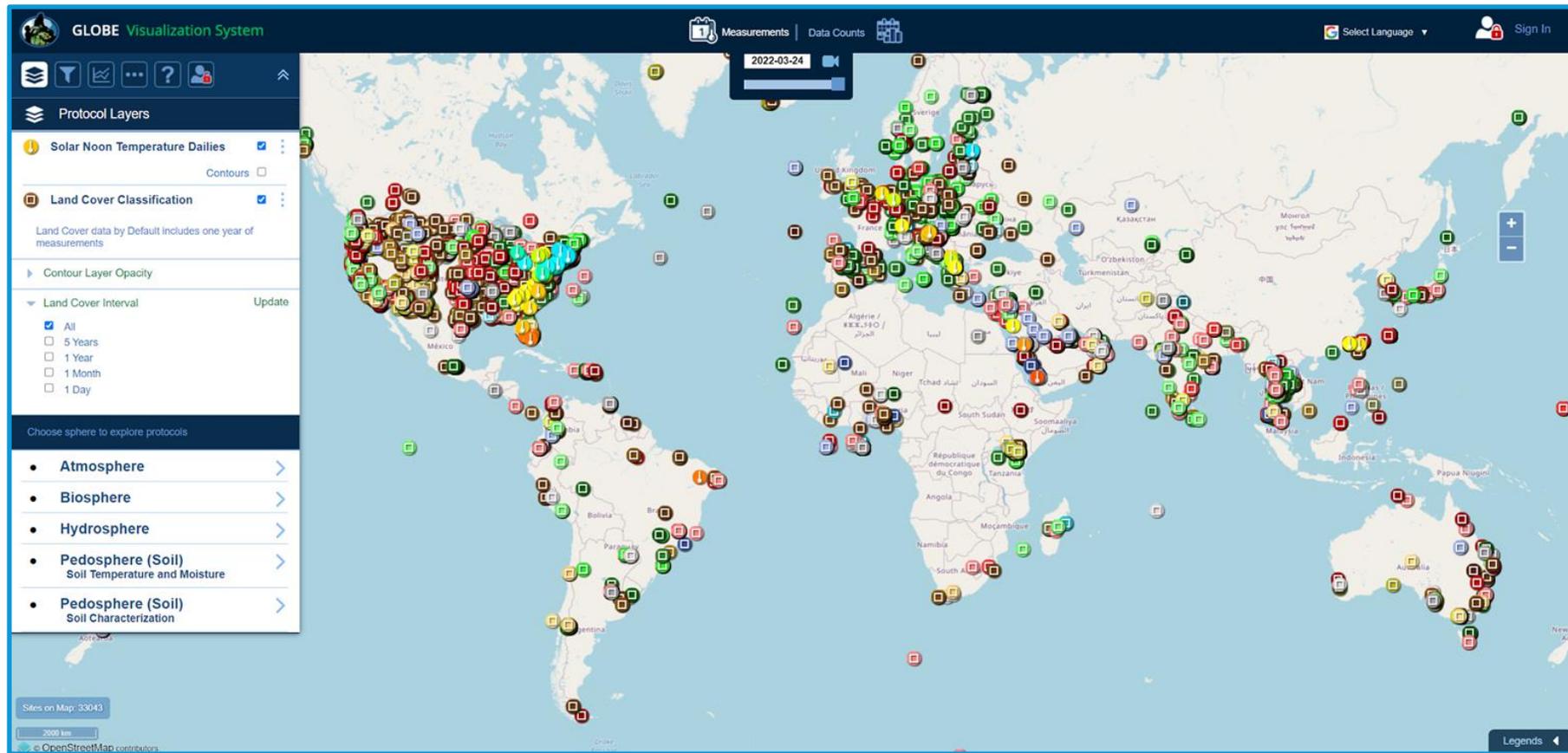
- Global Learning and Observations to Benefit the Environment
- Global network
- Many projects are available
 - Atmosphere
 - Earth as system
 - Hydrology
 - Land Cover
 - Soil
 - Biology

The screenshot shows the GLOBE Program website homepage. At the top, there is a navigation bar with the GLOBE logo, the text "THE GLOBE PROGRAM", and the tagline "A Worldwide Science and Education Program". Below this is a secondary navigation bar with links for "About", "Get Started", "Get Trained", "Do GLOBE", "GLOBE Data", "Community", "News & Events", and "Support". The main content area features a large yellow banner for "EARTH DAY 2022" with the words "collect", "visualize", and "connect" below it. A central image shows a group of children looking at a globe, with a text box overlay that reads "Earth Day 2022. Earth Day, 22 April, marks the 27th Anniversary of the launch of The GLOBE Program!" and a "More >" link. To the right, there is a photo of two women looking at a small globe. Below the banner, there is a section for "See GLOBE in your Country or Region:" with a dropdown menu set to "United States of America" and a "Go" button. Further down, there is a "RECENT MEASUREMENTS" section with a navigation bar showing "IgdOM, Clouds, Measured on: 2022-03-24" and "Canada Citizen Science, Canada, cl" with "Enter Data" and "Visualize Data" buttons. At the bottom right, it says "Recent Measurements: Last 7 Days".



GLOBE data visualization vis.globe.gov/GLOBE/

- Student collected data from 6 continents!

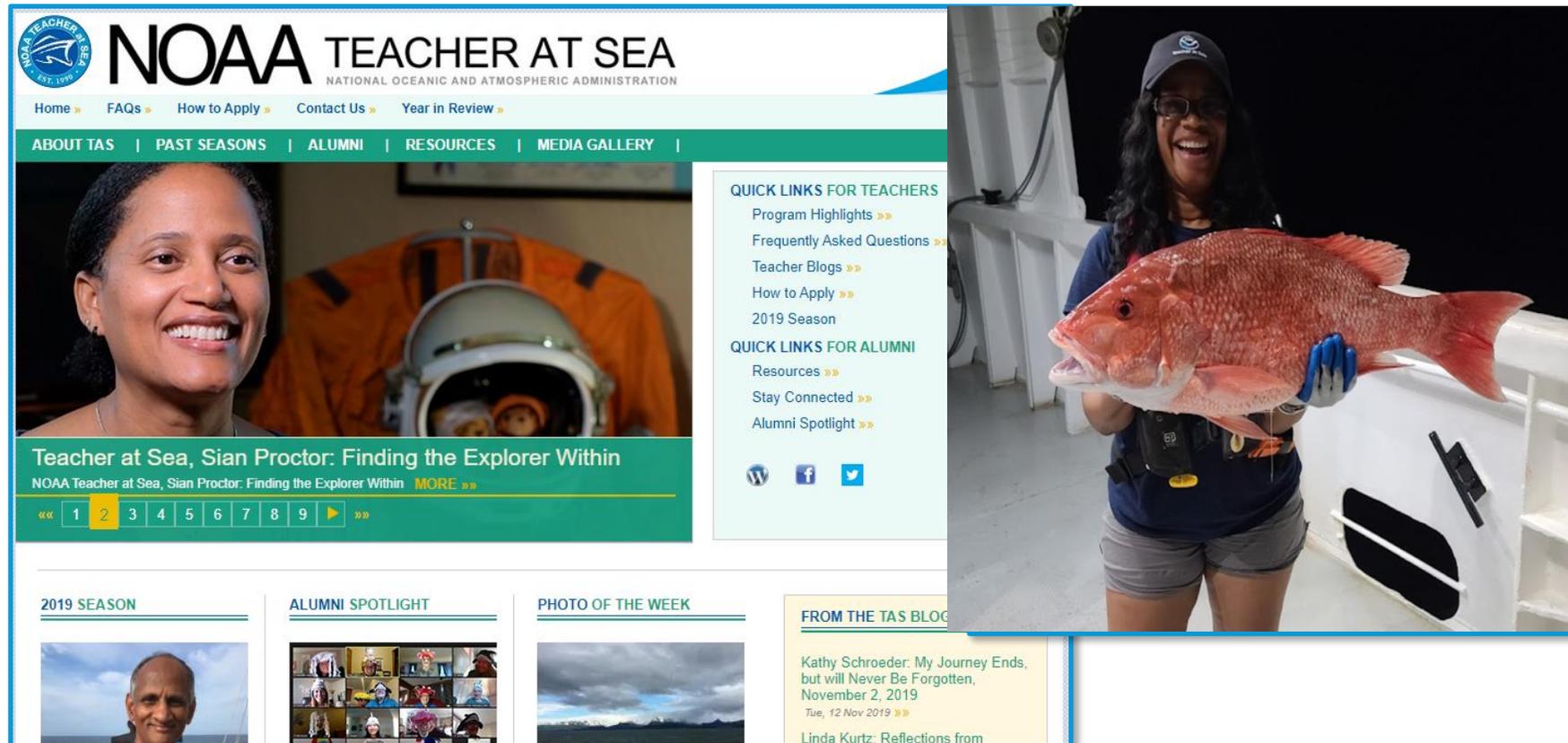


Adopt a Drifter buoy <https://www.adp.noaa.gov/>



Teacher at Sea: <https://teacheratsea.noaa.gov>

- Note: Website is being updated. New applications in 2023.



The image shows a screenshot of the NOAA Teacher at Sea website. The header features the NOAA logo and the text "NOAA TEACHER AT SEA NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION". Navigation links include Home, FAQs, How to Apply, Contact Us, and Year in Review. A main navigation bar lists ABOUT TAS, PAST SEASONS, ALUMNI, RESOURCES, and MEDIA GALLERY. The main content area features a large photo of a smiling woman, Sian Proctor, with the text "Teacher at Sea, Sian Proctor: Finding the Explorer Within". To the right, there are "QUICK LINKS FOR TEACHERS" and "QUICK LINKS FOR ALUMNI". Below the main content, there are sections for "2019 SEASON", "ALUMNI SPOTLIGHT", "PHOTO OF THE WEEK", and "FROM THE TAS BLOG".

Collect tissue samples & the otolith from the Red Snapper

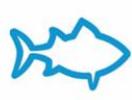


Professional development from the American Meteorological Society (AMS)

<https://www.ametsoc.org/index.cfm/ams/education-careers/education-program/k-12-teachers/>

- Fully funded summer PD programs:
 - Project Ocean
 - Project Atmosphere
- Online content and fee opportunities also available through DataStreme

<h3>Project Atmosphere</h3> <p>Join fellow science teachers from across the country in Kansas City, Missouri, at NOAA's National Weather Service Training Center (NWSTC) and learn from experts in meteorology and the atmospheric sciences, while gaining valuable field experience. Travel, lodging, meals, and all materials are provided for the one-week, on-site portion. Participants are required to complete online course components prior to the on-site portion using a course management system.</p> <p>LEARN MORE</p>	<h3>Project Ocean</h3> <p>Explore the physical foundations of oceanography in Chestertown, Maryland and gain hands-on experience in oceanographic research through an excursion on the Chesapeake Bay. Travel, lodging, meals, and all materials are provided for the one-week, on-site portion. Participants are required to complete online course components prior to the on-site portion using a course management system.</p> <p>LEARN MORE</p>	 <h3>DataStreme Atmosphere</h3> <p>Learn about the atmospheric environment, its interaction with other components of the Earth System, and the implications of those interactions on humankind.</p> <p>LEARN MORE</p>	 <h3>DataStreme Ocean</h3> <p>Dive into ecosystems and life in the ocean as you investigate the interrelationships between the ocean, atmosphere, and climate.</p> <p>LEARN MORE</p>	 <h3>DataStreme Earth's Climate System</h3> <p>Using real-time data and results from the most recent National Climate Assessment, discover causes of both natural and anthropogenic climate change.</p> <p>LEARN MORE</p>
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Educator opportunities:

www.noaa.gov/education/opportunities/educators

Home / Education

Education home About NOAA Education Resource collections Educator opportunities Student opportunities Grants & networks

Educator opportunities

Find information about educational opportunities that are available to educators through NOAA.

Show opportunities for College & university All Opportunities Showing 13 of 13 opportunities

ACLIPSE: Advancing Climate Literacy through investment in In-Service and Pre-Service Science Educators

The ACLIPSE course engages grade 6–12 teachers and teacher candidates in climate science/change activities using authentic data. ACLIPSE uses climate science as the context for applying current research about teaching and learning aligned with the Framework for K–12 Science Education. Educators and their students also improve their skills for using and interpreting real- and near real-time data. ACLIPSE includes instructional materials developed with NOAA's financial and scientific support.

Audience: College & university, K-12 educators
Opportunity Type: In person, Online

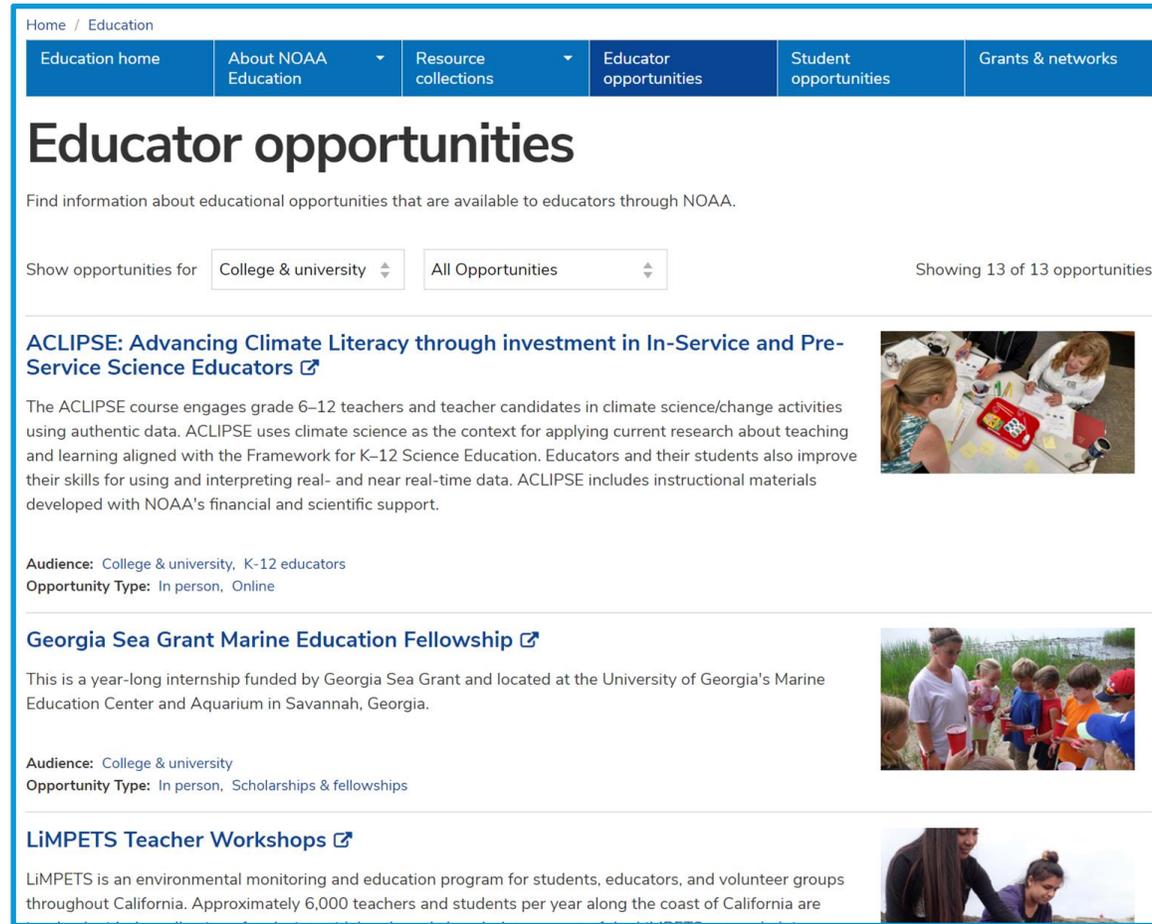
Georgia Sea Grant Marine Education Fellowship

This is a year-long internship funded by Georgia Sea Grant and located at the University of Georgia's Marine Education Center and Aquarium in Savannah, Georgia.

Audience: College & university
Opportunity Type: In person, Scholarships & fellowships

LiMPETS Teacher Workshops

LiMPETS is an environmental monitoring and education program for students, educators, and volunteer groups throughout California. Approximately 6,000 teachers and students per year along the coast of California are



Student opportunities

www.noaa.gov/students

- Be sure to check out our flagship scholarship programs: Hollings & EPP/MSI
- Students apply during the fall of their sophomore year



Interactive Quiz on [Blooket.com](https://www.blooket.com)

**Bait 100
hooks aboard
the NOAA
Oregon II
with
Mackerel**



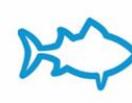
Request: Help NOAA help you!

Take our 3 minute Multimedia Needs Assessment.
Tell us the kinds of multimedia resources you want NOAA to
create for your students, and your professional development.



Questions?

dharrington@marinesanctuary.org
Maronda_Hastie@dekalbschoolsga.org



- NOAA in your backyard: <https://www.noaa.gov/education/noaa-in-your-backyard>
- NOAA data education resources: <https://www.noaa.gov/education/resource-collections/data>
- NOAA Education searchable database (in beta): www.noaa.gov/education/resources
- NOAA Data Discovery Portal: <https://data.noaa.gov/>
- National Centers for Environmental Information (NCEI): <https://www.ncei.noaa.gov/>
- National Weather Service: <https://www.weather.gov/>
- JetStream: An online school for weather: <https://www.weather.gov/jetstream/>
- River forecasts: <https://water.weather.gov/ahps/>
- Climate Data Online (past weather): <https://www.ncdc.noaa.gov/cdo-web/>
- Climate at a Glance: <https://www.ncdc.noaa.gov/cag>
- Climate at a Glance tiny tutorial: <https://www.noaa.gov/education/resource-collections/data/tiny-tutorials/climate-at-glance>
- Climate.gov maps & data: <https://climate.gov/maps-data>
- The Climate Explorer: <https://crt-climate-explorer.nemac.org/>
- Global Monitoring Lab atmospheric data: <https://gml.noaa.gov/dv/iadv/>
- Paleoclimatology data: <https://www.ncei.noaa.gov/products/paleoclimatology>
- NOAA View data exploration tool: <https://www.nnvl.noaa.gov/view>
- Science On a Sphere (SOS) Explorer mobile app: <https://sos.noaa.gov/sos-explorer/mobile-faq>
- NOAA Satellites: <https://www.nesdis.noaa.gov/real-time-imagery/imagery-collections>
- GOES East and West satellite imagery: <https://www.star.nesdis.noaa.gov/GOES/index.php>
- National Snow & Ice Data Center: <https://nsidc.org/>
- Repeat glacier photography: https://nsidc.org/data/glacier_photo
- National Data Buoy Center: <https://www.ndbc.noaa.gov>
- Sea level rise viewer: <https://coast.noaa.gov/slr>
- Great Lakes Environmental Research Lab: <https://www.glerl.noaa.gov>
- Integrated Ocean Observing System (IOOS): <https://ioos.noaa.gov>
- CLEAN climate & energy education network: <https://cleanet.org/index.html>
- ACLIPSE climate and data: <https://mare.lawrencehallofscience.org/curriculum/climate-data-aclipse-activities>
- Oysters in the Chesapeake Bay: <https://oceanservice.noaa.gov/education/oysters-in-the-chesapeake-bay/welcome.html>
- Data in the Classroom: <https://dataintheclassroom.noaa.gov/>
- Federal citizen science projects: <https://www.citizenscience.gov/>
- NOAA citsci suggested projects: <https://www.noaa.gov/work-with-us/volunteer-opportunities-citizen-scientists>
- CoCoRaHS: <https://www.cocorahs.org>
- The GLOBE Program: <https://www.globe.gov>
- GLOBE data visualization <https://vis.globe.gov/GLOBE/>
- Adopt a Drifter buoy: <https://www.adn.noaa.gov/>