NOAA is:

National Ocean Service

Environmental Satellites

National Weather Service

Marine Fisheries

OMAO

Oceanic & Atmospheric Research
NOAA is good at:

- Real-world data collection to solve real-world problems
- Multidisciplinary/full range of STEM
- Extensive monitoring of earth systems, ocean/coastal ecosystems, fish and marine mammals
- Systems modeling, predictions for health and safety
- Monitoring and modeling human impacts on systems
- Focus on future solutions
Our Field Offices

- Over 600 professionals engage audiences about NOAA
- Google “NOAA in your State” to find us
Taking the pulse of the planet

- 160 Doppler radars
- Surface Observations
- Radiosondes
- 4 weather satellites
- Citizen scientists
NOAA offers Educators:

- Lesson plans, curriculum for earth, life sciences, environmental science
- Online professional development
- Multimedia, Edugames, Interactives
- Data in the Classroom
- Science on A Sphere
- Summer research opportunities
- Learning communities
- Citizen science projects
- Access to scientists
Welcome to the NOAA Data Discovery Portal

We are currently providing two approaches to enable searching NOAA's vast data holdings: the traditional NOAA Data Catalog for all data, and the new NOAA OneStop catalog which initially includes only the archived datasets but will eventually replace the traditional catalog.

OneStop

NOAA OneStop provides enhanced collection and granule searching for only those datasets archived at the National Centers for Environmental Information (NCEI). Emphasis is on both improved search relevancy and overall user experience.

NOAA Data Catalog

The NOAA Data Catalog is an inventory of all NOAA data collections. The user interface allows web-based searching by keywords and other attributes; machine-to-machine searching is available using the OGC CSW protocol (Open Geospatial Consortium Catalog Service for the Web).
Search by Topic:

Weather, Climate, Satellites, Fisheries, Coasts, Oceans

Featured Data Sets:

GOES-16

Digital Elevation Models
NWLOM and PORTS
Climate Data Record (CDR)
Put Big Ocean 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**
Coming Soon - new, updated module resources, curriculum and data tools.

**Water Quality**
Coming Soon - new, updated module resources, curriculum and data tools.

**Ocean Acidification**
Coming Soon - new, updated module resources, curriculum and data tools.

Teaching Resources

- In Each Module
- Using the Technology
- Pedagogical Approach
- Community and News

[https://dataintheclassroom.noaa.gov/](https://dataintheclassroom.noaa.gov/)
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.
Data in the Classroom

Home  El Nino  Sea Level

UNDERSTANDING SEA LEVEL

Scientists know that sea level is rising, and that we experience some of these impacts as more frequent and intense storm surge and coastal flooding events. Using data from NOAA's satellites and coastal stations, you will do the analysis to see sea level changing. Explore our Sea Level activity and download our Teacher's Guide.

LAUNCH THE ACTIVITY

Teaching Resources

Teacher's Guide  Supplemental PowerPoint  Student Activity Sheets  Science Standards

Materials Needed

<table>
<thead>
<tr>
<th>Level</th>
<th>Computer with an internet connection</th>
<th>Student Worksheets</th>
<th>Additional Activities in Teacher's Guide</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level One</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Level Two</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Level Three</td>
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<td></td>
<td></td>
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<tr>
<td>Level Four</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Level Five</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Data in the Classroom

In Each Module
The Data in the Classroom Team, comprised of education and technology experts, along with teachers, wants to make each of these resources as easy to use for you and your classroom as possible.

Each module is built with the same structure and sets of resources:

- **Story Map**
  The StoryMap activity works with any display device (desktop, laptop, tablet) connected to the internet. Within each StoryMap, there are tabs for each Activity Level (1-5), Get Data tools, and Teacher Resources. Please visit the Using the Technology page for a better understanding of the StoryMaps.

- **Teacher’s Guide**
  A Teacher’s Guide (PDF) that goes through each activity in great detail, provides all of the information that you’ll need to work through any of the activities with either the StoryMap or the printable resources.

- **Supplemental PowerPoint**
  Since not every classroom can be fully “wired” there are PowerPoint files that have each map or image used in the online activity as a printable version.

- **Student Activity Sheets**
  Student Activity sheets can be used to log data observations and analysis for each of the modules and activity levels.

- **Science Education Standards**
  Data in the Classroom is committed to developing resources that support the needs of educators. Key to the framework’s design is three dimensional learning that includes science or engineering practices (SEP), a disciplinary core idea (DCI), and a crosscutting concept (CC). Learn more about how each module specifically relates to the Framework, as well as the Next Generation Science Standards, by visiting the Teacher Guide section of any of the online modules.
**Invention Level:** Invention is the highest cognitive level. Exercises need to be designed where pedagogy and technology are integrated simultaneously. This is where the inquiry approach can be fully implemented. This area is very student driven.

**Interactivity Level:** This level features the use of complex technology interactions. Here problem-solving techniques are introduced that can be very student directed. Tools are needed for students to analyze data and discuss findings.

**Adaptation Level:** Students use portal tools to play and practice what they know. These interactions can be student-directed.

**Adoption Level:** Many teachers appreciate having prescriptive approaches to utilizing online tools. We recommend some form of drill and practice exercises that are predictable to teachers and will be available for them to share with their students. Once understood teachers can move to the next level of online interactivity and teacher technology inclusion.

**Entry Level:** The developers are making the basic assumption that first-time users of a new portal are at an entry level and need direct guidance in how to use the portal and demonstration site. This level of interaction is very teacher directed. Once teachers learn how to use the site they are ready to skip this level and move on to more complex levels. The Entry Level provides teachers with a teach-back system to help their students enter into the portal and its use.
<table>
<thead>
<tr>
<th>Science and Engineering Practices (SEPs)</th>
<th>Middle School SEP</th>
<th>How the SEP Is Addressed by the Module</th>
<th>Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Analyzing and Interpreting Data</td>
<td>Analyze and interpret data to determine similarities and differences in findings. (MS-ESS3-2).</td>
<td>Students compare their data assessments of typical tidal range at a given location, from Level 3, with tide data during a storm event to determine the effect of storms on coastal sea level.</td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>Developing and Using Models</td>
<td>Develop and use a model to describe phenomena. (MS-ESS2-4)</td>
<td>Students access and analyze NOAA data tools (data being used as a basis for models) to identify and explain changes in sea level resulting from winds and tides. Students use tide data to construct a model (diagram) to describe the approximate orientation of the moon relative to the earth.</td>
<td>1 2 3 4 5</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Disciplinary Core Ideas (DCIs)</th>
<th>Middle School DCI</th>
<th>How the DCI Is Addressed by the Module</th>
<th>Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>The Roles of Water in Earth’s Surface Processes</td>
<td><strong>MS-ESS2.C:</strong> Global movements of water and its changes in form are propelled by sunlight and gravity. (MS-ESS2-4)</td>
<td>Students understand that sea level continually fluctuates due to variations in wind, currents and water density (all by-products of the sun’s energy) and tides (caused by gravitational forces).</td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>Natural Hazards</td>
<td><strong>MS-ESS3.B:</strong> Mapping the history of natural hazards in a region, combined with an understanding of related geologic forces can help forecast the locations and likelihoods of future events.</td>
<td>Students optionally analyze and interpret satellite data to investigate the history of hurricanes and related sea surface height deviations in the Gulf of Mexico.</td>
<td>1 2 3 4 5</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Crosscutting Concepts (CCCs)</th>
<th>Middle School CCC</th>
<th>How the CCC Is Addressed by the Module</th>
<th>Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patterns</td>
<td>Graphs, charts, and images can be used to identify patterns in data. (MS-ESS3-2).</td>
<td>Students use tide graphs (and optionally satellite maps) to identify sea level patterns associated with storms.</td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>Energy and Matter</td>
<td>Within a natural or designed system, the transfer of energy drives the motion and/or cycling of matter. (MS-ESS2-4)</td>
<td>Students understand that sea level continually fluctuates due to variations in wind, currents and water density (all by-products of the sun’s energy) and tides (caused by gravitational forces).</td>
<td>1 2 3 4 5</td>
</tr>
</tbody>
</table>
Coral Reef Locations and Temperature

Coral Reef Habitat and Range

Building upon the earlier maps, analyze this map that combines coral reef locations, average SST, and ocean depth, along with a grid of latitudes and longitudes.

In the Layers box at the upper right, you can turn on/off each layer, or click the > next to the layer name and a slider will appear that allows you to change the transparency of a layer.

**Question 4:** Which best describes the range of coral reef habitats?

- Coral reefs occur anywhere that the SST is above 20°C
- Coral reefs occur at any temperature that is close to land
- Coral reefs occur in warm, deep waters between 30°N latitude and 30°S latitude
- Coral reefs occur in warm, shallow waters between 30°N latitude and 30°S latitude

Check my answer
Monitoring Coral Reefs In the Field

Calculating Percent Bleaching Using Quadrat Sampling

Scientists often use an ecological sampling technique called a quadrat to estimate the percentage of bleaching on a reef. In this method a square is divided into 100 smaller squares. The scientist chooses squares at random to sample.

Procedure

Choose one of these reef locations and use your log sheet to record your observations.

Reef #1, Reef #2, Reef #3, Reef #4, Reef #5

1. Click the image below to create a set of random numbers from 1-100. Different individuals or groups should choose different columns, allowing each person to sample their reef image differently.

2. Go to the quadrat box that matches your random number.
3. Using your skills at identifying healthy, bleached, or dead corals, record your observation. If your box has more than one type, use the description that takes up the most area of the box.
4. Repeat for 10 boxes total.
5. Calculate the percent of healthy, bleached, or dead.

% Bleached = Number of Bleached Boxes / 10
Monitoring Coral Reefs in the Field

Identifying the Effect of Bleaching on Coral Reefs

You've seen the difference between a bleached and healthy coral up close, now look at how reefs around the world look when they're healthy vs. bleached.

The map on the right has a series of locations with images of coral reefs that are either healthy, bleached, or dead. Use your student logs to make 3-5 observations about each reef.

**Question 1**: Besides the change in color, what are some other signs that a coral reef has undergone a bleaching event?

- Unhealthy reefs appear more dense than healthy reefs
- There are more algae on bleached reefs
- There are fewer fish swimming around bleached reefs
- B and C

[Check my answer]
Corals

Corals are some of the most diverse ecosystems in the world. Thousands of species rely on reefs for survival. Thousands of communities all over the world also depend on coral reefs for food, protection, and jobs.

The Coral Tutorial is an overview of the biology of and threats to coral reefs, as well as efforts being made to conserve and protect them. It includes images, animations, and videos.

The Roadmap to Resources complements the tutorial. It directs you to specific online coral data and information from the National Ocean Service and NOAA.

---

Satellites & Bleaching

Introduction

Welcome | About Coral Reef Watch

The purpose of these modules is to introduce users to satellite tools that are used to pinpoint and monitor areas around the world where corals are presently at risk for bleaching. At present, this tutorial focuses mainly on Coral Reef Watch's heritage suite of operational 50-km products; it will be updated in the coming months to focus on the new 5-km products released in February 2015.

The Coral Reef Watch (CRW) program, part of the U.S. National Oceanic and Atmospheric Administration (NOAA), assesses bleaching risk using satellite, modeled, and in situ environmental data. Since this tutorial focuses only on satellite monitoring of coral bleaching, we first provide background on satellite remote sensing. We then introduce some of the main tools CRW produces from NOAA's 50-km satellite data, including Sea Surface Temperature (SST), SST Anomaly, Coral Bleaching HotSpot, and Degree Heating Week products. We also introduce briefly our Virtual Stations product and Satellite Bleaching Alert email system. (As noted above and throughout the website, the 50-km tools in this tutorial are now produced as next-generation, daily products at 5-km resolution, derived from a blend of geostationary and polar-orbiting environmental satellite data; however, the new 5-km products are not the focus of this tutorial at this time.)

The aim of this tutorial is to teach you enough about Coral Reef Watch's 50-km satellite products so that you can feel comfortable using the data independently in the future. You will gain the skills needed to access and
http://oceanservice.noaa.gov/facts/
Remote Sensing and Coral Reefs
A Curriculum for 4th - 6th Grade Students

Satellites have revolutionized communication, entertainment, and scientific monitoring. It becomes increasingly relevant for our 21st-century students to learn about these objects that hover around our planet. Satellite monitoring of the environment around coral reefs offers invaluable information to those working to preserve these unique ecosystems.

The lessons in this unit are designed to be taught in sequence, however, many of the activities are suited to teaching in isolation. This science unit is appropriate for grades four through six. Some concepts tend to be abstract, so depending on students’ ability and background knowledge, this unit might be more suitable in a gifted and talented setting.

Below, the lesson plans and Power Point presentations are available for download. Users may choose a zipfile of the entire curriculum, or individual lesson plans. All files are PDF, unless otherwise indicated.

**Entire curriculum** (zipfile with PDF and PowerPoint files)

**National Science Content Standards** met by the curriculum

- **Beginning**
  - Table of Contents
  - Acknowledgements
  - Introduction
  - Culmination of Remote Sensing and Coral Reef Unit
- **Lesson #1: Remote Sensing and the Electromagnetic Spectrum**
  - Beyond the Red activity
  - Spectrum poster
- **Lesson #2: Altimetry**
  - Radar Run activity
  - Satellite Altimetry Facts
- **Lesson #3: Phytoplankton and Ocean Color**
  - Phytoplankton Farming activity
  - Phytoplankton Facts
  - Blooming Algae activity
  - Ocean Color Evaluation
- **Lesson #4: Introduction to Coral Reefs**
Scenario 2
The reef shown below has begun to bleach due to a continued increase in water temperature during the warm summer months. As reef manager, you must decide the best course of action. Click the possible “solutions” that you think are advisable and see how it affects the reef.

A. Stop construction and limit fertilizer use along coastal areas.
B. Use shade cloths in affected areas or areas with the highest increase in water temperatures.
C. Limit recreational boating, fishing, and diving in the affected area.
D. Do nothing. There is nothing you can do as a local reef manager to stop the pressures of increasing ocean temperatures all over the world.

http://oceanservice.noaa.gov/education/pd/corals/
http://oceanservice.noaa.gov/education/pd/oceans_weather_climate/
Coral Comeback?
In this important new series we explore the evolution and biology, beauty and benefits of corals and coral reefs. We then help students understand the science behind ocean acidification and coral bleaching. Corals all over the world are dying. With such odds against them, can coral reefs make a comeback? NOAA scientists believe yes. Watch the series to learn more.

http://oceantoday.noaa.gov/every-full-moon/full-moon-coralcomeback.html
NOAA COASTAL DATA

https://coast.noaa.gov/digitalcoast
Future Tipping Points?

Projections say the majority of coastal communities will experience 30 days of high tide flooding annually by 2050.

Source: NOAA's Center for Operational Oceanographic Products and Services (CO-OPS)

Report: Sea Level Rise and Nuisance Flood Frequency Changes around the United States - PDF

Press Release: El Niño made a nuisance of itself in 2015
Teaching about Tides and Currents

- Roadmap to Resources:

- Tutorial:
  [http://oceanservice.noaa.gov/education/tutorial_tides/](http://oceanservice.noaa.gov/education/tutorial_tides/)

- Professional Development:
Lesson Plans

- Ups and Downs
- Salinity and Tides
- Using Real-Time Tide Data
- Oil Spill Model
- Charting a Course
- Motion in the Ocean
- Ready, Set, Drift!
- Climate Change and Tides
- Climate Change and Currents
Monitoring the Tides and Sea Level Change

- Since the early 1800s, NOAA and its predecessor organizations have been measuring, describing and predicting tides along the coastal US.
- Tide gauges are surveyed-in relative to land elevations.
- Tide gauges measure local sea level change relative to the land.
A Tide Lesson Using Real NOAA Data

• Lesson Plan (Grades 9-12): “Ups and Downs”
  https://oceanservice.noaa.gov/education/lessons/ups_downs.html

• Student Worksheet: “Analyzing Real-time Water Level Data from Monitoring Stations”
  – 175 continuously operating water-level stations in the National Water Level Observation Network (NWLON)
A Tide Lesson Using Real NOAA Data

- All Station Data: [tidesandcurrents.noaa.gov/gmap3](http://tidesandcurrents.noaa.gov/gmap3)
• All Station Data:
  tidesandcurrents.noaa.gov/gmap3
Possible Future Sea Level Change

What’s expected: sea-level rise to 2100

Post-IPCC Peer-reviewed Research

(IPCC 2007)

The National Academies, America’s Climate Choices, 2010, vol 1
Observed Sea Level Measurements from Tide Gauges

- Calculation of relative sea level trends and analyses at U.S. and Global stations, for Local, Regional & Global trend comparison

http://tidesandcurrents.noaa.gov/sltrends/index.shtml
Example of sea level rise

- Baltimore 1902-2006

The mean sea level trend is 3.08 millimeters/year with a 95% confidence interval of +/- 0.15 mm/yr based on monthly mean sea level data from 1902 to 2006 which is equivalent to a change of 1.01 feet in 100 years.
What Does Sea Level Rise Look Like?

- Observed flood frequency
- Example: Galveston Pier 21 Tide Gauge, TX

http://www.csc.noaa.gov/slr/viewer
What Does Sea Level Rise Look Like?

- Simulation of Sea Level Rise
- Example: US Coast Guard Station in South Padre, TX at 0 and 3ft Sea Level Rise

http://www.csc.noaa.gov/slr/viewer
JetStream - An Online School for Weather

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
- Remote Sensing
- Tsunamis
- The National Weather Service
- Appendix
“Devastating damage expected... A most powerful hurricane with unprecedented strength... Most of the area will be uninhabitable for weeks, perhaps longer... At least one half of well constructed homes will have roof and wall failure... all wood framed low rising apartment buildings will be destroyed... High rise office and apartment buildings will sway dangerously, a few to the point of total collapse... airborne debris will be widespread... persons, pets, and livestock exposed to the winds will face certain death if struck...”

~ from Urgent Weather Statement issued by Robert Ricks, Meteorologist, National Weather Service, New Orleans/Baton Rouge Office, August 28, 2005

This weather statement, warning of Hurricane Katrina’s approach, probably saved many lives. Providing weather forecasts and warnings is one of the ways the National Weather Service carries out its mission to protect life and property and enhance the national economy. The National Hurricane Center (part of the National Weather Service) tracks tropical storms and hurricanes, and issues hurricane watches...
<table>
<thead>
<tr>
<th>Date</th>
<th>Latitude (North)</th>
<th>Longitude (West)</th>
<th>Wind Speed (knots)</th>
</tr>
</thead>
<tbody>
<tr>
<td>24/8/2005</td>
<td>23.4</td>
<td>75.7</td>
<td>30</td>
</tr>
<tr>
<td>25/8/2005</td>
<td>26.0</td>
<td>77.7</td>
<td>45</td>
</tr>
<tr>
<td>26/8/2005</td>
<td>25.9</td>
<td>80.3</td>
<td>70</td>
</tr>
<tr>
<td>27/8/2005</td>
<td>24.6</td>
<td>83.3</td>
<td>90</td>
</tr>
<tr>
<td>28/8/2005</td>
<td>24.8</td>
<td>85.9</td>
<td>100</td>
</tr>
<tr>
<td>29/8/2005</td>
<td>27.2</td>
<td>89.2</td>
<td>140</td>
</tr>
<tr>
<td>30/8/2005</td>
<td>32.6</td>
<td>89.1</td>
<td>50</td>
</tr>
<tr>
<td>31/8/2005</td>
<td>38.6</td>
<td>85.3</td>
<td>30</td>
</tr>
</tbody>
</table>

Hurricane Symbol: 

Tropical Storm Symbol: 

Is It a Tropical Depression, Tropical Storm, or Hurricane?

Tropical Depressions, Tropical Storms, and Hurricanes are all cyclones, which are areas of low pressure in the atmosphere that have a spiraling inward pattern of air movement. In the Northern Hemisphere, the spiral turns counterclockwise, while cyclones in the Southern Hemisphere have spirals that turn clockwise.

A Tropical Depression is a tropical cyclone in which the maximum sustained wind speed is 38 mph or less.

A Tropical Storm is a tropical cyclone in which the maximum sustained wind speed ranges from 39 mph to 73 mph.

Hurricanes are tropical cyclones with maximum sustained wind speeds of 74 mph or greater. Hurricanes are classified into five categories:

- Category One: Winds 74-95 miles per hour
- Category Two: Winds 96-110 miles per hour
- Category Three: Winds 111-130 miles per hour
- Category Four: Winds 131-155 miles per hour
- Category Five: Winds greater than 155 miles per hour
Middle School STEM lessons

www.GPS-STEM.com
Climate.gov

Maps & Data Section

Easy-to-understand ready-for-reuse climate data and graphics

LuAnn.Dahlman@noaa.gov
NOAA's Mike Halpert explains the agency's 2018 spring climate outlook

March 15, 2018

Filed in: News & Features

The Climate Prediction Center's Mike Halpert runs down the 2018 spring forecast for flooding, temperature, precipitation, and drought.

read more
Data Snapshots: Reusable Climate Maps

Explore a range of easy-to-understand climate maps in a single interface. Featuring the work of NOAA scientists, each “snapshot” is a public-friendly version of an existing data product.

Average Monthly Temperature

Monthly Temperature Outlook

Drought Monitor

Severe Weather Climatology

Browse the Dataset Gallery
This visual catalog with convenient filtering options can help you find the climate data you need. How-to instructions can help you navigate data access tools.

Enter the Dataset Gallery

GIS Data Locator (Advanced Users)
Launch Map Application

Climate Data Primer
Ready to learn some of the basics about climate data? Find out about measuring, modeling, and predicting climate and ways to find and use climate data.

The Primer includes information on instruments used to measure weather and climate; how weather observations relate to climate products; how climate scientists check the quality of observations, and tools you can use for exploring climate data.

Open the Primer’s table of contents

Recently Updated Datasets
- El Niño-Southern Oscillation Indicators
- Past Weather by Zip Code - Data Table
Global Average Temperature (°C)
The temperature near Earth’s surface is rising: the bars show each year’s average temperature compared to the 20th century average.

Carbon Dioxide (ppm)
The amount of carbon dioxide in the atmosphere has risen by 25% since 1958, and by about 40% since the Industrial Revolution.

Spring Snow Cover (million km²)
Snow is melting earlier: each bar shows spring snow cover in the Northern Hemisphere compared to the long-term average.
Climate Change: Global Temperature

Author: LuAnn Dahlman

September 11, 2017

Temperatures measured on land and at sea for more than a century show that Earth’s globally averaged surface temperature is rising. Since 1970, global surface temperature rose at an average rate of about 0.17°C (around 0.3°F Fahrenheit) per decade—more than twice as fast as the 0.07°C per decade increase observed for the entire period of recorded observations (1880-2015). The average global temperature for 2016 was 0.94°C (1.69°F) above the 26th century average of 13.9°C (57.0°F), surpassing the previous record warmth of 2015 by 0.04°C (0.07°F).

Highlights:

- During 2016, the average temperature across global land and ocean surfaces was 1.69°F (0.94°C) above the twentieth-century average.

- This was the third year in a row, and the fifth time since 2000, that a new temperature record was set.

- 1976 was the last time the annual average temperature was cooler than the twentieth-century average.

- All 16 years of the twenty-first century rank among the 17 warmest years on record.

Rating:

Average: 3.8 (140 votes)

Share This: Twitter Facebook

Tags: temperature dashboard

Average surface temperature in 2016 compared to the 1981-2010 average. NOAA Climate.gov map, adapted from Plate 2.1a in State of the Climate in 2016.
Change over time
Though warming has not been uniform across the planet, the upward trend in the globally averaged temperature shows that more areas are warming than cooling. Since 1880, surface temperature has risen at an average pace of 0.13°F (0.07°C) every 10 years for a net warming of 1.69°F (0.94°C) through 2016. Over this 137-year period, average temperature over land areas has warmed faster than ocean temperatures: 0.18°F (0.10°C) per decade compared to 0.11°F (0.06°C) per decade. The last year with a temperature cooler than the twentieth-century average was 1976.

![History of global surface temperature since 1880](image)

**Explore this interactive graph:** Click and drag to display different parts of the graph. To squeeze or stretch the graph in either direction, hold your Shift key down, then click and drag. The graph shows average annual global temperatures since 1880 (source data) compared to the long-term average (1901-2000). The zero line represents the long-term average temperature for the whole planet; blue and red bars show the difference above or below average for each year.

According to the official 2016 global report from NOAA’s National Centers for Environmental Information,

[2016] marks the fifth time in the 21st century a new record high annual temperature has been set (along with 2005, 2010, 2014, and 2015) and also marks the 40th consecutive year (since 1977) that the annual temperature has been above the 20th century average. To date, all 16 years of the 21st century rank among the seventeen warmest on record (1998 is currently the eighth warmest.) The five warmest years have all occurred since 2010.
Climate Data Primer

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

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 find information or help them make decisions. For example:

- Folks who are planning outdoor events check climate normals data to help them choose a date when they can expect pleasant weather.
- Ranchers, farmers, and outdoor-recreation businesses regularly monitor drought conditions to see if they need to adjust their plans.
Dataset Gallery

To find datasets of interest, glance through the entries below, enter a search term to the left, or click terms under the filters to refine the list.

Past Weather by Zip Code - Data Table

Climate Data Online - Daily Summaries

How much rain fell over the weekend? What was the temperature over the last few weeks? Tables of daily weather observations can answer these common questions.

Weekly Drought Map

U.S. Drought Monitor

The U.S. Drought Monitor (USDM) is a weekly map—updated each Thursday—that shows the location and intensity of areas currently experiencing abnormal dryness or drought across the United States.

Record High & Low Daily Temperatures in the U.S. - Graphs and Tabular Data

DayRec: United States Record-Maximum/Minimum Daily Temperatures

Record high and low temperatures generate tremendous interest, largely because of the potential for impacts on human health, the environment, and built infrastructure.

Wind Roses - Charts and Tabular Data

Customized Wind Roses from Hourly Datasets

Wondering which direction the wind was from during your last cold snap, or which summer months usually have a breeze?
How warm do afternoons usually get during this month?

Based on daily observations from 1981-2010, colors on the map show the long-term average maximum temperature in each climate division for the month displayed. The map reveals the average of “afternoon high” temperatures during the month over the previous three decades.

Where do these measurements come from?

Temperatures for each month come from stations in the Global Historical Climatology Network. A combination of volunteer observers and automated instruments collected the highest temperature at each station every day from 1981 to 2010, and sent them to scientists at the National Center for Environmental Information (NCEI). After scientists checked the data quality to omit any systematic errors, they calculated each station’s average monthly maximum temperature: they took the sum of all the maximum temperatures and then divided by the number of days in the month times 30 years. NCEI scientists plotted the values for each station on a gridded map; to calculate values for other points on the grid, a computer program applied a scientifically reviewed mathematical filter to account for the distance between stations and variations in elevation. The average of all grid point values within each climate division is the long-term average maximum temperature for that division.

What do the colors mean?

The color in each climate division shows the average of the highest temperature recorded every day of the month for the 30 years from 1981 to 2010. Shades of blue show where the highest daily temperatures measured across a climate division from 1981 to 2010 averaged below 50°F for the month. The darker the shade of blue, the lower the temperature. Climate divisions shown in shades of orange and red have long-term average maximum temperatures above 50°F. The darker the shade of orange or red, the higher the temperature. White or very light colors show climate divisions where the average maximum temperature is near 50°F.
Learning Activity: Planning Ahead for your BIG Birthdays
Exploring Temperature Projections in Climate.gov Data Snapshots

Answer a few questions, and then visit Climate.gov Data Snapshots to help you prepare for your future celebrations! You’ll find an array of easy-to-understand and ready-for-reuse climate maps to view online or download for your own use.

Start thinking now about conditions on your hundredth birthday!

The 1981-2010 image shows conditions from the recent past.

Blue areas show temperatures below 60°F; orange and red show areas above 60°F.

Labels show month, decade, and selected future.

2020 to 2090 shows projections from global climate models.

Click "read more" for a fact sheet about the images.
Data Snapshots

February 2018 compared to 1981-2010

Difference from average temperature (°F)

-9 0 9

equator

Climate.gov/NNVL
Data: Geo-Polar SST

About This Snapshot:
Colors on this map show where and by how much monthly sea surface temperature differed from its 1981 to 2010 average. read more »
The National Climate Assessment offers a wealth of actionable science about the causes, effects, risks and possible responses to human-caused climate change. NOAA, the NCAnet Education Affinity Group, and members of the CLEAN Network have developed a series of guides for educators that focus on the regional chapters of the Assessment Report, helping to unpack the key messages of each region and point to related, high-quality online resources.
National Centers for Environmental Information

- World's largest climate data archive
- 6 million gigabytes of data
NOAA's National Centers for Environmental Information (NCEI) is responsible for preserving, monitoring, assessing, and providing public access to the Nation's treasure of climate and historical weather data and information. Learn more about NCEI »

How may we assist you?

I want to search for data at a particular location.
I want quick access to your products.
I want to see your monthly climate reports.
I want to find a specific dataset.
I want to know about climate change and variability.

Assessing the Global Climate in January 2016
The globally averaged temperature over land and ocean surfaces for January 2016 was the highest on record for the month.

NCDC partners

ncdc.noaa.gov
Paleoclimate Data

Borehole Data  Cave  Coral  Fauna  Fire History  Forcing

Historical  Ice Cores  Insect  Lake  Lake Levels  Loess

Paleo Modeling  Paleocean  Plant Macros  Pollen  Reconstructions  Tree-ring

http://www.ncdc.noaa.gov/paleoclimate-data
Trees: Recorders of Climate Change

Unit: Little Ice Age
Lesson: 5

Materials & Preparation

Time:
- Preparation: 20 minutes
- Teaching: Part A: 20 min, Part B: 30-40 min

Materials for the Teacher:
- Overhead projector
- Overhead transparency of tree rings (page 5)

Materials for the Class:
- Copies of simulated tree cores (page 6-7)

Materials for Individual

National Science Standards
- Science as Inquiry: Content Standard A
- Earth and Space Science: Content Standard D
- History and Nature of Science: Content Standard G

Colorado Science Standards
- Science: 1, 4.2b, 6d

Learning Goals
Students will
- Identify seasonal and annual growth in a cross section of a tree.
- Understand that thickness of a tree ring is affected by environmental conditions.
- Understand that evidence of past climates is recorded in series of tree rings.
- Learn to interpret past climate conditions from tree ring thickness.
- Collect and analyze tree ring data, testing a hypothesis and drawing conclusions.

What Students Do in this Lesson
Students are introduced to tree rings by examining a cross section of a tree, also known as a “tree cookie.” They discover how tree age can be determined by studying the rings and how ring thickness can be used to deduce times of drought and other environmental conditions.
10 Signs of a Warming

- Air Temperature over Ocean
- Arctic Sea Ice
- Ocean Heat Content
- Sea Surface Temperature
- Humidity
- Snow
- Global Sea Level
- Air Temperature over Land
- Temperature of the Lower Atmosphere
- Glaciers

What can we do?
**Weather.gov**

**NATIONAL WEATHER SERVICE**

**Home Forecast Past Weather Weather Safety Information Center News Search**

We Need Your Feedback! Take Our Weather Survey

The NWS is undertaking its annual research to better serve your needs. Please take our survey at the link below. The survey about 20 minutes to complete and need not be finished all at once. We also encourage you to take a moment and complete one or more of the additional sections focused on Hazardous Weather, Marine Weather, and Aviation Weather. Thank you.

Read More...

**2 MILES S CAPE SAINT CLAIRE MD**

- **Humidity**: 40%
- **Wind Speed**: NW 8 mph
- **Barometer**: 29.86 in (1011.3 mb)
- **Dewpoint**: 47°F (5°C)
- **Visibility**: 10.00 ns

Current conditions at Annapolis (U.S. Naval Academy): 63°F (17°C)

More Local WX 3 Day History Mobile Weather

**TODAY**

- **Mostly Clear**
- **Low**: 57°F
- **High**: 72°F

**TOMORROW**

- **Mostly Sunny**
- **Low**: 53°F
- **High**: 72°F

**TODAY NIGHT**

- **Mostly Clear**
- **Low**: 36°F
- **High**: 72°F

**TOMORROW NIGHT**

- **Mostly Sunny**
- **Low**: 53°F
- **High**: 67°F

**HAZARDOUS WEATHER CONDITIONS**

Hazardous Weather Outlook

**7-DAY FORECAST**

- **TODAY**: Mostly clear, with a few around 47. Northwest wind 5 to 7 mph becoming calm in the evening.

- **WEDNESDAY**: Mostly sunny, with a high near 60. Calm wind becoming south 5 to 8 mph in the afternoon.

- **WEDNESDAY NIGHT**: Mostly clear, with a few around 53. South wind around 10 mph.
THE CLIMATE EXPLORER

Explore maps and graphs of historical and projected climate trends in your local area. View data by topics to see how climate change will impact things you care about.

Online at https://toolkit.climate.gov/ce2
National Climate Assessment

- Evidence
- Impacts
- Responses

Trends in Flood Magnitude

http://nca2014.globalchange.gov/
NOAA Environmental Visualization

http://www.nnvl.noaa.gov/
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<tr>
<th>Name</th>
<th>Category</th>
<th>Date Added</th>
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<td>2 Billion More Coming to Dinner</td>
<td>Land: Human Impact, Land Cover, Agriculture</td>
<td>May 2012</td>
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<td>Age of the Seafloor (topography)</td>
<td>Water: Seafloor</td>
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<td>Age of the Seafloor (vegetation)</td>
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<tr>
<td>Age of the Seafloor Contour Lines</td>
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<td>Agriculture: Cropland Intensity</td>
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<tr>
<td>Flood: Crop Flood</td>
<td>Land: Human Impact, Land Cover, Agriculture</td>
<td>May 2012</td>
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A Global Tour of Precipitation

Description

Precipitation (falling rain and snow) is our fresh water reservoir in the sky and is essential for life. A Global Tour of Precipitation shows how rain and snowfall moves around the world from the vantage of space using measurements from the Global Precipitation Measurement Core Observatory, or GPM. This is a joint mission between NASA and the Japanese Aerospace Exploration Agency (JAXA) and offers the most detailed and worldwide view of rain and snowfall ever created.

This narrated movie will guide you through a variety of precipitation patterns and display features such as the persistent band of the heaviest rainfall around the equator and tight swirls of tropical storms in the Northern Hemisphere. At subtropical latitudes in both hemispheres there are persistent dry areas and this is where the majority of the major deserts reside. Sea surface temperatures and winds are shown to highlight the interconnectedness of the Earth system.

How to Use in Presentation

This show concludes with near-real time global precipitation data from GPM, which is provided to Science On a Sphere roughly six hours after the observation.

This video needs to be paired with the Precipitation – Real Time dataset, which should be played immediately after ‘A Global Tour of Precipitation’ video, to allow your audience to connect to current weather events that are happening.

It is encouraged to play the ‘A Global Tour of Precipitation’ video with z-rotation enabled to allow the audience to see the top and bottom of the sphere. The default speed of one rotation per minute is also recommended.

Length of dataset: 3:50

Notable Features

- Everywhere around the globe, rain and snowfall occur in unsteady patterns (which are hard to forecast)
- Starting at the Equator and moving toward the poles, there are alternating bands of low and high precipitation
- Swirls close to the Equator are tropical storms; at higher latitudes, lows and frontal bands are visible

Related Datasets
Questions?

Peg.steffen@gmail.com