



It's a Feast !

NASA Climate Resources Galore on
NASA's Global Climate Change Website

<http://climate.nasa.gov>



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NASA's Global Climate Change Website

<http://climate.nasa.gov>

NASA's one-stop shop for news, current data, multimedia, and teaching tools

Continuously updated
Key Indicators of
climate change

Interactives

Images of
Change

Climate Reel:
videos and
animations

Tips n' Tricks
for Teachers

The screenshot shows the NASA Global Climate Change website. The header includes the NASA logo and the text "National Aeronautics and Space Administration". Below this is the main title "GLOBAL CLIMATE CHANGE" and the subtitle "NASA's Eyes on the Earth". A banner at the top right says "Experience Earth satellites in 3D".

The "VITAL SIGNS OF THE PLANET" section displays five key indicators:

ARCTIC SEA ICE MINIMUM	CARBON DIOXIDE	SEA LEVEL	GLOBAL TEMPERATURE	LAND ICE
↓ 11.5 % per decade	↑ 391 parts per million	↑ 52 mm since 1993	↑ 1.9 °F avg. temp. since 1880	↓ 24 (Greenland) cubic miles per year

The left sidebar contains a list of navigation links: Key Indicators, Evidence, Causes, Effects, Uncertainties, Solutions, Interactives, NASA's Role, Missions, Key Websites, Earth Science Week 2010, A WARMING WORLD, IMAGES OF CHANGE, CLIMATE REEL, CLIMATE KIDS, FOR EDUCATORS, and a search bar. The "Key Indicators", "Interactives", "IMAGES OF CHANGE", "CLIMATE REEL", and "FOR EDUCATORS" links are circled in red.

The main content area features a large video player titled "Is Antarctica melting? Latest data show net loss since 2002" showing penguins. To the right of the video is a "NEW STUFF" section with links to "EYES ON THE EARTH 3D", "SEA LEVEL VIEWER", "CLIMATE TIME MACHINE", and "GLOBAL ICE VIEWER". Below the video is a "NEWS AND FEATURES" section with articles like "Unchained goddess", "Another sign of global warming", and "Images of change". On the far right is a "COMMUNICATIONS FROM THE FIELD" section with a blog "my big fat planet" and a "CLIMATE KIDS" section.

Annotations with yellow arrows point from the text on the left to the corresponding sections on the website: "Continuously updated Key Indicators of climate change" points to the Vital Signs section; "Interactives" points to the Interactives link in the sidebar; "Images of Change" points to the IMAGES OF CHANGE link in the sidebar; "Climate Reel: videos and animations" points to the CLIMATE REEL link in the sidebar; and "Tips n' Tricks for Teachers" points to the FOR EDUCATORS link in the sidebar. A yellow arrow also points from the text "Near real time satellite data in 3D" to the "EYES ON THE EARTH 3D" link in the NEW STUFF section.

Near real time
satellite data
in 3D



Key Indicators

<http://climate.nasa.gov/keyIndicators/>

Vital signs of the planet:

5 Key indicators

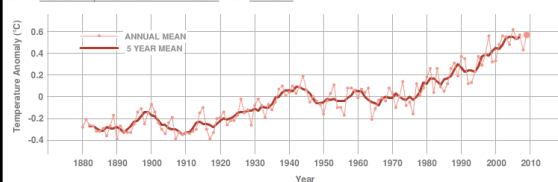
- Scroll over from mainpage
- Current satellite datapoints
- Interactive slider bars

Global Surface Temperature

Data updated 12.10.10

GLOBAL LAND-OCEAN TEMPERATURE INDEX

Source: NASA/GISS. This research is broadly consistent with similar constructions prepared by the Climatic Research Unit and the National Atmospheric and Oceanic Administration. Credit: NASA/GISS



WHAT DOES THIS MEAN?

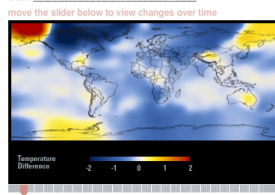
▲ This graph illustrates the change in global surface temperature relative to 1951-1980 average temperatures. The gray error bars represent the uncertainty on measurements. January 2000 to December 2009 was the warmest decade on record. (Source: NASA/GISS) This research is broadly consistent with similar constructions prepared by the Climatic Research Unit and the National Atmospheric and Oceanic Administration.

► The time series at right shows the progression of changing global surface temperatures from 1885 to 2007. Dark blue indicates areas cooler than average. Dark red indicates areas warmer than average.

NASA missions that contribute to surface temperature monitoring: AIRS • MODIS • Jason-2/OSTM

TIME SERIES: 1884-2006

Data source: NASA/GISS
Credit: NASA/Goddard Scientific Visualization Studio

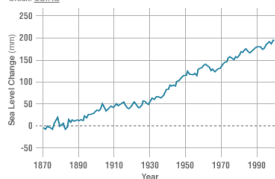


Sea Level

Data updated 12.10.10

GROUND DATA: 1870-2000

Data source: Coastal tide gauge records.
Credit: CSIRO



*estimate for 20th century

WHAT DOES THIS MEAN?

▲ Sea level rise is caused by the thermal expansion of sea water due to climate warming and widespread melting of land ice. The chart on the left shows historical sea level data derived from coastal tide gauge records (trend calculated using the linear regression method). The chart on the right shows the average sea level since 1993 derived from global satellite measurements.

► The time series at right shows average annual sea-surface height anomalies. Red and yellow are regions where sea levels are higher than normal; purple and dark blue show where sea levels are lower.

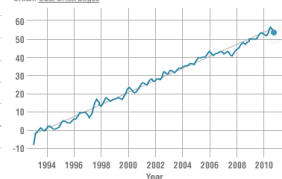
NASA missions that monitor sea level:
Jason-1 • Jason-2/OSTM

RATE OF CHANGE

↑ 1.70 mm per yr*

SATELLITE DATA: 1993-PRESENT

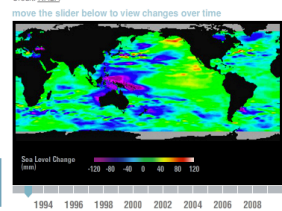
Data source: Satellite sea level observations.
Credit: CLS/CNES/Lagos



Inverse barometer applied and seasonal signals removed.
*estimate for 1993-2010

TIME SERIES: 1993-2009

Data source: OSTM/Jason-1/Tropex-Poseidon
Credit: NASA

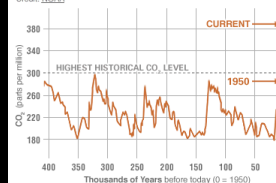


Carbon Dioxide Concentration

Data updated 12.10.10

PROXY (INDIRECT) MEASUREMENTS

Data source: Reconstruction from ice cores.
Credit: NOAA



*estimate for 20th century

WHAT DOES THIS MEAN?

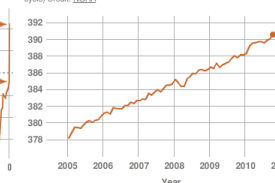
▲ Carbon dioxide (CO₂) is an important greenhouse gas released through natural processes such as respiration and volcanic eruptions and through human activities such as deforestation and burning fossil fuels. The chart on the left shows the CO₂ levels in the Earth's atmosphere during the last three glacial cycles, as reconstructed from ice cores. The chart on the right shows CO₂ levels in recent years, corrected for average seasonal cycles.

► The time series at right shows global distribution and variation of the concentration of mid-tropospheric carbon dioxide in parts per million (ppmv) at an altitude range of 3-13 km (1.9 to 8 miles).

NASA missions that help monitor CO₂:
AIRS • Orbiting Carbon Observatory (launch 2013)

DIRECT MEASUREMENTS: 2005-PRESENT

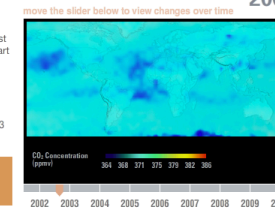
Data source: Monthly measurements (corrected for average seasonal cycle) Credit: NOAA



*estimate for 20th century

TIME SERIES: 2002-2009

Data source: (Atmospheric Infrared Sounder) AIRS
Credit: NASA

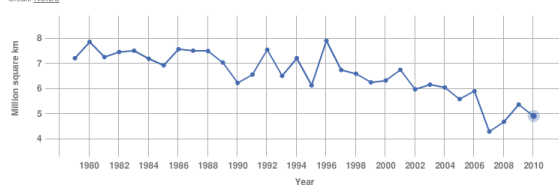


Arctic Sea Ice

Data updated 12.10.10

AVERAGE SEPTEMBER EXTENT

Data source: Satellite observations
Credit: NSIDC



WHAT DOES THIS MEAN?

▲ September Arctic sea ice is now declining at a rate of 11.5 percent per decade, relative to the 1979 to 2000 average.¹ Arctic sea ice reaches its minimum each September. The graph above shows the average monthly Arctic sea ice extent in September from 1979 to 2010, derived from satellite observations. The September 2010 extent was the third lowest in the satellite record.

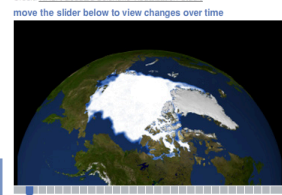
► The time series at right shows the annual Arctic sea ice minimum since 1979, based on satellite observations.

¹ National Snow and Ice Data Center

NASA mission that help monitor sea ice:
Grace • Terra • IceSAT

TIME SERIES: 1979-2008

Data source: Satellite observations
Credit: NASA/Goddard Scientific Visualization Studio

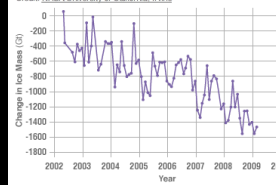


Land Ice

Data updated 12.10.10

ANTARCTICA MASS VARIATION SINCE 2002

Data source: Ice mass measurement by NASA's Grace satellites.
Credit: NASA/University of California, Irvine



Note: In the above charts, negative numbers indicate mass loss; positive numbers indicate mass gain. (Reference)

WHAT DOES THIS MEAN?

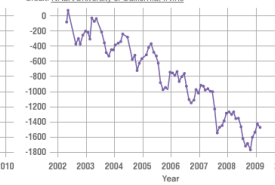
▲ Data from NASA's Grace satellite show that the land ice sheets in both Antarctica and Greenland are losing mass. The continent of Antarctica (left chart) has been losing more than 100 cubic kilometers (24 cubic miles) of ice per year since 2002.

► The time series at right shows average ice mass changes in Greenland each year for the month of September. Purple and blue colors indicate the areas and amount of ice loss, and white and red indicates areas of ice gain. The measurements are calculated in terms of centimeters of equivalent waterheight change per year.

NASA missions that help monitor land ice:
Grace • IceSAT

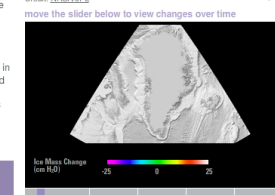
GREENLAND MASS VARIATION SINCE 2002

Data source: Ice mass measurement by NASA's Grace satellites.
Credit: NASA/University of California, Irvine



GREENLAND TIME SERIES: 2003-2008

Data source: NASA/Grace
Credit: NASA/JPL





Interactive Visualizations

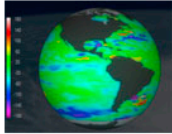
<http://climate.nasa.gov/interactives/>



Climate Time Machine

Go backward and forward in time with this interactive visualization that illustrates how the Earth's climate has changed in recent history.

[Click here to launch](#)



Sea Level Viewer

Explore the world of ocean topography from space with this 3D interactive viewer.

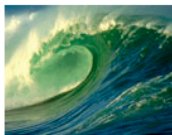
[Click here to launch](#)



Global Ice Viewer

Explore the sentinels of climate change with this 3D interactive global ice viewer.

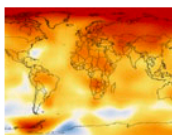
[Click here to launch](#)



Quizzes

Explore and test your knowledge with these interactive quizzes.

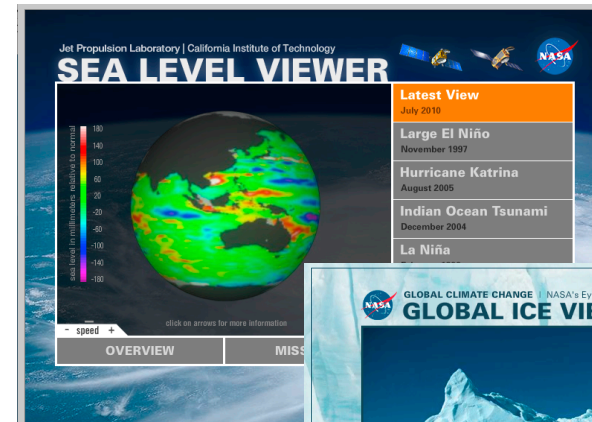
[Click here to view](#)



How Hot is the Earth?

Take a look at the latest worldwide temperature trends and what they mean.

[Click here to launch](#)



- Create immersive experience
- Help viewers visualize complicated scientific concepts
- Students have fun and forget they are being educated



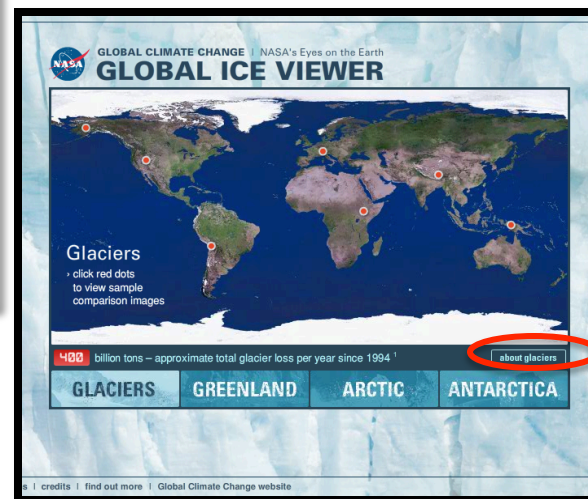
Global Ice Viewer

<http://climate.nasa.gov/GlobalIceViewer/index.cfm>

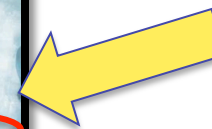
Just a taste: one interactive



The Main Screen: Four choices



Before and after glacier pairs at seven locations around the world



About buttons



McCarty Glacier 1909 and 2004



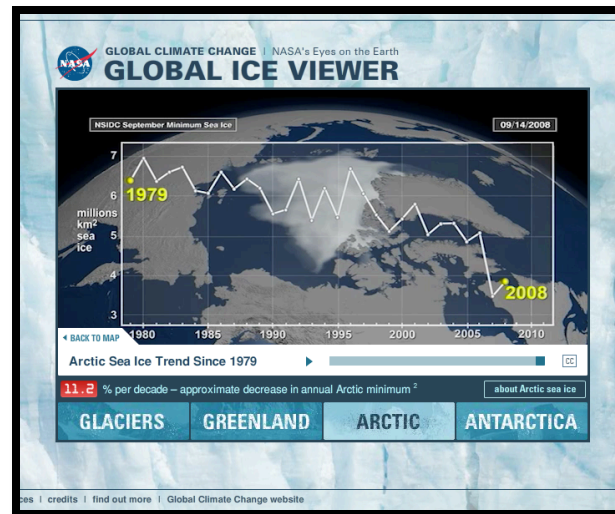
Global Ice Viewer

<http://climate.nasa.gov/GlobalIceViewer/index.cfm>

Just a taste: one interactive



Six time lapse glacial movement videos
One narrated animation



Sea Ice Trend narrated animation
Northwest Passage Graphic



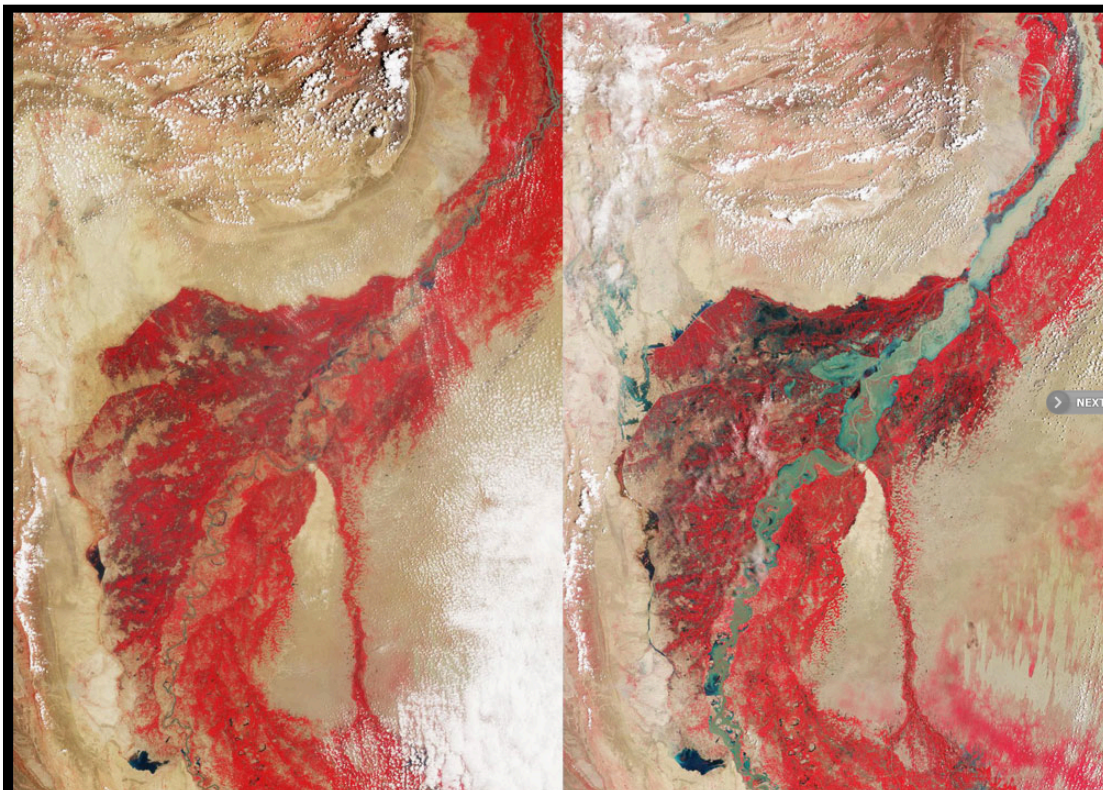
Major Ice Shelves
Ice Flow Map



Images of Change

<http://climate.nasa.gov/stateOfFlux/>

State of Flux features images of locations on planet Earth, showing change over time periods ranging from centuries to days. Some of these changes are related to climate, some document the effects of urbanization, or the ravage of natural hazards such as fires and floods. All show our planet in a state of flux.



Southern Pakistan.
Left: August 8, 2009.
Right: August 11, 2010.

- Dates
- Description
- Instrument/spacecraft detail

AND THE WATERS CAME

Southern Pakistan. Left: August 8, 2009. Right: August 11, 2010. Twenty percent of the country is currently underwater as a result of floods caused by heavy monsoon rains that began in late July 2010. According to reports, six million Pakistanis are now homeless and around 17 million people have been affected in some way. This false-color image pair of the affected region was acquired by the Multi-angle Imaging SpectroRadiometer (MISR) instrument onboard NASA's Terra spacecraft. The Indus River can be seen snaking across the image from lower left to upper right. In the image from 2009, the Indus is about 1 kilometer (0.6 mile) wide. In the 2010 image, the river is 23 kilometers (14 miles) wide or more in parts.

Credit: NASA/GSFC/ROJPL, MISR Team. Caption adapted from JPL's Photojournal.



Climate Reel

<http://climate.nasa.gov/ClimateReel/>

Climate Reel is a collection of NASA's best videos and visualizations of climate change. At the top of the page is a selection of the most popular videos, followed by lists of videos organized by theme.





Tips 'n' Tricks for Teachers:

6 ways to use NASA's Global Climate Change Website in your classroom

<http://climate.nasa.gov/TipsandTricks/index.cfm>


- Teacher-friendly interactive downloadable pdf on the “For Educators” button
- Gives teachers guidelines for creating educational content with NASA resources
- Gives teachers suggestions about using our website's Internet interactive features to improve:
 - student participation
 - topic comprehension
 - scientific curiosity
 - interest in Earth and climate science across diverse student populations.

THE SIX TOPICS:


- 1 CLIMATE TIME MACHINE
- 2 SEA LEVEL VIEWER
- 3 IMAGES OF CHANGE
- 4 GLOBAL ICE VIEWER
- 5 CLIMATE REEL
- 6 EYES ON THE EARTH 3D

Tips 'n' Tricks for Teachers

6 ways to use NASA's Global Climate Change Website in your classroom

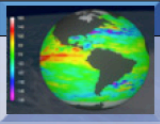


1 CLIMATE TIME MACHINE





GOALS	To experience an interactive representation of recent changes in Earth's global temperatures and to initiate a discussion about it.
TO DO	<ul style="list-style-type: none">• Open the interactive Climate Time Machine.• Select "Average Global Temperature" from the menu on the bottom right.• This map shows a progression of changing five-year average global surface temperatures from 1881 to 2009.• Have students direct your cursor as you slowly guide the handle along the timeline. Pause as often as necessary for questions or comments.• This demonstration typically creates a big stir as the cursor moves into the last decade; repeat the dragging a few times as the discussion continues.
OPTIONS	<ul style="list-style-type: none">• Adapt for a small group lab activity by assigning specific geographical areas to student groups to graph the data.• Select the other menu preferences: Sea Ice, Sea Level and Carbon Emissions on other days.• Students pursue further research on global surface temperatures.• Metadata for this visual and more can be found at Goddard Institute for Space Studies (GISS) Surface Temperature Analysis (GISTEMP) http://data.giss.nasa.gov/gistemp/
OUTCOMES	Students discover how Earth's surface temperatures have changed over time and place.

2 SEA LEVEL VIEWER



GOALS	To demonstrate the relationship between sea surface height and ocean temperatures and to observe events that influence sea level.
TO DO	<ul style="list-style-type: none">• Open the interactive Sea Level Viewer and select the "Latest View" from the menu top right. You can click the arrow on the globe to stop it from rotating.• Observe the latest sea level height closest to your local area.• Explain how warm water expands; sea level is higher where ocean water is warmer.• Discuss the color scale and what this amount of extra water height would look like in your local area.• Click on "Overview" at the bottom of the screen to hear information on how data was collected to make this visualization.• Half the world population lives within 100 Km of a coastline. Lead a discussion about the impacts of sea level rise on coastal communities.
OPTIONS	<ul style="list-style-type: none">• Select the additional menu options: El Niño, Hurricane Katrina, Tsunami, and La Niña.• Select "Missions" at the bottom of the global view screen to get further information on the satellites involved in collecting this data.• Select the "Sea Level" button on Climate Time Machine to view sea level rise at four low-lying coastal areas.
OUTCOMES	Students learn that sea level varies over space and time, is affected by changes in climate and naturally occurring events (earthquakes, tsunamis) and can have a vast global impact.





My Goal: Widespread Classroom Use

**In Lecture:
Students wake up and
stop texting**



In lab: interactive activities create immersive, non-linear experiences by utilizing 3D modeling and video game aesthetics. Students have fun and “forget” they are being educated.



Eyes on the Earth 3D

<http://climate.nasa.gov/eyes>

Near real-time animations of NASA Earth satellites and datasets:

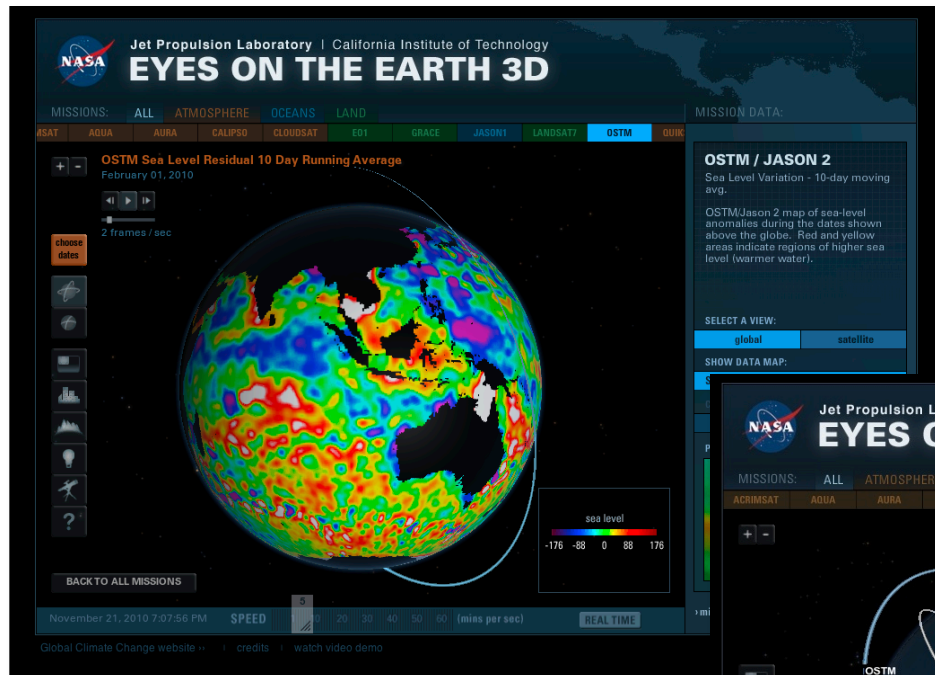
AQUA: CO₂, CO, Water Vapor, Temperature

JASON-2: Sea level

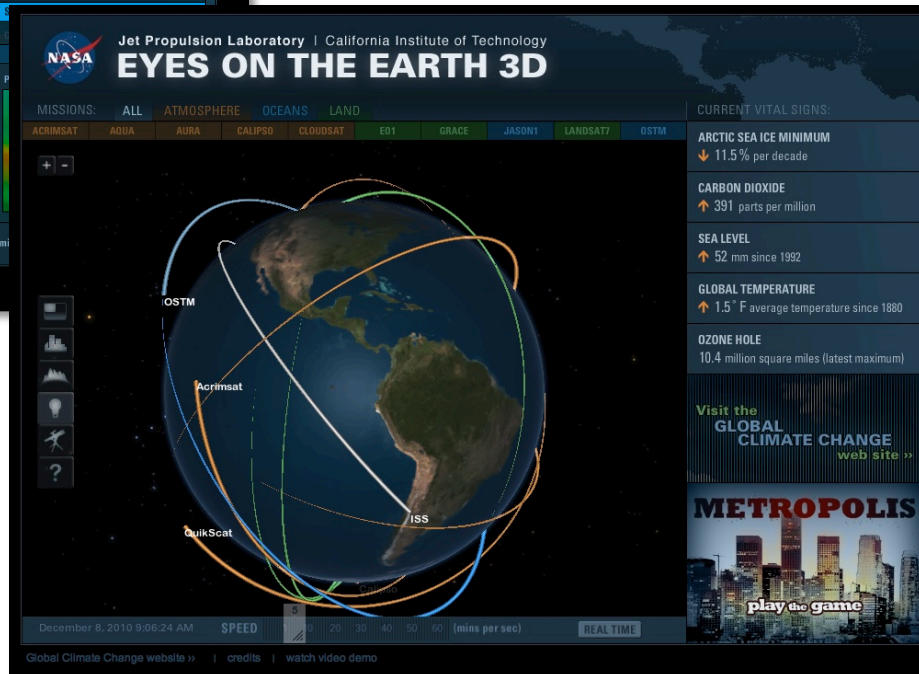
MODIS: Ice Cover

GRACE: Gravity maps

Cloudsat: Vertical cloud structure



Sea Surface Height



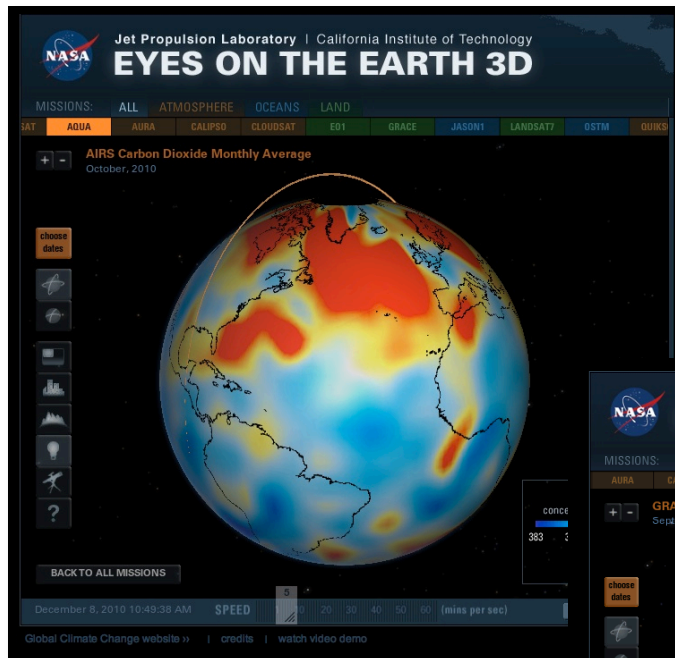
All Missions



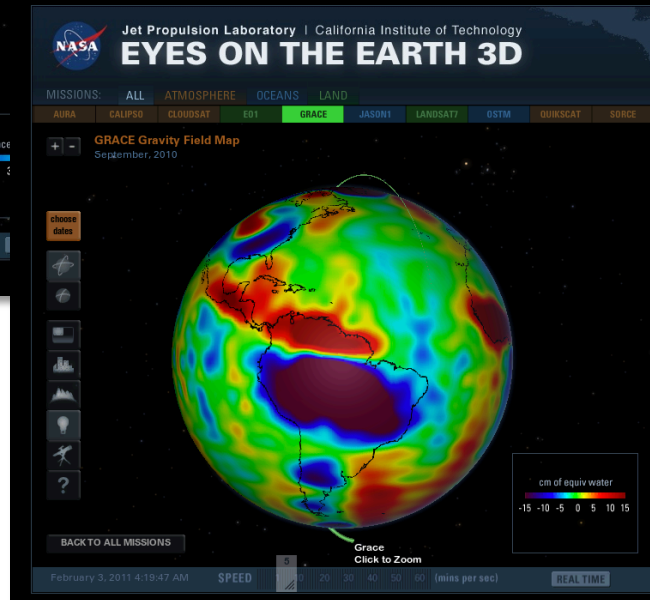
Eyes on the Earth 3D

<http://climate.nasa.gov/Eyes/>

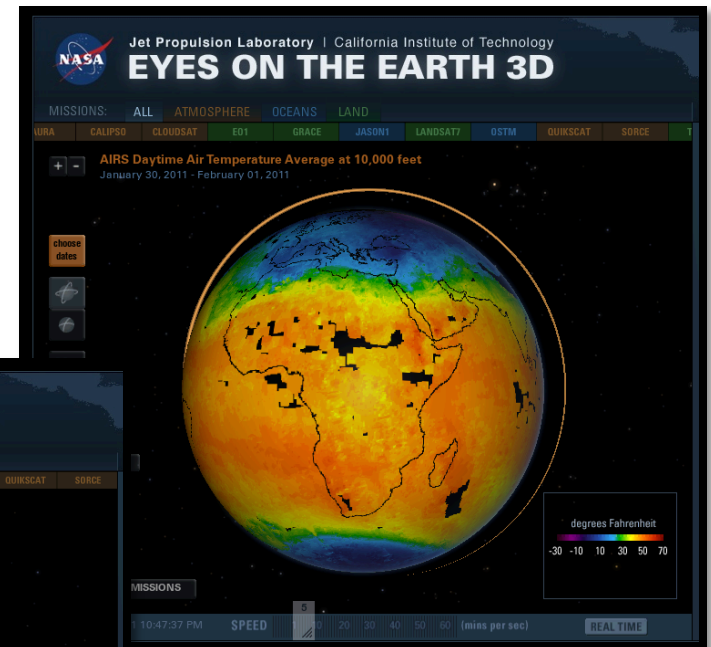
Near real time datamaps: clickable, spinable, zoomable, interactive.



Carbon Dioxide



Gravity Field



Air Temperature



NASA's Global Climate Change Website

<http://climate.nasa.gov>

What's next?

- New learning modules
- Weekly Newsletter
- Meta-site for educational resources
- New Earth Science/Climate Science video series
- Greenhouse Gas Interactive

