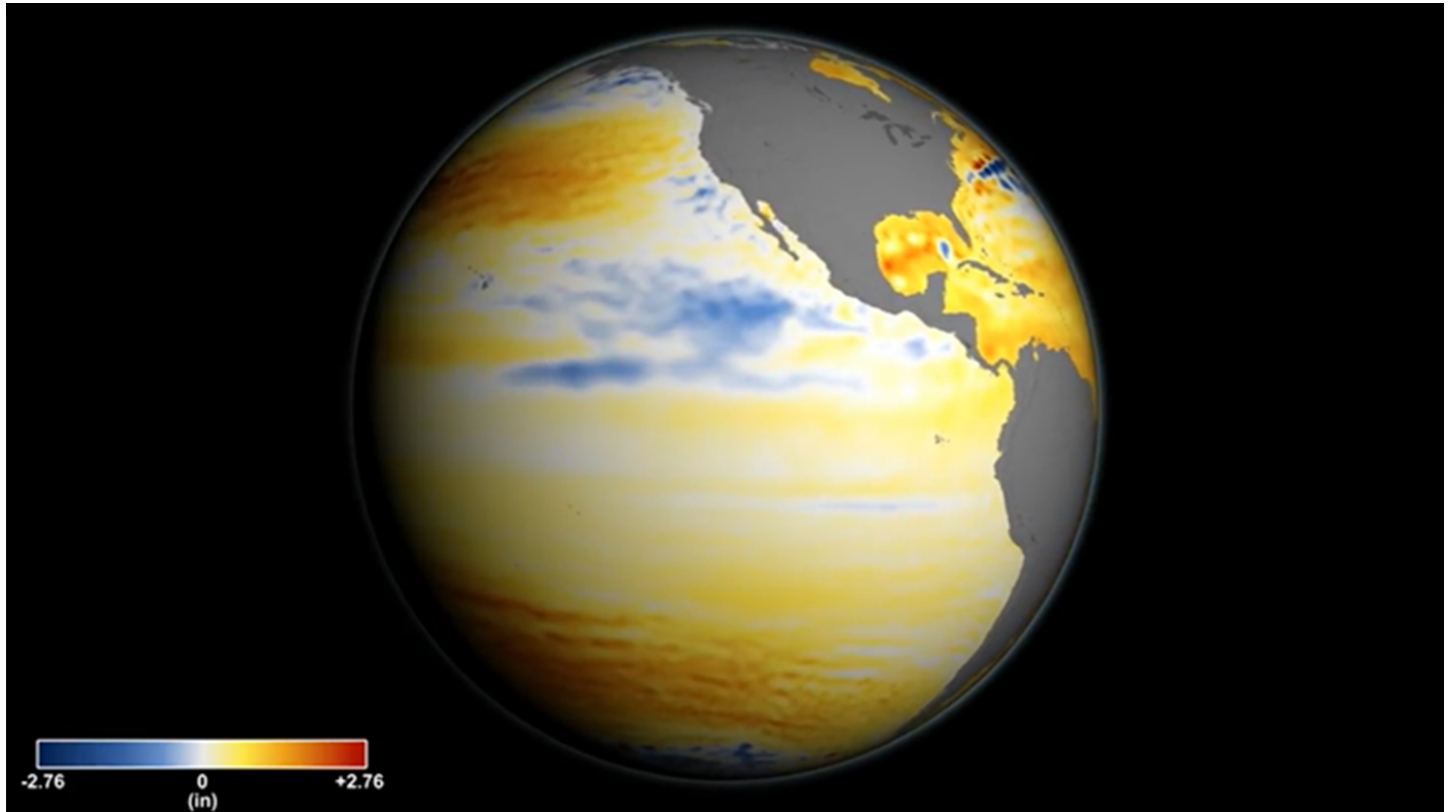

My NASA Data - Lesson Plans

Lessons in Sea-Level Rise



Overview

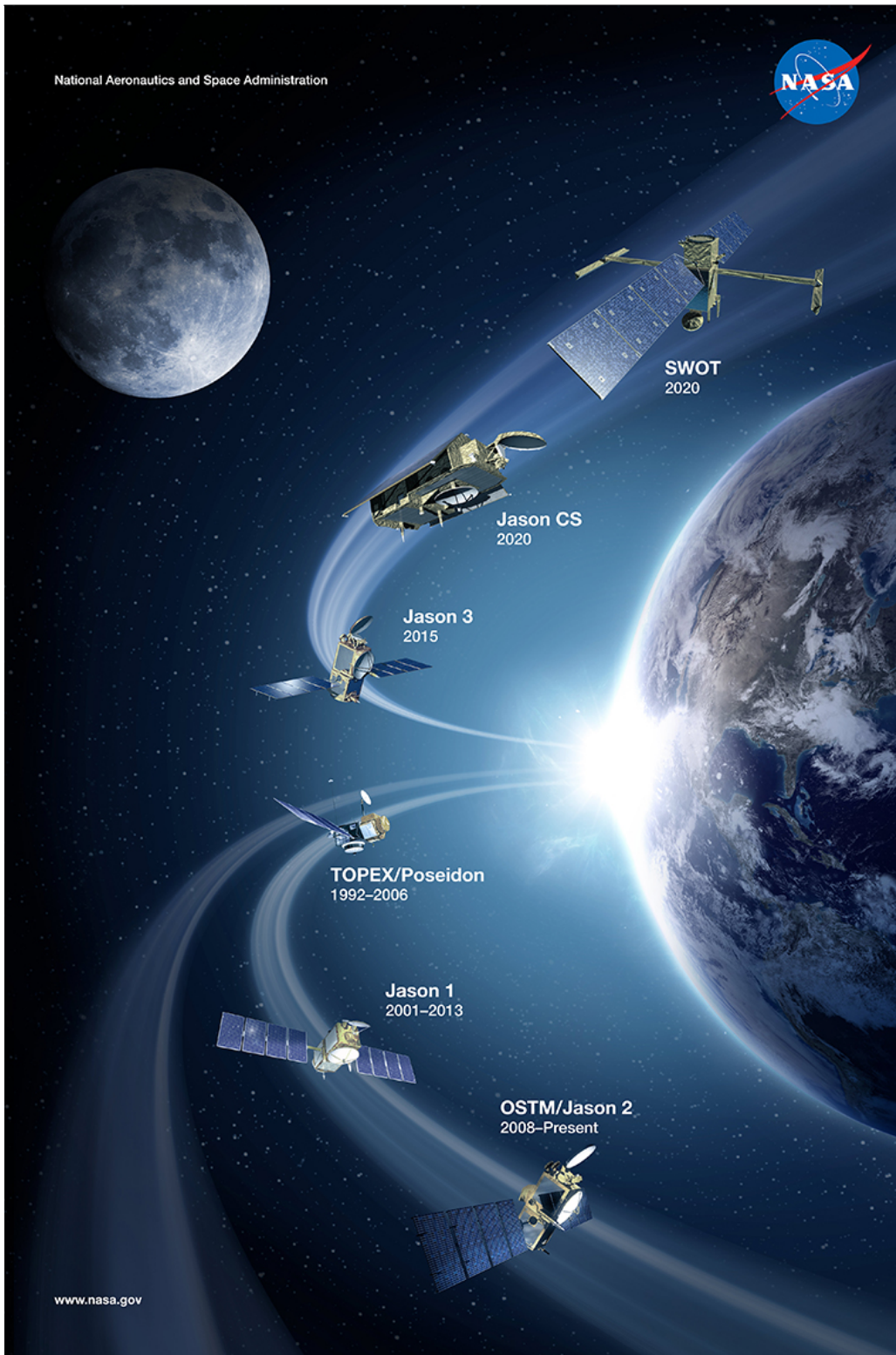
What is sea-level rise and how does it affect us? This "Teachable Moment" looks at the science behind sea-level rise and offers lessons and tools for teaching students about this important climate topic.

Learning Objectives

The students will:

- examine the satellite data graphs
- connect their observations to literature about sea level rise
- draw conclusions about the impact of sea level rise
- discuss their findings with others

Why Does NASA Study This Phenomenon?



NASA keeps track of sea level change and its causes from space. Since 1992 NASA, NOAA and European partners have been tracking global ocean surface topography with joint ocean altimeter satellite missions from an orbit 1,336 km above the ocean surface. The spacecrafts' radar altimeters measure the precise distance between the satellite and sea surface. This record began with TOPEX/Poseidon, followed by Jason-1 and the Ocean Surface Topography Mission on Jason-2, and will be continued by Jason-3.

Radar altimetry from orbit revolutionized global sea-level observations, capturing variations across most of the planet's oceans every 10 days, as well as at other time intervals. The first measurements precise enough to track changes in global mean sea level began with the launch of the NASA-CNES

TOPEX/Poseidon satellite in 1992 (CNES is the French space agency). The spacecraft was equipped with two altimeters and a microwave [radiometer](#), which corrected for the effects of water vapor on radar signal transmission; other instruments ensured precision tracking of the satellite's orbital position [Mitchum et al. 2010].

The advent of gravimetric measurements with the twin GRACE satellites in 2002, along with more recent deployment of floating [Argo](#) sensors, opened the way to “closure” of the [sea level budget](#)—that is, when the sum of observed ocean mass and density changes equals total [sea level change](#) [Leuliette and Willis, 2011].

[GRACE](#) measures changes in water mass, including terrestrial storage in the form of groundwater, rivers, snow and ice, and mass changes within the ocean itself, as well as the movement of water between land and ocean.

Early attempts did not achieve closure of the sea level budget for four-year trend lines [Willis et al., 2008, Chang et al., 2010], leading to concerns about possible instrument drift. More recent efforts, however, led to reports of closure for more extended periods, including a NOAA report covering 2005 to 2013 ("The Budget of Recent Global Sea Level Rise, 2005-2013," by Eric Leuliette).

The deployment of floating sensors across the world's oceans, known as the Argo project, reached a critical mass in 2007, with some 3,000 of the devices set adrift to measure temperature and [salinity](#) in the ocean's upper 2,000 meters [Leuliette and Willis, 2011]. These sensors profile ocean expansion, the thermosteric sea-level rise that, as we have seen, is a consequence of ocean [heat absorption](#). The Argo floats play critical roles in recent studies of trends in [ocean heat content](#), which generally show increased warming over decades. One recent estimate, covering 1955 through 2010 [Levitus et al., 2012], relied upon historical data and more modern readings from the World Ocean Database 2009, additional data from NOAA through 2010, and Argo data that became available in early 2011. Some of the Argo data had been corrected by Argo quality-control teams, although uncorrected data also were used. (The authors say that temperature measurements from the floats, unlike salinity measurements, show few instances of data drift.)

Essential Questions

- What sea level data is collected and why are these important?
- When do we see the most change in sea level?
- How might change in the Hydrosphere affect changes in the other parts of the Earth System?

Materials Required

- Student Worksheet - [download PDF](#)
- Internet access or copies of the graphs [referenced in problem set](#)

Management

The questions involved in this [activity](#) refer to interactive online graphs. For the most accurate results, be sure students have access to the Internet. However, if Internet access is not available for students, consider projecting one set of graphs for the whole class to consult and appointing one student to mouse over appropriate points. Alternately, print hard copies of the graphs for students to mark up and estimate using their graph-reading skills.

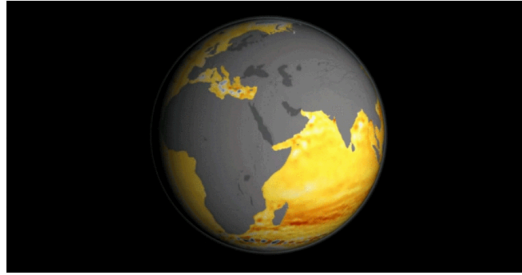
Because preconceived notions may influence the perception of fact, be sure to have students do the math first, then attempt to draw scientific conclusions. This sequencing will provide them with independent data from which to make statements.

Procedure

See NASA's JPL for access to [full lesson plan and resources](#).

PROBLEM SET

Lessons in Sea-Level Rise



This animation made with data from NASA Earth satellites shows how sea level has changed across the globe over the last 23 years. The red areas

This activity is related to a Teachable Moment from Sept. 3, 2015. See "[The Science of Earth's Rising Seas](#)."

› [Explore more on the Teachable Moments Blog](#)

Overview

What is sea-level rise and how does it affect us? This "Teachable Moment" looks at the science behind sea-level rise and offers lessons and tools for teaching students about this important climate topic.

Materials

- Student Worksheet - [download PDF](#)
- Internet access OR copies of [graphs referenced in problem set](#)
- Video: "[Watching Rising Seas from Space](#)" (streaming or downloaded, for class viewing)

Activity Details

Subjects: [SCIENCE](#), [MATHEMATICS](#)

Types: [PROBLEM SET](#), [TEACHABLE MOMENTS](#)

Grade Levels: [5 - 12](#)

Primary Topic: [EARTH AND SPACE SCIENCE](#)

Additional Topics:
[ALGEBRA](#)
[DATA COLLECTION, ANALYSIS AND PROBABILITY](#)
[EARTH PROCESSES](#)
[EARTH SCIENCE](#)
[PROBLEM SOLVING](#)
[SCIENCE AND SOCIETY](#)

Time Required: 30 mins - 1 hr

Next Generation Science Standards ([Website](#))

[MS-ESS3-5](#)
[MS-ESS3-3](#)
[HS-ESS2-4](#)
[HS-ESS3-5](#)

Common Core State Standards for Mathematics ([Website](#))

[5.G.A.2](#)
[7.RP.A.2.B](#)
[HSF.IF.B.6](#)

Extensions

Activity

- [Global Warming Demonstration](#)

Videos

- [NASA's Earth Minute Video Series](#)

Images and Graphics

- [Images of Change](#)
- [Beautiful Earth Photo Gallery](#)
- [Sea Level Rise Infographic](#)

Interactives

- [Earth's Vital Signs](#)
- [Earth Now App](#)
- [Eyes on the Earth](#)
- [NASA Climate Interactive Features](#)

News and Resources

- [Earth Right Now Blog](#)
- [NASA Sea Level Change Portal](#)
- [Article: "Warming Seas and Melting Ice Sheets"](#)
- [Article: "The Fingerprints of Sea Level Rise"](#)
- [NASA's Climate Change website](#)
- [NASA Earth Missions](#)
- [Teachable Moments Blog](#)