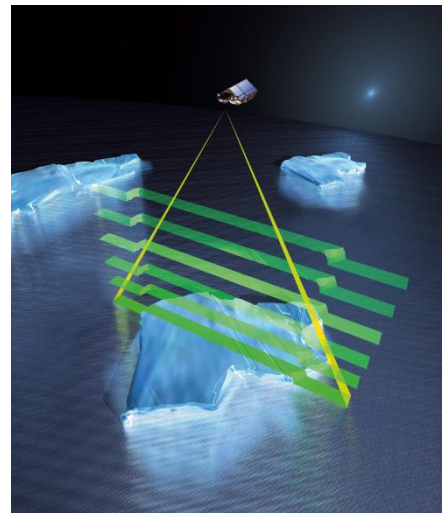


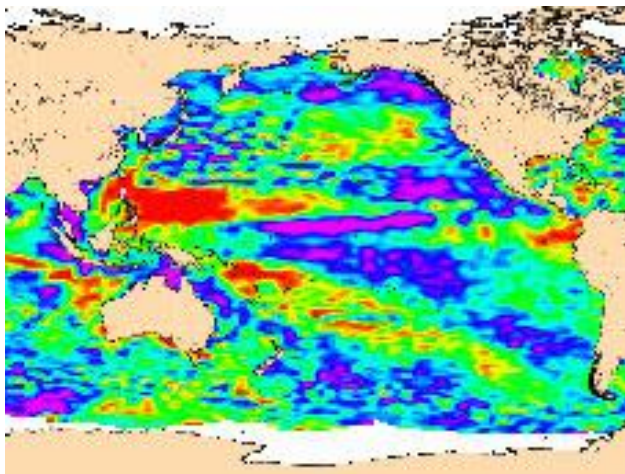
Satellite technology has allowed for extraordinary advances in monitoring and understanding Earth's dynamic climate. Read below for a few recent developments likely to have significant impacts on climate change science.

RECENT DEVELOPMENTS

CryoSat-2: Launched on April 8, 2010 from the Baikonur Cosmodome in Kazakhstan, CryoSat-2 is dedicated to precise monitoring of changes in the thickness of ice floating in the polar oceans as well as variations in the thickness of the Antarctic and Greenland Ice Sheets. CryoSat-2, a European Space Agency satellite, began operations soon after NASA's IceSat was retired due to instrument failure in February 2010. CryoSat-2 orbits at an altitude of about 442 miles, covering latitudes as high as 88 degrees. CryoSat-2's primary payload is the Synthetic Aperture Interferometric Radar Altimeter (SIRAL). SIRAL sends radar pulses to the Earth, where they are reflected, and measures the time it takes these signals to come back to the craft, making the distance between the satellite and the surface clear. Comparable satellites of the past that orbit at 4.3 miles per second used instruments that transmit pulses every 500 milliseconds; SIRAL sends out pulses every 50 milliseconds. The shorter time period between pulses allows for greater resolution of surface features. The Doppler Orbit and Radio Positioning Integration by Satellite (DORIS) is needed to assess the satellite's position so that the surface height data can be calculated. DORIS uses a network of 50 radio beacons around the world to determine the satellite's position to an accuracy of half a meter. The craft relies on sensors that take five pictures per second of star positions, which the computer compares to star charts for orientation. Researchers anticipate CryoSat-2 being operational for at least three years.



Above: An artist's depiction of CryoSat-2 taking measurements of an iceberg. Image courtesy of ESA.



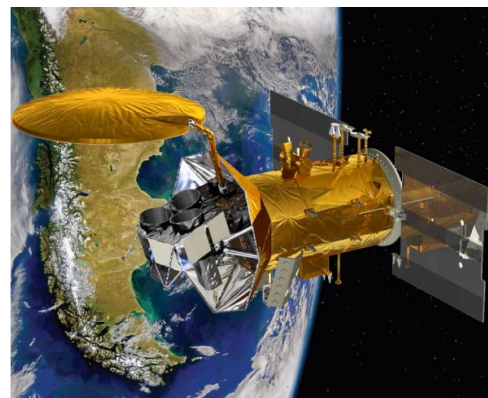
Above: Sea surface height anomalies measured by Jason-2. Image courtesy of NASA.

Jason-2: As a continuation of the Topex-Poseidon and Jason-1 missions, NASA, NOAA, France's Centre National d'Etudes Spatiales (CNES) and the European Meteorological Satellite Organization (EUMETSAT) collaborated to launch Jason-2 as part of the Ocean Surface Topography Mission. Jason-2 focuses on measuring sea surface heights. The launch of Topex-Poseidon in 1992 and Jason-1 in 2001 resulted in the continuous monitoring of sea levels, which rose at three millimeters per year from 1993 onward. Jason-2, launched in 2008 and orbiting at an altitude of 830 miles, carries five instruments: a radar altimeter to measure ocean height; a radiometer to measure water vapor, which can affect the altimetry measurements; and three other sensors for orientation and navigation, including a DORIS instrument. Jason-2's measurements of ocean surface heights are crucial to monitoring ocean heat content and the dynamics of systems like the El Niño-Southern Oscillation. These observations will be useful for mid to long-term climate prediction. Jason is able to monitor 95 percent of the ocean surface in 10 days.

Glory: Perhaps the most disappointing recent Earth observation news was a launch vehicle failure on March 4, 2011 that resulted in the Glory satellite disappearing into the South Pacific. The Glory project focused on aerosols, which are some of the least understood yet potentially crucial climate variables. The craft carried an Aerosol Polarimetry Sensor (APS) that would have looked at aerosols from many different angles to understand their multispectral properties. The craft also featured a Total Irradiance Monitor (TIM) and cloud camera. Researchers hoped that the mission would have been operational now as the sun is heading into the maximum of its 11-year solar cycle. The information Glory would have provided will not likely be available for at least another decade.

UPCOMING MISSIONS:

Aquarius: A collaboration between NASA and Argentina's Comisión Nacional de Actividades Espaciales (CONAE), Aquarius will focus on measuring ocean salinity on a global scale, which is an important variable when making estimates of changes in the global water cycle as well as changes in ocean circulation that reflect long-term changes in climate. Aquarius will measure sea surface salinity with an integrated polarimetric radiometer that measures thermal emissions from the ocean, which vary according to the salinity level of the waters. All other things being equal, salty water appears cooler than freshwater to the radiometer. Several other instruments measure variables that can affect the radiometer's measurements, such as wind speed, sea ice concentrations, water vapor and sea surface temperature variability itself. Aquarius is set to launch from Vandenberg Air Force Base on June 9, 2011.



Above: An artist's depiction of the Aquarius satellite, which is scheduled to be in orbit by mid-June 2011. Image courtesy of NASA.

SMAP: Based on recommendations from the National Research Council's Decadal Survey report, NASA announced in early 2008 that the Soil Moisture Active Passive (SMAP) mission would be one of its two new Earth science missions. The SMAP mission is currently in Phase B, focused on reviewing system requirements and design. Launch of the spacecraft is scheduled for November 1, 2014. SMAP will provide global measurements of soil moisture and soil freeze/thaw states. Monitoring soil moisture is crucial for having a more detailed picture of Earth's water, energy and carbon cycles, which is necessary to improve weather and climate predictions. The spacecraft will employ a synthetic aperture radar that can sense soil moisture even through moderate vegetation cover. The measurement swath will be about 385 miles and will provide global coverage over the course of three days at the equator and two days at boreal latitudes higher than 45 degrees North.



Above: The Global Microwave Subsystem imager receiver, with the channels completed. This equipment will receive the microwave signals after they bounce off clouds and the surface. Image courtesy of NASA.

GPM: The Global Precipitation Measurement (GPM) mission is a joint venture between NASA and the Japan Aerospace Exploration Agency (JAXA). As the name suggests, GPM is focused on providing more accurate and frequent (three hour) monitoring of precipitation. These measurements, along with those gathered from SMAP, will facilitate a clearer picture of the global water cycle and improve short term weather forecasts and seasonal flood and drought prediction. It will also assist climate assessments and test the hypothesis that a warmer world features an accelerated water cycle. Launched in 1997 and still active, the Tropical Rainfall Measuring Mission (TRMM) satellite was the forerunner of the GPM, but TRMM only monitors rainfall in the tropics. The launch of a core GPM satellite, which is in the confirmed phase of development, will augment coverage into the higher latitudes. The GPM core satellite will carry both an active precipitation radar and a passive microwave radiometer.

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For More Information

CryoSat-2:

- ESA Cryosat: www.esa.int/esaMI/Cryosat/index.html and www.esa.int/esaLP/ESAOMH1VMOC_LPcryosat_0.html

Jason-2

- NOAA: www.osd.noaa.gov/ostm/
- NASA: www.nasa.gov/mission_pages/ostm/main/index.html
- CNES: smc.cnes.fr/JASON2/
- EUMETSAT: www.eumetsat.int/Home/Main/Satellites/Jason-2/index.htm

Glory

- NASA: glory.gsfc.nasa.gov/

Aquarius

- NASA: aquarius.nasa.gov/

SMAP

- NASA: smap.jpl.nasa.gov/

GPM

- NASA: gpm.gsfc.nasa.gov/
- JAXA: www.eorc.jaxa.jp/GPM/index_e.htm

National Research Council

- Decadal Survey Report: www.nap.edu/catalog.php?record_id=11820

For a description of the different phases of NASA missions, visit www2.jpl.nasa.gov/basics/bsf7-1.php