2012 Calendar

GOES-R

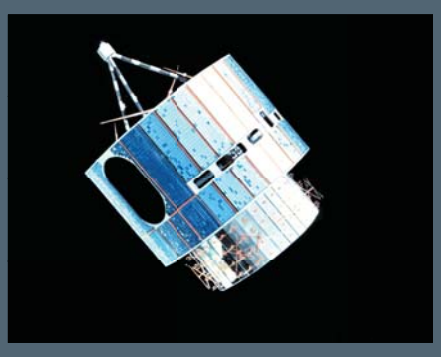
Geostationary Operational Environmental Satellite - R series

www.nasa.gov

www.noaa.gov

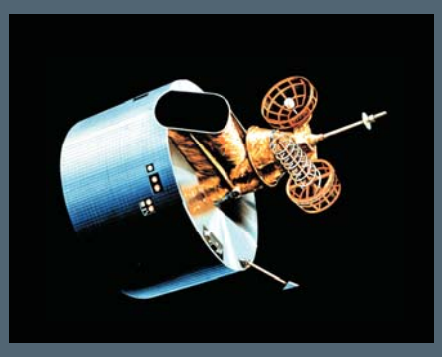
GOES environmental satellites

For almost 40 years, weather satellites stationed high above Earth's equator in geostationary orbit have been the workhorses providing continuous imagery and data on atmospheric conditions and solar activity (space weather) affecting Earth. The data products of these Geostationary Operational Environmental Satellites (GOES) have led to improved weather and climate models, enabling more accurate and faster weather forecasting and better understanding of long-term climate. GOES have even helped in the search and rescue of people in distress. The National Oceanic and Atmospheric Administration (NOAA) operates the GOES. The National Aeronautics and Space Administration (NASA) builds and launches them. Since the development and launch of the first of the GOES in 1974, these two organizations have pushed the technology to its current advanced state, as represented by GOES-R, the next generation weather satellite.



GOES A-C series

Launched from 1974 – 1978, this generation of GOES provided data in only two dimensions—three if you consider time. There was no indication of cloud thickness, moisture content, temperature variation with altitude, or any other information in the vertical dimension. Weather forecasters looking at a satellite image could not really nail down the coordinates of the low-resolution object that represented a storm, or clearly define its edges. Their forecast of affected regions could miss by a county or even a small state.

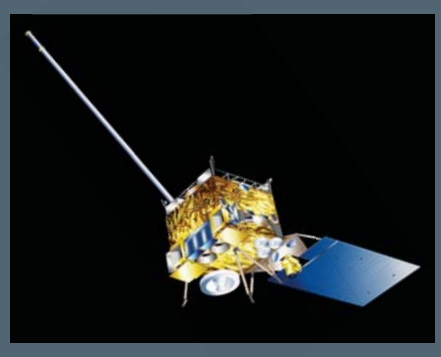


GOES D-H series

In the 1980s, the GOES acquired the capability to obtain vertical profiles of temperature and moisture throughout the atmosphere. This added dimension gave forecasters a more accurate picture of the intensity and extent of storms, allowed them to monitor rapidly changing events, and to predict fog, frost and freeze, dust storms, flash floods, and even the likelihood of tornadoes. However, as in the 70s, the imager and sounder still shared the same optics system. That meant the instruments had to take turns. Also, the satellites were still spin-stabilized, which meant that they were pointed toward Earth only about 10% of the time.

GOES I-M series

It was GOES-I, launched in 1994, that brought real improvement in the resolution, quantity, and continuity of the data. Advances in two technologies were responsible: three-axis stabilization of the spacecraft and improved and separate optics for imaging and sounding. Three-axis stabilization meant that the imager and sounder could work simultaneously. Forecasters had much more accurate data to pinpoint locations of storms and potentially dangerous weather events such as lightning and tornadoes. The satellites could temporarily suspend their routine scans of the hemisphere to concentrate on a small area of quickly evolving events to improve the short-term weather forecast for that area.



GOES N-P series

Launched from 2006 – 2010, GOES-N, O, and P further improved imager and sounder resolution with the Image Navigation and Registration subsystem, which uses geographic landmarks and star locations to pinpoint the coordinates of intense storms. Detector optics were also improved. Because of better batteries and more available power, imaging became continuous.

Credit: Lockheed Martin

GOES-R series

The next series of GOES, currently under development will be a giant leap forward in the technology, in terms of accuracy, resolution, quantity, speed, and types of data products available. Although the current GOES system provides critical weather information, improvements over the current capabilities are required to meet future users' needs for enhanced observations, improved weather forecasting, ecosystems management, and monitoring of changing climatic conditions. The user community is not only looking for improvements in instrument capabilities, but is also seeking new products and applications, along with faster data dissemination techniques and reduced product lag time.

Winter in Black Forest, Germany. (From Wikimedia Commons, photo by Richardfabi)

January 2012

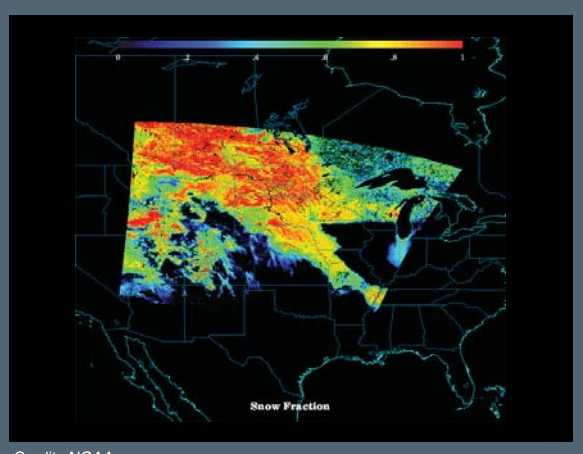
NEW MOON · FIRST QUARTER · FULL MOON · LAST QUARTER

SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
1 New Year's Day	2	3	4	5 Perihelion	6	7
8	9	10	11	12	13	14
15	16 Martin Luther King, Jr., Day observed	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31				

Assessing snow cover

The Snow Cover product uses GOES-R Advanced Baseline Imager spectral information in the visible and near-visible wavelengths to estimate fractional snow cover per pixel and grain size and the snow albedo of that fractional snow cover. This product will be assimilated into NOAA's snow model. It will also be used in hydrologic forecasts and warnings, including river and flood forecasts, as well as water management, snowpack monitoring and analysis, and climate studies.

Example of the Snow Cover product as generated by the GOES-R snow fraction algorithm using MODIS data.



Credit: NOAA

Augustine volcano, Alaska. (Image courtesy of U.S. Geological Survey. Image Creator: McGimsey, Game.)

February 2012

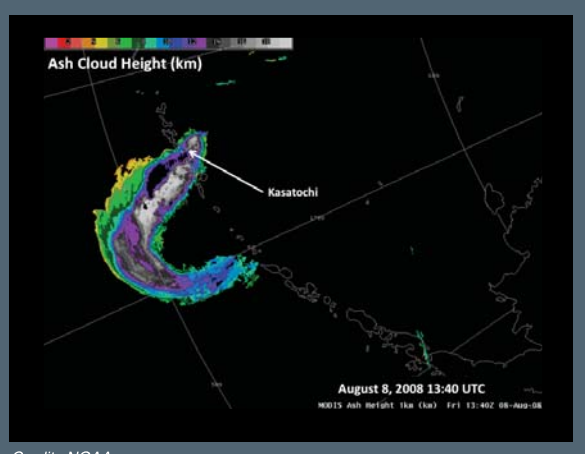
NEW MOON · FIRST QUARTER · FULL MOON · LAST QUARTER

SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
			1	2	3	4
5	6	7	8	9	10	11
12	13	14 Valentine's Day	15	16	17	18
19	20 President's Day	21	22	23	24	25
26 GOES-G launched, 1987	27	28	29 Leap Day			

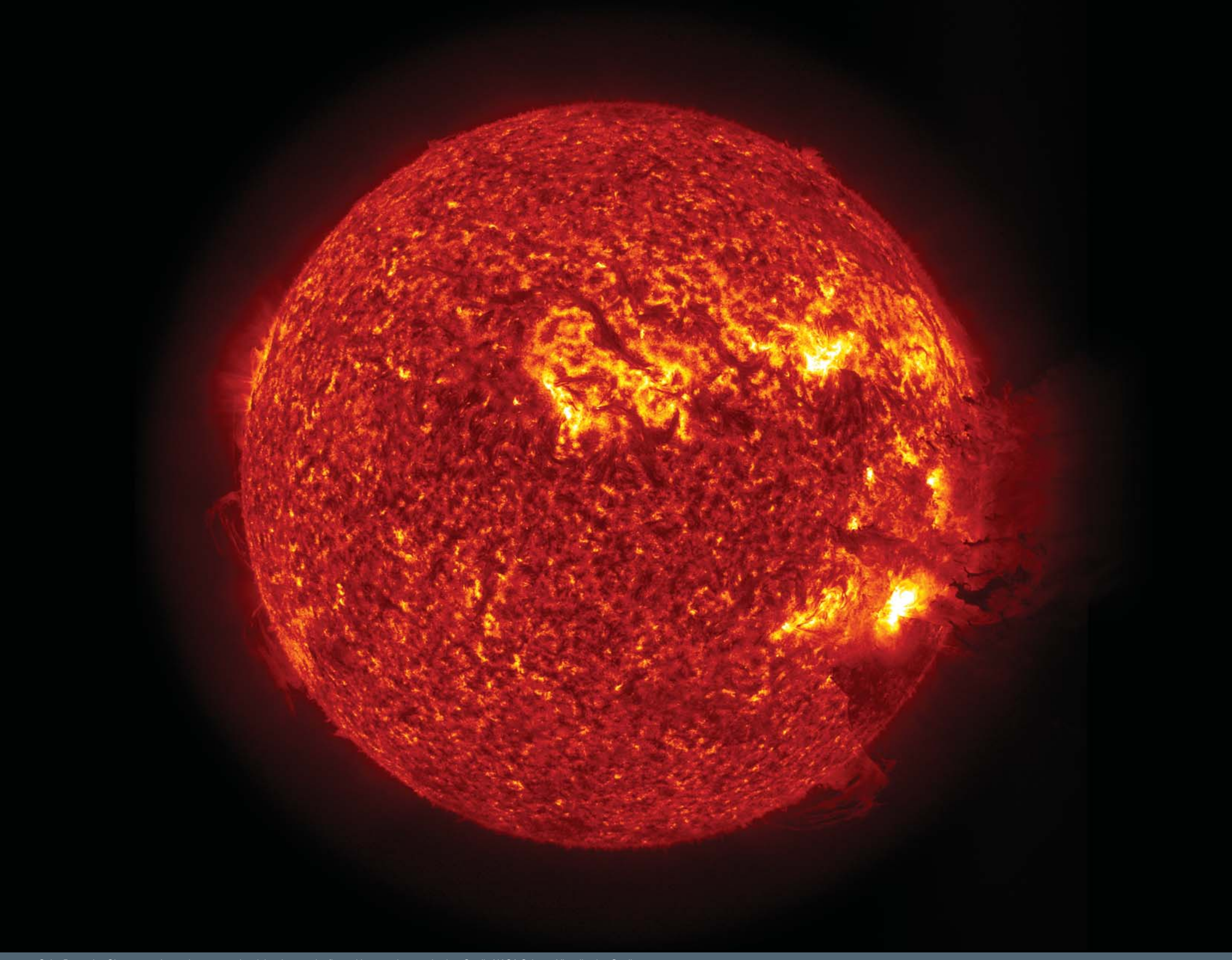
Detecting volcanic ash in the atmosphere

Airborne volcanic ash has significant aviation, health, infrastructure, and economic impacts. It is important to monitor volcanic regions and promptly identify ash clouds in order to minimize risk. The advanced spectral, spatial, and temporal resolution of the GOES-R Advanced Baseline Imager will be used to generate a complete set of volcanic cloud detection and monitoring products, resulting in improved air and ground safety as well as economic savings. The GOES-R products will also improve the modeling of volcanic ash clouds, which will allow for more accurate ash cloud dispersion and ash fall forecasts.

GOES-R Volcanic Ash product will identify significant volcanic ash plumes. This example is from the Kasatochi Volcano in Alaska, using MODIS imager data as a proxy for the GOES-R Advanced Baseline Imager.



Credit: NOAA



Solar Dynamics Observatory image in extreme ultraviolet shows solar flare with coronal mass ejection. Credit: NASA Science Visualization Studio.

March 2012

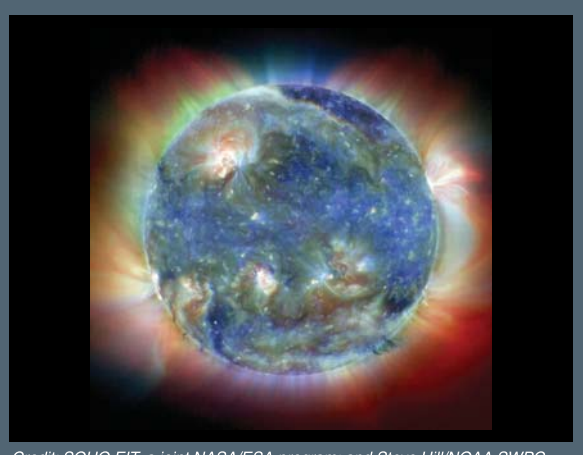
NEW MOON · FIRST QUARTER · FULL MOON · LAST QUARTER

SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
				1	2	3
4 GOES-P launched, 2010	5	6	7	8	9	10
11 Daylight Saving Time begins	12	13	14	15	16	17
18	19	20 Vernal Equinox	21	22	23	24
25	26	27	28	29	30	31

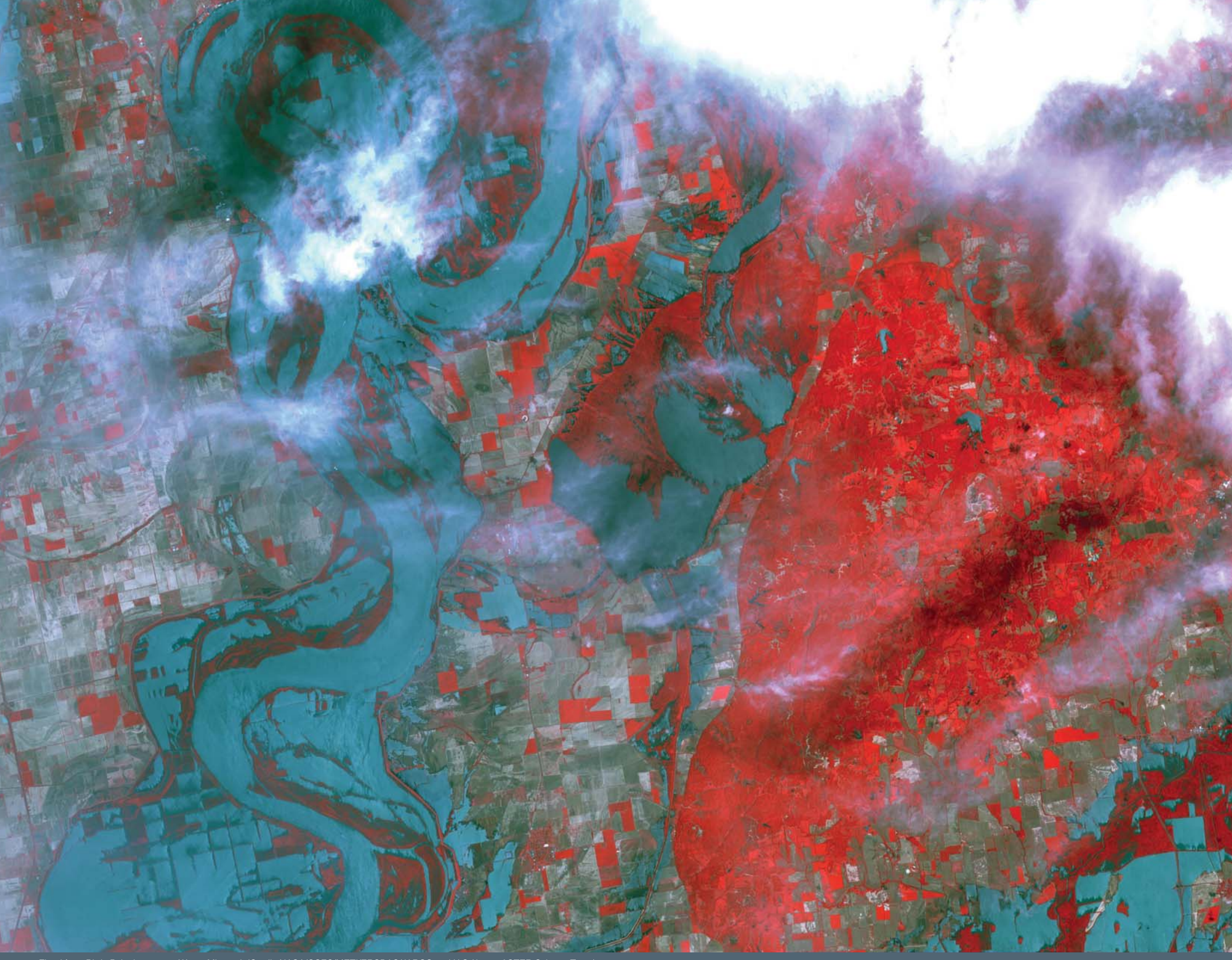
Forecasting space weather

The Solar Ultraviolet Imager (SUVI) on GOES-R is a telescope that observes the Sun in the extreme ultraviolet wavelength range. SUVI will observe active regions of the Sun in order to detect solar flares and the warning signs of coronal mass ejections. Depending on the size and trajectory of solar eruptions, the energetic particles reaching Earth's environment in space can disrupt power utilities, communication, and navigation systems, and may hurt satellites, the International Space Station, and astronauts. SUVI observations will provide an early warning of such impacts to the Earth environment. SUVI will replace the current GOES Solar X-ray Imager (SXI) instrument and will produce multi-band "color" images at the same rate as SXI produces single band images.

Simulated GOES-R SUVI image from the Solar and Heliophysics Observatory (SOHO) Extreme Ultraviolet Imaging Telescope.



Credit: SOHO EIT, a joint NASA/ESA program; and Steve Hill/NOAA SWPC



Flood from Birds Point levee near Wyatt, Missouri. (Credit: NASA/GSFC/METI/ERSDAC/JAROS and U.S./Japan ASTER Science Team)

April 2012

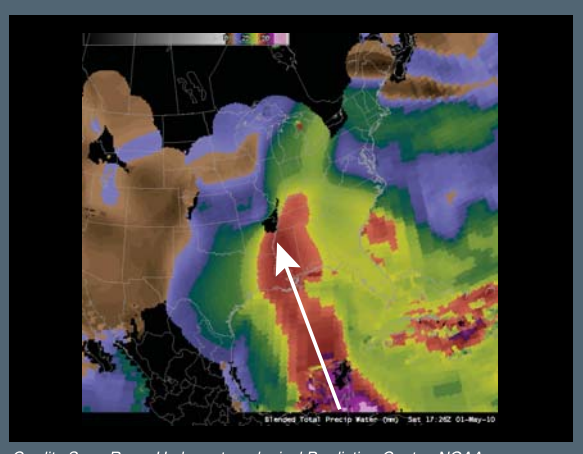
NEW MOON · FIRST QUARTER · FULL MOON · LAST QUARTER

SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
1	2	3	4	5	6	7
8 Easter	9	10	11	12	13 GOES-I launched, 1994	14
15	16	17	18	19	20	21
22	23	24	25 GOES-K launched, 1997	26	27	28 GOES-F launched, 1983 GOES-H launched, 1987
29	30					

Predicting heavy rain and flooding

Long, narrow filaments of moisture can persist in the atmosphere for several days and can transport as much water as the Amazon River. Combining data from GOES-R's Advanced Baseline Imager and from POES (NOAA's Polar-orbiting Operational Environmental Satellites), a new product will depict these "atmospheric rivers" and the total precipitable water (TPW) they carry. This product will help to predict heavy rain events, such as that experienced by Nashville, Tennessee, in May 2010, when a plume of deep tropical moisture extended from the southern Gulf of Mexico northward into the Tennessee River Valley.

This TPW image (with highest values of water vapor shown in red) clearly shows an atmospheric river extending from the Gulf of Mexico and western Caribbean northward into the lower Mississippi River Valley.



Credit: Sean Ryan, Hydrometeorological Prediction Center, NOAA

Tornado in Elie, Manitoba, Canada, 2007. (From Wikimedia Commons, photo by Justin Hobson)

May 2012

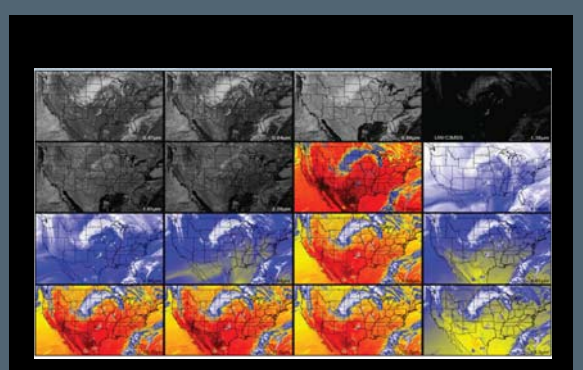
NEW MOON · FIRST QUARTER · FULL MOON · LAST QUARTER

SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
		1	2	3 GOES-L launched, 2000 GOES-G launched, 1986	4	5
6	7	8	9	10	11	12
13 Mother's Day	14	15	16	17	18	19
20	21	22 GOES-E launched, 1981	23 GOES-J launched, 1995	24 GOES-N launched, 2006	25	26
27	28 Memorial Day	29	30	31		

Improving tornado warning time

The Cloud and Moisture Imagery product will use all 16 spectral bands of the GOES-R Advanced Baseline Imager (ABI) instrument to monitor the Earth, atmosphere, and ocean systems. The algorithms used in this product produce digital maps of clouds and moisture in the atmosphere based on the measured reflectance within the visible bands and radiance within the infrared bands. These are converted into Brightness Values (BVs) and Brightness Temperatures (BTs), respectively. The BVs and BTs will be used to generate an array of forecast products aiding meteorologists in monitoring and predicting all kinds of hazards, including tornados and other weather, oceanographic, and climate-related phenomena.

Example of ABI imagery for each of the 16 bands as simulated from high-resolution numerical weather prediction model output and state-of-the-art radiative transfer models.



Credit: NOAA

Great Barrier Reef, Queensland, Australia. (From Wikimedia Commons, photo by Toby Hudson)

June 2012

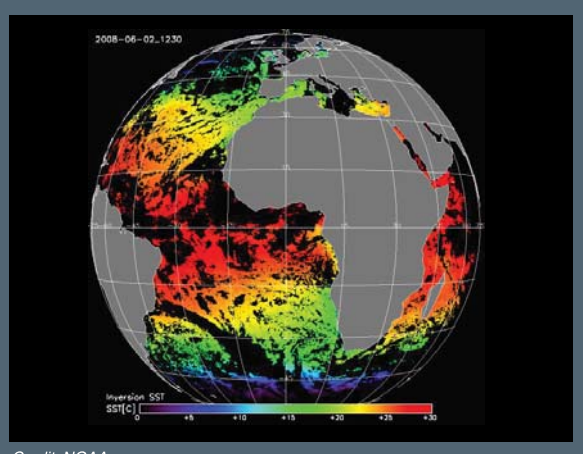
NEW MOON · FIRST QUARTER · FULL MOON · LAST QUARTER

SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
					1 Atlantic hurricane season begins	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16 GOES-B launched, 1977 GOES-C launched, 1978
17 Father's Day	18	19	20 Summer Solstice	21	22	23
24	25	26	27 GOES-O launched, 2009	28	29	30

Monitoring sea surface temperature

GOES-R will give forecasters a Sea Surface Temperature for each cloud-free pixel over water identified by the GOES-R Advanced Baseline Imager. Sea surface temperature data are useful for climate monitoring and forecasting, seasonal forecasting, operational weather and ocean forecasting, military and defense operations, validating or forcing ocean and atmospheric models, tracking of sea turtles, coral bleach warnings and assessment, tourism, and commercial fisheries management.

Proxy of product generated by the GOES-R Sea Surface Temperature algorithm using SEVIRI data.



Credit: NOAA

Lightning over Victoria, Australia, 2008. (From Wikimedia Commons, photo by Fir0002/Flagstaffotos.com)

July 2012

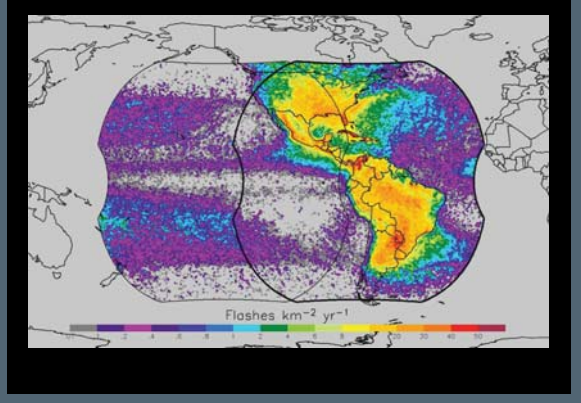
NEW MOON · FIRST QUARTER · FULL MOON · LAST QUARTER

SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
1	2	3	4 U.S. Independence Day	5 Aphelion	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23 GOES-M launched, 2001	24	25	26	27	28
29	30	31				

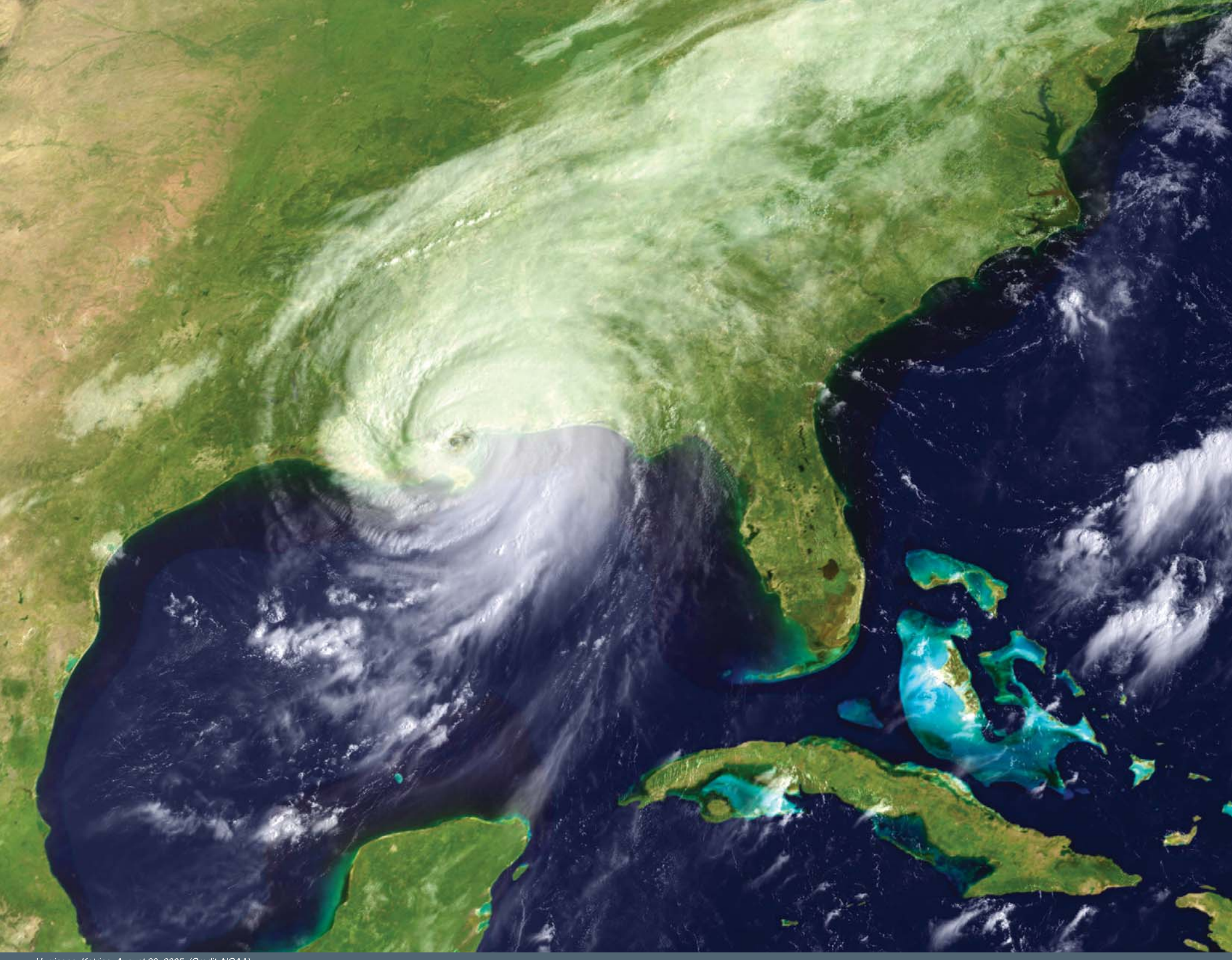
Detecting lightning

The Geostationary Lightning Mapper (GLM) on GOES-R will detect both cloud-to-ground and cloud-to-cloud lightning. This data will help severe weather forecasters identify rapidly intensifying thunderstorms and issue accurate and timely severe thunderstorm and tornado warnings.

Lightning activity observed by the Lightning Imaging Sensor aboard the Tropical Rainfall Measuring Mission (TRMM) observatory, with the GLM view of the western hemisphere superimposed.



Credit: NOAA



Hurricane, Katrina, August 29, 2005. (Credit: NOAA)

August 2012

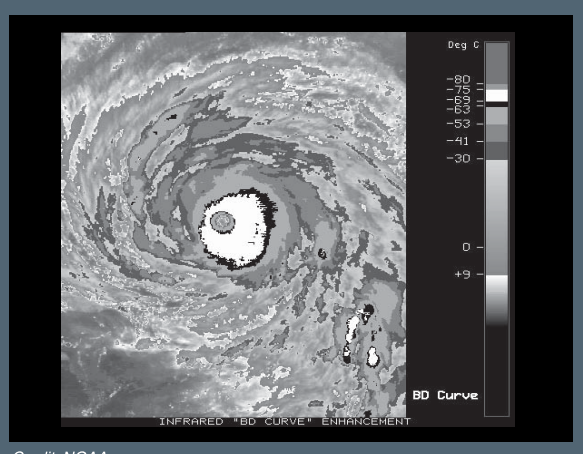
NEW MOON · FIRST QUARTER · FULL MOON · LAST QUARTER

SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	31	

Estimating hurricane intensity

The advanced observational capabilities available from GOES-R will enable the NOAA's National Hurricane Center to estimate hurricane track and intensity more accurately, leading to improved forecasts and extended forecast lead times. The new information from the Geostationary Lightning Mapper and Advanced Baseline Imager on GOES-R will also improve forecasts through continuous high-resolution spatial and temporal data for hurricane simulation models.

GOES-R imagery will provide higher resolution of hurricane intensity indicators, such as temperature differences throughout the storm structure.



Credit: NOAA

Controlled fire in Western Alberta, Canada. (From Wikimedia Commons, photo by Cameron Strandberg)

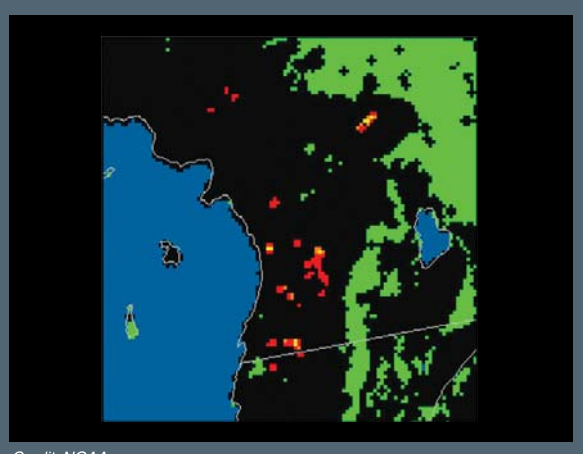
September 2012

NEW MOON · FIRST QUARTER · FULL MOON · LAST QUARTER

SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
						1
2	3 Labor Day	4	5	6	7	8
9 GOES-D launched, 1980	10	11	12	13	14	15
16	17	18	19	20	21	22 Autumnal Equinox
23 30	24	25	26	27	28	29

Detecting intensity and extent of wild fires

Fires produce a heat signature detectable by satellites even when the fires represent a small fraction of the pixel. Compared to the current GOES imager, the GOES-R Advanced Baseline Imager will be able to detect this heat signature with improved thermal, temporal and spatial resolution. It will thus detect smaller fires and provide a more accurate estimate of the intensity of large fires. GOES-R will represent a step forward in the ability of the hazards and air quality monitoring communities to detect fires and their properties.



Example of the GOES-R Fire/Hot Spot Characterization product.

Credit: NOAA

Coast Guard rescue practice. (Credit: United States Coast Guard)

October 2012

NEW MOON · FIRST QUARTER · FULL MOON · LAST QUARTER

SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
	1	2	3	4	5	6
7	8 ◐ Columbus Day	9	10	11	12	13
14	15 ○	16 GOES-A launched, 1975	17	18	19	20
21	22 ◐	23	24	25	26	27
28	29 ●	30	31 Halloween			

Helping to take the "search" out of search and rescue

GOES-R will carry a dedicated Search and Rescue Satellite Aided Tracking (SARSAT) transponder to detect signals transmitted from emergency beacons on aircraft, maritime vessels, or carried by individuals in distress. The transponder provides constant coverage to immediately receive and relay a 406-MHz emergency beacon alert to ground stations called Local User Terminals. In turn, this signal is routed to a SARSAT Mission Control Center and then sent to the Rescue Coordination Center nearest the alert, which dispatches a search and rescue team to the location of the distress. GOES-R continues the legacy Geostationary SAR (GEOSAR) function of the SARSAT system carried on NOAA's GOES satellites since GOES-I. It has contributed to the rescue of thousands of individuals in distress in the United States and around the world.

Emergency beacon transmitters and SARSAT play an essential role in saving lives.

Credit: From Wikipedia Commons, Photo by Brandon Weeks

Earth image composed of data from MODIS, AVHRR, GTOPO 30, and Defense Meteorological Satellite Program. (Credit: NASA/NOAA/USGS/DoD.)

November 2012

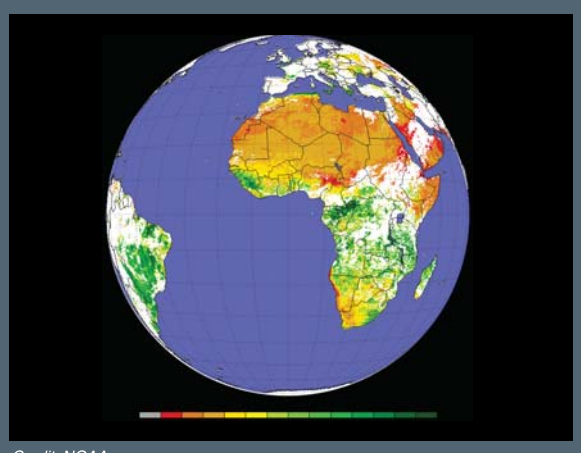
NEW MOON · FIRST QUARTER · FULL MOON · LAST QUARTER

SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
				1	2	3
4 Daylight Saving Time ends	5	6 Election Day	7	8	9	10
11	12 Veteran's Day observed	13	14	15	16	17
18	19	20	21	22 Thanksgiving Day	23	24
25	26	27	28	29	30 Atlantic hurricane season ends	

A world view

The GOES-R satellite will provide continuous imagery and atmospheric measurements of Earth's Western Hemisphere. It will be the primary tool for detecting and tracking hurricanes and severe weather and provide new and improved applications and products for fulfilling NOAA's missions with respect to water and weather, climate, commerce, and ecosystem.

The GOES-R Vegetation Index compares visible and near-infrared reflectances to assess the state of vegetation. Forecasters will be able to identify changes in vegetative activity and health, which will help in monitoring droughts and predicting fire weather. (This example of the GOES-R algorithm uses data from the Meteosat imager as a proxy for the ABI.)



Credit: NOAA

www.goes-r.gov

Aurora Borealis, Bear Lake, Alaska. (Credit: US Air Force, photo by Joshua Strang)

December 2012

NEW MOON · FIRST QUARTER · FULL MOON · LAST QUARTER

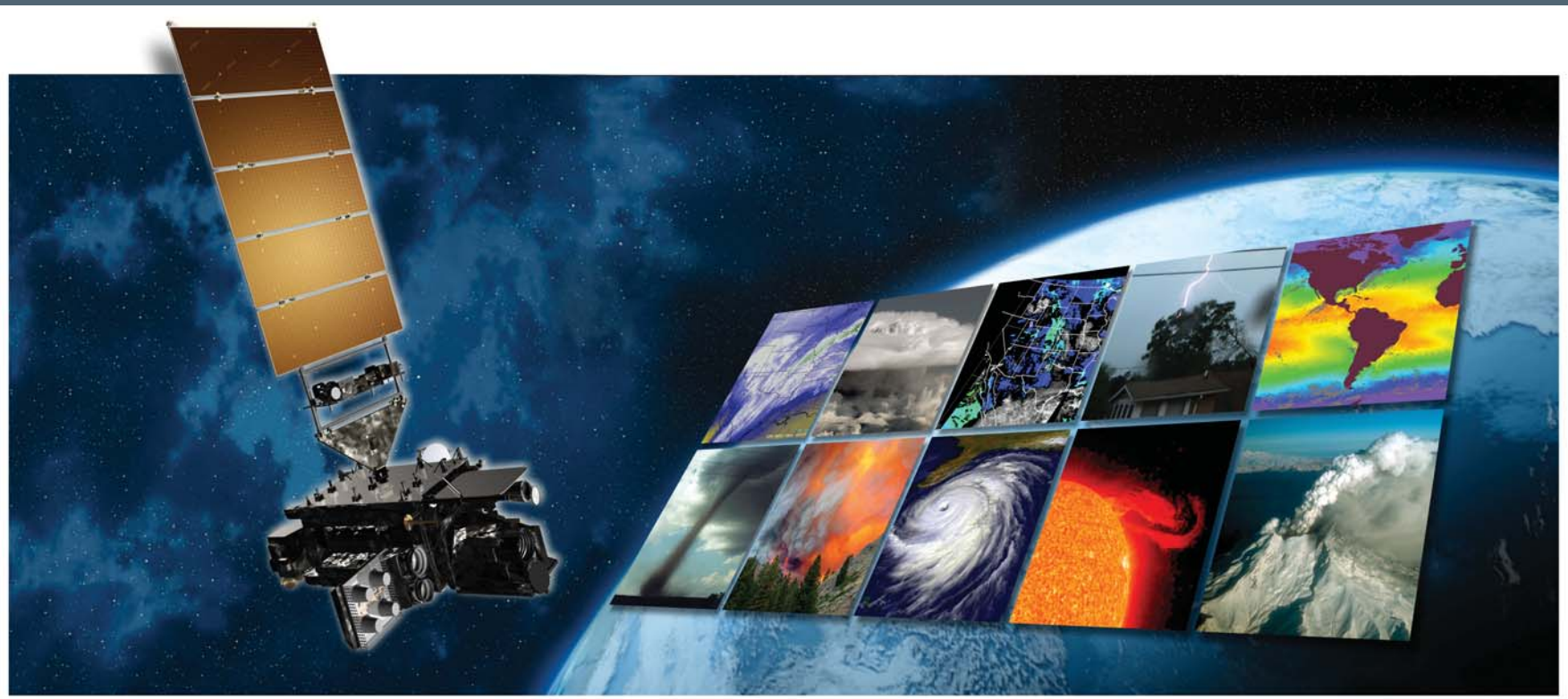
SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21 Winter Solstice	22
23 30	24 31	25 Christmas Day	26	27	28	29

Monitoring the magnetosphere

The Space Environment In-Situ Suite (SEISS) on GOES-R will monitor the proton, electron, and heavy ion fluxes in the magnetosphere at geosynchronous orbit (~22,300 miles above the equator). The information provided by the SEISS is critical for assessing the radiation hazard to astronauts and satellites. In addition to hazard assessment, the information from the SEISS can be used to warn of high flux events, mitigating any damage to radio communication. Data from SEISS will determine the solar radiation storm portion of NOAA's space weather scales that describe the severity of geomagnetic storms, solar radiation storms, and radio blackouts.

Astronauts working outside the International Space station are especially vulnerable to radiation from solar storms.

Credit: NASA



GOES-R will offer advanced imaging for more accurate forecasts, real-time mapping of lightning activity, and improved monitoring of solar activity. It will improve support for the detection and observation of meteorological phenomena that directly affect public safety, protection of property, and ultimately, economic health and development.

Each month of this 2012 calendar has more information about the capabilities and products of GOES-R.

NOAA manages the GOES-R Program with an integrated NOAA-NASA program office located at NASA's Goddard Space Flight Center and staffed with personnel from NOAA and NASA .

For more information, visit the GOES-R web site at http://www.goes-r.gov/

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