2013 Calendar

GOES-R

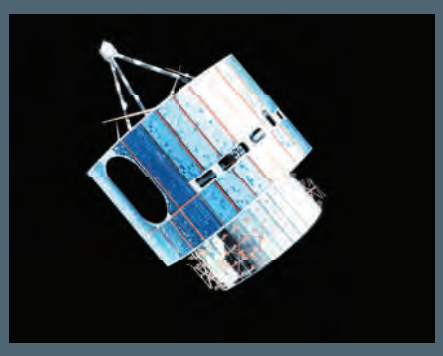
Geostationary Operational Environmental Satellite - R series

www.nasa.gov

www.noaa.gov

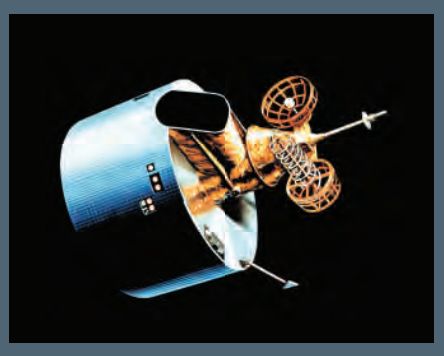
GOES environmental satellites

For almost 40 years, weather satellites stationed high above Earth's equator in geostationary orbit have been the workhorses providing nearly 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 series.



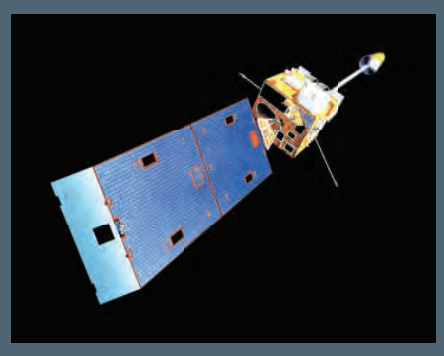
GOES A-C series

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.



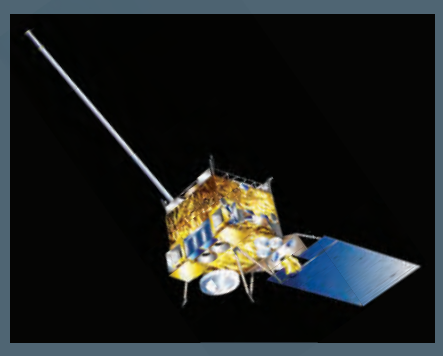
GOES D-H series

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.



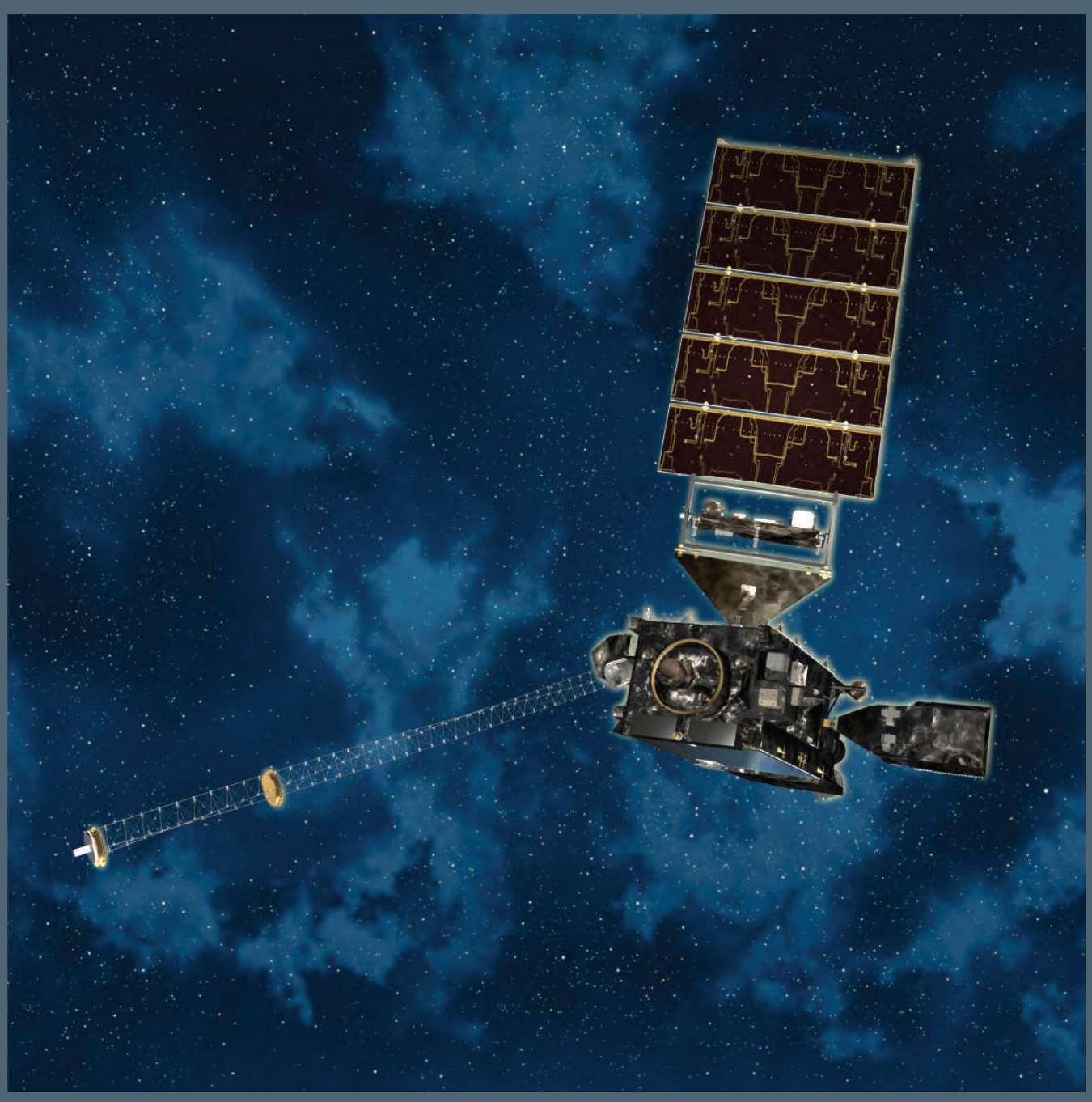
GOES I-M series

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 communities are not only looking for improvements in instrument capabilities, but are also seeking new products and applications, along with faster data dissemination techniques and reduced product lag time.

Snow-covered spruce trees in northern Finland. Photo by Muu-karhu.

January 2013

Moon phases are Universal Time (UT)

NEW MOON · FIRST QUARTER · FULL MOON · LAST QUARTER

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

DECEMBER

S	M	T	W	T	F	S
						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					

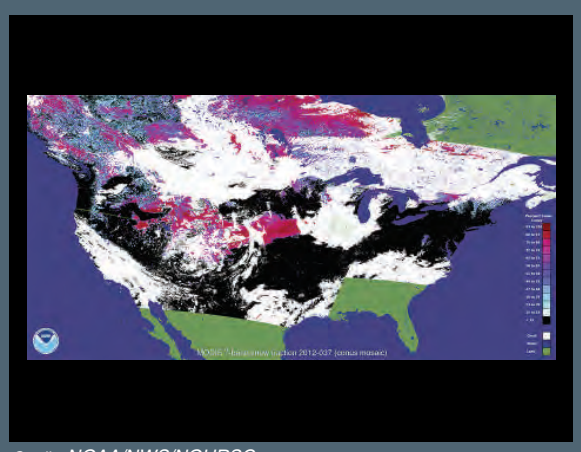
FEBRUARY

S	M	T	W	T	F	S
					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		

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, as well as 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/NWS/NOHRSC

Storm brewing over Bodie Historic State Park, California. Photo by Dave Toussaint.

February 2013

Moon phases are Universal Time (UT)

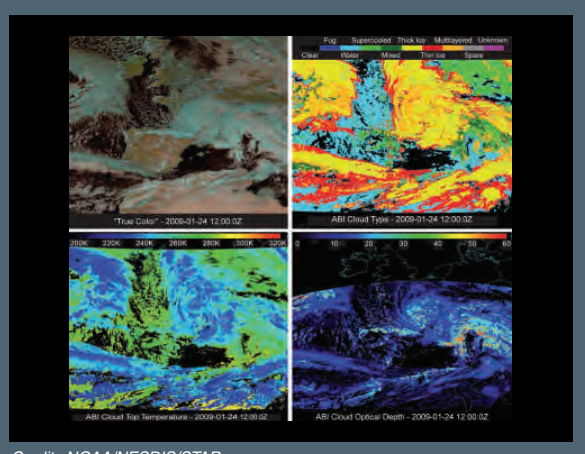
NEW MOON · FIRST QUARTER · FULL MOON · LAST QUARTER

SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
JANUARY S M T W T F S 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	MARCH S M T W T F S 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				1	2
◐ 3	4	5	6	7	8	9
○ 10	11	12	13	14 Valentine's Day	15	16
◑ 17	18 President's Day	19	20	21	22	23
24	● 25	26	27	28		

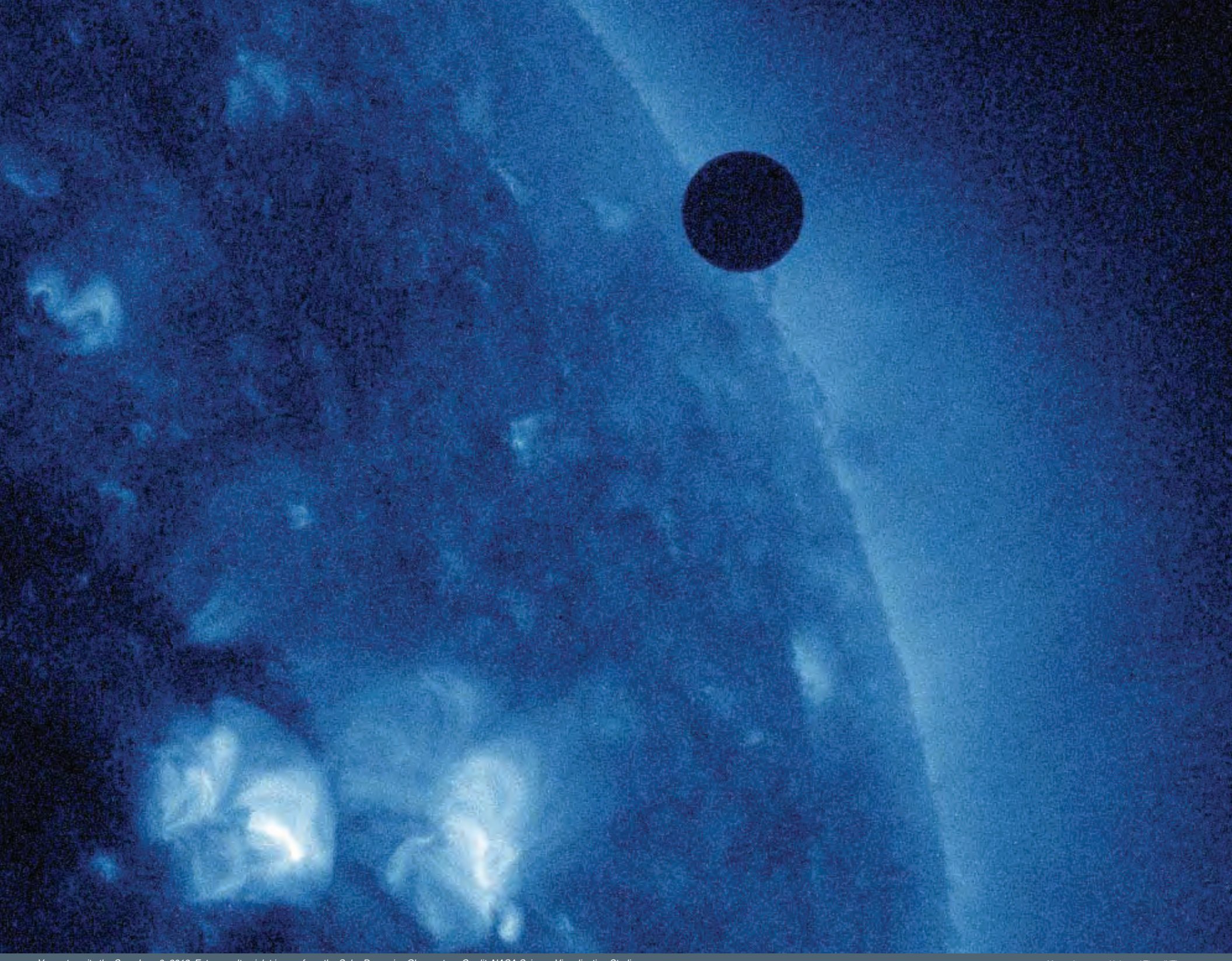
Understanding clouds

The **Cloud Top Height, Cloud Top Temperature**, and **Cloud Top Pressure** products indicate where the top of a cloud resides for a particular cloud-containing pixel. Cloud height information is used in weather prediction models and to forecast storm development. Cloud Top Height also contributes to aviation safety, enabling aircraft to be routed around towering thunderstorms and convective storm hazards.

GOES-R simulated cloud product images using data from SEVIRI (Spinning Enhanced Visible and Infrared Imager) for a severe storm over France on January, 24, 2009. Credit: NOAA/NESDIS/STAR.



Credit: NOAA/NESDIS/STAR



Venus transits the Sun, June 6, 2012. Extreme ultraviolet image from the Solar Dynamics Observatory. Credit: NASA Science Visualization Studio.

March 2013

Moon phases are Universal Time (UT)

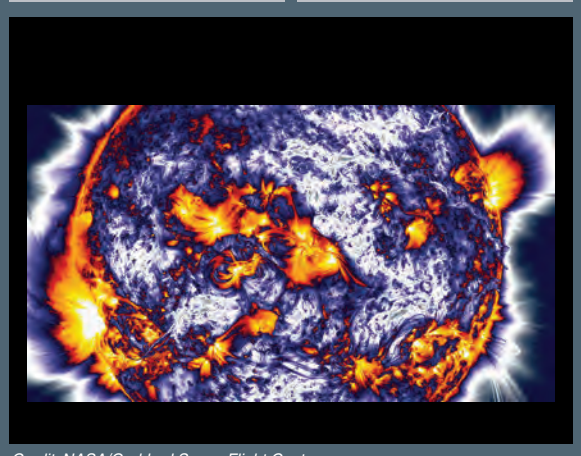
NEW MOON · FIRST QUARTER · FULL MOON · LAST QUARTER

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

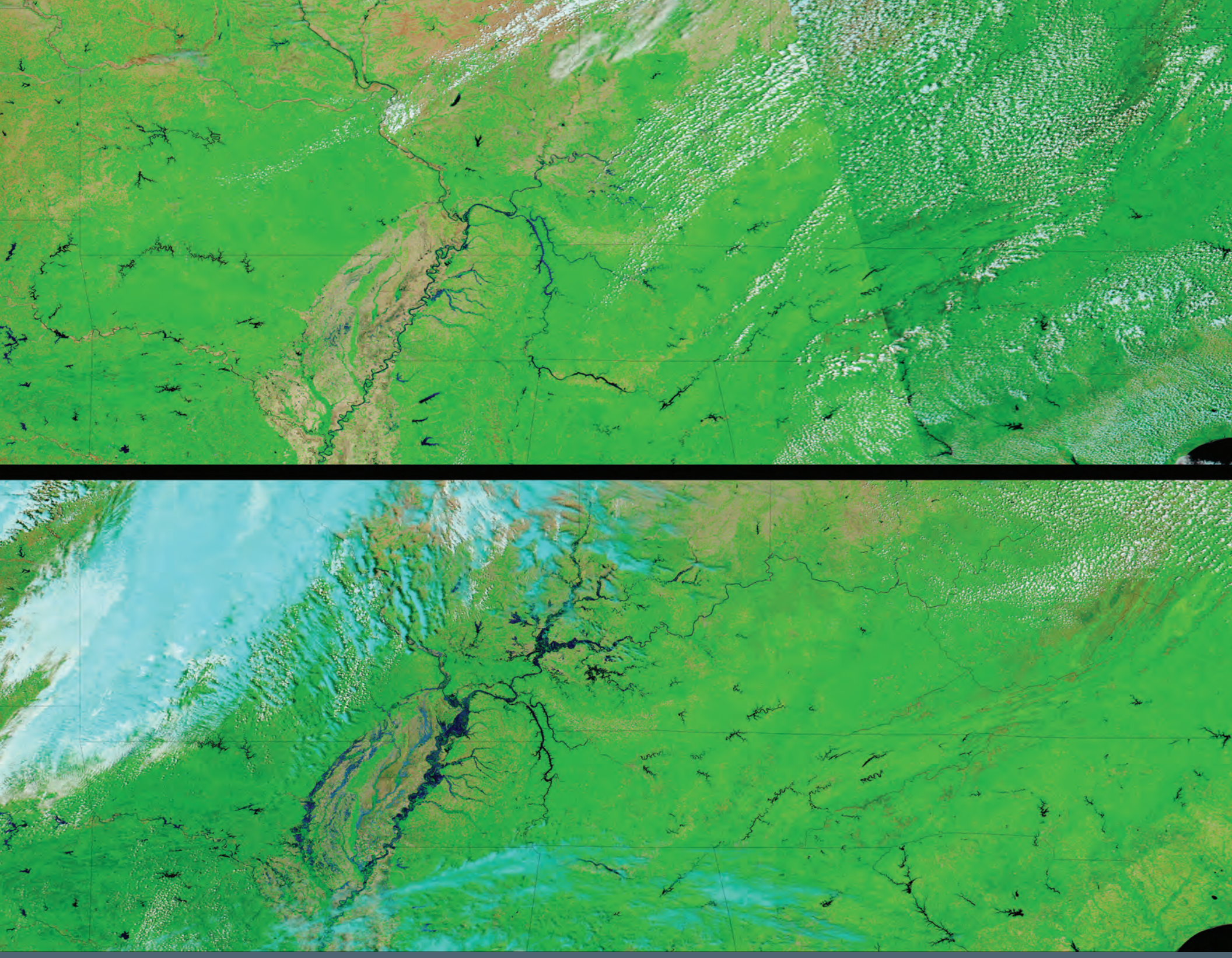
Forecasting space weather

The Solar Ultraviolet Imager (SUVI) on GOES-R 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. This one is from the Solar and Heliophysics Observatory Extreme Ultraviolet Imaging Telescope.



Credit: NASA/Goddard Space Flight Center



The Moderate Resolution Imaging Spectroradiometer (MODIS) on NASA's Aqua satellite imaged the Mississippi river near Memphis, Tennessee on May 6, 2010 (top) and May 6, 2011, after the river's water level had reached major flood stage. NASA images courtesy MODIS Rapid Response Team, Goddard Space Flight Center. Caption by Michon Scott.

April 2013

Moon phases are Universal Time (UT)

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 GOES-I launched, 1994
14	15	16	17	18	19	20
21	22 Earth Day	23	24	25 GOES-K launched, 1997	26	27
28 GOES-F launched, 1983 GOES-H launched, 1987	29	30				

MARCH

S	M	T	W	T	F	S
					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						

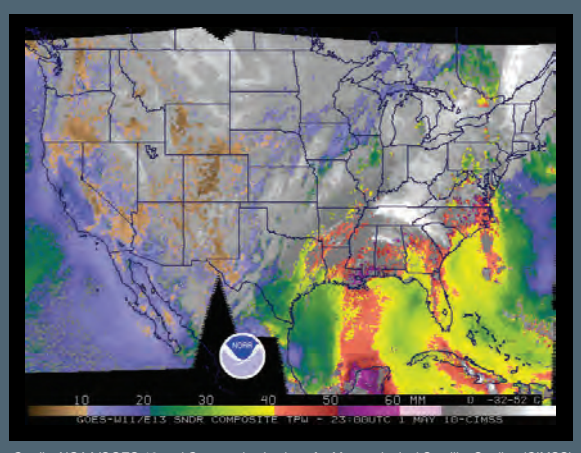
MAY

S	M	T	W	T	F	S
			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	

Predicting heavy rain and flooding

Total Precipitable Water is the amount of liquid water in a column of atmosphere from the surface to the top of the atmosphere. It is derived from atmospheric moisture profiles. Visualization of this product can reveal "atmospheric rivers." These are long, narrow filaments of moisture that can persist in the atmosphere for several days and can transport as much water as the Amazon River.

The Total Precipitable Water 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.



Credit: NOAA/GOES-13 and Cooperative Institute for Meteorological Satellite Studies (CIMSS).

Recently formed tornado near Bowdle, South Dakota, May 22, 2010. Photo shot by Paul Samaras during operations with the TWISTEX (Tactical Weather Instrumented Sampling in/near Tornadoes Experiment) research team.

May 2013

Moon phases are Universal Time (UT)

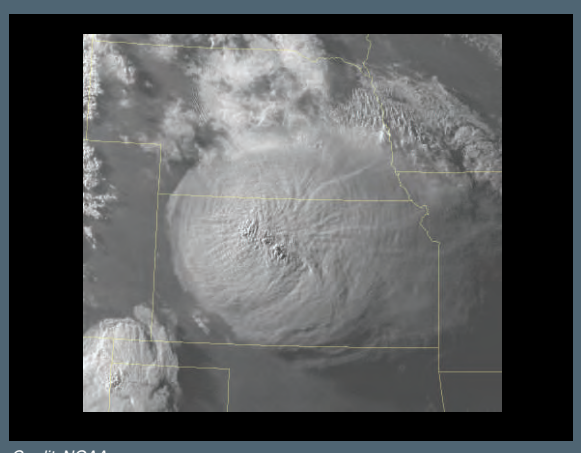
NEW MOON · FIRST QUARTER · FULL MOON · LAST QUARTER

SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
APRIL S M T W T F S 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	JUNE S M T W T F S 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		1	2	3 GOES-L launched, 2000 GOES-G launched, 1986	4
5	6	7	8	9	10	11
12 Mother's Day	13	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 Memorial Day	28	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.

Satellite image of a supercell with overshooting cloud tops that mean severe weather is imminent. These clouds over Kansas portended a rash of severe, destructive tornadoes January 22 and 23, 2012. Credit: NOAA/NWS



Credit: NOAA

The very active Rabaul (Tavurvur) volcano in Papua New Guinea. Image by Taro Taylor.

June 2013

Moon phases are Universal Time (UT)

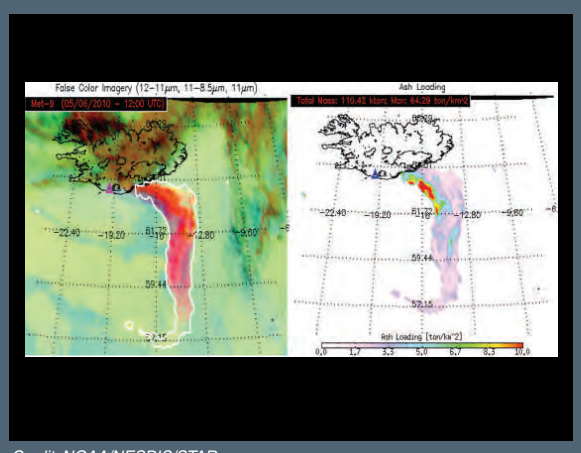
NEW MOON · FIRST QUARTER · FULL MOON · LAST QUARTER

SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
MAY S M T W T F S 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	JULY S M T W T F S 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					1 Atlantic hurricane season begins
2	3	4	5	6	7	8
9	10	11	12	13	14	15
Father's Day 16 GOES-B launched, 1977 GOES-C launched, 1978	17	18	19	20	21 Summer Solstice	22
23 30	24	25	26	27 GOES-O launched, 2009	28	29

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.

Ash Detection product (left), as indicated by white contour overlaid on false color Meteosat-9/SEVIRI (Spinning Enhanced Visible and Infrared Imager) image. The associated ash loading retrievals are also shown (right).



Credit: NOAA/NESDIS/STAR

Thunderstorm just after sunset, Bennett, Colorado , August 22, 2011. Photo by Paul Samaras.

July 2013

Moon phases are Universal Time (UT)

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			

JUNE

S	M	T	W	T	F	S
						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						

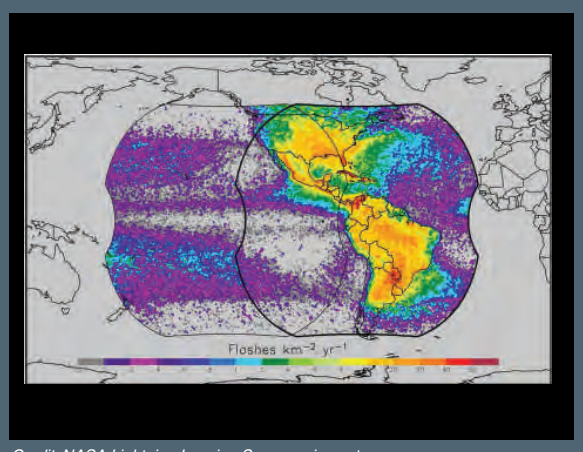
AUGUST

S	M	T	W	T	F	S
				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

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: NASA Lightning Imaging Sensor science team.

Hurricane Isaac, August 23, 2012. NASA image by Jeff Schmaltz, LANCE/EOSDIS Rapid Response.

August 2013

Moon phases are Universal Time (UT)

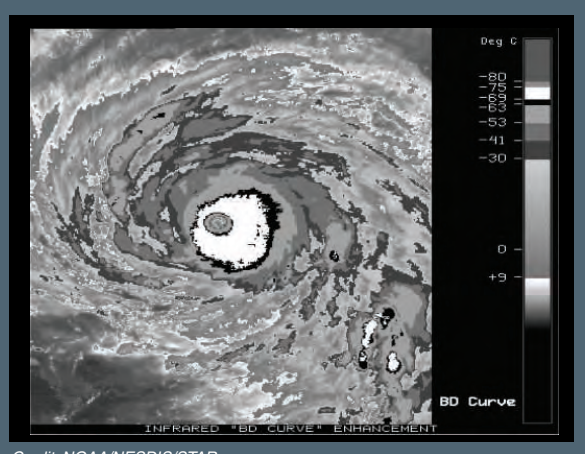
NEW MOON · FIRST QUARTER · FULL MOON · LAST QUARTER

SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
JULY S M T W T F S 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	SEPTEMBER S M T W T F S 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			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/NESDIS/STAR

Sea turtle in Hawaiian reef. Image by Brocken Inaglory.

September 2013

Moon phases are Universal Time (UT)

NEW MOON · FIRST QUARTER · FULL MOON · LAST QUARTER

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

AUGUST

S	M	T	W	T	F	S
				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

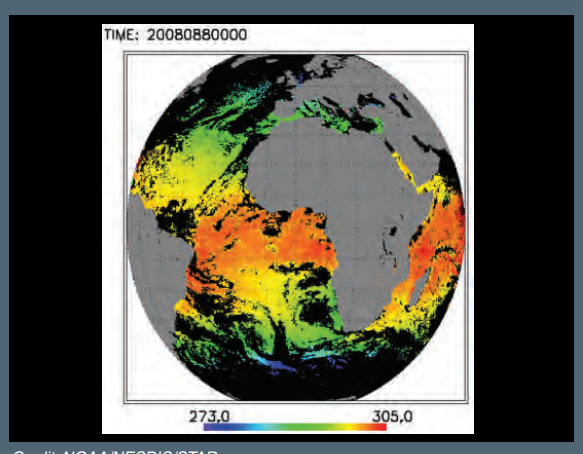
OCTOBER

S	M	T	W	T	F	S
		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		

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 (Spinning Enhanced Visible and Infrared Imager)data.



Credit: NOAA/NESDIS/STAR

Coast Guard rescue operation on the Alaskan coast. Credit: US Coast Guard

October 2013

Moon phases are Universal Time (UT)

NEW MOON · FIRST QUARTER · FULL MOON · LAST QUARTER

SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
SEPTEMBER S M T W T F S 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	NOVEMBER S M T W T F S 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	1	2	3	4	○ 5
6	7	8	9	10	◑ 11	12
13	14 Columbus Day	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.

Different types of emergency alert beacon transmitters are available for individuals, aircraft, and marine vessels.

Credit: Wikimedia Commons, photo by Brandon Weeks

Crooked Creek channel entering Wood River Marsh in southern Oregon. Credit: Natural Resources Conservation Service; United States Department of Agriculture.

November 2013

Moon phases are Universal Time (UT)

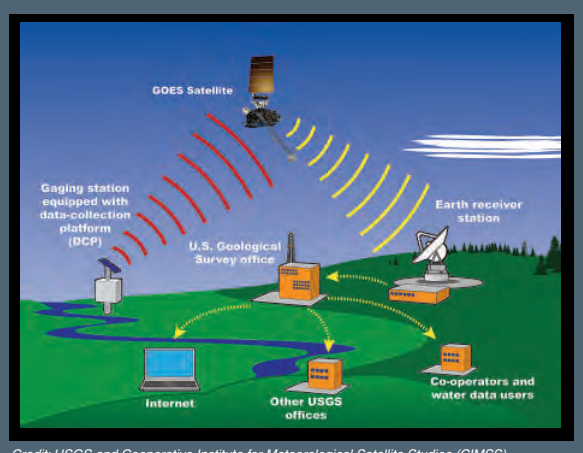
NEW MOON · FIRST QUARTER · FULL MOON · LAST QUARTER

SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
OCTOBER S M T W T F S 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	DECEMBER S M T W T F S 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				1	2
○ 3 Daylight Saving Time ends	4	5 Election Day	6	7	8	9
◑ 10	11 Veteran's Day observed	12	13	14	15	16
● 17	18	19	20	21	22	23
24	◑ 25	26	27	28 Thanksgiving Day	29	30 Atlantic hurricane season ends

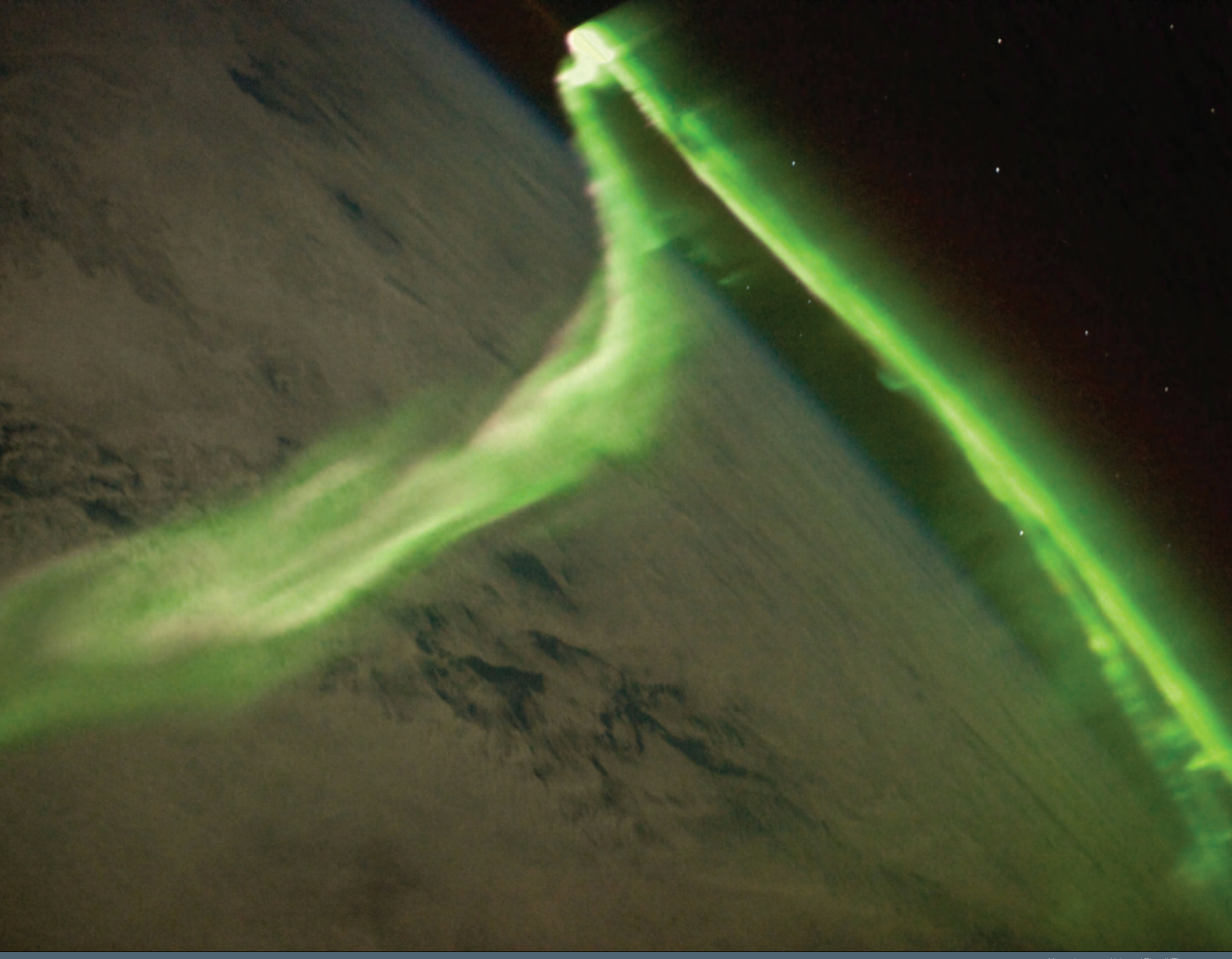
Data Collection System

The Data Collection System is a satellite relay system used to collect information from Earth-based data collection platforms that transmit in-situ environmental sensor data, such as stream or river flow, tide-levels, weather conditions, etc. The transmissions can occur on predefined frequencies and schedules, in response to thresholds in sensed conditions, or in response to interrogation signals. The transponder on board the GOES satellite detects this signal and then rebroadcasts it so that it can be picked up by other ground-based equipment. Federal, state and local agencies then monitor the environment through the transmission of observations from these surface-based data collection platforms. The platforms can be placed in remote locations and left to operate with minimal human intervention. The Data Collection System thus allows for more frequent and more geographically complete environmental monitoring. Enhancements to the DCS program during the GOES-R era include expansion in the total number of user-platform channels from 266 to 433.

Example of USGS use of the Data Collection System. .



Credit: USGS and Cooperative Institute for Meteorological Satellite Studies (CIMSS).



Aurora Australis as observed from the International Space Station, May 29, 2010. Credit: NASA ISS Expedition 23 crew.

December 2013

Moon phases are Universal Time (UT)

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	24	25 Christmas Day	26	27	28
29	30	31				

NOVEMBER

S	M	T	W	T	F	S
					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

JANUARY

S	M	T	W	T	F	S
			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	

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 2013 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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