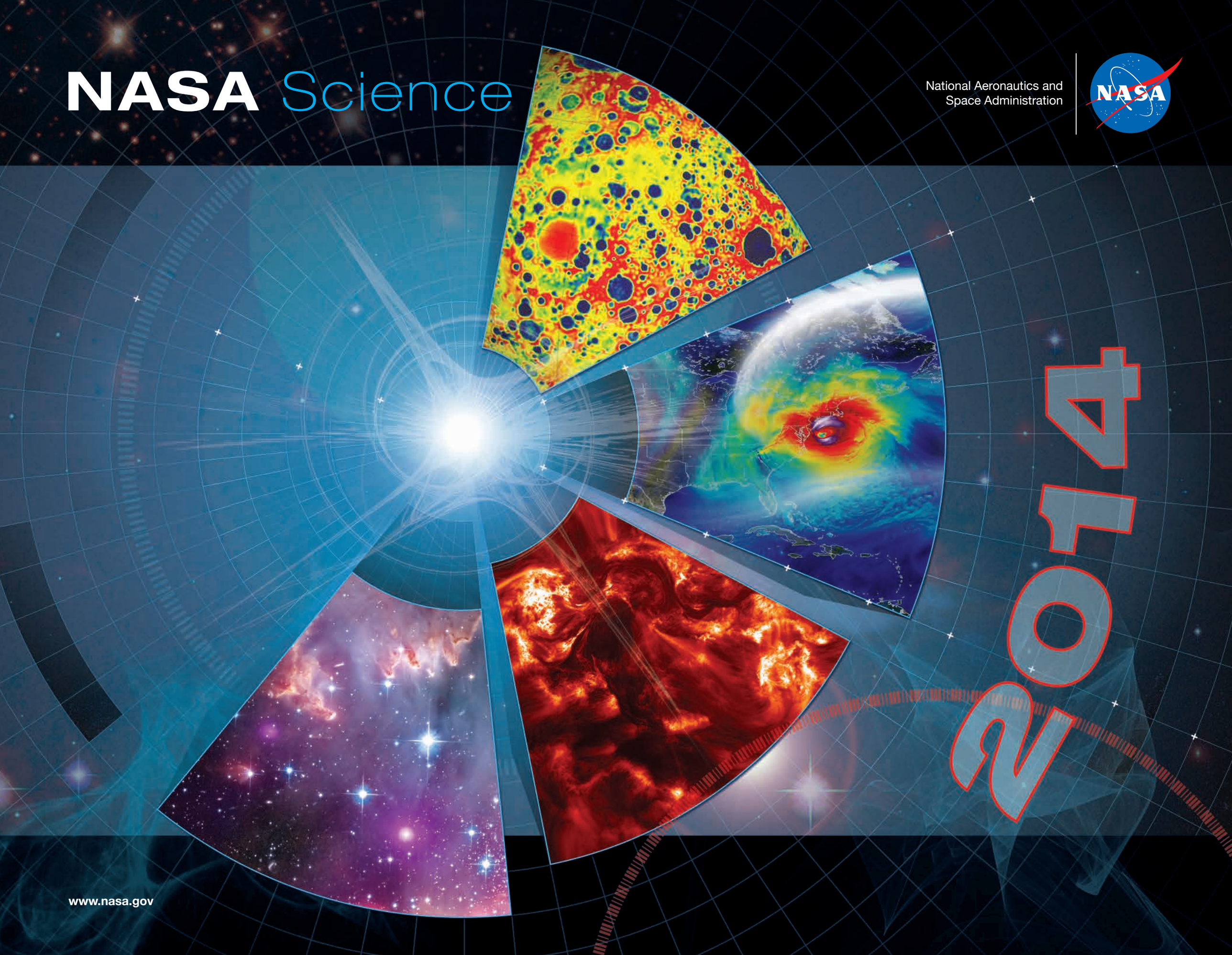
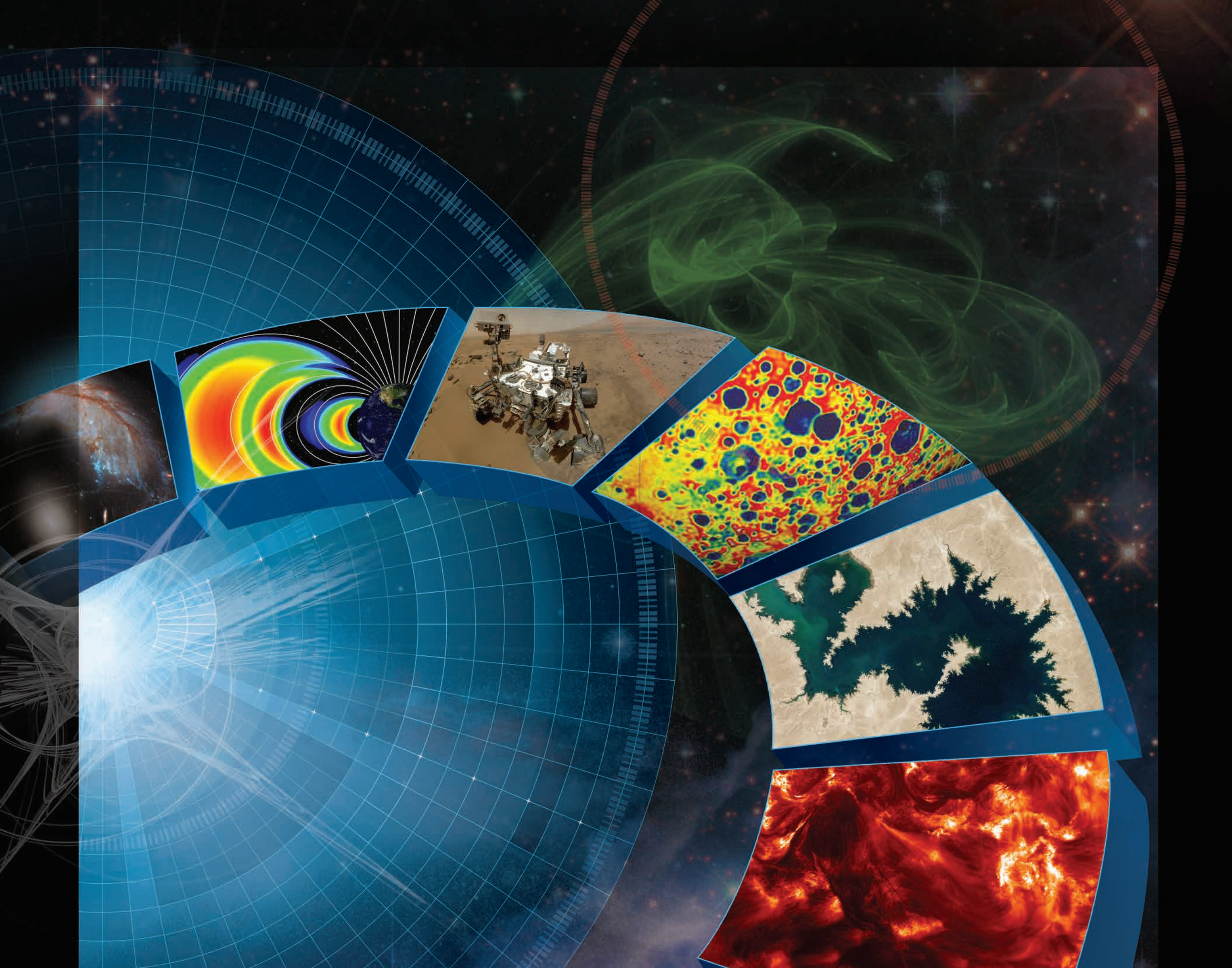
NASA Science

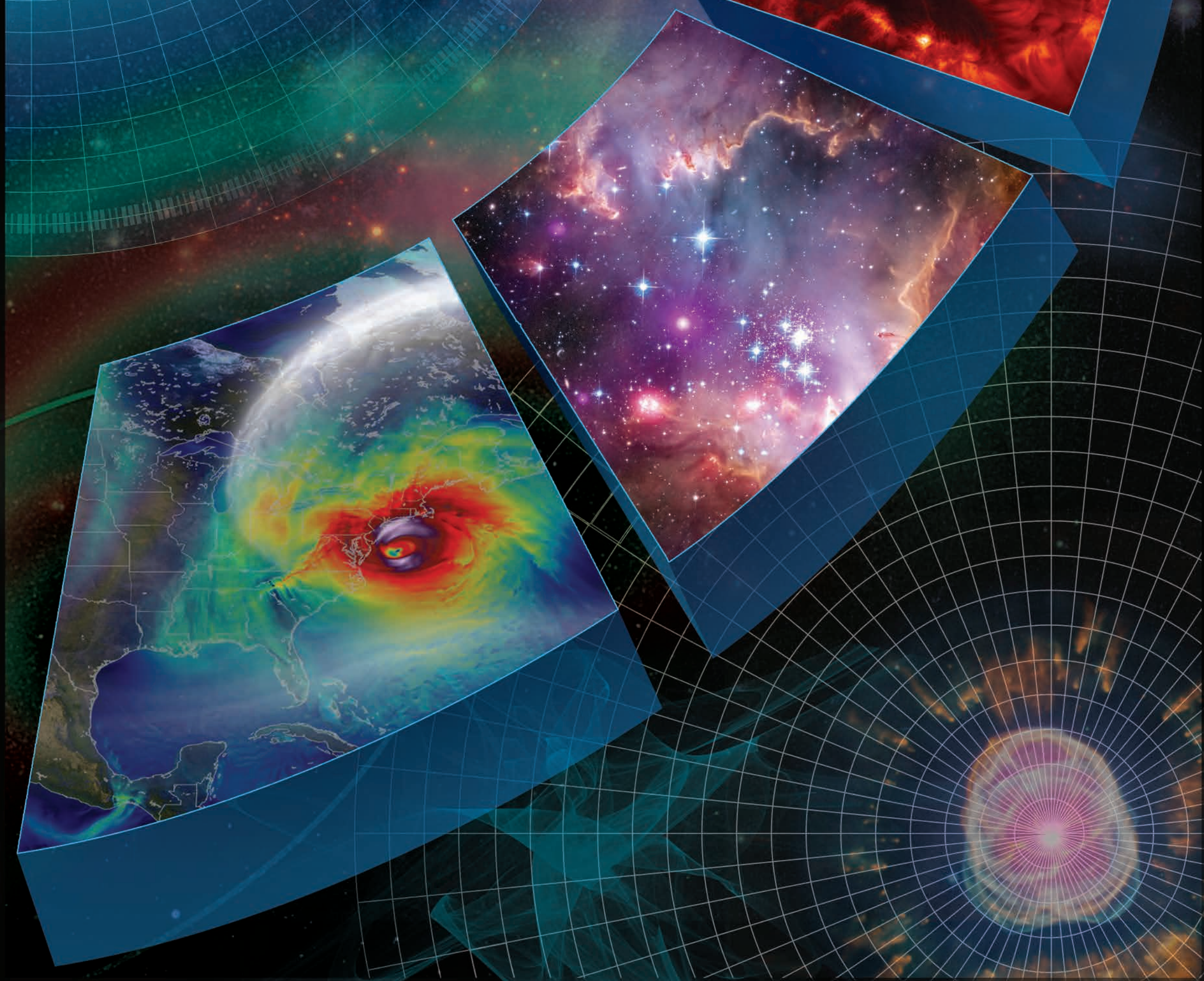
National Aeronautics and Space Administration



2014

www.nasa.gov





JANUARY 2014

New Moon · First Quarter · Full Moon · Last Quarter

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
			1 New Year's Day	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20 Birthday of Martin Luther King, Jr.	21	22	23	24	25
26	27	28	29	30	31	

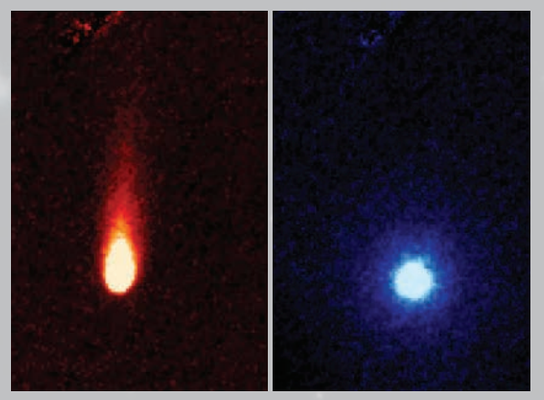
Comet ISON's Dance Among the Stars

There is a "new" comet in our neighborhood. Discovered in September 2012 by two Russian scientists, it has officially been designated as C2012/S1, but the world has come to know it as comet ISON—an acronym for the Russian *International Science Observation Network* through which it was discovered. Here, the comet looks like a bright white smudge [*top right*] among other colorful distant stars and galaxies on a canvas that depicts interstellar space.

NASA's Hubble Space Telescope observed ISON on April 30, 2013, as it passed near the orbit of Jupiter. The resulting image, shown here, combines observations from two Hubble filters and is a simulation of what our eyes, with their ability to dynamically adjust to brighter and fainter objects, would see if we could look up at the heavens with the resolution of Hubble. One filter lets in red light, represented as faint red shades, while the other filter lets in a greenish-yellow light, represented as faint blue shades. In general, faint red objects are older and more evolved than blue objects—this is true both for the crosshair-spiked stars and the smaller and dimmer smudges of distant galaxies.

This newly discovered comet is believed to have originated in the *Oort Cloud*—a "source region" for many comets, located on the fringe of the solar system. Scientists believe that ISON is making its very first trek toward the sun, and its first known visit will be an extremely close encounter—making the potential for new discovery very high.

Image and partial text credit: NASA/European Space Agency/Space Telescope Science Institute/Association of Universities for Research in Astronomy



These views of ISON were taken by the Spitzer Space Telescope on June 13, 2013, at two infrared wavelengths. The left shows a dusty tail, and the right an atmosphere of carbon dioxide. Image credit: NASA/Spitzer

DECEMBER 2013

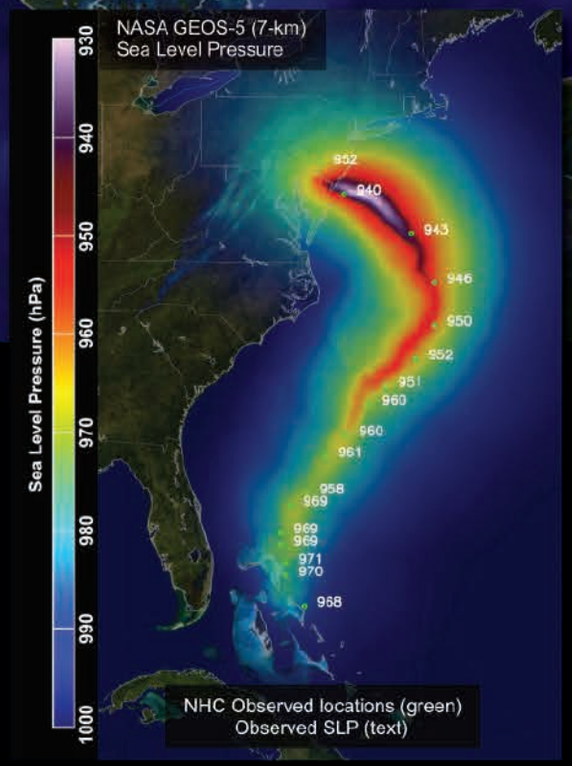
S	M	T	W	T	F	S
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31				

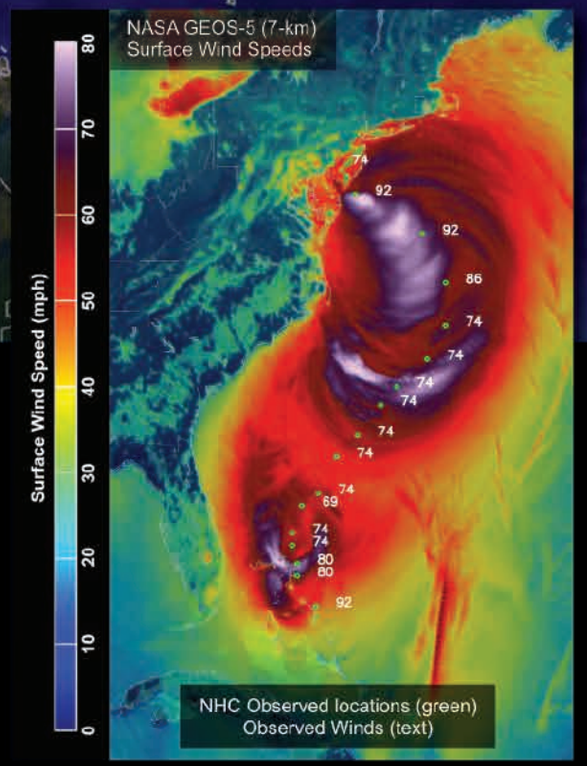
FEBRUARY 2014

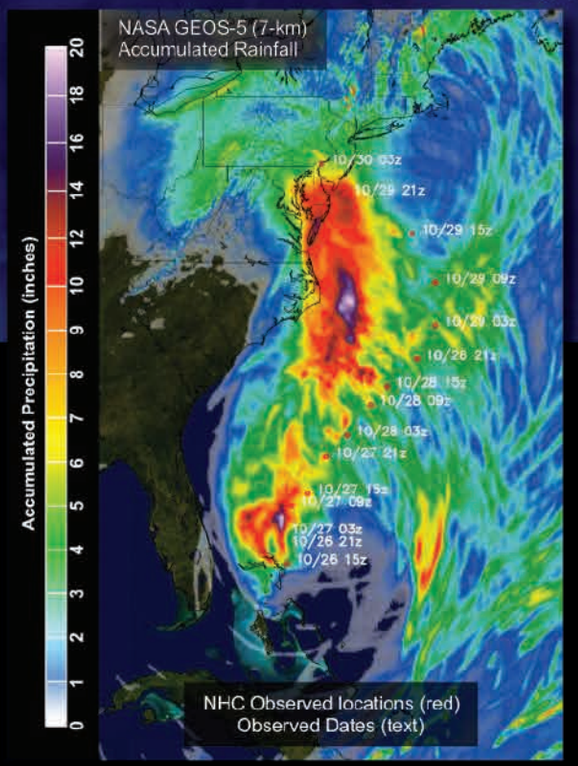
S	M	T	W	T	F	S
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	

Surface Wind Speed (mph)

0 10 20 30 40 50 60 70 80







FEBRUARY 2014

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 Washington's Birthday (observed date)	18	19	20	21	22
23	24	25	26	27	28	

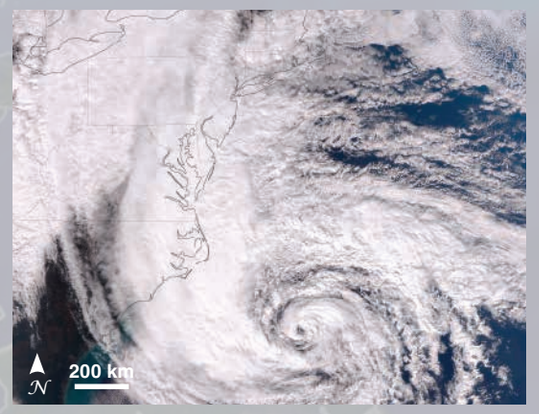
Analyzing Superstorm Sandy

A rare convergence of environmental conditions during Hurricane Sandy's lifecycle led to a storm of unforgettable destruction—hence its nickname, *Superstorm Sandy*. Scientists can analyze the structure and lifecycle of severe storms like Sandy using weather prediction models and incorporate what they learn into newer models, which hopefully result in even more accurate hurricane forecasts in the future.

Scientists at NASA used the Goddard Earth Observing System Model, *Version 5* (GEOS-5) to simulate surface wind speeds across the Atlantic during Sandy's lifecycle. The large image above shows surface wind speeds on October 29, 2012, as simulated by the GEOS-5 at 7-kilometer (~4.3-mile) resolution just before the storm made landfall near Atlantic City, New Jersey. Wind speeds range from approximately 10 miles per hour (15 kilometers per hour), shown as dark blue, to 80 miles per hour (130 kilometers per hour), shown as very light purple. In the days following landfall, the remnants of Sandy moved inland over Northern New England and Canada before finally dissipating.

The three smaller images show how GEOS-5 simulations of sea level pressure [*left*], surface wind speeds [*center*], and accumulated rainfall amounts [*right*] from October 26, 2012 to October 31, 2012, compare to observations from the National Oceanic and Atmospheric Administration's National Hurricane Center.

Image and partial text credit: NASA's Scientific Visualization Studio



The Suomi National Polar-orbiting Partnership satellite acquired this natural-color image of Sandy at 1:50 PM Eastern Daylight Time (17:50 Universal Time) on October 28, 2012. Image credit: NASA's Earth Observatory

JANUARY 2014

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 2014

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						1
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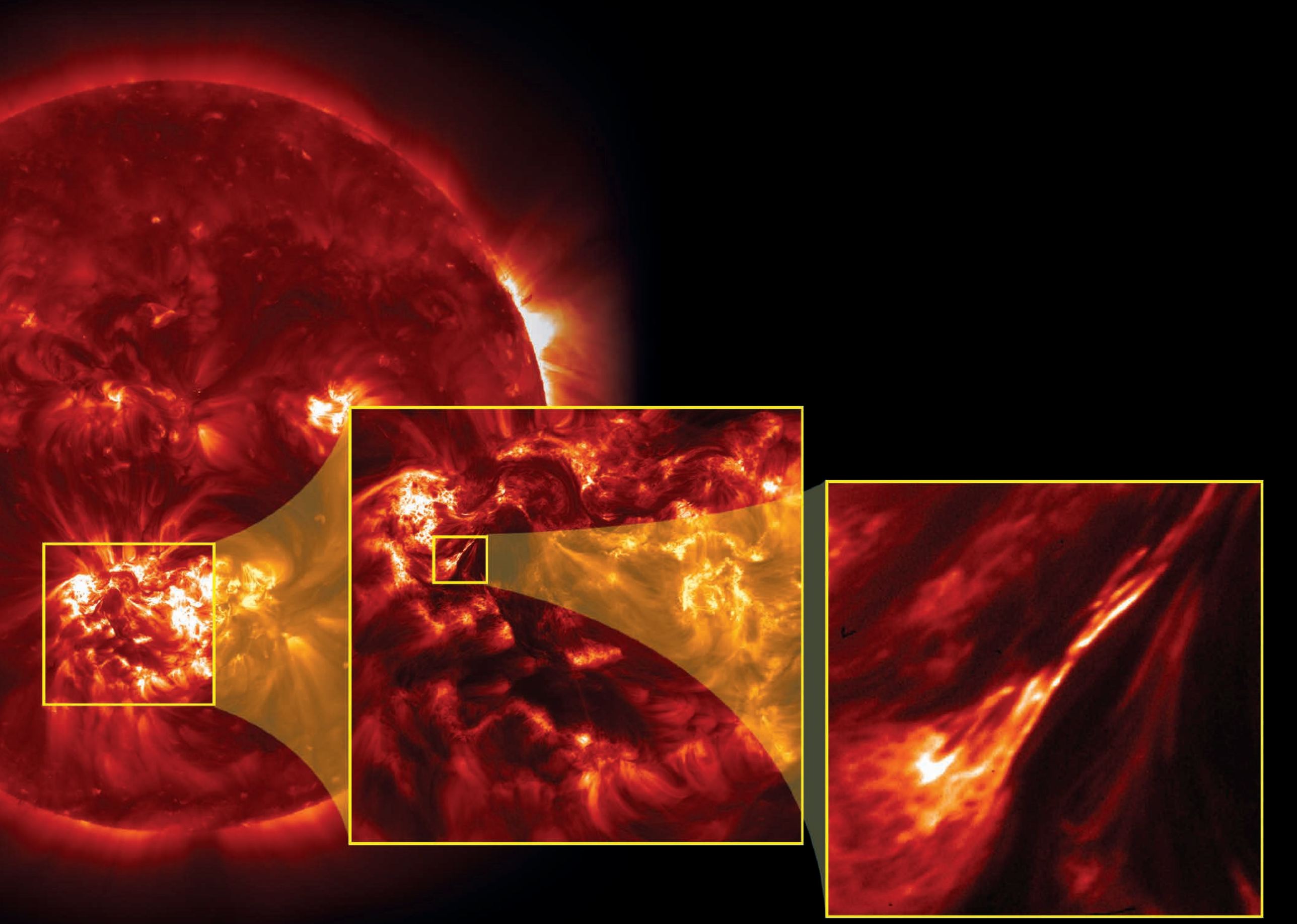
16	17	18	19	20	21	22
23/30	24/31	25	26	27	28	29



MARCH 2014

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
Daylight Saving Time Begins						
16	17	18	19	20	21	22
23 30	24 31	25	26	27	28	29

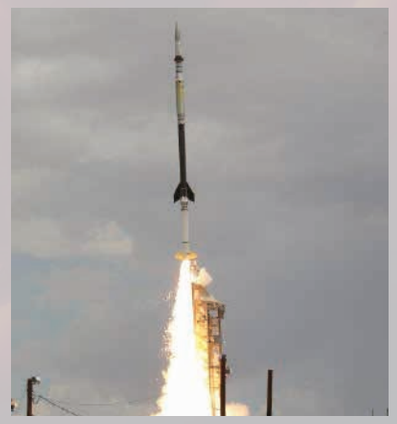
Sharpest-Ever Images of the Sun's Corona

In July 2012 NASA's High Resolution Coronal Imager, or Hi-C, telescope launched on a sounding rocket and captured the highest-resolution images ever taken of the sun's million-degree atmosphere, or *corona*. The square area outlined in yellow in the full disk image of the sun [*left*], taken by the Atmospheric Imaging Array (AIA) on NASA's Solar Dynamics Observatory (SDO), represents the Hi-C field-of-view.

The Hi-C telescope captured five minutes of data of the solar corona at about five times finer resolution than SDO's AIA. Within the Hi-C field-of-view [*center*], scientists identified several examples of *coronal braiding*—structures that appear to be wrapped and woven together. Zoomed in [*right*], these braided structures appear to be several strands, or *magnetic field lines*, tangled together, illuminated by hot plasma. This particular braided structure released energy in a small solar flare, shortly after the Hi-C flight.

For decades scientists have sought to understand why the corona is 50 to 100 times hotter than the surface of the sun. Images like these, taken by Hi-C, hint that these braided structures release magnetic energy that likely contributes to the intense heating of the solar corona.

Image and text credit: NASA



Hi-C was launched on a NASA Black Brant IX two-stage rocket from White Sands Missile Range in New Mexico on July 11, 2012. Image credit: NASA

FEBRUARY 2014

S	M	T	W	T	F	S
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23	24	25	26	27	28	

APRIL 2014

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13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30			

APRIL 2014

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			

Peering Under the "Wing" of the Small Magellanic Cloud

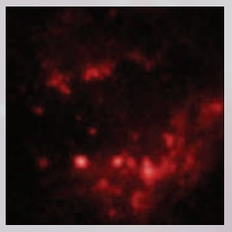
The Small Magellanic Cloud (SMC) is one of the Milky Way's closest galactic neighbors. Even though it is a small, or so-called dwarf galaxy, the SMC is so bright that it is visible to the unaided eye from the Southern Hemisphere and near the equator. Many navigators, including Ferdinand Magellan who lends his name to the SMC, used it to help find their way across the oceans.

NASA's Chandra X-ray telescope has made the first detection of X-ray emission from young *solar-type stars*—stars with characteristics broadly similar to those of our sun—that lie outside our Milky Way galaxy. These stars live in a region known as the "Wing" of the SMC. This image of the Wing is a composite that combines data from three sources into one (see images at right). X-ray data from Chandra are shown in purple; optical (i.e., visible) light seen by the Hubble Space Telescope is in red, green, and blue; and infrared data from the Spitzer Space Telescope are colored red. X-rays from young stars trace the activity and strength of stellar magnetic fields. Magnetic activity provides clues to a star's convection (the rising and falling of hot gas in the star's interior) and rotation rates. The combined X-ray, optical, and infrared data also reveal, for the first time outside our galaxy, objects that resemble very young, low-mass stars, which scientists call "young stellar objects." These objects have ages of a few thousand years and are still embedded in the pillar of dust and gas from which stars form.

Image and partial text credit: NASA/European Space Agency/Chandra X-ray Observatory/University of Potsdam/Jet Propulsion Laboratory-Caltech/Space Telescope Science Institute

Chandra X-ray Data

Hubble Optical Data



Spitzer Infrared Data

Combined X-ray, Optical, and Infrared

MARCH 2014

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
23/30	24/31	25	26	27	28	29

MAY 2014

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 2014

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 Mother's Day	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26 Memorial Day	27	28	29	30	31

Colliding Galaxies

This NASA Hubble Space Telescope image illustrates that close encounters between galaxies are messy business. This interacting galaxy duo contains the disturbed, star-forming spiral galaxy NGC 2936—which looks like the profile of a celestial bird—along with its elliptical companion, NGC 2937 at lower left. Once a normal, flat, spiral-disk galaxy, NGC 2936's appearance and the orbits of its stars have become scrambled due to gravitational tidal interactions with NGC 2937. The interactions have warped and distorted NGC 2936's spiral shape and interstellar gas has been strewn out into giant tails that look like stretched taffy.

Collectively, these two galaxies are called Arp 142—so named because astronomer Halton C. Arp was the first to observe them in the 1960s. Arp 142 lies 326 million light-years away in the southern constellation Hydra and is a member of the Arp catalog of peculiar galaxies. The image is a composite of photos from the Wide Field Camera 3 taken in blue-green, yellow-red, and near-infrared light.

Image and partial text credit: NASA/European Space Agency/Hubble Heritage Team/Space Telescope Science Institute/Association of Universities for Research in Astronomy

This photo of Hubble was taken from the Space Shuttle *Atlantis* on May 19, 2009, following Servicing Mission 4. Servicing missions have ensured Hubble's health and productivity into the twenty-first century. Image credit: NASA

APRIL 2014

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 2014

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					

Salton Sea

El Centro

Mexicali

10 km

N

Salton Sea

El Centro

Mexicali

Approximate Temperature (°C)

25 30 40 50

JUNE 2014

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 Flag Day
15 Father's Day	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30					

Landsat Data Help Water-Resource Managers

In the Western United States between 80 and 90% of freshwater is used for agriculture. In Southern California irrigated farmland stretches southward across the desert from the Salton Sea—an artificial inland sea—to the Mexico border. In the natural-color image [*left*] acquired on May 15, 2013, by Landsat 8's Operational Land Imager, blocks of square farmland appear in shades of green and tan, while urban areas such as El Centro, California and Mexicali, Mexico appear in shades of gray. Accurate estimates of total crop area provided by Landsat satellites can be used to help forecast commodities in the United States and the world food market.

On that same day, thermal measurements from Landsat 8's Thermal Infrared Sensor [*right*] show different temperatures between crop fields as well as urban and desert areas. Cooler areas (e.g., irrigated crops) appear as dark purple and red shades, while warmer areas (e.g., urban and desert areas) appear as shades of bright yellow and white. Plants cool down when they transpire, so the combination of water evaporating from the plants and the ground (i.e., evapotranspiration) lowers the temperature of the irrigated land. Pixels representing cooler areas in thermal images from TIRS help water-resource managers determine where water is being used for irrigation, allowing them to make management decisions on water distribution to preserve this scarce resource. When an earlier design of Landsat 8 did not include a thermal infrared band, the Western States Water Council advocated for its inclusion. The TIRS on Landsat 8 carries two thermal bands that continue and improve upon the thermal infrared observations collected by a single thermal band on previous Landsat satellites.

Image and partial text credit: NASA's Earth Observatory

MAY 2014

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 2014

S	M	T	W	T	F	S
		1	2	3	4	5
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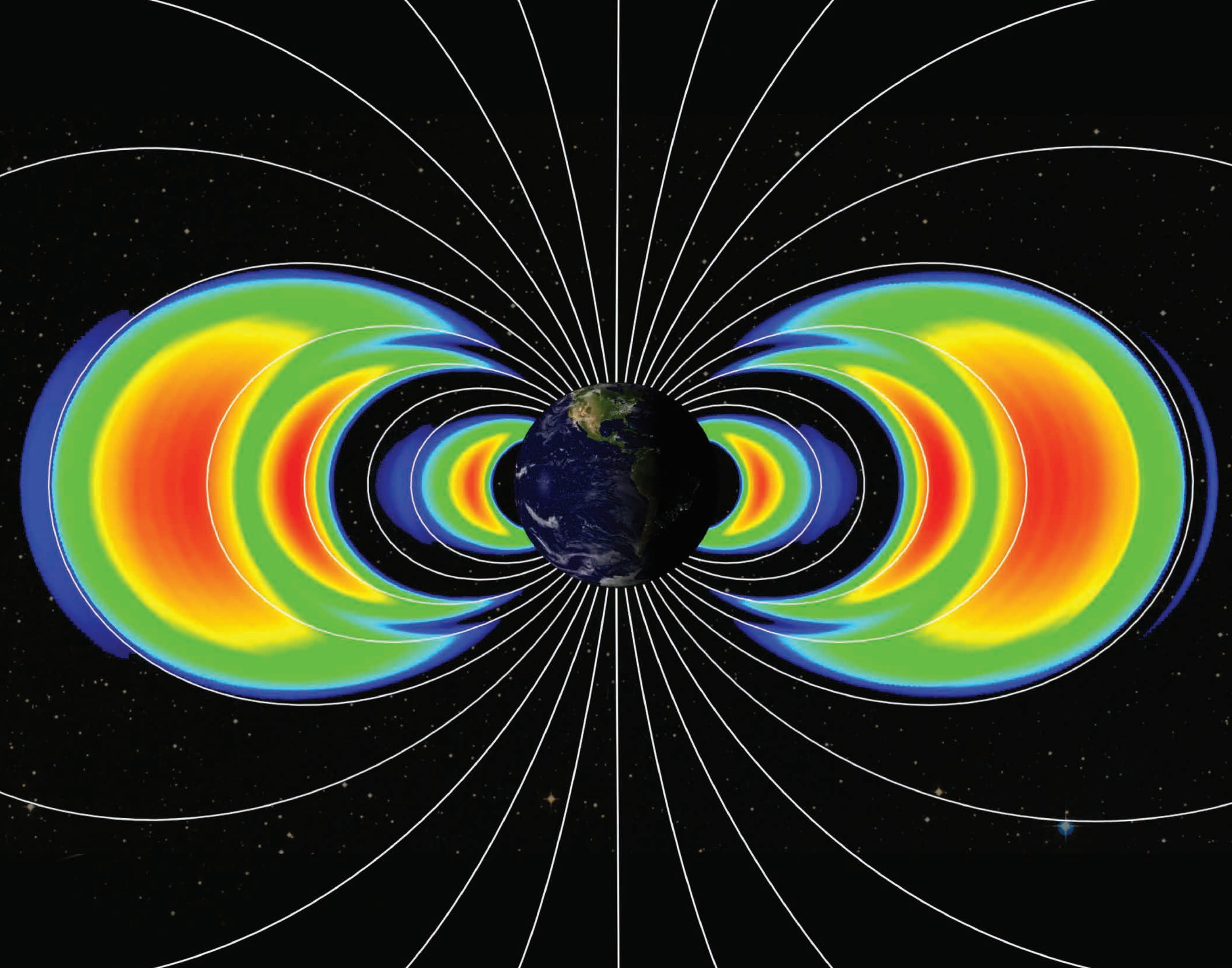
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31		



JULY 2014

New Moon · First Quarter · Full Moon · Last Quarter

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
		1	2	3	4 Independence Day	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		

Van Allen Probes Discover New Radiation Belt Around Earth

Shortly after launch on August 30, 2012, particle detection instruments aboard NASA's twin Van Allen Probes revealed to scientists the existence of a new, transient, third radiation belt around Earth. In this image, three distinct radiation belts are represented as orange and red shades with the emergence of a second empty slot region [green], in between the second and new, outermost third belt.

Named after their discoverer James Van Allen, these belts are critical regions for modern society, which is dependent on many space-based technologies. The Van Allen belts are affected by space weather and can swell dramatically during solar storms. When this occurs, they can pose dangers to communications and global positioning system (GPS) satellites, as well as humans in space.

This discovery shows the dynamic and variable nature of the radiation belts and improves our understanding of how they respond to solar activity. Scientists observed the third belt for four weeks before a powerful interplanetary shock wave from the sun annihilated it. Data from the Van Allen Probes are important for the study of the effect of space weather on Earth, as well as the fundamental physical processes observed around other objects, such as planets in our solar system and distant nebulae.

Image and partial text credit: NASA/John's Hopkins University, Applied Physics Laboratory

This graphic depicts the twin Van Allen Probes in orbit within Earth's magnetic field. Image credit: John's Hopkins University, Applied Physics Laboratory

JUNE 2014

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 2014

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
24/31	25	26	27	28	29	30

AUGUST 2014

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 31	25	26	27	28	29	30

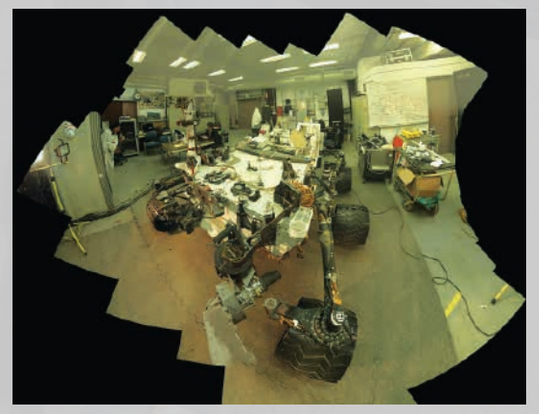
Curiosity's Self-Portrait

On October 31, 2012, the Mars Science Laboratory's *Curiosity* rover captured this "self-portrait." Curiosity used the Mars Hand Lens Imager (MAHLI) located at the end of its robotic arm to capture a set of 55 thumbnail images that were then stitched together to create this full-color mosaic. The rover is located at "Rocknest," the spot in Gale Crater where the mission's first scoop sampling took place. Four scoop scars can be seen in the regolith in front of the rover. A fifth scoop was collected later.

The rover's robotic arm was positioned out of the shot in the images, or portions of images, used to create the mosaic and therefore, is not visible. Self-portraits like this one document the state of the rover and allow mission engineers to track changes over time, such as dust accumulation and wheel wear. Only MAHLI (among the rover's 17 cameras) is able to image some parts of the craft, including the port-side wheels.

August 5, 2014, is the second Earth-year anniversary of Curiosity's landing on Mars. After a nearly perfect landing in 2012, the rover has been working its way up the rugged slopes of Mount Sharp, which rise about 3.4 miles (5.5 kilometers) above Gale Crater. Along the way, the rover has been using its 10 instruments to study the composition of the Martian surface and search for any signs that this area could have ever supported life.

Image and partial text credit: NASA/Jet Propulsion Laboratory-Caltech/Main Space Science Systems



The rover team typically uses a test rover at the NASA/Jet Propulsion Laboratory (JPL) to try new maneuvers before sending commands for those maneuvers to Curiosity. This self-portrait of the Vehicle System Test Bed rover resulted from pre-testing the commands for Curiosity's self-portrait. Image credit: NASA/JPL-Caltech/Main Space Science Systems

JULY 2014

S	M	T	W	T	F	S
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13	14	15	16	17	18	19
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27	28	29	30	31		

SEPTEMBER 2014

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				

SEPTEMBER 2014

New Moon · First Quarter · Full Moon · Last Quarter

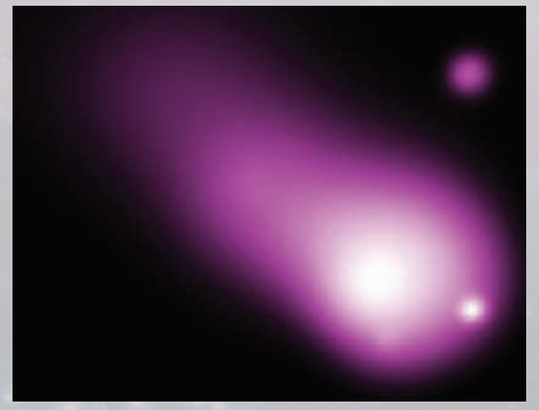
Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
	1 Labor Day	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17 Constitution Day	18	19	20
21	22	23	24	25	26	27
28	29	30				

Dwarf Galaxy Caught Ramming into a Large Spiral

Shown above, observations from NASA's Chandra X-ray telescope reveal a massive cloud of multimillion-degree gas in a galaxy about 60 million light years from Earth. The hot gas cloud is likely caused by a collision between a dwarf galaxy [*bottom left*] and a much larger galaxy called NGC 1232 [*center*]. The image, which combines X-rays and optical light, shows the scene of the collision. Chandra X-ray data, in purple, show the hot gas has a comet-like appearance, caused by the motion of the dwarf galaxy. Optical data from the European Southern Observatory's Very Large Telescope reveal the spiral galaxy in blue and white. The X-ray emission source at the top right of the image appears to be unrelated to the galaxy collision.

If confirmed, this discovery would mark the first time such a collision has been detected only in X-rays, and could have implications for understanding how galaxies grow through similar collisions. The impact between the dwarf galaxy and the spiral galaxy caused a shock wave—akin to a sonic boom on Earth—that generated the hot gas with a temperature of about 6 million degrees.

Image and partial text credit: NASA/Chandra X-ray Observatory/Huntingdon Institute for X-ray Astronomy/G.Garmire/European Southern Observatory/Very Large Telescope



This view shows Chandra's X-ray data isolated from the main image above. Image credit: NASA/Chandra X-ray Observatory/Huntingdon Institute for X-ray Astronomy/ G.Garmire

AUGUST 2014

S	M	T	W	T	F	S
					1	2
3	4	5	6	7	8	9
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17	18	19	20	21	22	23
24/31	25	26	27	28	29	30

OCTOBER 2014

S	M	T	W	T	F	S
			1	2	3	4
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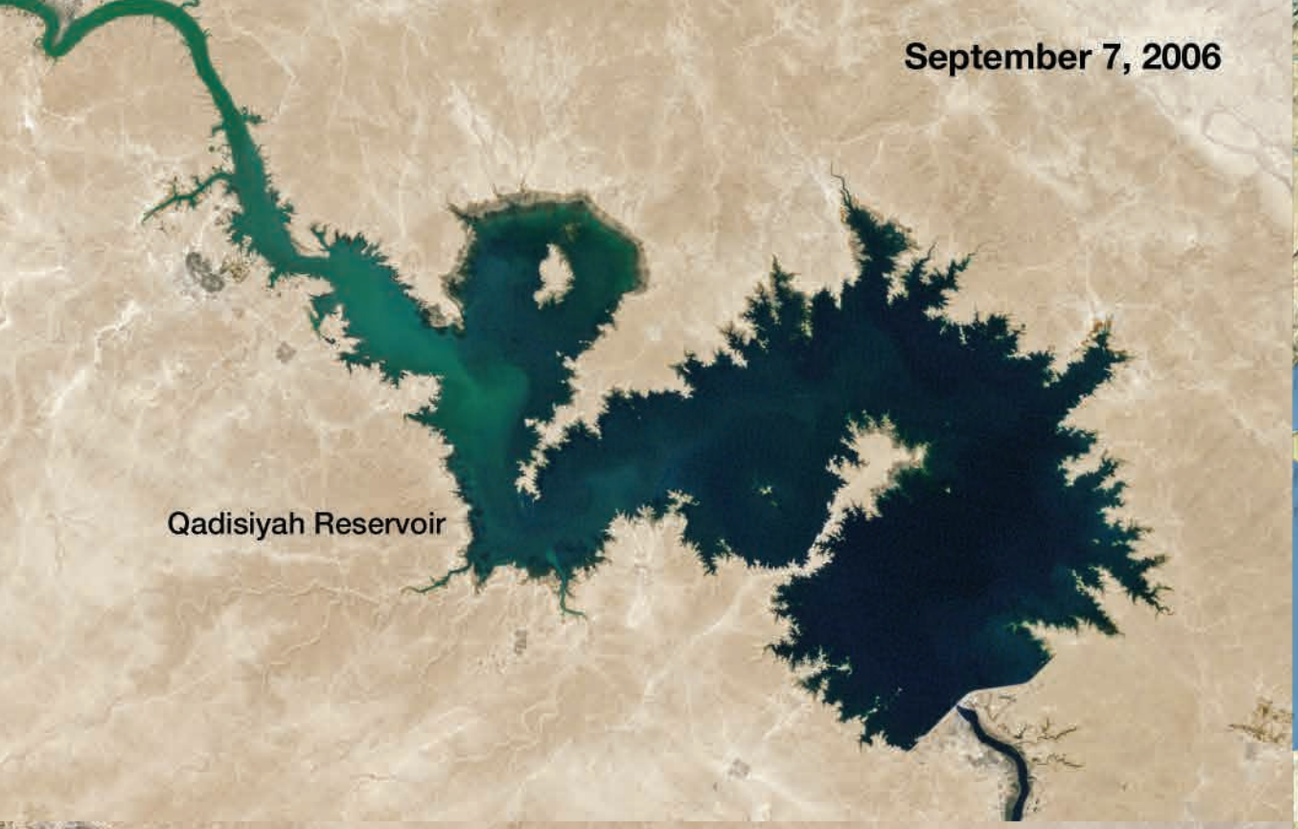
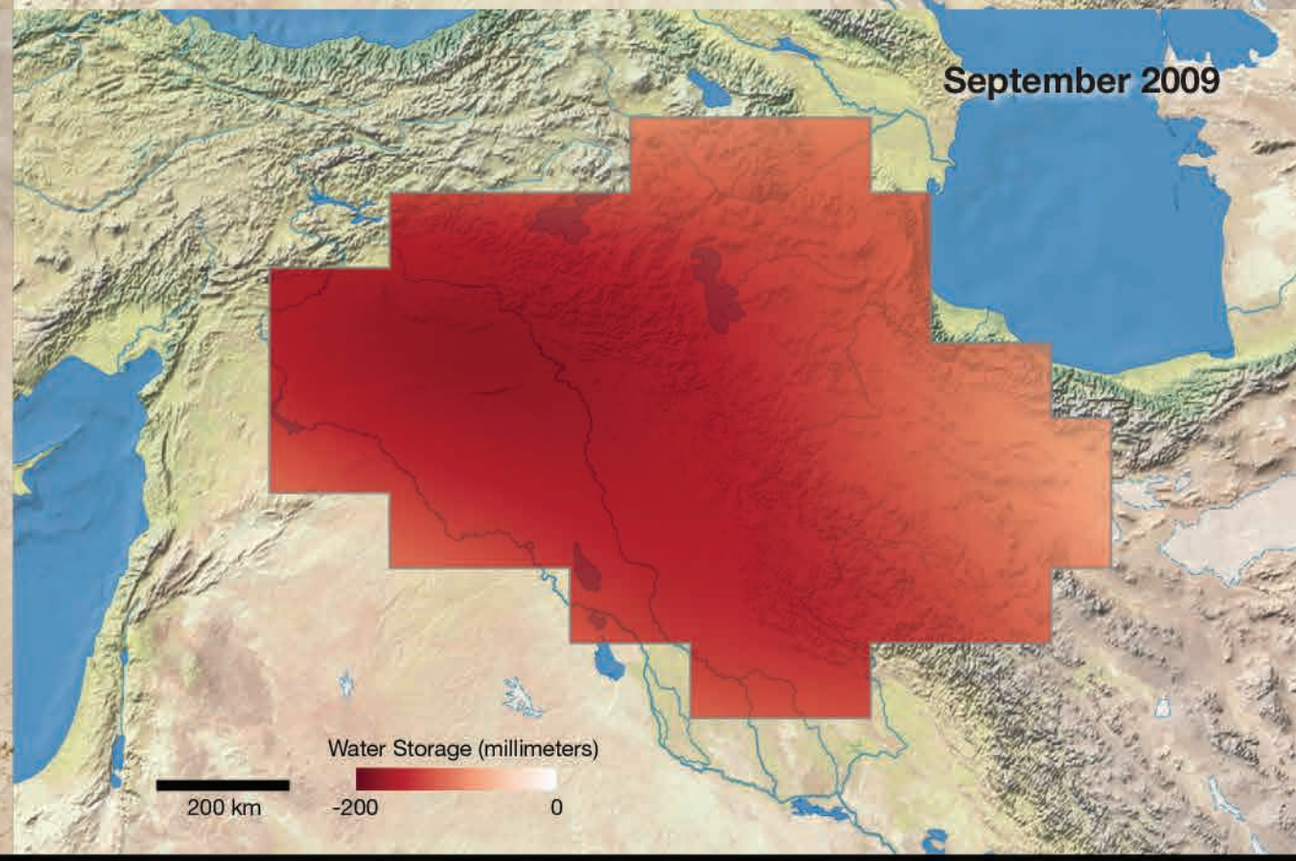
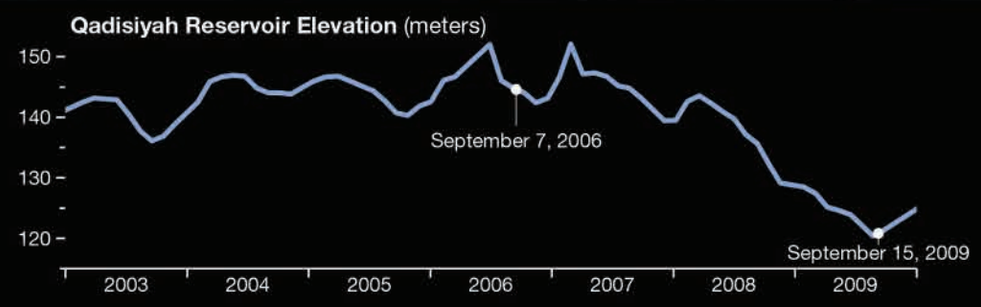
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	31	

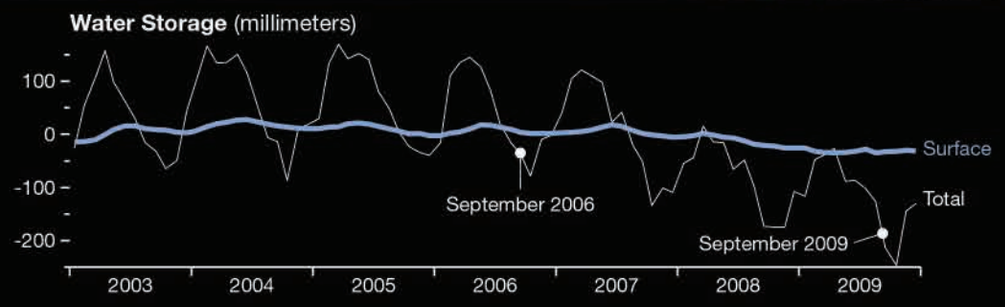

September 7, 2006
Qadisiyah Reservoir

September 15, 2009
N
4 km

September 2006
Euphrates
Tigris
Qadisiyah Reservoir


September 2009
Water Storage (millimeters)
200 km
-200
0


Qadisiyah Reservoir Elevation (meters)
150
140
130
120
September 7, 2006
September 15, 2009
2003
2004
2005
2006
2007
2008
2009


Water Storage (millimeters)
100
0
-100
-200
Surface
Total
September 2006
September 2009
2003
2004
2005
2006
2007
2008
2009

OCTOBER 2014

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 Columbus Day	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	31 Halloween	

Observing Freshwater Losses in the Middle East

A study using data from NASA's Gravity Recovery and Climate Experiment (GRACE) satellites found that large parts of the arid Middle East region lost freshwater reserves rapidly during the past decade. Scientists found that during a seven-year period beginning in 2003, parts of Turkey, Syria, Iraq, and Iran along the Tigris and Euphrates river basins lost 117 million acre feet (144 cubic kilometers) of total stored freshwater. The researchers attribute about 60% of the loss to pumping of groundwater from underground reservoirs. Meanwhile, demand for freshwater continues to rise. The two natural-color images on the left were acquired by the Landsat 5 satellite and show the shrinking of the Qadisiyah Reservoir in Iraq between September 7, 2006 [*top left*] and September 15, 2009 [*bottom left*]. The graph below these two images shows the elevation of the water in that reservoir between January 2003 and December 2009. The elevation is a proxy measurement for the total volume of water stored there.

The two regional images on the right were created with GRACE data and show total water storage in the Tigris and Euphrates river basins for September 2003 [*top right*] and September 2009 [*bottom right*]. The graph shows a decrease in water storage for the study area as measured by GRACE from January 2003 to December 2009. The gray line depicts *total water storage*—groundwater, surface water bodies, and soil moisture—while the green line depicts changes in surface water. The difference between those two lines reflects the change in water stored in underground aquifers. The total water storage shows a seasonal fluctuation, but also an overall downward trend, suggesting that groundwater is being pumped and used faster than natural processes can replenish it. Data from satellites such as GRACE are essential to providing a more complete global picture of water storage trends.

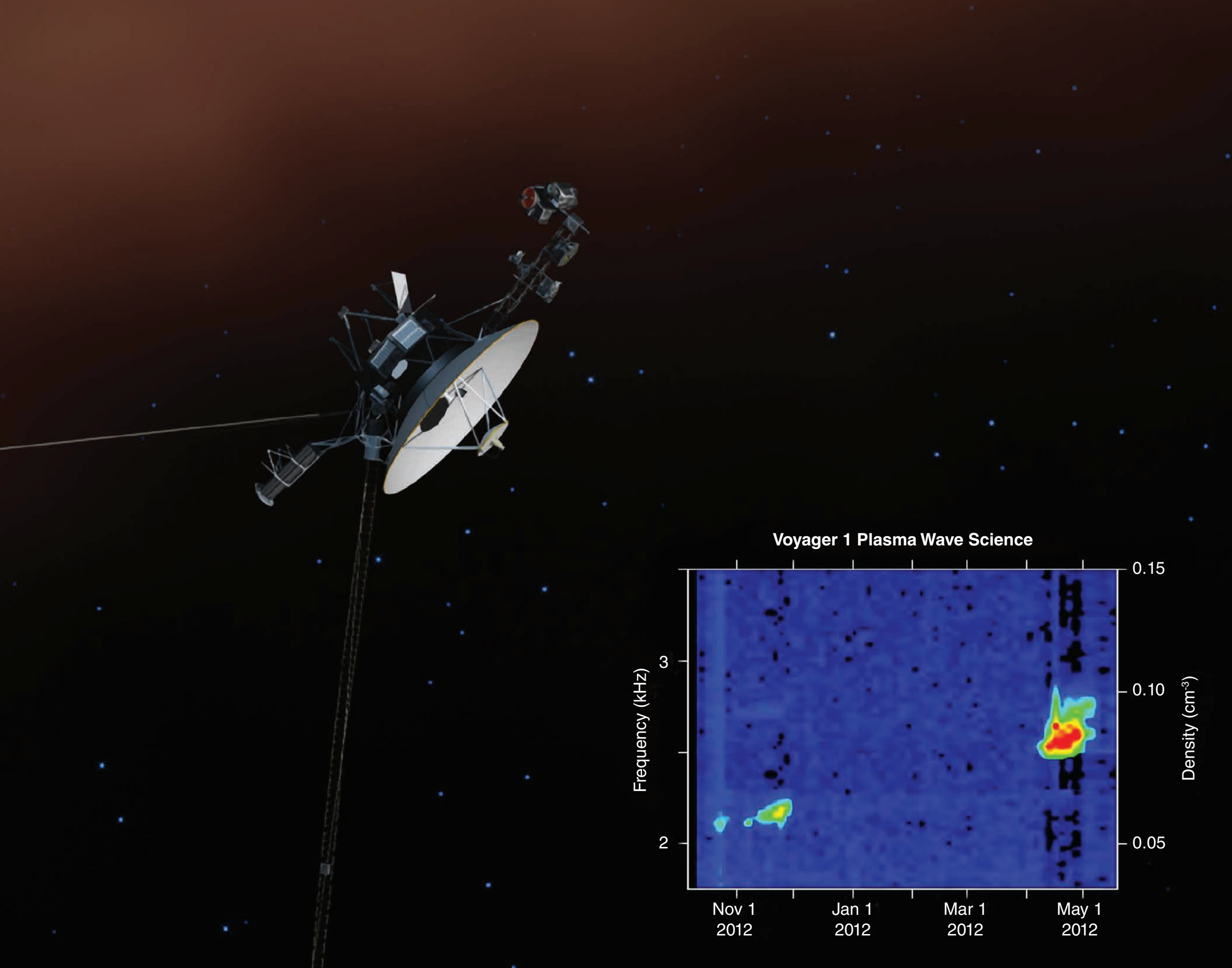
Image and partial text credit: NASA's Earth Observatory, Jet Propulsion Laboratory, Natural Earth

SEPTEMBER 2014

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 2014

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
23/30	24	25	26	27	28	29


Voyager 1 Plasma Wave Science
Frequency (kHz)
3
2
0.15
0.10
0.05
Density (cm-3)
Nov 1
2012
Jan 1
2012
Mar 1
2012
May 1
2012

NOVEMBER 2014

New Moon · First Quarter · Full Moon · Last Quarter

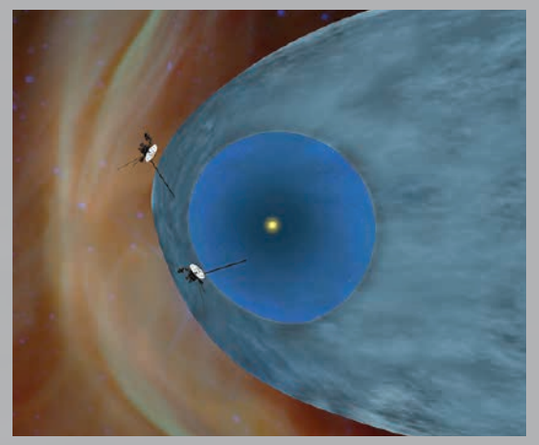
Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
						1
2 Daylight Saving Time Ends	3	4 Election Day	5	6	7	8
9	10	11 Veterans Day	12	13	14	15
16	17	18	19	20	21	22
23/30	24	25	26	27 Thanksgiving Day	28	29

Voyager 1 Exits Heliosphere

At 122 times our distance from the sun, NASA's Voyager 1 spacecraft is the first human-made object to leave the *heliosphere*, the far-reaching extended atmosphere of the sun. Launched in 1977, Voyager 1 is traveling away from Earth at a speed of about 340 million miles (540 million kilometers) per year. In the summer of 2012, Voyager 1 started its journey into *interstellar space*, or the space between stars. This artist's concept depicts Voyager 1 exiting the heliosphere and entering the interstellar medium (brown hue at the top of the image).

When Voyager 1's *Plasma Wave Subsystem* detects vibrations it allows scientists to characterize the plasma, or ionized gas, the spacecraft is embedded in. From October to November 2012 and again from April to May 2013, Voyager 1's plasma wave instrument detected vibrations caused by previous explosions on the sun. The inset graph shows the frequency of the waves, which is directly related to the plasma density. The high density clearly indicates that Voyager 1 is embedded in "cold" interstellar plasma, left over from the death of nearby giant stars millions of years ago, which dominates interstellar space. Through extrapolation of measured plasma densities from both events, teams of scientists determined that Voyager 1 first entered interstellar space in the summer of 2012. To listen to the audio version of the oscillations detected by Voyager 1, visit: *www.nasa.gov/voyager*. Its increasing pitch indicates increasing interstellar plasma density over time.

Image and partial text credit: NASA/Jet Propulsion Laboratory-Caltech/The University of Iowa



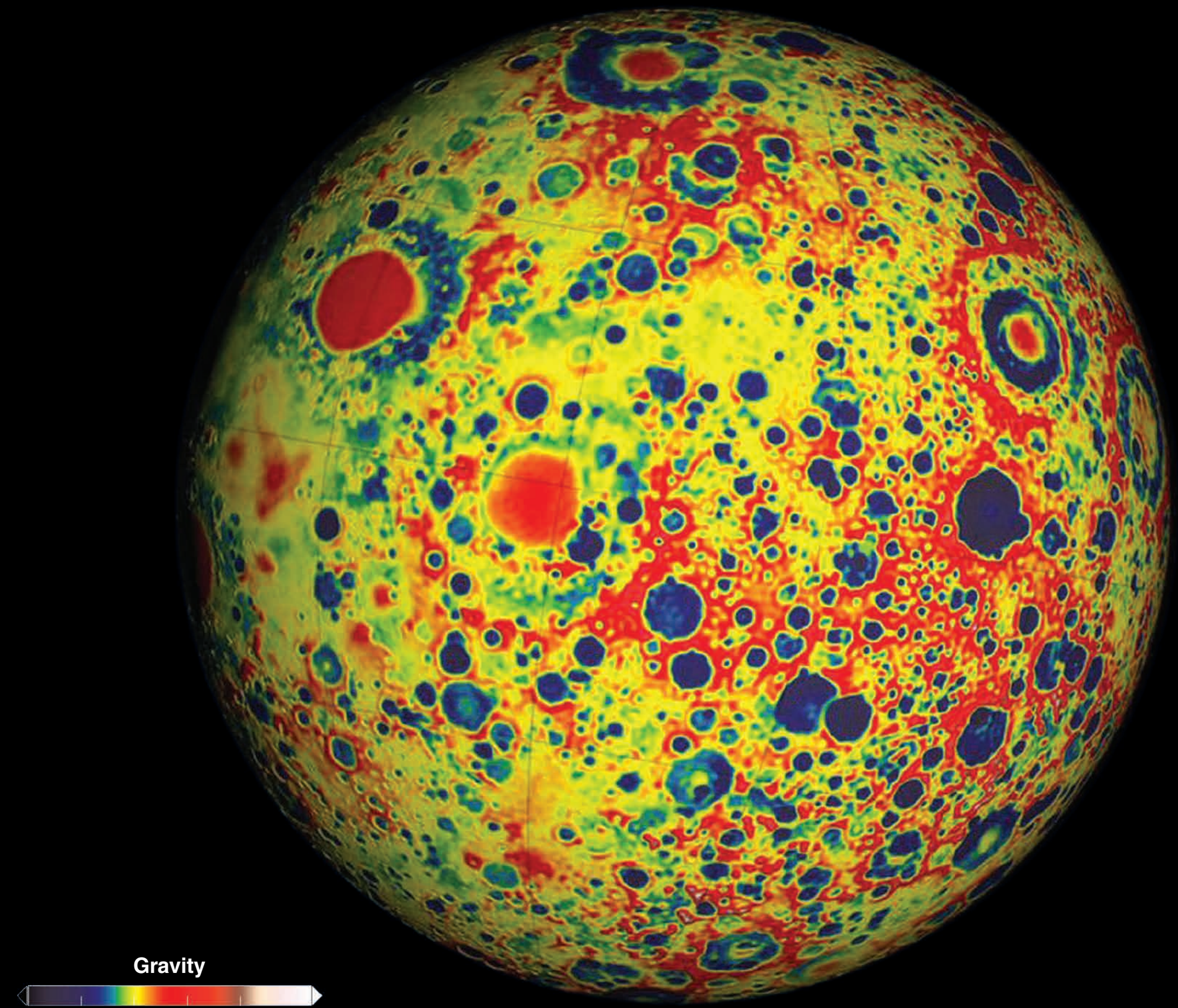
This artist's concept shows the general locations of Voyager 1 [*top*] and Voyager 2 [*bottom*] in September 2013. Voyager 2 still explores the outer layer of the heliosphere. Image credit: NASA/Jet Propulsion Laboratory-Caltech

OCTOBER 2014

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 2014

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			


Gravity
-600
-300
0
300
600
900
mGal

DECEMBER 2014

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 Christmas Day	26	27
28	29	30	31			

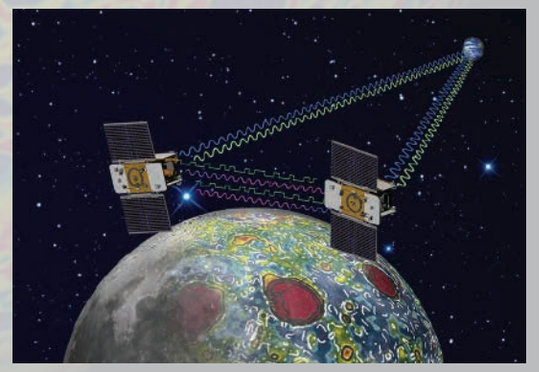
GRAIL Creates Most Accurate Moon Gravity Map

This colorful image of Earth's moon shows variations in the lunar gravity field, as measured by NASA's twin Gravity Recovery and Interior Laboratory (GRAIL) satellites. Dark blue shades indicate areas that have a low local gravity, while red shades indicate areas that have a high degree of local gravity. The high-resolution gravity field map resolves spatial scales as fine as 13 kilometers (~8 miles) and reveals distinct lunar features including impact basins, complex craters, and simple craters.

As the twin spacecraft move along the same orbit, they react to the mass of features on the surface below them (e.g., mountains and craters) as well as features hidden beneath the surface. In orbit, the two spacecraft transmit radio signals to define precisely the distance between them. Scientists translate this information into highly precise maps of gravity that allows them to learn about the moon's internal structure and composition, providing a better understanding of how Earth and other rocky planets in the solar system formed and evolved.

After revealing much about the moon's interior composition, GRAIL's extremely successful primary mission ended in December 2012; unlike most missions, however, GRAIL went out with a bang. The twin spacecraft, called *Ebb* and *Flow*, were intentionally crashed into a mountain near the moon's north pole to study the resulting dust cloud and learn more about the composition of the lunar surface.

Image and partial text credit: NASA/Jet Propulsion Laboratory/Massachusetts Institute of Technology



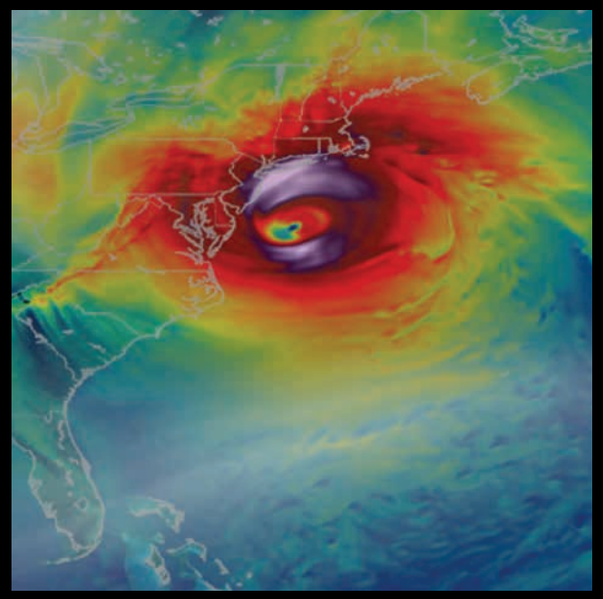
This artist's concept shows the twin GRAIL spacecraft using a precision formation-flying technique to map the moon's gravity field. Image credit: NASA/Jet Propulsion Laboratory-Caltech

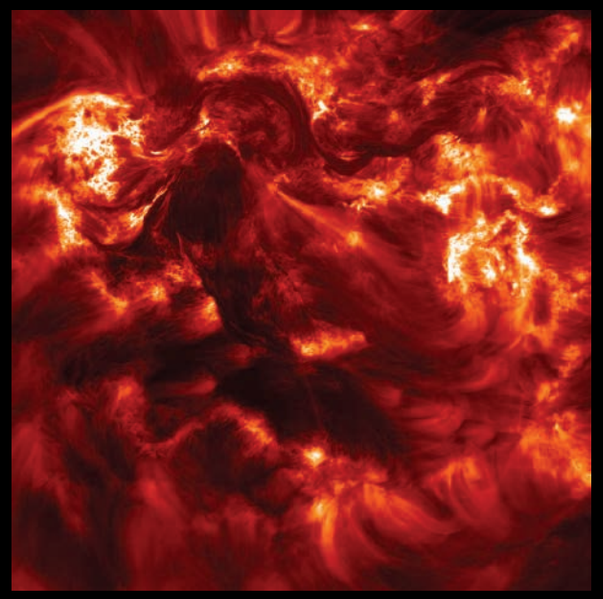
NOVEMBER 2014

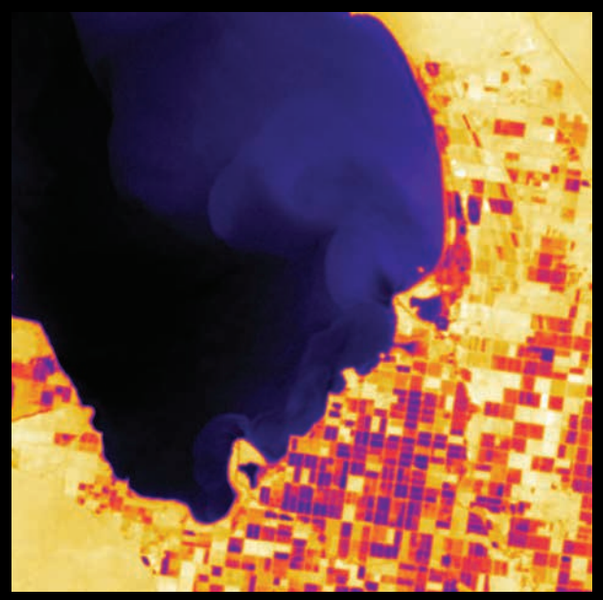
S	M	T	W	T	F	S
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23/30	24	25	26	27	28	29

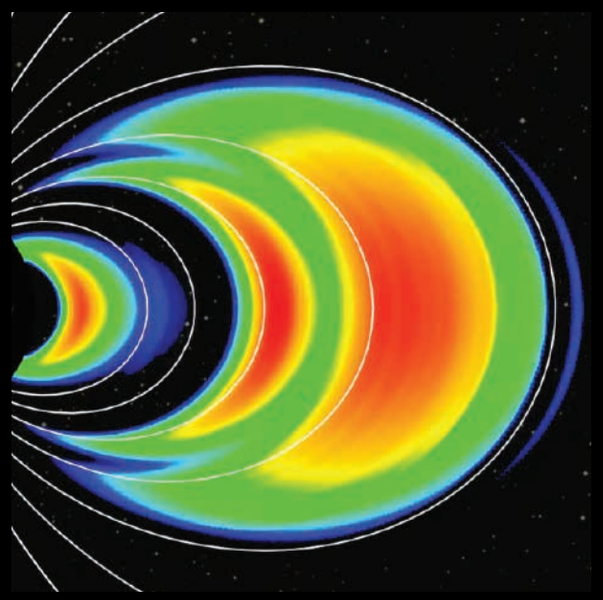
JANUARY 2015

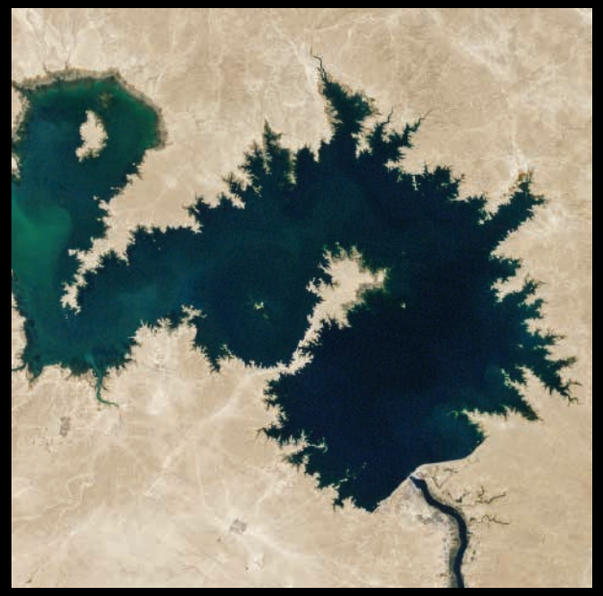
S	M	T	W	T	F	S
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	31

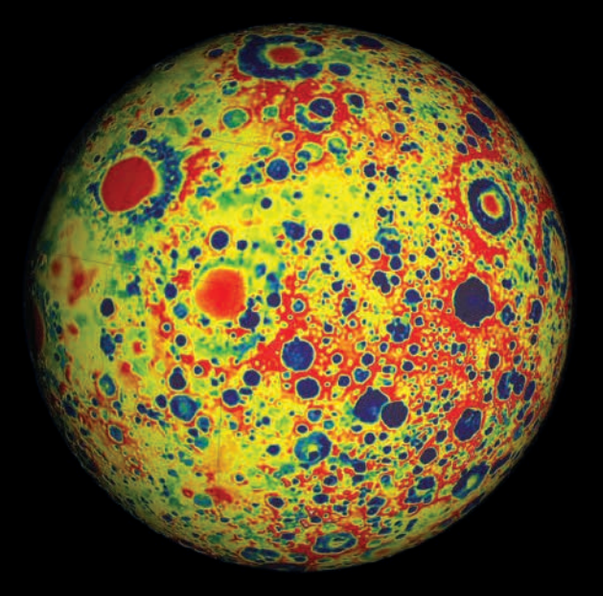












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