NASA Science

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Space Administration

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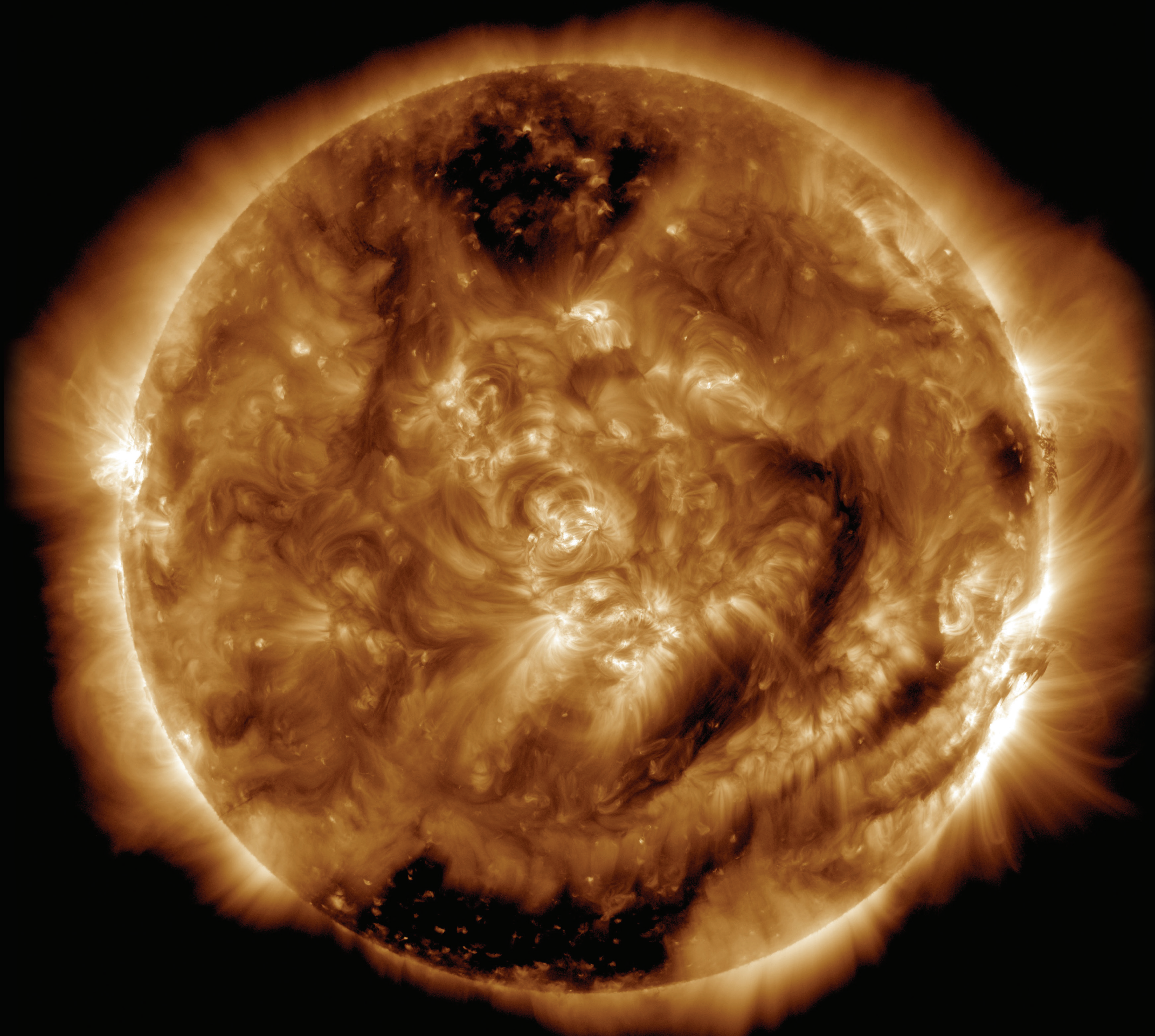


January 2016

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 Birthday of Martin Luther King, Jr. (observed date)	19	20	21	22	23
24/31	25	26	27	28	29	30

Telescope on NASA's Solar Dynamics Observatory Collects Its 100 Millionth Image

On January 19, 2015, at 12:49 PM EST, an instrument on NASA's Solar Dynamics Observatory (SDO) captured its 100 millionth image of the sun, shown above. The instrument is the Atmospheric Imaging Assembly (AIA), which uses four telescopes working in parallel to gather eight images of the sun—cycling through 10 different wavelengths—every 12 seconds. The image above shows extreme ultraviolet light with a wavelength of 193 angstroms.

Between the AIA, the Helioseismic Magnetic Imager (HMI), and the Extreme Ultraviolet Variability Experiment (EVE) (the two other instruments onboard), SDO sends down a whopping 1.5 terabytes of data a day. AIA is responsible for about half of those data. Each day, AIA provides 57,600 detailed images of the sun that show how solar material dances and sways across the surface, sometimes erupting in the solar atmosphere, or corona.

Since its launch on February 11, 2010, SDO has provided images of the sun to help scientists better understand how the dynamic corona rises to temperatures some 1,000 times hotter than the sun's surface, what causes giant eruptions such as solar flares, and why the sun's magnetic fields are constantly on the move.

Image and partial text credit: NASA, Solar Dynamics Observatory, Atmospheric Imaging Assembly, Lockheed Martin Solar and Astrophysics Laboratory

For more information:
www.nasa.gov/sdo

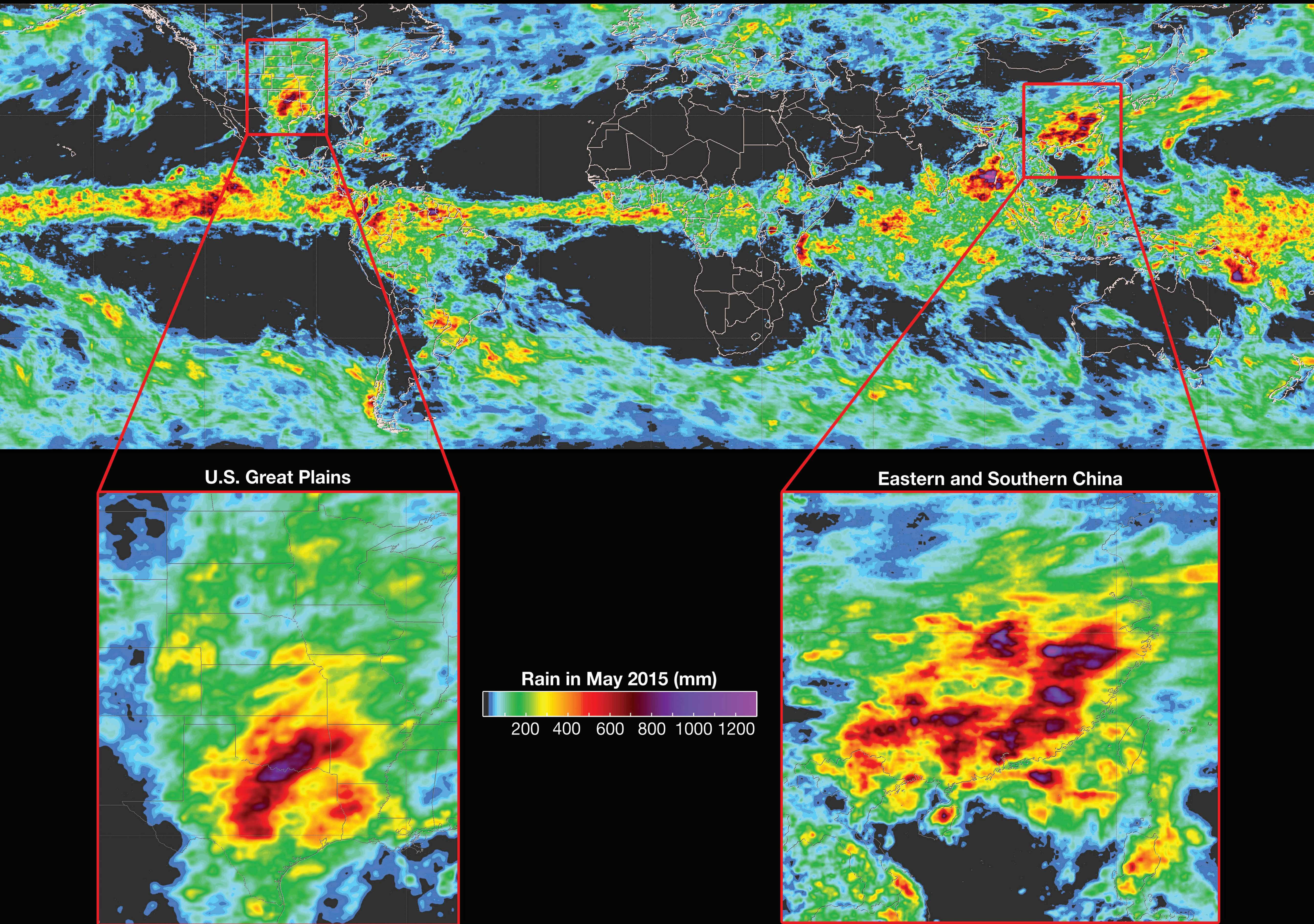
SDO observes the sun from the inside out by providing observations of the solar interior, solar surface, and the solar atmosphere. It uses its HMI instrument to measure the sun's inner magnetic dynamo, the source of all solar activity. The EVE instrument studies the sun's extreme ultraviolet output and how it impacts Earth's upper atmosphere. Image credit: NASA

December 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		

February 2016

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					


U.S. Great Plains
Eastern and Southern China
Rain in May 2015 (mm)
200 400 600 800 1000 1200

February 2016

New Moon | First Quarter | Full Moon | Last Quarter

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
	1 (Last Quarter)	2	3	4	5	6
7	8 (New Moon)	9	10	11	12	13
14	15 Washington's Birthday (observed date) (First Quarter)	16	17	18	19	20
21	22 (Full Moon)	23	24	25	26	27
28	29					

GPM Takes a Closer Look at Extreme Precipitation Around the Globe

After three years of drought, states in the southern U.S. Great Plains witnessed record rainfall and flooding in the spring of 2015. The precipitation map above shows the extreme amounts of rain that were observed in May 2015 by the joint NASA/Japan Aerospace Exploration Agency (JAXA) Global Precipitation Measurement (GPM) mission. In particular, the map was created by first combining data from two advanced instruments onboard the GPM Core Observatory: the GPM Microwave Imager (GMI) and Dual-frequency Precipitation Radar (DPR). In a manner similar to how an orchestra tunes to the oboe, these instruments are used to "tune" (i.e., adjust) precipitation estimates from the nine other satellites that are currently part of GPM's international constellation. The additional satellites are operated by other domestic and international agencies and designed for different purposes; however, the shared data are combined to create a nearly global map of estimated precipitation every half hour that is available to the public as soon as six hours after the precipitation occurs.

Similar to the southern U.S. Great Plains, excessive rainfall wreaked havoc in eastern and southern China during May 2015 triggering deadly floods and landslides that caused extensive property damage. Unlike ground-based measurements of precipitation, which present challenges due to large gaps between monitoring sites, satellite observations can provide near-global coverage, including precipitation amounts over the ocean, unpopulated land areas, and conflict zones. Global precipitation measurements from GPM are used in numerous scientific studies, from improving our understanding of how precipitation is affected by other meteorological conditions to tracking El Niño events and specifying the state of Earth's climate. Data from GPM are also used in a range of societal applications such as monitoring water resources, evaluating natural disasters, improving crop forecasting, and forecasting outbreaks of vector-borne and water-related diseases such as malaria and cholera.

Image and partial text credit: NASA's Goddard Space Flight Center, Mesoscale Atmospheric Processes Laboratory

For more information:
www.nasa.gov/gpm

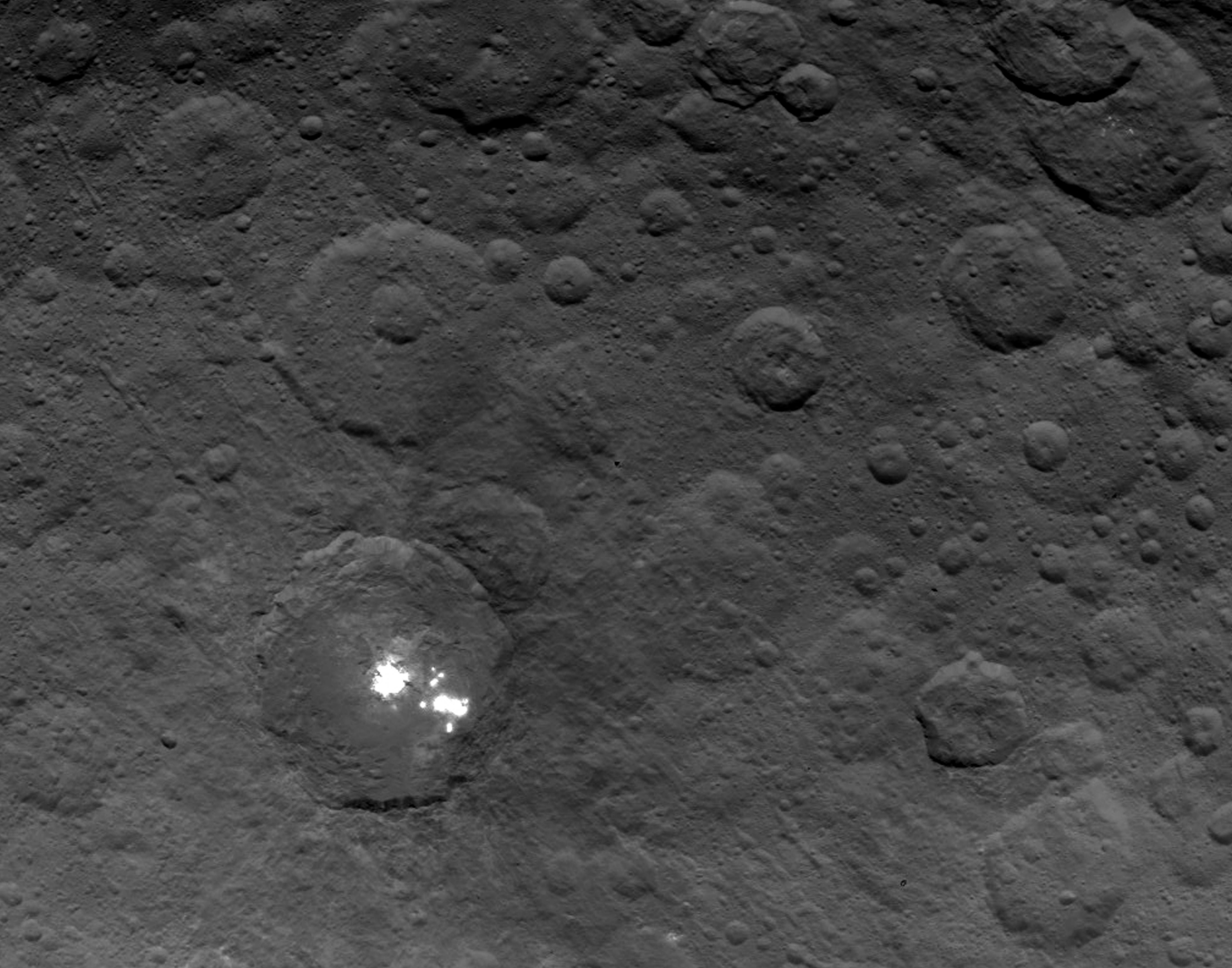
Artist's rendering of the GPM Core Observatory [*foreground*] with constellation satellites [*background*]. Image credit: NASA

January 2016

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

March 2016

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 2016

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 Daylight Savings Time Begins	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31		

Bright Spots on Dwarf Planet Ceres

In 2011–2012, NASA's Dawn mission orbited and explored the giant protoplanet Vesta. Dawn took tens of thousands of images of Vesta [*see inset image, right*], and made many observations about the body's composition and other properties. Vesta was confirmed to be a fascinating world more closely related to the terrestrial planets (including Earth) than to typical asteroids.

In March 2015, Dawn began orbiting and exploring a second new world—dwarf planet Ceres. On June 6, 2015, Dawn captured the image above of bright spots on the surface of Ceres, from an altitude of 2,700 miles (4,345 kilometers) above its surface. Located in a crater about 55 miles (90 kilometers) across, the spots consist of many individual bright points of differing sizes, with a central cluster. Puzzled by the nature of these bright spots, scientists are considering explanations that include salt and ice. Numerous other features on Ceres intrigue scientists as they contrast this world with others. Larger yet less dense than Vesta, Ceres is believed to have a large amount of ice and may even have subsurface liquid water. Craters abound on both planetary bodies, but Ceres appears to have had more activity on its surface, with evidence of flows, landslides, and collapsed structures. Ceres was briefly considered to be a planet following its discovery in 1801 but, like Pluto, it is now called a dwarf planet.

Image and partial text credit: NASA/Jet Propulsion Laboratory (JPL)-Caltech, University of California Los Angeles (UCLA), Max Planck Institute for Solar System Research (MPS), German Aerospace Center (DLR), Institute of Computer and Network Engineering (IDA)

For more information: www.nasa.gov/dawn

This mosaic image of Vesta synthesizes some of the best views acquired by the Dawn spacecraft, which is a NASA Discovery Program mission. A towering mountain at the south pole—more than twice the height of Mount Everest—is visible at the bottom of the image. The set of three craters known as the "snowman" can be seen at the top left. Image credit: NASA/JPL-Caltech, UCLA, MPS, DLR, IDA

February 2016

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					

April 2016

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

April 2016

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

Celestial Fireworks

The brilliant tapestry of young stars flaring to life resembles a glittering fireworks display. The sparkling centerpiece is a giant cluster of about 3,000 stars called Westerlund 2, named for Swedish astronomer Bengt Westerlund, who discovered the grouping in the 1960s. The cluster resides in a raucous stellar breeding ground known as Gum 29, in the constellation Carina.

To capture this image, Hubble's Wide Field Camera 3 pierced through the dusty veil shrouding the stellar nursery in near-infrared light, giving astronomers a clear view of the nebula and the dense concentration of stars in the central cluster. The image's central region, which contains the star cluster, blends visible-light data taken by Hubble's Advanced Camera for Surveys with near-infrared exposures taken by the Wide Field Camera 3. The surrounding region is composed of visible-light observations taken by the Advanced Camera for Surveys. The red colors in the nebulosity represent hydrogen; the bluish-green hues are predominantly oxygen.

Image and partial text credit: NASA, European Space Agency (ESA), the Hubble Heritage Team [Space Telescope Science Institute/Association of Universities for Research in Astronomy (STScI/AURA)], A. Nota (ESA/STScI), and the Westerlund 2 Science Team

For more information:
www.nasa.gov/hubble

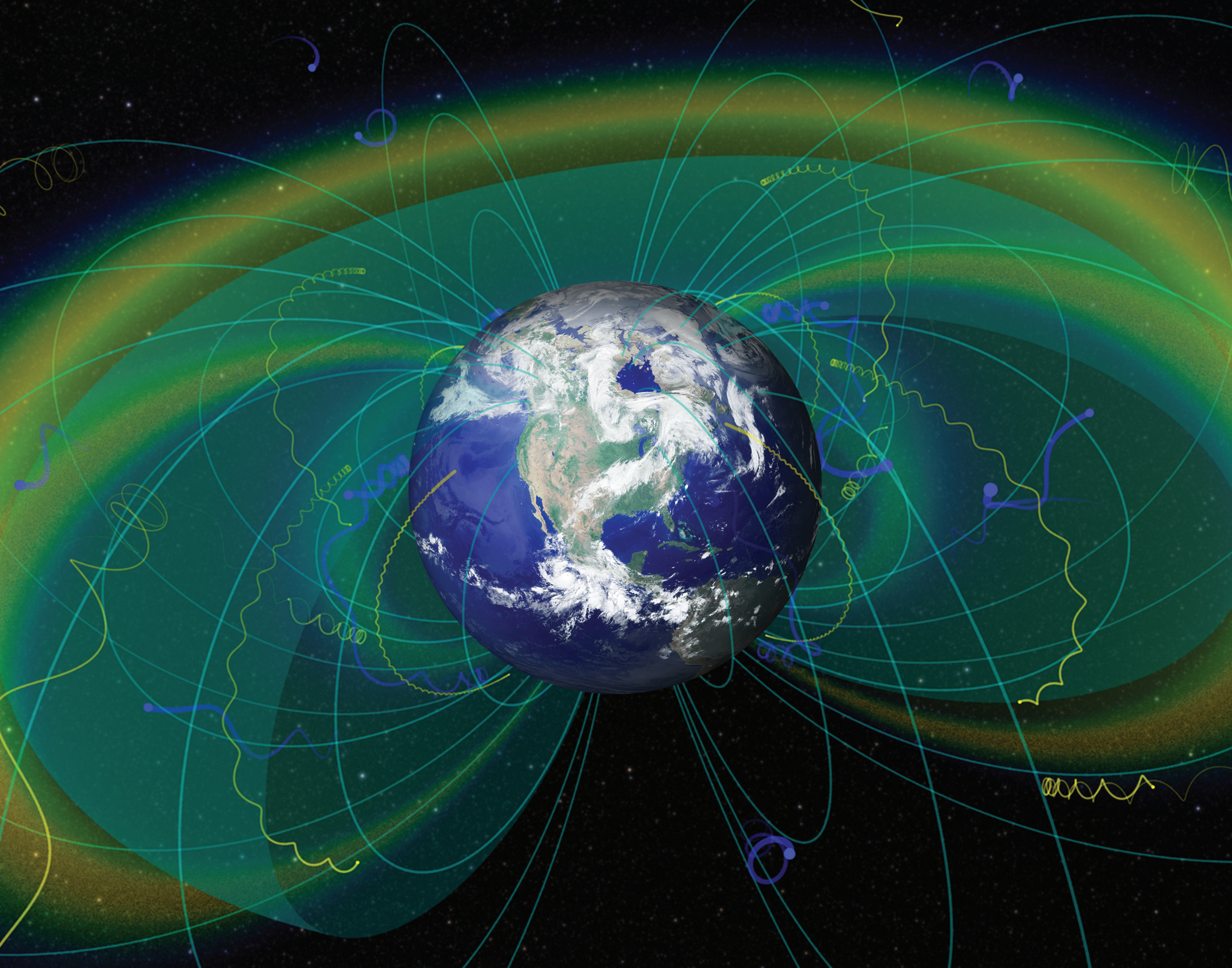
This photo of Hubble was taken from the Space Shuttle *Atlantis* on May 19, 2009, following Servicing Mission 4 (STS-125). Servicing missions have ensured Hubble's health and productivity into the twenty-first century. Image credit: NASA

March 2016

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 2016

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 2016

New Moon | First Quarter | Full Moon | Last Quarter

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
1	2	3	4	5	6	7
8 Mother's Day	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30 Memorial Day	31				

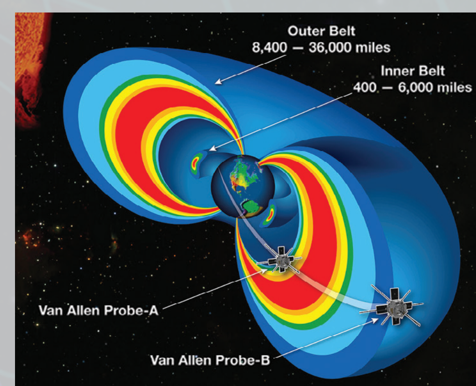
NASA's Van Allen Probes Discover an Impenetrable Barrier in Space

The "Van Allen Belts," named for their discoverer James Van Allen, are two donut-shaped regions encircling Earth, where charged particles from the sun and space are trapped by our planet's magnetic field. Their populations can wax and wane in response to incoming energy from the sun, sometimes swelling enough to expose satellites in low-Earth orbit to damaging radiation. In 2014, researchers used data from NASA's twin Van Allen Probes to discover a sharp edge in the outer belt that acts as a barrier preventing high-energy electrons from coming closer to Earth.

The Van Allen Belts (depicted as bands with an orange/yellow/green hue in the image above) were the first significant discovery of the space age, measured by NASA's Explorer 1 spacecraft in 1958. In the decades since, scientists have learned that the two belts of energetic ions and electrons can wax, wane, merge, or even (as the Van Allen Probes discovered) separate and divide into three belts. Generally, the inner belt stretches from 400 to 6,000 miles (644 to 9,660 kilometers) above Earth's surface and the outer belt stretches from 8,400 to 36,000 miles (13,520 to 57,940 kilometers) above Earth's surface. A slot of fairly empty space typically separates the inner and outer belts. Data from the Van Allen Probes show that the inner edge of the outer belt is often very sharp and forms a barrier that the fastest, highest-energy electrons simply cannot penetrate.

The radiation belts are not the only particle structures surrounding Earth. A giant cloud of dense, relatively cool, charged particles called the plasmasphere (the blue/green surface shown above) extends outward from Earth's upper atmosphere into the outer Van Allen Belt. There is also a ring current of medium energy particles in this region that contributes to Earth's dynamic space environment. Understanding this environment can help scientists predict impacts to sensitive electronics on satellites orbiting Earth.

Image and partial text credit: NASA's Goddard Space Flight Center, Scientific Visualization Studio



A cutaway model of the radiation belts showing their respective distances from Earth with an artist's concept of NASA's twin Van Allen Probes in orbit. Image credit: NASA

For more information:
www.nasa.gov/vanallenprobes

April 2016

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 2016

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 2016

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

An EPIC View of Earth and the Moon

On July 16, 2015, a NASA camera onboard the Deep Space Climate Observatory (DSCOVR) satellite returned a series of images of the entire sunlit side of Earth and the moon from its orbit at the first Lagrange point (L1), about 1,000,000 miles (1,609,344 kilometers) from Earth. This image from the series, taken by the Earth Polychromatic Imaging Camera (EPIC), shows the far side of the moon, illuminated by the sun, as it crossed between DSCOVR and Earth. The effects of sunlight scattered by air molecules gives Earth a characteristic bluish tint.

The image was generated by combining red, blue, and green exposures taken by EPIC in quick succession (about 30 seconds apart). Because the moon moved in relation to Earth between the time the first (red) and last (green) exposures were taken, a thin green offset appears on the right side of the moon. This natural lunar movement also produces a slight red and blue offset on the left side of the moon.

At the time of this writing, regular data acquisition is scheduled to begin in September 2015 with images available every day, 12 to 36 hours after they are acquired by EPIC. Data from EPIC will be used to measure ozone and aerosol levels in Earth's atmosphere, cloud height, vegetation properties, and the ultraviolet reflectivity of Earth. NASA will use these data for a number of Earth science applications, including dust and volcanic ash maps of the entire planet.

The primary objective of DSCOVR, a partnership between NASA, the National Oceanic and Atmospheric Administration (NOAA), and the U.S. Air Force, is to maintain the nation's real-time solar wind monitoring capabilities, which are critical to the accuracy and lead time of space weather alerts and forecasts from NOAA.

Image and partial text credit: NASA, NOAA

For more information: www.nesdis.noaa.gov/DSCOVR

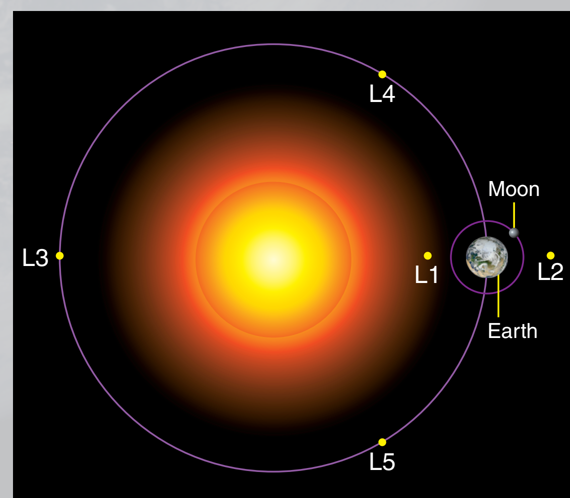


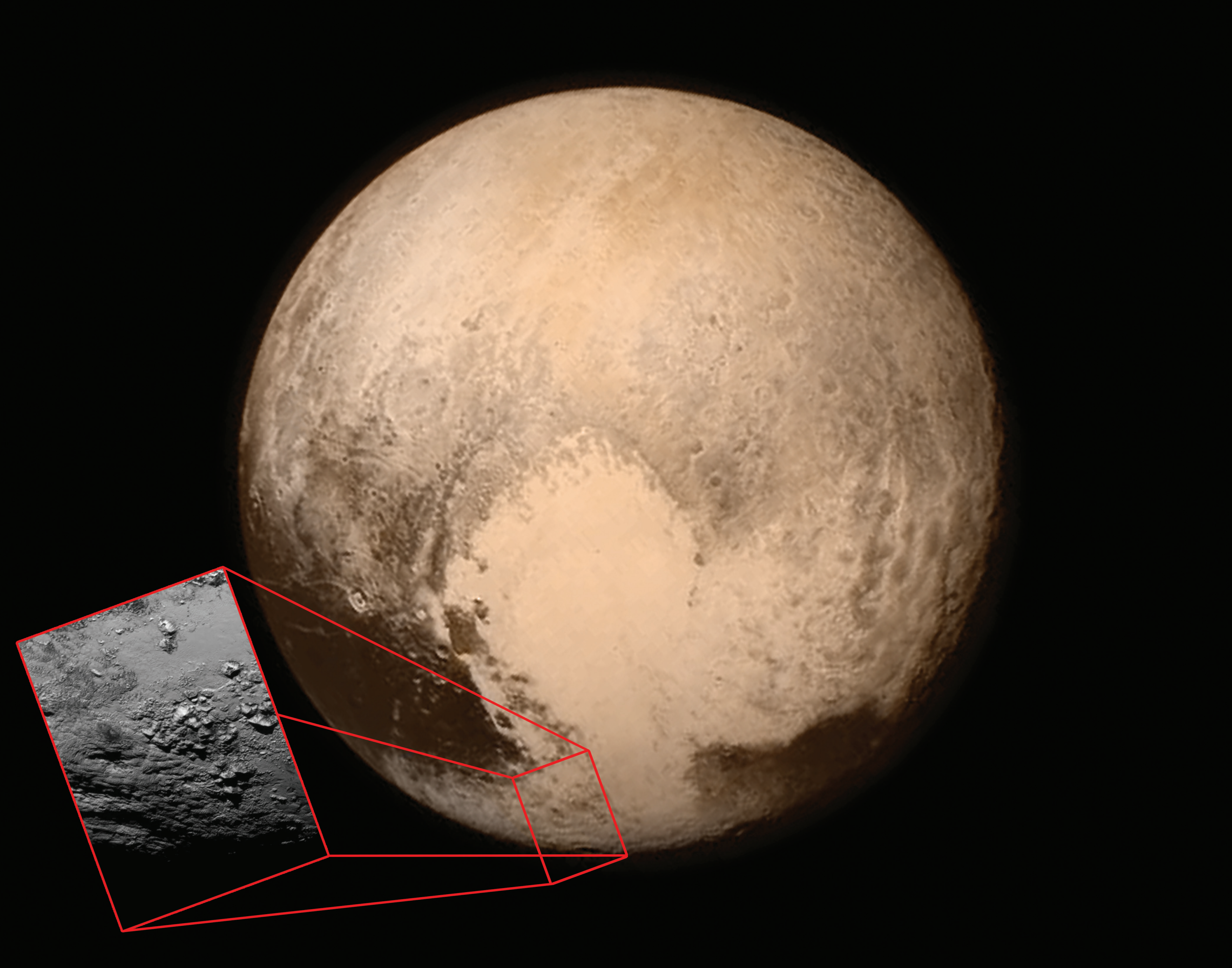
Diagram of the five Lagrange points in the sun–Earth system (not to scale). Image credit: NASA

May 2016

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 2016

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



July 2016

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 / 31	25	26	27	28	29	30

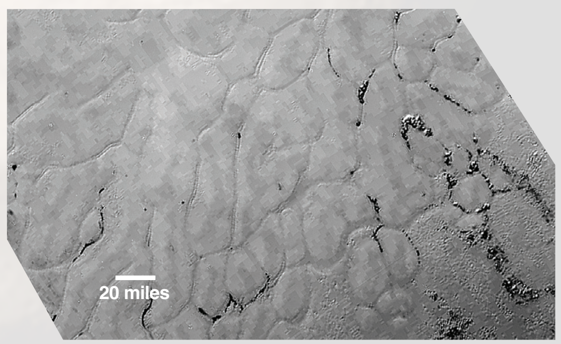
New Horizons' Encounter with Pluto Reveals Icy Mountains and Frozen Plains

Launched in January 2006 on a 3-billion-mile (~4.8-billion-kilometer) journey, NASA's New Horizons made history as the first spacecraft to fly by the dwarf planet Pluto. The Long Range Reconnaissance Imager (LORRI) aboard New Horizons acquired the main image above when the spacecraft was 476,000 miles (768,000 kilometers) from Pluto on July 13, 2015. It was the last and most detailed image sent to Earth before the spacecraft's closest approach to Pluto on July 14. The image was combined with lower-resolution color information acquired earlier from New Horizons' Ralph instrument. This view is dominated by a large, bright heart-shaped feature—informally named Tombaugh Regio, after Clyde Tombaugh, who discovered Pluto in 1930. At this resolution, much of the heart's interior appears remarkably featureless—possibly a sign of ongoing geologic processes.

The area outlined in red—showing a close-up view near the base of Pluto's heart—was taken about 1.5 hours before New Horizons' nearest approach to Pluto, when the spacecraft was just 47,800 miles (77,000 kilometers) away. The image reveals a range of youthful mountains rising as high as 11,000 feet (3,500 meters) above Pluto's icy surface. The lack of craters in this scene led scientists to estimate that the mountains likely formed no more than 100 million years ago—mere youngsters relative to the 4.56-billion-year age of the solar system. During the flyby, details of Pluto's heart came into view, revealing a vast, craterless plain [*see inset image, right*]. This frozen area in the center-left of the heart feature, north of Pluto's icy mountains, was informally named *Sputnik Planum* (or Sputnik Plain), after Earth's first artificial satellite.

Image and partial text credit: NASA, Johns Hopkins University Applied Physics Laboratory (JHUAPL), Southwest Research Institute (SWRI)

For more information: www.nasa.gov/newhorizons



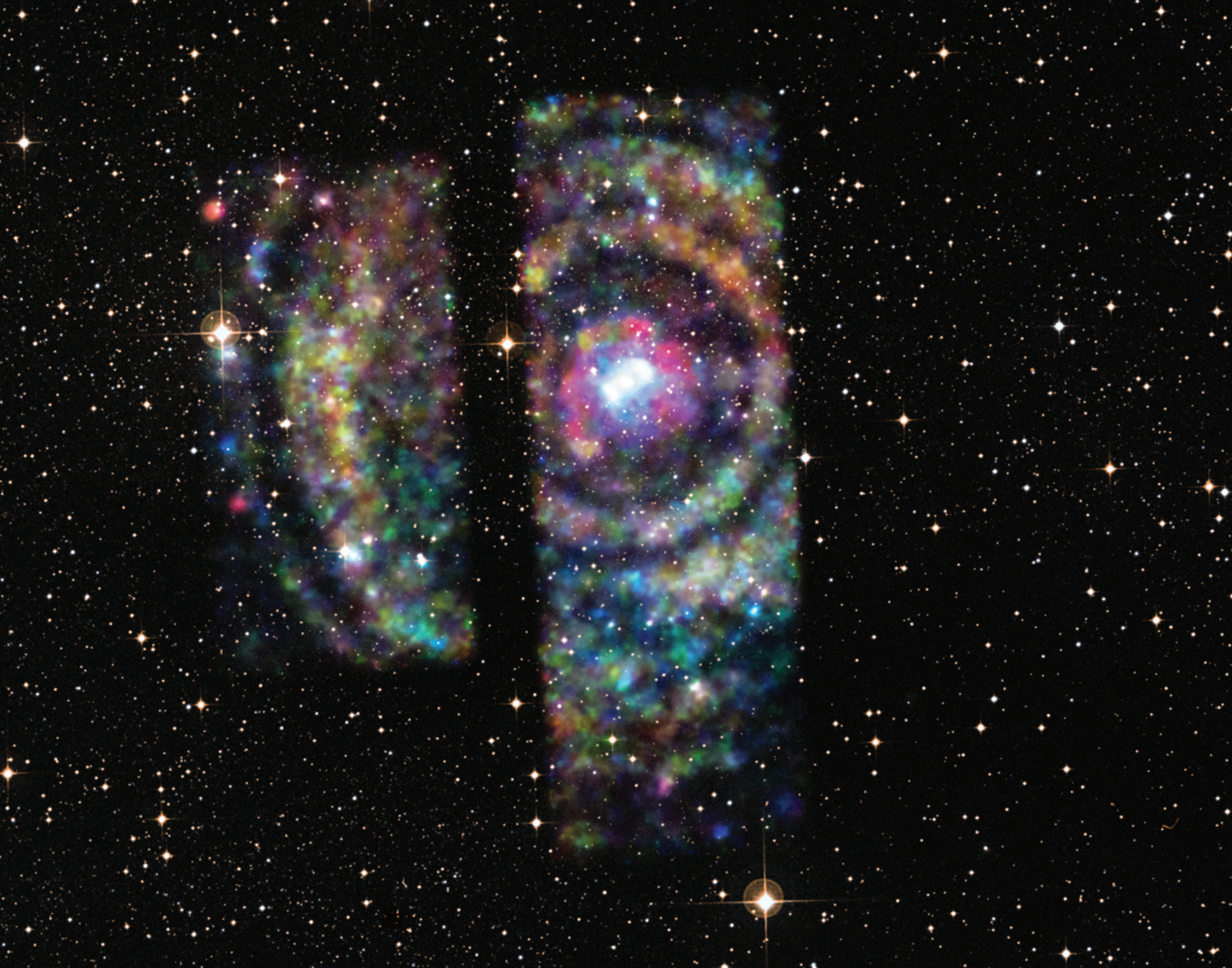
This image of *Sputnik Planum* was acquired by New Horizons' LORRI camera on July 14, 2015. The surface appears to be divided into irregularly-shaped segments that are ringed by narrow troughs. Features that appear to be groups of mounds and fields of small pits are also visible. Mission scientists will learn more about these mysterious terrains from higher-resolution and stereo images that New Horizons will pull from its digital recorders and send back to Earth during the next year. Image credit: NASA, JHUAPL, SWRI

June 2016

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 2016

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			



August 2016

New Moon | First Quarter | Full Moon | Last Quarter

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
	1	2 (New Moon)	3	4	5	6
7	8	9	10 (First Quarter)	11	12	13
14	15	16	17	18 (Full Moon)	19	20
21	22	23	24	25 (Last Quarter)	26	27
28	29	30	31			

X-ray Echoes Pinpoint Neutron Star

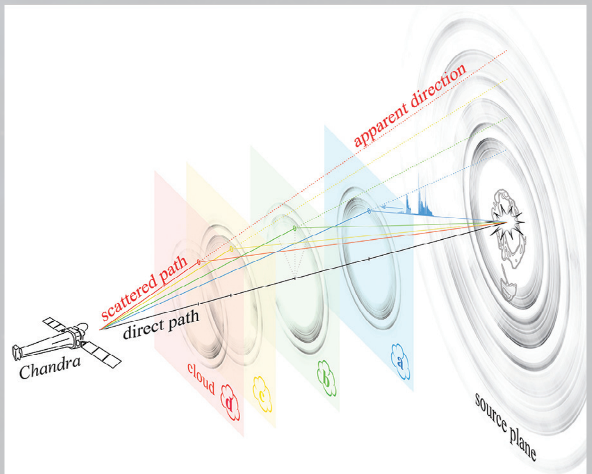
Astronomers using NASA's Chandra X-ray Observatory have discovered the largest and brightest set of rings from X-ray light echoes ever observed. The rings appear as circles around Circinus X-1, a double star system in the plane of our galaxy containing a neutron star in orbit with another massive star. The image above combines X-ray data from Chandra [*center*] shown in red, green, and blue (corresponding to low, medium, and high-energy X-rays, respectively), with visible light from the Digitized Sky Survey [*starry background*]. The rings exceed the field-of-view of Chandra's detectors, resulting in a partial image of X-ray data.

Researchers determined that the rings are echoes from a burst of X-rays emitted by Circinus X-1 in late 2013. The X-rays reflected off of clouds of dust located between Circinus X-1 and Earth. By combining Chandra data with data from the Mopra radio telescope in Australia, researchers determined that Circinus X-1 is 30,700 light-years from Earth. The smallest ring in the image is 41 light-years in width while the largest ring is 55 light-years in width.

The artist's illustration [*inset image, right*] shows in detail how the ringed structure seen by Chandra is produced. Each ring is caused by X-rays from the Circinus X-1 flare bouncing off of different dust clouds. If the cloud is closer to us, the ring appears to be larger. The result, as seen by Chandra, is a set of concentric rings with different apparent sizes depending on the distance of the intervening cloud from Earth. The physical sizes of the rings, using the labels given in the illustration, are 41 light-years (*ring a*), 49 light-years (*ring b*), 55 light-years (*ring c*), and 52 light-years (*ring d*).

Image and partial text credit: X-ray: NASA, Chandra X-ray Center, University of Wisconsin-Madison, S.Heinz *et al.*; Optical: Digitized Sky Survey

For more information:
www.nasa.gov/chandra



This diagram shows how the ringed structure seen by Chandra was produced. Image credit: University of Wisconsin-Madison, S.Heinz

July 2016

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

September 2016

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 2016

New Moon | First Quarter | Full Moon | Last Quarter

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

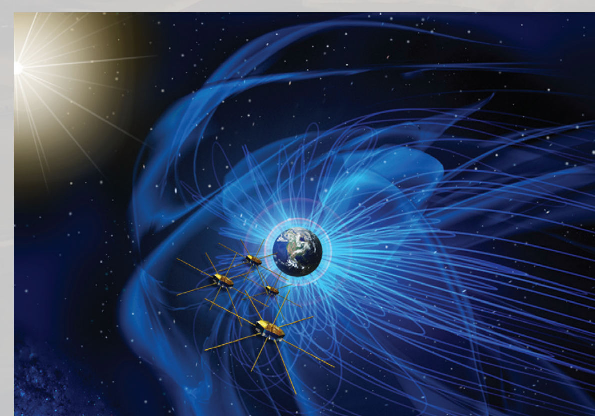
NASA Launches the Magnetospheric Multiscale Mission to Study Reconnection Events Near Earth

Following a successful launch at 10:44 PM EDT on March 12, 2015, NASA's Magnetospheric Multiscale (MMS) spacecraft began the first space mission dedicated to the study of a phenomenon called *magnetic reconnection*. This process is thought to be the catalyst for some of the most powerful explosions in our solar system. The four spacecraft that make up MMS were stacked one on top of the other on a United Launch Alliance Atlas V 421 rocket and launched from Cape Canaveral Air Force Station, in Cape Canaveral, Florida. After reaching orbit, each spacecraft deployed from the rocket's upper stage sequentially, in five-minute increments.

Magnetic reconnection is a fundamental process that occurs throughout the universe. It occurs when magnetic fields connect, disconnect, and reconfigure explosively, releasing bursts of energy that can reach the order of billions of megatons of trinitrotoluene (commonly known as TNT). These explosions can send particles surging through space near the speed of light. The mission will provide the first three-dimensional views of reconnection occurring in Earth's protective magnetic space environment known as the *magnetosphere*. By studying reconnection in this local, natural laboratory, MMS helps scientists understand reconnection events elsewhere, such as in the atmosphere of the sun and other stars, in the vicinity of black holes and neutron stars, and at the boundary between our solar system's heliosphere and interstellar space. The spacecraft fly in a tight tetrahedron formation through regions of reconnection activity and use sensors designed to measure the space environment at rates 100 times faster than any previous mission. As of fall 2015, the four MMS spacecraft were flying the tightest, most precise formation in the history of spaceflight.

Image and partial text credit: United Launch Alliance

For more information:
www.nasa.gov/mms



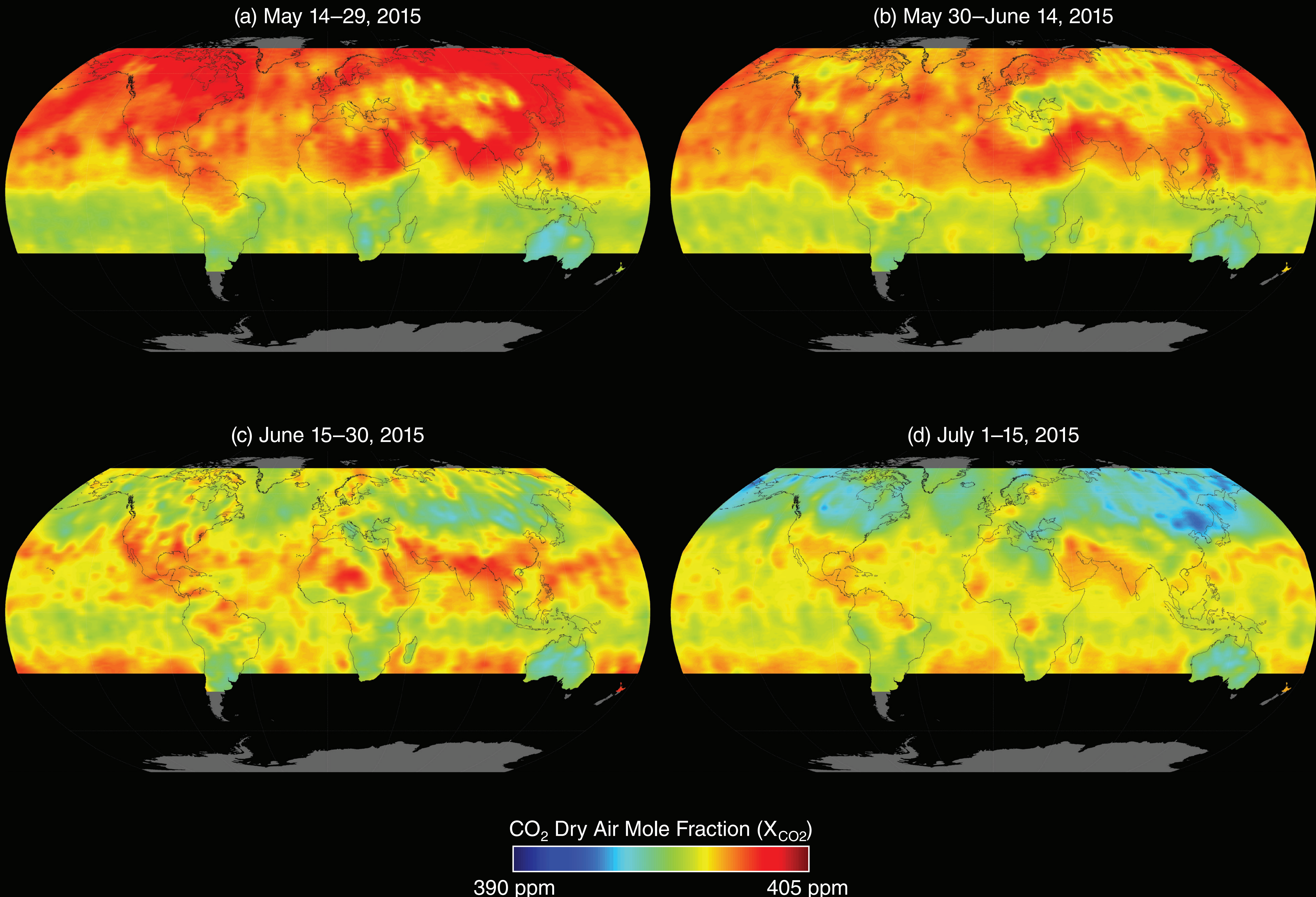
Artist's concept of the four identical MMS spacecraft flying in formation. Image credit: NASA

August 2016

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 2016

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


(a) May 14–29, 2015
(b) May 30–June 14, 2015
(c) June 15–30, 2015
(d) July 1–15, 2015
CO_2 Dry Air Mole Fraction (X_{CO2})
390 ppm
405 ppm

October 2016

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 Columbus Day	11	12	13	14	15
16	17	18	19	20	21	22
23/30	24/31 Halloween	25	26	27	28	29

OCO-2 Observes the Spring CO_2 Drawdown in the Northern Hemisphere

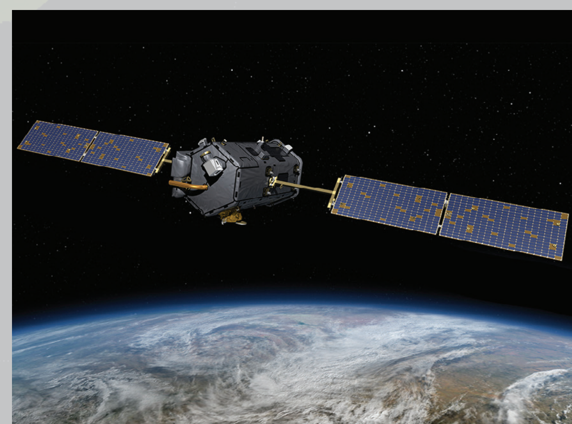
The NASA Orbiting Carbon Observatory-2 (OCO-2) has been collecting observations of atmospheric carbon dioxide (CO_2) since early September 2014. Estimates of the column-averaged CO_2 dry air mole fraction (X_{CO2}) retrieved along the narrow OCO-2 measurement tracks were combined to produce the smoothed global maps shown above. These maps show a series of two-week periods in the late spring and early summer of 2015: (a) May 14–29, (b) May 30–June 14, (c) June 15–30, and (d) July 1–15. The OCO-2 spectrometer measures the absorption of reflected sunlight by CO_2. The range of latitudes observed in the Southern Hemisphere is limited during this season because the sun is near its northernmost latitude.

At this time of year, land plants in the Northern Hemisphere rapidly absorb CO_2 from the air to form new leaves, branches, and roots, through the process of photosynthesis. This process reduces the atmospheric CO_2 concentration enough that the sensitive three-channel spectrometer onboard OCO-2 is able to observe this so-called drawdown.

These maps indicate that the column-averaged CO_2 dry air mole fraction decreased by 2–3% (8–12 parts per million out of the ambient 400 parts per million background concentration) over much of the Northern Hemisphere during this two-month drawdown period. Observations collected during fall and winter of 2014 indicate that a comparable amount of CO_2 was emitted into the atmosphere, through the process of respiration, while the Northern Hemisphere biosphere was dormant. These seasonal fluxes are some of the most robust features of the global carbon cycle. As the carbon cycle science community continues to analyze OCO-2 data, information on regional-scale sources (emitters) and sinks (absorbers) as well as far more subtle features are expected to emerge from this unique, global dataset.

Image and partial text credit: NASA/Jet Propulsion Laboratory (JPL)-Caltech

For more information:
www.nasa.gov/oco2



Artist's rendering of OCO-2. Image credit: NASA/JPL-Caltech

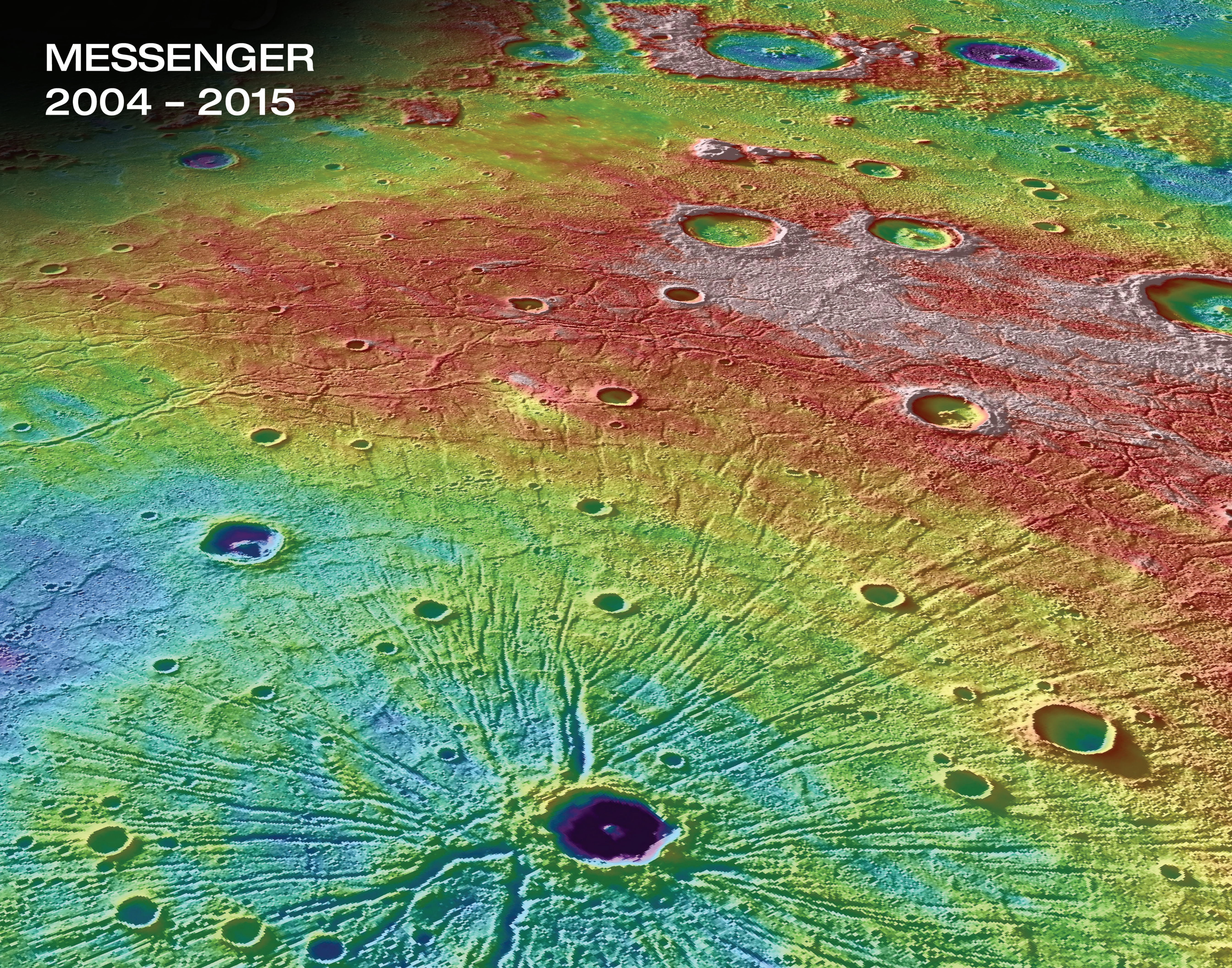
September 2016

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 2016

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			

NASA


MESSENGER
2004 – 2015

November 2016

New Moon | First Quarter | Full Moon | Last Quarter

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

A Tribute to MESSENGER: The First Spacecraft to Orbit Mercury

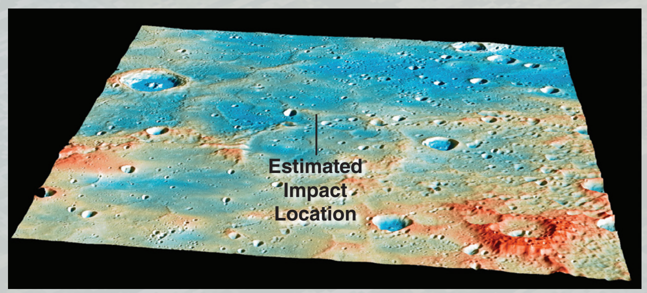
The MErcury Surface, Space ENvironment, GEochemistry, and Ranging (MESSENGER) spacecraft was launched in 2004 and ended its operations in 2015, after becoming the first spacecraft to orbit Mercury. Originally planned as a one-year orbital mission, MESSENGER circled Mercury for more than four years, accomplishing technological firsts and making scientific discoveries about the origin and evolution of the solar system's innermost planet. MESSENGER's highly successful mission ended on April 30, 2015, as the spacecraft ran out of propellant and the force of solar gravity slammed it into Mercury's surface [*see inset image, right*].

All told, MESSENGER acquired and returned to Earth more than 277,000 images. This image shows the Caloris basin, a depression about 930 miles (1,500 kilometers) in diameter formed by the impact of a large projectile. The scene, looking northwest over the basin, is speckled with several small impact craters. Pink, red, and orange shades represent high topography, while green, blue, and purple shades represent low topography, with a total height difference of roughly 2.5 miles (4 kilometers). A mountain range is visible at the edge of the basin (depicted as red shades) and a set of tectonic troughs, known as *Pantheon Fossae*, radiates from the center of the basin [*bottom center*]. A 25-mile (41-kilometer)-diameter impact crater, Apollodorus (dark purple), is superposed just off from the center of Pantheon Fossae.

The image combines data from MESSENGER's Mercury Dual Imaging System (MDIS) and Mercury Laser Altimeter (MLA) instruments, both draped over a digital elevation model derived from MLA data.

Image and partial text credit: NASA, Johns Hopkins University Applied Physics Laboratory (JHUAPL), Carnegie Institution of Washington (CIW)

For more information: www.nasa.gov/messenger



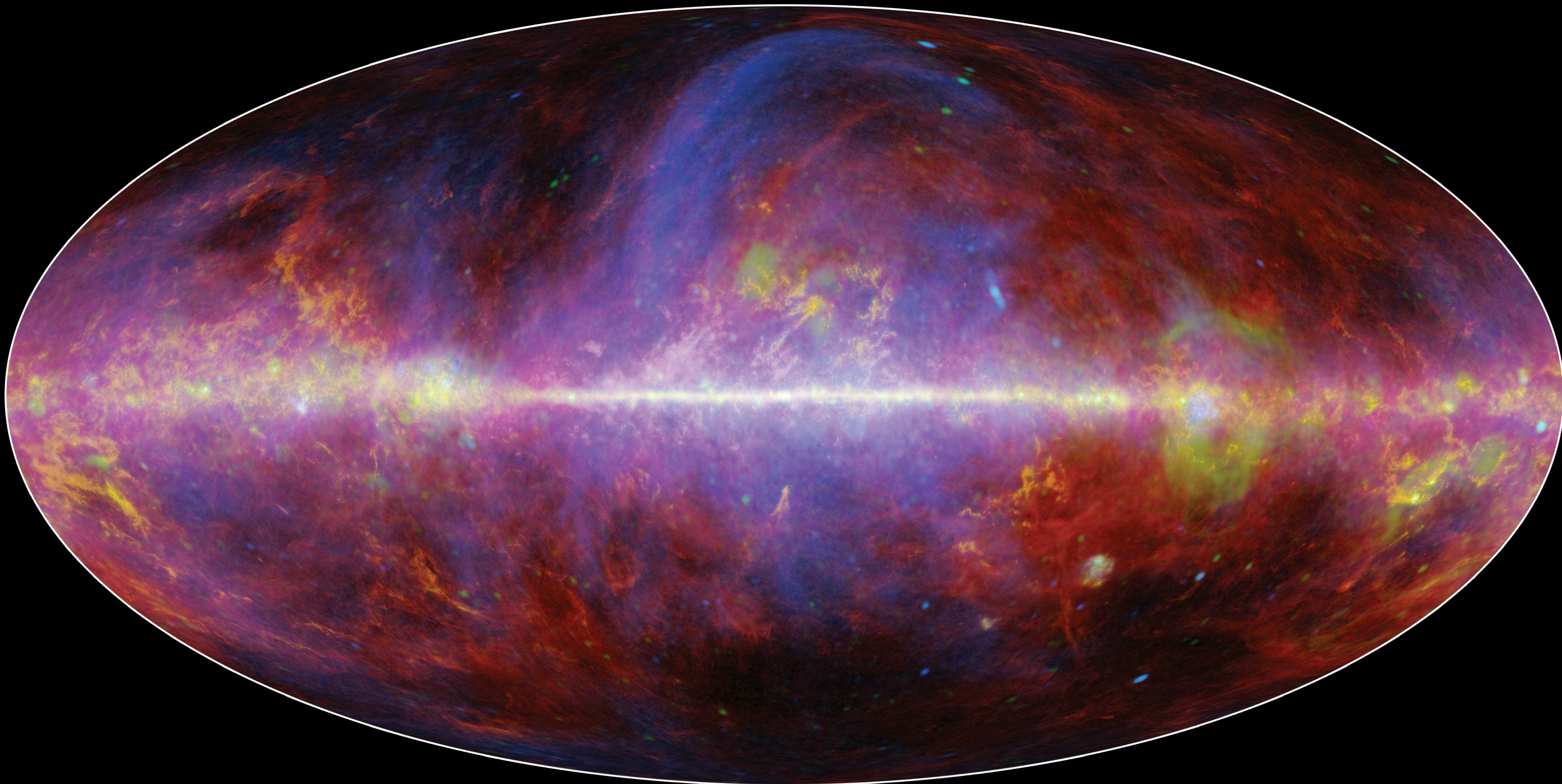
The MESSENGER spacecraft was speeding at over 8,700 miles per hour (3.91 kilometers per second) when it crashed into Mercury's surface on April 30, 2015—creating a crater estimated to be 52 feet (16 meters) in diameter. The day before impact, scientists predicted that the spacecraft would strike a ridge slightly northeast of impact basin Shakespeare. Because the probe hit on the far side of the planet, no Earth-based telescope was able to observe the impact. Radio silence confirmed the end of the MESSENGER mission. Image credit: NASA, JHUAPL, CIW

October 2016

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

December 2016

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 2016

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

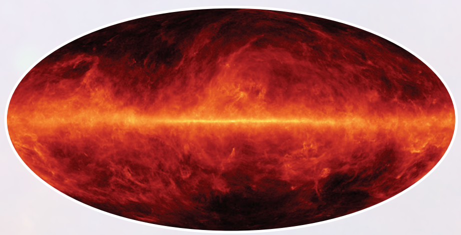
Portrait of Our Milky Way Galaxy

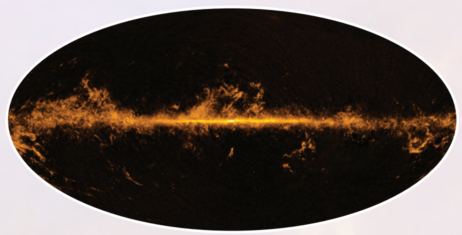
Pictured above, a new dynamic portrait of our Milky Way galaxy shows a frenzy of gas, charged particles, and dust. The image was constructed by combining several observations made at microwave and millimeter wavelengths of light, which are not visible to human eyes.

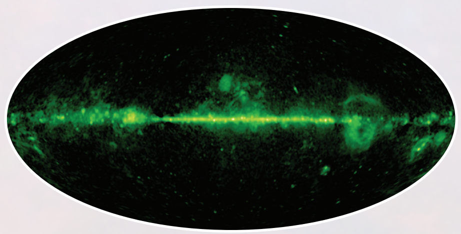
The four components that make up the image above are shown to the right. The red-colored map shows light coming from the thermal glow of dust throughout our galaxy. The yellow-colored map shows carbon monoxide gas, which is concentrated along the plane of our Milky Way galaxy in dense clouds of gas and dust that are churning out new stars. The green-colored map shows a kind of radiation known as free-free, which is associated with hot, ionized gas near massive stars. The blue-colored map indicates a type of radiation called synchrotron, which occurs when fast-moving electrons, often released in supernova explosions, are captured in the galaxy's magnetic field. These data were acquired by the European Space Agency's Planck mission in which NASA played a key role.

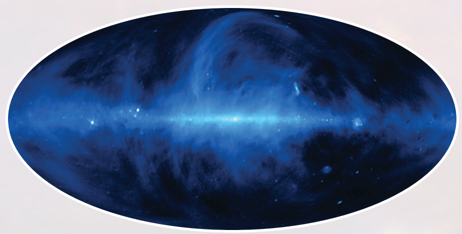
Image and partial text credit: European Space Agency, NASA/Jet Propulsion Laboratory-Caltech

For more information:
www.nasa.gov/planck


Red: Dust Glow


Yellow: Carbon Monoxide Gas


Green: Free-Free Radiation

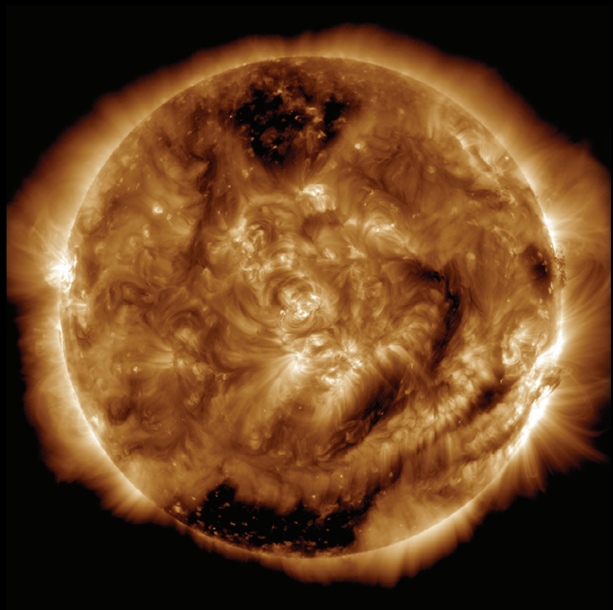
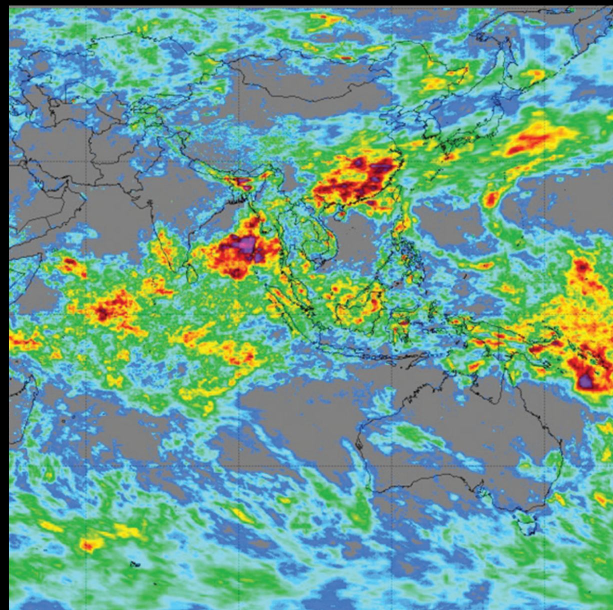
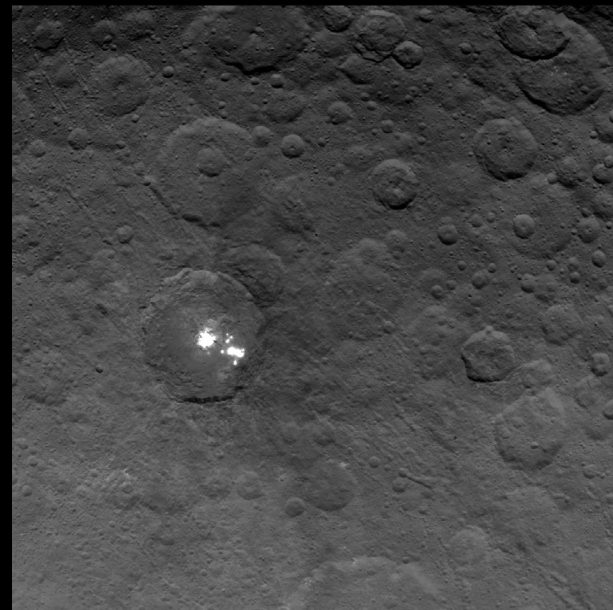

Blue: Synchrotron Radiation

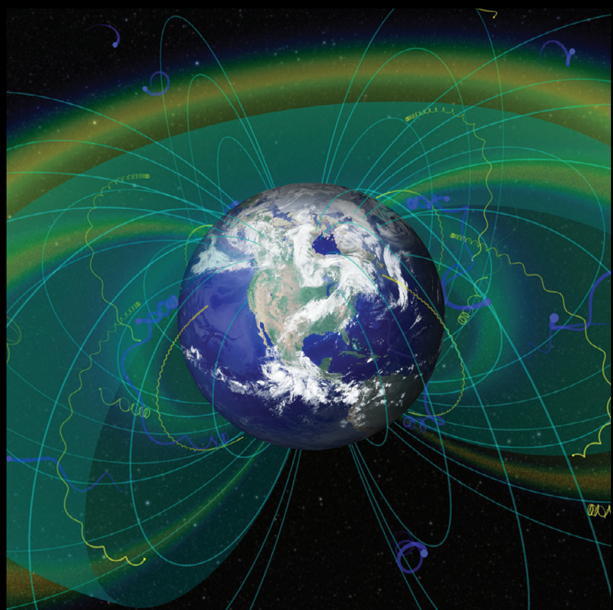
November 2016

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			

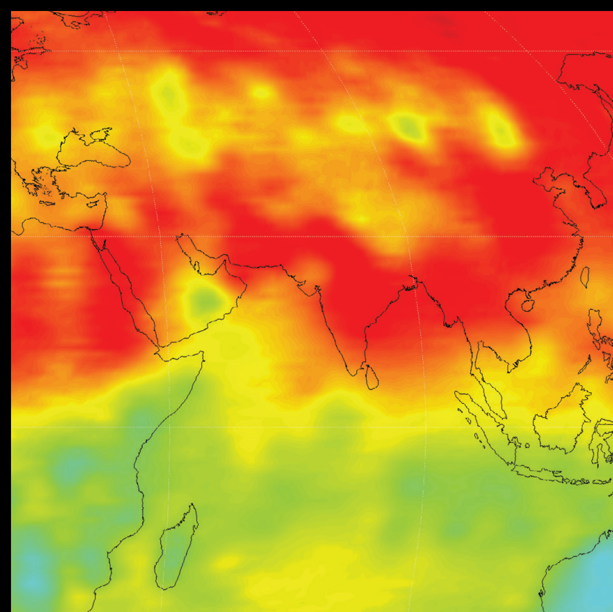
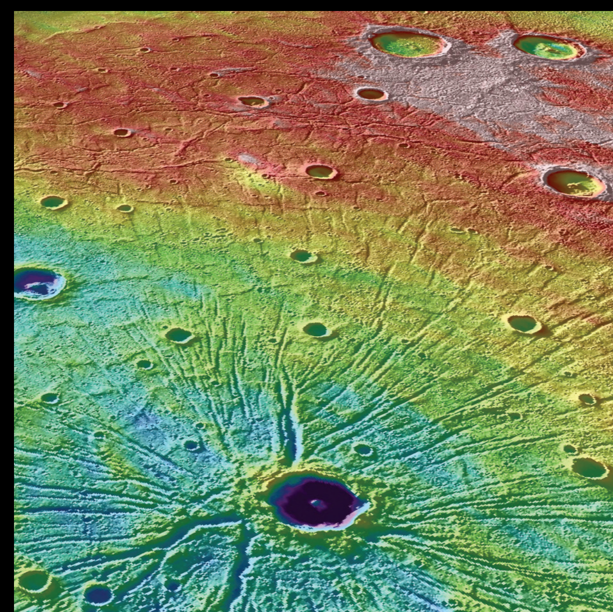
January 2017

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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