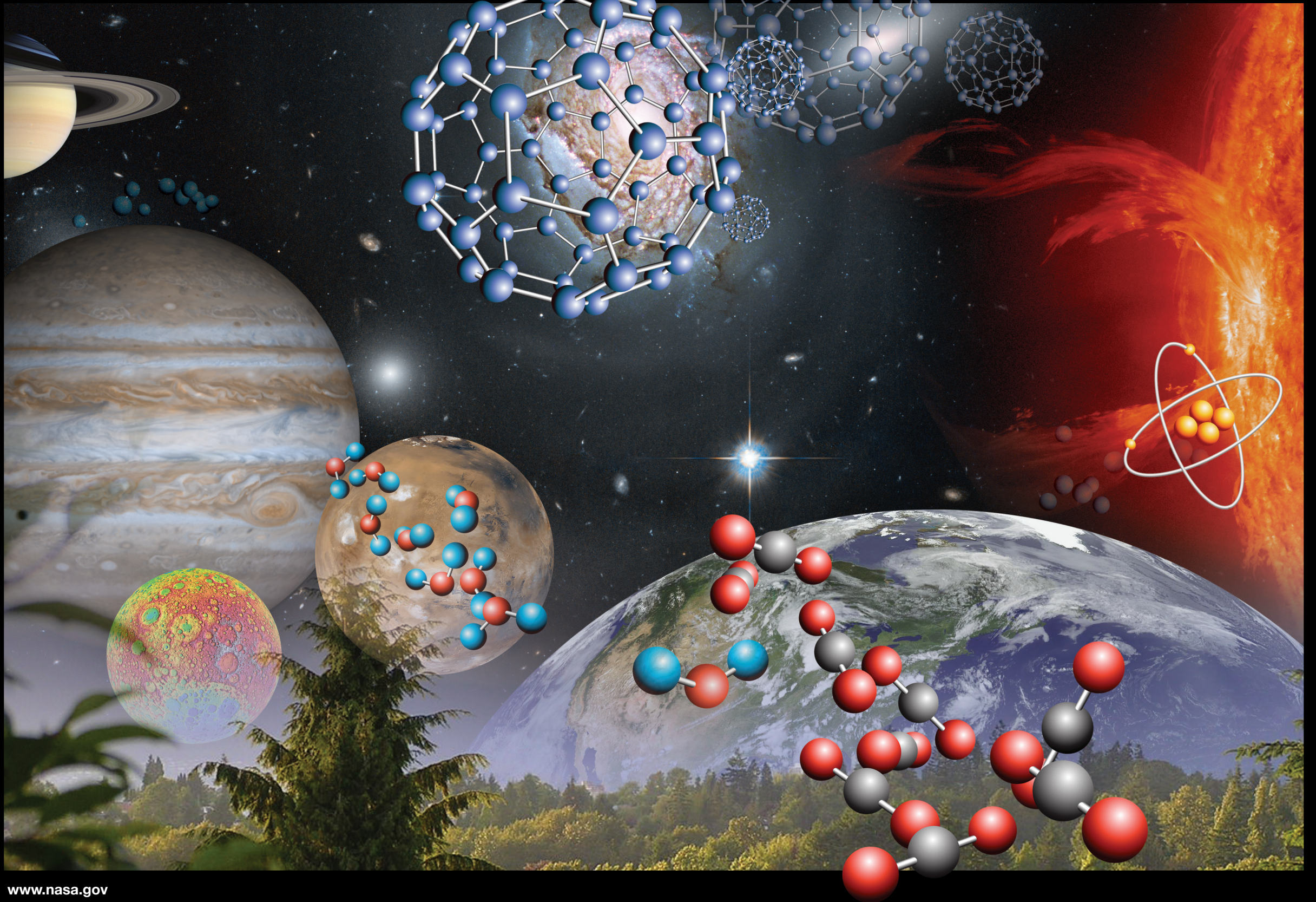
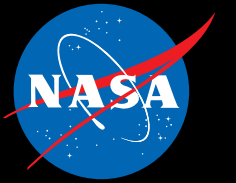
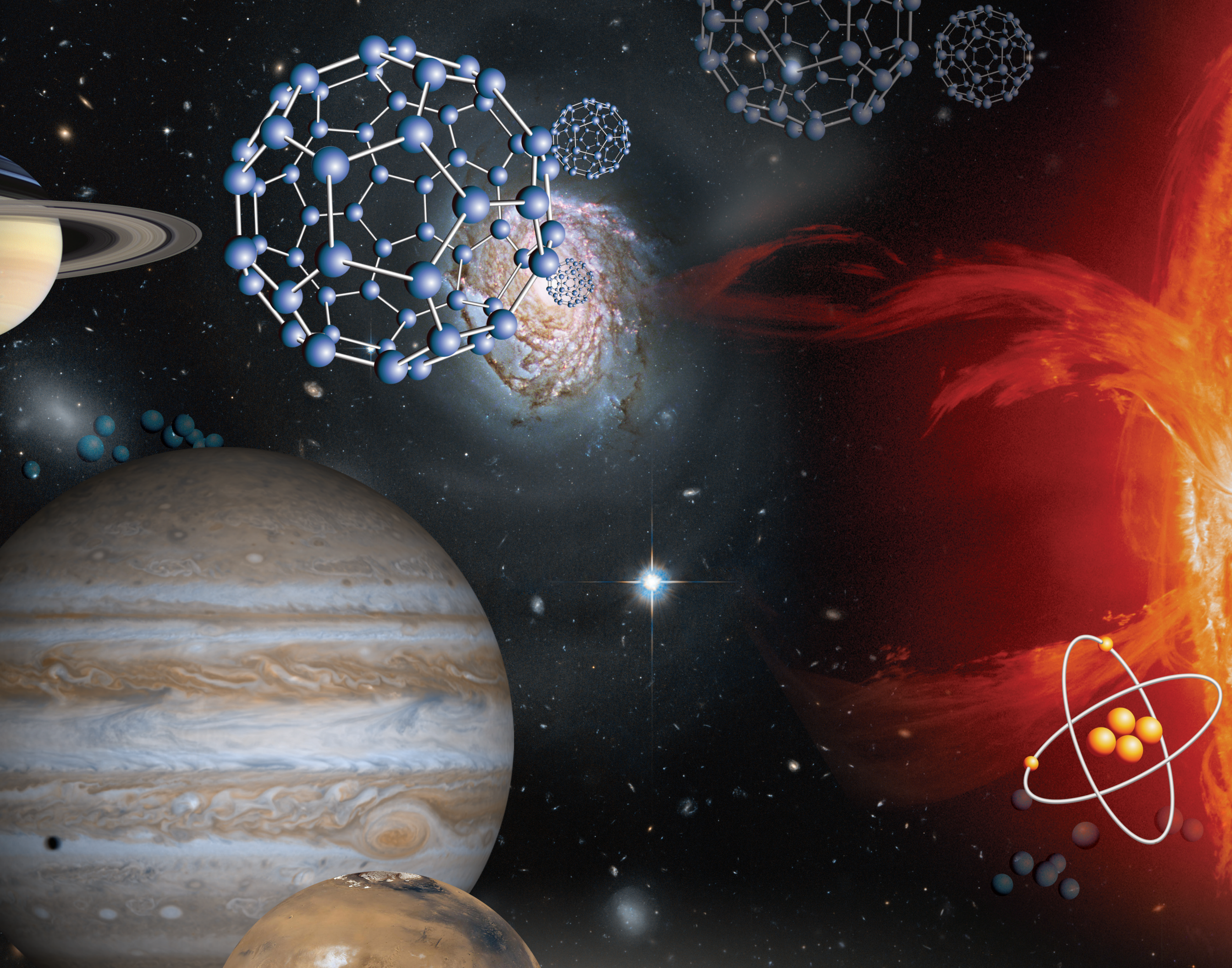
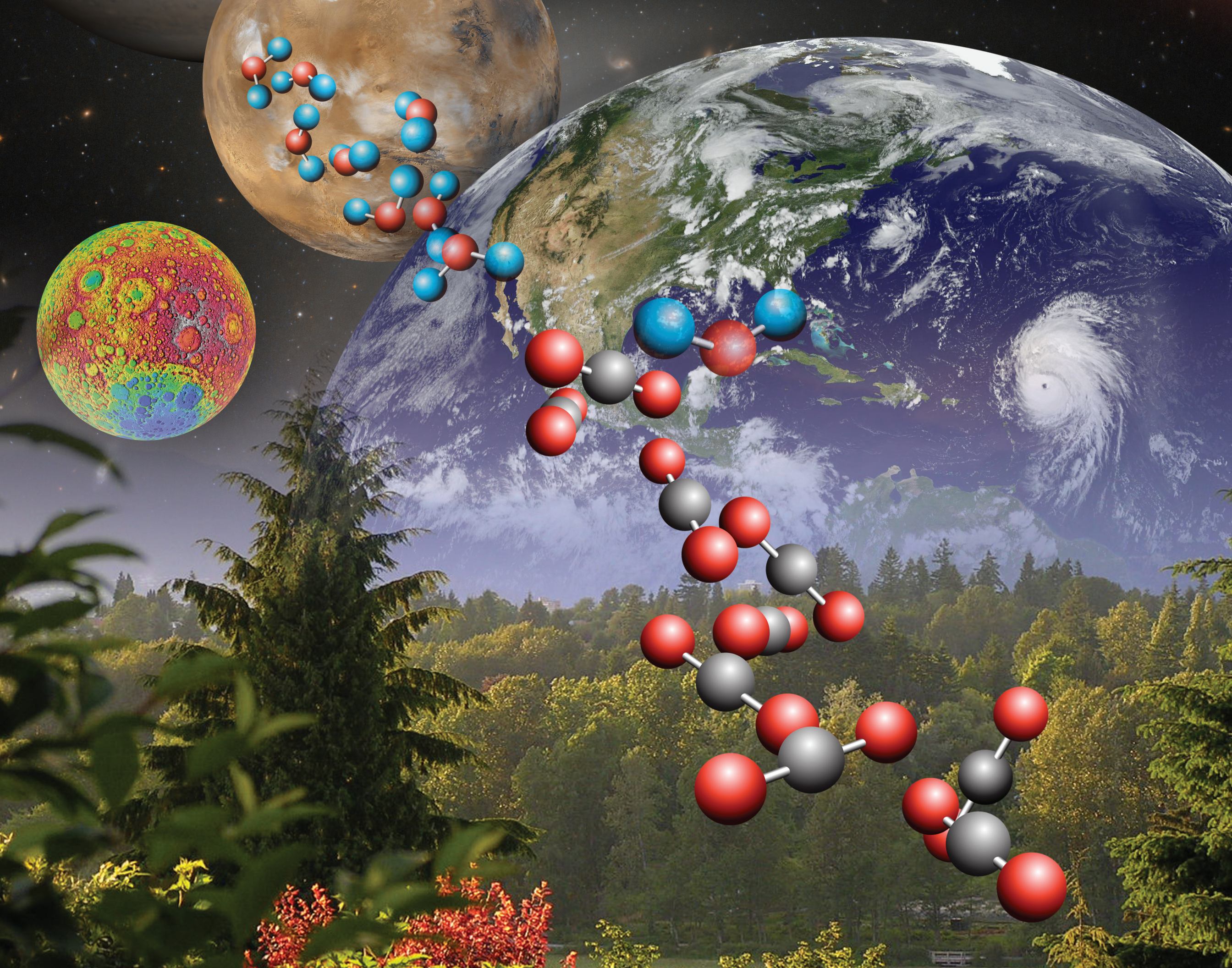


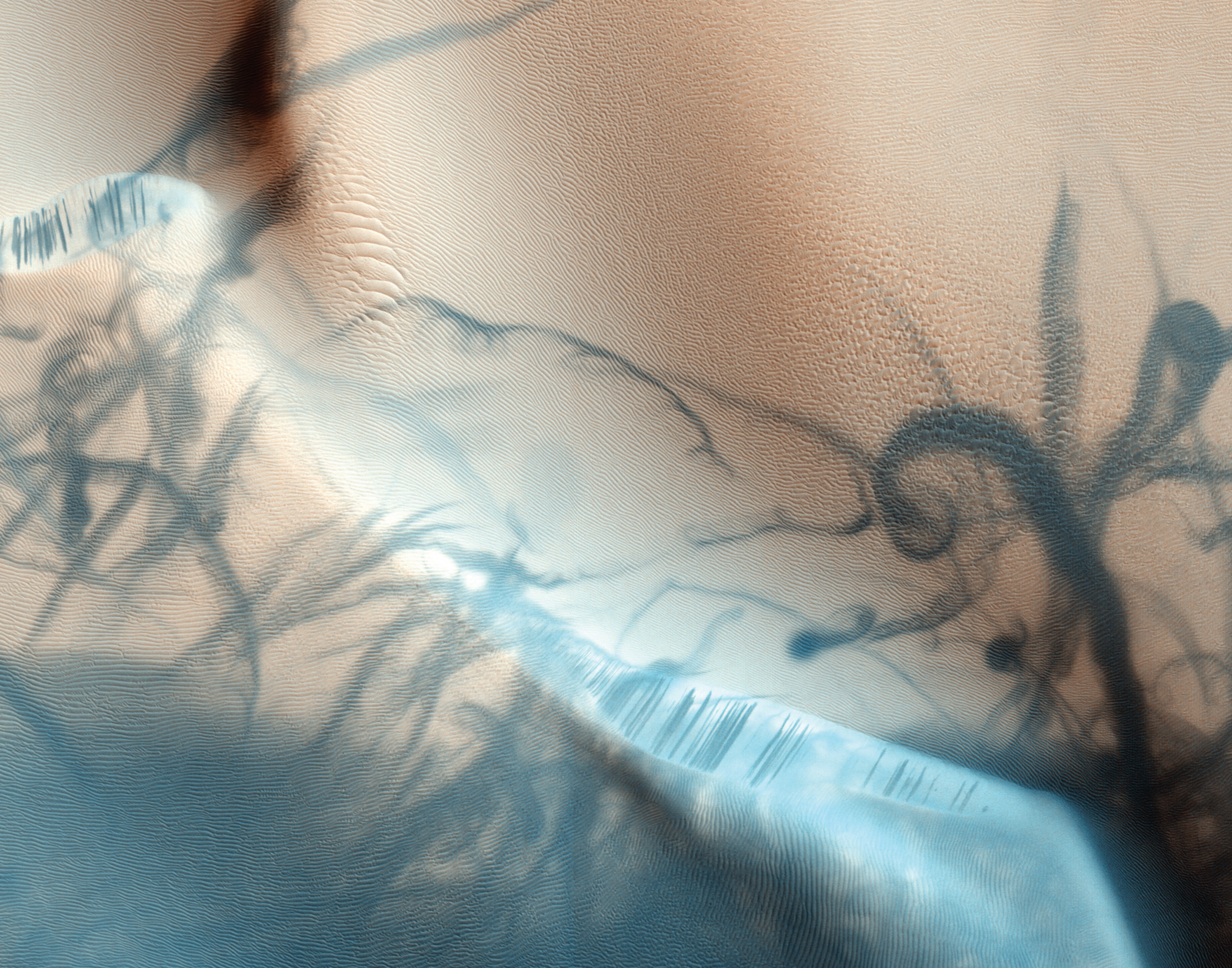
# NASA Science 2011

National Aeronautics and  
Space Administration









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
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	Martin Luther King, Jr. Day					
23	24	25	26	27	28	29
30	31					

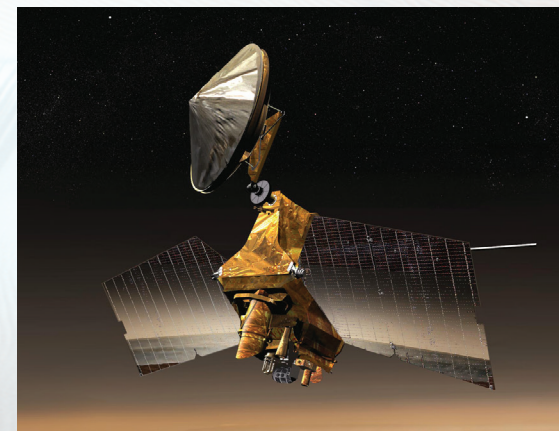
## Following the "Footprints" of the Martian Wind

In March 2006, the Mars Reconnaissance Orbiter (MRO) reached its destination and began science observations of the Red Planet in November 2006. MRO joined several other spacecraft that were already orbiting Mars or exploring its surface. These explorations pave the way for future spacecraft by monitoring daily weather and surface conditions, studying potential landing sites, and hosting a new telecommunications system.

MRO contains a host of scientific instruments that are used to analyze the landforms, stratigraphy, minerals, and ice of Mars. One of these instruments is the High Resolution Imaging Science Experiment (HiRISE) camera, the most powerful one of its kind ever sent to another planet. Its high resolution allows us to see Mars like never before, and helps other missions choose a safe spot to land for future exploration.

Just as it does on Earth, the wind helps to shape the Martian surface. It's sometimes difficult to "observe" wind directly, but as the HiRISE image reveals, we can certainly observe its impact. As strong winds blow across the Martian landscape, they generate and propel dust devils, which produce temporary dark scars across the long-term, intricate patterns of lighter sand dunes as seen above. This image shows an area about .6 miles (1 km) wide.

Image and Partial Text Credit: NASA/JPL/University of Arizona



Artist's illustration of the Mars Reconnaissance Orbiter.  
Credit: NASA/JPL-Caltech

### DECEMBER 2010

S	M	T	W	T	F	S
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### FEBRUARY 2011

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27	28					





Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
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20	21	22	23	24 ●	25	26
27	28					

Washington's Birthday

## Under the Celestial Mountains, Stars are Born

The Hubble Space Telescope holds the distinction of being the only telescope in space specifically designed to be serviced by humans—and that feature has certainly come in handy. On five separate occasions since its launch in 1990, astronauts on the Space Shuttle have done spacewalks to make repairs and modifications to Hubble. The latest (and last) of these servicing missions (STS 125) took place in May 2009. On the first spacewalk of this mission, astronauts installed Wide Field Camera 3 (WFC3), Hubble's last and most technologically advanced instrument to take images in the visible spectrum—it replaced the Wide Field and Planetary Camera 2.

WFC3 captured the above image of star-birth in the Carina Nebula—one of the largest “stellar nurseries” in the galaxy. The image evokes memories of the *Pillars of Creation* image (a classic Hubble image from 1995) but is even more detailed and intricate. The towering celestial “mountains” of gas and dust shown here are over three light years tall, and are being slowly eroded by the brilliant light of nearby bright stars. The massive pillars of dust also face pressure from within. Infant stars buried inside them fire off jets of gas that can be seen streaming from towering peaks like arrows sailing through the air. The colors in this composite image correspond to the glow of oxygen [blue], hydrogen and nitrogen [green], and sulfur [red].

Image and Partial Text Credit: NASA/ESA/Hubble 20th Anniversary Team (STScI)



Hubble drifts over Earth after its release on May 19, 2009, following the completion of *Servicing Mission 4*.  
Credit: NASA

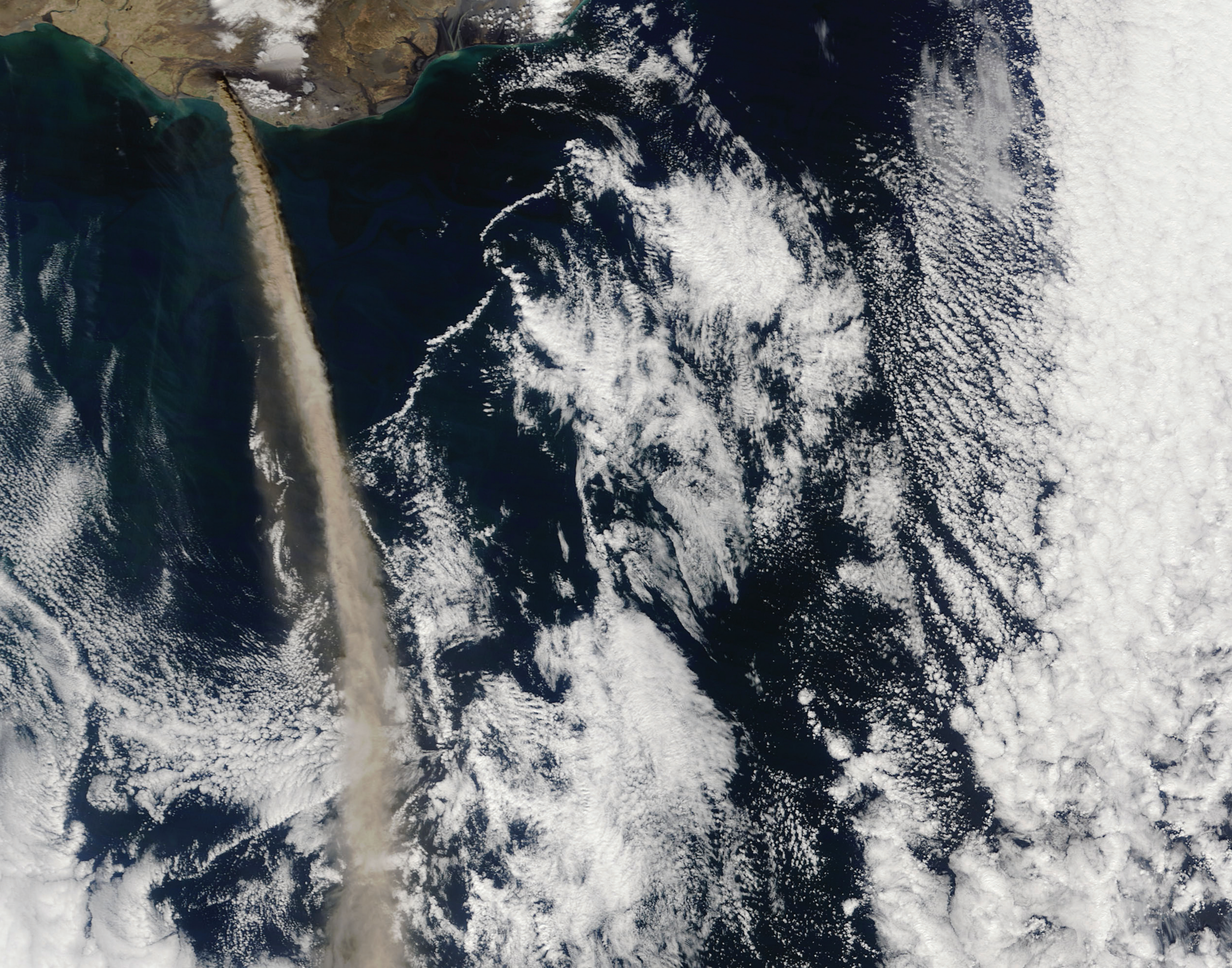
### JANUARY 2011

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30	31					

### MARCH 2011

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Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
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13	14	15	16	17	18	19 ●
Daylight Saving Time Begins						
20	21	22	23	24	25	26 ●
27	28	29	30	31		

## Tracking Plumes of Volcanic Ash

Launched in December 1999, Terra is the flagship of NASA's Earth Observing System, a coordinated series of polar-orbiting and low inclination satellites for long-term global observations of the land surface, biosphere, solid Earth, atmosphere, and oceans. Terra was the first of three larger multi-instrument missions that are now part of EOS—Aqua (2002) and Aura (2004) are the other two. Terra has been beaming back comprehensive information about Earth's land, oceans, cryosphere, and atmosphere for over ten years. The Moderate Resolution Imaging Spectroradiometer (MODIS) is one of the five instruments on Terra (an identical instrument flies on Aqua). One area for which MODIS imagery has proven especially useful is for monitoring natural disasters such as fires, floods, and volcanoes.

Iceland's Eyjafjallajökull Volcano began erupting on March 20, 2010 and continued on and off until May 23, 2010. The eruption projected volcanic ash several kilometers into the atmosphere. The resulting ash cloud caused significant air travel disruption in northwest Europe in April and May 2010, including the closure of airspace over many parts of Europe and even Northern Africa. As seen in the MODIS image above, on May 11, 2010, the ash was streaming almost directly south, visibly extending at least 530 miles (860 km) from Eyjafjallajökull. According to the London Volcanic Ash Advisory Center, the ash reached altitudes of 14,000–17,000 feet (4,300–5,200 m).

Image and Partial Text Credit: NASA/GSFC MODIS Rapid Response Team



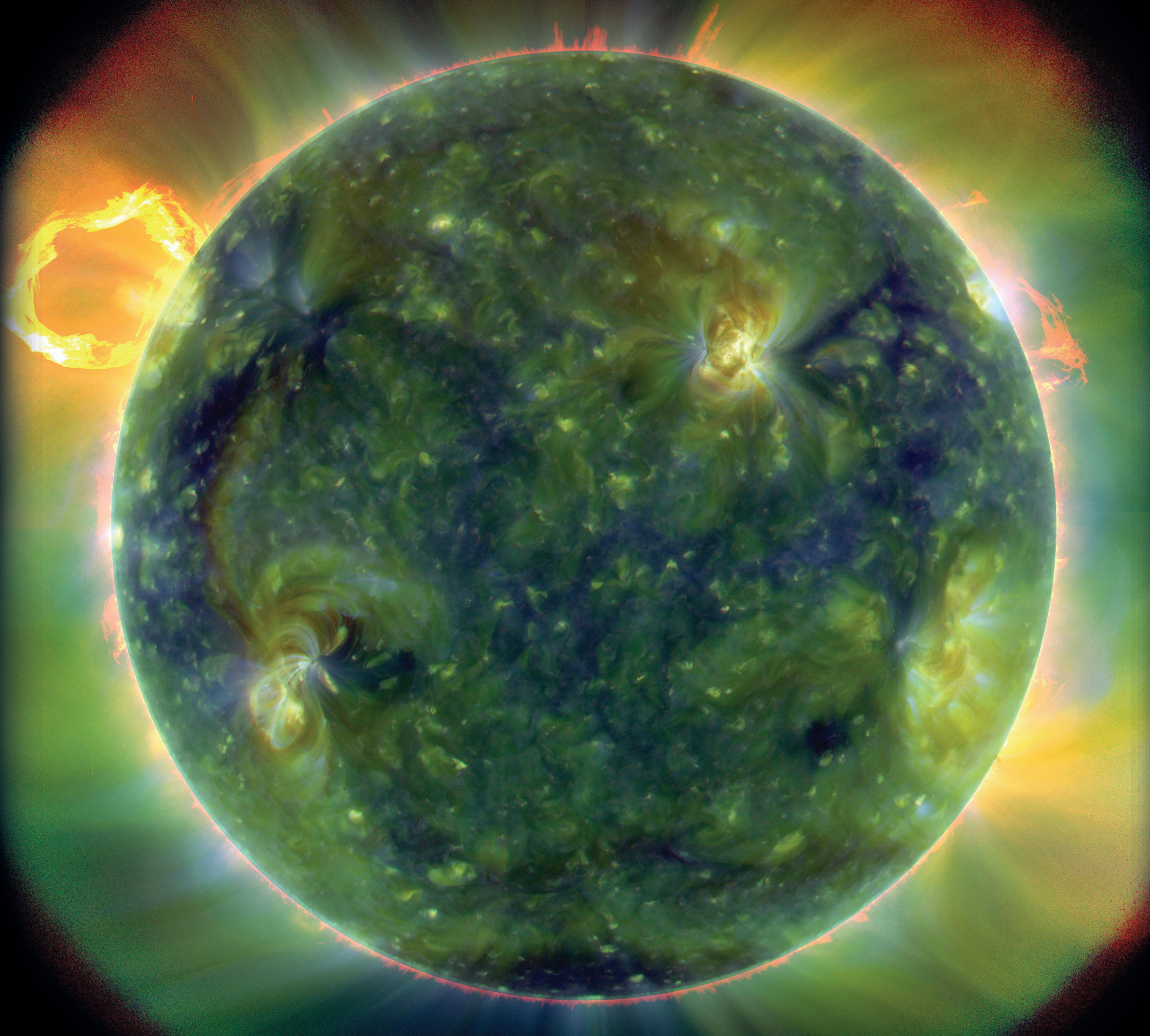
### FEBRUARY 2011

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27	28					

### APRIL 2011

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24	25	26	27	28	29	30





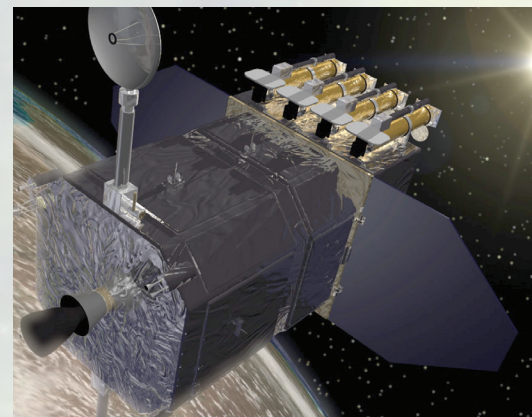
Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
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3 ●	4	5	6	7	8	9
10	11 ●	12	13	14	15	16
17	18 ●	19	20	21	22	23
24	25 ●	26	27	28	29	30

## Seeing the Sun as Never Before

Launched on February 11, 2010, the Solar Dynamics Observatory (SDO) is the most advanced spacecraft ever designed to study the sun. During its five-year mission, it will examine the sun's magnetic field and also provide a better understanding of the role the sun plays in regulating Earth's atmospheric chemistry and climate. SDO is returning more comprehensive science data faster than any other solar observing spacecraft and the clarity of the images is ten times better than high-definition television. The results returned from SDO are expected to enable a huge leap forward in our understanding of heliophysics, similar to that which the Hubble Space Telescope led to for modern astrophysics.

The image shown above is one of SDO's "first light" images taken on March 30, 2010. It is a full-disk multi-wavelength extreme ultraviolet image, taken by SDO's bank of telescopes called the Atmospheric Imaging Assembly (AIA). False colors trace different gas temperatures. Reds are relatively cool—about 60,000 K (107,540°F); blues and greens are hotter greater than 1 million K (1,799,540°F).

Image and Partial Text Credit: NASA/GSFC/SDO/AIA



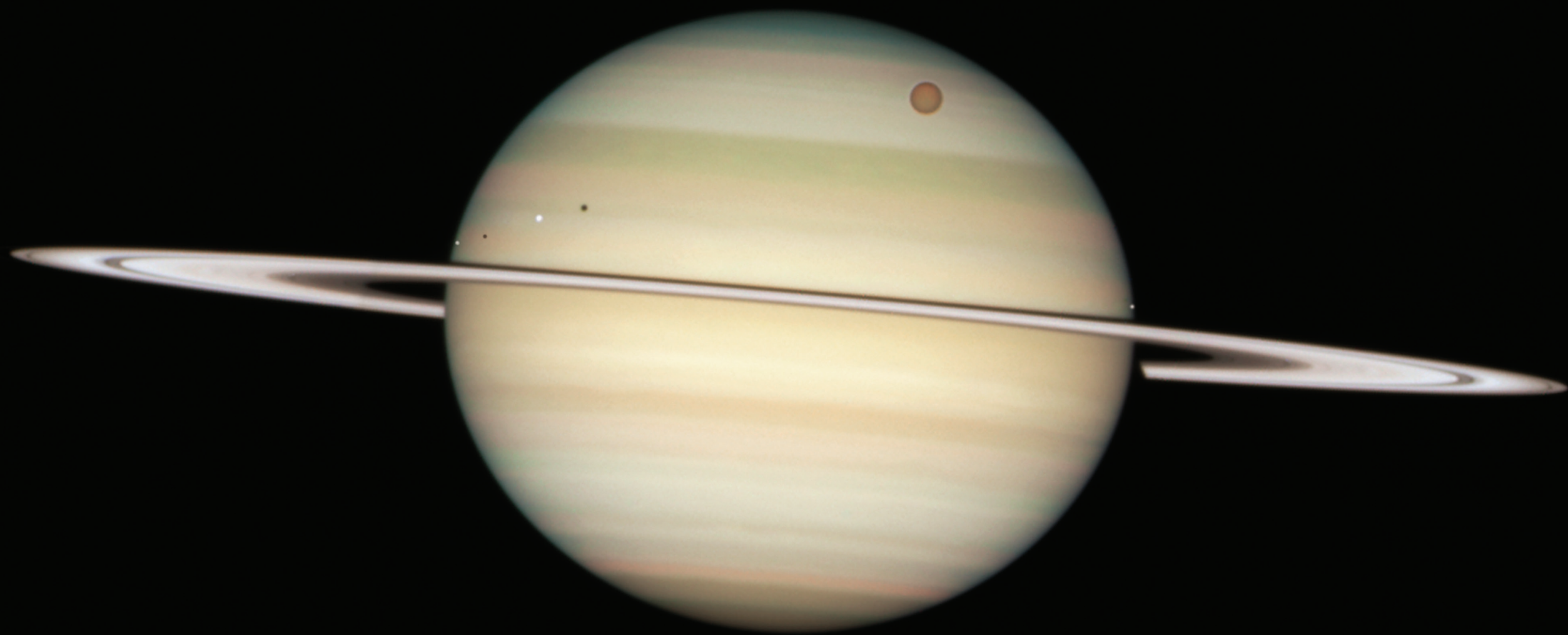
Artist's rendition of the Solar Dynamics Observatory.  
Credit: NASA/GSFC Conceptual Image Lab

### MARCH 2011

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27	28	29	30	31		

### MAY 2011

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



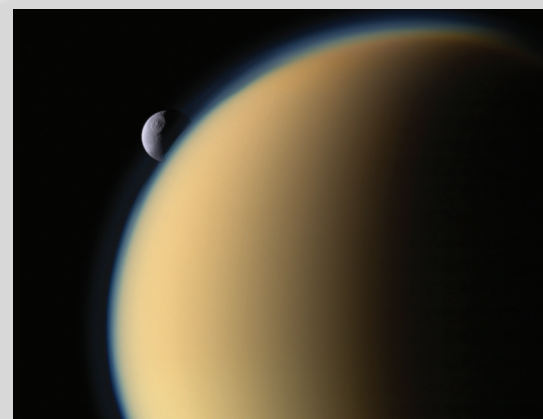
Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
1	2	3 ●	4	5	6	7
8	9	10 ●	11	12	13	14
Mother's Day 15	16	17 ●	18	19	20	21
22	23	24 ●	25	26	27	28
29	30	31				
Memorial Day						

## Four Moons Over A Gas Giant

The Hubble Space Telescope was launched into space from the Space Shuttle *Discovery* on April 24, 1990. Now 21 years after its launch, the venerable observatory continues to beam back remarkable images of the vast reaches of our universe with unprecedented clarity. It also observes objects much closer to home, revealing the intricate details of objects in our solar system—it can see objects as small as 300 km. Hubble is expected to remain in operation at least until the launch of its successor, the James Webb Space Telescope.

The image shown above captures the transit of several moons across the face of the planet Saturn. The giant orange moon Titan—larger than the planet Mercury—can be seen at upper right. The white icy moons that are much closer to Saturn, hence much closer to the ring plane in this view, are, from left to right: Enceladus, Dione, and Mimas. The dark band running across the face of the planet slightly above the rings is the shadow of the rings cast on the planet. This picture was taken with Hubble's Wide Field Planetary Camera 2 on February 24, 2009, when Saturn was at a distance of roughly 1.25 billion km from Earth.

Image and Partial Text Credit: NASA/ESA/Hubble Heritage Team (STScI/AURA). Acknowledgment: STScI/UC Berkeley/Philippines



NASA's Cassini spacecraft captured this image as Saturn's moon, Tethys, slipped behind Titan on November 26, 2009. Credit: NASA/JPL/Space Science Institute

APRIL 2011						
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JUNE 2011						
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12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30		





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 Flag Day	22	23 ●	24	25
26 Father's Day	27	28	29	30		

## A Seagull, a Lizard, and a “Big Dog”

Launched in December 2009, the Wide-field Infrared Survey Explorer (WISE) is the most advanced infrared-wavelength astronomical telescope to date. WISE is mapping the sky in infrared light, searching for the nearest and coolest stars, the origins of stellar and planetary systems, and the most luminous galaxies in the universe. As of July 2010, WISE had completed one full survey of the sky. Because of its ability to see cool objects in infrared, WISE data are also used to detect near-Earth objects. WISE should be able to map about half the sky again before its supply of coolant is exhausted.

On May 20, 2010, WISE captured this image of the Seagull Nebula, which is so-named because when viewed a certain way, the formation resembles a gull in flight. On the other hand, if you rotate the image 180° you will notice that it bears a passing resemblance to a galloping lizard—or perhaps a dragon or a dinosaur. The image spans an area about seven times as wide as the full moon, and three times as high (3.55 x 1.37°); it straddles the border between the constellations Monoceros and Canis Major (the “Big Dog”). So you might say this lizard is running with the “Big Dog,” while the gull is flying from it.

All four infrared detectors aboard WISE were used to make this image. Color is representational: blue and cyan represent infrared light at wavelengths of 3.4 and 4.6 μm—the predominant source is light from stars. Green and red represent light at 12 and 22 μm—primarily light emanating from warm dust.

Image and Partial Text Credit: NASA/JPL-Caltech/WISE Team



Artist's concept of the Wide-field Infrared Survey Explorer.  
Credit: NASA/JPL-Caltech

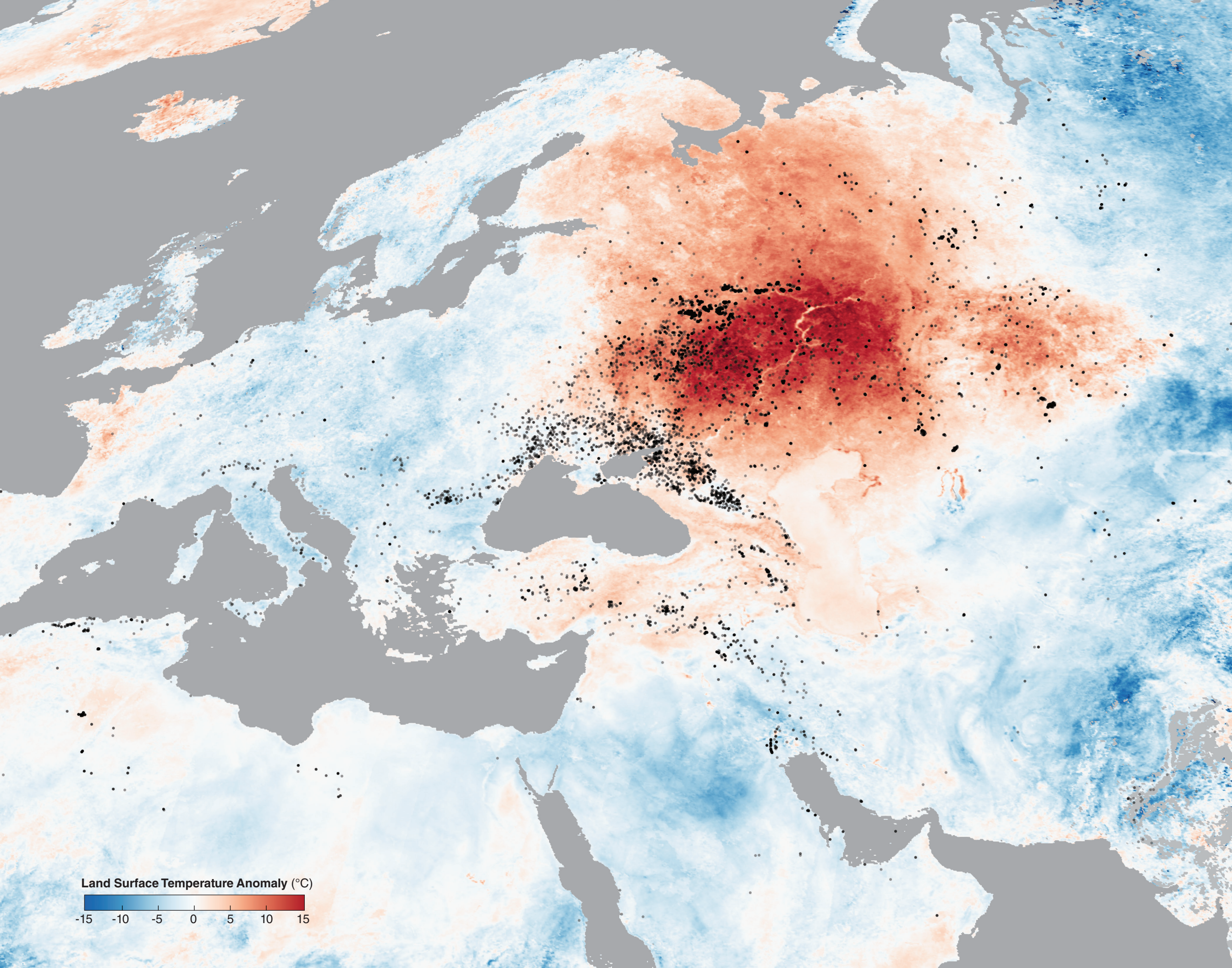
### MAY 2011

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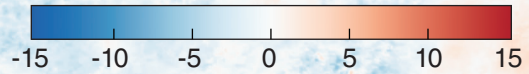
### JULY 2011

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Land Surface Temperature Anomaly (°C)





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

## It's Been a Long Hot Summer...

Extreme heat gripped many parts of the world in 2010, but perhaps no area was impacted more than parts of Eastern Europe and Russia. The Russian heatwave was truly historic in scope and duration, and garnered international attention last summer.

The extreme heat over Russia was primarily a product of an atmospheric pattern known as blocking. In the midlatitudes, weather systems move from west to east across the globe, but sometimes the presence of a strong and persistent atmospheric feature can block the normal flow. In this case, a strong area of high pressure parked itself over this area in mid-summer and didn't budge for months. In a normal progressive pattern, periodic intrusions of cooler air and precipitation would bring temporary relief from summer heat. But with the blocking high in place, the relief never came. Day after day, temperatures soared to near record levels, and the landscape became tinder dry. The stage was set for what happened next...an increase in wildfire activity.

The Moderate Resolution Imaging Spectroradiometer on Terra and Aqua has compiled a nearly ten-year record of global surface temperature—at least one MODIS instrument has been in operation since 2000. The map above shows daytime temperature anomalies for the five-day period covering July 28–August 1—i.e., the map shows how these five-day 2010 temperatures differ from the ten-year MODIS average. Reds indicate where temperatures are above average and blues where temperatures are below average. The black dots represent the location of active fires as detected by MODIS on Terra and Aqua throughout the five-day period.

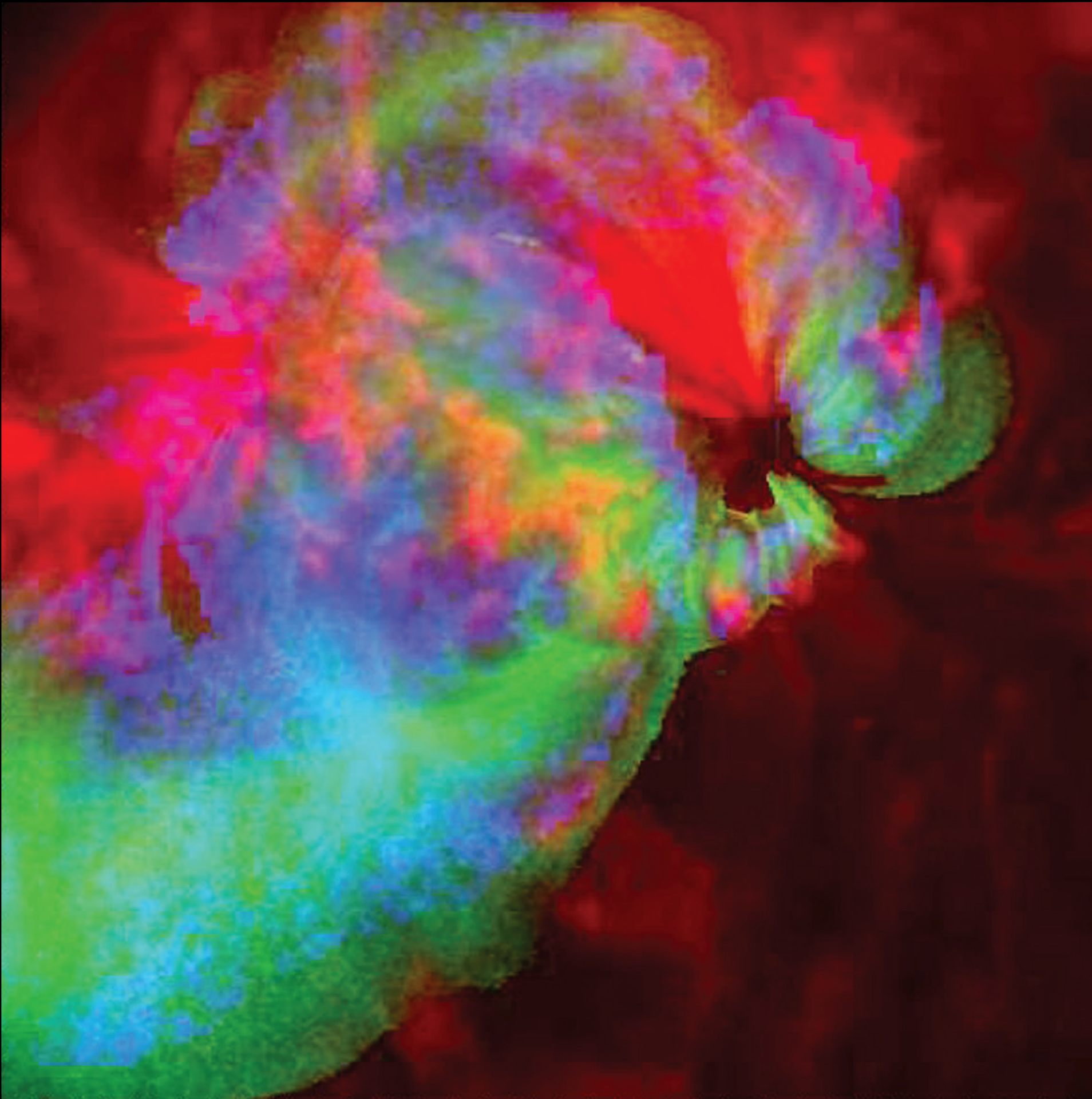
Image and Partial Text Credit: NASA/MODIS Science Team/University of Maryland Fire Information for Resource Management System (FIRMS)



JUNE 2011						
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AUGUST 2011						
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21	22	23	24	25	26	27
28	29	30	31			







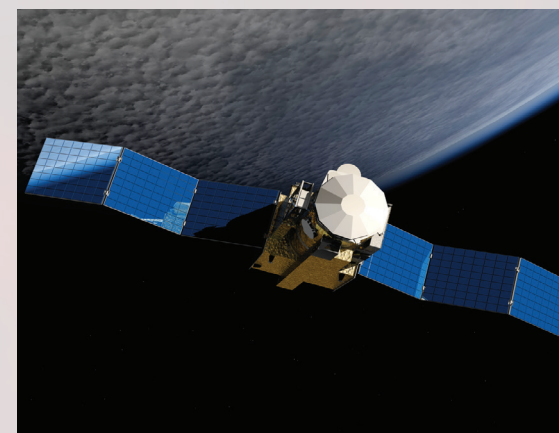
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28	29 	30	31			

## Hinode Solves Mystery of Why Temperatures in the Sun's Atmosphere Are Much Hotter Than at the Sun's Surface

The mystery of why temperatures in the solar corona, the sun's outer atmosphere, soar to several million degrees Kelvin (K)—much hotter than temperatures nearer the sun's surface—has puzzled scientists for decades. New observations made with instruments aboard the joint JAXA/NASA Hinode satellite reveal the cause to be nanoflares. Nanoflares are small, sudden bursts of heat and energy. They occur within tiny strands that are bundled together to form a magnetic tube called a coronal loop. Coronal loops are the fundamental building blocks of the thin, translucent gas known as the sun's corona.

This false-color temperature map shows solar active region AR10923, observed close to the center of the sun's disk. Blue regions indicate plasma near 10 million degrees K.

Credit: NASA/JAXA

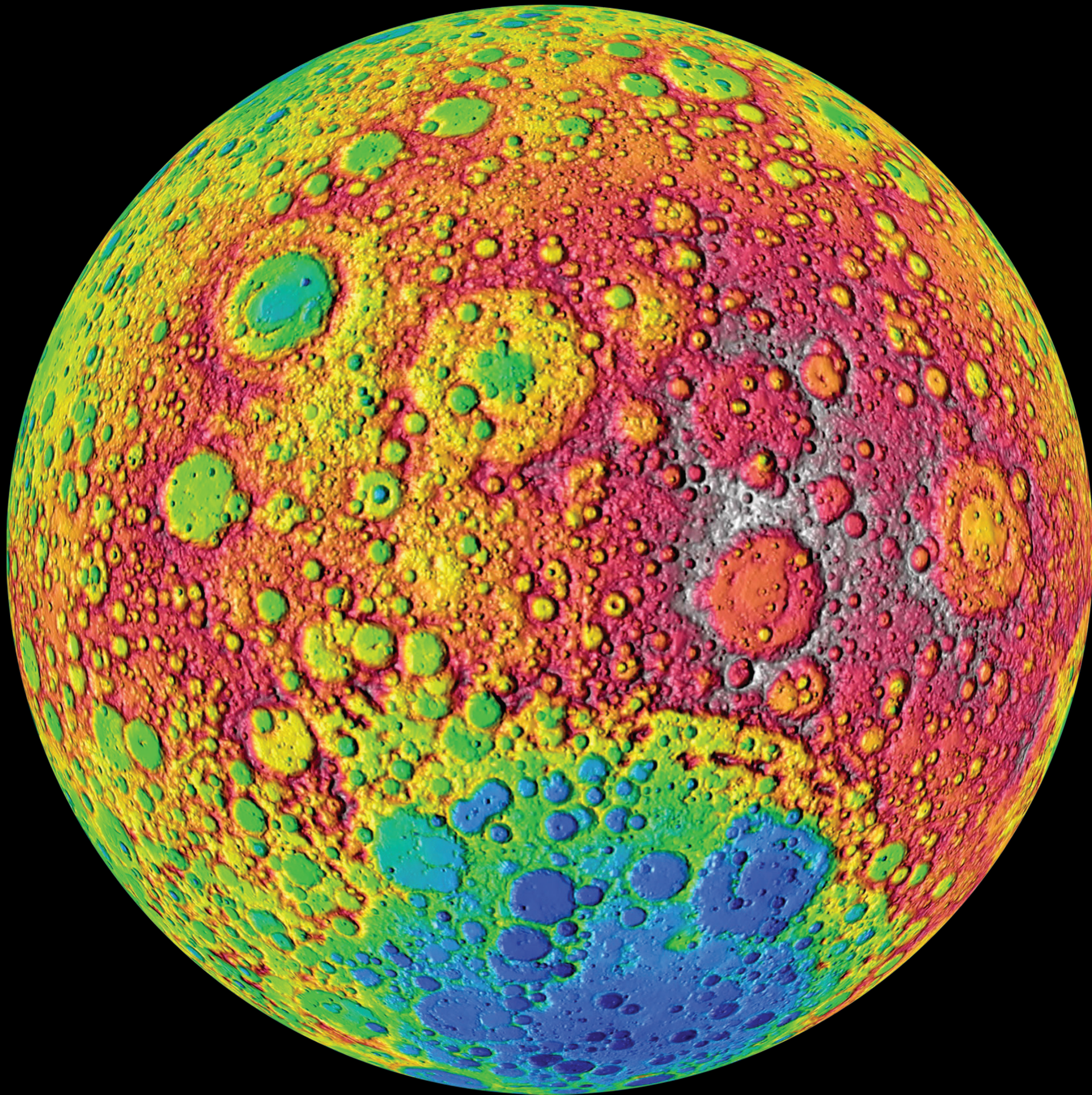


Artist's illustration of the Hinode Spacecraft. Credit: NASA

JULY 2011						
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17	18	19	20	21	22	23
24 <del>31</del>	25	26	27	28	29	30

SEPTEMBER 2011						
S	M	T	W	T	F	S
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18	19	20	21	22	23	24
25	26	27	28	29	30	







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

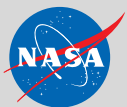
## Craters on the Far Side of the Moon

The Lunar Reconnaissance Orbiter (LRO) aims to create a detailed map of the moon to help identify safe landing sites for future human exploration, locate potential resources on the moon, characterize the radiation environment, and demonstrate new technology. NASA intends LRO to prepare the way for future manned missions to the moon.

The Lunar Orbiter Laser Altimeter (LOLA) provides a precise global lunar topographic model and geodetic grid that allows scientists to identify and map the distribution of impact craters and basins on the lunar surface. These data help them determine the age of the lunar crust and document early bombardment of the Solar System.

LOLA gives us a particularly revealing look at the side of the moon that (as a result of tidal forces between the Earth and the moon) is permanently hidden from view on Earth's surface. (This is often called the *dark side of the moon*, but a more correct name would be the *far side of the moon* since it receives just as much sunlight as the side that faces us.) The data reveal a violent impact history on the far side of the moon. The lunar far side is a rugged environment—much rougher and with many more craters than the near side. Quite a few of the most fascinating lunar features are located there, including one of the largest known impact craters in the Solar System, the South Pole–Aitken Basin. In this false-color image, the highest elevations up above 20,000 feet are in red and the lowest areas down below -20,000 feet in blue.

Image and Partial Text Credit: NASA/GSFC



Artist's rendering of the Lunar Reconnaissance Orbiter circling the moon. Credit: NASA

AUGUST 2011						
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21	22	23	24	25	26	27
28	29	30	31			

OCTOBER 2011						
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16	17	18	19	20	21	22
23 <del>30</del>	24 <del>31</del>	25	26	27	28	29



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
<del>23</del>	<del>24</del>	25	26 	27	28	29
30	31 Halloween					

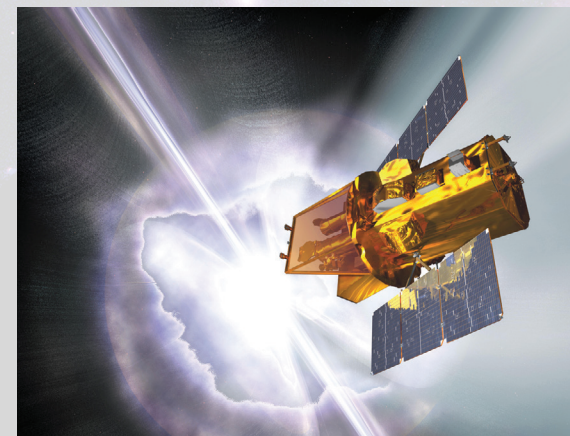
## A Swift Portrait of Andromeda

The Swift mission is designed to study the most powerful explosions the Universe has seen since the Big Bang. Called *gamma-ray bursts* (GRBs) these elusive pulses occur approximately once per day and are brief, but intense, flashes of gamma radiation. There's a lot scientists don't understand about GRBs, such as what causes them and how they may be connected to other phenomena, e.g., the formation of black holes or the collisions of neutron stars. With Swift, scientists have a tool dedicated to answering these questions and solving the GRB mystery.

But on September 16, 2009, Swift took a break from its usual task to peer at a nearby (relatively speaking) galaxy. The image shown here is the highest-resolution view of a neighboring spiral galaxy ever attained in the ultraviolet. The galaxy, known as M31 in the constellation Andromeda, is the largest and closest spiral galaxy to our own. M31 is more than 220,000 light-years across and lies 2.5 million light-years away. On a clear, dark night, the galaxy is faintly visible as a misty patch to the naked eye.

From May 25–July 26, 2008, Swift's Ultraviolet/Optical Telescope (UVOT) acquired 330 images of M31 at wavelengths of 192.8, 224.6, and 260 nm. The images—85 gigabytes worth!—represent a total exposure time of 24 hours, and reveal about 20,000 ultraviolet sources—especially hot, young stars and dense star clusters.

Image and Partial Text Credit: NASA/Swift/GSFC/UMCP



Artist's concept of the Swift spacecraft with a gamma-ray burst in the background. Credit: NASA/Spectrum Astro

## SEPTEMBER 2011

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25	26	27	28	29	30	

## NOVEMBER 2011

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20	21	22	23	24	25	26
27	28	29	30			







# November 2011



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

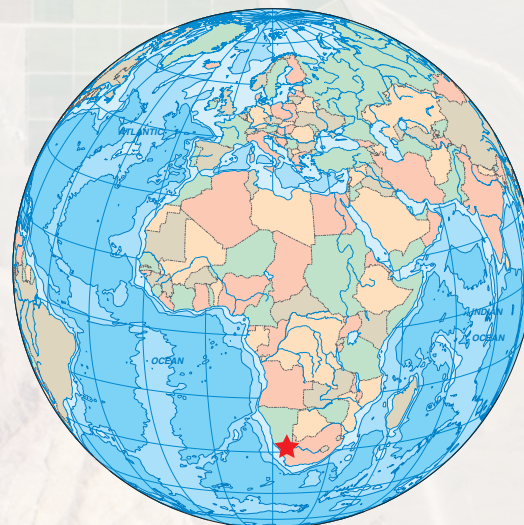
## A Patchwork of Green on an Arid Landscape

The Earth Observing-1 (EO-1) satellite was created as part of NASA's New Millennium Program to demonstrate new technologies that will help enable the development of future Earth imaging observatories. EO-1 successfully completed its baseline mission on November 20, 2001 and since then has been operating in an Extended Mission operations phase. The Extended Mission operates within constraints imposed by its technology-pioneering origins, but it also provides unique and valuable observing capabilities.

The Advanced Land Imager (ALI) is a multi-spectral instrument on EO-1 that has been shown to be a significant improvement over the Advanced Thematic Mapper Plus on Landsat 7.

On February 15, 2010, ALI captured a true color image that shows the dramatic impact that irrigation has on the landscape around the Orange River that forms part of the border between Namibia and the Republic of South Africa. Located roughly 60 miles (100 km) inland from where the river empties into the Atlantic Ocean, these irrigation projects draw water from the river and use soils from the floodplains to grow produce. In the image, the irrigated areas show up as a network of bright rectangles of varying shades of green that stands in stark contrast to the surrounding gray, beige, tan, and rust. Immediately south of a large collection of irrigated plots, faint beige circles reveal center-pivot irrigation fields apparently allowed to go fallow.

Image and Partial Text Credit: NASA Earth Observatory/EO-1 Team



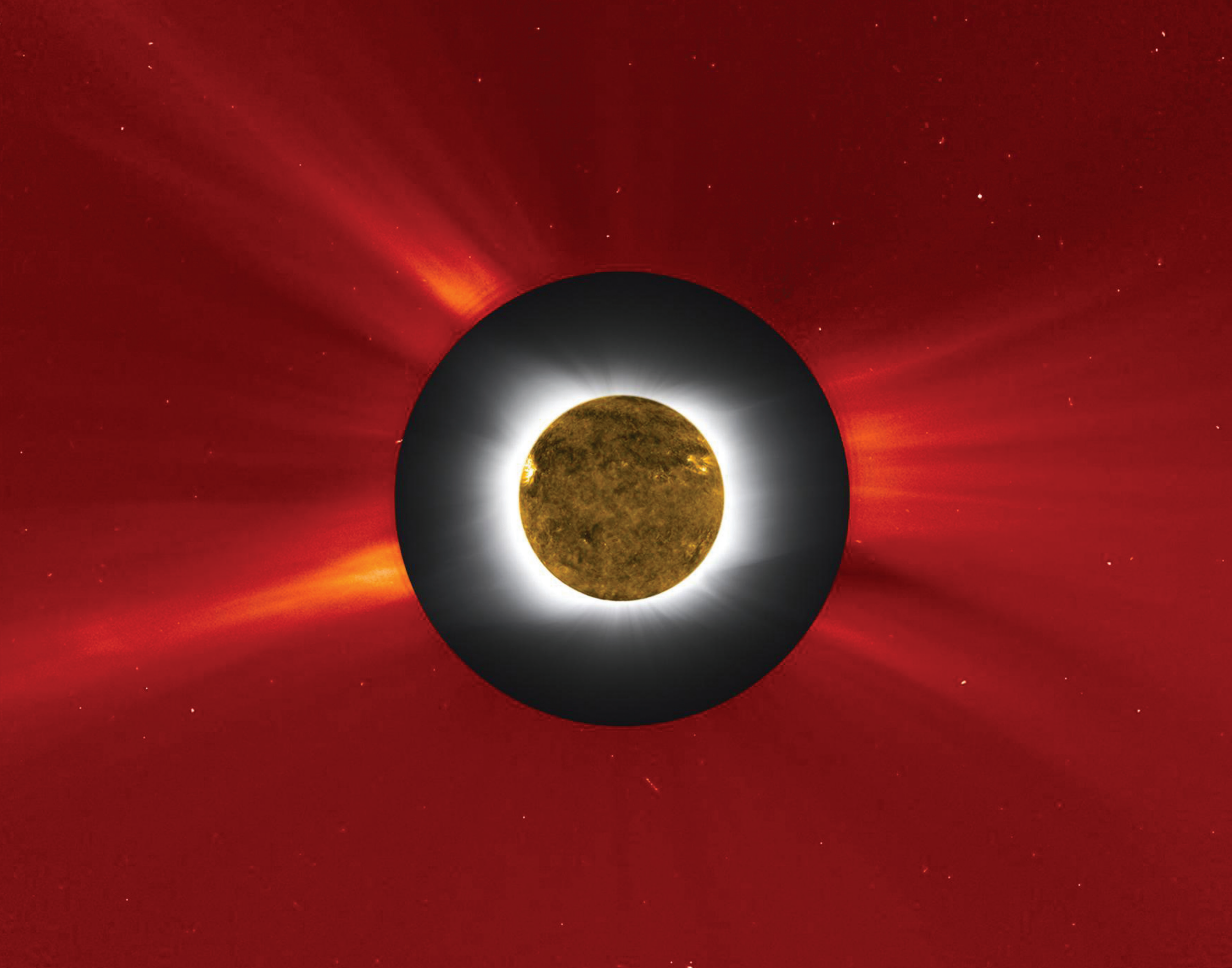
## OCTOBER 2011

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 2011

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





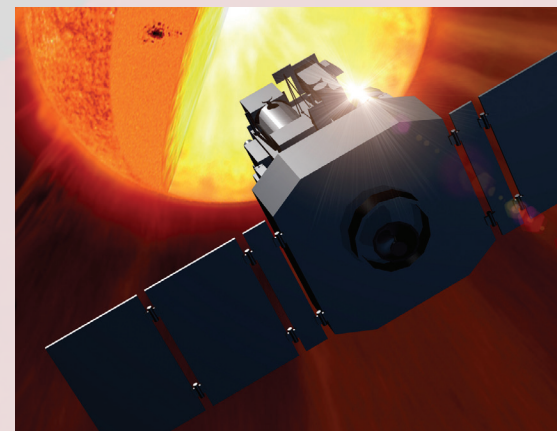
Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
				1	2 	3
4	5	6	7	8	9	10 
11	12	13	14	15	16	17
18 	19	20	21	22	23	24 
25	26	27	28	29	30	31

Christmas Day

## SOHO and SDO Observe Easter Island Eclipse

On July 11, 2010, the new moon passed directly in front of the sun, causing a total solar eclipse in the South Pacific. In this image, the solar eclipse is shown in gray and white from a photo provided by the Williams College Expedition to Easter Island. It was embedded with an image of the sun's outer corona taken by the Large Angle Spectrometric Coronagraph (LASCO) on the Solar and Heliospheric Observatory (SOHO) spacecraft and shown in red false color. LASCO uses a disk to blot out the bright sun and the inner corona so that the faint outer corona can be monitored and studied. Further, the dark silhouette of the moon was covered with an image of the sun taken in extreme ultraviolet light at about the same time by the Atmospheric Imaging Assembly on the Solar Dynamics Observatory (SDO). The composite brings out the correlation of structures in the inner and outer corona.

Image Credit: NASA/ESA/Williams College Eclipse Expedition



Artist's concept of the SOHO spacecraft exploring the sun.  
Credit: NASA/ESA

### NOVEMBER 2011

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 2012

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				



