National Aeronautics and Space Administration

Goddard View

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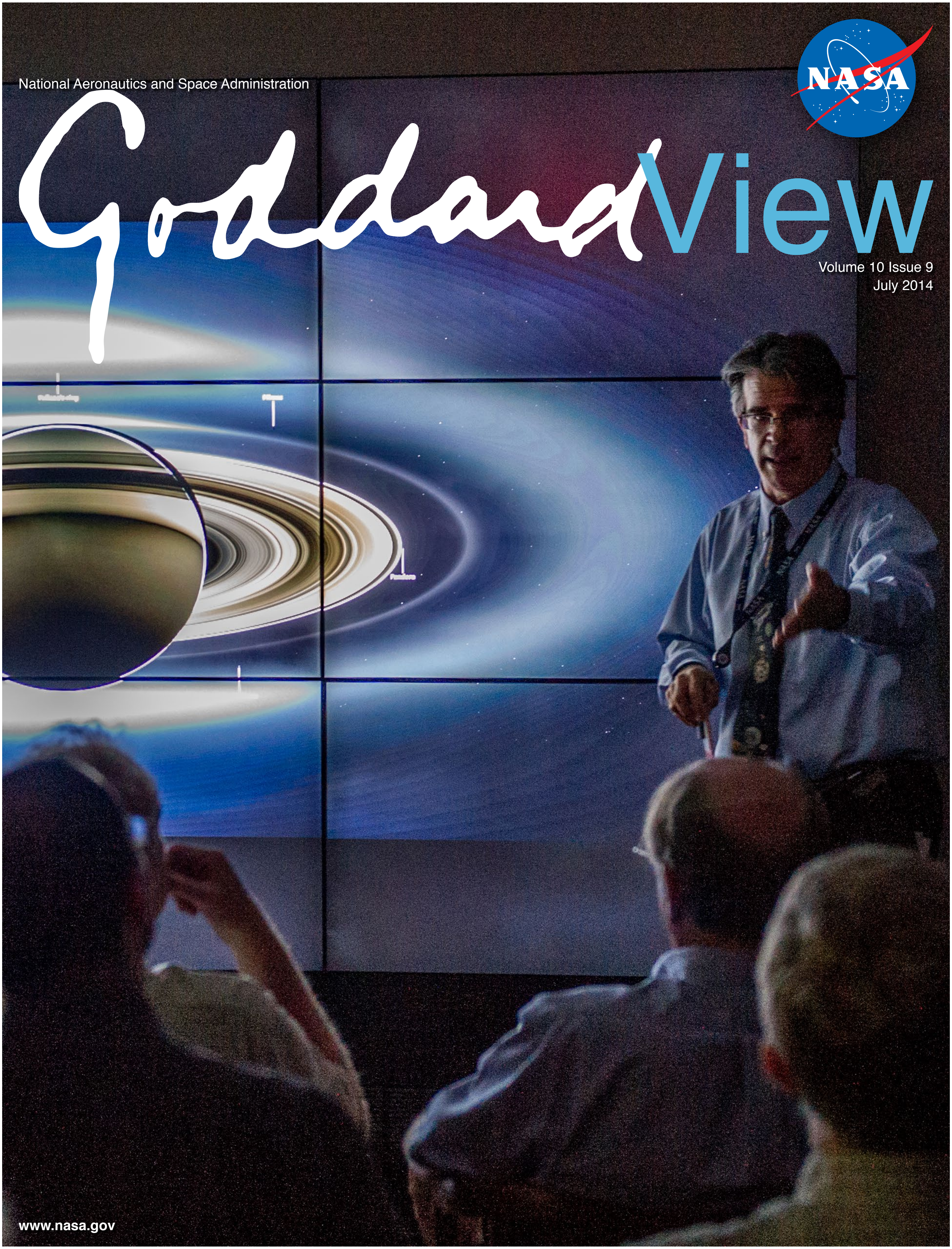

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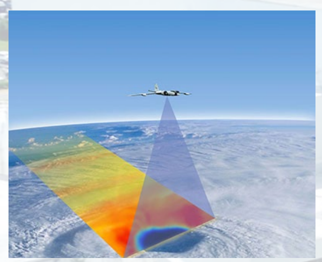
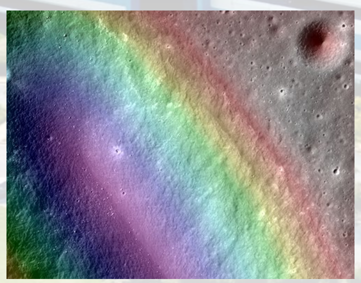
THE WEEKLY



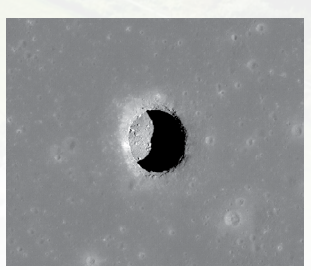
The HIRAD Instrument
The Hurricane Imaging Radiometer, known as HIRAD, will fly aboard one of two unmanned Global Hawk aircraft during NASA's Hurricane Severe Storm Sentinel or HS3 mission from Wallops beginning August 26. Learn more about HS3 by clicking on the image.

A Colorful Look at Birt E Crater
This false color image of Birt E crater shows the topography of the moon and is thought to be the source region for lava that carved out Rima Birt, a rille in Mare Nubium. For more information and more stunning images, click on the image.



Goddard in the Galaxy
Goddard has released a video giving a general overview of some of Goddard's active missions and the ways NASA Goddard explores the universe. The popular video features a soundtrack from the popular rock group Fall Out Boy. To see the video, click on the image.

Lunar Pits Could Shelter Astronauts
While the moon's surface is battered by millions of craters, it also has over 200 holes—steep-walled pits that in some cases might lead to caves that future astronauts could explore and use for shelter, according to new LRO observations. Explore more by clicking on the photo.



GoddardView

On the cover: Goddard Chief Scientist James Garvin gives a presentation in front of the Hyperwall during this year's Science Jamboree. Photo credit: NASA/Goddard/Bill Hrybyk

GoddardView Info

Goddard View is an official publication of NASA's Goddard Space Flight Center. Goddard View showcases people and achievements in the Goddard community that support Goddard's mission to explore, discover and understand our dynamic universe. Goddard View is published by NASA Goddard's Office of Communications.

You may submit contributions to the editor at john.m.putman@nasa.gov. Ideas for new stories are welcome but will be published as space allows. All submissions are subject to editing.

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NOAA'S GOES-R SATELLITE MAGNETOMETER READY FOR SPACECRAFT INTEGRATION

By: Rob Gutro

The Magnetometer instrument that will fly on NOAA's GOES-R satellite when it is launched in early 2016 has completed the development and testing phase and is ready to be integrated with the spacecraft.

The Magnetometer will monitor magnetic field variations around the Earth and enable forecasters at NOAA's Space Weather Prediction Center to better predict the consequences of geomagnetic storms. These storms pose a threat to orbiting spacecraft and human spaceflight. In addition, the measurements taken by the Magnetometer will aid in providing alerts and warnings to power companies and satellite operators due to the potential damage a change in magnetic flux can have on electric power grids and satellite systems.

"This milestone is another example of our continuing progress to develop, build and launch GOES-R," said Greg Mandt, NOAA system program director for the GOES-R Series Program at NASA's Goddard Space Flight Center in Greenbelt, Maryland.

The Magnetometer instrument hosts a boom that, once in space, will extend 26 feet away from the satellite. This allows the sensor to be much more perceptive of the space magnetic environment, resulting in even better forecasting of space weather. The magnetometer sensors and electronics elements were built by Macintyre Electronic Design Associates, Inc. in Sterling, Virginia and the boom element of the instrument was built by ATK in Goleta, California.

The electronics units were installed on the spacecraft panels and the sensors and the boom will be integrated onto the satellite in the fall. The Magnetometer is the fifth of six total instruments to be completed for GOES-R.

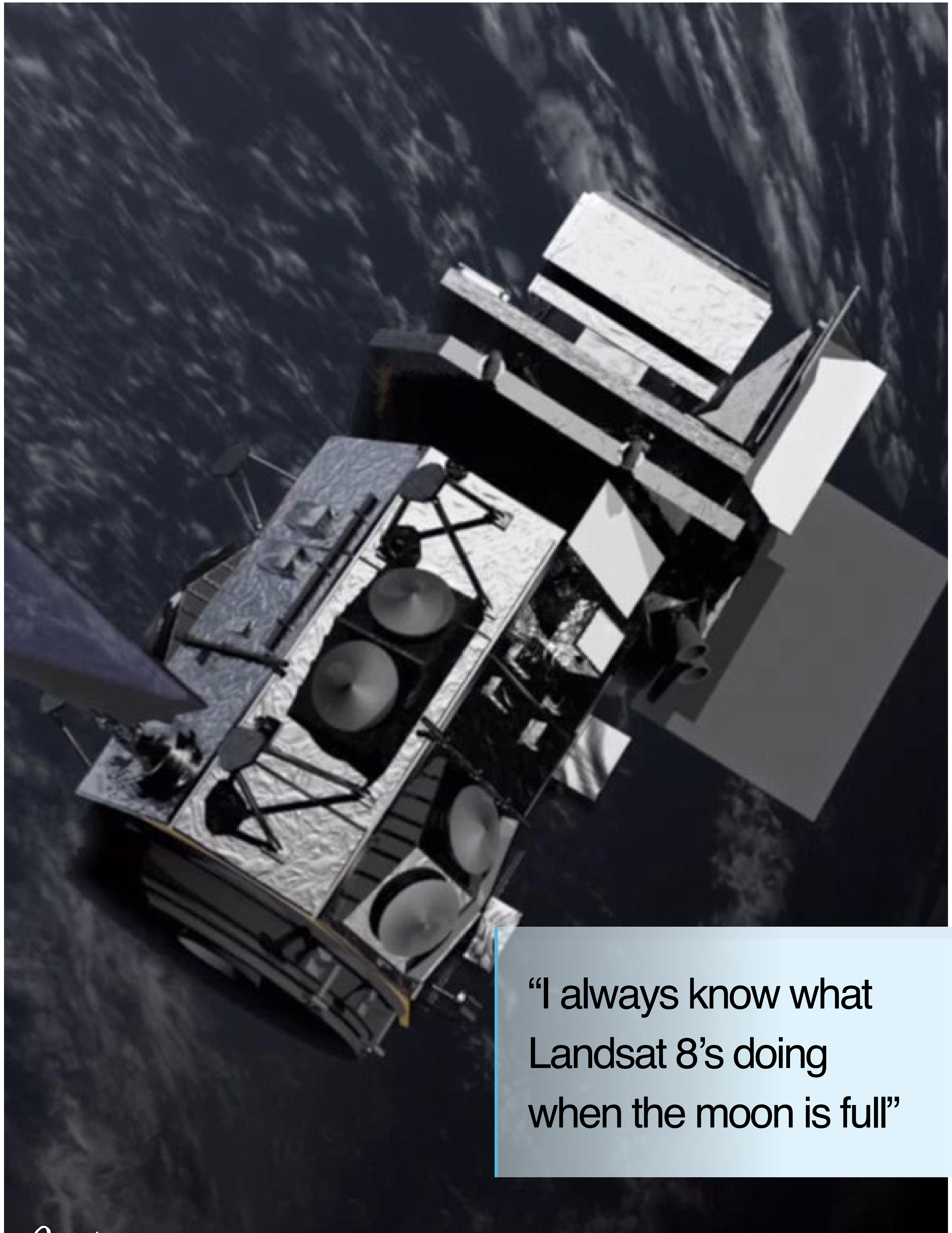
The advanced spacecraft and instrument technology on the Geostationary Operational Environmental Satellite–R will result in more timely and accurate weather forecasts. It will improve support for the detection and observations of meteorological phenomena and directly affect public safety, protection of property and, ultimately, economic health and development.

The GOES-R series will be more advanced than the current GOES fleet. The satellites are expected to more than double the clarity of today's GOES imagery and provide more atmospheric observations than current capabilities with more frequent images.

NOAA manages the GOES-R Series Program through an integrated NOAA-NASA program office, located at NASA's Goddard Space Flight Center in Greenbelt, Md.

NOAA's mission is to understand and predict changes in Earth's environment, from the depths of the ocean to the surface of the sun, and to conserve and manage our coastal and marine resources. ■

Above: The first functional deployment of the Magnetometer boom. Photo credit: ATK/Goleta



> “I always know what Landsat 8’s doing when the moon is full”

LANDSAT LOOKS TO THE MOON

By: Kate Ramsayer

Every full moon, Landsat 8 turns its back on Earth. As the satellite’s orbit takes it to the nighttime side of the planet, Landsat 8 pivots to point at the moon. It scans the distant lunar surface multiple times then flips back around to continue its task of collecting land-cover information of the sunny side of Earth below.

These monthly lunar scans are key to ensuring the land-imaging instrument aboard Landsat 8 is detecting light consistently. For this, engineers need a consistent source of light to measure. And while there are some spots on Earth—like the Sahara Desert or other arid sites—that reflect a relatively stable amount of light, nothing on our planet beats the moon, which lacks an atmosphere and has an unchanging surface, barring the odd meteorite.

“We really wanted something we could trust for Landsat 8,” said Brian Markham, leader of the calibration team for Landsat 8, which was built and launched by NASA and is now operated by the U.S. Geological Survey. “We do have Earth sites we look at for calibration. But the precision with which you can track things by using the Earth, because of the atmosphere, is not as good as the moon.”

Landsat 8’s Operational Land Imager, or OLI, collects information on the visible, near infrared and shortwave-infrared light reflecting off Earth’s surface. Each wavelength of light provides information about the ground surface below. OLI has 14 detector modules, each of which contains hundreds of individual detectors that record different spectral bands. The calibration team at NASA’s Goddard Space Flight Center in Greenbelt, Maryland and the U.S. Geological Survey’s EROS facility in South Dakota is tasked with making sure each of those detectors register light consistently over time.

Aboard the spacecraft, lamps provide light to calibrate OLI’s detectors, but the lamps aren’t perfect. On the Landsat 7 satellite, the lamps started to fade before the detectors did. Another option, solar diffusers, which use indirect sunlight, can darken as well.

“Everything else we’ve tried to use to monitor the stability of our instruments has often not been as good as the instruments themselves,” Markham said. But the moon is a steady, not-too-bright light in the sky. “As long as we know what its illumination conditions are, we can trend our instrument performance to it because we trust its stability.”

So Landsat 8 planners designed this latest satellite to image the moon as a baseline calibration. If, during these lunar tests, the OLI detectors indicate that the moon is getting slightly duller or brighter, then the Goddard scientists will know the instrument—not the moon—is off. With that data, they can adjust the algorithms that calculate land cover information during Landsat’s regular Earth-observation orbits.

It’s a fairly complicated operation to scan the moon each month, said Susan Good, a flight dynamics engineer at Goddard who works with Landsat 8.

“There are 14 detector modules,” Good said, “each of these has to scan the same path along the moon, so that you collect exactly the same data on each sensor.”

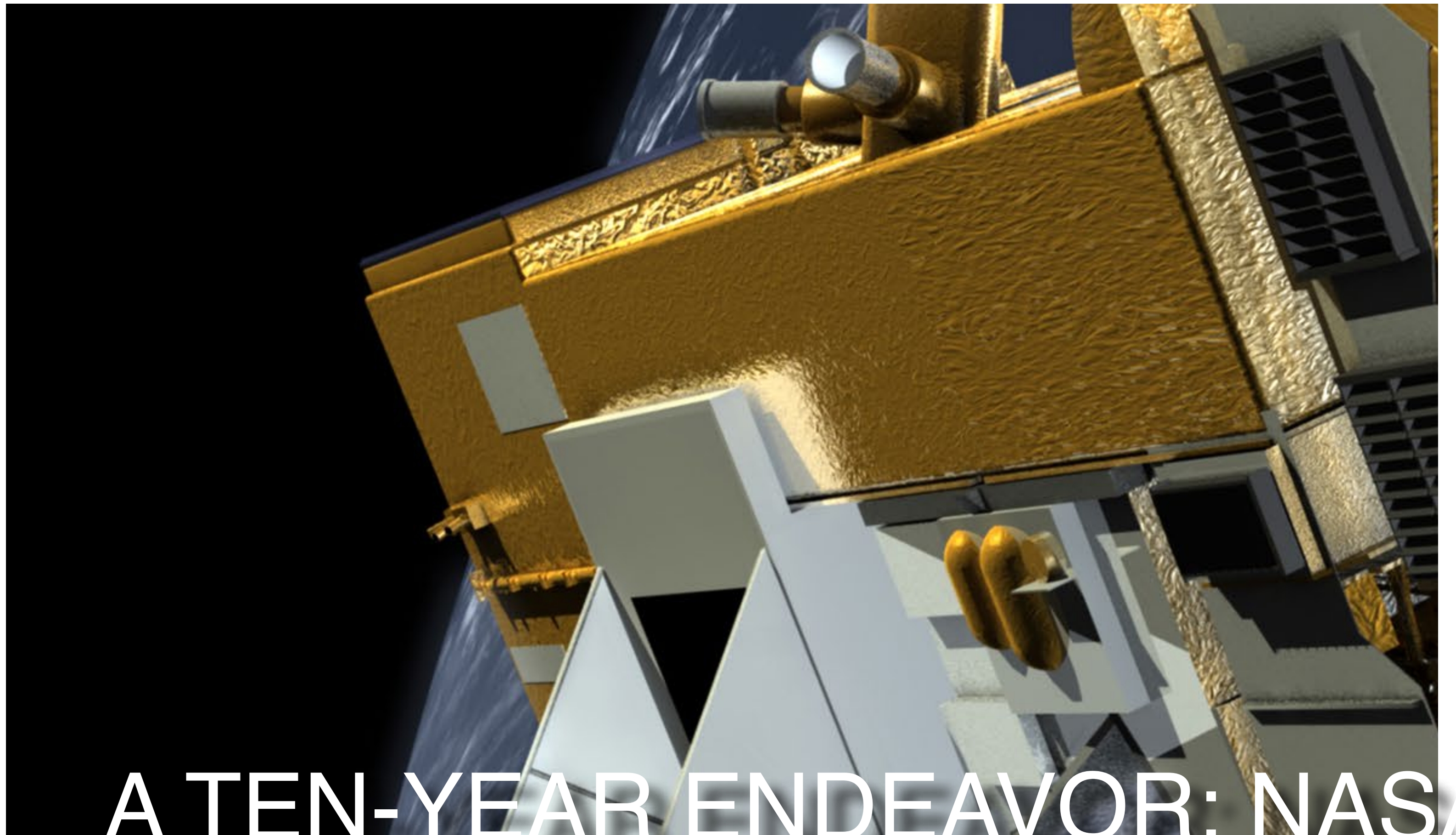
The flight dynamics software determines precisely where the spacecraft will need to point during a lunar calibration. The timing is set for just after the moon is completely full. Then, as Landsat 8 passes over Antarctica and heads north in Earth’s shadow, the spacecraft maneuvers to the precise location to start the first scan across the lunar surface.

It executes tiny and precise scans to take seven or eight passes across the moon—each one angled so that a different detector is centered on the moon. This takes about 18 minutes, by which time the spacecraft has almost reached the Arctic. So it maneuvers back to point at Earth, and complete its day-lit imaging. Then, Landsat 8 pivots to face the moon again, completing additional passes to test the remaining detectors. After two orbits, the lunar calibration is complete.

In Landsat 8’s first year, the lunar calibration tests show that the detectors are stable, Markham said, within a fraction of a percent. If the lunar calibrations and other tests show the detectors are off, the scientists can adjust the calculations that turn the raw Landsat data into information on land cover brightness, maintaining their accuracy.

Since the regular checks on Landsat 8’s performance, Good jokes that she will never look at the full moon the same. “I think oh, we’re having a lunar calibration,” she said. “I always know what Landsat’ 8’s doing when the moon is full.” ■

Opposite: One of three of NASA’s newest antennas, AS-3 on part of the University of Alaska–Fairbanks. Photo credit: NASA/Goddard/Dewayne Washington.




A TEN-YEAR ENDEAVOR: NASA'S AURA AND CLIMATE CHANGE

By: Kasha Patel

Celebrating its tenth anniversary this July, NASA's Aura satellite and its four onboard instruments measure some of the climate agents in the atmosphere including greenhouse gases, clouds and dust particles. These global datasets provide clues that help scientists understand how Earth's climate has varied and how it will continue to change.

When the sun shines on Earth, some of the light reaches and warms the surface. The surface then radiates this heat back outward, and greenhouse gases stop some of the heat from escaping to space, keeping the surface warm. Greenhouse gases are necessary to keep Earth at a habitable temperature, but since the industrial revolution, greenhouse gases have increased substantially, causing an increase in temperature. Aura provides measurements of greenhouses gases such as ozone, helping scientists understand the gases that influence climate.

Tropospheric ozone is one of the most important human-influenced greenhouse gases. Aura's Tropospheric Emission Spectrometer (TES) delivers global maps showing annual averages of the heat absorbed by ozone, in particular in the middle troposphere altitude region. Using these maps and computer models, researchers learned that ozone trapped different amounts of heat in Earth's atmosphere depending on its geographic location. For instance, ozone appeared to be a more effective greenhouse gas over hotter regions like the tropics or cloud-free regions like the Middle East.

"If you want to understand climate change, you need to monitor the greenhouse gases and how they change over time," said Bryan Duncan, an atmospheric scientist at NASA's Goddard Space Flight Center in Greenbelt, Maryland. Along with ozone, Aura measures other important greenhouse gases such as methane, carbon dioxide and water vapor.

Aura measures several other constituents relevant to climate—smoke, dust and clouds including the ice particles within the clouds—that are important for testing and improving climate models.

"If you don't have any data, then you don't know if the models are right or not." said Anne Douglass, Aura Project Scientist at Goddard. "The models can only be as good as your knowledge."

Clouds affect Earth's climate depending on their altitude and latitude. Two of Aura's instruments have provided information about tropical clouds. Like greenhouse gases, high, thin clouds in the tropics absorb some of Earth's outgoing heat and warm the surface. Aura's High Resolution Dynamics Limb Sounder (HIRDLS) instrument provided global maps showing cirrus clouds in the upper altitudes in the tropics. Researchers have used these data along with data records from previous satellites going back to 1985 to show that the tropical cirrus cloud distribution has been steady, giving scientists information about the interplay between water vapor, ice and the life cycle of these clouds.

Aura's Microwave Limb Sounder (MLS) instrument made the first global measurements of cloud ice content in the upper troposphere, providing new data input for climate models. MLS showed cloud ice is often present over warm oceans. Along with satellite rainfall data, MLS shows that dirty, polluted clouds rain less than clean clouds. The novel relationships obtained from HIRDLS and MLS connect ocean temperatures with clouds and ice and quantify effects of pollution on tropical rainfall—which are important assessments for climate models.

Aerosols, small particles in the atmosphere, influence climate. However, their influence is challenging to decipher because they play several different roles. Aerosols reflect radiation from the sun back into space; this tends to cool Earth's surface. Aerosols such as dust and smoke also absorb radiation and heat the atmosphere where they are concentrated. Aura's Ozone Monitoring Instrument (OMI) is especially good at observing these absorbing aerosols above clouds and bright deserts. Both OMI and TES also provide data on gases, such as sulfur dioxide and ammonia, which are primary ingredients for other types of less absorbing aerosols. Aura data, in conjunction with other satellite data, are helping scientists understand how aerosols interact with incoming sunlight in the Earth's atmosphere; this in turn helps scientists improve long-term predictions in climate models.

Researchers investigated how natural phenomena such as El Niño affect tropospheric ozone concentrations—a study made possible by Aura's extensive data set.

El Niño is an irregularly occurring phenomena associated with warm ocean currents near the Pacific coast of South America that changes the pattern of tropical rainfall. Occasional appearance of areas of warmer temperatures in the Pacific Ocean shifts the stormiest area from the west to the east; the region of upward motion—a hallmark of low ozone concentrations over the ocean—moves along with it.

Without a decade-long data record, researchers would not be able to conduct such a study. Using the extensive data set, researchers are able to separate the response of ozone concentrations to the changes in human activity, such as biomass burning, from its response to natural forcing such as El Niño.

"Studies like these that investigate how the composition of the troposphere responds to a natural variation are important for understanding how the Earth system will respond to other forcing, potentially including changes in climate," said Douglass. "The Earth system is complex, and Aura's breadth and the length of the composition data record help us to understand this important part of the system." ■

Above: Artist's rendition of the Aura spacecraft. Image credit: NASA

GODDARD'S MEDICAL AND ENVIRONMENTAL TEAM CREATES HAVEN FOR WILDLIFE

Maryland Department of Natural Resources Conservation Corps volunteers and members of the Medical and Environmental Management Division (Code 250) created a wildlife habitat garden using plants native to Maryland in front of the new Goddard Child Development Center garden. ■

Photo credit: NASA/Goddard/Debora McCallum

VAN ALLEN PROBES SHOW HOW TO ACCELERATE ELECTRONS

By Karen C. Fox

One of the great, unanswered questions for space weather scientists is just what creates two gigantic donuts of radiation surrounding Earth, called the Van Allen radiation belts. Recent data from the Van Allen Probes—two nearly identical spacecraft that launched in 2012—address this question.

The inner Van Allen radiation belt is fairly stable, but the outer one changes shape, size and composition in ways that scientists don't yet perfectly understand. Some of the particles within this belt zoom along at close to light speed, but just what accelerates these particles up to such velocities? Recent data from the Van Allen Probes suggests that it is a two-fold process: One mechanism gives the particles an initial boost and then a kind of electromagnetic wave called Whistlers does the final job to kick them up to such intense speeds.

"It is important to understand how this process happens," said Forrest Mozer, a space scientist at the University of California in Berkeley and the first author of the paper on these results that appeared online in Physical Review Letters on July 15, 2014, in conjunction with the July 18 print edition. "Not only do we think a similar process happens on the sun and around other planets, but these fast particles can damage the electronics in spacecraft and affect astronauts in space."

Over the last few decades, numerous theories about where these energetic particles come from have been developed. They have largely fallen into two different possibilities. The first theory is that the particles drift in from much further out, some 400,000 miles or more, gathering energy along the way. The second theory is that some mechanism speeds up particles already inhabiting that area of space. After two years in space, the Van Allen Probes data has largely pointed to the latter.

Additionally, it has been shown that once particles attain reasonably large energies of 100 keV, they are moving at speeds in synch with giant electromagnetic waves that can speed the particles up even more—the same way a well-timed push on a swing can keep it moving higher and higher.

"This paper incorporates the Whistler waves theory previously embraced," said Shri Kanekal, the deputy mission scientist for the Van Allen Probes at NASA's Goddard Space Flight Center in Greenbelt, Maryland. "But it provides a new explanation for how the particles get their initial push of energy."

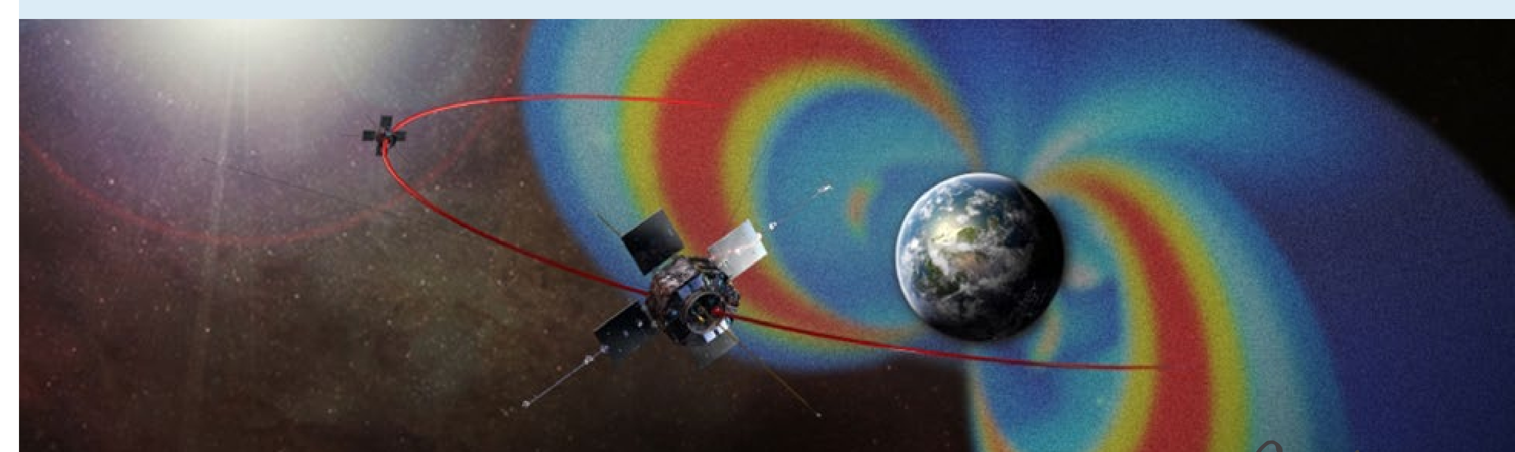
This first mechanism is based on something called time domain structures, which Mozer and his colleagues have identified previously in the belts. They are very short duration pulses of electric field that run parallel to the magnetic fields that thread through the radiation belts. These magnetic field lines guide the movement of all the charged particles in the belts. The particles move and gyrate around the lines as if they were tracing out the shape of a spring. During this early phase, the electric pulses push the particles faster forward in the direction parallel to the magnetic fields. This mechanism can increase the energies somewhat—though not as high as traditionally thought to be needed for the Whistler waves to have any effect. However, Mozer and his team showed, through both data from the Van Allen Probes and from simulations, that Whistlers can indeed affect particles at these lower energies.

Together the one-two punch is a mechanism that can effectively accelerate particles up to the intense speeds, which have for so long mysteriously appeared in the Van Allen belts.

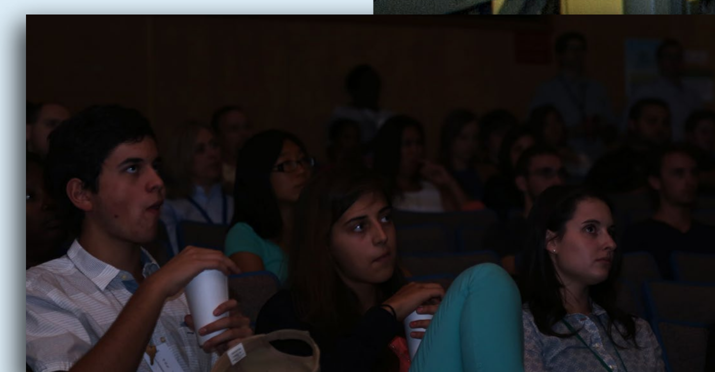
"The Van Allen Probes have been able to monitor this acceleration process better than any other spacecraft because it was designed and placed in a special orbit for that purpose," said Mozer. "The mission has provided the first really strong confirmation of what's happening. This is the first time we can truly explain how the electrons are accelerated up to nearly the speed of light."

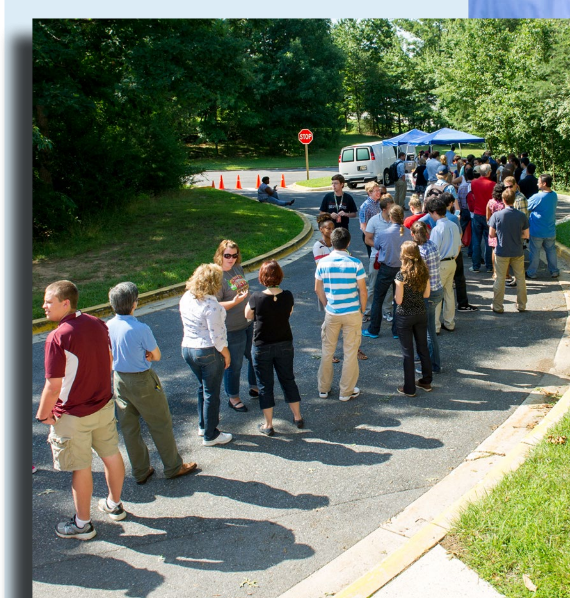
Such knowledge helps with the job of understanding the belts well enough to protect nearby spacecraft and astronauts. ■

Below: NASA's Van Allen Probes orbit through two giant radiation belts surrounding Earth. Image credit: NASA



2014 EMPLOYEE ENGAGEMENT ACTIVITIES





From experiencing tours of Goddard facilities to hunting for clues and fascinating objects, Goddard employees explored and discovered the center during the 2014 Employee Engagement Activities.

On July 15, the Name that Org. game entertained and enlightened. Dozens of employees toured Goddard facilities like the Satellite Servicing Capabilities office, the James Webb Space Telescope, and MMS. Visitors also saw the Goddard torture chamber while touring the Spacecraft Integration and Testing facility. Food trucks outside Building 8 served delicious treats.

On July 16, rockets and dreams soared at the Visitor Center model rocket demonstrations. Employees explored the universe during the guided Astrobiology Walk. Goddard came together to bring food donations for the Feds Feed Families food drive. Employees checked out the many GEWA clubs and Advisory Committees on center. The Mission Success event that day inspired and motivated.

On July 17, employees and interns searched for artifacts in the Goddard Scavenger Hunt. The Science Jamboree filled Building 28 with displays and demonstrations from all science divisions. Employees enjoyed tours of Goddard's TV and animation studios. A compilation of videos and images at the Goddard Film Fest entranced viewers. Employees savored more food trucks outside of Building 28.

The Employee Engagement Activities are a great opportunity for employees to experience exclusive opportunities to see a different side of Goddard. Employees enjoyed varied activities designed to encourage knowledge sharing, team building and recognizing accomplishments. ■

Photo credit: NASA/Goddard/Bill Hrybyk and Debora McCallum

EMPLOYEE SPOTLIGHT

Brad Douglas

Position: Student trainee-Code 320/administrative support

Before goddard: aircraft line technician

Interests: Playing music, aviation

Why Goddard? I wanted to be a part of the missions that help humankind progress in our knowledge and understanding of our universe.

Jerel Meadows

Position: Code 120/ sign language interpreter

Before Goddard: sign language interpreter

Interests: snowboarding, golf, going to the beach and traveling.

Why Goddard? I have always been fascinated with space exploration and to be a NASA employee is a dream come true!

Roshell Renae Brown

Position: Code 800-wallops/student trainee

Before Goddard: college student, who worked part-time.

Interests: cooking, traveling, gardening, and my children's sporting events

Why Goddard? I am thrilled that the once in a lifetime opportunity came along because I wanted to be a part of the new and exciting things that NASA Goddard is affiliated. I find the educational opportunities to be limitless.

Other information: I am a mother of three children, ages 18, 15 and 7.

Thomas A. Gadson

Position: Code 598, Wallops

Before Goddard: electronic technician for communication company

Why Goddard? Better opportunity.