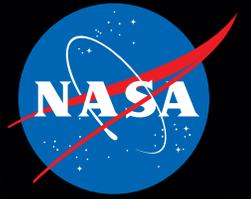


National Aeronautics and Space Administration



# GoddardView

Volume 10 Issue 7  
June 2014



# GoddardView

## THE WEEKLY

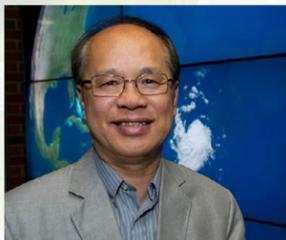
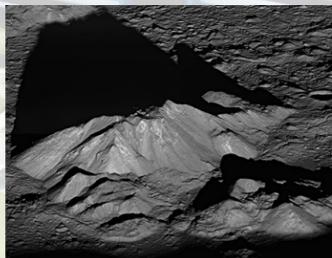
### Goddard Employee Engagement Activities

#### Employee Engagement Activities

Goddard's employee engagement activities are coming. On July 15, 16 and 17, all employees can experience exclusive opportunities to see a new side of Goddard. To see the entire schedule, visit the Goddard Employee Engagement Activities [website](#).

#### LRO's Moon As Art Collection

The Lunar Reconnaissance Orbiter celebrated its fifth anniversary in space with a collection of moon images gathered over the life of the mission. The public chose a favorite image for the cover of a special image collection. Click to see the winner and the full collection of images.



#### Conversations with Goddard

A man of three continents, climate scientist William Lau sees Earth as one. Lau studies clouds, precipitation, winds and climate change in Goddard's Earth Science Division. Click on the photo of Lau to learn about him and to explore Conversations with Goddard.

#### Hubble Eyes Golden Rings

Taking center stage in this new Hubble Space Telescope image is galaxy NGC 3081, set against an assortment of glittering galaxies in the distance. Located in the constellation of Hydra, NGC 3081 is over 86 million light-years from Earth. Learn more by clicking on the image.



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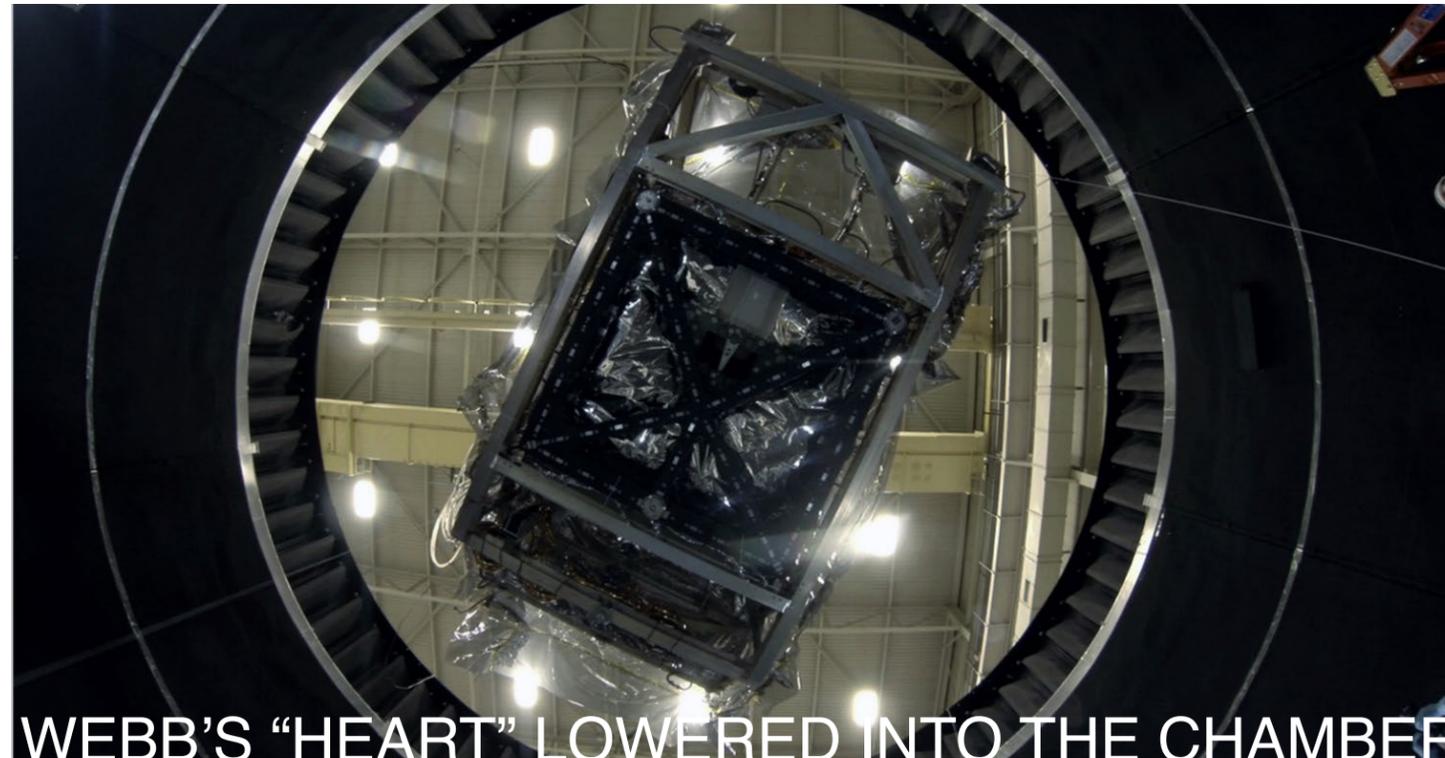
**On the cover:** This storm cell photo was taken from NASA's high-altitude ER-2 aircraft on May 23, 2014 as part of ground validation efforts for the [Global Precipitation Measurement](#) mission. More information can be found on Goddard's Flickr [photostream](#). Photo credit: NASA/Stu Broce

### 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. [GoddardView](#) is published by Goddard's Office of Communications.

You may submit contributions to the editor at [john.m.putman@nasa.gov](mailto: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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## WEBB'S "HEART" LOWERED INTO THE CHAMBER

By: [Laura Betz](#)

Engineer Jack Marshall held his breath. The "heart" of the James Webb Space Telescope hung from a cable 30 feet in the air as it was lowered slowly into the massive thermal vacuum chamber at NASA's Goddard Space Flight Center in Greenbelt, Maryland.

This "heart" of [Webb](#) is called the Integrated Science Instrument Module, which along with its thermal vacuum test frame and supporting hardware, weighs about as much as an elephant. Within this test frame, ISIM sits inside a big-mirrored cube of cryo-panels and blankets. This process can be seen in a [video](#) by a Goddard videographer.

"This is the first time we are able to test the 'heart' in this configuration, which includes all four of Webb's science instruments installed on ISIM," said Marshall.

This major milestone was reached on schedule, but before the thermal vacuum chamber can be put into use ISIM's cooling system must be checked out. This cooling system relies on using helium says team member Marc Sansebastian of NASA Goddard who is carefully checking for any leaks.

"Helium is a very hard gas to contain because it is such a small molecule," said Sansebastian.

Once the Webb team is assured that all of the cooling lines are helium tight and all electrical connections have been completed and tested, a four-months long test on ISIM will begin by pumping out all of the air, and then dropping temperatures in the chamber, down to simulate the exceptionally cold temperatures in space.

Goddard's massive thermal vacuum chamber, called the Space Environment Simulator, uses eight vacuum pumps

to achieve a vacuum and plumbing with nitrogen and cold gaseous helium to reduce the temperature inside a helium shroud to as low as -423.6 F (-253.15 C or 20 kelvins).

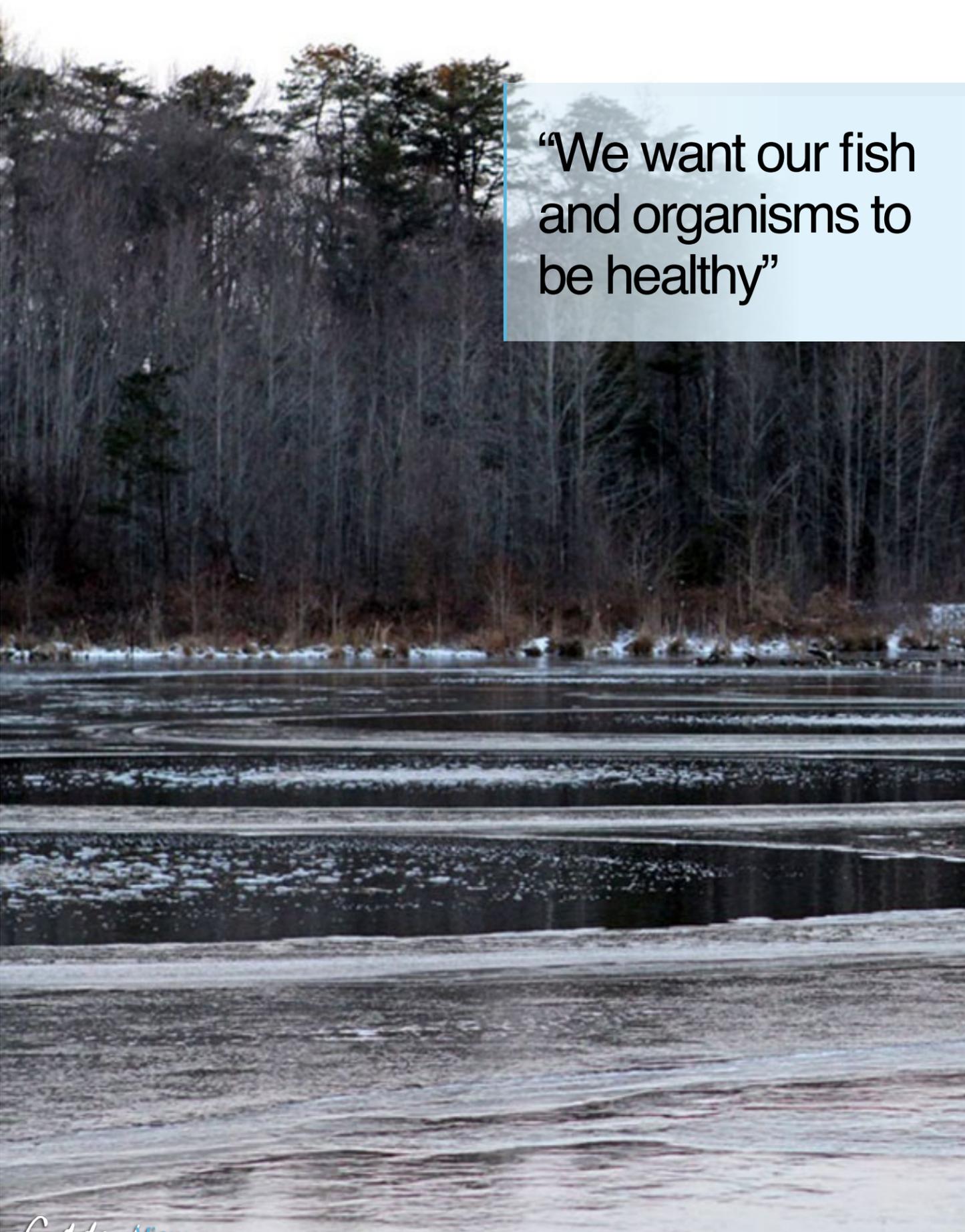
During this testing of ISIM, there are over 1,000 temperature sensors, almost 200 heater circuits, ten helium lines and a lot of thermal zones that need to be hooked up, says Calinda Yew, Webb test engineer for the thermal vacuum chamber.

"Now we are in the process of connecting all of those sensors and heaters. The sensors will help monitor temperatures during the test and the heaters will help achieve target temperatures. We will inject helium into a shroud to lower the science instruments temperatures even further," says Yew.

After four months of testing, the "heart" of Webb, ISIM, will return back to the world's largest clean room at Goddard for additional work and testing. Another thermal vacuum test of ISIM is scheduled in 2015.

The James Webb Space Telescope is the successor to NASA's Hubble Space Telescope. It will be the most powerful space telescope ever built and will observe the most distant objects in the universe, provide images of the first galaxies formed, and see unexplored planets around distant stars. The Webb telescope is a joint project of NASA, the European Space Agency and the Canadian Space Agency. ■

Above: The James Webb Space Telescope's "heart" (formally the Integrated Science Instrument Module) descends into a vacuum chamber at NASA Goddard. Image Credit: NASA/Goddard



“We want our fish and organisms to be healthy”

# NEW POND PUMPS SHOW SCIENCE BEHIND THE BUBBLES

By: [Claire Saravia](#)

Something new is bubbling to the surface of the Goddard pond, thanks to a new set of pumps installed to keep the water healthy.

In an effort to fix several health issues that have plagued the pond for several years, the Goddard Facilities Management Division installed an aeration system in April 2013. The system’s pumps house compressed air that constantly releases bubbles at the pond’s surface, a process that keeps the water moving.

Because of the constant circulation, the pond water is no longer stratified, a layering process that causes certain key water properties like oxygen and pH to change at different depths. By moving the water, facilities management engineer Ann Wagner said the new aeration pumps keep these important factors consistent throughout the pond.

Before installing the pumps, Wagner said the pond suffered from high pH and algae blooms, a sign of poor water health, in the summer. In 2012, the pond experienced an algae bloom that was not only unappealing to look at, but decreased oxygen available in the water once the algae died off.

“The algae was really obvious, and we were also having pH problems, which was symptomatic of an unhealthy pond,” Wagner said.

Now that there’s adequate oxygen throughout the pond, Wagner said all organisms—both big and small—could function to maintain the pond’s health. Bacteria can use oxygen to break down sediment sinking to the bottom, and other organisms like fish and insects can survive.

“All the wildlife in the pond need oxygen, so we need it at every level,” Wagner said.

The installation of the aeration pumps demonstrated how critical it was for officials on center to work together to monitor and maintain the pond, which has been a part of the campus since Goddard’s earliest years in the 1960s. The Medical and Environmental Management Division at Goddard first identified the pond’s stratification problems as part of their continual monitoring, which is required in order to maintain the pond’s discharge permit with the Maryland Department of the Environment.

“Part of the permit requires us to monitor water to make sure we’re not polluting area waters,” MEMD environmental engineer Janine Pollack said. “When we notice problems, we work with other relevant organizations to determine a solution.”

In this case, MEMD called on the Facilities Management Division to bring in a pond consultant, eventually leading Facilities Management to install the aeration system as a solution.

So far, the solution seems to be working. Organisms are thriving in the water, and the pond didn’t experience an algae bloom in 2013.

“When you have a stagnant pond, you’re not going to get that mixing, so we have to introduce what nature normally does on its own [without stratification],” Pollack said. “We want our fish and organisms to be healthy.”

Pollack said addressing the pH and oxygen issues helped avoid larger problems for the pond, like a major fish kill. In addition, Goddard employees and visitors can now enjoy the pond and all of the organisms that call it home.

“I’ve seen huge snapping turtles and all different types of snakes, insects, and butterflies,” Pollack said. “It’s really pretty if you sit there and wait a while, because you’ll see a lot of different species come by.”

In addition to people just enjoying the scenery, others even more acquainted with the pond appreciate the improvements. Goddard Fishing Club president Bobby Patschke said the rising oxygen levels have helped the fishing.

“It helps keep the fish a little more diversified throughout the pond, instead of being against the shoreline trying to get oxygen,” Patschke said.

While Wagner said the aeration system itself requires regular maintenance, Goddard officials will continue to monitor the pond to ensure it stays healthy for both its wild and human visitors.

“The fishing club uses it, a lot of people walk around it, and everyone who drives in from the parkway sees it,” Wagner said. “It’s a real cultural resource on campus.” ■

Opposite: Bubbles from the aeration system create a unique design of bubbles on the surface of the Goddard pond. Photo credit: NASA/Goddard/Ann Wager



# CRACKS IN PLUTO'S MOON COULD INDICATE IT ONCE HAD AN UNDERGROUND OCEAN

By: [Bill Steigerwald](#)

If the icy surface of Pluto's giant moon Charon is cracked, analysis of the fractures could reveal if its interior was warm, perhaps warm enough to have maintained a subterranean ocean of liquid water, according to a new NASA-funded study.

Pluto is an extremely distant world, orbiting the sun more than 29 times farther than Earth. With a surface temperature estimated to be about 380 degrees below zero Fahrenheit (around minus 229 degrees Celsius), the environment at Pluto is far too cold to allow liquid water on its surface. Pluto's moons are in the same frigid environment.

Pluto's remoteness and small size make it difficult to observe, but in July of 2015, NASA's New Horizons spacecraft will be the first to visit Pluto and Charon, and will provide the most detailed observations to date.

"Our model predicts different fracture patterns on the surface of Charon depending on the thickness of its surface ice, the structure of the moon's interior and how easily it deforms, and how its orbit evolved," said Alyssa Rhoden of NASA's Goddard Space Flight Center in Greenbelt, Maryland. "By comparing the actual New Horizons observations of Charon to the various predictions, we can see what fits best and discover if Charon could have had a subsurface ocean in its past, driven by high eccentricity." Rhoden is lead author of a paper on this research now available online in the journal *Icarus*.

Some moons around the gas giant planets in the outer solar system have cracked surfaces with evidence for ocean interiors – Jupiter's moon Europa and Saturn's moon Enceladus are two examples.

As Europa and Enceladus move in their orbits, a gravitational tug-of-war between their respective parent planets and neighboring moons keeps their orbits from becoming circular. Instead, these moons have eccentric (slightly oval-shaped) orbits, which raise daily tides that flex the interior and stress the surface. It is thought that tidal heating has extended the lifetimes of subsurface oceans on Europa and Enceladus by keeping their interiors warm.

In Charon's case, this study finds that a past high eccentricity could have generated large tides, causing friction and surface fractures. The moon is unusually massive compared to its planet, about one-eighth of Pluto's mass, a solar system record. It is thought to have formed much closer to Pluto, after a giant impact ejected material off the planet's surface. The material went into orbit around Pluto and coalesced under its own gravity to form Charon and several smaller moons.

Initially, there would have been strong tides on both worlds as gravity between Pluto and Charon caused their surfaces to bulge toward each other, generating friction in their interiors. This friction would have also caused the tides to slightly lag behind their orbital positions. The lag would

act like a brake on Pluto, causing its rotation to slow while transferring that rotational energy to Charon, making it speed up and move farther away from Pluto.

"Depending on exactly how Charon's orbit evolved, particularly if it went through a high-eccentricity phase, there may have been enough heat from tidal deformation to maintain liquid water beneath the surface of Charon for some time," said Rhoden. "Using plausible interior structure models that include an ocean, we found it wouldn't have taken much eccentricity (less than 0.01) to generate surface fractures like we are seeing on Europa."

"Since it's so easy to get fractures, if we get to Charon and there are none, it puts a very strong constraint on how high the eccentricity could have been and how warm the interior ever could have been," adds Rhoden. "This research gives us a head start on the New Horizons arrival—what should we look for and what can we learn from it. We're going to Pluto and Pluto is fascinating, but Charon is also going to be fascinating."

Based on observations from telescopes, Charon's orbit is now in a stable end state: a circular orbit with the rotation of both Pluto and Charon slowed to the point where they always show the same side to each other. Its current orbit is not expected to generate significant tides, so any ancient underground ocean may be frozen by now, according to Rhoden.

Since liquid water is a necessary ingredient for known forms of life, the oceans of Europa and Enceladus are considered to be places where extraterrestrial life might be found. However, life also requires a useable energy source and an ample supply of many key elements, such as carbon, nitrogen, and phosphorus. It is unknown if those oceans harbor these additional ingredients, or if they have existed long enough for life to form. The same questions would apply to any ancient ocean that may have existed beneath the icy crust of Charon.

This research was funded by the NASA Postdoctoral Program at the NASA Goddard Space Flight Center, administered by Oak Ridge Associated Universities, and NASA Headquarters through the Science Innovation Fund. ■

Above: This artist concept shows Pluto and some of its moons as viewed from the surface of one of the moons. Pluto is the large disk at center. Charon is the smaller disk to the right. Image Credit: NASA, ESA and G. Bacon (STScI)



The solar array that will provide power to NOAA's Geostationary Operational Environmental Satellite-R Series satellite has been tested, approved and shipped to a facility where it will be incorporated on the spacecraft. The five sections of the solar array come together as one to resemble a giant black wing.

On May 13, 2014, the [GOES-R](#) satellite solar array panels were successfully deployed in a Lockheed Martin clean room in Sunnyvale, California. The completed solar array was then delivered to Lockheed Martin's facility near Denver.

"The GOES-R solar array generates more than 4,000 watts of power, twice as much as that of the previous generation of GOES satellites, in order to operate the larger and more capable instruments carried by GOES-R," said Pam Sullivan, GOES-R flight project manager at NASA's Goddard Space Flight Center in Greenbelt, Maryland.

The GOES-R spacecraft uses a photovoltaic solar array to derive electricity from sunlight. Photovoltaics is a method that uses semiconductors to convert solar radiation into direct current electricity.

The solar array is comprised of five separate solar panels that are folded up at launch. After the satellite is released by the launch vehicle, the solar panels are deployed into a single solar array wing that rotates once per day on orbit to continuously point the solar array photovoltaic cells towards the sun.

The solar array provides a stable platform that tracks the seasonal and daily movement of the sun relative to the space-

craft. It will power all of the instruments, including the computers, data processors, attitude control sensors and actuators, and telecommunications equipment.

The instruments include the Extreme Ultraviolet and X-ray Irradiance Sensors, the Magnetometer, the space environment in-situ suite, solar ultraviolet imager, the advanced baseline imager, geostationary lightning mapper, and unique payload services.

The GOES-R advanced spacecraft and instrument technology will result in more timely and accurate weather forecasts. It will improve support for the detection and observations of meteorological phenomena and directly enhance public safety, protection of property, and ultimately, economic health and development.

GOES-R will be more advanced than NOAA's 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.

The National Oceanic and Atmospheric Administration, manages the GOES-R Series Program through an integrated NOAA-NASA program office, staffed with personnel from NOAA and NASA, and co-located at NASA Goddard ■

Above: The successful deployment of the GOES-R satellite solar array in a Lockheed Martin clean room in Sunnyvale, California, on May 13, 2014. Photo credit: Lockheed Martin

## NOAA GOES-R SATELLITE BLACK WING READY FOR FLIGHT

By: [Rob Gutro](#)

# NASA NAMES NEW DIRECTOR OF THE GODDARD INSTITUTE FOR SPACE STUDIES

NASA has named Gavin A. Schmidt to head the agency's Goddard Institute for Space Studies in New York, a leading Earth climate research laboratory.

Currently deputy director of the institute, Schmidt steps into the position left vacant after the retirement of long-time director James E. Hansen and becomes only the third person to hold the post.

"Gavin is a highly respected climate scientist who already also has proven himself as a terrific leader of the GISS team," said NASA's Chief Scientist Ellen Stofan. "He is the perfect candidate to continue leading this vital research institute at a critical time for the U.S. and the world."

Schmidt, an expert in climate modeling, began his career at [GISS](#) in 1996. His primary area of research is the simulation of past, present and future climates. He has worked on developing and improving computer models that integrate ocean, atmosphere, and land processes to simulate Earth's climate, and is particularly interested in how their results can be compared to paleoclimatic data.

"It's an honor to lead the team of talented scientists at GISS," he said. "The work being done here has implications for societies across the planet, and I will strive to make that research as valuable as possible."

[Schmidt](#) received a bachelor's degree in mathematics from Oxford University in 1988 and a doctorate in applied mathematics from University College London in 1994. He came to New York as a 1996 National Oceanic and Atmospheric Administration Postdoctoral Fellow in Climate and Global Change Research.

In addition to more than 100 published, peer-reviewed articles, he is the co-author of "Climate Change: Picturing the Science" (W.W. Norton, 2009), a collaboration between climate scientists and photographers. In 2011, he was awarded the American Geophysical Union Climate Communications Prize.

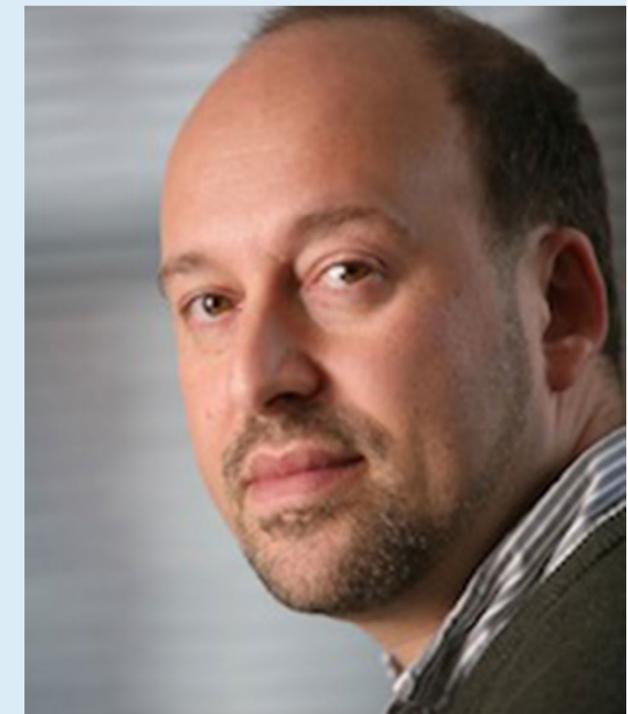
GISS was founded in 1961 as NASA's theoretical division for work on planetary atmospheres, under the direction of Robert Jastrow, and is today a leading Earth climate research laboratory. Major areas of GISS research include measurements, remote sensing and simulation of Earth's climate, the forces driving climate change and its impacts on human society, agriculture and ecosystems and continuing work on planetary climates in the solar system and beyond. GISS works closely

with partners at NASA's Goddard Space Flight Center in Greenbelt, Maryland, and with the Earth Institute and School of Engineering at Columbia University.

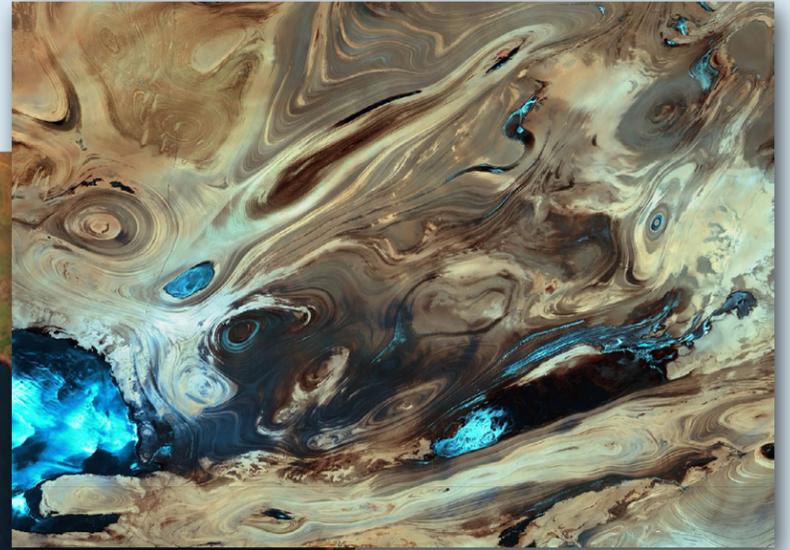
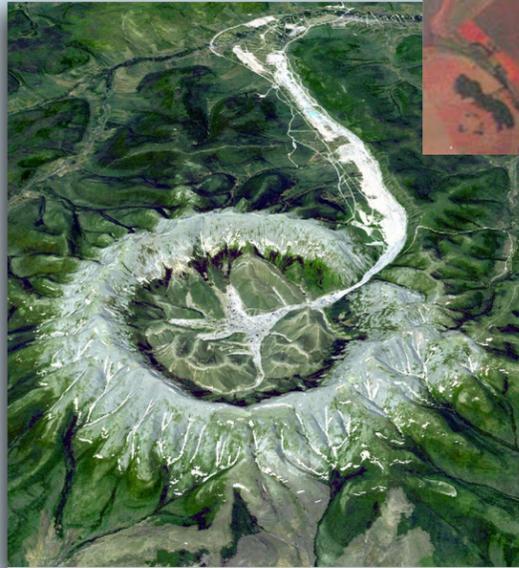
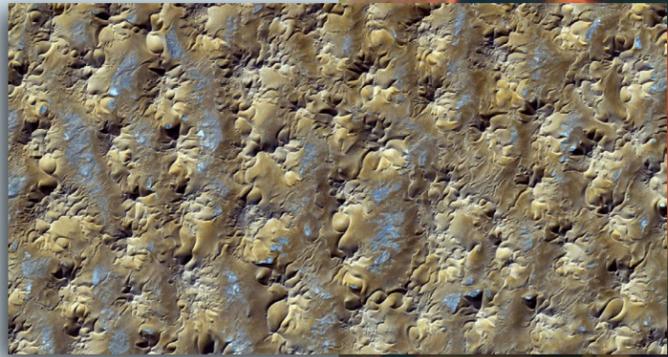
NASA's Earth science program monitors the planet's vital signs from land, air and space with a fleet of satellites and ambitious airborne and ground-based observation campaigns.

NASA develops new ways to observe and study Earth's interconnected natural systems with long-term data records and computer analysis tools to better see how our planet is changing. The agency shares this unique knowledge with the global community and works with institutions in the United States and around the world that contribute to understanding and protecting our home planet. ■

Below: Dr. Gavin A. Schmidt, new director of NASA's Goddard Institute for Space Studies. Photo credit: B. Field



# NASA AT THE WORLD CUP



These images are part of a set of NASA images representing countries participating in the [2014 World Cup](#). More images are online at Goddard's Flickr [site](#).

Good luck to all of the teams!

Center: Brazil.

Top left to bottom left: Switzerland, Ageria and Russia.

Top right to bottom right: Iran, South Korea and Ivory Coast.

Credit: NASA. ■

# OUTSIDE GODDARD

By: [Elizabeth M. Jarrell](#)

## The Silent Singer

Software engineer Carlos A. Gomez-Rosa cannot sing, dance, play an instrument or even act, but he has shared the spotlight with Placido Domingo in operas staged by The Washington National Opera at the John F. Kennedy Center for the Performing Arts in Washington, D.C. He is a supernumerary, which is a non-speaking, non-singing part on stage.

“There is an abstract beauty in putting a spacecraft together, in putting a mission together to explore outer space and distant planets. Opera is stunning: the music, the orchestra and the sounds hitting your soul. If you think about it, Galileo probably went to the opera,” said Gomez-Rosa.

He began his stage career working as an usher for the Kennedy Center’s Eisenhower Theater in the early 1990s. His costume was a white shirt, a red jacket and a black bow tie. He received a small fee and was allowed to attend the performances.

One night in 1997, he was called to be a substitute usher at the performance of “Il Pagliacci.” As Gomez-Rosa was enjoying the production, he recognized a few of the faces scattered about the stage during the village scenes. The familiar faces were some of his fellow ushers. Intrigued, he discovered that some of the ushers were supernumeraries.

He auditioned at the next casting call. He figured out that the main qualifications for being a supernumerary are looking the part and being able to follow directions. The casting director gushed that he had “a beautiful profile for opera.” And a supernumerary was born.

Grand opera’s long tradition involves gorgeous costumes, elaborate stages, a full orchestra, an enormous cast and the best voices in the world. Today, however, one set of costumes and staging travels the country to different opera houses and companies. Costumes cannot be altered dramatically, but the costume directors are excellent at instantly selecting the right costume to fit each person.

“The fun part of the dress rehearsal is that is the first time that you get to wear the costume and see everyone else in theirs,” said Gomez-Rosa. “It’s so magical as, instantaneously, the costumes transform regular people into operatic characters.”

Gomez-Rosa’s first appeared as both a village priest and a bartender in Amadeo Vive’s “Dona Francisquita.” Placido Domingo, the general director of the Washington National Opera at the time, was known for bringing in interesting operas not necessarily well known to the Washington audience.

Through the years, he has appeared in numerous operas, the most memorable of which was Umberto Giordano’s “Fedora.” During the party scene, multiple rotating platforms twirled guests dressed in tuxedos and evening gowns and sipping champagne.

“I was the butler serving the champagne on a tray.

The glasses were real crystal and they were not taped to the tray. In one rehearsal, my tray, fully loaded with glasses filled with champagne, came tumbling down, but in the productions I was perfect. It so happened that Placido Domingo appeared in this party scene as well. Whenever he was in any scene, everyone froze. The house went almost entirely dark except for one big spotlight on him. That was the moment the audience waited for every performance. By bad luck, I was always behind him holding up this tray of filled champagne glasses. Do you know the pressure I felt not to dampen his scene?” said Gomez-Rosa.



The morning news the following day included a clip of the performance, which happened to feature Domingo’s aria. Gomez-Rosa could see himself trembling.

Gomez-Rosa met Placido Domingo many times and found him to be extremely humble and kind. Once at a cast party, when Gomez-Rosa was discussing one of his prior roles with Domingo among others. Domingo spontaneously burst into song. So, technically speaking, Placido Domingo personally sang a song to him.

“I shot for the moon and I got it. Growing up, I always wanted to work at NASA and now I do. I also always wanted to be on stage and now I am. Whatever you want to do, just do it. There is never the perfect moment in life. Stop being afraid, stop planning and just go do it,” said Gomez-Rosa. ■

Center: Gomez-Rosa readies for one of his parts. Photo courtesy of Carlos Gomez-Rosa