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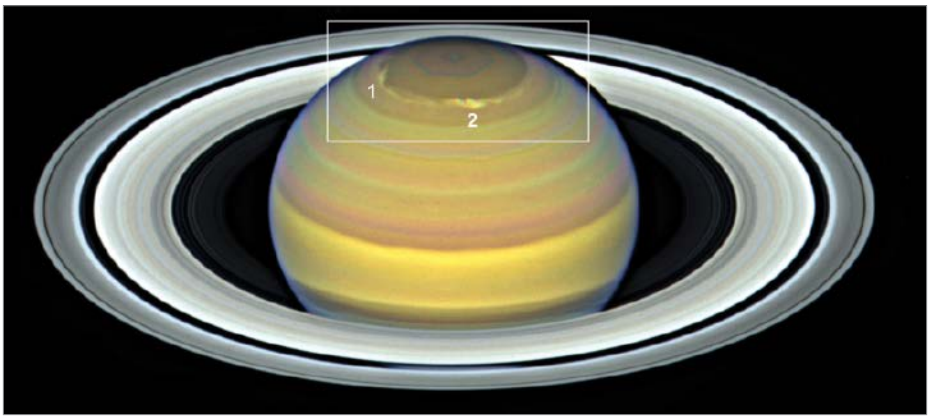
ADVANCING EARTH AND SPACE SCIENCE

New Type of Storm Spotted on Saturn



In 2018, a new type of storm appeared on the surface of Saturn. The first storm (above) appeared as a white blemish near the north pole of the planet, growing to a size of 2,000 kilometers across in just a few days. A second storm appeared about 2 months later. Credit: NASA/ESA

If we look past Saturn's rings, we see that the planet's surface has few distinctive features. Most of the planet is made of hydrogen, helium, and such trace elements as ammonia, methane, and water, which create the planet's visible bands and clouds.

Occasionally, however, Saturn's surface lights up a bit with bright white spots. These are storms, formed when water clouds in the inner layers of the atmosphere—200 kilometers below the visible surface—heat up and rise, much like a summer storm anywhere on Earth but on a larger scale.

Until recently, researchers had observed just two types of Saturnian storms. The small ones, typically 2,000 kilometers in diameter, look like irregular bright clouds and last for a few days. The really big ones are known as great white spots. These are monster storms, up to 20,000 kilometers across—large enough to cover the entire Earth—that can persist for several months.

But in 2018, a new type of storm appeared on the surface of the ringed planet. Rather than a giant spot, four medium-sized storms appeared in sequence at slightly different latitudes near the north pole.

Identifying Midsized Storms

The first storm appeared on 29 March as a white blemish near the north pole of the planet, growing to a size of 2,000 kilometers across in just a few days. It stood alone, traveling westward at a speed of 220 kilometers per hour, until 25 May, when a second spot appeared. In August, two more storms joined the pair. Each storm appeared slightly to the north of the preceding one.

The storms moved at different speeds, probably under the influence of the local winds at their respective latitudes. This caused several close encounters. Every time they got close, the storms seemed to disrupt each other, causing them to sprout filaments that filled with dark and bright orbs, probably eddies that offered a brief glimpse at the lower layers of the atmosphere below the clouds. The first storm to appear was the longest lived, lasting for 214 days and reaching a maximum size of 4,000 kilometers across.

These interactions eventually altered an entire latitudinal band, turning it into a light-colored stripe near the north pole. The band persists today, even though the last storm disappeared in October 2018.

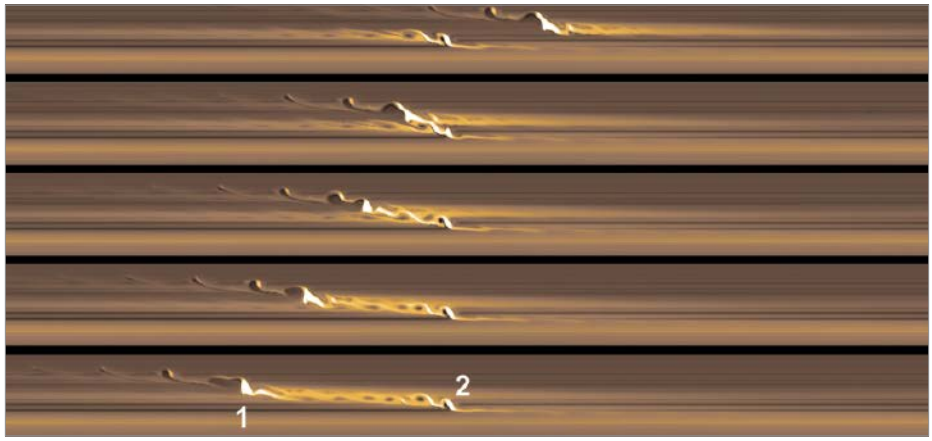
"This is something entirely new," said Agustin Sánchez-Lavega, a planetary scientist at University of the Basque Country in Spain. He is the lead author of a study published in *Nature Astronomy* describing the event (bit.ly/Saturn-storm).

Sánchez-Lavega highlights the contribution of amateur astronomers to this discovery. His university hosts a website called Planetary Virtual Observatory and Laboratory, where amateurs can contribute their planetary observations for research purposes (bit.ly/amateur-astronomers).

In this case, the first indication that something was happening in Saturn's atmosphere came from an image captured by an amateur astronomer in Brazil. "As soon as I saw it, I knew it could be interesting, and we issued an alert for our community of amateur astronomers observing the gas giants," explained Sánchez-Lavega. "This is very important because, thanks to them, we have daily images showing how the storm system has evolved."

Sánchez-Lavega and his team also gathered observations from the Hubble Space Telescope and the 2.2-meter telescope in Calar Alto, Spain. They were also able to use images from Cassini, which crashed onto Saturn in September 2017 but had imaged the cyclonic vortex where the first storm originated. "This is a very unusual spot for a storm to originate," Sánchez-Lavega explained.

The team members also used computer simulations to gauge the energy needed to gener-



A computer simulation (seen here) of the interactions between storms 1 and 2 helped scientists identify and model the movement of the new type of Saturnian storm. Credit: E. García-Melendo/M. Soria/Universitat Politècnica de Catalunya

ate the storms. They concluded that these were intermediate storms also in terms of energy, requiring about 10 times more energy to form than a typical small storm but around 100 times less energy than great white spots.

Another Piece of the Saturnian Puzzle

Still, the team doesn't know much about the mechanism that powers these and other storms on Saturn. Questions like why they appear at certain latitudes, why they've been observed only in the northern hemisphere, or why the great white spots seem to appear roughly every 60 years are open to debate.

"What this tells us is that there is a certain dynamic that occurs below the upper clouds that we see, known as the weather layer. This dynamic must happen at the base of the water cloud, 200 kilometers below the surface," Sánchez-Lavega said.

"Discovering a third type of storm on Saturn will add yet another piece to the puzzle of Saturn's intricate weather system."

"Saturn's atmosphere is a complex, dynamic environment with its own seasons and cycles, much like weather cycles on Earth but spanning decades rather than years," said Cassini project scientist Linda Spilker, who wasn't involved in the study. "Discovering a third type of storm on Saturn will add yet another piece to the puzzle of Saturn's intricate weather system."

According to Sánchez-Lavega, now that the Cassini mission is over, this is a good time to go back to the lab and focus on refining the computer models of Saturn's atmosphere.

"We hope that the James Webb Space Telescope will allow us to see in the infrared how these storms and other phenomena occur, characterizing the chemical composition so we can feed it into the models," Sánchez-Lavega said. "Our future research will focus [on understanding] the thermodynamic cycle of water in Saturn using observations from advanced telescopes like the James Webb."

By **Javier Barbuzano** (@javibarbuzano), Science Writer

Climate Change Will Make Us Sicker and Lose Work Hours

Climate change has medical experts worried about our health, according to a recent report from the Lancet Countdown, an interdisciplinary group of 34 academic institutions and United Nations agencies. Authors include climate scientists, doctors, economists, and other experts (bit.ly/Lancet-Countdown).

Heat and air pollution are some of the worst offenders, according to the report. Rapidly reducing greenhouse gas emissions will be the only way to lower health risks in the long run.

The report issued results for countries across the world, and it gives the United States a dismal diagnosis: People will face higher exposure risk to Zika virus from longer mosquito seasons and a widening habitat; they'll have an elevated risk of diarrheal illnesses and water contamination from worsening floods, and they'll witness disasters that could cause anxiety and post-traumatic stress. These are just a few examples of the wide-ranging consequences to health from climate change.

Here are four major takeaways from the report for public health in the United States:

1. Worker productivity is dropping because of soaring temperatures. Hotter days are only growing more frequent: Since the turn of the century, we've experienced 18 of 19 of the hottest years on record. Scorching temperatures are now limiting the number of hours people can work outside in agriculture and industry. Last year alone, the United States lost 64.7 million potential labor hours from extreme heat. Mississippi, Alabama, and Louisiana are some of the U.S. states most at risk of losing productivity hours and have some of the highest rates of poverty.

2. Older adults are more and more at risk from heat waves. By 2030, all members of the baby boomer generation will be over the age of 65. This aging population will be more at risk of falling sick or dying from increased temperatures because they may lack the ability to seek shelter from the heat or have preexisting health issues that heat could exacerbate. Heat zaps our ability to think, leads to dehydration and complications for people on certain medications, and in the most severe cases can cause heatstroke and heart failure. Heat wave exposures have been increasing in recent years and—like many other health effects from climate change—hurt communities that are already vulnerable.

3. Soot and small particles from burning coal and oil are killing people. Air pollution from burning fossil fuels is causing thousands of premature deaths in the United States every year. Burning fossil fuels releases fine particles (smaller than 2.5 micrometers in diameter) that can lead to a whole host of health problems, including asthma and birth complications. Black and Latinx people are hit harder by air pollution compared with the general population, despite contributing the least to the problem. In 2016, 64,200 people died prematurely in the United States from air pollution.

4. Children will face a lifetime of health risks from climate change. Children born today will face far greater negative impacts on their health than those of earlier generations, and children of color will be the most affected. From birth complications in the womb to heat-related illness in infancy and young adulthood, children will face health impacts at each stage of development that can affect them throughout their lives. As the authors write in the report, "without significant intervention, this new era [of climate change] will come to define the health of an entire generation."

Fine particles can lead to a host of health problems.

Paths Forward

Limiting carbon emissions will be crucial to curtailing inequality and reducing future health care costs.

The United States has a way to go to meet suggested emissions cutbacks. Last year, the country's carbon dioxide emissions rose by more than 3%. But some states have already begun to take action: Ten states and the District of Columbia rolled out plans for 100% clean or renewable electricity, and even more have enacted low-emissions standards for vehicles.

By **Jenessa Duncombe** (@jrdscience), Staff Writer