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SCIENCE NEWS BY AGU

A Coral Reef in the Australian Desert

Mercury Pollution Goes Deep

Subsea Cables Get SMART

SCIENCE AT THE SEAFLOOR

Researchers are taking long looks at the bottom of the ocean.

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The authors recommend "low-regrets" solutions—methods that provide both immediate benefits and long-term security. For instance, "if you have informal urbanization, very often there's no water management," explained Thorsten Wagener, a hydrologist at the University of Potsdam and a coauthor of the study. Simple features like roof gutters and water tanks "might be beneficial for the household and at the same time reduce the landslide risk," he said.

"Local knowledge can be really critical for translating this into meaningful action."

A Need for Local Knowledge

The threat of landslides isn't news in the tropics. Residents know the risks, and many mitigation strategies are already in place, said Sandra Catane, an engineering geology professor at the University of the Philippines Diliman.

"These are great ideas, but the challenge is the implementation," she said. "The politics, the economic factors—it's easier said than done."

The researchers recognized that in many regions both inside and outside the tropics, decisionmaking is siloed. City planners try to enforce building codes, engineers focus on stabilizing slopes, and social scientists study the factors forcing residents onto dangerous hillsides. Their study suggests more integrated ways to approach landslide mitigation.

Sharing knowledge with the local population can also be a challenge. Modeling can demonstrate the problem, Wagener said, "but getting that information to the people is a very, very complicated issue.... Local knowledge can be really critical for translating this into meaningful action."

Catane agreed, adding that nongovernmental organizations often have a unique capacity to assist at the local level. She's happy to see attention focused on the tropics and looks forward to further research on the socioeconomic pieces of the puzzle. "There has to be a long-term plan," she said, but "I'm not pessimistic. It can be done."

By **J. Besl** (@J_Besl), Science Writer

Could Jupiter's Heat Waves Help Solve a Planetary Energy Crisis?

Jupiter has been unusually prominent in both headlines and the night sky over the past year—not only because the gas giant made its closest approach to Earth in 59 years but also because it's been surprisingly hot. Researchers recently announced the discovery of an unexpected heat system measuring 700°C in the planet's upper atmosphere. The finding could shed light on why the giant planets in our solar system are surprisingly warm.

Planetary "Heat Wave"

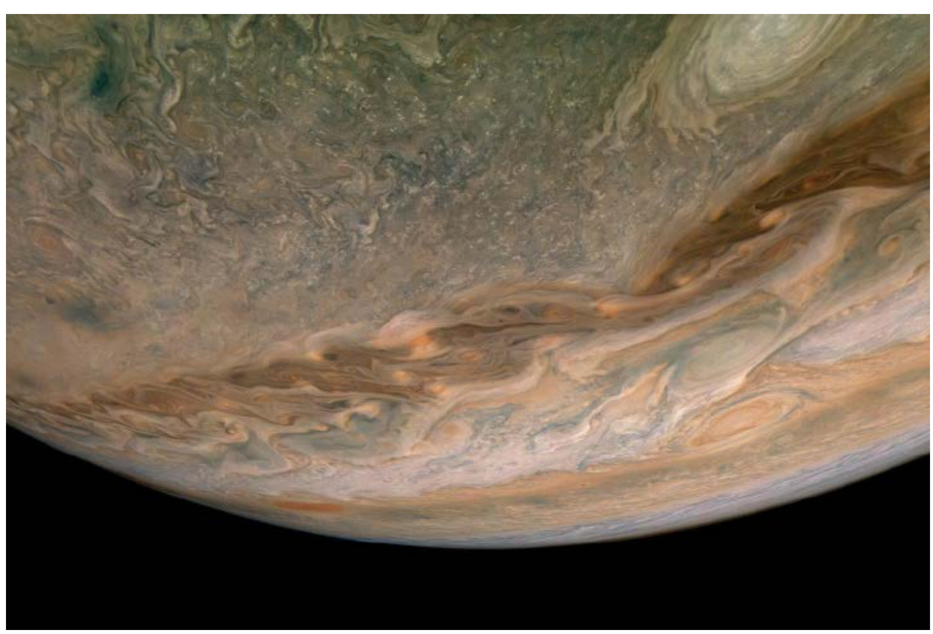
Jupiter's churning atmosphere is famous for its many cloud bands, storms, and the Great Red Spot. Close-up observations began only with the Pioneer probes of the 1970s, and the planet can still surprise.

Because it's so far from the Sun, receiving less than 4% of the sunlight that Earth gets, temperature models predict that the highest part of Jupiter's cloud layers should be −70°C. Researchers who presented findings at the Europlanet Science Congress 2022, however, measured them at more than 400°C. The conference was held in Granada, Spain, in September.

The researchers described the disparity between modeling and measurement as an "energy crisis," adding that the nonauroral upper atmospheres of Jovian planets (Jupiter, Saturn, Uranus, and Neptune) are "hundreds of degrees warmer than expected based on solar heating alone, motivating a search for missing heat sources." In the case of Jupiter, they believe the heat is being generated by solar wind exciting auroras at the poles. Unlike the transient auroras of Earth, Jovian auroras are always present and can raise polar temperatures to more than 700°C.

"While the auroras continuously deliver heat to the rest of the planet, these heat wave 'events' represent an additional, significant energy source," the team wrote in the presentation. "These findings add to our knowledge of Jupiter's upper atmospheric weather and climate, greatly helping to solve the 'energy crisis' plaguing the giant planets" (bit.ly/Jupiter-heat-wave).

James O'Donoghue, a planetary scientist at the Japan Aerospace Exploration Agency who presented the results, has spent about 10 years trying to unravel the mystery of why giant planets are hotter than they are expected to be. He and his colleagues used observational data from the high-resolution Near Infrared Spectrometer on the Keck II telescope on Hawai'is Mauna Kea to analyze



Temperatures in Jupiter's northern hemisphere soared to up to 400°C, according to recent studies of infrared data. Credit: NASA/JPL-Caltech/SwRI/MSSS the heat gradient between Jupiter's poles and its equator. They examined emissions of triatomic hydrogen (H_3^+) ions, electrically charged molecules that are everywhere in Jupiter's upper atmosphere, and used a model to derive temperature values.

They found a smooth gradient between the poles and the equator, suggesting the aurora was causing heating, but also found what they call a "heat wave" extending from the poles to the lower latitudes. The heat wave, which measured more than 130,000 kilometers across (about 10 Earth diameters), was observed traveling toward the equator at speeds of thousands of kilometers per hour.

"It was kind of a chance discovery that happened to be in that data set."

During an earlier quiet period, Jupiter's magnetosphere was being populated, as usual, with plasma originating from the volcanic moon Io. A dense pocket of solar wind likely activated the system, leading to charged-particle precipitation in the aurora getting accelerated into the atmosphere, apparently heating it dramatically.

"It took this event of compressing Jupiter's magnetic field with the solar wind to shake it up like a snow globe," said O'Donoghue. He described "a large dumping of heat in the aurora" with nowhere to go. As a result, the heat "will firmly expand the atmosphere, spilling over to the equator and the pole.... Around the planet, you see this giant heat wave."

A Chance Discovery

The researchers focused on only the northern hemisphere on the particular day studied (25 January 2017), but O'Donoghue speculated that they might have seen a similar feature in the south. Asked why our understanding of Jupiter's atmospheric temperature has been poor, O'Donoghue offered two reasons. One reason, he noted, is that relatively few scientists focus on the subject. Another is that few telescopes are large enough for such high-resolution observations, so data are lacking. His team was lucky because it happened upon evidence of a large, dense pocket of solar wind hitting Jupiter at just the right time.

"It was kind of a chance discovery that happened to be in that data set," O'Donoghue said.

Solar wind was not thought to play a role in Jupiter's magnetosphere, but scientists have been wondering about the relationship since the Pioneer 10 observations decades ago. The recent findings show that the "solar wind does indeed alter the properties of Jupiter's magnetosphere, at least during events when the planet is hit by a dense stream of solar wind particles," said Sushil Atreya, a professor of climate and space sciences and engineering director at the Planetary Science Laboratory at the University of Michigan in Ann Arbor, who was not involved in the study.

The findings do not fully resolve the question of the energy crisis on big planets, Atreya added, noting that space probes and other observations have found even greater temperature differences with predicted values. "Any coordination between future telescopic observations of H_3^+ from Earth and the Jovian Infrared Auroral Mapper observation of the same from the Juno spacecraft at Jupiter, together with joint analysis employing also the magnetospheric and auroral data collected on Juno," he said, "would go a long way in satisfactorily resolving the question of [the] energy crisis at the giant planets."

O'Donoghue and his colleagues hope to work with Juno operators to have a companion data set that can show when and to what degree Jupiter was affected by solar wind events. Hard data could serve as a backup for the solar wind model that the team has been using. As the Sun enters a more active phase, researchers hope to find more heat waves and gather detailed readings on their magnitude, frequency, and other variables, as well as whether a similar phenomenon is happening on other Jovian planets.

"We'll try to track down future waves—it's difficult to plan for those things," O'Donoghue said. "We need the Sun to be kicking off a coronal mass ejection or something like that, and hopefully we can time our observation to be on Jupiter then."

By **Tim Hornyak** (@robotopia), Science Writer