Dazzling auroras are just a warm-up as more solar storms are likely, scientists say

***Nature* talks to physicists about what to expect in the next few months and beyond as the Sun hits its 'maximum'.**

Stunning photographs of the northern and southern lights, seen at much lower latitudes than usual, saturated social media on 10 and 11 May. For space-weather scientists, the auroras, created by a raging solar storm, were long-expected but dramatic evidence that the Sun is nearing the peak of its 11-year cycle of activity.

Satellite operators, electrical-grid managers and others who maintain crucial technological infrastructure are still assessing the impacts of this historic event — the severest geomagnetic storm since 2003. But most major systems seem to have weathered the blast.

That's encouraging, because more storms are likely: the most powerful geomagnetic storms of a solar cycle can occur after the 'solar maximum', which is expected later this year. *Nature* explains what caused the storm and what solar physicists are anticipating next.

People in Whitley Bay, UK, snap photos of the aurora borealis on 10 May.

IAN FORSYTH/GETTY

Why is this happening now?

The immediate cause is a cluster of sunspots, known as active region 3664, that appeared below the Sun's equator on the side then facing Earth. The cluster is around 17 times as wide as Earth, and is probably the largest and most complex sunspot region observed during the current solar cycle, which began in 2019, says Shawn Dahl, a space-weather forecaster at the US National Oceanic and Atmospheric Administration's Space Weather Prediction Center in Boulder, Colorado.

Starting around 8 May, active region 3664 sent at least seven blasts of magnetized plasma, or coronal mass ejections, racing in Earth's direction at speeds of up to 1,800 kilometres per second. Along with other waves of charged plasma and solar debris, the coronal mass ejections swamped space-weather detectors. The experience was "hypnotic", says solar physicist Ryan French at the National Solar Observatory in Boulder — first watching the data flood in, and then later because of the "raw awe" of witnessing the aurora.

How big was this storm?

Huge — by a number of measures. It was 'extreme' on the five-tiered scale that describes geomagnetic storms, and a 'superstorm' according to an index of changes in Earth's magnetic field.

And then there were the auroras. Earth's magnetic field shields humans and other life from the effects of solar storms by redirecting harmful particles around the planet. But when the material from coronal mass ejections slams into the magnetic field, it dumps energy into Earth's upper atmosphere. Chemical elements there, such as oxygen and nitrogen, become ionized and glow in various colours, creating auroras.

The lights are usually seen near Earth's poles, but on 10 May, because of the intensity of the solar storm, auroras were seen at remarkably low latitudes, including in Mexico.

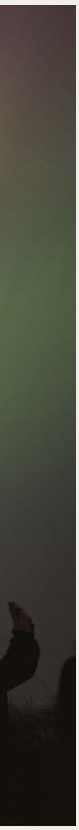
"Unforgettable," says Steph Yardley, a space physicist at Northumbria University in Newcastle-upon-Tyne, UK. The auroras were so active that she had to look south, rather than north, from her viewing point in Scotland to see it.

What impacts did it have?

The solar storm interrupted radio and GPS communications across the globe. The broadband internet connection provided by Starlink, a division of the aerospace firm SpaceX — a service that relies on more than 5,000 satellites — reported some temporary degradation in the quality of its signals. That could be because of communications disruptions or because the storm changed the density of Earth's atmosphere and created drag on the satellites, space-weather physicist Tamitha Skov posted on the social-media platform X (formerly Twitter).

In anticipation of the extreme solar activity, electrical-grid operators had taken protective measures — geomagnetic storms can induce extra electrical currents in the grid, causing power cuts. New Zealand's electrical-transmission service temporarily turned off some circuits around the country to prevent equipment damage.

NASA said on 10 May that it foresaw no



threat to the four US and three Russian astronauts aboard the International Space Station. Three people are aboard China's Tiangong space station, but there have been no reports of precautionary actions taken there, either.

Some satellites did stop making scientific observations. For instance, NASA's Chandra X-ray Observatory temporarily ceased gathering astronomical data as a precaution before the storm and stowed its instruments to protect them from radiation blasts. And during the storm, NASA's ice-measuring ICESat-2 satellite automatically stopped doing science when it experienced unexpected rotation, probably caused by increased atmospheric drag, a NASA spokesperson said.

What else can scientists learn from the storm?

There might be fresh insights to come. The European Space Agency's Solar Orbiter probe is nearly behind the Sun with respect to Earth, giving it a different view of the storm. Active region 3664 has rotated off the side of the Sun seen from Earth and into the field of view of Solar Orbiter. "We should get a better idea in the next few days if this sunspot intends to keep packing the punches on the other side of the Sun," says David Williams, one of the spacecraft's instrument operations scientists. The sunspot region is also now facing NASA's Parker Solar Probe — which is in the middle of a series of dives through the Sun's outer atmosphere and happens to be at the outermost part of its looping orbit around the Sun. Both probes are built to withstand the onslaught of solar eruptions.

When could the next big storm affect Earth?

At any time. Scientists expect the current solar cycle to peak some time this year, owing to the number of sunspots they are observing. The biggest storms typically happen months to years after this official peak. Furthermore, as the solar cycle progresses, sunspots tend to appear closer to the Sun's equator, increasing the chances of coronal mass ejections that will head directly for Earth rather than out into space, Dahl says.

By Alexandra Witze

News explainer

DOCTOR ORANGUTAN: FIRST WILD ANIMAL SEEN USING MEDICINAL PLANT

The Sumatran orangutan used a plant known to humans for its therapeutic qualities.

By Gayathri Vaidyanathan

An orangutan in Sumatra surprised scientists when he was seen treating an open wound on his cheek with a poultice made from a medicinal plant. It's the first scientific record of a wild animal healing a wound using a plant with known medicinal properties. The findings were published this month in *Scientific Reports*[1].

"It shows that orangutans and humans share knowledge. Since they live in the same habitat, I would say that's quite obvious, but still intriguing to realize," says Caroline Schuppli, a primatologist at the Max Planck Institute of Animal Behavior in Konstanz, Germany, and a co-author of the study.

In 2009, Schuppli's team was observing Sumatran orangutans (*Pongo abelii*) in the Gunung Leuser National Park in South Aceh, Indonesia, when a young male moved into the forest. He did not have a mature male's big cheek pads, called flanges, and was probably around 20 years old, Schuppli says. He was named Rakus, or 'greedy' in Indonesian, after he ate all the flowers off a gardenia bush in one sitting.

In 2021, Rakus underwent a growth spurt and became a mature flanged male. The researchers observed Rakus fighting with other flanged males to establish dominance and, in June 2022, a field assistant noted an open wound on his face, possibly made by the canines of another male, Schuppli says.

Rakus's wound was under his right eye.

Days later, Rakus was observed eating the stems and leaves of the creeper akar kuning (*Fibraurea tinctoria*), which local people use to treat diabetes, dysentery and malaria, among other conditions. Orangutans in the area rarely eat this plant.

As well as eating the leaves, Rakus chewed them without swallowing and used his fingers to smear the juice on his facial wound for seven minutes. Some flies settled on the wound, whereupon Rakus spread a poultice of leaf-mash on the sore. He ate the plant again the next day. Eight days after his injury, his wound was fully closed.

The research group has seen no other orangutans in the national park self-medicate using akar kuning in 21 years of observation. This could be because wild orangutans in the region are rarely injured. Or perhaps Rakus is the only one who knows of this treatment, which could be a behaviour he picked up before he moved into the area.

"It is the first study to scientifically demonstrate that an animal is using a plant with medicinal properties applicable to wounds, and putting those on the wounds and consistently treating over a period of time," says Michael Huffman, who studies animal self-medication at the Institute for Tropical Medicine at Nagasaki University in Japan.

Huffman says self-medication is seen in many species. Canadian snow geese (*Anser caerulescens*) swallow leaves whole to expel tape worms[2]. Dusky-footed wood rats (*Neotoma fuscipes*) line their nests with aromatic plants to fumigate parasites[3]. And chimpanzees (*Pan troglodytes*) in Gabon have been observed rubbing insects near their wounds[4], potentially as treatment.

Humans might even have discovered some remedies by watching animals, he says. "Probably our ancestors were looking at other animals and learning about medicines." When social animals communicate, "that information sticks and can last over generations".

1. Laumer, I. B. *et al. Sci. Rep.* **14**, 8932 (2024).
2. Huffman, M. A. & Caton, J. M. *Int. J. Primatol.* **22**, 329–346 (2001).
3. Hemmes, R. B., Alvarado, A. & Hart, B. L. *Behav. Ecol.* **13**, 381–385 (2002).
4. Mascaro, A., Southern, L. M., Deschner, T. & Pika, S. *Curr. Biol.* **32**, R112–R113 (2022).

ARMAS