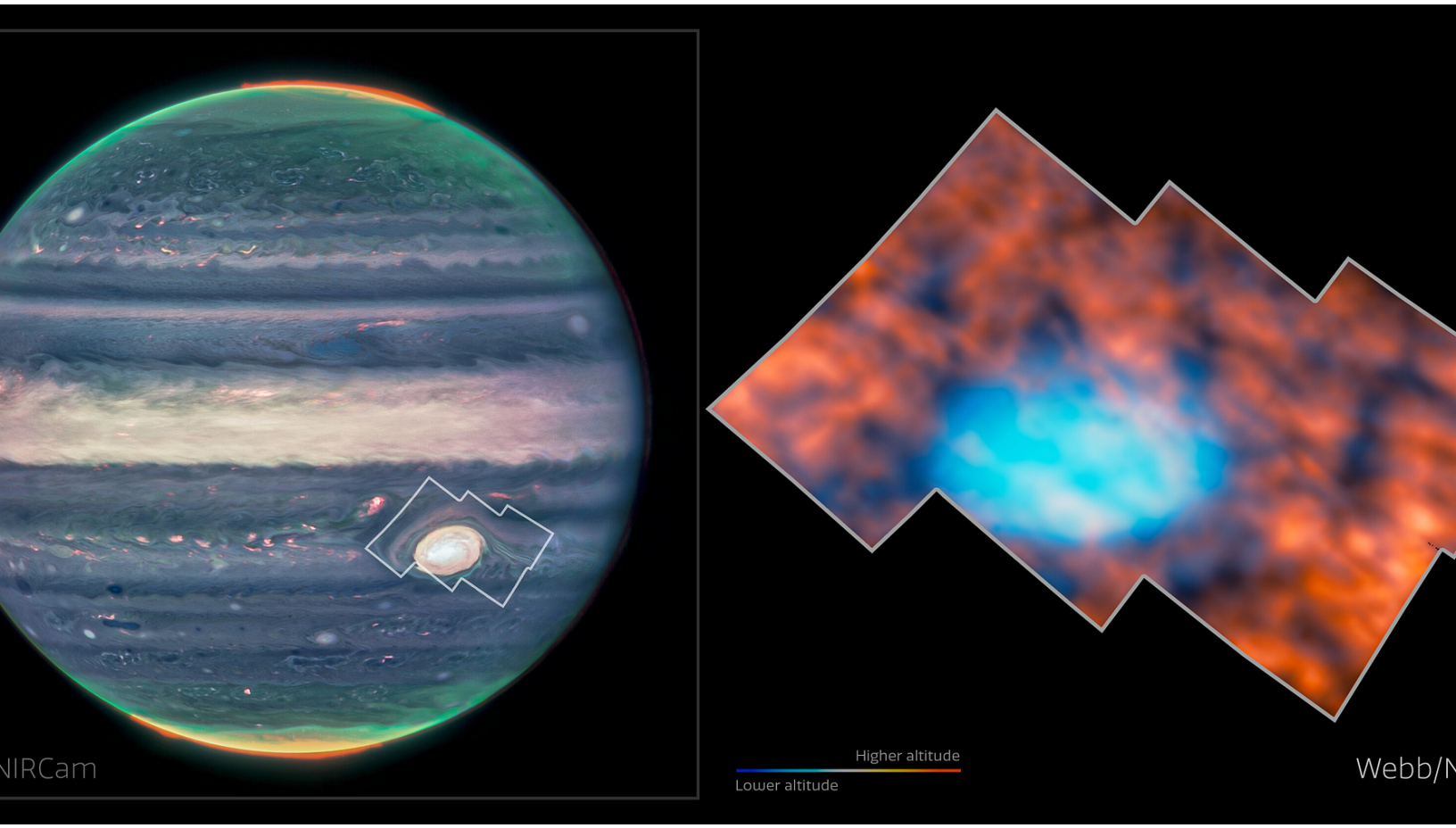
Northumbria University NEWCASTLE



Jupiter's atmosphere around the Great Red Spot (NIRCam and NIRSpec). Photo credit: ESA/Webb, NASA & CSA, Jupiter ERS Team, J. Schmidt, H. Melin, M. Zamani (ESA/Webb)

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Telescope reveals unexpected activity above Jupiter's Great Red Spot

It is Jupiter's most recognisable feature – a storm that has been raging for hundreds of years – but up until now little has been known about how activity at the gas giant's Great Red Spot affects its surroundings overhead.

Thanks to images taken by the world's largest deep-space telescope, scientists have now been able to reveal fascinating new details about the effect the spot has on Jupiter's upper atmosphere – a region known as the

ionosphere.

By analysing images captured by the James Webb Space Telescope researchers have discovered that the region directly above the Great Red Spot features intricate structures and never-before-seen activity.

Their findings, published in *Nature Astronomy*, theorise that the storm surrounding the Spot creates gravity waves, which move upwards until they reach Jupiter's ionosphere, where they break like waves on a beach.

This releases the energy within the gravity waves, shaping the structure of the ionosphere in this area.

The findings came as a surprise to the international team of scientists analysing the images, as research lead Dr Henrik Melin explains: "The ionosphere is generally a pretty boring region – there is some auroral activity around Jupiter's poles, but the equatorial region where the Great Red Spot is located was expected to be very smooth.

"We were therefore surprised to see that the images from the James Webb Space Telescope showed there were some really interesting and unexpected small-scale structures such as arcs, bands and spots in the ionosphere in the region directly above the Spot.

"We believe the gravity waves produced by the huge storm beneath this area are actually shaping the density of the structure of the ionosphere when they reach the upper atmosphere and release their energy."

Until now our understanding of the upper atmosphere of Jupiter – the largest planet in our solar system – has mostly come from images of the planet captured from Earth.

However, in recent years access to NASA's James Webb Space Telescope (JWST) has allowed scientists to take new images in unprecedented detail.

Launched in 2021, JWST uses infrared radiation to look deep into space, meaning it can observe the first stars and even the formation of the first galaxies.

The power of the telescope means when it is directed at planets closer to home we can uncover incredible detail, allowing us to gain better understanding of our solar system.

Tom Stallard, Professor of Planetary Astronomy at Northumbria University, was part of the team behind the new findings. His research focusses on the upper atmospheres of giant gas planets such as Jupiter, Saturn and Uranus.

Professor Tom Stallard

He said: “We used to think of a planet’s aurora as the only interesting place in terms of ionospheric activity, but these new images show that is not always the case.

“Even spacecraft which have gone to Jupiter, such as the NASA Juno mission, have not had the sensitivity required to pull out this level of ionospheric detail.

“In future it would be interesting to observe how the patterns we see over the Great Red Spot change, and how these waves move throughout Jupiter’s

upper atmosphere.

“Although Jupiter appears very different to Earth there is actually much we can learn about our own planet by studying Jupiter. The processes going on are very similar, but Jupiter’s magnetic field is much stronger, and stranger.”

Access to JWST is highly competitive, with scientists allowed to apply for an opportunity to access the telescope once a year, with only one in nine proposals being accepted.

The images used for this latest finding were taken in July 2022 and were among the first captured as part of ‘early release observations’ designed to mark the beginning of the telescope’s operations and demonstrate its capabilities.

Professor Stallard, who is a member of Northumbria University’s Solar and Space Physics research group, was successfully awarded time during cycle 2, which took place in September last year, and is currently analysing the results.

Both he and Dr Melin, who will join the group this summer, have also been awarded time during cycle 3, which runs from July 2024 to June 2025.

Professor Stallard will observe Saturn’s northern auroral region through an entire Saturnian day, 10.6 hours in length, to observe the changing temperature of this region as the planet rotates.

During his time with the telescope, Dr Melin will observe the aurora of Uranus, capturing images over the course of a single Uranian day, or one full rotation of the planet.

Proposals for cycle 4 of JWST will be submitted in October this year.

Northumbria’s Solar and Space Physics researchers collaborate extensively with partners including UK Research and Innovation, the UK Space Agency, the European Space Agency, the UK Met Office, and over 40 industrial partners.

Last year the University announced ambitious plans to develop a £50 million space skills, research and development centre, set to transform the UK space industry. The North East Space Skills and Technology centre (NESST) is expected to directly support the creation of over 350 jobs and inject over £260 million into the North East economy over the next 30 years, playing a critical role in the government's levelling-up agenda and immediately becoming a catalyst for the wider development of the UK space sector in the North East region.

Visit www.northumbria.ac.uk/space to discover more about how Northumbria University is powering the next generation of space innovation.

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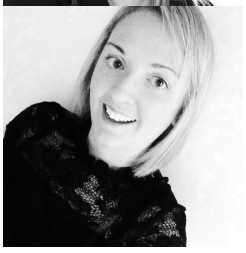

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