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Jupiter's Spot Seen Glowing

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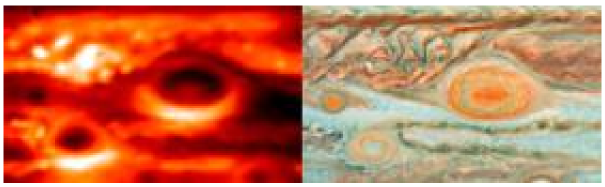

New thermal images from ESO's Very Large Telescope (VLT) and other ground-based telescopes show swirls of warmer air and cooler regions never seen before within Jupiter's Great Red Spot. The image on the left was obtained with the VISIR on the VLT in Chile on May 18, 2008. It was taken in the infrared wavelength range of 10.8 microns, which is sensitive to Jupiter's atmospheric temperatures in the 300 to 600 millibar pressure range. That pressure range is close to the altitude of the white, red and brown aerosols seen in the visible-light image on the right, which was obtained by the NASA/ESA Hubble Space Telescope on May 15, 2008. These images show the interaction of three of Jupiter's largest storms -- the Great Red Spot and two smaller storms nicknamed Oval BA and Little Red Spot. Credit: ESO/NASA/JPL/ESA/L. Fletcher

(PhysOrg.com) -- New ground-breaking thermal images obtained with ESO's Very Large Telescope and other powerful ground-based telescopes show swirls of warmer air and cooler regions never seen before within Jupiter's Great Red Spot, enabling scientists to make the first detailed interior weather map of the giant storm system linking its temperature, winds, pressure and composition with its colour.

"This is our first detailed look inside the biggest storm of the Solar System," says Glenn Orton, who led the team of astronomers that made the study. "We once thought the Great Red Spot was a plain old oval without much structure, but these new results show that it is, in fact, extremely complicated."

The observations reveal that the reddest colour of the Great Red Spot corresponds to a warm core within the otherwise cold storm system, and images show dark lanes at the edge of the storm where gases are descending into the deeper regions of the planet. The observations, detailed in a paper appearing in the journal Icarus, give scientists a sense of the circulation patterns within the solar system's best-known storm system.

Sky gazers have been observing the Great Red Spot in one form or another for hundreds of years, with continuous observations of its current shape dating back to the 19th century. The spot, which is a cold region averaging about -160 degrees Celsius, is so wide that about three Earths could fit inside its boundaries.

The thermal images were mostly obtained with the VISIR instrument attached to ESO's Very Large Telescope in Chile, with additional data coming from the Gemini South telescope in Chile and the National Astronomical Observatory of Japan's Subaru Telescope in Hawaii. The images have provided an unprecedented level of resolution and extended the coverage provided by NASA's Galileo spacecraft in the late 1990s. Together with observations of the deep cloud structure by the 3-metre NASA Infrared Telescope Facility in Hawaii, the level of thermal detail observed from these giant observatories is for the first time comparable to visible-light images from the NASA/ESA Hubble Space Telescope.

VISIR allows the astronomers to map the temperature, aerosols and ammonia within and surrounding the storm. Each of these parameters tells us how the weather and circulation patterns change within the storm, both spatially (in 3D) and with time. The years of VISIR observations, coupled with those from the other observatories, reveals how the storm is incredibly stable despite turbulence, upheavals and close encounters with other anticyclones that affect the edge of the storm system.

"One of the most intriguing findings shows the most intense orange-red central part of the spot is about 3 to 4 degrees warmer than the environment around it," says lead author Leigh Fletcher. This temperature difference might not seem like a lot, but it is enough to allow the storm circulation, usually counter-clockwise, to shift to a weak clockwise circulation in the very middle of the storm. Not only that, but on other parts of Jupiter, the temperature change is enough to alter wind velocities and affect cloud patterns in the belts and zones.

"This is the first time we can say that there's an intimate link between environmental conditions — temperature, winds, pressure and composition — and the actual colour of the Great Red Spot," says Fletcher. "Although we can speculate, we still don't know for sure which chemicals or processes are causing that deep red colour, but we do know now that it is related to changes in the environmental conditions right in the heart of the storm."

More information: This research was presented in a paper to appear in *Icarus* ("Thermal Structure and Composition of Jupiter's Great Red Spot from High-Resolution Thermal Imaging", by L. Fletcher et al.).

Provided by ESO

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