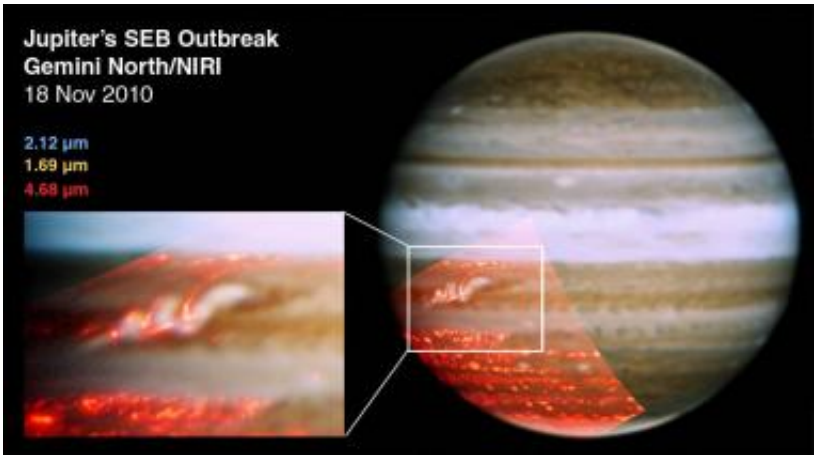
Jupiter gets its stripe back

November 25 2010, By Robert Sanders



This Nov. 18 Gemini North Telescope image of Jupiter combines blue, red and yellow images into a false-color composite that clearly shows the storm in the South Equatorial Belt. The belt is now turning dark after a brief fade to white. (Credit: JPL, University of Oxford, UC Berkeley, Gemini Observatory, University of San Carlos, Philippines).

(PhysOrg.com) -- Astronomers using three telescopes atop Mauna Kea in Hawaii have recorded the return of a unique belt on Jupiter that periodically fades from dark brown to white. It's most recent fade-out started earlier this year, but November observations with the Keck, Gemini and Infrared Telescope Facility show the brown returning. It appears that reflected sunlight off high elevation clouds of ammonia ice have been blocking our view of the darker clouds below.

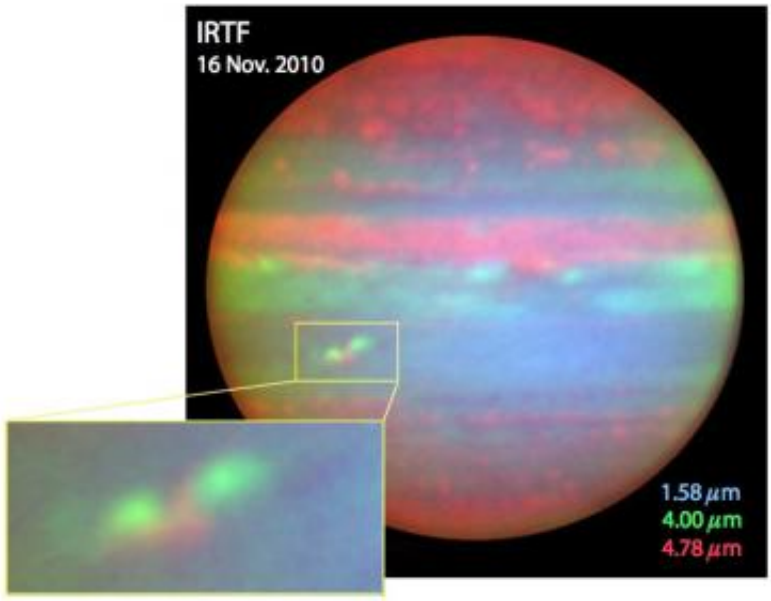
One of Jupiter's dark brown stripes that faded out last spring is regaining

its color, providing an unprecedented opportunity for astronomers to observe a rare and mysterious phenomenon caused by the planet's winds and cloud chemistry.

Earlier this year, amateur astronomers noticed that the long-standing stripe, known as the South Equatorial Belt (SEB), just south of Jupiter's equator, had turned white. In early November, amateur astronomer Christopher Go of Cebu City in the Philippines observed a prominent bright spot in the unusually whitened belt, piquing the interest of professional and amateur astronomers around the world.

After follow-up observations with NASA's Infrared Telescope Facility (IRTF), the 10-meter Keck telescope and the 8-meter Gemini telescope, all atop Mauna Kea in Hawaii, scientists at the University of California, Berkeley, and elsewhere now believe the stripe is making a comeback.

Astronomers announced first-glimpse images of the reappearing stripe Nov. 24.



NASA's Infrared Telescope Facility False obtained this false-color composite image on Nov. 16. The prominent region just to the left of the center, expanded in the insert, shows the region of the South Equatorial Belt outbreak. In the coming weeks, further outbreaks are expected to take place to the west (left) of those seen in this image. The clear atmospheric regions (in red) will begin to fill this latitude band at the same time as the dark brown color typical of this region returns. (Credits: JPL, University of Hawaii, University of Oxford, UC Berkeley)

"The reason Jupiter seemed to 'lose' this band — camouflaging itself among the surrounding white bands — is that the usual downwelling winds that are dry and keep the region clear of clouds died down," said Glenn Orton, a research scientist at NASA's Jet Propulsion Laboratory (JPL) in Pasadena, Calif. "One of the things we were looking for in the infrared was evidence that the darker material appearing in visible light was actually the start of clearing in the cloud deck, and that is precisely what we saw."

This white cloud deck is made up of white ammonia ice. When the white clouds float at a higher altitude, they obscure the view of the lower brown clouds. Every few decades or so, the South Equatorial Belt turns completely white for perhaps one to three years, an event that has puzzled scientists for decades. This extreme change in appearance has only been seen with the South Equatorial Belt, making it unique to Jupiter and to the entire solar system.

The bright storm that Go observed in the faded belt was quite unusual, said Imke de Pater, UC Berkeley professor of astronomy.

"At infrared wavelengths, images in reflected sunlight show that the spot is a tremendously energetic 'outburst,' a vigorous storm that reaches extreme high altitudes," de Pater said. "The storms are surrounded by

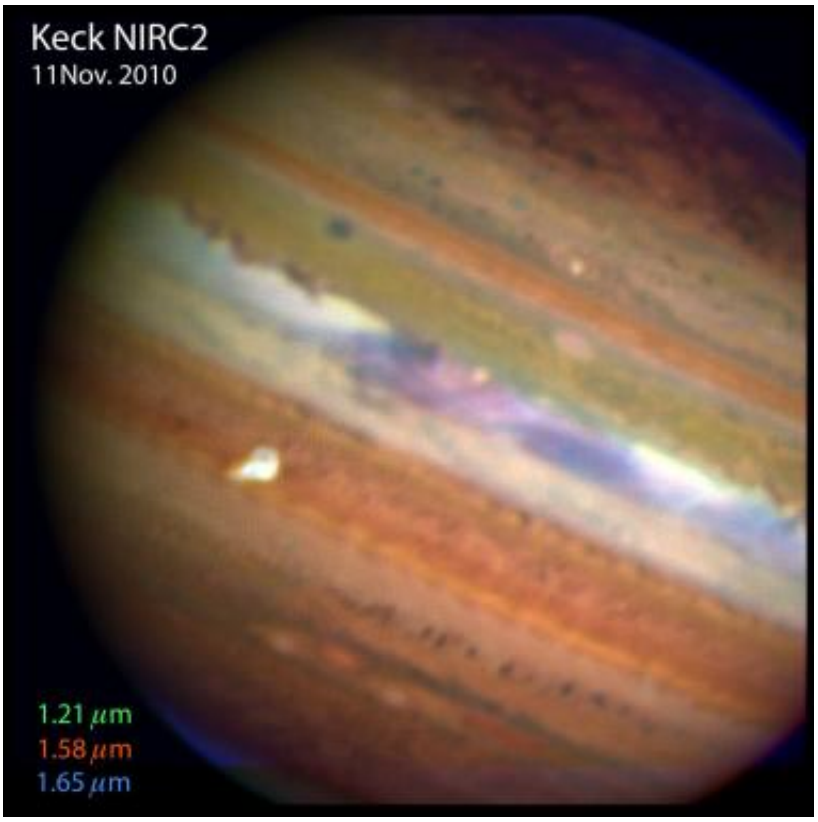
darker areas, bluish-grey in the visible, indicative of 'clearings' in the cloud deck."

To confirm the presence of such clearings, the team obtained data at longer wavelengths (5 micron) sensitive to thermal emission from Jupiter's deep atmosphere. These data confirm that the visibly dark material indeed is being seen through holes in the cloud deck, "perhaps signaling the start of the SEB revival," added Glenn Orton.

The white band wasn't the only change on the big, gaseous planet. At the same time, Jupiter's Great Red Spot became a darker red color. Orton said the color of the spot — a giant storm on Jupiter that is three times the size of Earth and a century or more old — will likely brighten a bit again as the South Equatorial Belt makes its comeback.

The South Equatorial Belt underwent a slight brightening, known as a "fade," just as NASA's New Horizons spacecraft was flying by on its way to Pluto in 2007. Then there was a rapid "revival" of its usual dark color three to four months later. The last full fade and revival was a double-header event, starting with a fade in 1989, revival in 1990, then another fade and revival in 1993. Similar events have been captured visually and photographically back to the early 20th century, and they are likely to be a long-term phenomenon in Jupiter's atmosphere.

Scientists are particularly interested in this event because it's the first time they've been able to use modern instruments to determine the details of the chemical and dynamical changes of this phenomenon.



This false-color image, taken Nov. 11 by the Keck telescope, shows sunlight reflected off Jupiter's upper cloud deck — the same clouds that are seen in visible light. The bright spot in the South Equatorial Belt is the outbreak where winds are lofting particles to high altitudes. (Credit: UC Berkeley, University of Toronto, University of San Carlos, Philippines)

"These observations may help to unravel the mystery of why this transition occurs, and may allow us to understand the longevity of Jupiter's belt/zone structure," added Leigh Fletcher, a scientist at Oxford University in England.

The event also signifies another close collaboration between professional and amateur astronomers. The amateurs, located worldwide, are often well equipped with instrumentation and are able to track the rapid developments of planets in the solar system. These amateurs are

collaborating with professionals to further study the changes that are of great value to scientists and researchers everywhere.

"I was fortunate to catch the outburst," Go said. "I had a meeting that evening, and it went late. I caught the outburst just in time as it was rising. Had I imaged earlier, I would not have caught it."

Go witnessed the disappearance of the stripe earlier this year, and in 2007 he was the first to catch the stripe's return. "I was able to catch it early this time around because I knew exactly what to look for," he said.

Since the discovery of the first spot, there have been several more outbreaks of varying strengths. The SEB revival is happening fast, with violent eruptions, de Pater said.

Observing this event carefully may help to refine the scientific questions that will be posed by NASA's Juno spacecraft, due to arrive at Jupiter in 2016, and a larger mission to orbit Jupiter and explore its satellite Europa after 2020.

The observations were conducted by a large team of observers around the world. At UC Berkeley, the following researchers are involved: Imke de Pater, Michael Wong, James Graham, Shelley Wright and Franck Marchis. More observations at near- and mid-infrared wavelengths are planned for the coming weeks.

More information: For more images and a comparison of Jupiter before and after the SEB's fade-out, link to Imke de Pater's Web page.

Provided by University of California - Berkeley