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Observations from the Cassini Spacecraft Provide Details of Saturn's Winds

Work of UH's Li and Jiang Published in Nature Geoscience

Liming Li, a research assistant professor, and Xun Jiang, an assistant professor, both in the University of Houston's Department of Earth and Atmospheric Sciences, were co-authors on a paper in the November 2011 issue of Nature Geoscience. The article appeared online on October 16.

Entitled "Equatorial winds on Saturn and the stratospheric oscillation," the paper explores the high-altitude winds of Saturn, focusing on high-altitude jet and oscillation in Saturn's equatorial region. The research was supported by a grant to Li and Jiang from the NASA Cassini Data Analysis Program. Additional co-authors on the paper provided assistance in interpreting the observational results.

In a Question & Answer format, Li and Jiang share some insight on the information covered in the paper. Li has studied the zonal jets on the giant planets since 2001 when he was a graduate student at Caltech.

How would you summarize the article?
Li and Jiang: Even though there is some debate, the zonal jets (winds, ~100 - 500 meters per second) on the giant planets are generally thought to be constant with time. However, our analysis of observations from the Cassini spacecraft reveals an acceleration of wind velocities in Saturn's high-altitude equatorial jet between 2004 and 2009, by 20 m s−1 at tropopause level and by 60 m s−1 in the stratosphere. The observations were taken using multiple instruments, including an imaging instrument and infrared spectrometer, on Cassini.

Would you briefly describe the research and method used to make the observations?
Li and Jiang: There are no anemometers to measure wind speed on Saturn. However, there are two ways to measure the planetary winds. The first way is easy to understand; we track clouds in images taken by spacecrafts at different time intervals. Then, we divide the displacements of clouds by the time intervals to get the wind speed. The second way is a little harder to understand; there is a relationship between the temperature field and wind field in planetary atmospheres, which in meteorology is called the "thermal wind relationship." The basic idea behind the "thermal wind relationship" is that we can derive the wind field if the temperature field is known.

From 2004 to 2009, we collected Cassini observations (images and temperature maps) to measure the winds using both methods. Both sets of measurements, those using the first method (cloud tracking) and the second (deriving winds from temperature field), show time variations of Saturn's zonal winds.

What are your goals with this research and in this area of study?
Li and Jiang: One goal is to monitor the time variation of Saturn's winds. Ultimately, we want to examine the time variation of meteorology and climate on the giant planets. We hope this work will not only help us better understand the formation and evolution of planetary atmospheres in our solar system but will also shed light on climate change of Earth.

What does this research mean for scientists studying Saturn? Is there any impact on the general public?
Li and Jiang: Our discovery will help scientists explore atmospheric oscillation and atmospheric dynamics because the zonal jets are closely related to the atmospheric oscillation and atmospheric

dynamics. The new discovery will also help scientists validate the theories and models of general circulations on the giant planets because the predictions/simulations from these theories/models must be consistent with the new observations.

The atmospheric oscillation and circulation are also related to climate change on the giant planets. Exploration of climate change on other planets will help us understand and explore climate change on Earth in a wider view.

How does this impact ongoing and further research in this area?
Li and Jiang: Our discovery will draw scientists' attention to the time variation of meteorology on the giant planets. The new discovery also provides scientists with an opportunity to re-think and re-examine some popular theories explaining the general circulation on the giant planets.

How did you become interested in this topic?
Li: When I saw the amazing images of Jupiter taken by the Cassini spacecraft in 2001 (my first year as graduate student at Caltech), I was shocked. Since then, I've had a strong interest in exploring the atmospheres of giant planets. The long-term observations of Saturn (2004 and going forward) from Cassini provide a perfect opportunity to examine the time variation of this amazing phenomenon in our solar system: the strong zonal jets on the giant planets.

- Kathy Major, College of Natural Sciences and Mathematics

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