Cassini's Visual and Infrared Mapping Spectrometer detects vast polar ethane cloud on Titan

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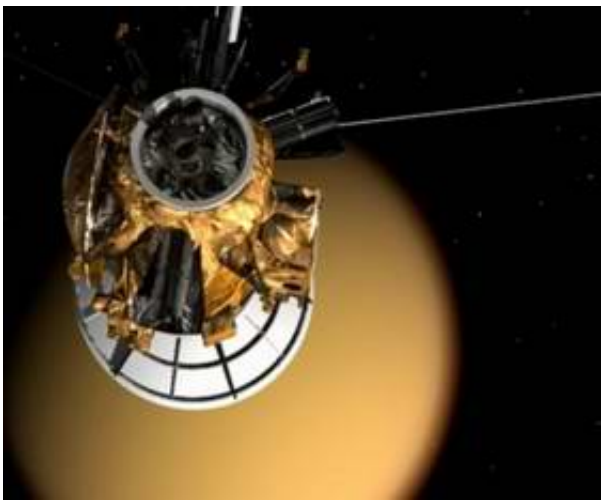

Cassini's Visual and Infrared Mapping Spectrometer (VIMS) has detected what appears to be a massive ethane cloud surrounding Titan's north pole. The cloud might be snowing ethane snowflakes into methane lakes below.

The cloud may be the clue needed in solving a puzzle that has confounded scientists who so far have seen little evidence of a veil of ethane clouds and surface liquids originally thought extensive enough to cover the entire surface of Titan with a 300-meter-deep ocean.

Before the Cassini-Huygens mission began visiting Titan in 2004, "We expected to see lots of ethane -- vast ethane clouds at all latitudes and extensive seas on the surface of Saturn's giant moon Titan," University of Arizona planetary scientist Caitlin Griffith said.

That's because solar ultraviolet light irreversibly breaks down methane in Titan's mostly nitrogen atmosphere. Ethane is by far the most plentiful byproduct when methane breaks down. If methane has been a constituent of the atmosphere throughout Titan's 4.5-billion-year lifetime -- and there was no reason to suspect it had not -- the large moon would be awash with seas of ethane, scientists theorized.

NASA's Cassini spacecraft radar found lakes in Titan's north arctic latitudes on a flyby last July 22. However, "We now know that Titan's surface is largely devoid of lakes and oceans," Griffith said. She is a member of the UA-based Cassini VIMS team, headed by Professor Robert Brown of UA's Lunar and Planetary Lab.

The missing ethane is all the more mysterious because Cassini images suggest that other less abundant solid precipitates from the photochemical reactions in Titan's atmosphere have formed dunes and covered craters on its surface, Griffith said.

VIMS made the first detection of Titan's vast polar ethane cloud when it probed Titan's high northern latitudes on Cassini flybys in December 2004, August 2005, and September 2005.

VIMS detected the cirrus cloud as a bright band at altitudes from between 30 km and 60 km at the edge of Titan's arctic circle, between 51 degrees and 69 degrees north latitude. VIMS saw only part of the cloud because most of the northern polar region is in winter's shadow and won't be fully illuminated until 2010, Griffith noted.

"Our observations imply that surface deposits of ethane should be found specifically at the poles, rather than globally distributed across Titan's disk as previously assumed," Griffith said. "That may partially explain the lack of liquid ethane oceans and clouds at Titan's middle and lower latitudes."

"We think that ethane is raining or, if temperatures are cool enough, snowing on the north pole right now. When the seasons switch, we expect ethane to condense at the south pole during its winter," Griffith said. If polar conditions are as cool as predictions say, ethane could accumulate as polar ice.

Ethane dissolves in methane, which scientists predict is raining from the atmosphere at the north pole during its cool winter. "During the polar winters, we expect the lowlands to cradle methane lakes that are rich with ethane," Griffith noted. "Perhaps these are the lakes recently imaged by Cassini."

If ethane was produced at today's rate over Titan's entire lifetime, a total of two kilometers of ethane would have precipitated over the poles. But that seems unlikely, Griffith said.

Scientists have no direct evidence for polar caps of ethane ice. Titan's north pole is in winter darkness, and Cassini cameras have yet to see it in reflected light. Cassini cameras have imaged Titan's south pole. "The morphology seen in those images doesn't suggest a two kilometer polar ice cap, but the images do show flow features," Griffith said.

"We're going to start making more polar passes in the upcoming months," she added. "By the end of next year Cassini will have recorded the first polar temperature profile of Titan, which will tell us how cold conditions are at the pole."

Griffith is first author on the article, "Evidence for a Polar Ethane Cloud on Titan," published in the current (Sept.15) issue of Science. Paulo Pinteado and VIMS team leader Robert Brown of the UA and researchers from France, the Jet Propulsion Laboratory in Pasadena, Calif., the U.S. Geological Survey, Cornell University, NASA Ames Research Center, Portugal and Germany are co-authors.

Griffith, Pinteado and Robert Kursinski of UA collaborated earlier in studies of the thousand-mile-long methane clouds that band Titan at southern latitudes. They concluded from analyzing VIMS images that these highly localized, convective clouds, which are composed of methane, result from summer heating much as thunderstorms form on Earth.

The VIMS instrument is an imaging spectrometer that produces a special data set called an image cube. It takes an image of an object in many colors simultaneously. An ordinary video camera takes images in three primary colors (red, green, and blue) and combines them to produce images as seen by the human eye. The VIMS instrument takes images in 352 separate wavelengths, or colors, spanning a realm of colors far beyond those visible to humans. All materials reflect light in a unique way. So molecules of any element or compound can be identified by the wavelengths they reflect or absorb, their "signature" spectra.

Source: University of Arizona