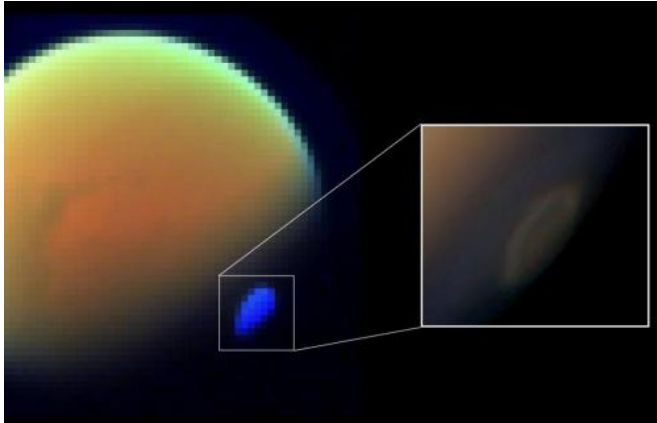


Cyanide ice in Titan's atmosphere

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These two views of Saturn's moon Titan show the southern polar vortex, a huge, swirling cloud that was first observed by NASA's Cassini spacecraft in 2012. Credit: NASA/JPL-Caltech/ASI/University of Arizona/SSI/Leiden Observatory and SRON

Gigantic polar clouds of hydrogen cyanide roughly four times the area of the UK are part of the impressive atmospheric diversity of Titan, the largest moon of Saturn, a new study led by Leiden Observatory, the Netherlands Institute for Space Research and the University of Bristol has found. The research is published today in *Nature*.

Titan is unique in our solar system because of its dense nitrogen-methane atmosphere, which is very similar to Earth's in some ways, but very different in others. For example, air temperatures are around 200 degrees colder and, in contrast to the warm salt water seas of Earth, frigid hydrocarbon lakes populate Titan's surface.

Titan has seasons just like Earth, only each season lasts over seven years instead of three months due to its ponderous orbit around the Sun. After equinox in 2009, Titan's [south pole](#) entered the perpetual darkness of polar winter. Soon after, instruments on NASA's Cassini spacecraft observed the development of a gigantic polar cloud covering over one million square kilometres –

roughly four times the area of the UK.

Bristol researcher and co-author Dr Nick Teanby said: "The cloud was first seen in images from Cassini's cameras taken in 2012. It started off quite small but soon grew to cover the entire [south polar region](#). This was totally unexpected and set us puzzling over what the cloud could be made of. Unfortunately, while the images showed that the cloud was very high up, at over 250km above the surface, they did not allow us to figure out what the cloud was actually made of or why it was there."

For the next two years Cassini gathered more data including infrared spectra of the cloudy region.

Lead author Remco de Kok said: "When we looked at the spectra, we saw two large peaks that weren't present in spectra of other places on Titan. These peaks coincided exactly with the peaks you'd expect from ice particles of [hydrogen cyanide](#), or 'blauwzuur' (blue acid) as it's known in the Netherlands, which is highly toxic. This was very surprising to us, since we did not expect HCN ice to be able to form so high in Titan's atmosphere."

This new research suggests that Titan's south pole must be extremely cold to allow hydrogen cyanide to condense. In fact, the [upper atmosphere](#) must have cooled by over 50 degrees in less than a year to reach a blisteringly cold -150C.

Remco de Kok concluded: "This is a very rapid change given Titan's long annual cycle and is much colder than previously thought possible. It suggests that once the pole is in shadow the upper atmosphere acts as a very efficient radiator of heat, perhaps due to the high abundance of exotic hydrocarbon and nitrogen based compounds, which emit strongly in the infrared.

"Cassini is set to continue observing Titan until it takes a dive into Saturn at the end of its mission in 2017. It will be fascinating to see how the cloud will develop."

More information: HCN ice in Titan's high-altitude southern polar cloud, *Nature*, [dx.doi.org/10.1038/nature13789](https://doi.org/10.1038/nature13789)

Provided by University of Bristol

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