Image: Understanding the atmosphere of Venus

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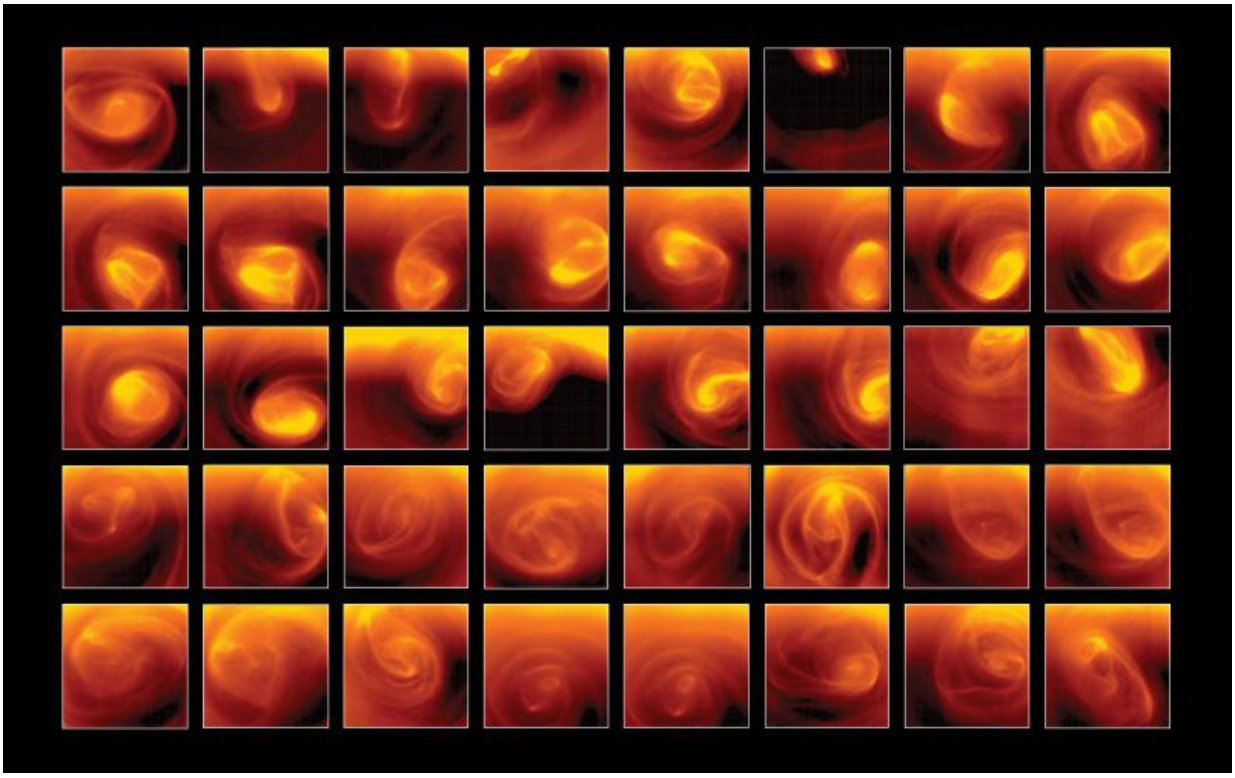

Credit: ESA/VIRTIS-Venus Express/INAF-IAPS/LESIA-Obs. Paris/G. Piccioni

On 9 November 2005, 10 years ago today, ESA's Venus Express spacecraft left Earth and began its 153-day journey to Venus. The craft then spent eight years studying the planet in detail before the mission came to an end in December 2014.

One of the mission aims was to observe the planet's atmosphere continuously over long periods in a bid to understand its dynamic behaviour.

The atmosphere is the densest of all the terrestrial planets, and is composed almost entirely of carbon dioxide. The planet is also wrapped in a thick layer of cloud made mostly of sulphuric acid. This combination of greenhouse gas and perennial cloud layer led to an enormous greenhouse warming, leaving Venus' surface extremely hot – just over 450ºC – and hidden from our eyes.

Although winds on the planet's surface move very slowly, at a few kilometres per hour, the atmospheric density at this altitude is so great that they exert greater force than much faster winds would on Earth.

Winds at the 65 km-high cloud-tops, however, are a different story altogether. The higher-altitude winds whizz around at up to 400 km/h, some 60 times faster than the rotation of the planet itself. This causes some especially dynamic and fast-moving effects in the planet's upper atmosphere, one of the most prominent being its 'polar vortices'.

The polar vortices arise because there is more sunlight at lower latitudes. As gas at low latitudes heats it rises, and moves towards the poles, where cooler air sinks. The air converging on the pole accelerates sideways and spirals downwards, like water swirling around a plug hole.

In the centre of the polar vortex, sinking air pushes the clouds lower down by several kilometres, to altitudes where the atmospheric temperature is higher. The central 'eye of the vortex' can therefore be clearly seen by mapping thermal-infrared light, which shows the cloud-top temperature: the clouds at the core of the vortex are at a higher temperature, indicated by yellow tones, than the surrounding region, and therefore stand out clearly in these images.

Venus Express has shown that the polar vortices of Venus are among the most variable in the Solar System. This series of images of Venus' south pole was taken with the VIRTIS instrument from February 2007 (top left) to April 2008 (bottom right).

The shape of this vortex core, which typically measures 2000–3000 km across, changes dramatically as it is buffeted by turbulent winds. It can resemble an 'S', a figure-of-eight, a spiral, an eye, and more, quickly morphing from one day to the next.

Each of the images in this frame is roughly 4000 km across.

Provided by European Space Agency