

This volcano didn't just erupt—it triggered a hidden atmospheric cleanup scientists never expected to see

May 7 2026



The Hunga Tonga–Hunga Ha'apai volcanic eruption on 15 January 2022. Image taken from a video of the eruption. Credit: Tonga Geological Services

When the submarine volcano Hunga Tonga–Hunga Ha'apai in the South Pacific erupted in January 2022, it was not only one of the most violent volcanic eruptions in modern times. The volcano also did something

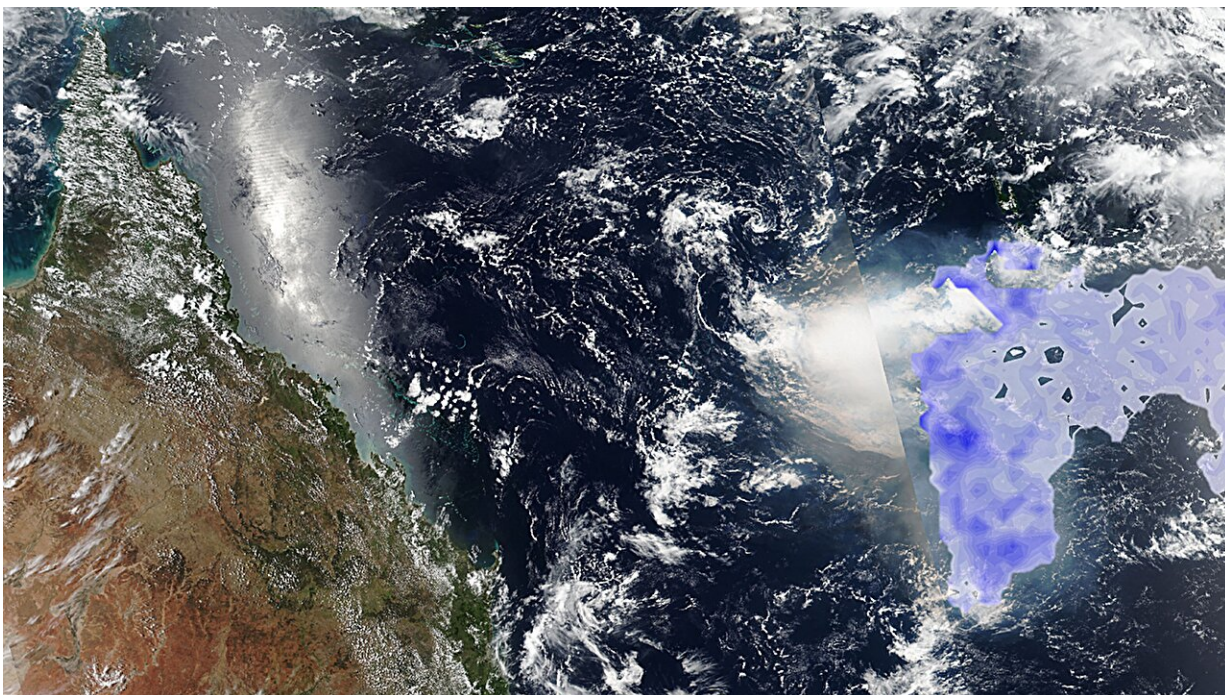
completely unexpected: it helped clean up some of the methane pollution it released. This phenomenon could potentially be key to how humans can slow global warming.

Using advanced satellite measurements, researchers observed unusually high concentrations of formaldehyde in the massive volcanic plume following the eruption. This was crucial evidence: when methane is destroyed in the atmosphere, formaldehyde forms as a short-lived intermediate.

"When we analyzed the satellite images, we were surprised to see a cloud with a record-high concentration of formaldehyde. We were able to track the cloud for 10 days, all the way to South America. Because formaldehyde only exists for a few hours, this showed that the cloud must have been destroying methane continuously for more than a week," explains Dr. Maarten van Herpen from Acacia Impact Innovation BV.

"It is known that volcanoes emit methane during eruptions, but until now it was not known that volcanic ash is also capable of partially cleaning up this pollution," he adds.

[The study](#) has been published in *Nature Communications*.



Satellite image using the VIIRS satellite on 16 January 2022, 13:30 UTC, showing in blue the cloud of formaldehyde measured by TROPOMI. To the left is the Australian coast of Queensland. Credit: van Herpen et al. (2026)

Salt, sunlight and new chemistry

According to the researchers, everything points to a very special process taking place—one they first discovered in 2023, but in a completely different part of the world.

They found that when dust from the Sahara is blown over the Atlantic Ocean, it mixes with sea salt from sea spray, forming small particles known as iron salt aerosols. When sunlight hits these aerosols, chlorine atoms are produced. These chlorine atoms react with methane and help break it down in the atmosphere. This discovery changed scientific understanding of tropospheric chemistry.

"What is new—and completely surprising—is that the same mechanism appears to occur in a volcanic plume high up in the stratosphere, where the physical conditions are entirely different," says Professor Matthew Johnson from the Department of Chemistry at the University of Copenhagen, one of the researchers behind both discoveries.

The 2022 eruption hurled enormous amounts of [salty seawater](#) into the stratosphere along with volcanic ash. The theory is that when sunlight hit this mixture, highly reactive chlorine was formed, helping to break down the methane released during the eruption. The visible evidence of this methane breakdown was the large amounts of formaldehyde detected in satellite images.

Methane is currently responsible for one third of global warming. Over a 20-year period, methane is about 80 times as potent as CO₂. However, methane breaks down relatively quickly in the atmosphere—typically within about 10 years.

This means that if we reduce methane emissions now, it could have a noticeable impact on the climate within a decade. For this reason, researchers sometimes refer to [methane reduction](#) as an "emergency brake" on climate change—one that may help prevent climate tipping points in the coming decades. However, reducing CO₂ emissions remains essential to stabilize temperatures in the long term.

Inspiration for future solutions

The researchers behind the new study believe their findings could inform a growing field working on solutions to reduce methane emissions by artificially accelerating its breakdown in the atmosphere—similar to how the volcano effectively cleaned up after itself. Various methods are currently under investigation, but a key challenge is measuring and verifying how much methane is actually

removed.

"How do you prove that methane has been removed from the atmosphere? How do you know your method works? It's very difficult. But here we address that problem by showing that methane breakdown can in fact be observed using satellites," says Dr. Jos de Laat from the Royal Netherlands Meteorological Institute, senior author of the study.

The research was conducted with the advanced [TROPOMI instrument](#) aboard the European Space Agency's Sentinel-5P satellite, which monitors air pollution and greenhouse gases worldwide on a daily basis.

"Retrieving formaldehyde from TROPOMI in a stratospheric volcanic plume is far outside the instrument's standard operating conditions—we had to carefully correct the satellite's sensitivity for the unusual altitude of the signal and account for interference from the high sulfur dioxide concentrations. Getting these corrections right was essential to confirm that what we were seeing was real," said Dr. Isabelle De Smedt, Royal Belgian Institute for Space Aeronomy.

The researchers believe the new findings will inspire engineers in industry:

"It's an obvious idea for industry to try to replicate this natural phenomenon—but only if it can be proven to be safe and effective. Our satellite method could offer a way to help figure out how humans might slow global warming," concludes Johnson.

"We now know that atmospheric dust—for example from a volcanic eruption—impacts the methane budget, meaning the budget of how much methane is added to the atmosphere and how much is removed. Because dust has not previously been taken into account, it is important that we correct the data on which these estimates are based," says

Johnson.

More information: Maarten M.J.W. van Herpen et al, Satellite quantification of enhanced methane oxidation applied to the stratospheric plume following Hunga Tonga-Hunga Ha'apai eruption, *Nature Communications* (2026). [DOI: 10.1038/s41467-026-72191-4](https://doi.org/10.1038/s41467-026-72191-4)

Provided by University of Copenhagen

Citation: This volcano didn't just erupt—it triggered a hidden atmospheric cleanup scientists never expected to see (2026, May 7) retrieved 7 May 2026 from <https://sciencex.com/news/2026-05-volcano-didnt-erupt-triggered-hidden.html>

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