

Remote consequences of the 'eruption of the century'

Sentinel-2 MSI acquired on 08 December 2021 at 21:59:09 UTC

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Sentinel-5P TROPOMI SO2 acquired on 14 January 2022 at 00:51:04 UTC

Sentinel-2 MSI acquired on 17 January 2022 at 21:59:09 UTC

Sentinel-5P TROPOMI SO2 acquired on 20 January 2022 from 00:33:25 to 10:34:53 UTC

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[2D Layerstack](#)

Fig. 1 - S2 (08.12.2021) - Hunga Tonga & Hunga Ha'apai islands were almost obliterated by an eruption which had consequences far away. [2D view](#)

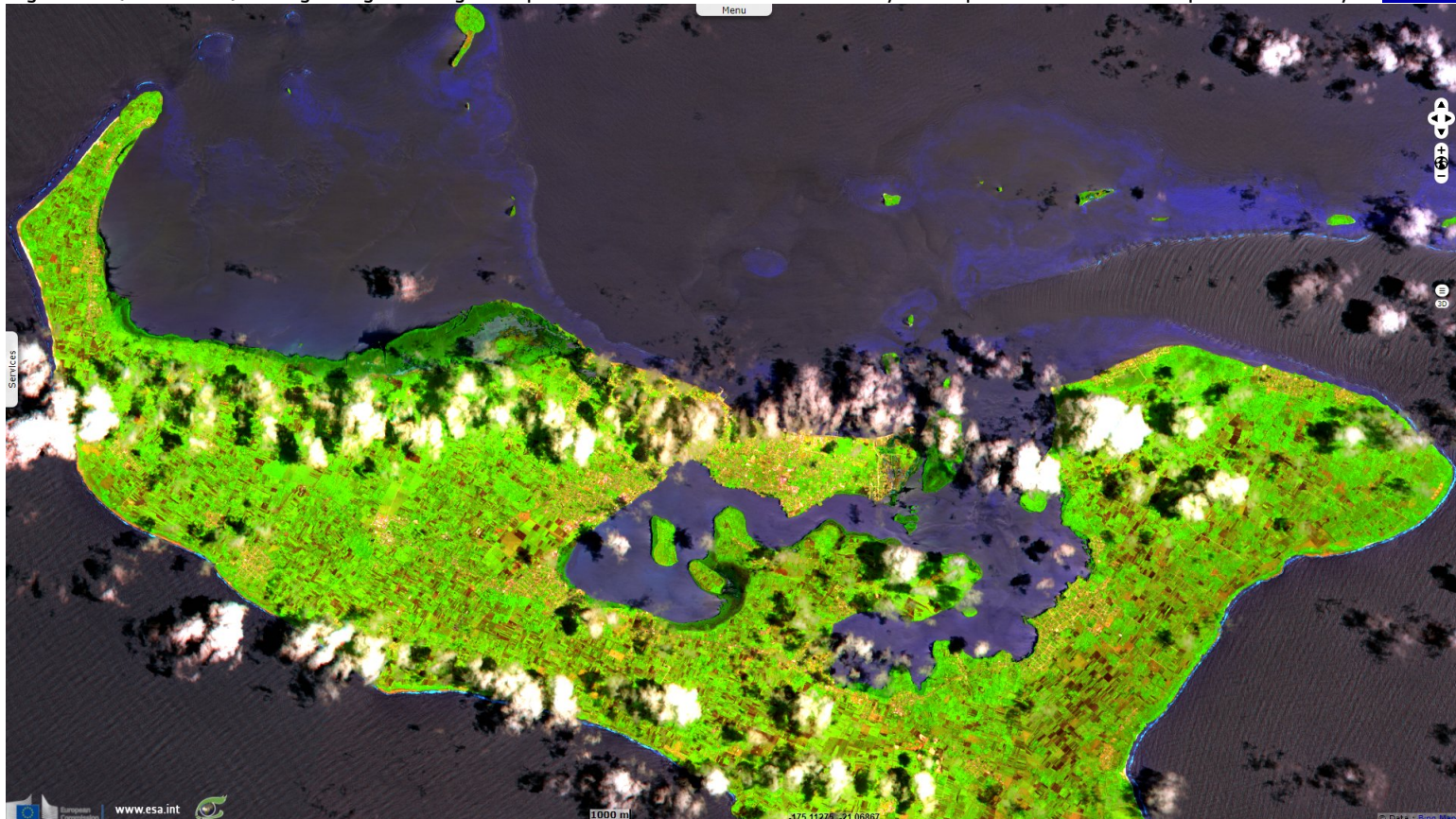


Fig. 2 - S2 (17.01.2022) - The main island of Tonga, Tongatapu, where lies the capital Nuku'alofa was hit by a tsunami wave. [2D view](#)

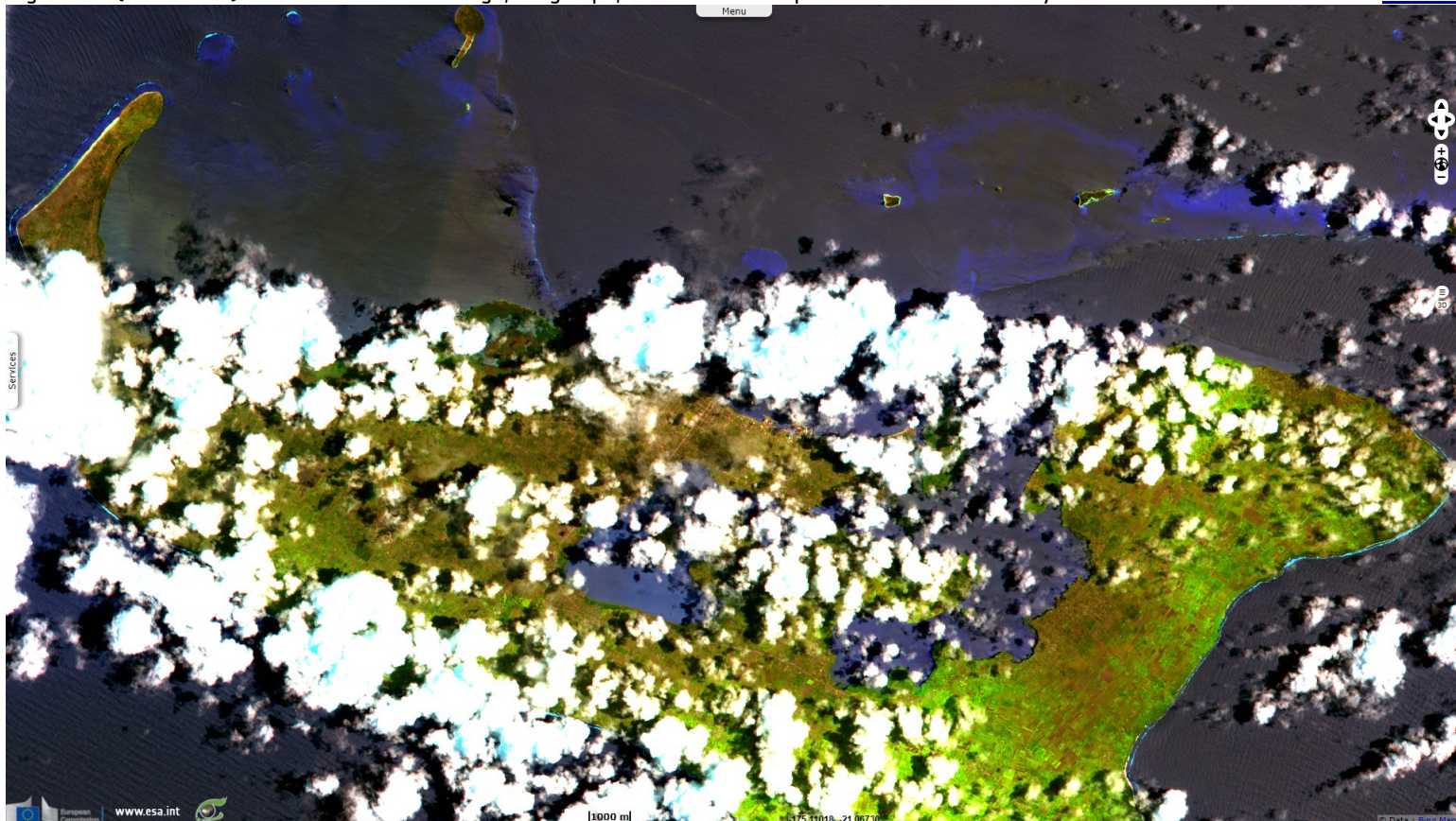
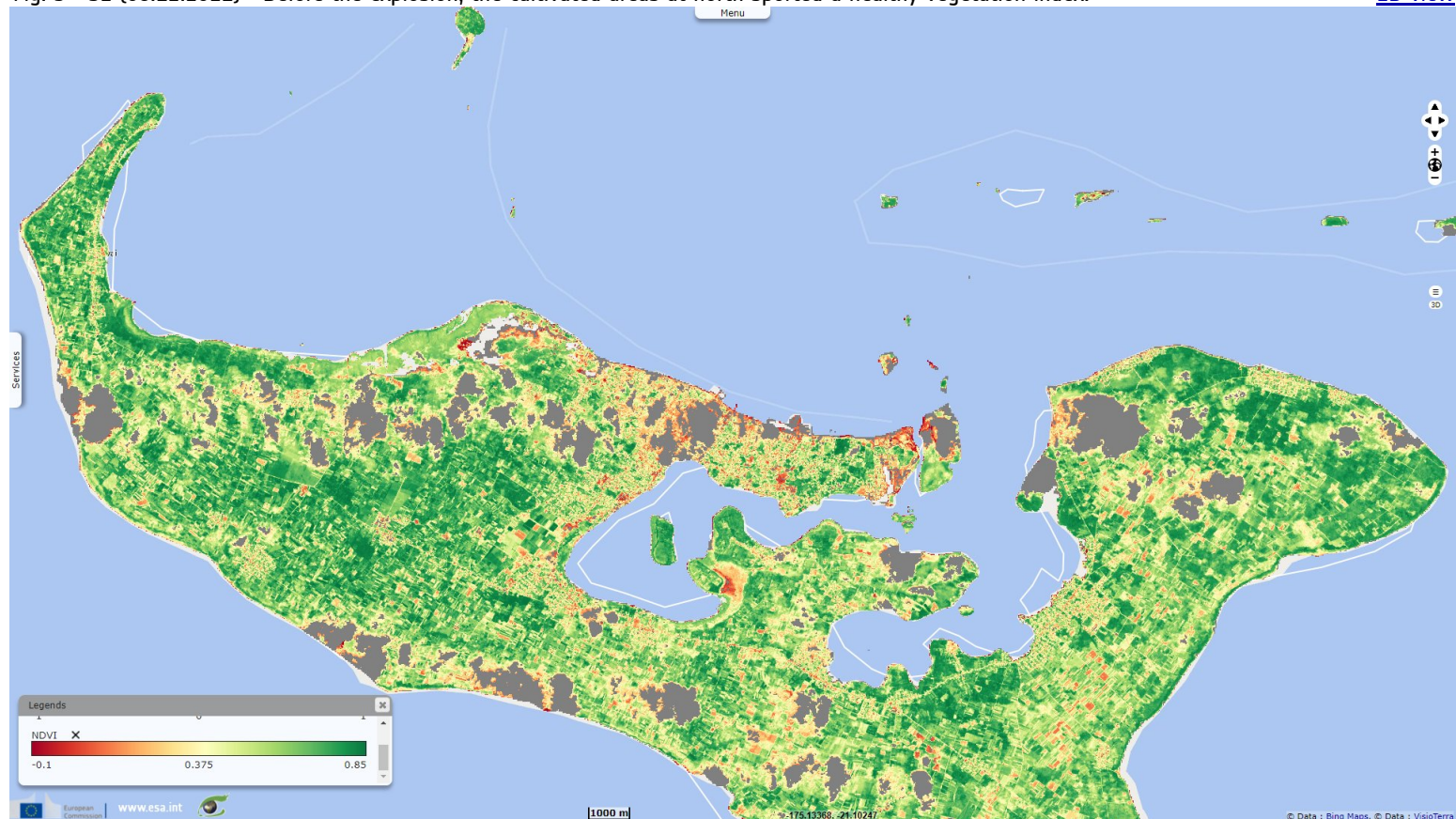


Fig. 3 - S2 (08.12.2021) - Before the explosion, the cultivated areas at north sported a healthy vegetation index.

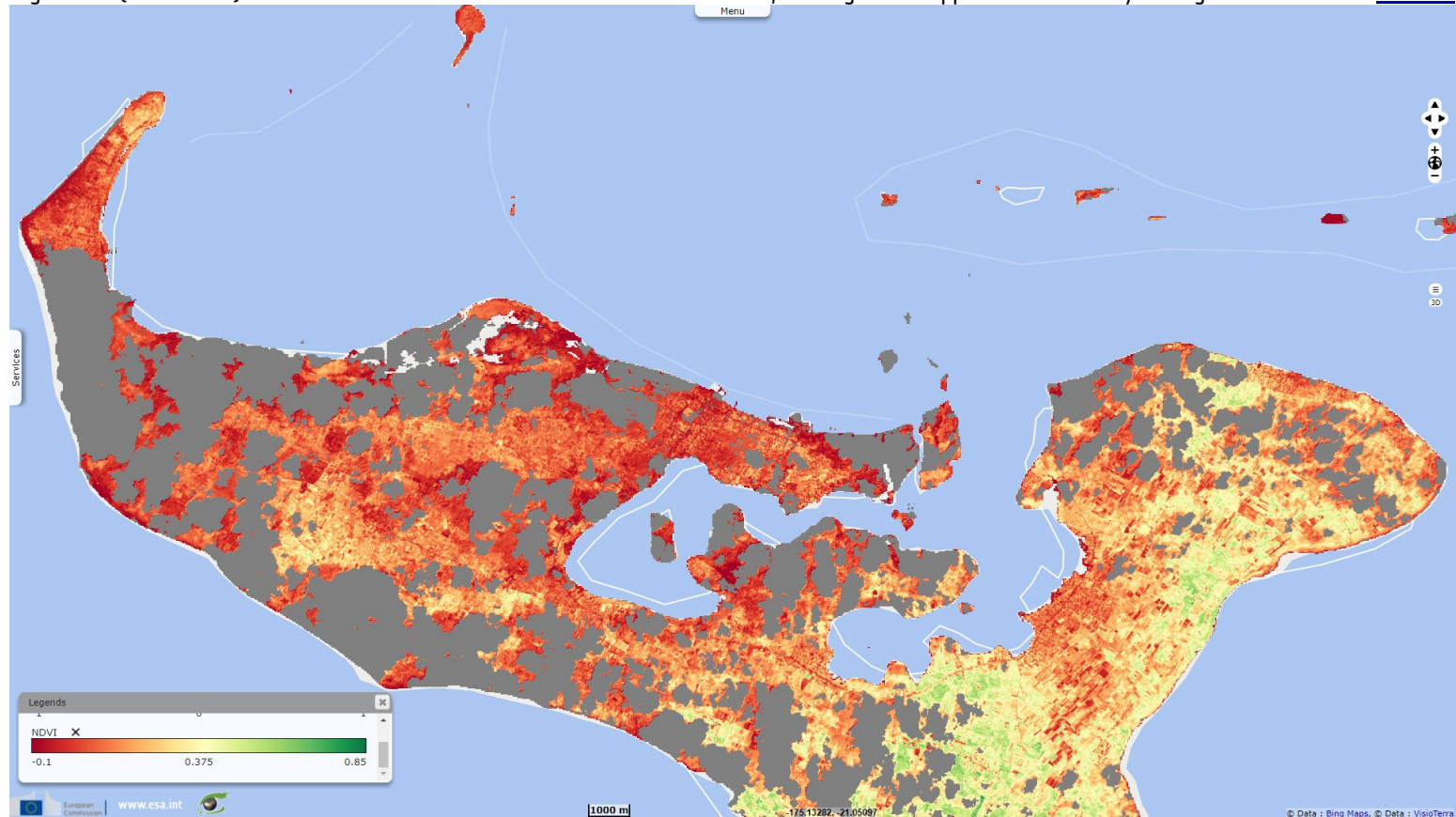
[2D view](#)



The effects of the Tonga eruption and in particular the explosion it caused on 15 January and the ensuing emissions and tsunamis. While the shockwave had no consequence by itself, it was heard thousands of kilometres away and detected everywhere on the globe. Donna Lu [documents](#) the event in her article published in the Guardian on 17 January: *"Data from the Australian Bureau of Meteorology shows the shockwave travelled faster than 1000 km/h – almost as fast as the speed of sound – and resulted in a noticeable jump in atmospheric pressure. Sonic booms from the eruption were heard across the Pacific, including in Fiji and Vanuatu, and as far as Alaska, more than 9000 km away."*

Fig. 4 - S2 (17.01.2022) - After the tsunami and the fallout of volcanic material, the vegetation appears to be heavily damaged.

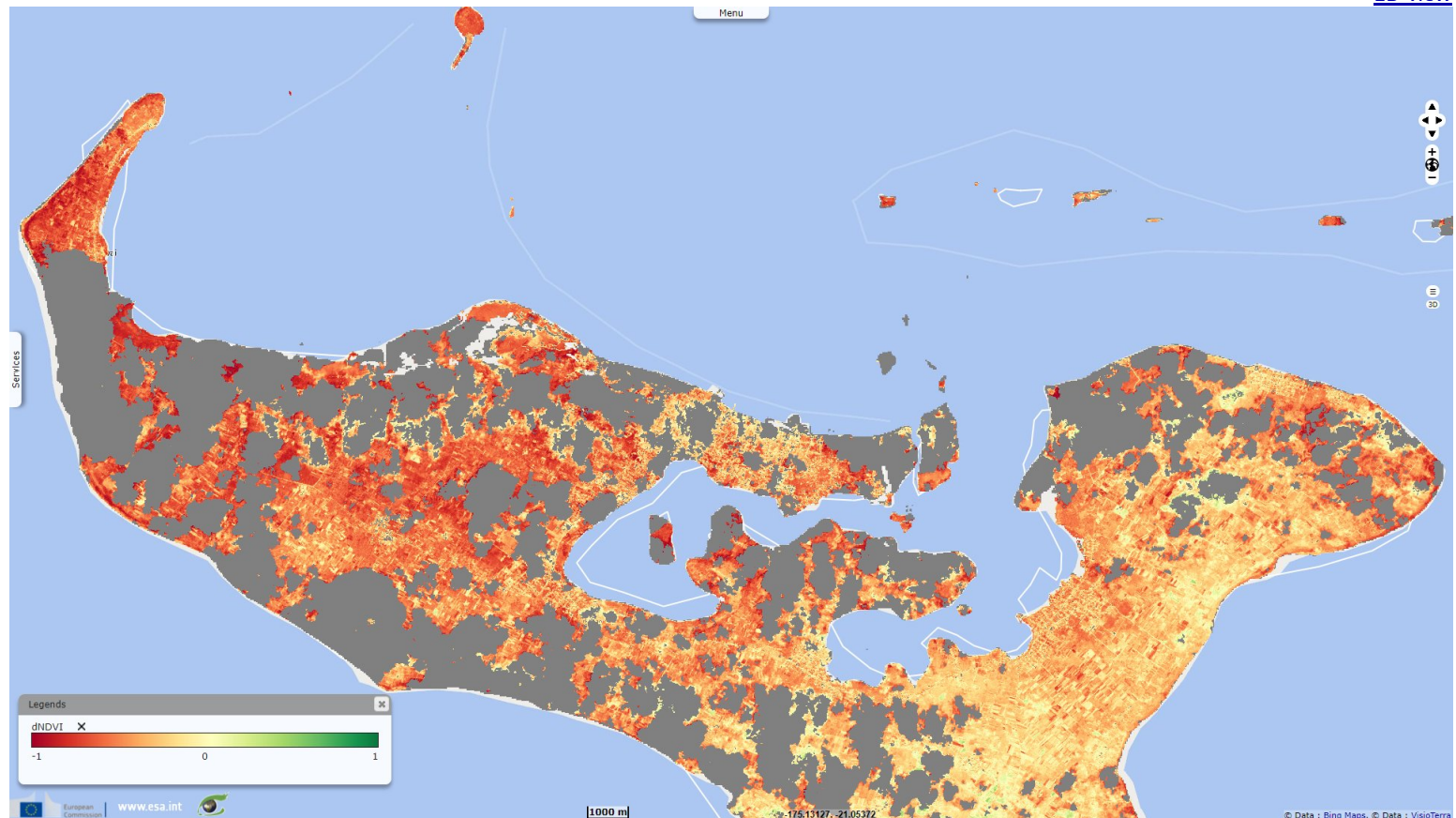
[2D view](#)



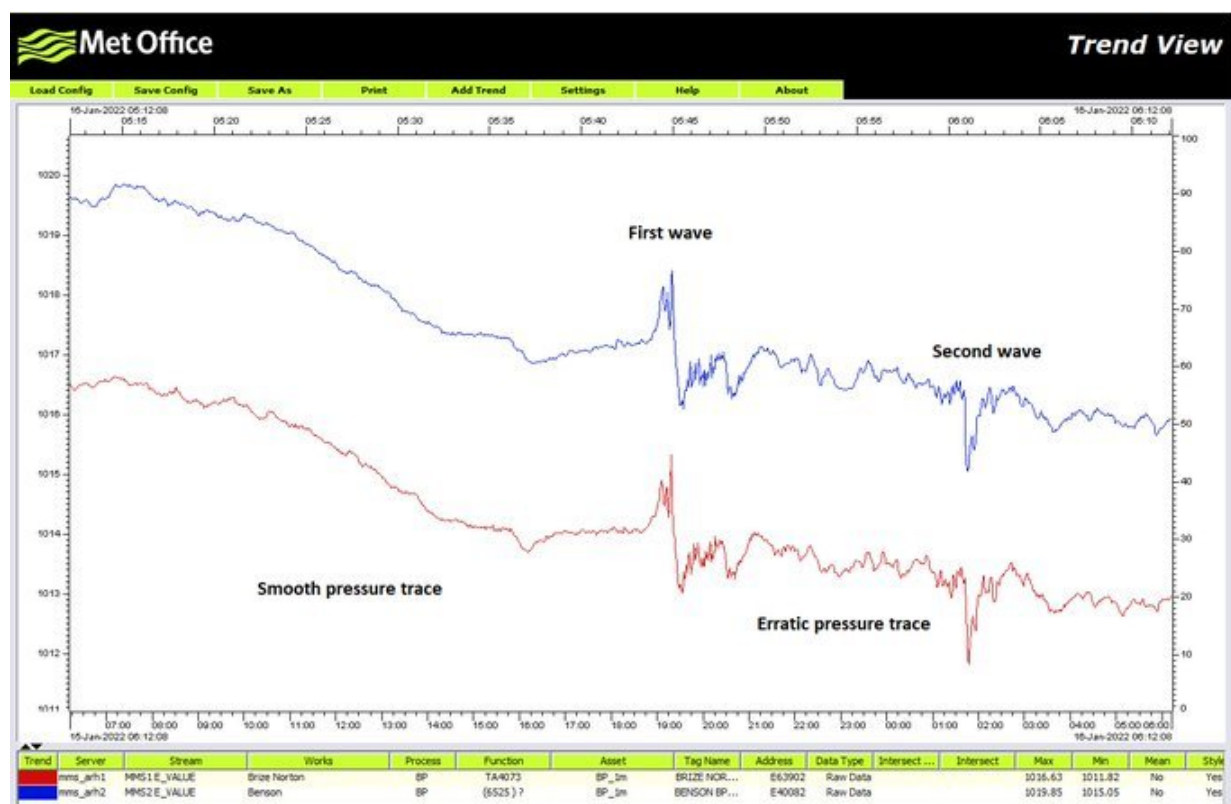
"In the hours that follow, tsunami warnings are issued across the Pacific, including in New Zealand, Australia, the west coast of the US, and Japan, where around 230 000 people across eight prefectures are ordered to evacuate. Experts believe the tsunami activity could have been triggered either by shock waves propagating through water, or by a landslide on the undersea part of the volcano. Only an estimated 5% of tsunamis have historically resulted from volcanoes, including the 1883 eruption of Krakatoa, which caused a devastating tsunami in the Indian Ocean. Krakatoa's violent eruption was reported to have been heard 4800 km away." Among the few victims of the eruption, the article reports: *"Two people drown off a beach in the Lambayeque region of Peru, after unusually high waves are recorded there."*

Fig. 5 - S2 (08.12.2021 & 17.01.2022) - The areas at south and south-east don't seem to be affected while the rest of the island appears severely hit.

[2D view](#)



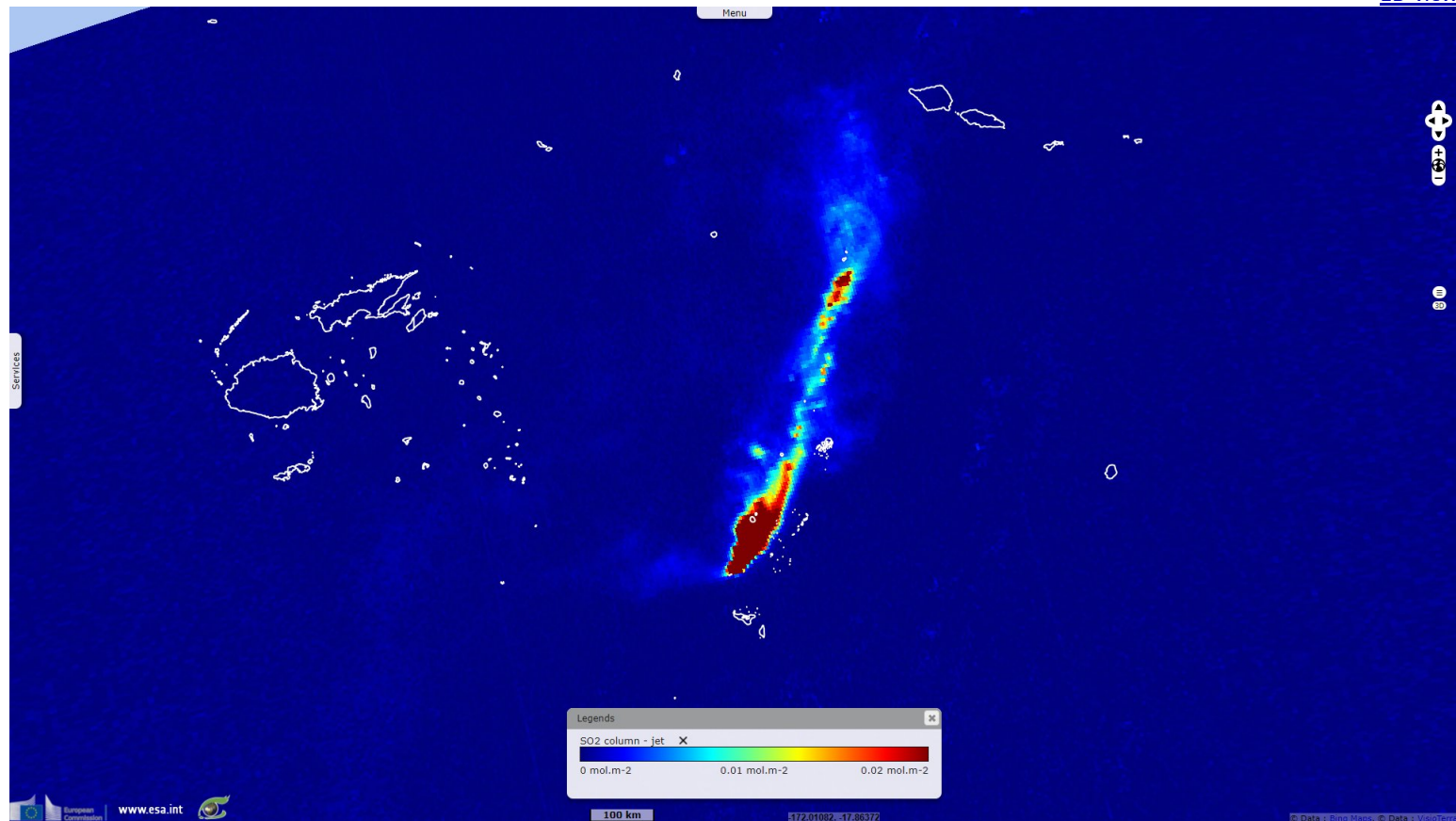
The Japanese paper Nikkei [completes](#): "In Japan, starting with the southern island of Chichijima just before 8 p.m. local time on Jan. 15, and then throughout the rest of the country, the air pressure rose by about 2 hectopascals. Experts think the shock wave from the eruption may have caused an instantaneous change in atmospheric pressure."



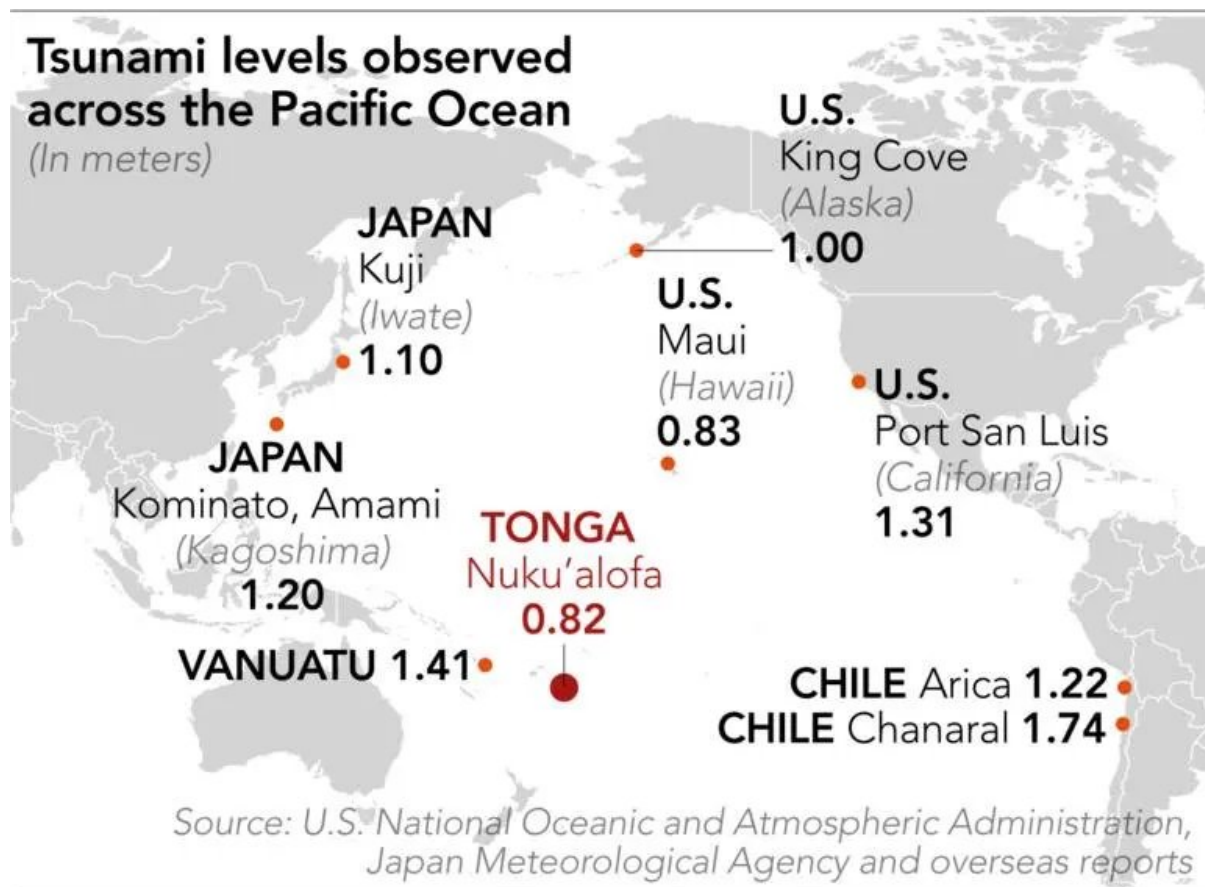
Even though the #Tonga volcano is around 16000 kilometres away from the UK, our observation sites picked up the shockwave in the evening of 15 January. Here are the pressure traces from Brize Norton and Benson - Source: [Met Office](#)

Fig. 6 - S5P TROPOMI (22.12.2021) - During the first phase of the eruption, the volcano emitted only a burst of sulfur dioxide that dissipated quickly.

[2D view](#)



"A tsunami measuring more than 1 meter high was observed at Amami Oshima just before midnight on Jan. 16, and another was seen at the port of Kuji in Iwate Prefecture at around 2:30 a.m. that day. That was more than two hours earlier than the arrival time generally expected for tsunamis from volcanic eruptions and earthquakes. 'Atmospheric vibrations caused by the eruption may have created resonance between the atmosphere and the waves at sea level, and the waves may have been made larger by changes in air pressure,' according to Fukashi Maeno, an associate professor at the Volcano Research Center, Earthquake Research Institute at the University of Tokyo."



Tsunami levels observed across the Pacific Ocean - Source: [NOAA](#)

"In many cases, tsunamis in more distant areas were larger than the one that hit Tonga: the tsunami seen in Vanuatu was about 1.4 meters high, while the wave was measured at about 1.1 meters high in the French territory of New Caledonia, in one California location it was about 1.3 meters high and over 1 meter high at one location in Chile. 'The tsunamis could have been caused by the collapse of a mountain or topographical changes,

but that doesn't explain the small wave that headed toward Saipan,' said Maeno. 'The tsunamis observed in Japan and elsewhere were likely caused by a different mechanism.'

Fig. 7 - S5P TROPOMI (14.01.2022) - The massive final explosion caused a much more important emission.

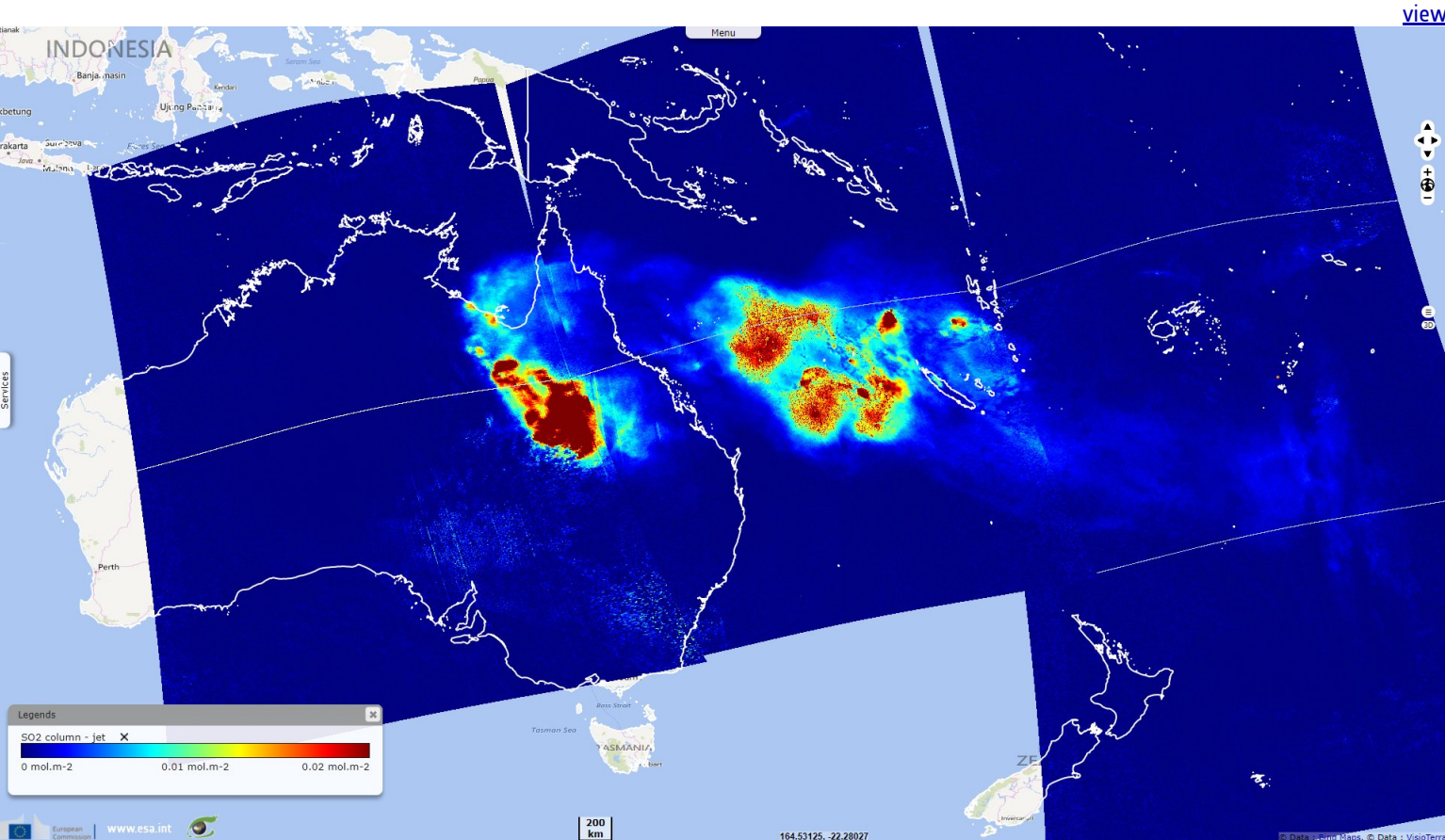
[2D view](#)



Kim Moodie [interviewed](#) several specialists for Radio New Zealand: "Volcanologist Professor Shane Cronin of the University of Auckland said Tonga's water supply and agriculture could be severely affected in the fallout from the eruption and international aid will be critical. 'Acid rain associated with the volcanic ash can burn the leaves of crops, leafy vegetables, things like that.'"

Fig. 8 - S5P TROPOMI (17.01.2022) - Three days later, a concentrated panache could be detected over New Caledonia and north-east Australia.

[2D view](#)



"NIWA (National Institute of Water and Atmospheric Research) hydrodynamics scientist and tsunami expert Dr Emily Lane said the devastating tsunami that followed the eruption was also a rare occurrence. Most tsunami are triggered by underwater earthquakes, and only about 5 percent of historical tsunamis have been caused by volcanic eruptions, she said. 'We haven't seen a volcanic tsunami of this magnitude in over 100 years,' she said. 'This is pretty much shattering the mould. One of the tricky things about tsunamis is that they happen very infrequently; think about the Japanese tsunami and its predecessor was over 1000 years beforehand.' 'We haven't seen very many volcanic tsunamis. We've certainly never seen

a volcanic tsunami that has affected the entire Pacific in this way.' Lane said the only similar volcanic tsunami event was Indonesia's Krakatau eruption in 1883, which killed tens of thousands of people and obliterated the island."

Fig. 9 - S5P TROPOMI (20.01.2022) - A concentrated plume sulfur dioxide can be seen over east Indonesia while the earlier burst dissipated over Australia.

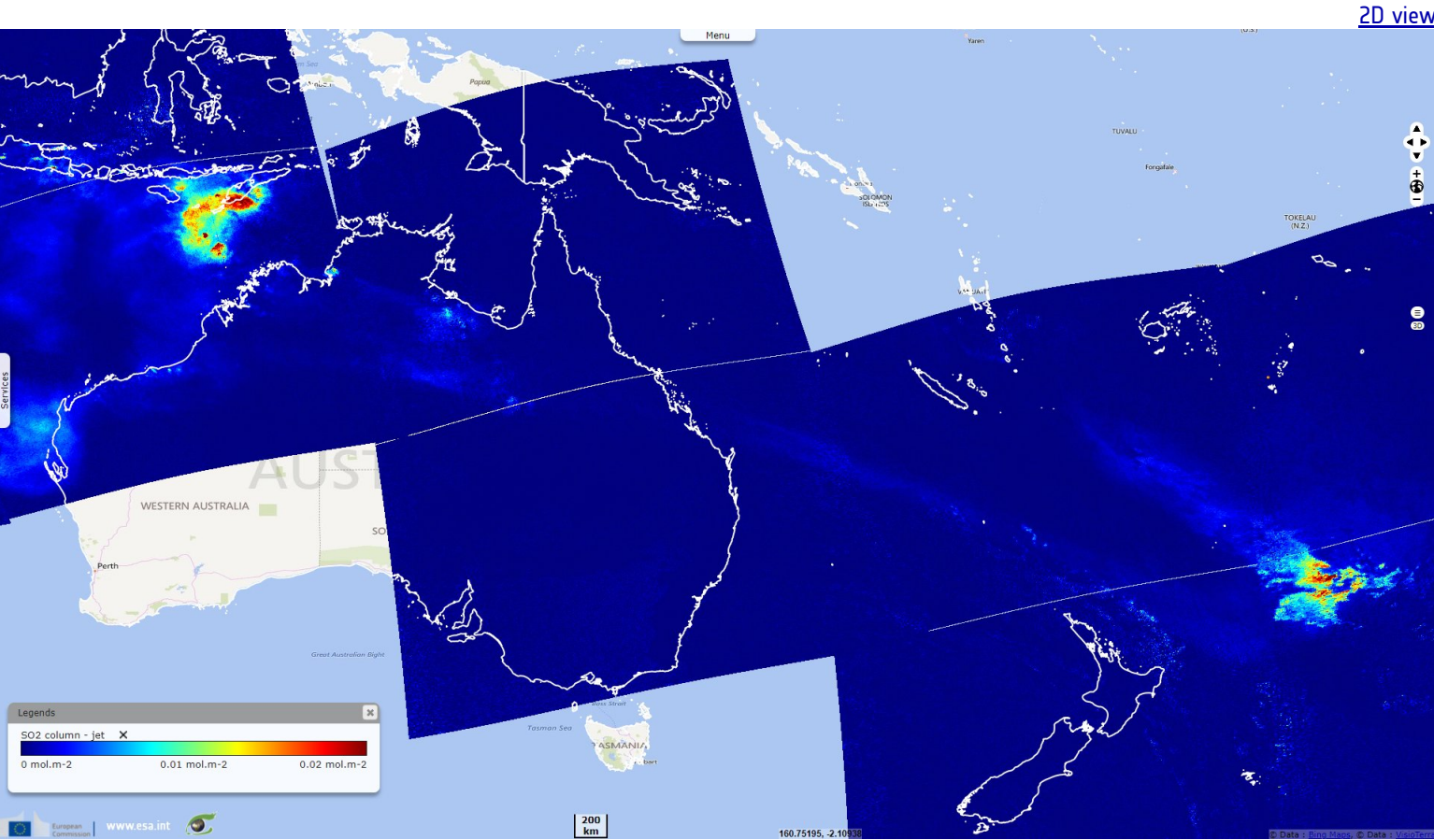














Fig. 10 - S5P TROPOMI (14-21.01.2022) - Animation of the path over the Coral Sea and then through the Indian Ocean.



The US Media CNN [investigated](#) the consequences of the emissions of Sulphur Dioxide: "The Hunga-Tonga-Hunga-Ha'apai eruption on Saturday was enormous; likely the largest in 30 years, according to experts. It injected a huge cloud of ash and sulfur dioxide, or SO2, high into the atmosphere, more than 30 kilometers above sea level, according to data from NASA satellites. For instance, the Mount Pinatubo eruption in 1991 released 15 to 20 teragrams of SO2 high into the atmosphere, resulting in a 0.6 degree Celsius (1 degree Fahrenheit) drop in global temperature over the next 15 months, according to NASA. Erik Klemetti, associate professor of Geosciences at Denison University in Granville, Ohio, said the sulfur dioxide spewed into the atmosphere by the Hunga Tonga eruption was 'well below the usual threshold for anything that's going to have any significant impact on

climate in general.' 'But right now, it seems like it was a short enough event that didn't have enough sulfur in it to likely cause much of a climate impact.'

The views expressed herein can in no way be taken to reflect the official opinion of the European Space Agency or the European Union.
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