

# Tonga volcano eruption released more energy than the most powerful nuclear bomb

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Credit: NASA/GOES/NESDIS

The eruption of the underwater volcano in Tonga that triggered a tsunami earlier this year (January 2022), released more energy than the Tsar Bomba—the most powerful nuclear bomb ever detonated—according to a new study.

Researchers from the University of Sheffield harvested data from [weather stations](#) and social media worldwide and compared it against [historical data](#) to determine that the [eruption](#) released more energy than

the largest human-made explosion in history.

On January 15, 2022, the volcano at Hunga Tonga-Hunga Ha'apai Island erupted producing a devastating tsunami and volcanic plumes that reached the stratosphere. [Another recent study](#) revealed the explosion generated acoustic-gravity waves that reached the edge of space and were recorded by satellites and instruments across the globe, including in the U.K.

Weather stations all over the world, including sites in London, Fife and the Scottish Highlands, registered the passing of a type of acoustic-gravity wave called a Lamb wave. Data from the sites shows how local atmospheric pressure suddenly increased with a pressure pulse, followed by a negative phase, before returning to [ambient conditions](#) that typically lasted for around 45 minutes—in comparison, earthquakes typically last for a few seconds to only a few minutes.

Weather enthusiasts in every continent began sharing screenshots of their measurements on [social media](#), including location, local time of arrival of the Lamb wave, and pressure data, which were a valuable source of scientific information to help researchers determine the size of the volcanic eruption.

Dr. Sam Rigby, senior lecturer in blast and impact engineering at the University of Sheffield and co-author of the study, said, "The Hunga Tonga-Hunga Ha'apai eruption was without a doubt one of the most energetic events to have occurred over the last century, more so than the largest nuclear bomb ever detonated.

"The eruption was equivalent to around 61 Mt of TNT, whereas the Tsar Bomba released between 50–58 Mt. The Tonga volcanic eruption released energy equivalent to a magnitude 8.4 earthquake, and the pressure wave traveled several times around the globe.

Jorge Diaz, a [theoretical physicist](#) and co-author of the study from Indiana University, said, "On January 15 nature made us feel small triggering a large-scale event with tragic consequences. This study shows that this powerful eruption also generated a spontaneous and global science project, bringing together enthusiasts and professionals openly sharing their valuable measurements from all corners of the planet for characterizing the properties of this event.

"This study highlights the potential of 'citizen science' data for providing key scientific insights on the explosive power of volcanic eruptions."

The full paper, Energetic output of the 2022 Hunga Tonga-Hunga Ha'apai [volcanic eruption](#) from [pressure](#) measurements, is published in *Shock Waves*.

**More information:** J. S. Díaz et al, Energetic output of the 2022 Hunga Tonga–Hunga Ha'apai volcanic eruption from pressure measurements, *Shock Waves* (2022). [DOI: 10.1007/s00193-022-01092-4](https://doi.org/10.1007/s00193-022-01092-4)

The dataset is available on Github: [github.com/jsdiazpo/Hunga-Tonga ...](https://github.com/jsdiazpo/Hunga-Tonga-2022-data-Diaz-Rigby)  
[main/data/Diaz-Rigby](https://github.com/jsdiazpo/Hunga-Tonga-2022-data-Diaz-Rigby)  
[%202022%20data%20Hunga%20Tonga%20Hunga%20Haapai.csv](https://github.com/jsdiazpo/Hunga-Tonga-2022-data-Diaz-Rigby)

Provided by University of Sheffield

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