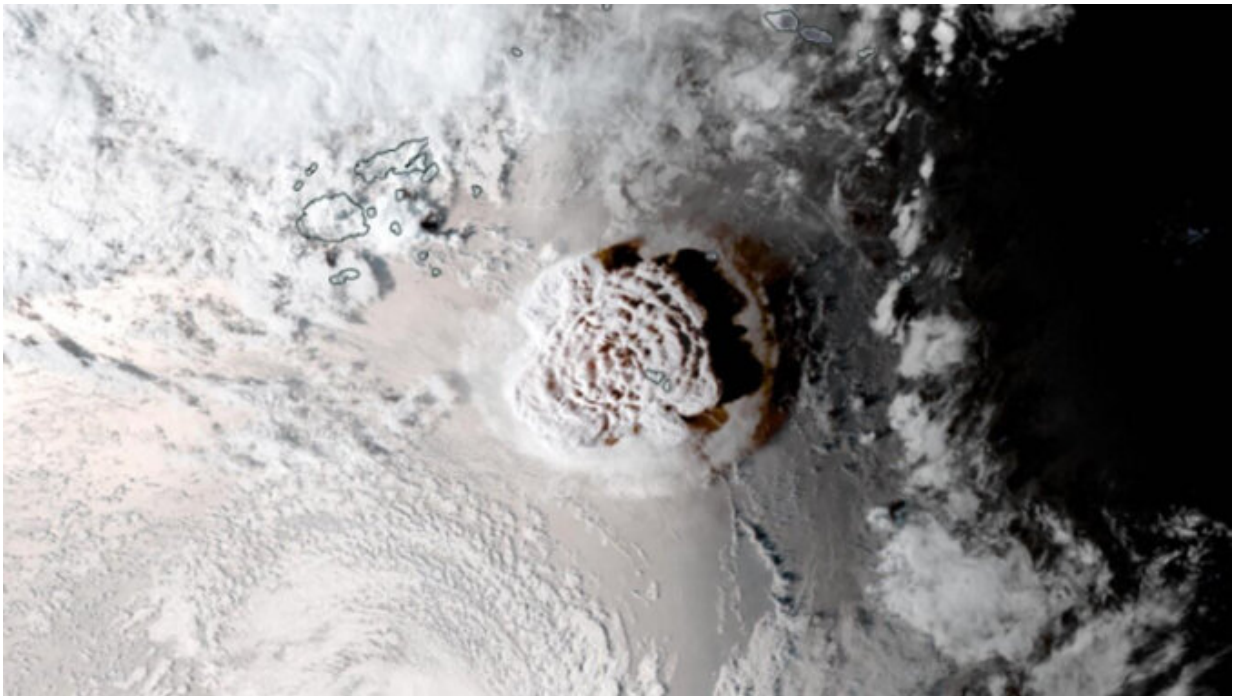


Elusive atmospheric wave detected during Tonga volcanic eruption

September 19 2022



Satellite image of Tonga volcanic eruption, 2022. Credit: NASA Worldview, NOAA / NESDIS / STAR

The catastrophic eruption of the Hunga Tonga–Hunga Ha‘apai volcano in 2022 triggered a special atmospheric wave that has eluded detection for the past 85 years. Researchers from the University of Hawai‘i at Mānoa, Japan Agency for Marine–Earth Science and Technology (JAMSTEC), and Kyoto University relied on state-of-the-art observational data and

computer simulations to discover the existence of Pekeris waves—fluctuations in air pressure that were theorized in 1937 but never proven to occur in nature, until now.

The study was published in the *Journal of the Atmospheric Sciences*.

The eruption in the South Pacific earlier this year released what was likely the most powerful explosion the world has experienced since the famous 1883 eruption of Mt. Krakatau in Indonesia. The rapid release of energy excited pressure waves in the atmosphere that quickly spread around the world.

The atmospheric wave pattern close to the eruption was quite complicated, but thousands of miles away the disturbances were led by an isolated wave front traveling horizontally at more than 650 miles per hour as it spread outward. The air pressure perturbations associated with the initial wave front were seen clearly on thousands of barometer records throughout the world.

"The same behavior was observed after the Krakatau eruption, and in the early 20th century a physical theory for this wave was developed by the English scientist Horace Lamb," said Kevin Hamilton, emeritus professor of atmospheric sciences at the UH Mānoa School of Ocean and Earth Science and Technology.

"These motions are now known as Lamb waves. In 1937, the American-Israeli mathematician and geophysicist Chaim Pekeris expanded Lamb's theoretical treatment and concluded that a second wave solution with a slower horizontal speed should also be possible. Pekeris tried to find evidence for his slower wave in the pressure observations after the Krakatau eruption but failed to produce a convincing case."

Successfully identifying the wave

Scientists applied a broad range of tools now available, including geostationary satellite observations, [computer simulations](#) and extremely dense networks of [air pressure](#) observations, to successfully identify the Pekeris wave in the atmosphere following the Tonga eruption.

Lead author, Shingo Watanabe, deputy director of the Japan Agency for Marine-Earth Science and Technology's Research Center for Environmental Modeling, performed computer simulations of the response to the Tonga [eruption](#).

"When we investigated the computer simulated and observed pulses over the entire Pacific basin, we found that the slower wave front could be seen over broad regions and that its properties matched those predicted by Pekeris almost a century ago," said Hamilton.

More information: Shingo Watanabe et al, First Detection of the Pekeris Internal Global Atmospheric Resonance: Evidence from the 2022 Tonga Eruption and from Global Reanalysis Data, *Journal of the Atmospheric Sciences* (2022). [DOI: 10.1175/JAS-D-22-0078.1](https://doi.org/10.1175/JAS-D-22-0078.1)

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