

Observations of the Tonga Volcanic Explosion

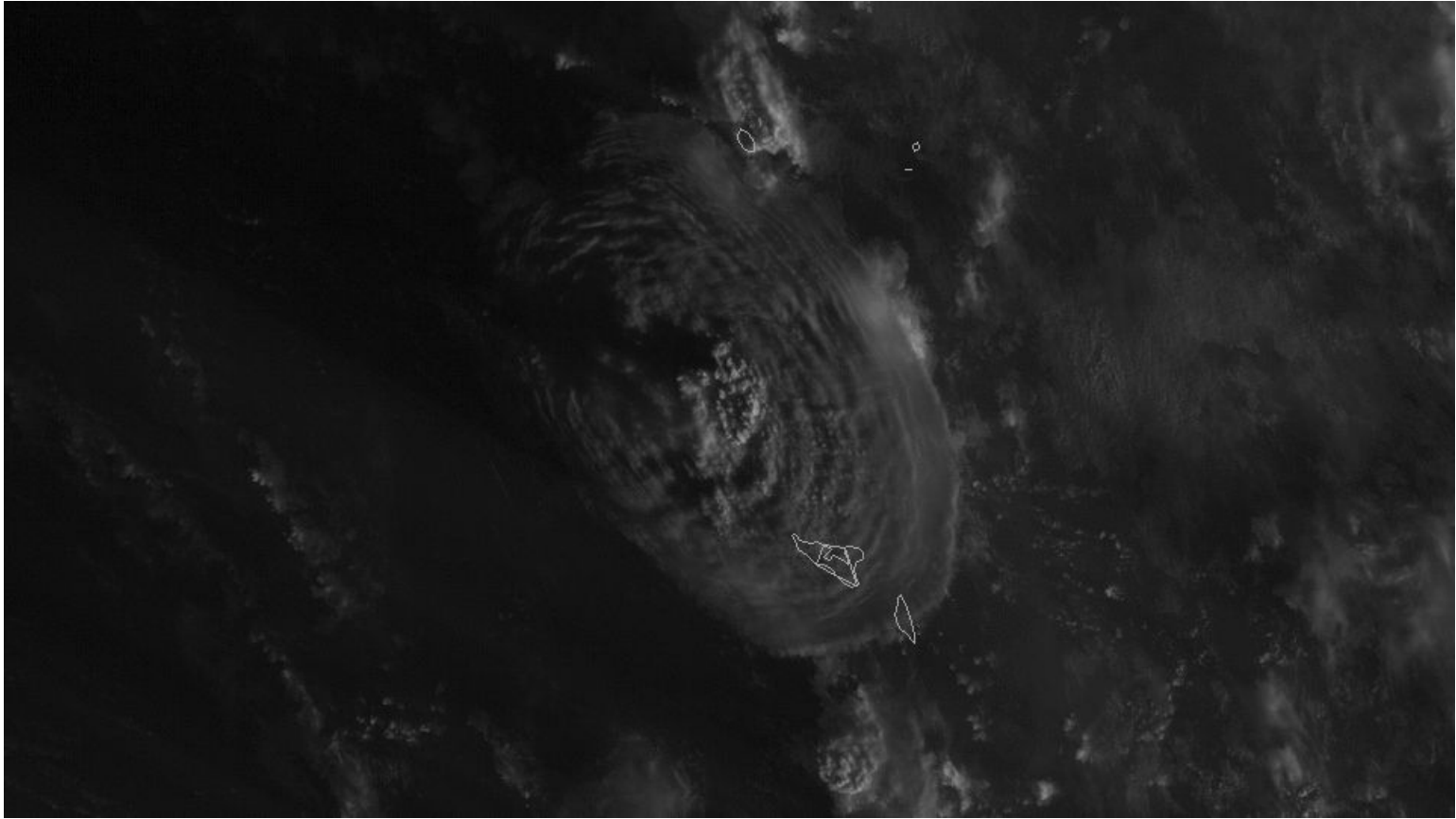
The submarine Hunga-Tonga-Hunga-Ha'apai volcano exploded on Saturday, 15 January 2022 after erupting for several days

The exact time of the explosion was not originally reported but the submarine fibre optic cable to the island(s) failed at 18:40 (Tongan) = 05:40 (UTC)_(see next slide)

More information on the timing

- It now appears there were multiple tsunamis / explosions. The first was smaller which allowed the residents to reach higher ground before the larger events.
- It appears that 2 fibre optic cables were broken 10's of km from the volcano. It is not clear on the mechanism and therefore which event the failures relate to and therefore the timing in relation to the shock wave.
- USGS report the time of the major explosion as 2022-01-15 04:14:45.000 UTC (from seismometer data) – I have used this for the calculations.
- It is not clear why there were no reports of deafness from a very large explosion. People were deafened by Krakatoa 40km away.
- Summary at https://en.wikipedia.org/wiki/2022_Hunga_Tonga%E2%80%93Hunga_Ha%27apai_eruption_and_tsunami
- More current information on the Twitter account <https://twitter.com/scronin70>

Viewed from Space



The eruption was captured by a National Oceanic and Atmospheric Administration satellite © NOAA/GOES
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UK Observations

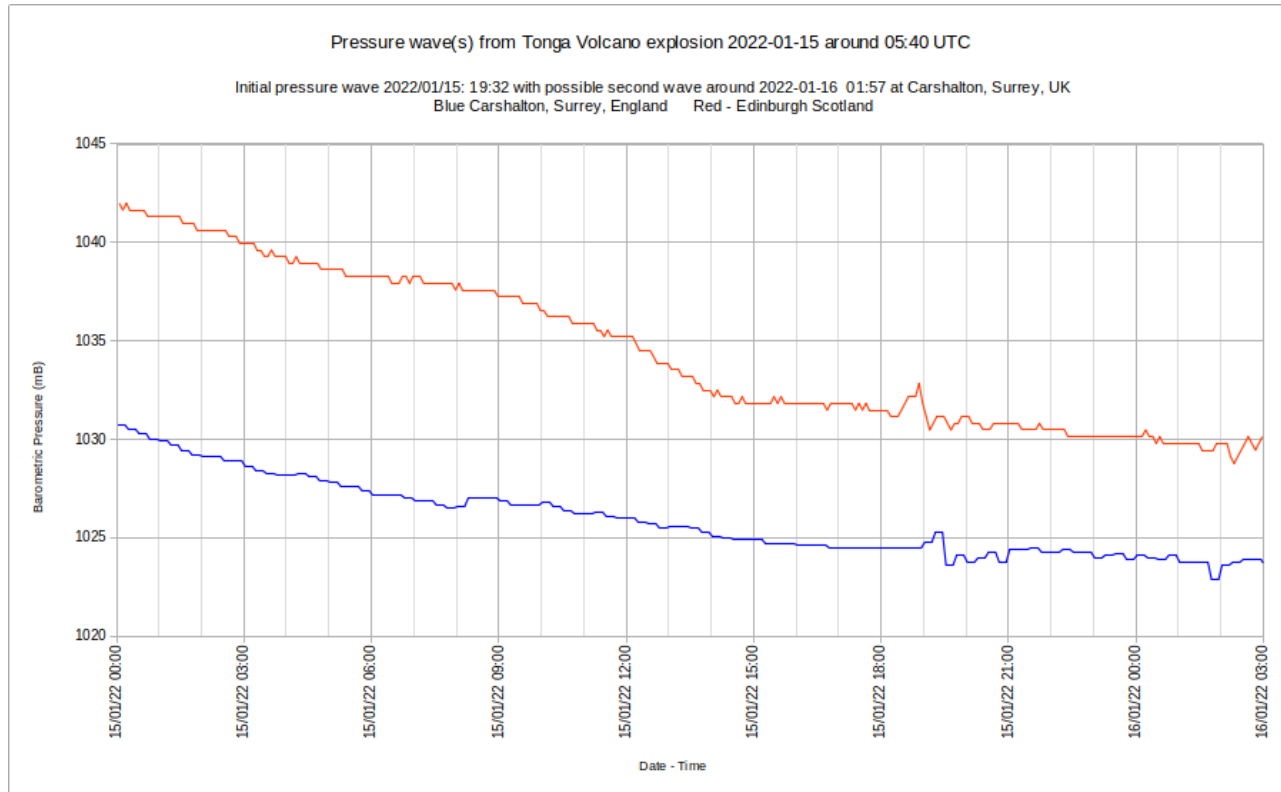
- The explosion created an atmospheric pressure wave
- It was detected as a fluctuation by Met Office barographs, they tweeted the recording from two airfields in the English Midlands



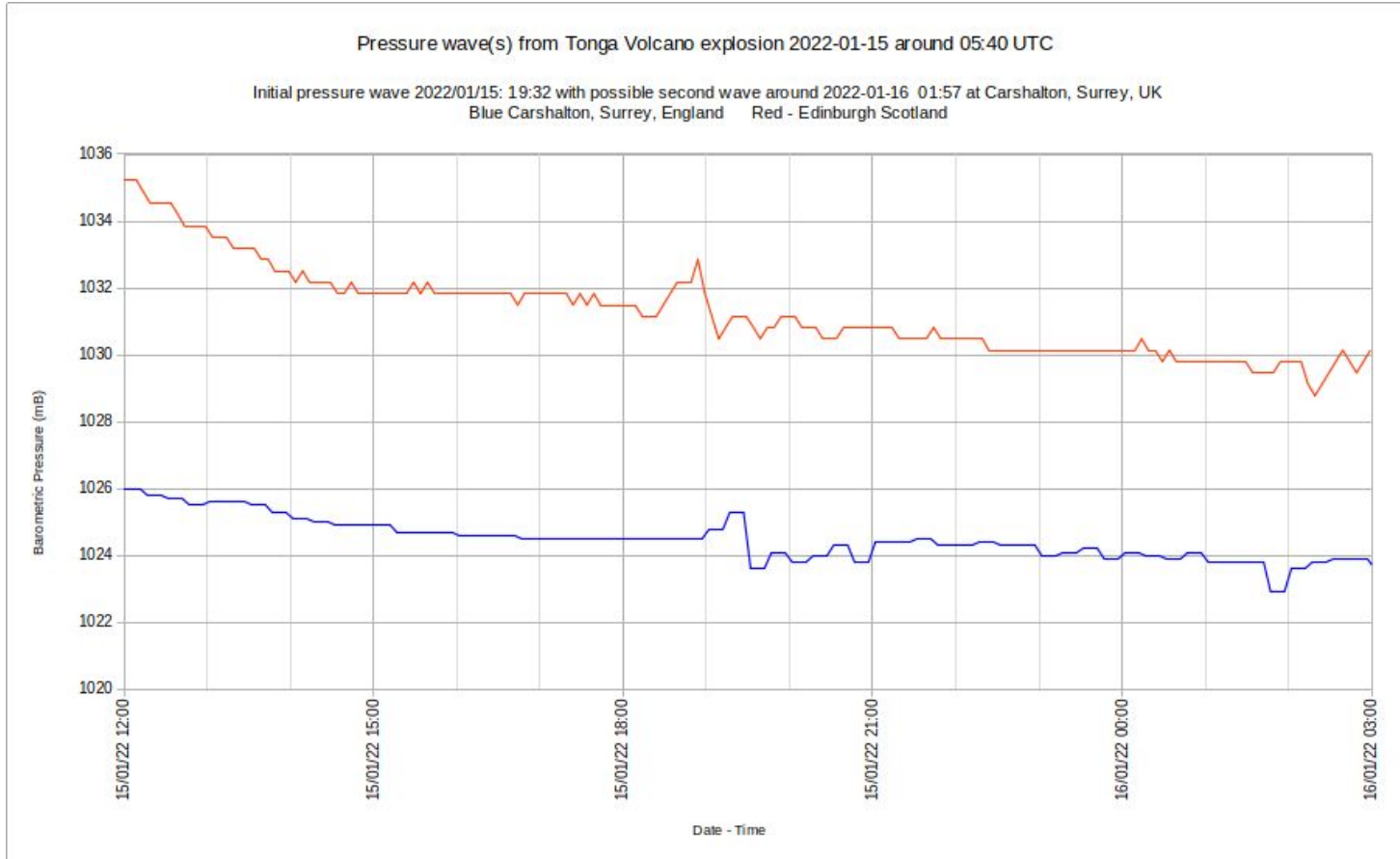
I decided to check the recordings from the weather station in my garden
Success – I recorded the pressure change though at lower sampling rate (every 5 min)
Timing similar to Met office
To confirm speed & direction I asked Ian Smith for data from his weather station in Edinburgh

Benson in Blue
Brize Norton in Red

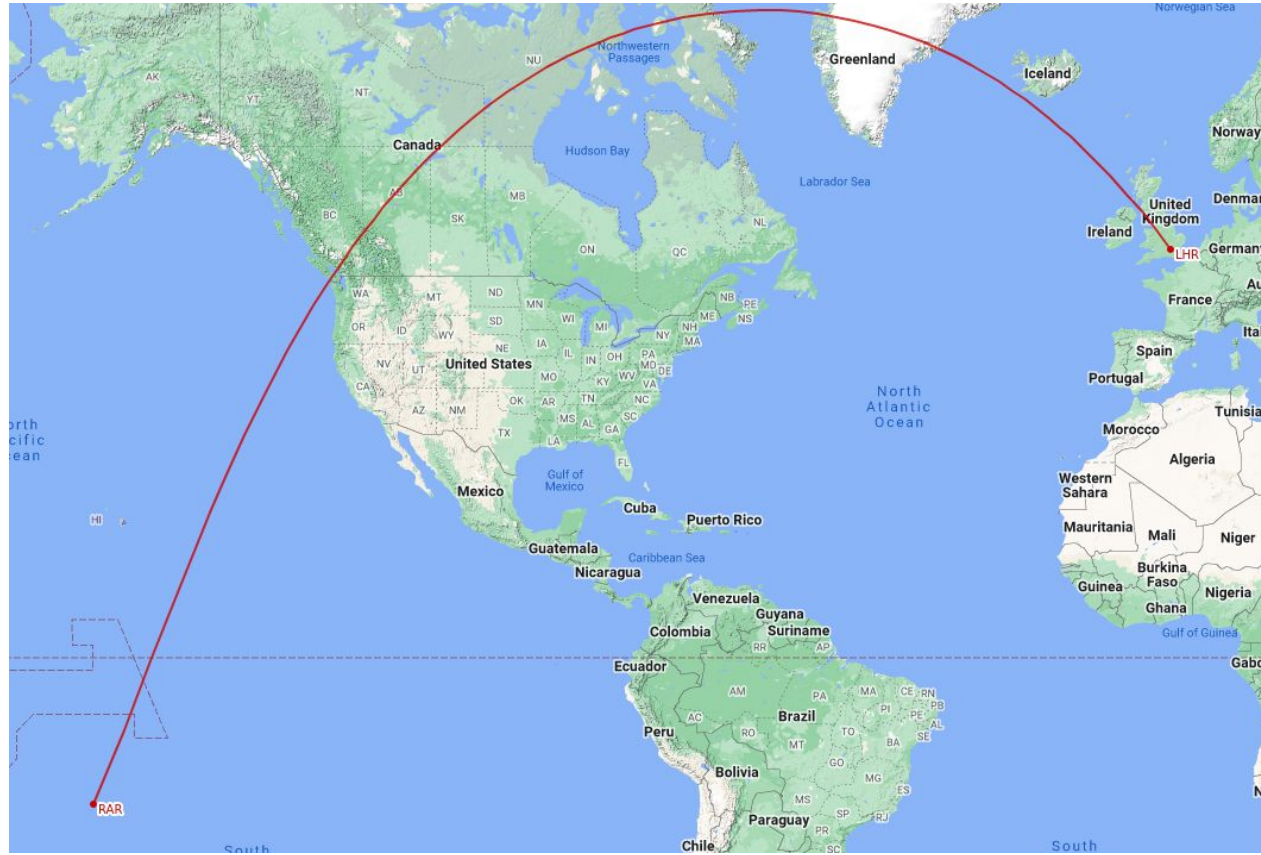
Pressure plots from Carshalton & Edinburgh



Zoom in to events(s)



Great Circle Route – Tonga to London



16220 km or 8750 nm

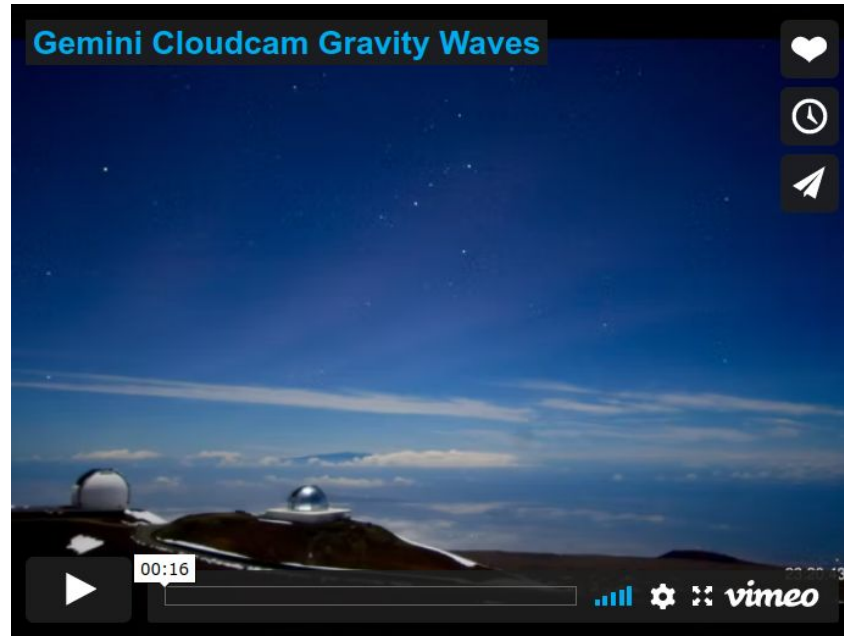
Pressure wave speed calculation

- Pressure wave is confined to an acoustic duct between the surface and the stratosphere as the top of the duct but sometimes the thermosphere.
- Distance (great circle) Tonga to Carshalton = 16,220 km
- Times 15/1/2021 UTC : (arrival) 19:32 -(event) 04:15 = 55k seconds
- Velocity $= (16,220\text{km} \times 1000) / 55,000\text{s} = 295 \text{ m/s}$
- Speed of sound at (commercial jet altitude) 15,000 m, -50C = 300 m/s
- So pressure wave travelled at pretty much the speed of sound.

Additional link – Gravity Wave(s) Observation

- An interesting video of the gravity waves (not to be confused with gravitational waves !) passing above the Gemini Observatory in Hawaii from the explosive eruption in Tonga.
- <https://spaceweather.com/archive.php?view=1&day=18&month=01&year=2022>
- View the video full screen for best view

Video of Gravity waves above Hawaii



https://vimeo.com/666991592?embedded=true&source=video_title&owner=73339908

The gravity waves are the faint red wave like structures above the normal clouds.

Impacts of the pressure wave

- None of major significance
- It set off several pressure alarms in the Alice Detector at CERN
 - <https://alice-collaboration.web.cern.ch/node/35254>
 - Detected 3 waves – 20220115 19:30, 20220116 01:00 and 20220117 07:45 UTC
 - First wave was 1.3 hPa or mBar
 - Pressure control systems in the detector struggled to compensate.
- I have tried to find results from the infra sound detectors but only atomic bomb tests appear to be publicly available !
- The sound was detected by the 55 worldwide infra sound detectors but the results do not appear to have been published.