Nine-day global seismic wave linked to climate change-induced tsunami

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A little over a year ago, seismic instruments across the planet picked up an unprecedented signal of unknown origin for which, until recently, no scientific explanation had been discovered.

The mysterious signal was first detected on September 16, 2023, and lasted for nine days, reverberating throughout the globe. Scientists noted that this had never been observed before. Most earthquake or tsunami seismic observations last for a few minutes and have a limited and localised range.

Termed a "very-long-period" (VLP) seismic signal, it had a frequency of 10.88 millihertz, which corresponds to a 92-second time interval between the peaks. Beyond the fact that the signal had an unusually long period and lasted for over a week, it also tapered off far more slowly than would be expected of a typical earthquake or tsunami.

The puzzling nature of this phenomenon led researchers to a number of hypotheses about what could have triggered it. Initial propositions included some kind of tectonic instability, volcanic activity, or even a massive weapons test.

Scientists around the world initially termed the signal's unknown origins as an "unidentified seismic object" (USO). It was found to have originated around the Dickson Fjord in Greenland, which is 540 metres deep and 2.7 kilometres wide. But the event itself was yet to be determined.

Last month, a paper was published in the journal *Science*, titled "A rockslide-generated tsunami in a Greenland fjord rang Earth for 9 days." It was the product of an international collaboration of 68 scientists from 40 different institutions.

The team used a number of methods that included field measurements, satellite imagery and computer simulations. They found that the signal was caused by a tsunami that occurred from the impacts of climate change.

The study outlines the complex series of events that led to the signal, which the researchers trace back to a landslide that plunged 25 million cubic metres of rock and ice into the Dickson Fjord. The paper describes a "large body of metamorphic rock" dropping down the mountain peak called Hvide Støvhorn at a 45-degree slope and shattering a 200-metre wide glacier. This occurred on the same day the VLP was first noticed.

The combined rock-ice avalanche in turn triggered a huge tsunami in the fjord, a confined water body. Similar events on a smaller scale have previously been recorded in various parts of the world, including in western Greenland in 2017, when a tsunami originating with an avalanche in the Karrat Fjord killed four people. But prior to the September 2023 event, seismic signals of such tsunami waves lasted for minutes, or hours at the longest, and were only picked up by seismometers in the local region.

The latest event, beside being the first one recorded in East Greenland, was markedly different, with its nine-day length and global propagation. The tsunami, trapped and reflecting off the sides of the fjord, produced an interference pattern known as a standing wave. Because of the fjord's shape, the tsunami and its reflection reinforce one another to establish a wave that appears to be stationary—in this case of huge magnitude—that only dissipates over time. In a body of water, this is known as a seiche. The average height of the tsunami waves was 110 metres, but they also reached up to 200 metres. The research team reported finding a dark sediment band on the glaciers face marking the tallest of these waves.

The paper outlines four key results that led the researchers to the conclusion that the seiche produced the VLP signal. The first was the near-identical frequences of the VLP signal (10.88 mHz) and a simulation of the seiche (11.45 mHz) based on the fjord's geometry. The second was the similarity and consistency between the VLP signal radiation pattern and the modelled behaviour of the fjord's water body. The third was that both the simulated seiche oscillations and the observed VLP signal showed very similar values of slow decay rates. And fourth, seismic modelling showed that the horizontal force of the oscillating waves in the fjord matched the VLP signal pattern.

Though the tsunami wave over the course of the next few days settled into a much smaller 7-metre height, its impact on the fjord still produced the seismic signal. The energy contained within the standing wave was prevented from rapidly dissipating as normally would occur. That was due to both the structure of the fjord's mouth and the presence of a glacial dam at the opposite end. Furthermore, the bottom of the fjord is rounded, creating an additional barrier that prevented energy dissipation compared to a normal wave.

The rockslide that generated the tsunami had its origins in climate change. Specifically, global warming led to the thinning of the glacier. The decades-long process of reducing glacial thickness leaves the walls of the slope unsupported, dislodges the rocks on it, and produces a higher probability of a rockslide. The paper notes that steep slopes are "prone to destructive landslides that are increasingly likely to occur because of climate change."

Around 70 percent of global glacier mass loss from melting can be attributed to human causes, namely, greenhouse gas emissions that warm the atmosphere. This is a significant contributor to sea level rise, which can also raise the risk of tsunamis.

Climate change can increase the risk of landslides through other mechanisms as well, such as more intense heavy rainfall, which can reduce the strength of soil and dislodge debris. Devastating events from this mechanism have occurred several times over the past decade or so. The most damaging of these was from 2013 in India, where heavy rains induced a landslide from the slope of a glacier. The combined floods and landslides killed at least 6,000 people.

The researchers conclude: "Our findings highlight how climate change is causing cascading, hazardous feedbacks between the cryosphere, hydrosphere, and lithosphere."

Such hazardous feedbacks are critical to understand, predict, and prepare for, to the extent that the most advanced methods of modern science are capable of doing. In addition, the climate crisis itself is scientifically possible to resolve by drastically cutting greenhouse gas emissions and replacing fossil fuels with renewable energy sources on a mass scale.

Both these requirements, however, are inevitably subordinated to the corporate profit motive under capitalism, making it the root cause of environmental destruction. The climate crisis threatens humanity with increased extreme weather events, including landslides and tsunamis, especially endangering the poorest and most vulnerable populations.

The increasingly urgent scientific necessity of containing and mitigating climate change to avoid further catastrophes poses the need for a socialist program to be fought for by the international working class to abolish this outdated system.