Scientists model Anak Krakatau volcano, tsunami to help prep US for future tsunamis

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Last month's eruption of the Anak Krakatau volcano in Indonesia and the deadly tsunami that followed caused two University of Rhode Island scientists to spring to action.

Tsunami expert Stephan Grilli and volcanologist Steven Carey were planning to visit the site next summer to conduct surveys of the seafloor nearby. The area around Anak Krakatau is the former site of the Krakatau volcano, which erupted in 1883 and is still considered one of the largest catastrophic volcanic eruptions in modern history.

The recent eruption of Anak Krakatau—which means "son of Krakatau—is providing Grilli and Carey with a new opportunity to gain additional insights and create models that they hope will help the United States better prepare for future tsunamis.

"Having real-time evidence like this allows us to test our ideas and validate our models," said Grilli, a professor of ocean engineering whose research contributes to the U.S. National Tsunami Hazard Mitigation Program. "We have seismic sources, volcanic islands and underwater landslides in the Atlantic and the Pacific that could cause tsunamis to hit our coastlines. So we're creating tsunami simulations and maps to show the potential inundation we could face."

Through episodic bursts of lava called Strombolian eruptions, Anak Krakatau had been growing steadily since it emerged from the sea in 1928. Those bursts grew in intensity beginning last June, but on

December 22 the volcano collapsed during an eruption. This type of collapse and associated tsunami had been anticipated in a paper published in 2012.

"But it came without warning, so people were taken by surprise," said Grilli. More than 430 people were killed by the tsunami.

Using tide gauges, satellite images and photographs, Grilli created a model of the volcanic flank collapse caused by the eruption that shows how part of the southwest side of the volcano slid into the water and generated the tsunami.

"Close to the source, our model predicts the maximum wave height was about 40 meters, and there were multiple waves created with a short interval between them," he said. "The maximum reported impact was a wave of more than 16 feet at the village of Sumur on the coast of Java."

The volcano has been greatly reduced in size and is still very active, which could cause difficulties for Grilli and Carey if they want to get close enough to survey the area around it in the coming months.

"A big part of the volcano failed, and from a volcanological standpoint, seawater now has access to the vent, allowing water to mix with the hot magma," explained Carey. "That water flashes to steam and ruptures the magma, causing an explosive eruption. The result is going to be a different style of volcanism that will take place there in the future. It's a situation that has many hazards and will influence whether we can get close to it."

Ideally, the scientists and their colleagues will maneuver a ship close enough to collect samples of the material that slid into the ocean, assess the volume of the material and how far it traveled along the seafloor.

"Now we're estimating the volume of the collapse based on radar images, but we can't see the submarine part of the collapse," Carey said.

Grilli and Carey were awarded a $489,000 grant from the National Science Foundation last spring to survey the site of the 1883 eruption, along with a matching grant to colleagues from England and California. They still intend to follow their original plan, though the recent eruption may move up their timeline.

Their objective is to study the underwater deposits of lava from the 1883 eruption because many questions still remain about it. That eruption caused a 50-foot tsunami wave that wreaked havoc on the islands of Java and Sumatra, but scientists are still uncertain exactly how it happened.

"The idea is that new surveys will help us recreate the mechanism of the eruption so we can model the tsunami that followed," said Grilli. "There are three possibilities, the most likely of which is a discharge of hot pyroclastic flows into the sea, but to prove it we need more data to simulate it."

"There wasn't just one tsunami in 1883, there were many. And there wasn't just one mechanism for the eruption," added Carey. "We still have to explain how multiple tsunamis happened."

Carey has studied the eruption of Krakatau since the late 1980s with URI faculty member Haraldur Sigurdsson, but for most of that time they studied it from a volcanological perspective. This is the first time it is being assessed using Grilli's sophisticated tsunami models.

"When Krakatau erupted, there were no people there, but the energy of the eruption was transferred over a much larger area via the tsunami," Carey said. "There are present-day volcanoes that could have the same mechanism and create devastating tsunamis that we need to be prepared

for today."

Provided by University of Rhode Island

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