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Scenario of the 22 December 2018 tsunami induced by the eruption of Anak Krakatau, Sunda Strait, Indonesia, explored through numerical simulations

Stefano Tinti, Maria Ausilia Paparo, Filippo Zaniboni, Gianluca Pagnoni, Glauco Gallotti, and Alberto Armigliato
University of Bologna, Dipartimento di Fisica e Astronomia (DIFA), Bologna, Italy (stefano.tinti@unibo.it)

On 22 December 2018 the Anak Krakatau in the middle of the Sunda Strait between Java and Sumatra (Indonesia), started to erupt. As one of the consequences, at 21:27 (UTC+7) the SW flank of the volcanic edifice collapsed generating a powerful and lethal tsunami. The waves hit all the coasts of the Strait and, according to the latest local estimates (as for January 2018), they caused about 450 fatalities and missing people, more than 14000 injured, more than 33700 displaced persons and about 3000 destroyed housing units. The Pandeglang district of the Banten province in Java suffered the worst hit with 296 people dead and 7656 injured. Further, the tsunami surveys conducted by the Tsunami and Disaster Mitigation Research Center of the Syiah Kuala University (from December 24, 2018 until January 1, 2019) confirm that the highest flow height of 9.6 m and the maximum run-up height of 14 m have been measured at the Cipenyu Beach of Tanjung Lesung in the Pandeglang district.

Comparing the satellite Sentinel-1 images before and after the main eruptive event, one can easily see that a large volume, including the summit, was missing in the subaerial part of the volcano and further that the southwestern coastline of the island had remarkably changed, which is suggestive that the mass failure involved also the submarine flank of the volcanic edifice. In our work, we propose a tsunamigenic landslide as the possible explanation of the tsunami observations in the Sunda Strait.

A direct proper estimation of the volume involved in the flank collapse is very hard to make since the erupted material during the days following the tsunami replaced part of the detached mass. Therefore, lacking in-situ volcanological measurement data, we have estimated the source volume by means of a back analysis method. More specifically, we have numerically explored different tsunami scenarios varying the volume and position of the tsunamigenic landslide and have selected as the most suitable scenario the one that fits best the available tide gauge data and the inundation observed. To compute the landslide evolution, we have used the numerical model UBO-BLOCK1, which provides the input for the tsunami generation model, while to simulate the tsunami propagation we have used the shallow water model UBO-TSUFD. Both numerical codes were developed and are being maintained by the tsunami research team of the University of Bologna.

Results are discussed also in view of the perspective of tsunami early warning, and in view of the fact that the tsunami warning systems (TWS) in operation today have been devised for tsunamis generated by earthquakes rather than for tsunamis dependent from other types of sources. The Anak Karakatau tsunami case unveils the urgent need to extend the TWS coverage to all potentially catastrophic events, no matter the kind of the source, in order to enhance the TWS efficiency in saving lives and minimizing property losses.