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The enigmatic 1693 AD tsunami in the eastern Mediterranean Sea: new insights on the triggering mechanisms and propagation dynamics

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The disastrous earthquake that affected south-eastern Sicily in 1693 caused over 60,000 casualties and the total destruction of several villages and towns along the coastline between Siracusa, Ragusa, and Catania. During the aftermath of the earthquake, a tsunami struck the Ionian coasts of Sicily and the Messina Strait and was probably recorded even in the Aeolian Islands and Malta. Over the course of the past decades, the event has been highly debated regarding the location of the seismogenic source and the possible cause of the associated tsunami. The marine event has been correlated to both, a submarine landslide and a coseismic displacement at the seafloor. To better defining the most reliable sources and dynamics of the tsunami, we couple high-resolution marine seismic survey data with hydrodynamic modelling to simulate various scenarios of tsunami generation and propagation. Results from the simulations have been compared with geomorphological evidences of past tsunami impacts, described in previous work along the coast of south-eastern Sicily, and within historical chronicles and reports. The most reliable scenario considers the 1693 event composed by two different tsunami waves: a first wave generated by the coseismic fault displacement at the seafloor and a second wave generated by a submarine landslide, triggered by the earthquake shaking. Distinct tsunami modelling runs showed that a simultaneous movement between fault displacement and submarine mass movement could determine a destructive interference on the tsunami waves, with a reduction of wave height. For this reason, the second tsunami wave was probably generated with a maximum delay of few minutes after the one generated by the earthquake and induced a higher flooding. The double-source model could explain the observation why in the course of other destructive earthquakes which occurred in south-eastern Sicily, like that of 1169 AD, the associated tsunami caused less damages. This implies the need to better map, define and evaluate the coastal hazards offshore eastern Sicily accounting to this kind of tsunami events.