

What would a tsunami in the Mediterranean look like?

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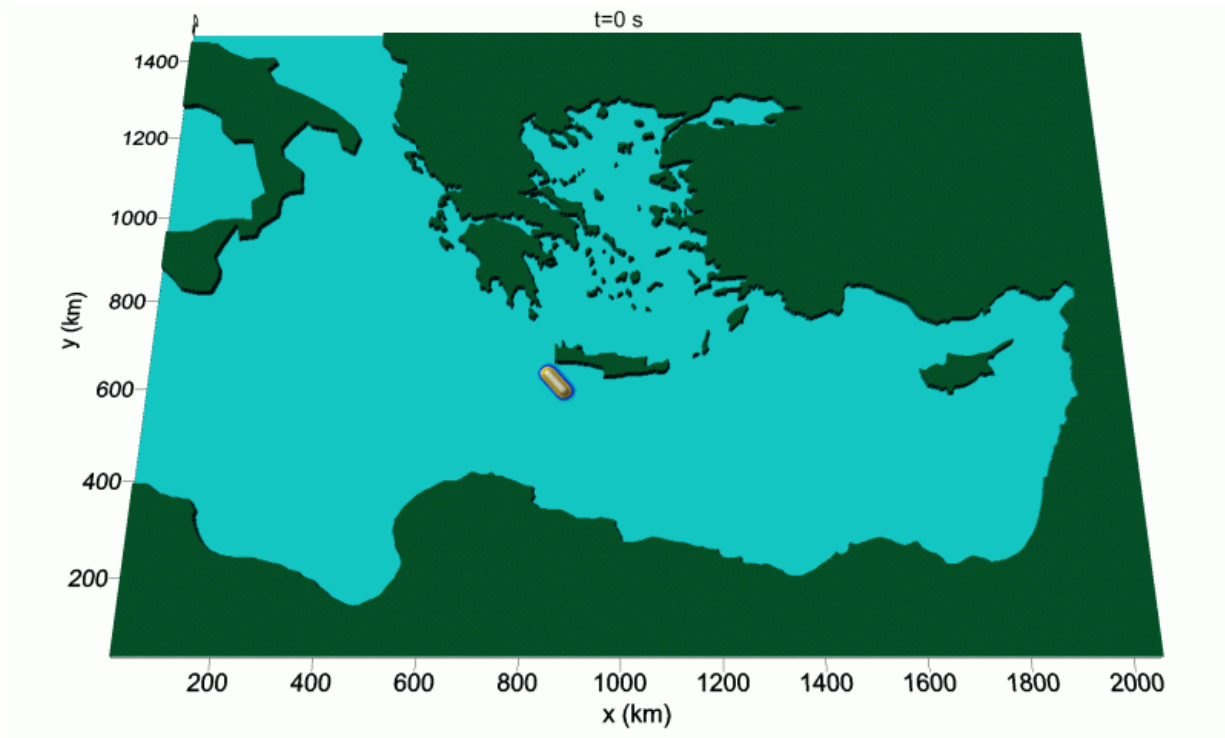


The Matala beach in southern Crete is one of the areas that could be affected by a tsunami in the Eastern Mediterranean. Credit: This image is licensed under a Creative Commons Attribution licence. Source: Wikimedia Commons

A team of European researchers have developed a model to simulate the impact of tsunamis generated by earthquakes and applied it to the Eastern Mediterranean. The results show how tsunami waves could hit and inundate coastal areas in southern Italy and Greece. The study is published today in *Ocean Science*, an open access journal of the European Geosciences Union (EGU).

Though not as frequent as in the Pacific and Indian oceans, tsunamis also occur in the Mediterranean, mainly due to earthquakes generated when the African plate slides underneath the Eurasian plate. About 10% of all tsunamis worldwide happen in the Mediterranean, with on average, one large tsunami happening in the region once a century. The risk to coastal areas is high because of the high population density in the area - some 130 million people live along the sea's coastline. Moreover, [tsunami waves](#) in the Mediterranean need to travel only a very short distance before hitting the coast, reaching it with little advance warning. The new study shows the extent of flooding in selected areas along the coasts of southern Italy and Greece, if hit by large tsunamis in the region, and could help local authorities identify vulnerable areas.

"The main gap in relevant knowledge in tsunami modelling is what happens when tsunami waves approach the nearshore and run inland," says Achilleas Samaras, the lead author of the study and a researcher at the University of Bologna in Italy. The nearshore is the zone where waves transform - becoming steeper and changing their propagation direction - as they propagate over shallow water close to the shore. "We wanted to find out how coastal areas would be affected by tsunamis in a region that is not only the most active in the Mediterranean in terms of seismicity and tectonic movements, but has also experienced numerous tsunami events in the past."



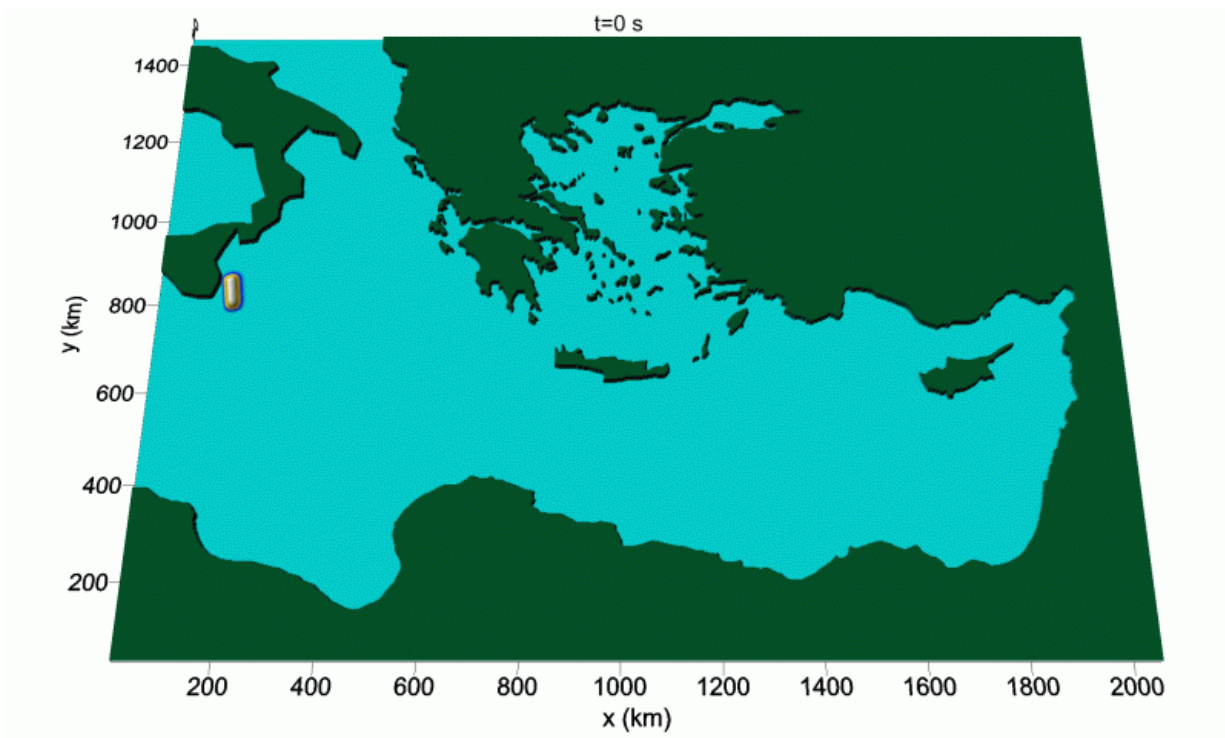
Animation showing water elevation for an earthquake-induced tsunami at the Southwest of Crete. Credit: Samaras et al., *Ocean Science*, 2015. The copyright holder has authorised the use of this image under the conditions specified by the Creative Commons Attribution-ShareAlike licence.

The team developed a computer model to represent how tsunamis in the Mediterranean could form, propagate and hit the coast, using information about the seafloor depth, shoreline and topography. "We simulate tsunami generation by introducing [earthquake](#)-generated displacements at either the sea bed or the surface," explains Samaras. "The model then simulates how these disturbances - the tsunami waves - propagate and are transformed as they reach the nearshore and inundate coastal areas."

As detailed in the *Ocean Science* study, the team applied their model to

tsunamis generated by earthquakes of approximately M7.0 magnitude off the coasts of eastern Sicily and southern Crete. Results show that, in both cases, the tsunamis would inundate the low-lying [coastal areas](#) up to approximately 5 metres above sea level. The effects would be more severe for Crete where some 3.5 square kilometres of land would be under water.

"Due to the complexity of the studied phenomena, one should not arbitrarily extend the validity of the presented results by assuming that a tsunami with a magnitude at generation five times larger, for example, would result in an inundation area five times larger," cautions Samaras. "It is reasonable, however, to consider such results as indicative of how different areas in each region would be affected by larger events."



Animation showing water elevation for an earthquake-induced tsunami at the East of Sicily. Credit: Samaras et al., Ocean Science, 2015. The copyright holder

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"Although the simulated earthquake-induced tsunamis are not small, there has been a recorded history of significantly larger events, in terms of earthquake magnitude and mainshock areas, taking place in the region," says Samaras. For example, a clustering of earthquakes, the largest with magnitude between 8.0 and 8.5, hit off the coast of Crete in 365 AD. The resulting tsunami destroyed ancient cities in Greece, Italy and Egypt, killing some 5000 people in Alexandria alone. More recently, an earthquake of magnitude of about 7.0 hit the Messina region in Italy in 1908, causing a tsunami that killed thousands, with observed waves locally exceeding 10 metres in height.

The team sees the results as a starting point for a more detailed assessment of coastal flooding risk and mitigation along the coasts of the Eastern Mediterranean. "Our simulations could be used to help public authorities and policy makers create a comprehensive database of tsunami scenarios in the Mediterranean, identify vulnerable coastal regions for each scenario, and properly plan their defence."



The maps on the left-hand side show the location and elevation of the low-lying coastal areas in south-southwest Crete (top) and in east-southeast Sicily (bottom). The ones on the right show the areas in these two locations that would be inundated in the earthquake-induced tsunami scenarios studied. The coloured lines are terrain-elevation contours. Credit: Samaras et al., *Ocean Science*, 2015; base images from Google Earth, 2015

More information: *Ocean Science*, www.ocean-sci.net/11/643/2015/os-11-643-2015.html

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