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Generation and impact of scenario tsunamis in the Corinth Gulf (Greece)

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The Gulf of Corinth represents one of the most interesting areas in Europe and in the world from the geological and geophysical point of view. Geodetic measurements clearly indicate that this E-W elongated basin is subject to extensive tectonics and that it is opening in a predominant N-S direction at one of the highest velocities in the world (1.5 cm/year). A complex system of north-dipping, shallow-angle normal faults runs through the southern border of the Gulf. Some authors support the existence of a similar system of active south-dipping faults offshore the northern coasts. Furthermore, microseismic data lead to the hypothesis of the existence of a very shallow angle (10˚-20˚) detachment zone, 8-12 km deep, possibly linking the two aforementioned fault systems. This complicated pattern is reflected by a very high seismicity rate, with historically recorded highest magnitudes in the order of 6.8-7.

The existence of such a large number of active normal faults along the coasts of the basin, and possibly also offshore, is responsible for the relevant tsunami hazard in the region. Recent tsunami catalogues list about twenty events occurred in historical times, some of which produced devastating effects. It is important to stress that earthquakes are not the only sources of tsunamis in the Corinth Gulf. The steep coastal topography, the peculiar basin bathymetry and the high sedimentation rates strictly connected with the river deltas' deposit discharge, are the main responsible for the rather frequent triggering of submarine mass movements, which typically involve only the surface sedimentary layers and are hence characterised by moderate volumes and thicknesses. Coastal and submarine landslides, triggered by earthquakes or by pure gravitational instability, have generated local tsunamis in the past and must still be considered as potential tsunamigenic sources in the Corinth basin.

In the framework of the EU project "3HAZ-Corinth", we studied the generation of

tsunamis in the Corinth Gulf by both earthquakes and landslides. We have taken into account not only sources that have been proposed as possible responsible for historical tsunamis, but also (and mainly) sources that are not necessarily associated to historical events but are believed to be potentially tsunamigenic based on different kinds of observations (geological, geomorphological, geotechnical). For each studied case, we simulated the propagation of the ensuing tsunami in the Corinth Gulf, trying to highlight the main features of the phenomenon, with special emphasis on the typical periods of the water waves generated by earthquakes and landslides, on the time evolution of the tsunami field and on the geographic distribution of the predicted maximum water heights in the basin and along the coasts. As regards the modelling techniques, the initial conditions for earthquake-generated tsunamis is taken to be identical to the vertical coseismic deformation of the seafloor, computed through the classical linear elastic half-space approach. The dynamics of the landslides is modelled by means of an original Lagrangian numerical model, developed both in 1-D and in 2-D, in which the sliding body is split into a set of constant-volume contiguous blocks, and the equation of motion is solved in correspondence with the centre of mass of each block. Finally, the propagation of the tsunami waves is simulated through a numerical finite-element code solving the hydrodynamics equations in the shallow-water approximation.