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Tsunami early warning in the central Mediterranean: effect of the heterogeneity of the seismic source on the timely detectability of a tsunami

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The central Mediterranean, and in particular the coasts of southern Italy, is one of the areas with the highest tsunami hazard in Europe. Limiting our attention to earthquake-generated tsunamis, the sources of historical events hitting this region, as well as the largest part of the potential tsunamigenic seismic sources mapped there, are found at very short distances from the closest shorelines, reducing the time needed for the tsunami to attack the coasts themselves to few minutes. This represents by itself an issue from the Tsunami Early Warning (TEW) perspective. To make the overall problem even more intriguing and challenging, it is known that large tsunamigenic earthquakes are generally characterized by highly heterogeneous distributions of the slip on the fault. This feature has been recognized clearly, for instance, in the giant Sumatra 2004, Chile 2010, and Japan 2011 earthquakes (magnitude 9.3, 8.8 and 9.0, respectively), but it was a property also of smaller magnitude events occurred in the region considered in this study, like the 28 December 1908 Messina Straits tsunamigenic earthquake (M=7.2). In terms of tsunami impact, the parent fault slip heterogeneity usually determines a high variability of run-up and inundation on the near-field coasts, which further complicates the TEW problem. The information on the details of the seismic source rupture coming from the seismic (and possibly geodetic) networks, though of primary importance, is typically available after a time that is comparable or larger than the time comprised between the generation and the impact of the tsunami.
In the framework of the EU-FP7 TRIDEC Project, we investigate how a proper marine sensors coverage both along the coasts and offshore can help posing constraints on the characteristics of the source in near-real time. Our approach consists in discussing numerical tsunami scenarios in the central Mediterranean involving different slip distributions on the parent fault; the tsunamigenic region we take into consideration is the Hyblaean-Malta escarpment located offshore eastern Sicily, where several large historical tsunamigenic earthquakes took place (e.g. 11 January 1693). Starting from different slip configurations on a chosen fault, we compare the time series of wave elevation simulated for tide gauges placed along the coast and for virtual deep sea sensors placed at different distances from the source area. The final goal is to understand whether a properly designed marine sensor network can help determining in real-time the slip characteristics along the parent fault and hence forecasting the pattern of impact of the tsunami especially along the closest coasts.