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Study of the tsunami source in the Palu Bay following the Mw7.5 2018 Sulawesi earthquake

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On 28 September 2018 a Mw 7.5 strike-slip earthquake occurred on the Palu-Koro fault system in the Sulawesi Island. Immediately after the earthquake a powerful tsunami hit the Palu Bay causing large damages and numerous fatalities.

Several works, inverting seismic or geodetic data, clearly estimated the slip distribution of this event, but the causative source of the tsunami is still not completely understood; indeed, the strike-slip mechanism of the seismic source alone might not be sufficient to explain the large runups observed (> 6 m) along the coast of the Palu Bay, and thus one or more additional non-seismic sources like a landslide could have contributed to generate the big tsunami. An insight of that can be found in an extraordinary collection of amateur videos, and on the only available tide gauge in the Bay, at Pantoloan, that showed evidence for a short period wave of at least 2-3 minutes, compatible with a landslide.

In this study, we attempt to discriminate the contribution in the tsunami generation of both the seismic source and some supposed landslides distributed along the coast of the Bay.

In particular, we attempt to estimate the causative source of the tsunami by means of a nonlinear joint inversion of geodetic (InSAR) and runup data. We use a fault geometry consistent with the Sentinel-2 optical analysis results and analytically compute the geodetic Green's functions. The same fault model is used to compute the initial condition for the seismic tsunami Green's functions, including the contribution of the horizontal deformation due to the gradient of the bathymetry (10 m spatial resolution); the landslide tsunami Green's functions are computed the software BingClaw by placing several hypothetical sources in the Bay. In both the cases the tsunami propagation is modelled by numerically solving the nonlinear shallow water equations.

In this work we also attempt to address the validity of Green's functions approach (linearity) for earthquake and landslide sources as well as the wave amplitude offshore as predictor of nearby runup.