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Investigation on the source of the 28 September 2018 Sulawesi tsunami: numerical simulations and comparison with observed data

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On 28th September 2019 an earthquake of magnitude Mw=7.5 characterized by a prevalent strike-slip mechanism and with an epicenter located to the north of Palu Gulf, island of Sulawesi, Indonesia. The earthquake was followed by a tsunami that struck with run-up height that reached values exceeding 6 m in the area of Palu, located in the southern end of the homonymous gulf, causing about 2200 fatalities. The island of Sulawesi and in particular the region affected by this event was hit in the last century by at least 3 large tsunamis (1927, 1968, 1996) not so different as regards the magnitude of the parent earthquake and the values of the observed run-ups. In addition to the tsunami, other seismically induced effects were observed in the Palu area, among which the most important are soil liquefaction in several places and a number of subaerial and probably submarine landslides. Initially, the size of this catastrophic tsunami event appeared to be incompatible with an earthquake of strike-slip mechanism which is considered as unfavorable for the generation of large tsunamis. Therefore, it has been suggested that the tsunami were mostly due to submarine mass failures. In this paper, however, we focus on the tectonic origin of the tsunami and are able to show that the earthquake alone may explain most of the observed tsunami features. The effect of the coastal detachments, documented by videos and by post-event field surveys cannot be neglected, but, according to the present study, they increased the tsunami power only in a local scale. We take into account two different earthquake sources provided by the USGS (source A) and the NOAGI (source B) and simulate the associated tsunamis by means of the nonlinear shallow water model of UBO-TSUFD, which is suitable for computing sea inundation. To this purpose, we performed a careful reconstruction of the coastal topography in the Palu area where tsunami flooding was the most severe. The results of the simulations are compared with the tsunami signal recorded at Pantoloan station and with the inundation observed in the Palu area. Our results demonstrate that the tsunami induced by source B, if the contribution of sea tide is also taken into account, explains quite well the observations. The finding of this study can be also considered as background to study the additional effects of the coastal and submarine landslide sources.