EGU General Assembly 2020

EGU2020-7922
https://doi.org/10.5194/egusphere-egu2020-7922
EGU General Assembly 2020

Seismological Constraints on Fault-Slip Source Models and Rupture Characteristics of Global Large Earthquakes (Mw ≥ 7.5) and Associated Tsunamis

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Large and destructive earthquakes (M_w≥ 7.5) occur worldwide particularly along the major subduction zones causing extensive damage and loss of life in the hinterland of epicentral region. Source models and rupture characteristics of these earthquakes (i.e. faulting geometry, focal depth, non-uniform finite-fault slip distributions) can be precisely determined by using seismological data and multidisciplinary earth-science observations. It is also known that earthquake source parameters play key roles in the modelling of secondary events such as earthquake-induced tsunamis. There are many studies emphasizing the importance of using heterogonous slip distribution models of earthquakes in mathematical tsunami simulations to predict synthetic tsunami waves more consistent with the observed ones. In this study, we obtained double-couple source mechanisms and slip distribution models of complex large earthquakes (M_w≥ 7.5) lately occurred at different parts of the Earth. For this purpose, we used point-source teleseismic P- and SH- body waveform inversion and kinematic slip distribution inversion techniques. Besides, azimuthal distributions of P- wave first motion polarities, which are recorded by near-field and regional seismic stations, are checked to approve obtained minimum misfit source mechanism parameters of earthquakes. We essentially observed that tsunamigenic earthquakes occurred at shallow focal depths (h ≤ 70 km) with dip-slip source mechanisms and rather complex slip distributions along the fault planes. However, in some cases, tsunami waves may be unexpectedly triggered due to the secondary effects of large strike-slip earthquakes (e.g., September 28, 2018 Palu, Indonesia - M_w7.5). Here, we discuss our inversion results, which reveal the significant contributions of earthquake source studies on resolving the relationships between the faulting geometry, rupture characteristics and tsunami generation. Furthermore, the necessity of high-resolution bathymetry data in numerical tsunami simulations is highlighted for the modelling of tsunami waves, in particular, recorded at the near-field tide-gauge stations. This study is partially supported by the Turkish Academy of Sciences (TÜBA) through GEBIP program.