Do subduction earthquakes influence slip rates on nearby major transform faults? The Sulawesi case.

Riva, Riccardo; Nijholt, Nicolai; Simons, Wim

Geophysical Research Abstracts
Vol. 21, EGU2019-13220, 2019
EGU General Assembly 2019

Do subduction earthquakes influence slip rates on nearby major transform faults? The Sulawesi case.

Riccardo Riva (1), Nicolai Nijholt (1), and Wim Simons (2)

(1) Delft University of Technology, Dept. of Geoscience and Remote Sensing, Delft, Netherlands (r.e.m.riva@tudelft.nl), (2) Delft University of Technology, Dept. of Space Engineering, Delft, Netherlands

In SE Asia, the island of Sulawesi is home for several sources of seismic hazard. The Celebes Sea oceanic lithosphere subducts beneath the north arm of the island of Sulawesi at the Minahassa subduction zone. Here, Mw > 7.5 earthquakes produced tsunamis in the past. At the western termination of the Minahassa subduction zone, it connects to the left-lateral Palu-Koro strike-slip fault zone, which strikes onshore at Palu Bay and then crosses Sulawesi. The Palu-Koro fault delimits the overriding plate of the subduction zone and accommodates the differential motion between northern Sulawesi and Borneo/the Makassar Straits and on 28 September 2018 was the locus of a Mw 7.5 earthquake, which also produced a tsunami. Interseismic velocities indicate that the Palu-Koro fault zone accommodates about 4 cm/yr of relative motion over several fault strands in the Palu Bay area. The Minahassa trench has a variable interseismic slip rate: about 4 cm/yr in the west to about 2 cm/yr in the east.

We have a >20-year record of GNSS velocities on Sulawesi, including an extensive network of campaign sites. The densest cluster of monument sites surrounds the Palu-Koro fault, specifically around Palu Bay, whereas the rest of the island is less densely covered. Due to the length of the observational record, we obtain high quality estimates of interseismic velocities. These show clearly the transform motion of the Palu-Koro fault zone and its interseismic locking. However, an additional second-order complex pattern of deformation is revealed when the GNSS time series are detrended: the velocities in northern Sulawesi and around the Palu-Koro fault do not follow their estimated, linear, interseismic trends after a major subduction earthquake has occurred, for several years after the event. This is not surprising for those stations fairly close to the event and/or on the north arm of Sulawesi, but the effect reaches more than 400 km away from the epicentre. Moreover, it appears that the slip rate of the Palu-Koro fault (a major fault that only connects to the subduction interface at its western termination) is altered for 1-2 years after a subduction event.

We construct a 3D numerical model based on the structural and seismological data in the Sulawesi region. Through forward model calculations, we seek to determine whether there is a link between the post-seismic relaxation pattern from the subduction earthquake and the slip rate on the Palu- Koro fault. We aim to obtain a better grasp on the seismic hazard in the Sulawesi region, which has been struck by devastating earthquakes so many times already. This study then seeks to show whether the potential range of influence by large-scale subduction earthquakes exceeds the nearby overriding plate region, and whether slip rates on nearby major fault systems may be influenced, thereby altering their seismic hazard potential.