



Re-evaluation of the 1976 Guatemala earthquake taking into account the environmental effects

Sabina Porfido (1), Eliana Esposito (1), Efsio Spiga (2), Marco Sacchi (1), Flavia Molisso (1), and Salvatore Mazzola (1)

(1) IAMC-CNR, Naples, Italy (sabina.porfido@iamc.cnr.it), (2) Independent Researcher, Avellino, Italy

Guatemala is one of the most seismically active countries in Central America. The largest earthquakes are produced by along the subduction zone of the Cocos and Caribbean plates in the Middle America Trench in the Pacific Ocean. Large earthquakes are also triggered along the boundary between the North American and the Caribbean plates, defined by a zone of large left lateral strike-slip faults that run through Guatemala from the Swan Fracture Zone in the Caribbean Sea. The earthquakes generated along these transcurrent faults, although less frequent, have a great importance to seismic hazard in Central America, more than the subduction-related earthquakes, because of their shallow ipocenters and the proximity of many cities and villages to these active structures.

The most destructive event in this region was the earthquake occurred on 4, February 1976 in Guatemala, associated with the Motagua fault, causing 23 000 deaths, and 77 200 injuries. This study attempts at reconstructing the coseismic effects on the environment, to better assess the intensities according to the ESI scale 2007.

For the Guatemala 1976 earthquake ($M=7,5$), the original scientific seismic, geological and macroseismic reports have been reviewed in order to highlight effects on natural environment. The maximum estimated intensity was IX MM in Gualan, in the Mixco area and in the centre of Guatemala City. Intensities value were underestimated despite there was a high level of damages, in fact several towns and villages were totally destroyed and although the earthquake triggered very large and spectacular primary and secondary ground effects.

On the basis of all the gathered information has been possible to detect and to localize coseismic environmental effects, and classify them into six main types: surface faulting, slope movements, ground cracks, ground settlements, hydrological changes and tsunamis. Primary effects was identified in the Motagua Valley and the mountainous area W of the valley, a strike-slip fault with a total length of 230 km, and maximum horizontal displacement of 3.25 m, secondary faults were observed in the Mixco area, in the western part of Guatemala City, with total length of ca. 10 km. Secondary effects were mostly landslides, (ca. 50.000) throughout a broad region of central Guatemala parallel to the main fault, mainly involving rock falls, debris slides, and flows as well as thick pumiceous pyroclastic rocks. Lateral spreads and liquefaction phenomena occurred in the Motagua valley, along Atlantic coast of Guatemala and Honduras, and along the shores of Lake Amatitlan, evidence of a tsunami was reported in Honduras. According to the ESI2007 scale, IO XI corresponds to 230 km total rupture length and maximum horizontal offset of 3.25 m, in good agreement to the total area of relevant ground effects of about 18.000 km. The IO = XI ESI 2007 indicate a more realistic value with respect to intensity IX MM assessed by Espinosa e al.1976. Once again it is important to underline the role played by environmental effects on the seismic hazard evaluation for the national and regional seismic hazards.