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Fault Parameters of the 1868 and 1877 earthquakes, inferred from historical records: Run-up measurements, Isoseismals and coseismic deformation

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The Mega-thrust zone of southern Peru and northern Chile is recognized as a tsunamigenic zone. In Southern Peru and Northern Chile, large earthquakes have not occurred in the last 130 years. The 1868 and 1877 were the last earthquakes with rupture larger than 400 km. The fault parameters and slip distribution of these earthquakes is not well understood, because only a few tide gauges recorded these events at far field distance. We studied simultaneously the near field effect, run-up, isoseismals, coseismic historical descriptions and far field tide gauges in the Pacific Ocean. We define several rupture scenerios which are numerically modeled using NEOWAVE program obtaining the tsunami propagation and coseismic deformation. New coupling models from are used to model scenarios. These results are compared with historical near field and far field observations, our preferred scenario fitted well these records and it agrees with the proposed isoseismals. For 1868 southern Peru earthquake our preferred scenario has a seismic rupture starting at the south part of 2001 Camaná Peru earthquake 16.8°S to 19.3°S through the Arica bending at 18°S, with a rupture of 350-400 km, maximum slip of 15 meters and seismic magnitude between M_w∼8.7-8.9. For the 1877 earthquake our preferred scenario has a length of 400 kilometers from 23°S to 19.3°S, a maximum slip of 25 meters and seismic moderate magnitude of M_w∼8.8. In both earthquakes the dip (10°-20°) is controlled by the geometry of subducting Nazca plate and larger slip distributions are located in the shallow part of the contact, from the trench to 30 km depth. Finally strong slip distribution in the shallow seismic contact for these historical mega-earthquakes could explain the apparent dual behavior between these mega-earthquakes Mw > 8.5 and moderate magnitude earthquakes Mw ∼ 8.0 which apparently only have occurred in the depth zone of the contact i.e. the earthquakes of 1967 Mw 6.7 and 2007 Mw 7.7 in Tocopilla. However, more detailed studies are required to locate all historical Mw ∼ 8.0 earthquakes in the deeper contact zone.