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2010 Chile Mega earthquake survey report: Source process and its relation with strong motion

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The 2010/2/27 Maule (Chile) mega-earthquake, the fifth largest earthquake in instrumental history, was located in the subduction of the Nazca plate in Meridional Andes beneath the South American plate. This earthquake fills a well studied seismic gap between the source areas of the largest ever recorded 1960 Great Valdivia earthquake (M 9.5), and the 1985 Valparaiso earthquake (M7.8) [2]. The source process of this earthquake is characterized by two asperities with a peak slip of nearly 8m, a rupture area of approximately 400 km and an average rupture velocity of 2.6 km/s. The first asperity is located at the hypocenter and the second at 200 km to the North-East [4].

Observed Strong Motion characteristics

The Maule earthquake was recorded by nearly 30 strong motion near-source stations belonging to Chile University. Maximum reported PGA and PGV values reached 909 cm/s/s, and 69 cm/s respectively. The source rupture was characterized by two distinct sub-events; the first located at the hypocenter and the second located approximately 200 km north-east of the hypocenter. Strong ground motions recorded in Santiago and Viña also display two clear sub-events separated by 15s to 20s, which are consistent with a rupture velocity value of 2.6 km/s.

Observed and Simulated permanent displacement at Concepción

We calculated the displacement at Concepción city from a strong ground motion recording of the earthquake observed at the CCSP station, by double integrating and de-trending unfiltered acceleration data. Our results show a ~3m permanent displacement to the West which is in very good agreement with the results obtained by a 1Hz - GPS recording of the earthquake at the TIGO observatory in Concepción [3].

Strong Motion Simulation

Using our source rupture model we made a preliminary simulation of the strong ground motion at Concepción city (CSSP site), by using a broadband strong motion simulation technique which combines the calculation of the theoretical wave propagation for the low frequencies (below 1Hz), and a finite-fault stochastic methodology for the calculation of high frequencies [1]. Our preliminary results are able to describe the general characteristics of observed ground motion.

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References

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