3D velocity model of the Bogota basin (Colombia) based on dense microtremors arrays measurements, gravity, and geological data

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Bogotá, a megacity with almost 8 million inhabitants is prone to a significant earthquake hazard due to nearby active faults as well as subduction megathrust earthquakes. The city has been severely affected by many historical earthquakes in the last 500 years, reaching MM intensities of 8 or more in Bogotá. The city is also located at a large lacustrine basin composed of extremely soft soils which strongly amplify the ground shaking from earthquakes. The basin extends approximately 40 km from North to South and East to West, is bounded by the Andes range to the East and South, and sharply deepens towards the West of Bogotá. We construct a velocity model of the basin based on dense microtremors arrays measurements (radius from 60 cm to 1700 m) at 200 sites within the basin (Figure 1a), as well as single microtremors measurements at 600 points. Horizontal to vertical ratios of microtremors show large predominant peaks for periods as large as 3.5 seconds, near the center of the basin (Figure 1b). The 3D velocity model of the basin for layers with S-wave velocities (Vs) smaller than 700 m/s were directly interpolated from profiles obtained from dense microtremors array data (2 km spacing). To constraint the velocity model for deeper layers (layers with Vs from 700 to 3000 m/s) we use available gravity data (~800 points with 1 km spacing), as well as available geological information from boreholes within the basin. Our results show that the Bogota basin is composed of a deep Neogene-Quaternary deposits (deepest point at the center of the basin ~850 m), mainly composed of clays for the upper 300 m and clays with gravels and sand for the lower part, with a bottom S wave velocity of 700 m/s (Figure 2a). The seismic bedrock (Vs=3000 m/s) reach a depth of 3400 m at the deepest point of the basin (Figure 2b). Seismic records from shallow earthquakes as well as preliminary strong motion simulations of the basin indicate the generation of large amplitude and long duration surface waves generated at the basin edge.

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