Strong Motion Network of Medellín and Aburrá Valley:

technical advances, seismicity records and micro-earthquake monitoring

Gustavo Posada[1 2], Juan Camilo Trujillo[1 2], Carlos D. Hoyos[1 2], Gaspar Monsalve[2]

1. Sistema de Alerta Temprana de Medellín y Valle de Aburrá (SIATA)

2. Universidad Nacional de Colombia, sede Medellín

Introduction

The Aburrá Valley is located in the northern Central Cordillera of Colombia, in a medium seismic hazard region. Due to the level of hazard, there is a Strong Motion Network, which has a total of 25 active accelerometers, 5 of them in real-time.

Geologically the valley is composed of metamorphic rocks, cretaceous intrusives, and pieces of accreted oceanic terranes (Figure 1). There is no historical record of M>3.5 earthquakes with epicenters within the valley. The neotectonic evidence is limited: SIATA (the local Early Warning System) has begun installing a micro-earthquake monitoring network.

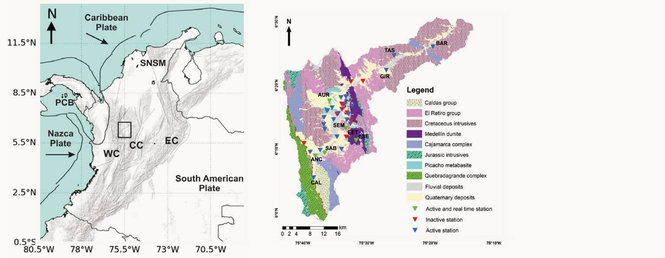


Figure 1.

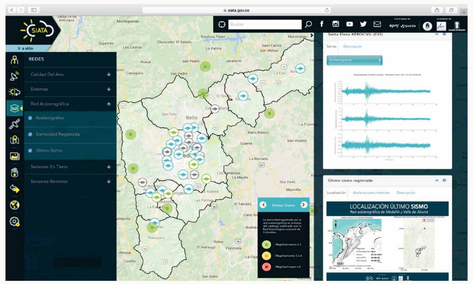
Left: Colombian tectonic settings, WC: Western Cordillera, CC: Central Cordillera, EC: Eastern Cordillera, PCB: Panama-Choco Block, SNSM: Santa Marta Massif. Black arrows indicate vectors of movement of each plate realive to stable South America.

Right: Stations of the ground motion network of the Aburrá Valley and local geology.

Real-time analysis

Figure 2. Real-time monitoring:

Acceleration, velocity, displacement, response spectrum, Fourier spectrum, Arias Intensiy, Housner Intensity, last earthquake, historical records and PGA. This information is available at ***www.siata.gov.co***

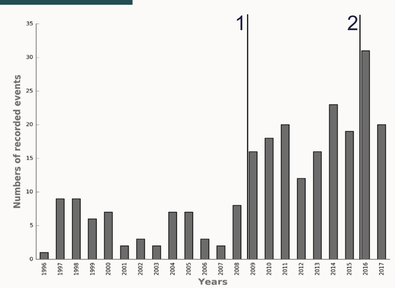


Earthquake database

A total of 241 earthquakes between 1996 and october 2017 have been recorded. The analyses are focused on peak ground motion, typical frequency and transfer function.

Figure 3.

Number events per year. There are two important moments, 1: consolidation of the seismological network of Colombia, 2: start of real time monitoring at SIATA



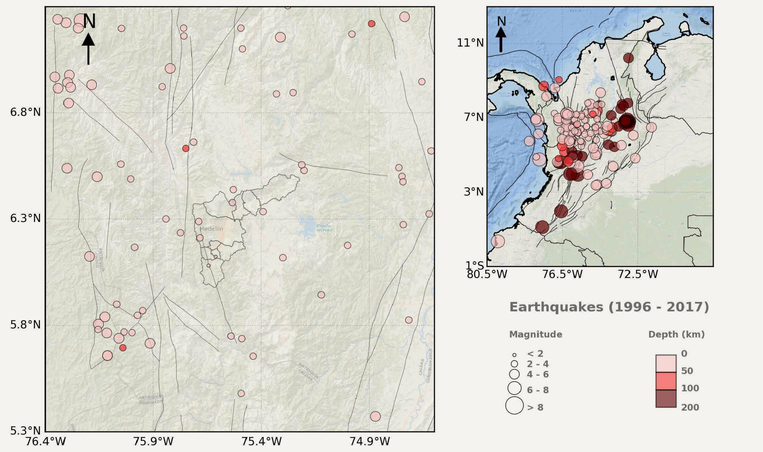


Figure 4.

Seismicity recorded by the Ground Motion Network of Medellín and Aburrá Valley. The earthquakes near Aburrá Valley are characterized by magnitudes lower than 3.5.and depths less than 20 km.

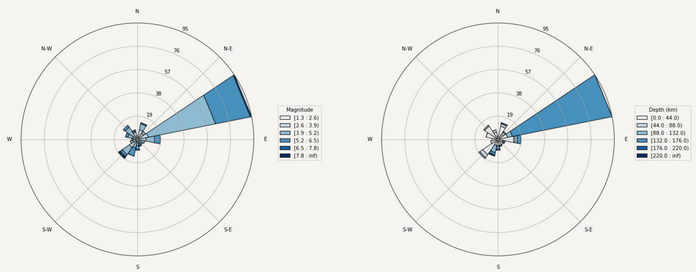


Figure 5.

Azimuthal coverage of recorded seismicity by the Ground Motion Network of Medellín and Aburrá Valley.

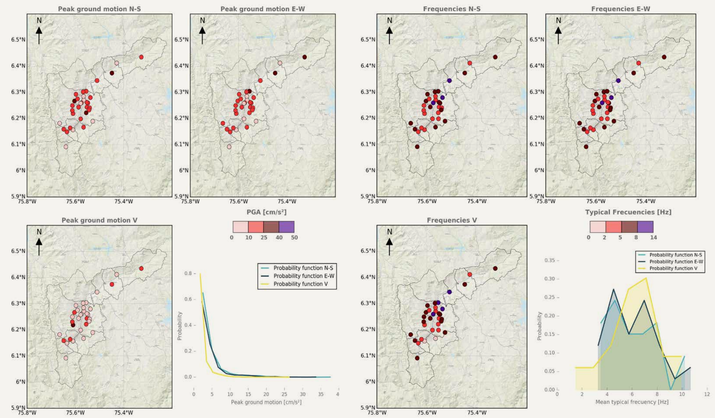


Figure 5.

Left: Historicaly recorded PGA (accelerations less than 40 gals); Rigth: Fourier spectrum allows to know the typical frequencies.

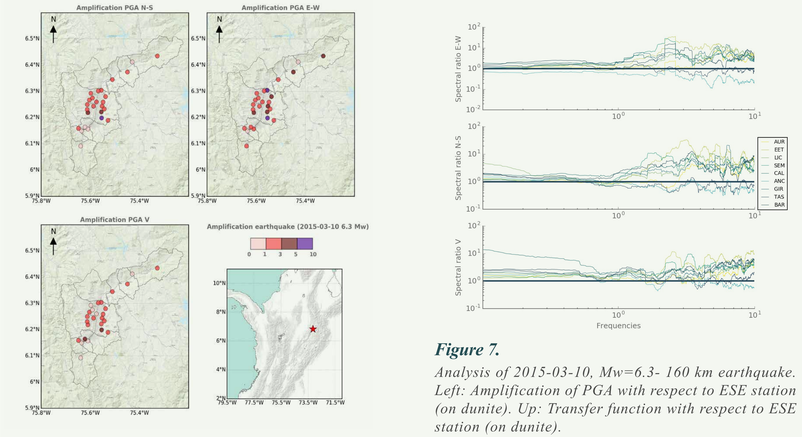


Figure 7.

Analysis of 2015-03-10, Mw=6.3- 160 km earthquake. Left: Amplification of PGA with respect to ESE station (on dunite). Up: Transfer function with respect to ESE station (on dunite).

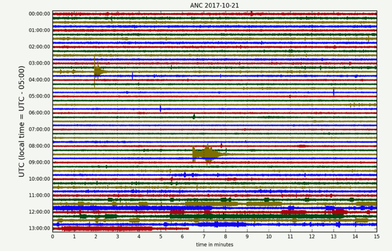
Micro-Earthquake Monitoring

We are in the process of implementing a low-cost seismometer network for 24/7 monitoring of local earthquakes, to improve the knowledge of seismic hazard, geological faults activity, and the geophysical conditions under the Aburrá Valley and its closer surroundings.

A *Raspberry Shake* seismograph network allows monitoring in real-time, and meets the minimum requirements.

Figure 8

Day plot at ANCON station. Up to date, we have installed two sensors in the valley. We expect to install 8 more within the next year.



Conclusions

- The implementation of new technologies, updates of accelerometers and real-time communication, allows to improve the seismic monitoring and the early report.
- The mean seismic source for the Aburrá Valley is the Bucaramanga nest (to the NE). Nearly 50 percent of earthquakes come from this area; other important sources are the active faults and subduction zone toward the west.
- In general, most stations have amplifications in high and low frequencies relative to ESE station. TAS and ANC stations are on hard rock, so they have high attenuations

Bibliography

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Contact

Gustavo Posada
gaposadar@unal.edu.co