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PROBABILISTIC SEISMIC HAZARD MAP FOR BOLIVIA (PSHBO-2019)

FERNANDEZ Gonzalo [1], NIETO Mayra [1], GRIFFITHS Teddy [1], ARCE Walter [1], ASSUMPCAO Marcelo [2], SCHINDELE François [3], GODEY Stephanie [3], BRACHET Nicolas [3].

Poster No. P1.2-272

POSTER

1.Fundación Privada de Files Observatorio San Calixto.

2.Centro de Sismologia Sao Paulo.

3. Commissariat à l'énergie atomique et aux énergies alternatives.

Probabilistic Seismic Hazard Map for Bolivia (PSHBO)

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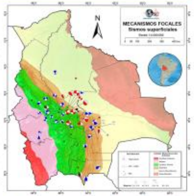
ABSTRACT

On this research we present a probabilistic seismic hazard map for Bolivia (PSH-BO-2019), this is the first map that integrated all variables available within the geo hazard for our country. We propose 13 seismic zones based on epicentral distribution, stresses and geology context, we applied the well know method for hazards assessment integration to all variables to have the maximum probable acceleration for each zone. Our results include a return period of 475 and 2475 years with five structural periods that let us to build the uniform hazard spectrum for our country. The crustal earthquakes located at along the Eastern Cordillera, Inter Andes and part of the Sub Andes (known as Bolivian Boomerang) present peak ground accelerations up to 24% of gravity, for the subduction earthquakes show almost 34% of gravity those are located at Western Cordillera, for Altiplano the peak ground accelerations reach up to 16%, for Chaco and Beni plains accelerations of 4% of gravity.

INTRODUCTION

Seismogenic sources for Bolivia, shallow crustal earthquakes (depth < 70km) by yellow dots, subduction earthquakes (depth between 100 to 350 km) by orange dots, deep earthquakes (depth between 500 to 700 km) by red dots.

Shallow crustal focal mechanism solutions for Bolivia, red beach balls were computed by Harvard Global Moment Tensor, brown beach balls were computed by Vega and Ayala before 2000, blue beach balls are the latest production within the new seismic network.



HOMOGENIZATION OF THE SEISMIC CATALOG OSC

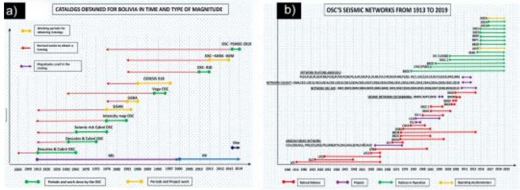


Figure 1. a) Different time periods of catalogs were taken into account to have a "Master Catalog" for the present study. **b)** The time period of different seismic station installed in our country and operated by OSC.

Ml to Mw Magnitude Relation for Harmonizing the Seismic Catalog

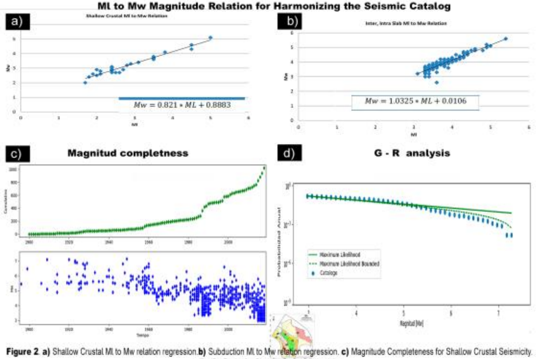
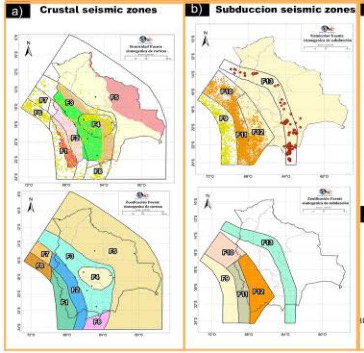


Figure 2. a) Shallow Crustal Ml to Mw relation regression. **b)** Subduction Ml to Mw relation regression. **c)** Magnitude Completeness for Shallow Crustal Seismicity. **d)** G - R plot for Shallow Crustal Seismicity.

SISMOGENIC SOURCES AND PARAMETERS



c) Parametes

	FUENTE	M min (Mw)	Lamda (Mw)	Beta	M max
FUENTES ASOCIADAS A DEFORMACIÓN CORTICAL	F1 - Zona Occidental	4,5	8,372	2,700	7
	F2 - Zona Altiplánica	4,5	3,020	2,43	6
	F3 - Zona Oriental	4,5	2,48	2,43	7
	F4 - Zona Boomerang	4,5	4,128	2,488	7
	F5 - Zona Cratónica	4,5	0,3585	1,271	7
	F6 - Zona Occidental peruana	4,5	7,32	3,2224	8
	F7 - Zona altiplano peruano	4,5	0,721	2,897	7
	F8 - Zona cordillera Argentina	4,5	2,687	3,998	7
FUENTES ASOCIADAS AL PROCESO DE SUBDUCCIÓN	F9 - Zona interplaca	4,5	8,393	2,758	9
	F10 - Zona intraplaca intermedia	4,5	8,67	2,172	7,8
	F11 - Zona intraplaca intermedia	4,5	41,39	2,169	8
	F12 - Zona intraplaca intermedia	4,5	12,586	2,478	7,7
	F13 - Zona intraplaca profunda	4,5	1,948	1,258	8,8

d) GMPE´s

GMPE Crustal

Abranhamson et al. 2014.
Boore et al. 2008.
Boore et al. 2014.

GMPE Subduccion

BCHydro 2016 (Abrahansom et al. 2016).
Montalva et al. 2017
Youngs et al. 1997

Figure 3. a) Shallow Seismicity M>5 distributed under the geomorphologic map and zonification. **b)** Interface, subduction and deep Seismicity M>5 and Zones delimitation for the analysis. **c)** Parameters taken into account with their magnitudes, lamda and beta values. **d)** GMPE´s used in this work.

RESULTS

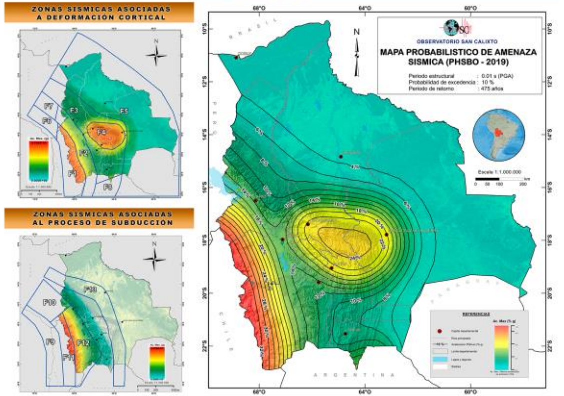


Figure 4. The seismic hazard map for Bolivia at 10% for 475 years. PGA's are expressed on % of g. Small left up side map shows the results for shallow crustal seismicity. Small left down side map show the results for subduction earthquakes.

DISCUSSION AND CONCLUSION

This seismic hazard map for the national territory was prepared within the framework of the international methodology proposed by different authors, it has been worked with two return periods 475 and 2475 years (10% and 2%) respectively, five spectral periods (0.0 , 0.1, 0.2, 0.5, 1.0, 2.0, 3.0, 4.0 seconds) were used to obtain the acceleration spectra of each of the department capitals.

The probable maximum acceleration values obtained for the different zones range from 10% to 32% of g., The Vs30 value of 760 m / s was considered. The greatest acceleration by cortical earthquakes is concentrated between Cochabamba, Chuquisaca and Santa Cruz, probable maximum values between 16% to 24% of g were obtained. Between the Bolivia - Chile border, maximum accelerations were obtained between 18% to 32% of g.

For the capitals of the departments of La Paz, Oruro and Potosí there are values between 12% to 14% of g. For the departments of Tarija, Beni and Pando, there are probable maximum accelerations between 6% and 8% of g. It should be mentioned that the seismicity of distant sources has an influence on the Municipalities of La Paz, Yacuiba and all those located near the border with Chile.

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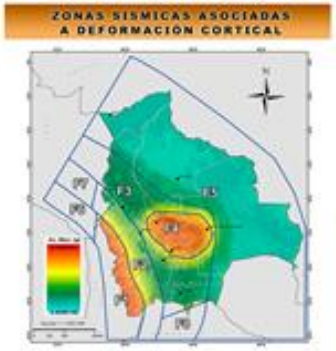

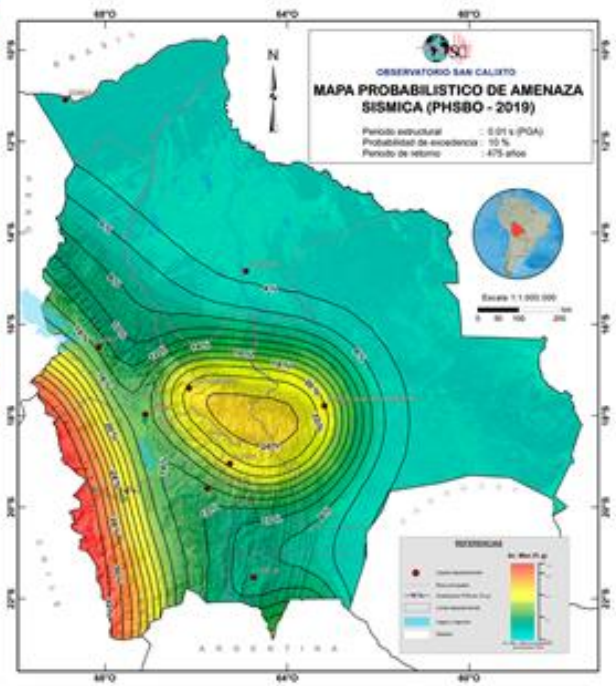

ABSTRACT

The newest probabilistic seismic hazard map for Bolivia (PSHBO-2019) was conducted to be the first map that integrated all variables available within the geo hazard for our country. 13 seismic zones based on epicentral distribution, stresses and geology context were found, furthermore the well know method for hazards assessment integration was applied to have the maximum probable ground motion acceleration for each zone. Our results include a return period of 475 and 2475 years with five structural periods that let us to build the Uniform Hazard Spectrum for all our country. The crustal earthquakes located at along the Eastern Cordillera, Inter Andes and part of the Sub Andes (known as Bolivian Boomerang) present peak ground accelerations up to 24% of gravity, for the subduction earthquakes show almost 34% of gravity those are located at Western Cordillera, for Altiplano the peak ground accelerations reach up to 16%, for Chaco and Beni plains accelerations of 4% of gravity.

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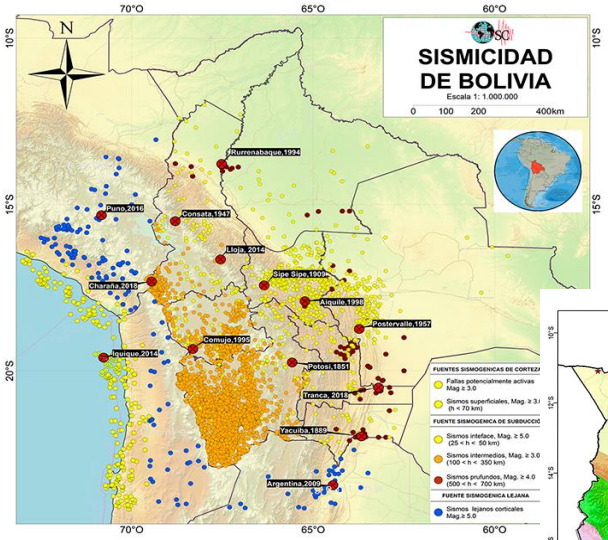

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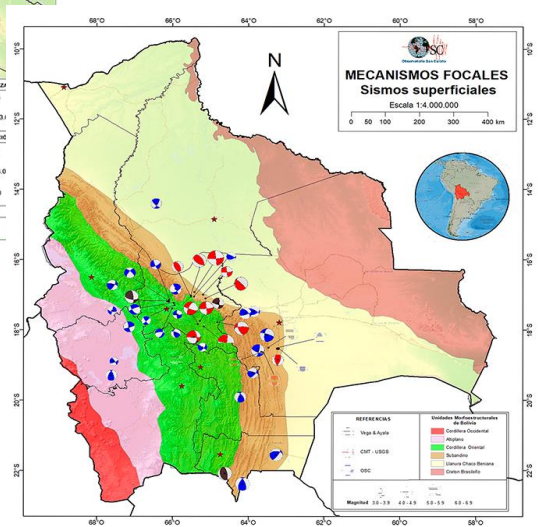

Figure 2. Shallow crustal focal mechanism solutions for Bolivia

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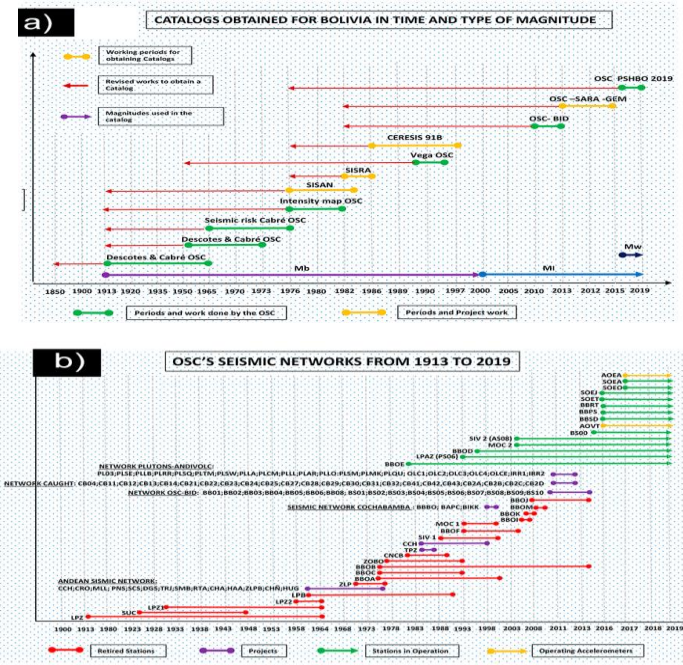

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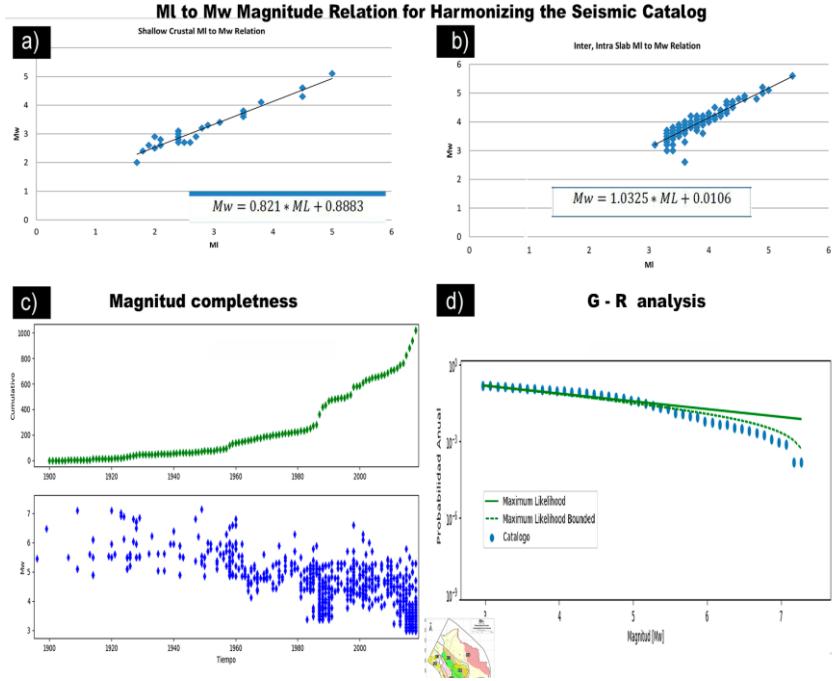

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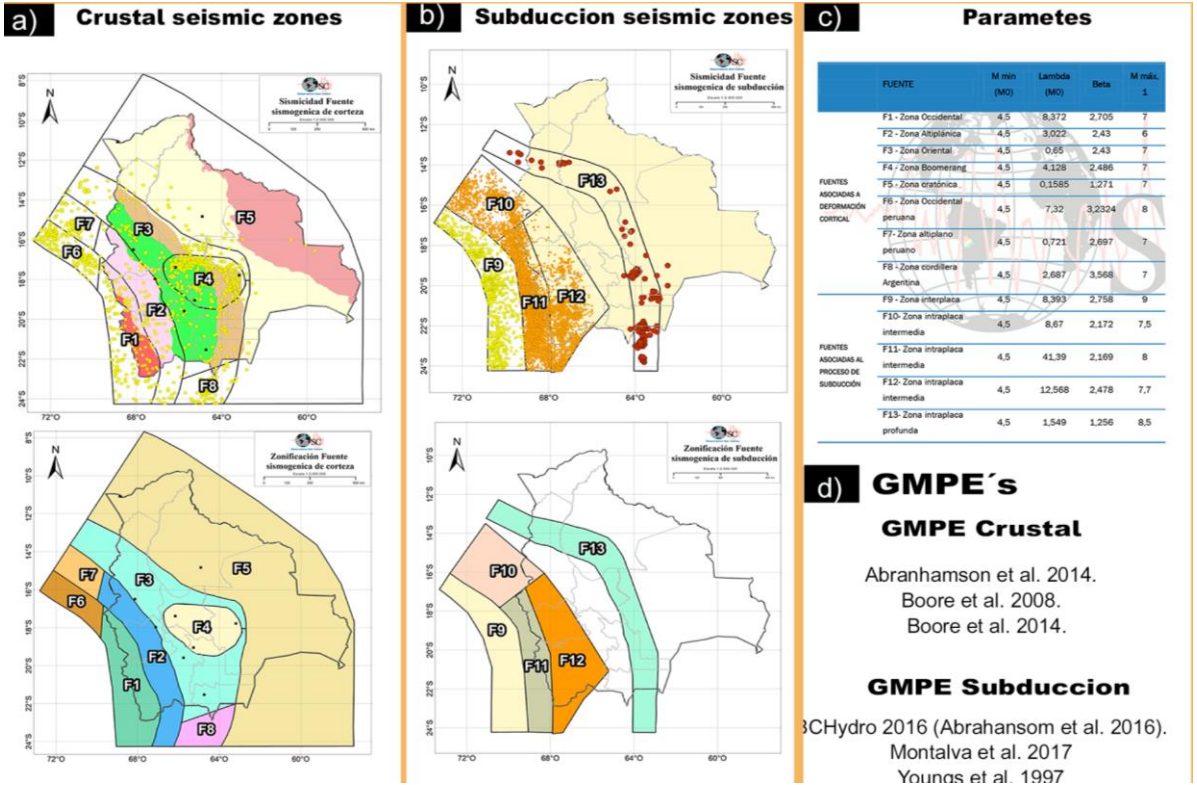

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a) Shallow Seismicity M>5 distributed under the geomorphologic map and zonification.

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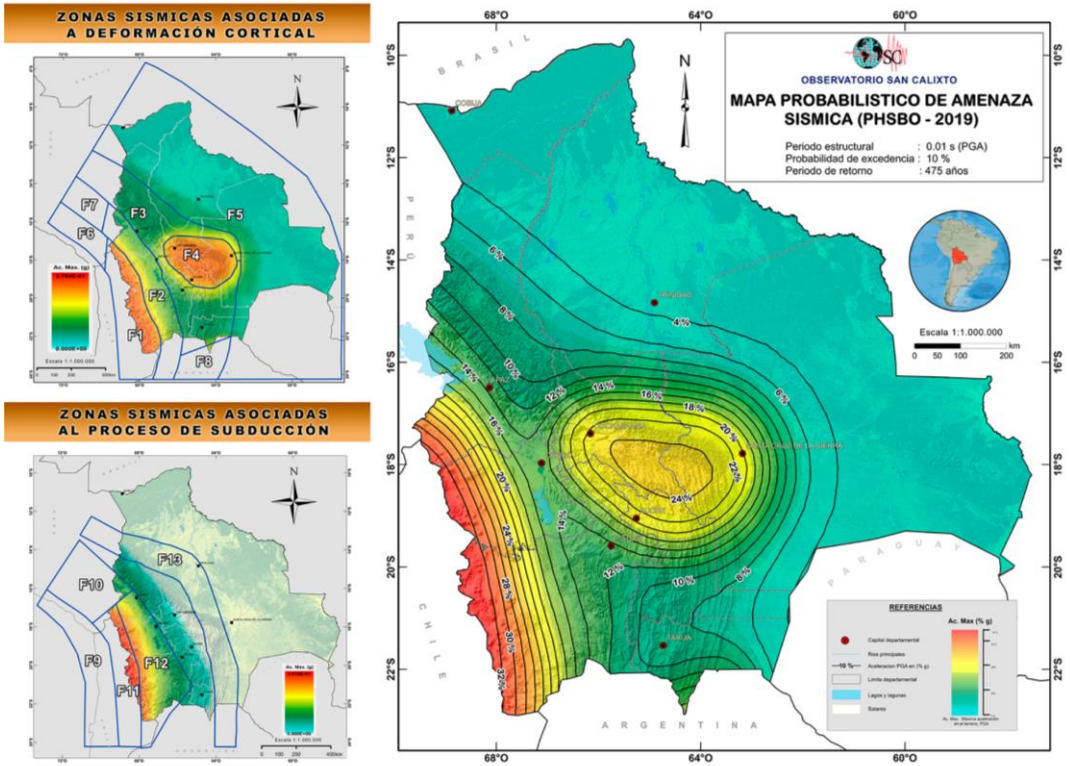

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DISCUSSION AND CONCLUSIONS

PSHBO-2019

Newest Seismic Hazard Map for our country was computed for 475 and 2475 years and Vs30 of 760m/s.

13 seismic zones have been identified, all integration variables were merged to have the maximum probabilistic ground motion. 5 spectral period were proposed to construct the Uniform Hazard Spectrum.

For the shallow seismicity the central part of Central Andes (Cochabamba, Chuquisaca and Santa Cruz departments) could experiment up to 24% of gravity.

For the subduction seismicity at Occidental part of Central Andes (La Paz, Oruro and Potosi) could experiment up to 32% of gravity.

For the South part of Central Andes (Tarija) could experiment up to 10% of gravity.

The Northern and Eastern part of Central Andes (Beni and Pando) could experiment up to 5% of gravity