Geological and Environmental Hazards in Mexico City: An introduction

Earthquakes have damaged the Mexico City basin since immemorial times. Floods and storms are recorded in indigenous documents. Popocatépetl volcano has erupted intermittently at least 500 000 years. At present people settle in hazardous areas such as scarps, steep slopes, ravines and stream channels. We need to study environmental hazards and risks in order to better inform decision makers.

The First International Symposium on Geological and Environmental Hazards in Mexico City was held on October 16 to 20, 2000 on the Campus of the National University of Mexico (UNAM).

The scope of the meeting included seismology, earthquake engineering, geology, geotechnical engineering, volcanology, meteorology, sociology and environmental sciences. This special issue contains a selection of studies presented during the meeting.

The contribution by García *et al.* aimes to model the earthquake response of soils of the basin of Mexico by neural networks. Results of a regression learning paradigm are presented and discussed. The authors claim to be able to predict the ground response to seismic events from different earthquake sources.

The effect of water pumping from shallow aquifers under Mexico City in discussed by Ovando-Shelley *et al.* Consolidation modifies the static and dynamic mechanical properties, and under certain conditions, some structures might be lost in decades. This implies a change in the seismic hazard distribution in the city and the vulnerability of the downtown area to high-frequency earthquakes is increasing.

Montalvo-Arrieta *et al.* discusses the seismic response at stations of the Accelerometric Network of Mexico City located in the hill zone. The response changes with magnitude, azimuth, epicentral distance and depth. Seven earthquakes from different seismic sources with magnitudes from 5.9 to 7.3 are analyzed. Regional amplification changes from the southwest hill zone to the north of the city, while local amplification depends on the area. The differences in amplification are explained in terms of the presence of soft soils under the lava flows where the stations were located.

Botero and Romo discuss dynamic analysis of slope failure considering the inertia of the moving soil mass. The higher modes are important when a slope is subject to large earthquake loadings, and the nonlinear behavior of the soil may affect the overall response of the slope. A finite element analysis is used to evaluate earthquake-induced displacements taking into account spatial variations of strength along the failure surface and the inertial effects of the sliding wedge considered as a multi-degree of freedom system. The analysis is carried out in the time domain.

Microtremors are useful tools for microzonation studies due to simplicity in data acquisition and analysis. Flores and Aguirre describe results for the Spatial Autocorrelation Method first proposed by Aki in 1957 and compare the results for Mexico City with those obtained with other methods. The disadvantage of the SPAC method compared to Nakamura's technique (1989) is that it requires a good time control, and simultaneous recordings at least for two instruments. However, the information obtained with the SPAC method is more complete, and may regresent a valuable option to estimate site effects in Mexico City.

Buried pipelines in seismic zones are vulnerable. Flores Berrones illustrates the problems caused by failure of water, gas or sewage pipes due to earthquakes. Some of the procedures for seismic design continuous or segmented buried pipelines are discussed.

Many hazards in the basin of Mexico depend on the weather. Magaña and colleagues address the problem of predicting precipitations in disaster preparedness. The number of severe storms in the basin have increased in the last decades. A criterion to define an extreme precipitation event in the basin of Mexico is proposed, and the zones of

Mexico City with the highest precipitations are identified. The authors discuss the capability of predicting extreme precipitations by using observations and a mesoscale model.

Melgar and co-workers tackle a major issue in Mexico City: air pollution. The authors measure the increase of health hazards on people who live close to pollutant emission sources, including cancer, emphysema, reproductive disorders and others. A four-step methodology was applied: hazard identification, dosage-response relationship, exposure assessment and risk assessment. They show how to find the exposed groups of people who present the highest health risk.

Photogrammetric techniques have been used for decades in Mexico to evaluate hazards. Julio Miranda and Delgado Granados use digital photogrammetry for fast evaluation of natural hazards at volcanoes. Digital elevation models by using photogrammetric software is applied to calculating ice volume and water equivalent in order to predict debris flows resulting from quick melting of the glacier on Popocatépetl volcano. The methodology is useful in dangerous situations where field work is not possible, and remote techniques are needed to rapidly provide data on hazards.

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