

GEOLYDER

Y CONSORCIO

UNIVERSIDAD POLITECNICA DE MADRID



UNIVERSIDAD COMPLUTENSE DE MADRID



**EXPERIENCIA DE PROYECTOS EN AMERICA LATINA E
INSTITUCIONES CON LAS QUE SE HA COLABORADO**

EXPERTISE

Geolyder is a recently created company that provides technical assistance and consulting in seismic hazard, ground motion characterization of specific sites and seismic risk assessment. The initial core of the company is the Earthquake Engineering Group of the Technical University of Madrid. During its more than ten years of existence, the Group has become a top team in the field of Earthquake Engineering in Spain, particularly on seismic hazard and risk assessment, ground motion characterization of sites for critical facilities and of special importance. Besides these specific areas, the Group works in other complementary and akin fields of Earth Sciences, such as Seismology, Geodesy and Remote sensing, and in particular, the organization, distribution and visualization of georeferenced data in Geographic Information Systems. The Group has a multidisciplinary character, with specialists on all these research areas, which makes it easier tackling investigations in different research areas and collaborating with scientists from other institutions.

The financial support from official and private entities obtained in a number of projects (co-)led by the Group and the recent grant of several projects demonstrate the confidence on the good-quality products delivered by the Group. Public institutions that have financed or finance our projects are the Ministry of Education and Science (MEC), Nuclear Security Council (CSN), National Enterprise for Radioactive Waste Disposal (ENRESA), Spanish Agency for International Cooperation (AECI), National Geographic Institute (IGN), Spanish Geological and Mining Institute (IGME) and Civil Protection Agencies. The Group has also developed projects in the International context, financed by NATO and EU. Results of these projects have been published in research papers, book chapters and official reports and presented in international and national conferences.

The central research line of the Group is the seismic characterization of sites and earthquake-resistant design of structures, both conventional and critical. Several methodological lines have been developed, with special focus on the particular characteristics of the Iberian Peninsula, an area with moderate seismic activity and lack of a complete local strong-motion database. Specifically, state-of-the-art methods have been adapted to the Spanish case with the adoption of singular, original hypotheses. A strong-motion records databank and the software tools for its exploitation and processing of data have been developed. Web viewers for the visualization of results have been also prepared. This constitutes an important achievement that facilitates seismic characterization of particular sites. The Group has also accomplished the seismic characterization

of sites for important facilities in response to the demand of different companies. It is worth highlighting the seismic study for the Ebro dam (financed by Nuclenor) and of the Spanish potential site for ITER at Vandellós, financed by CIEMAT-Empresarios Agrupados. The last projects in this regard are related to the seismic characterization of Spanish nuclear power plants and the temporal centralised storage of radioactive waste (ATC site).

The research activities of the Group also have a significant impact in issues affecting the society in general, such as the revision of the old Spanish Building Code (NCSE-94) and the new seismic hazard map of Spain (to be used in the future revision of the seismic code). Both works have been done in collaboration with IGN. Another important research line is seismic risk evaluation and associated risks, such as landslide risk. Civil Protection of Murcia co-financed the RISMUR project for seismic risk assessment of that area. Results of this study were the basis for the development of the SISIMUR emergency plan of Murcia, activated after the 2011 Lorca earthquake. The group has also developed the seismic risk studies of the Spanish regions of Andalusia and Navarre.

Special mention is due to the collaborative line of the Group with developing countries (Guatemala, El Salvador), which expertise and resources are limited. Another research line with Central America started in Guatemala with an AECI-funded technical assistance following the Mitch hurricane. A seismic hazard study in this country contributed to modify and update the earthquake-resistant code of this country. Another AECI-funded technical assistance following the devastating 2001 El Salvador earthquakes was the basis for the collaboration with this country. Dr. Benito helped evaluating damaged areas and recognizing areas with high landslide hazard and participated in a project for the installation of a strong-motion network in El Salvador and a study of the 2001 earthquakes. In addition, several courses and stays oriented to form local technicians and to promote research projects have been carried out in Guatemala, El Salvador, Nicaragua, Costa Rica.

Finally, it is worthy to remark the projects developed in Haiti, for seismic hazard and seismic risk assessment. These projects were funded by UPM and were carried out in collaboration with the Observatoire National de l'Environnement et de la Vulnérabilité and the universities of Almería and Alicante. The task accomplished in the project included: a new hazard map of La Hispaniola, new ambient noise measurements for site characterization in Port-au-Prince, a seismic risk

assessment of Port-au-Prince taking into account data from the 2010 Haiti earthquake and a preliminary landslide risk assessment study.

Several training courses were carried out in Port-au-Prince with a positive response from the audience.

INSTITUCIONES DE AMERICA LATINA CON LAS QUE SE HA COLABORADO

- Servicio Nacional de Estudios Territoriales (SNET) de El Salvador
- Instituto de Sismología, Vulcanología, Meteorología e Hidrología de Guatemala, (INSIVUMEH)
- Universidad de Panamá
- Instituto Costarricense de Electricidad (ICE)
- Universidad de Costa Rica
- Universidad de Honduras
- Instituto Nacional de Estudios Territoriales (INETER) de Nicaragua.
- Servicio Sismológico de República Dominicana
- Servicio sismológico de Puerto Rico
- Universidad de Cumaná (Venezuela)

Título del proyecto o contrato	Entidad contraparte	Entidad financiadora	Periodo de vigencia
Caracterización sísmica en el departamento de Quezaltenango (Guatemala)	MUNICIPALIDAD	Banco Interamericano para el Desarrollo	2014
Formación y orientación hacia la mitigación del riesgo sísmico en Haití: SISMO-HAITI I	Universidad del Estado de Haití	UPM	2011-2013
Reducción de la vulnerabilidad estructural y mejora de la habitabilidad en Haití: SISMO-HAITI	Observatorio Nacional de Medio Ambiente y Vulnerabilidad (ONEV)	UPM	2011-2012
Evaluación de la Amenaza y Riesgo Sísmico en Haití y Aplicación al Diseño Sismorresistente: SISMO-HAITI II	Observatorio Nacional de Medio Ambiente y Vulnerabilidad (ONEV)	U P M	2012-2014
Desarrollo de Estudios Geológicos y Sismológicos en El Salvador Dirigidos a La Mitigación del Riesgo Sísmico	Servicio Nacional de Estudios Territoriales	Agencia Española de Cooperación Internacional y Desarrollo (AECID).	2008-2010
Estudio de las deformaciones tectónicas actuales en el sistema de fallas del Valle Central mediante técnicas geodésicas y paleosísmicas: contribución para la mejora de las evaluaciones de la peligrosidad sísmica”	Universidad de Costa Rica Instituto Costarricense de Electricidad	Ministerio de Ciencia y Tecnología de Costa Rica	2009
Análisis de sensibilidad a la peligrosidad sísmica incorporando resultados de estudios recientes de tectónica activa en Centroamérica. Aplicación a la mitigación del riesgo sísmico en el SE de España	INSIVUMEH (Guatemala) SNET (El Salvador) ICE (Costa Rica) INETER (Nicaragua) Universidad de Panamá Universidad de Honduras	Ministerio de Ciencia e Innovación	2010 - 2013

Título del proyecto o contrato	Entidad contraparte	Entidad financiadora	Periodo de vigencia
Evaluación Regional de la Amenaza Sísmica en Centro América	INSIVUMEH (Guatemala) SNET (El Salvador) ICE (Costa Rica) INETER (Nicaragua) Universidad de Panamá Universidad de Honduras	U P M	2007-2009
Desarrollo de Estudios Geológicos y Sismológicos en El Salvador Dirigidos a La Mitigación del Riesgo Sísmico	SNET (El Salvador)	AECI	2008-2010
Estudio de las deformaciones tectónicas actuales en el Sistema de Fallas del Valle Central mediante Técnicas Geodésicas y Paleosísmicas: contribución para la mejora de las evaluaciones de la peligrosidad sísmica	ICE (COSTA RICA) UNIVERSIDAD DE COSTA RICA	MINISTERIO DE CIENCIA Y TECNOLOGÍA DE COSTA RICA	2008-2010
Earthquake risk reduction in Guatemala, El Salvador and Nicaragua with regional cooperation to Honduras, Costa Rica and Panama (Proyecto RESIS II)	INSIVUMEH (Guatemala) SNET (El Salvador) ICE (Costa Rica) INETER (Nicaragua) Universidad de Panamá Universidad de Honduras	NORAD (Cooperación noruega)	2007-2010
Caracterización de Acciones Sísmicas y Evaluación del Peligro de Deslizamientos de Laderas.	SNET (El Salvador)	Ministerio de educación, Ciencia y Deporte (Plan Nacional de I+D+I)	2006-2009

EJEMPLOS DE PROYECTOS EJECUTADOS EN AMERICA LATINA

AMENAZA SISMICA

2007-2010

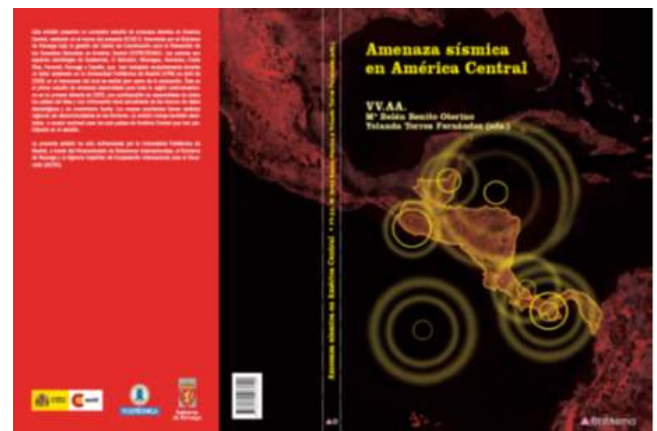
EARTHQUAKE RISK REDUCTION IN GUATEMALA, EL SALVADOR AND NICARAGUA WITH REGIONAL COOPERATION TO HONDURAS, COSTA RICA AND PANAMA (PROYECTO RESIS II).

PARTICIPANTES:

GEOLYDER-UPM
NORSAR (NORUEGA)

CONTRAPARTES:

INSIVUMEH (Guatemala)
SNET (El Salvador)
ICE (Costa Rica)
Universidad de Panamá
INETER (Nicaragua)
Universidad de COSTA RICA
Universidad de Honduras
Centro de Reducción de Desastres de América Central (CEPREDENAC)



RIESGO SÍSMICO

PROYECTO SISMO HAITI

2010-2014

Proyecto de cooperación para el cálculo de la amenaza y riesgo sísmico en Haití (SISMO-HAITI)

PARTICIPANTES:

Grupo GEOLYDER-UPM

Grupo de Tectónica Activa de la UCM

UNIVERSIDAD DE ALMERIA

SERVICIO SÍSMICO DE REPÚBLICA DOMINICANA

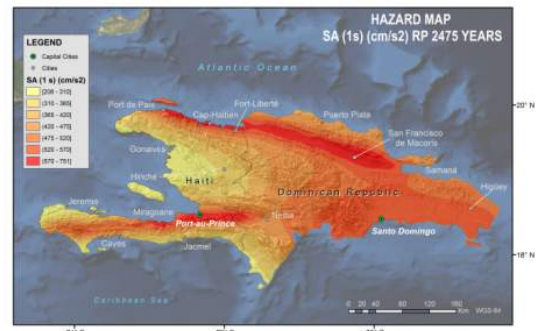
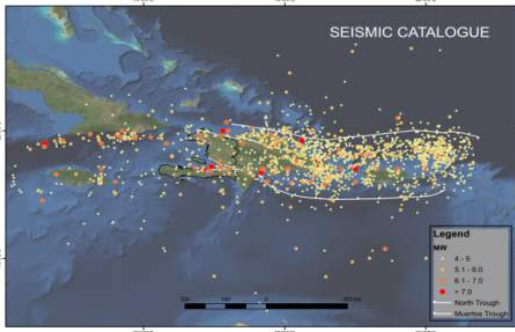
SERVICIO SÍSMICO DE PUERTO RICO

CONTRAPARTE

OBSERVATORIO NACIONAL DE MEDIO AMBIENTE Y VULNERABILIDAD DE HAITÍ (ONEV)

COMPONENTES DEL PROYECTO:

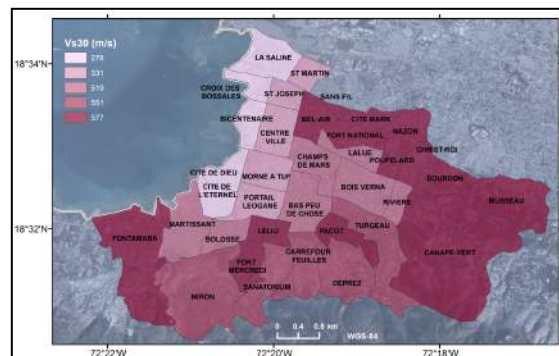
1. AMENAZA SÍSMICA



2. MICROZONATION

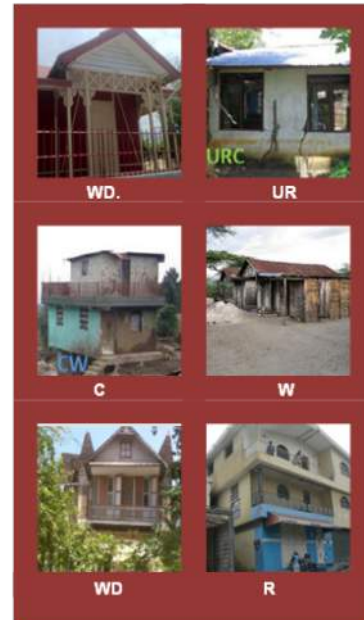
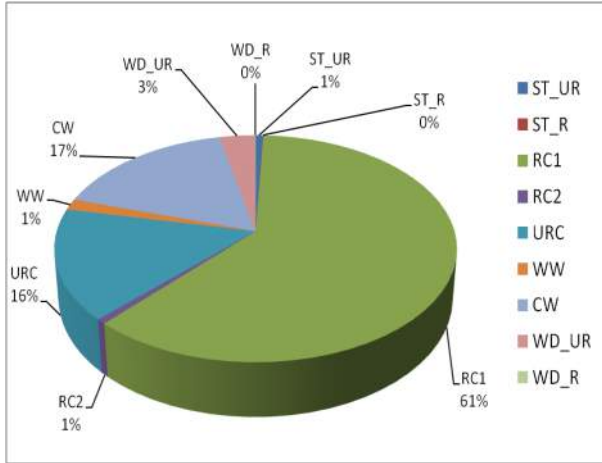


Mapa de Situación (Puntos de Medida HV)

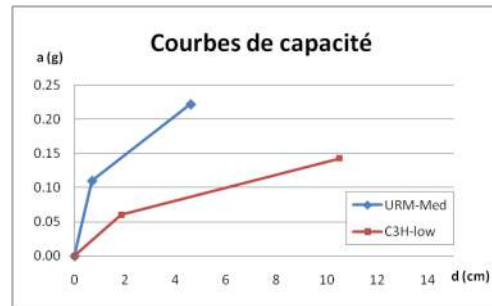


PROYECTO SISMO HAITI (CONTINUACIÓN)

3. DISTRIBUCION DE VULNERABILIDAD



4. RIESGO SISMICO Y DISTRIBUCION DE PERDIDAS



DIFUSION





POLITÉCNICA
"Engineering the future"

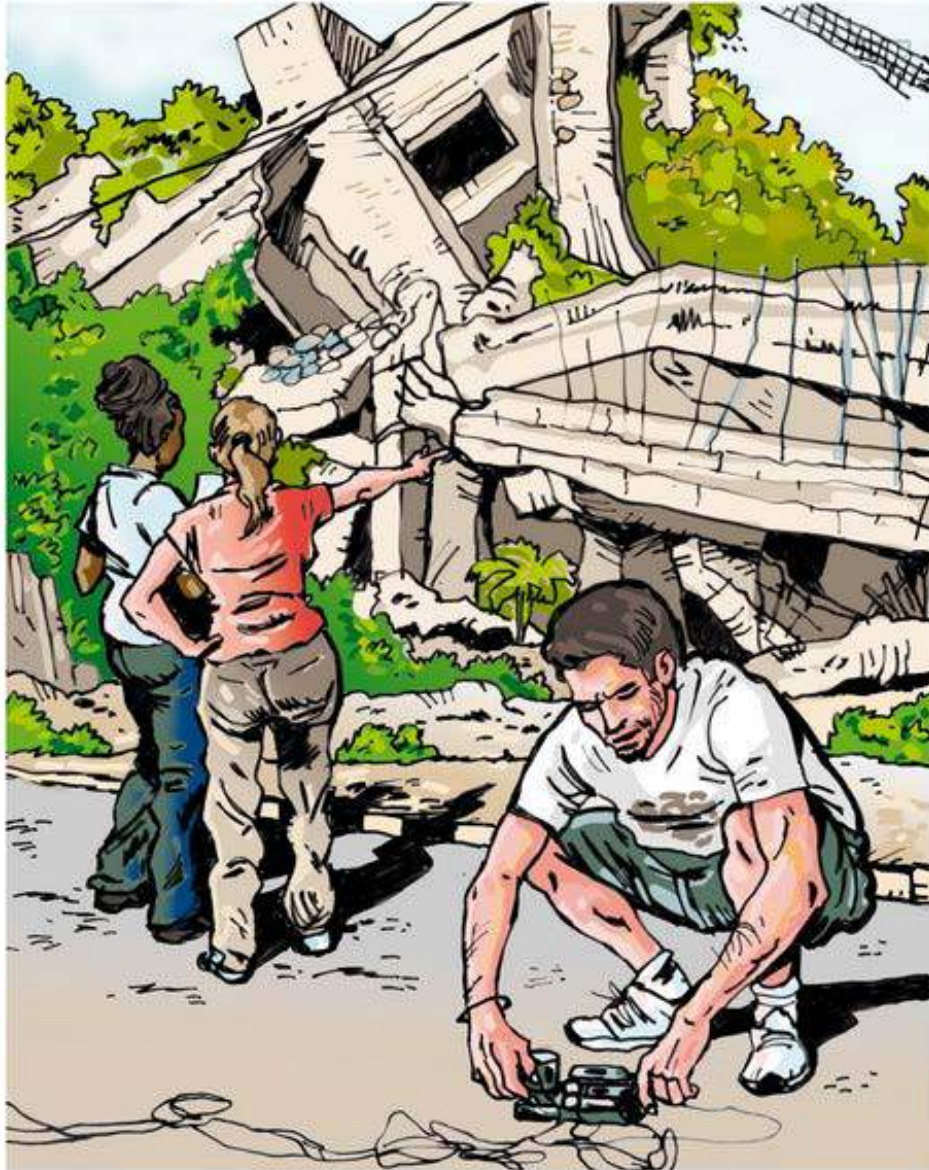
INTERNATIONAL
CAMPUS OF
EXCELLENCE

UPMCOMIC
THE HIGHER EDUCATION ADVENTURE

REAL UPM PROJECTS

2

February 2013



Haiti Earthquake Project

IN THE CARIBBEAN

SEISMIC ENGINEERING GROUP

School of Topographical, Geodesic and Cartographic Engineering
(Escuela Técnica Superior de Ingenieros en Topografía, Geodesia y Cartografía)

- Benito, B. C. Lindholm, E. Camacho, Á. Climent, G. Marroquín, E. Molina, W. Rojas, E. Talavera, J. J. Escobar, G. Alvarado, Y. Torres (2012): A New Evaluation of Seismic Hazard for the Central America Region. Bulletin of the Seismological Society of America, Vol. 102, No. 2, pp. 504–523
- M. B. Benito, C. Lindholm, E. Camacho, A. Climent, G. Marroquín, E. Molina, W. Rojas, J. Segura, E. Talavera, G.E. Alvarado. (2009). “New Seismic Hazard Assessment for Central America”. Bulletin of the Seismological Society of America, vol. 102. pp. 504-523.
- A. Climent, B. Benito, C. Lindholm, J. M. Gaspar-Escribano, D. Hernández and C. Guzmán. (2009). “Calibration of Strong-Motion Models for Central America Region”. Bulletin of the Seismological Society of America (BSSA).
- Rivas-Medina, A., Martínez-Cuevas, S., Quirós, LE., Gaspar-Escribano, J.M., Staller, A.(2014). Models for reproducing the damage scenario of the Lorca earthquake. Bulletin of Earthquake Engineering. DOI 10.1007/s 10518-014-9593-1
- Rivas-Medina, A., Gaspar-Escribano, J.M., Benito,B., Bernabé, M.A.(2013) The role of GIS in urban seismic risk studies: application to the city of Almeria (southern Spain). Natural Hazards and Earth System Science. Vol. 13, pp. 2717-2725.
- Rivas-Medina, A., Santoyo, M.A., Luzón, F., Benito, B., Gaspar-Escribano, J. M., García-Jerez, A. (2012). Seismic Hazard and Ground Motion Characterization at the Itoiz Dam (Northern Spain). Pure and Applied Geophysics. vol. 169, pp. 1519-1537.
- Benito, B., Rivas-Medina, A., Gaspar-Escribano, J. M., Murphy, P. (2012). El terremoto de Lorca (2011) en el contexto de la peligrosidad y el riesgo sísmico en Murcia. Física de la Tierra. vol. 24. pp. 255-287.
- Gaspar-Escribano, J. M., Iturrioz, T. (2011). Communicating earthquake risk: mapped parameters and cartographic representation. Natural Hazards and Earth System Science, vol. 11, pp. 359-366.
- Gaspar-Escribano, J. M., Navarro, M., Benito, B., García-Jerez, A., Vidal, F. (2010). From regional- to local-scale seismic hazard assessment: examples from Southern Spain. Bulletin of Earthquake Engineering. vol. 8, pp. 1547-1567.
- Benito, B., Navarro, M., Vidal, F., Gaspar-Escribano, J. M., Martínez Solares, J. M. (2010). A new seismic hazard assessment in the region of Andalusia (Southern Spain). Bulletin of Earthquake Engineering. vol. 8, pp. 739-766.
- Rivas-Medina, A., Gaspar-Escribano, J. M., Benito, B., García-Rodríguez, M. J. (2010). Evaluación del riesgo sísmico con técnicas de información geográfica. Aplicación en Navarra. Mapping. vol. 144. pp. 6-18.

- Alonso-Henar, J., W Montero, JJ Martínez-Díaz, JA Álvarez-Gómez, JM Insua, W. Rojas. (2013). The Aguacaliente Fault, source of the Cartago 1910 destructive earthquake (Costa Rica) *Terra Nova*,25-5: 368–373, DOI: 10.1111/ter.12045
- Canora, C., P. Villamor, J. J. Martínez-Díaz, K.R. Berryman, J. A. Álvarez-Gómez, R. Capote And W. Hernández (2012). Paleoseismic analysis of the San Vicente segment of the El Salvador Fault Zone, El Salvador, Central America. *Geológica Acta*,10(1):, p 1-20 doi: 101344/105.000001700.
- C. Aranda, F. Vidal, G. Alguacil, M. Navarro, J.F. Carvallo (2012). Damage analysis due to 2010 Chilean earthquake in Viña del Mar residential buildings. *Proceeding of the 15th World Conference on Earthquake Engineering*, Lisbon, Portugal, 2012. Paper No. 2008.
- S. Molina, Y. Torres, M. Navarro, B. Benito, J. Moise, E. Erduran (2012). Using 2010 Haiti Earthquake Data for Calibration of Future Seismic Risk Scenarios in Port-Au-Prince (Haiti). *European Seismological Commission, 33-rd General Assembly*, Moscow, Russian, 2012.
- Manuel Navarro, Takahisa Enomoto, Belén Benito, Dwinell Belizaire, Daniel Navarro, García-Jerez A., Haendel Dorfeuille (2013). Horizontal to vertical spectral ratio measurements in Port-au-Prince (Haiti) area damaged by the 2010 Haiti earthquake. *Meeting of the Americas. AGU. 14-17 May, Cancun, Mexico.*
- Yolanda Torres, Sergio Molina, Manuel Navarro, Belén Benito (2013). Use of damage data for calibration of GMPE's in Haiti. *Meeting of the Americas. AGU. 14-17 May, Cancun, Mexico.*

LIBROS Y CAPÍTULOS DE LIBRO

- ACTUALIZACIÓN DE MAPAS DE PELIGROSIDAD SÍSMICA DE ESPAÑA 2012.
Grupo de trabajo IGN-UPM
Páginas: 215; Año 2013; Lugar: Madrid; ISBN: 978-84-416-2685-0
- Benito, B. C. Lindholm, E. Camacho, Á. Climent, G. Marroquín, E. Molina, W. Rojas, E. Talavera, J. J. Escobar, G. Alvarado, Y. Torres y M. Pérez-Escalante (2010): *Amenaza sísmica en América Central*, Ed. Entimema. Madrid, enero 2010.