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PROJECT highlights

Galeras Volcano, Colombia

Reducing Vulnerability in South America

The Challenge: Reducing Vulnerability

Through the years, Chile, Colombia, Ecuador and Peru, have experienced disasters associated with earthquakes, volcanic activity, and other natural hazards. In Colombia the 2010 and 2011 rainy seasons (locally known as the "winter wave") combined with the climatic phenomenon of La Niña resulted in a significant increase in rainfall and large economic losses. On February 27, 2010, an 8.8 Mw earthquake struck central Chile generating a tsunami and leaving homes destroyed and scores dead. Ica, Peru also experienced loss of homes and lives from an 7.9 Mw, on August 15, 2007. Finally the activity of the Pichincha Volcano in Ecuador and the Galeras Volcano in Colombia continue to threaten nearby communities.

Natural hazards do not have to turn into destructive disasters. With an understanding of disaster risk and the integration of disaster risk management (DRM) into development planning, national and local governments are developing the capacities to face natural events and avoid unnecessary loss of life, property, and wealth. As part of these efforts, the Probabilistic Risk Assessment Initiative (CAPRA) first developed in Central America is now being implemented in South America.

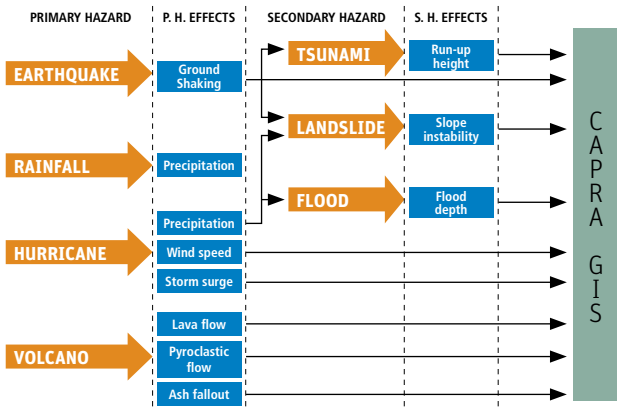
The Project: Innovation for a Multi-Hazard Approach

The first phase of CAPRA began in January, 2008 as a partnership of Centre for the Prevention of Natural Disasters in Central America (CEPREDENAC), the United Nations International Strategy for Disaster Reduction (UN-ISDR), the Inter-American Development Bank (IADB) and the World Bank, through its Latin America and Caribbean Disaster Risk Management team. The Global Facility for Disaster Reduction and Recovery (GFDRR), the Spanish Fund for Latin America and the Caribbean (SFLAC), the IADB, and the World Bank provided financial support for the Initiative. The engineering consulting consortium *Evaluación de Riesgos Naturales–América Latina* (ERN–AL) developed the CAPRA software and provided training services.

The CAPRA software suite is a free, modular, open-source, and multi-hazard tool for risk assessment. CAPRA provides a risk calculation platform (CAPRA-GIS) integrating exposure databases and physical vulnerability functions under a probabilistic approach. CAPRA evaluates risk in terms of physical damage and estimates direct economic and human losses. CAPRA uses a display platform geographical information system (GIS) to estimate the disaster risk of earthquakes, tsunamis, hurricanes, floods, landslides, and volcanoes.

CAPRA uses a multi-hazard risk approach allowing users to determine the risk accumulated from more than one hazard and analyzing several exposure portfolios of infrastructure. For example, a hurricane can be assessed in terms of precipitation, wind speed, and storm surge. The assessment continues through to an analysis of flooding. An earthquake is assessed in terms of shaking ground. Secondary hazards include tsunamis and landslides, whose effects include the run-up height (maximum height above sea level). (See Figure 1).

Figure 1. Multi-hazard Approach



During the second phase, the CAPRA Technical Assistance Projects (TAPs) are providing capacity building for national and regional governments, support for data collection, development of disaster risk management strategies, and is creating a community of users. Most importantly the TAPs are generating information for decision makers in policies related to disaster risk management. These activities require partnerships with public institutions, educational networks, universities and scientific associations.

The second phase is expanding the CAPRA Initiative into Colombia, Chile, Ecuador, Panama, and Peru. This *Project Highlights* describes progress in Colombia, Chile, and Peru.[1]

The Results

Chile: Territorial Regional Planning in Atacama Region

Implementation of the TAP in Chile is part of a process of transferring national responsibilities in land-use planning to the regional governments. Under the recently launched Regional Land-Use Plan (*Plan Regional de Ordenamiento Territorial,* PROT), the TAP process supports the incorporation of hazard and disaster risk assessment into territorial planning at the regional and city level.

> *"The TAP in Chile is also focused on the cities of Copiapó, Caldera, and Tierra Amarilla in Atacama Region, an area with a long history of earthquakes and tsunamis."*

The Division of Planning and Development of the Atacama regional government, with the collaboration of the Ministries of Public Works, Housing and Urbanism and the Sub-Secretariat of Planning and Regional Development, has taken over the leadership of the project. The University of Atacama's Geology Department is also a key player in this project.

The TAP's main objectives are to build technical capacity to generate, manage, and use information on hazards and risks and to strengthen the incorporation of seismic and tsunami risk reduction policies in territorial regional planning and urban management. The TAP is also focused on the cities of Copiapó, Caldera, and Tierra Amarilla in Atacama Region, an area with a long history of earthquakes and tsunamis. Before the TAP, very limited information about seismic and tsunami hazard had been developed.

The TAP began in September, 2011, with a CAPRA workshop on the use of seismic and tsunami software and needs assessment. The TAP should complete planned activities during the second semester of 2012. An assessment of seismic and tsunami risk and installed technical capacities will enable regional public entities, municipalities, and academia to analyze natural hazards on an ongoing basis. The TAP will (i) collect and analyze basic and detailed information on seismic and tsunami hazards, (ii) identify and build a database of selected portfolios of exposed elements in urban areas and develop specific vulnerability functions for government buildings and other essential infrastructure in the three cities, (iii) estimate probable human and economic losses at the regional and city level, and, finally, (iv) develop recommendations for incorporating disaster risk assessments results into the regional territorial planning. Finally, these activities will result in improved capacity for future analyses and ongoing expansion in the other regions of Chile.

Copiapó, Chile

1 An earlier ***Project Highlights*** described progress in Costa Rica, El Salvador, and Panama.

Colombia: Taming the Volcano and Assessing Earthquake Risk

Colombia has been a leader in disaster risk management in the Latin America and the Caribbean region. More than 25 active volcanoes, a number of exposed urban populations, and weaknesses in land-use management at the municipal level make volcanic risk management one of the critical policy areas for Colombia's sustainable development, in addition to seismic risk. Over the last 20 years Colombia has built high capacity for modeling disaster risk. Understanding and modeling volcanic risk remains a challenge for Colombia's Institute of Geology and Mining (*Instituto Colombiano de Geología y Minería,* INGEOMINAS).

Two TAPs in Colombia focused (i) on volcanic risk in Pasto and (ii) seismic risk in Pereira. The Pasto TAP focused on the Galeras Volcano related risk. Although it is not one of Colombia's most destructive volcanoes, Galeras is one of the country's most active. It is a hazard for the Nariño Department's capital, Pasto and neighboring towns—an area of around 888 square kilometers. Galeras began its most recent cycle of activity in 1987 and has lasted at least until 2010.

INGEOMINAS led the risk modeling process. Implementation began in March, 2011. The TAP's primary objectives were to use the probabilistic risk approach for the Galeras risk assessment (as a complement of the deterministic analysis conducted by INGEOMINAS) and to strengthen the capacity of INGEOMINAS to conduct vulnerability and risk evaluations. The hazard and risk assessment was related to falling ash (tiny jagged pieces of rock and glass), pyroclastic flows (high-density mixtures of hot, dry rock fragments and hot gases), and lava flows (streams of molten rock that pour or ooze from an erupting vent). The TAP also compared the deterministic (assessment of potential outcomes based on values assigned for discrete scenarios) and probabilistic (assessment of the likelihood of each scenario or outcome) risk assessment methodologies. Finally, the knowledge and experience gained will be shared with the Volcanic Risk Prevention Management Group (*Grupo de Gestión para la Prevención del Riesgo Volcánico*) of the Risk Management Office (*Dirección de Gestión de Riesgos,* DGR) for the Nevado del Huila and Machín volcanoes, both of which remain active.

The result of the Pasto TAP is improved vulnerability analysis on volcanic ash and pyroclastic flows. The 400,000 inhabitants of Pasto, La Florida, Consaca, Yacuanque, Tangua and other towns are benefitting from the strengthened institutional capacities to model volcanic risks and the ability to guide the definition of risk reduction measures.

> *"The goal is to increase regional capacity in risk modeling in order to support disaster risk management processes which inform development programs."*
>
> —Fernando Ramírez-Cortes, World Bank, Senior Disaster Risk Management Specialist and CAPRA Coordinator

The Pereira TAP began in January, 2011 and has organized three workshops focused on seismic risk, updating seismic micro-zonification, improving the information on more of 100 public buildings in education and health services, and improving the strategies to reduce risk in public buildings.

The next step is to continue the effort into other regions. As Julian Escallón, Civil Engineer of the Office for Risk Management, said, "We must seek to disseminate this knowledge to people who may at some future time be able to utilize the tools for risk management and decision-making, to calculate hazards and risks."

Peru: Seismic Risk Assessment for Schools and Hospitals

In Peru, two TAPs address different needs. The first TAP's objective is to develop seismic hazard information and maps at the national level and for the cities of Lima, Cuzco, and Arequipa. Under the second TAP, the seismic risk evaluation goes one step further and focuses on essential services and develops a probabilistic seismic risk assessment for schools and hospitals in the Lima Metropolitan Area. In addition, the TAP is providing training in probabilistic hazard and risk mode-

Pisco, Peru

Pereira, Colombia

ling using the CAPRA software suite, to students in the *Pontificia Universidad Católica del Perú*. The first TAP began implementation in November, 2010 and will be completed by June, 2012. The second TAP began implementation in September, 2011 and will be completed in the second semester of 2012.

The first TAP, developed by a team of researchers and engineers from the National Seismological Service of the Peruvian Geophysical Institute (*Instituto Geofísico del Perú,* IGP), was launched in November 2010 and has been collecting, generating and analyzing historical seismicity data, tectonic data, studying and testing different attenuation models to facilitate probabilistic seismic hazard evaluation. Two IGP researchers traveled to Mexico City to attend a workshop and a training session to learn from the Mexican experience. To update the process for the national building codes and standards, participants reviewed the final results and, in February, 2012, made a presentation to the National Committee for Building Codes and Norms.

The seismic hazard map and information produced by this TAP will serve as key inputs in the second TAP and will be integrated into the National Public Investment System (*Sistema Nacional de Inversión Pública,* SNIP) database. This is the first step in the plan to share the findings with the scientific community, the authorities, and the general public. This information will be essential in general urban development planning, design and construction of infrastructure, schools, and hospitals, among other public investments and private activity, as construction and mining. Finally, local engineers and researchers trained in the use of CAPRA will be able to use and update the maps and incorporate their finding in future analyses.

Conclusion: Reducing Risk with Knowledge

Probabilistic risk assessment contributes to a better understanding of risk and informs decision makers seeking solutions for problems in disaster risk reduction. As the eminent Peruvian astrophysicist, Ronald Woodman, has said, "We cannot reduce the hazard because … this is determined by Nature, but we can reduce vulnerability." To accomplish this requires institutional backing, technological know-how, and access to the appropriate data. As the cases of Atacama, Chile, Nariño, Colombia, and the three cities of Peru suggest, CAPRA is key to building vulnerability reduction programs by addressing the specific reality in each country and even in each city.

CAPRA provides valuable assistance in reducing vulnerability by addressing the challenge identified by Julian Escallón, of Colombia's Office of Disaster Risk Management of acquiring the necessary information. The ultimate goal is to develop the capacity to use the new knowledge to reduce vulnerability.

Finally, as Fernando Ramírez-Cortés, World Bank Senior Disaster Risk Management Specialist and CAPRA Coordinator, has said, the goal is to "increase regional capacity in risk modeling in order to support disaster risk management processes, which inform development programs."