Caribbean Urban Seismic Risk Forum

18-22 September 2016, Haiti

Workshop Report
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List of Acronyms

African, Caribbean and Pacific ACP
American Society of Civil Engineers ASCE
Association of Caribbean States ACS
Bureau de Recherches Géologiques et Minières BRGM
Caribbean Application Document (CAD) CAD
Caribbean Catastrophe Risk Insurance Facility CCRIF
Caribbean Development Bank CDB
Caribbean Disaster Emergency Management Agency CDEMA
Caribbean Regional Organization for Standards and Quality CROSQ
Caribbean Risk Information System CRIS
Centro Nacional de Investigaciones Sismológicas CENAIS
Cooperazione Internazionale COOPI
Council of Caribbean Engineering Organisations CCEO
Department for International Development DFID
Department of Foreign Affairs, Trade and Development DFATD
Directorate of Civil Protection DPC
Disaster Preparedness Programme of the European Commission's DIPECHO
Humanitarian Aid and Civil Protection department
Disaster Resistant Business DRB
Disaster Risk Reduction DRR
European Union EU
Humanitarian Aid and Civil Protection Department ECHO
Instituto Nacional de Estadística y Geografía INEGI
International Building Code (IBC)
International Search and Rescue Advisory Group (INSARAG)
Institute Physique du Globe de Paris (IPGP)
Isabela State University (ISU)
Japan International Cooperation Agency (JICA)
L'Alliance pour la Gestion des Risques et la Continuité des Activités (AGERCA)
Ministry of Public Works, Transport and Communications (MTPTC)
National Disaster Office (NDO)
National Science Foundation (NSF)
Non-governmental Organization (NGO)
Office of U.S. Foreign Disaster Assistance (OFDA)
Pan American Health Organization (PAHO)
Permanent Secretariat of Risk Management and Disasters (Haiti) (SPGRD)
Physical and Environmental Planning Sector Sub-Committee (PEPSSC)
Regional Technical Working Group (RTWG)
Seismic Research Centre (SRC)
Statistical Data Management Unit (SDMU) (SDMU)
United Nations Development Programme (UNDP)
United Nations Office for Disaster Risk Reduction (UNISDR)
United States Agency for International Development (USAID)
United States Geological Survey (USGS)
University of the West Indies (UWI)
World Bank (WB)
World Health Organization (WHO)
1. Executive Summary

Among the natural phenomena to which the Caribbean is susceptible, earthquakes rank among the highest in potential to cause the most destruction in one event. They are among the most difficult hazards for which effective loss reduction programmes can be established. Significant increases in the overall population numbers and a proliferation of costly infrastructure and housing in urban areas present significant challenges for reducing seismic risk in urban areas. In many instances the quality and siting of the infrastructure and housing contributes to vulnerability of people and infrastructure to seismic risk. Since the turn of the last century the Caribbean has witnessed high rates of urbanization, with eight countries including Jamaica, Trinidad and Tobago and The Bahamas having urban populations above two-thirds of the total population. Urbanization in the Caribbean reflects the influences of dependency, globalization, consumption, production, rural-urban migration, urban primacy and employment structure among other effects. Regardless of the causes, increased urbanization with the high population densities and public and private investments make urban areas a priority for disaster risk reduction (DRR) programmes. During the post-independence period neither adequate frameworks nor mechanisms were put in place to prescribe effective earthquake safety programmes. Most Caribbean territories therefore remain vulnerable to seismic risk because:

1. Preparedness levels are insufficient: deficiency in critical awareness of the dangers posed by earthquake hazards leading to paucity of drills, contingency planning and emergency exercises.
2. Scientific knowledge about the regional seismogenic sources need to be improved in order to refine the regional natural hazards maps
3. Poor risk governance
4. Building regulation framework is ineffective; consequently, building codes/standards are not enforced.
5. Natural hazards damage mitigation as part of the planning system is not effectively enforced.

The advancements and recommendations presented through previous seismic risk fora held in the region were highlighted during the Forum noting the shared emphasis on building codes and public awareness and education. These workshops were held in 2012 in the Dominican Republic with the objective of scientific and technical knowledge exchange as well as tools among disaster risk reduction partners; 2015 in Jamaica to present the results CDEMA-led Project that dealt with 1) enhanced readiness for earthquakes and tsunamis and 2) knowledge and awareness of resilience issues; and 2016 in Cuba where the focus was on exchanges on topics related to geologic risk and seismic and disaster engineering; Common among these initiatives is the focus on knowledge and experience sharing on earthquake risk and impacts. The challenge of risk-informed planning and construction

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1 World Bank Little Data Book 2000, UNCHS Human Settlement Indicators 2003
4 http://cienciastecnicas.eventos.uo.edu.cu/conferencia-sismos/
was highlighted along with the need for capacities to be built both formally and informally and increased awareness among decision-makers have also been highlighted.

The Forum focused on the follow three themes with the main objectives of presenting advances and good practices as well as experiences about seismic risk reduction in the Caribbean region; strengthening regional cooperation mechanisms related seismic risk reduction; and identifying of opportunities to advance in seismic risk prevention and reduction in the Caribbean:

1. Understanding Seismic Risk
2. Education and raising awareness for seismic risk reduction

During this three-day regional Forum, the following findings and recommendations were highlighted and also discussed as contributions to the development of the Regional Roadmap for Urban Seismic Risk Management (Annex 1).

**Achievements and challenges related to Urban Seismic Risk Reduction in the Caribbean: Highlighting regional achievements and challenges as well as initiatives and outcomes of previous regional Seismic Risk Reduction events in the Caribbean region**

<table>
<thead>
<tr>
<th>Key Points</th>
</tr>
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<tbody>
<tr>
<td>• Since 1994 ACS has led cooperation in the areas of the identification of risk, prevention and mitigation, risk transfer, preparation for response and recovery and reconstruction.</td>
</tr>
<tr>
<td>• The Physical and Environmental Planning Subsector Committee (PEPSSC) and the Regional Technical Working Group (RTWG) are developing a benchmark</td>
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<tr>
<td>• National DM Plans that include functional annexes to address response to seismic hazards</td>
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<tr>
<td>• Development and use of Seismic Risk maps, standards to guide use of seismic risk information in key sectors and development of risk profiles and standards to facilitate community risk assessment and profiles</td>
</tr>
<tr>
<td>• Well organized civil defence system in Cuba operationalizing disaster reduction plans at state agency, economic entities, province, municipal and community level; Multidisciplinary teams created to study risk, assess impact of vulnerability reduction actions in the mitigation of risks, and variations in magnitude of hazard associated with each event</td>
</tr>
<tr>
<td>• Haiti seismic risk roadmap prepared in 2013</td>
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<table>
<thead>
<tr>
<th>Recommendations</th>
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<tbody>
<tr>
<td>• There is a need to set up a regulatory framework to promote the application of the law</td>
</tr>
<tr>
<td>• Regional level building codes developed and shared</td>
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<tr>
<td>• Long term activities including risk integration need to be undertaken by all sectors and members of society</td>
</tr>
<tr>
<td>• There is a need for forging and strengthening partnerships &amp; governance mechanisms to advance advocacy efforts</td>
</tr>
<tr>
<td>• Combine efforts and resources to raise awareness among the many publics</td>
</tr>
<tr>
<td>• Promote opportunities to generate more research &amp; use of findings. Make these available via the CRIS</td>
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</tbody>
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For Cuba, there is a need for vulnerability assessments and capacity building; data collection for seismic resistant codes; and update of building codes.

- Mobilise of the sectors to integrate risk; the development and application of standards
- There is a need in Haiti for projects to undertake a rigorous risk analysis and provide solutions for mitigation; use of building standards; use of existing information on natural threats in land-use planning decisions and public policies; as well as knowledge acquisition on risk reduction.

### Risk transfer and business continuity

#### Key Points

- The 2010 Earthquake in Haiti allowed for changes in operations of Sogebank that included the development of a business continuity plan of activities (BCP)
- The role of human resources both pre-impact and during a crisis is just as important as the physical aspects of the business
- Disasters overwhelm the response capacity as produced in the quick bottleneck of all networks moment after the impact
- Small and medium size enterprises are vital to the prosperity of communities. Less than 40% of businesses have BCPs
- The Caribbean Catastrophe Risk Insurance Facility (CCRIF) products are designed to ensure liquidity at the moment where countries have the most need
- The pooling of insurance risk of catastrophes generates a lot of profits
- The Fund works with member countries to better plan the financial impact of disasters
- There are products and insurance services designed to allow customers to deal with a post disaster reality and the promotion of education on seismic risk

#### Recommendations

- Crises are best managed by managing vulnerability
- It is necessary to have business continuity plans; They can be flexible in order to respond to the evolution of a crisis situation
- Institutional culture should be fostered for risk and crisis management
- It would be useful to come up with a global plan for all businesses within a national plan that is regularly updated and tested
- Successes need to be shared to increase confidence in BCP
- Awareness and training are essential components of a BCP
- Governments must work to better plan disaster risk threats.
- It is important to manage the country's tax base to be able to ensure the prevention, intervention, and the transfer of risk
- The country needs a code of construction in line with international standards
- The actors concerned must resolve issues related to the culture of risk, prevention tools and the absence of information to the population
- The role of the Haitian State is vital in encouraging the development of the insurance market to protect the property and lives of the governed
- The private sector should get involved with research institutes to develop tools to identify exposed property

### Prioritized next steps from the Regional Roadmap
- Identify, assess, and prioritize critical infrastructure to facilitate risk sensitive planning.
- Work with the Association of Caribbean States (ACS) within the context of their cooperation initiatives with the Instituto Nacional de Estadística y Geografía (INEGI) of Mexico to complement the existing information platform to take it the required level of detail.
- Develop the Caribbean wide Disaster Resistant Business (DRB) Toolkit for Small and Medium Enterprises (SMEs) and Non-governmental Organizations (NGOs)/non-profits.

Seismic Risk Governance: Legislation, Policy and Institutional Arrangements

Key Points
- There is a growing trend of urban centres in the Caribbean and increasing vulnerabilities of residents/businesses in these spaces
- There is a regional mandate for disaster loss reduction promoted through the Comprehensive Disaster Management Strategy (Priority 1) and advanced through regional governance arrangement, particularly the Physical and Environmental Planning Sector Sub Committee
- More than 50% of CDEMA participating States and less than 50% have CDM Policies and CDM legislation respectively
- There is broad dissatisfaction with the current state of building codes and their enforcement in the Caribbean
- Risk governance is sectoral, centralized and fragmented, exclusively control-oriented, discriminatory against the informal sector

Recommendations
- Advocacy for re-integrating risk information into planning decisions and increase interface between science of risk and mitigation measures
- Strengthen and amend legislation in order to improve decision-making and for better integration across levels and sectors
- Invest in reducing risk
- More attention needs to be paid to educating the populace for better integration in development and planning
- Need for partnerships between the state and professional associations

Prioritized next steps from the Regional Roadmap
- Development of model legislation, regulation and policy to manage seismic risk and advocate for the adoption at the national level.
- Leverage the international financial and insurance institutions to incentivize national adoption of standards.
- Establishment of Chairs at credible universities within the region to coordinate geohazard/earthquake engineering research specific to the region.

Innovations and good practices: Land-use Planning and seismic-resistance building codes

Key Points
- The design and construction of earthquake-resistant works are not uniform in the Caribbean with the exception of the French Overseas Departments.
- There is a practical integration tool for the seismic risk in building codes and urban planning called the 'Methodological Guide for the Reduction of Natural Risk in Urban Areas'. The guide deals with i) characterization and mapping of hazards and issues, definition of zoning and land-use rules. (ii)
facilities, work and protection and mitigation; (iii) monitoring, alert, setting up of aid, organization of the backup; (iv) information, awareness and mobilization of the actors of the territory; and (v) design of modules and training tools

### Recommendations

- All actors involved in the construction sector should agree on standards and apply them across all projects from the design phase
- University training for engineering and architectural students that teaches fundamentals and rigorous testing
- Adoption of a modified French Antilles system for standards control
- Insurance industry should provide premium incentives for properties ‘certified’ to be well designed against seismic hazard
- Project lending and donor agency procedures that enable standards application
- More public awareness programmes for the general population

### Prioritized next steps from the Regional Roadmap

- Review planning legislation to incorporate Natural Hazard Impact Assessment (NHIA) as a consideration in the development approval process
- Adopt a modified French model of enforcement for building construction, considering it is a best practice of the region.
- Require all new investment projects (public and private) to be subject to the application of a seismic study including micro-zonation studies to be conducted for all existing critical infrastructure sites.

## Recovery Planning Frameworks & Reconstruction

### Key Points

- Prevention and response precede any discussion on recovery and reconstruction.
- Deconcentration and decentralization of the state is a tool to reduce the risk of disaster
- Reconstruction is strongly linked to the financial aspect, of which of the tools is risk transfer
- Social programmes need to integrate the risk variable for flexibility during a disaster

### Recommendations

- Response plans are needed prior to a hazard impact with trained personnel
- Laws for construction need to be immediately revised to correct errors and to facilitate development
- There needs to be assessments of critical infrastructure and for BCPs
- Need to develop a tool kit for NGOs in the Caribbean to intervene in disasters

### Prioritized next steps from the Regional Roadmap

- Build/establish SAR and specialized Emergency Response capacity including capacity for the conduct of quick assessment or building triaging in the aftermath of seismic events; Teams must be trained and adequately resourced.
- Promote rehabilitation and reconstruction in-keeping with existing standards and codes as well as promoting seismic retrofitting of existing vulnerable buildings.
- Establish information sharing platform for dissemination of accurate/reliable information post-seismic events.

## Understanding Seismic Risk

### Key Points
The Caribbean basin is one of the most active seismic regions of the world. It generates about 50 tremors of magnitude 5 per year.

The informal sector is a major group involved in construction in Haiti; professionals are not sufficiently involved in design and construction of structures.

There are many seismic vulnerabilities in the Grande Anse.

Key findings from the application of the methodological guide indicate that 1) the seismic threat in Haiti is constant, inexorable and non-negotiable, 2) exposure of the population and its vulnerability can be corrected, and 3) a wide range of technical solutions exist and can be applied without difficulty.

Beyond Grande Anse the assessment highlighted source information for North Grande Anse-Francs fault and the Peninsula of the South Island.

There is a new interpretation of the tectonic features associated with the Plain of the Dead indicating that in areas of dense population like Port-au-Prince seismic risk is greater than currently anticipated.

In 2001 one of the first maps of the seismic hazard was produced for Haiti but there were a lot of inconsistencies.

Microzoning is an effective forecasting tool as demonstrated in Haiti, that targets the most dangerous areas and allow for proper planning. It also allows for strategies for information and awareness of the population on the risks.

The 2010 earthquake prompted the development of a National Plan in the Dominican Republic that will address the production of knowledge, institutional capacity and decision-making for assessment and regulation of the construction sector among other disaster management functions at the national level.

In studies undertaken post-2010, there was a lack of common methodology, absence of common GIS, and lack of references and specific sources of data.

**Recommendations**

- The identification and characterization of active faults is essential to hazard assessment.
- The methodological guide needs to be broadly disseminated to increase knowledge of seismic risk that should then lead to reduced exposure and vulnerability of the population.
- A multidisciplinary approach must be applied.
- Monitoring is necessary along the Plain of the Dead because of the people and property exposed in crowded areas of the Metropolitan region.
- In order to improve the level of uncertainty, more GPS points are needed in relation to the study of the Plain of the Dead and scenarios need to be tested.
- Technical structures and trained local scientists are necessary.
- The new seismic zoning in Haiti must be promoted and applied by decision-makers at all levels.
- Buildings built prior to 2010 in Haiti need to be addressed and made to conform to standards.
- Reduction of vulnerability through the education of children.
- Systematise multi-hazard methodology in the urban context for development, planning and construction.
- Facilitate technical cooperation among the countries by creating a group of experts that can be mobilized for prevention and disaster management.
- Attention needs to be paid to the types of materials used for construction.

**Prioritized next steps from the Regional Roadmap**

- Evaluate status and availability of geologic maps for urban seismic risk.
- Update and maintain a Homogeneous Regional Seismic Catalogue (historical and instrumental).
Establish a standard mechanism/methodology for undertaking seismic risk and vulnerability assessments

## Education and Raising Awareness for Seismic Risk Reduction

### Key Points
- The National Vocational Training Institute, a public agency in Haiti, runs a network of 138 centres of vocational and technical training of workers (skilled and semi-skilled) and technicians, ensuring supervision of the informal sector; Training has been adapted to include new earthquake-resistant building techniques and cyclones.
- At least 700 construction professionals have been trained through ‘Introduction to earthquake engineering and security assessment aftershock of damaged structures’ at nine levels from May 2010 to May 2012 in Haiti.
- Industry certification at Masters level and earthquake engineering or certificate of Studies at the University of Buffalo have been established.
- Children belong to the most vulnerable groups, have a great capacity for learning and the transfer of knowledge, have an important role in the promotion of the culture of good behaviour in the face of the risk, and represent the future.
- The CDEMA earthquake awareness tool has helped to improve knowledge of the risk in priority sectors such as education, health, economy, housing, tourism and the development of the territory.
- The coastal population which is informed enough about the risk of a tsunami, a brochure, adapted to the reality of the villages and communities, has been published for their awareness in St. Vincent and the Grenadines. Since 2011, simulation exercises are held regularly to facilitate tsunami protocols.
- A comprehensive strategic framework for risk management in The British Virgin Islands implemented successfully a mass communication campaign, a continuing 10-year programme of courses for safer building practices, simulation sessions and involvement by disaster management in the review and approval of new facilities.

### Recommendations
- All stakeholders (engineers, architects, foremen, workers, materials dealers and municipal officers) should be trained in addition to be made aware of the seismic risk.
- Wide dissemination of information including home owners and prospective property owners.
- Incentivise the need for trained persons including women in the construction industry.
- At the regional level, the Interuniversity and transnational cooperation must be a reality to facilitate the understanding of the risk, training professionals and raise awareness.
- Education ministers of the Caribbean need to validate and adopt the regional roadmap on security in schools while ensuring its application.
- A regional assessment program of the schools for the entire region is required. Comparative and harmonized, this program must be operationalised in each country of the basin to be used as the basis for serious information by decision makers and funding agencies.
- Organisations responsible for sharing risk information need to provide truthful messages. The messages must not be speculative.
- Increase interventions in schools, because public education is able to change behaviour.

### Prioritized next steps from the Regional Roadmap
- Develop a multi-hazard, multi-pronged public awareness framework for the region, adaptable at the national level, under a regional coordination mechanism (CDMS).
The Caribbean Seismic Risk Forum was attended by more than 200 participants from National Disaster Management Agencies in the Region, national and regional technical seismic-focused institutions, the International Federation of Red Cross Societies, Non-Governmental Organizations as well as intergovernmental and United Nations organizations.

The Caribbean Urban Seismic Risk Forum was hosted by the Government of Haiti, jointly organized by the Ministry of Interior (the Civil Protection Direction, DPC), the Ministry of Public Works, the Ministry of Planning and External Cooperation (MPCE), the Directorate for Land Use Planning of the Ministry of Civil Engineering, the Interdepartmental Committee for Territorial Development (CIAT) and Building Unit for Public Housing and Buildings (UCLBP), the European Commission’s Directorate-General for Humanitarian Aid and Civil Protection (ECHO), the United Nations Office for Disaster Risk Reduction (UNISDR), the United Nations Development Program in Haiti (UNDP), Alliance for Risk Management and Business Continuity (AGERCA), Cooperazione Internazionale (COOPI) and the World Bank. The meeting was organized in close collaboration with the Caribbean Disaster Emergency Management Agency (CDEMA) as well as the Seismic Research Center (SRC) of the University of the West Indies.

The following countries and oversea territories were present: Anguilla, Dominican Republic, Haiti, Jamaica, Saint Lucia, Saint Vincent and the Grenadines, Cuba, British Virgin Islands, Grenada, Belize, Trinidad and Tobago, Puerto Rico, Ecuador, Montserrat,
2. Introduction

Seismic risk governance is of utmost importance in many developing countries of the Caribbean. Growth in population and investment in urban areas has correspondingly resulted in increased exposure and vulnerability of people and capital to risk including the seismic risk. It is the mandate of governments, international organizations, local authorities as well as the responsibility of each individual to reduce vulnerability. A wide range of solutions are provided through research and experiences such as proper land use planning, the establishment and use of building codes, public awareness campaigns and the establishment of mechanisms and procedures to increase resilience planning at all levels (public sector, private sector and individuals). The efficient implementation of prevention and mitigation strategies has proven effective in countries also subject to earthquakes (e.g. Peru, Chile, Ecuador, Japan, and California in the USA).

The Caribbean Urban Seismic Risk Forum provided a unique opportunity to gather experts, technicians, civil society representatives as well as local, national and international decision-makers to share knowledge, experiences and innovative tools in the field of knowledge, prevention, management and earthquake response; to capitalize on experiences at the regional level (problems encountered, good practices, learnt lessons etc.) regarding risk reduction; and to encourage exchanges and the development of improved cooperation between stakeholders on the regional scale. A key output of the Forum was the elaboration of a regional roadmap for seismic risk management in the Caribbean⁶.

The Forum was organized around the themes of 1) risk transfer and financing, 2) seismic risk governance, 3) understanding risk and 4) education and awareness raising for seismic risk reduction. The Forum facilitated

1. Sharing of advances and good practices as well as experiences about seismic risk reduction in the Caribbean region;
2. Strengthening regional cooperation mechanisms related seismic risk reduction;
3. Identification of opportunities to advance in seismic risk prevention and reduction in the Caribbean.

More than 200 participants⁷ from National Disaster Management Agencies in the Region, national and regional technical seismic-focused institutions, the International Federation of Red Cross Societies, Non-Governmental Organizations as well as intergovernmental and United Nations organizations were involved in the Forum. The workshop outcomes were achieved through presentations and panel discussions across the themes of the Forum as well as working group sessions towards the completion of the Regional Roadmap for Urban Seismic Risk Management in the Caribbean.

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⁷ The following countries and oversea territories were present: Anguilla, Barbados, Dominican Republic, Haiti, Jamaica, Saint Lucia, Saint Vincent and the Grenadines
The methodology of the workshop included panel discussions inclusive of key note presentations to provide context for the sessions. Presentations from panelists were followed by plenary discussions. On each day of the Forum, all regional representatives along with key Haitian partners were engaged in working groups to further elaborate the Regional Roadmap for Urban Seismic Risk Management in the Caribbean.

The concept note and presentations can be found on the [workshop website](#).
3. Achievements of the Workshop

This section will provide information on the workshop sessions and the results of the working groups to produce the Regional Roadmap for Urban Seismic Risk Management in the Caribbean.

Urban Seismic Risk Reduction in the Caribbean: Progress, achievements and challenges

This session sought to provide context for the Forum including successes and challenges on urban risk reduction. Presenters provided brief overviews of previous initiatives that took place in the region since 2012 highlighting the key areas of focus and synergies that the Forum should build on going forward.

Synopsis of the future for cities of the Caribbean seismic risk
Lloyd Lynch, Seismic Research Centre, Trinidad and Tobago

Based in Trinidad, the seismic Center Research (SRC) of the University of the West Indies (UWI) is an agency in charge of monitoring earthquakes and volcanoes in the English-speaking islands of the Eastern Caribbean. The Agency monitors and examines the threats in the region, and provides advice and information for emergency response, public safety and mitigation of losses. The Center uses the historicity of the seismicity in the Caribbean to be able to make projections of potential impact and better prepare for the future through mitigation measures.

The vulnerability of the Caribbean is mainly due to the high concentration of people in urban centres and also on the amount of property exposed on the coasts. The earthquake that struck Haiti in January 2010 was of such a magnitude compared to other similar events produced in the region since the 16th century that it broke all records. The earthquake caused 200 thousand deaths and 12 billion dollars in loss. As the first danger of an earthquake is the shaking of the ground, the buildings in the affected areas in Haiti and particularly in urban centres could not resist shaking and collapsed. This disaster is largely caused by the lack of building codes and standardised construction standards.

Although seismic monitoring has been established for Haiti, it has been proven that the adoption of the codes and their application are saving lives. The lack of use of the codes is a major problem in Haiti. It is necessary to set up a regulatory framework to promote the application of the law. At the regional level, countries must work harder to achieve more efficient building systems and share best practices.

Role of the Association of Caribbean States in coordination and cooperation to enhance the urban seismic risk reduction in the Caribbean
Arturo Lopez-Portillo Contreras, Association of Caribbean States

The Association of Caribbean States provides coordination and cooperation in the greater Caribbean for the reduction of the seismic risk. The organisation is composed of 25 Member States and 24 other countries are observer Members. Since July 1994, the date of the agreement of Cartagena in Colombia, the ACS has developed a unique expertise in the region to identify risk, map threats and vulnerability, evaluate risk, implement disaster scenarios and to collect basic socio-economic and environmental data.
The work of ACS translates into actions and key messages available through the components of 1) identification of risk, 2) prevention and mitigation, 3) transfer of risk, 4) preparation of the response in the event of hazard impacts.

On the basis of conclusive results validated by the members and partners of the ACS, it was recommended that participants consider the reduction of the risk of seismic disaster as a set of activities to develop in the long term. For this, all sectors and all members of society must be involved. At the same time, the countries concerned have no interest to withhold information since the promotion of technical cooperation in the greater Caribbean depends on information-sharing. This regional cooperation will allow countries to:

1. Take into account the information and lessons learned from the reconstruction and their challenges and their social consequences
2. Develop regional long-term projects
3. Optimize funding (add to projects)
4. Involve the right stakeholders in the process
5. Adequately manage and produce results
6. Plan and implement DRM component
7. Consider the different threats
8. Ensure sustainability and resilience

**Achievements & challenges related to Urban Seismic Risk Reduction within the CDM Framework**  
Ronald Jackson, CDEMA

The Caribbean Disaster Emergency Management Agency (CDEMA) is a regional inter-governmental organisation in the Caribbean which has the mandate to ensure the integrated management of all types of disasters in the region from the reduction of the vulnerability to reconstruction in the event of catastrophic impacts. In relation to the urban seismic risk, the urban population of the region has had an unprecedented increase as major cities. A high percentage of urban activities are either informal or very few are planned. People and property are exposed to threats, particularly those related to climate change.

Mr. Jackson highlighted the trends in urbanisation in the region, key areas of concern impacting on sustainable development along with achievements made related to seismic risk management against the CDM Framework. He expressed a need for forging or strengthening partnerships and governance mechanisms to advance advocacy efforts; combining efforts and resources to raise awareness among the many publics; and promoting opportunities to generate more research and use of findings requiring the availability of the Caribbean Risk Information System (CRIS).

**Reduce risk through the management of the causes and effects in Cuba**  
Grisela Morejón Blanco, CENAIS, Cuba

Cuba has a well-organized civil defense system in the Directive # 1, of the President of the National Defense Council for Disasters (2010) that is aimed at the realization of plans to reduce disasters for state agencies,
economic entities, provinces, municipalities and areas of defense (communities). These plans ensure the organization of the preparatory actions for the response and disaster recovery. Annually the councils of provincial and municipal administration, through multidisciplinary teams created in these instances to study risk, assess the impact of vulnerability reduction actions on mitigation, as well as variations in the magnitude of the hazard associated with each event.

It has been recommended that vulnerability assessments and capacity-building should be undertaken along with data collection and the update of the construction codes.

**Understand the risk UR Haiti 2014**
Yolene Surena, World Bank

In 2014 the Forum to understand the risk, introduce technological innovations to experts and the general public, promote best practices to natural threats, to develop initiatives and to encourage new initiatives was held at Port -au-Prince, Haiti. The forum was able to offer rapid methodological tools, more efficient and less doubtful for the risks on the one hand and on the other to help policymakers and communities to better understand and manage the risks that they face. The three main themes have guided the content of interventions and discussions were 1) understanding of risk: collection and analysis of data, through the transmission of knowledge in the Haitian cultural context; 2) integration of the risk in the development of the country with a special interest for: the planning, building and the resilience of vulnerable communities and 3) the implementation of an institutional and financial environment conducive to consideration of risk.

Ten key messages from the 2014 Forum in Haiti were outlined in the presentation related to institutional arrangements, sectoral approaches and sharing of data and information among others.

**Roadmap for the reduction of the seismic risk in Haiti**
Betonus Pierre, Scientific Coordination for Seismic Risk Reduction

The road map for the reduction of the seismic risk in Haiti was prepared in 2013 by an national and international expert Advisory Committee under the auspices of the Permanent Secretariat of Management of Risk and Disaster (SPGRD) with aim to provide a set of concrete multisectoral activities: i) a securing the population and economic heritage. (ii) establishment of a body for coordination of these activities so that they can be integrated optimally in the management of earthquake risk in Haiti.

Since the seismic threat in Haiti is steady and inexorable and vulnerability is extreme especially in urban areas, to protect lives and property it will be necessary to: i) submit projects to a rigorous risk analysis and operating solutions of mitigation; (ii) require the use of construction standards; (iii) use the existing information on the natural threats to land-use planning decisions; (iv) include reduction of the seismic risk in public policies; and (v) develop knowledge on risk reduction.

It is true that in Haiti a multitude of institutions are involved. Beyond the need to get a platform to coordinate, pooling national efforts, and also building connections to work in synergy at the regional level are required.
**Risk transfer and business continuity**

This session brought attention to the importance of the business continuity plans of operations and of the risk transfer through open dialogue between regional and national institutions in order to share their experiences regarding continuity of operations and the transfer of risk, lack of it and the benefits of planning and anticipation of potential disasters. Lessons learned and good practices from other countries will encourage the countries of the Caribbean to develop a culture of DRR in daily activities, such as the business continuity plans (BCP) and risk transfer strategies will increase their resilience and their ability to prevent potential disruptions, loss of lives and properties.

The focus on business continuity was presented in a panel discussion format. The key discussion points advanced are highlighted in the figure below.

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**Edwin Felix, Executive Director for Organisation & Methods at Sogebank**

Sogebank, a Haitian financial institution hired an expert to develop a Business Continuity Plan (BCP) of activities in the wake of the 2010 earthquake. Actions taken included: (i) crisis management procedures have been established; (ii) the process of products and services to customer service have been freelisted; (iii) a plan of relay operational branches was established and reviewed periodically since. (iv) testing of the BCP are undertaken twice a year; (v) the structure of crisis communication has been strengthened; and (vi) the Group synergy has been strengthened to allow better institutional responsiveness.

The Sogebank is convinced that a crisis best managed is to control vulnerability. It is essential to have a plan of action determined in advance even if it should be applied with flexibility to respond to the evolution of the situation. It is inconceivable or impossible to begin to organize at the time of the outbreak of a crisis. It is vital to ensure a culture of management of risk and crisis management in the institution prior to impact.

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**Gérard Laborde, Judicial and Legal, Digicel**

Disasters can overwhelm the response capacity of any company or State. The company has learned lessons from the disaster because it had under-estimated the seismic risk that produced a quick bottleneck of all networks moments after the impact. Employees who demonstrated extraordinary qualities during the crisis were able to restore the system while the company optimised its crisis management plan quickly.

It would be better and more useful to come up with a global plan for all businesses within a national plan that is updated regularly. Also, it is essential that this plan is regularly simulated to ensure good practices in the event of impact.
The second panel dealt with risk transfer. This session sought to highlight the progress made at the national and at regional level in terms of risk transfer particularly in regards to seismic risk. The presenters will discussed their experiences post-earthquake and identified enabling and constraining elements to insurance and re-insurance and possible next steps in achieving greater resilience in the private sector and in the region. The key points emanating from the discussion are recorded below.

**Increase availability through parametric insurance: the success of the Caribbean Catastrophe Risk Insurance Facility (CCRIF)**

Dario Luna, CCRIF

The Caribbean Catastrophe Risk Insurance Facility is a fund regional Caribbean of insurance that works with a parametric insurance mechanism providing liquidity to member countries whenever a policy is enabled, to allow fast recovery from a destructive disaster. The Republic of Haiti is covered at height of 20.7 million dollars for
earthquakes, 35.6 million dollars for tropical storms and 17.5 million dollars for exceptional rainfall. 14 days after
the earthquake in Haiti on January 12, 2010, the CCRIF paid 7.7 million of dollars to the Haiti Government. To
better serve its members, the Fund is constantly growing with the support of international cooperation.

Governments must work to better plan disaster risk threats. At the national level the most common instruments
are insurance, contingency and reserve funds allocated to disasters. It is important to manage the country's tax
base to be able to ensure the prevention, intervention, and the transfer of risk. Ex-post, in case of impact,
instruments can be operated without any form of planning. This is budget reallocation of domestic credits, of
external credits, increase taxes, and humanitarian assistance.

In the industry after the 2010 Earthquake
Paola Romain, Soge Insurance

Soge Insurance specializes in the creation and sale of insurance services and special financial compensation for
losses and damage of the insured property. While Soge Insurance did not experience the catastrophic earthquake
of January 12, 2010, the Sogebank Group well abreast of the post-earthquake evaluation, has understood that it
was its responsibility to provide a suitable response. This response is translated into products and insurance
services designed to allow customers to deal with a post disaster reality.

The company is aware of the lack of information among Haitians on the seismic phenomena with the absence of
a culture of risk management. Soge Insurance is therefore involved in the promotion of the education of the risk,
mainly seismic risk. It is clear that the country needs a code of construction in line with international standards.
At the same time, the actors concerned must resolve issues related to the culture of risk, prevention tools and
the absence of information to the population.

Mapping, a revolutionary tool for risk management
Emile Pantaléon, Alternative Insurance Company

AIC was able to assess the effectiveness of its actions after the January 2010 earthquake. It is true that the lack
of information about the real seismicity of the country has failed to limit the huge losses suffered by the
population. Devoid of anticipation tools insurance companies were also victims of this pervasive lack of planning.
Always ready to adapt to the change, the AIC has been able, after this experience, to utilise the various
technological tools as well as research and publications on the seismicity of the country to adjust its calculations,
its methods of selection and evaluation of seismic risk coverage. The zoning now allows the company to perform
a custom risk pricing; carry out reporting and mapping of risk; evaluate the exact need for reinsurance coverage
to be able to transfer the risks.
Broken experience of innovation and convinced of the need for a targeted pricing of customers taking into
account geographic data for determining the overall risk, the AIC recommended i) systematically mapping the
soils of all departments of the country; ii) to use satellite images to locate risk and register their spatial geo
coordinates; and iii) apply these data in the processing of claims on a large scale.

The greatest post-earthquakes for ALSA
Harold Cadet, ALSA

ALSA is a national company with a capital of 250,000,000 of gourds. After the earthquake, the insurance company
has understood the practice to ensure real estate is very little widespread in Haiti.
The insurance company has learned many lessons from the disaster following the 2010 earthquake because neither customers nor the insurance company was really prepared. The multiple lessons are especially techniques and they have helped the company of: i) closer to its policyholders. (ii) to revise the amounts insured; (iii) to obtain the engineering reports; and training of clients.

ALSA, strong on the fact that residential insurance is not used as an instrument for disaster preparedness, recommends a policy of promotion of residential insurance with the Haitian population. If the country wants to pursue its development objectives, the culture of insurance becomes therefore a prerequisite.

The role of the Haitian State is vital. **It should encourage the development of the insurance market to protect the property and lives of the governed.** This program must seep into the school curricula because we need to build the reduction of the vulnerability with children who are the citizens of tomorrow. In addition, **the private sector should get involved with research institutes to develop tools such as mapping that can identify exposed property.**

### Seismic Risk Governance

This session was carried out as a panel discussion providing an overview of the regional and national provisions for seismic risk reduction in urban areas from regional and national perspectives. The focus of the session was on the institutions and their roles in relation to themes identified in the subsection. A key note presentation was made by Mr. Ronald Jackson of CDEMA.

**The Enabling Environment for Urban Seismic Risk Management in the Caribbean**

Ronald Jackson, [CDEMA](https://www.cdema.org)

The trends in urbanization in the Caribbean and the increased exposure of lives and property to seismic risk present a daunting task for countries and regional organisations in risk management. CDEMA’s contribution to reducing risk is anchored in its establishing agreement at Article V that speaks to disaster loss reduction as well as in the Comprehensive Disaster Management (CDM) Strategy and Framework in Priority 1 that focuses on strengthening institutional arrangements and the development of policies, strategies and legislation in support of Article V. There is also a regional governance arrangement that allows for coordination on issues relevant to urban seismic risk management through the Physical and Environmental Planning Sector Sub Committee.

It was noted that there is slow movement on the areas of CDM policy, legislation and institutional arrangements and greater attention is required. It was highlighted that urban management is entrenched in colonial laws and regulations, there is a need for advocacy, greater commitment and an integrated approach to seismic risk management in the Caribbean.

**The Governance We Have vs. the Governance We Need**

Carolyn Trench-Sandiford

The governance of the seismic risk is equivalent to an integrated decision-making framework and its components as essential data, risk maps and models. Risk governance in the Caribbean may be described as sectoral, centralized and fragmented; interested exclusively in command and control; moderate compared to the environment; and discriminating against the informal sector while increasing poverty.
In order to improve the governance of seismic risk in the region, there needs to be (i) the building of resilience through people, families and the autonomous communities; (ii) a decision-making framework that is integrated at all levels of governance and in all sectors; (iii) an emphasis on attack and defence; (iv) reduction of the seismic risk while also taking into account the development challenges; (v) partnerships between the State and professional associations; and (vi) the integration of questions are related in a road map. In addition, planners should give much more importance to education to better integrate population in development and planning.

The Earthquake Unit in Jamaica and Urban Seismic Risk Reduction
Simon Mitchell, UWI, Jamaica

The Earthquake Unit (EQU) is charged with undertaking all seismic research in Jamaica and works with ODPEM in Jamaica and the SRC in Trinidad. The EQU runs two networks that provide real-time data through radio transmissions - The Jamaican Seismic Network which has 12 stations (4 broadband digital seismometers and 8 analogue seismometers) across the island and the Jamaica Strong Motion Network (17 Accelerometers). One of the most problematic features of the network is this real-time collection of data, because the aerials for the radios are struck by lightning. The EQU has also undertaken micro-zonation/micro-tremor studies. Working with the SRC, Trinidad, and the Disaster Risk Reduction Centre, Jamaica, and ODPEM, Jamaica, micro-zonation studies have been undertaken for the Kingston Metropolitan Area and Linstead in St Catherine.

A significant problem in developing the Strong Motion Network is the general lack of buy in from the public and private sector. The development of new 5- and 6-story buildings on the UWI Campus has not seen the installation of a single accelerometer, despite the known existence of significant site-effects due to very thick deposits of alluvium. Perhaps an incentive from the insurance industry would be one way of generating more interest.

The Building Code in Jamaica is being pressed for by the International Monetary Fund (IMF) loan agreement with Jamaica and has been slated as an important piece of legislation that must be passed. Even once it is passed it not certain m not sure there is political will to update the code based on micro-zonation studies, until there is a significant local seismic event.

Legal and institutional framework for seismic risk reduction in Haiti
Jean-Michel Sabbat

Innovation and good practices
Experience sharing in which innovations and good practices towards increasing urban seismic risk reduction pre- and post-impact (recovery and rehabilitation) were highlighted in this session. Panelists highlighted the pros and cons associated with their practice and recommended how these can be replicated in other areas.
The Status of Earthquake-resistant Design and Construction Practices in the Caribbean with Recommendations for Improvements
Tony Gibbs, Council for Caribbean Emergency Organization

With the exception of the French Antilles where there are standards control, earthquake resistant design and construction in the Caribbean is erratic. There is little uniformity within each country between design and construction companies; between engineers and architects and the treatment of different projects by the same designer. Reasons for the lack of uniformity include lack of sufficient knowledge of earthquake-resistant design and construction and lack of effective enforcement of standards by government agencies.

Among the current needs in the Caribbean are structure approaches to post-graduate training of professionals leading to more rigorous testing; the adoption of a modified French Antilles system for standards control; the insurance industry to provide premium incentives for properties certified to be well designed against the earthquake hazard; and demonstrated and practical actions by project lending and donor agencies to require safer projects, following the exemplary, multi-decadal lead of the Pan American Health Organisation (PAHO).

Practical tool for seismic risk integration into building codes and urban land-use planning
Jean Max Gabriel, MPCE & Samira Philip, UNDP Haiti

With the support of the United Nations program for development (UNDP), the Ministry of planning and external Cooperation (MPCE) has designed and elaborated a comprehensive management tool for prevention of natural risks with the objective to ensure the safety of people, property and sustainability of reconstruction investments in anticipating natural phenomena. Presented in the form of a methodological guide, divided into five sections, the guide suggests from A to Z, the process of taking into account the natural risk in urbanization, through a series of steps: prevention, protection, emergency planning, training, information and communication. This guide is intended for technicians, politicians (administrations and local authorities: municipalities, sections, etc.), developers, NGOs, public operators or private users of land in Haiti.

The tool is a solutions guide for: i) characterization and mapping of hazards and issues, definition of zoning and land-use rules. (ii) facilities, work and protection and mitigation; (iii) monitoring, alert, setting up of aid, organization of the backup; (iv) information, awareness and mobilization of the actors of the territory; and (v) design of modules and training tools

The Ministry of Planning and External Cooperation (MPCE) has already incorporated the notion of risk in its Strategic Plan of the development of Haiti (PSDH). This should be followed by all the institutions. This methodological guide, used properly, can be a major tool for the development of the territory. The guides needs to be widely disseminated and should be offered as a model for the Caribbean region.
Earthquake of 16A (Ecuador) "From mandate to action"
Ricardo Peñaherrera, Information Management and Risk Analysis, Ecuador

On April 16, 2016, Ecuador was struck by an earthquake of 7.8 magnitude on the Northwest Coast, 170 kilometres from the capital Quito. This was the biggest event of this kind since nearly thirty years. The losses in human lives and material damage were considerable. The law in Ecuador obliges institutions to coordinate their actions to prevent and mitigate risk. Organisation for the management of disasters is clearly defined.

Immediate and effective response of Ecuador after the earthquake, focused on recovery and reconstruction allowed Ecuador to conduct evidence-based experiments that deserve to be shared. Financing for recovery and reconstruction is through a contingency facility, states of emergency and exception, mandatory taxes and contributions, loans as well as donations and international assistance. Complementary actions for preparedness however are Tsunami Early Warning System, capacity building and strengthening, updating of emergency and/or contingency plans and promotion of the creation of the Risk Management Law.

The Government and people of Ecuador are convinced that recovery is possible with good prevention and response plans prepared in advance. There is a need for deconcentration and decentralization of the state to reduce risk and financial instruments need to be in place of one of these tools. Social programmes need to be designed to include the risk variable so that they are flexible in case of disasters. It was reiterated that preparedness is part of the risk management process.

Understanding Seismic Risk

National, international and regional technicians and experts in the field of seismic risk with experiences and tools provided risk knowledge, management and prevention information and achievements regarding risk prevention and knowledge in the region. The two key aspects were 1) understanding seismic risk: technological advances and innovations regarding seismic risk knowledge through concrete and innovating examples of applications in the Caribbean area, and 2) seismic risk reduction: developed or adapted appropriate tools and mechanisms for the integration of Disaster Risk Reduction in urban and land use planning as well as awareness raising.

Outlining of seismic fault in Grand-Anse: neotectonic inputs for enhancing of seismic threat knowledge in the region
Samira Philip, UNDP-Haïti

This study has allowed for the characterisation of the seismic sources of the Department of Grand Anse. The "North Grande Anse-Nippe" fault and the fault of the peninsula of the South Island, after assessment have led to preliminary conclusions: i) the current strain in the Grand Anse Department is diffused; (ii) it is expressed by very segmented local vulnerabilities; (iii) active faults are relatively young and in the course of evolution. (iv) active faults have low rates of deformation; and (v) the mechanism of deformation of a large part of these active faults is reversed stalling.

Identification and characterization of active faults, is an essential step in seismic hazard assessment. The dissemination of the methodological guide, which brings knowledge necessary for understanding of the seismic
hazard, should result in reduced exposure and vulnerability of the population. The whole country must be carefully analysed using a multidisciplinary approach.

**Active Distortion in the Cul-de-Sac Plain, Southern Haiti**
Steeve Symithe, Collaborator, BME/UEH

The National Laboratory for buildings and construction (LNBTP) beyond the mandate of the quality control of infrastructure construction carries out geotechnical studies for risk assessment. The National Center for Information Management (CNIGS), on the other hand, produces and distributes geospatial data with technical and methodological precision tools.

The active fault along the Cul de Sac Plain is a major tectonic feature in the South of the country. This fault presents a ‘set of active overlap, North-West-South-East orientation and dipping South that were mapped in the Bay of Port-au-Prince and the Cul-de-Sac Plain where the city of Port-au-Prince’ is located. One of them, the overlap of Lamentin, runs through the densely populated city of Carrefour then extends offshore to the West, in the Bay, where it controls the morphology of the fringing reef. To the East, the overlap of Lamentin connects to the large fault picking up (sinistral) of Enriquillo-Plantain Garden” [1]

This resulted in a new interpretation of the tectonic features of the area. It becomes obvious that the seismic risk, in areas with dense population like Port-au-Prince, is larger than expected. In case of a new impact prediction of peak intensity is twice that of 2010 and the impact on the sector of construction will lead to huge economic losses.

Noting the conclusions from the study, there is a need for more GPS sites in the study area given the people and property exposed in crowded areas of the metropolitan region. There is also a need to improve the uncertainties associated with the results and to test more models with more complex geometries. There is also a need for developing new seismic hazard maps for the area.

**Seismo-tectonic in Southern Haiti: A new fault model for the 12th of January 2010’s**
Newdeskarl Saint Fleur, Seismic expert, BME/UEH: [AC2]

An overview of the dynamics related to the January 12, 2010 was provided in the presentation. It was determined that the fold and thrust mapping in the Cul-de-Sac – Enriquillo Trough should be revisited.

**Scientific progress improves seismic-threat knowledge : Inputs of GPS measures**
Eric Calais, ENS-PARIS

Historically, the seismicity of Haiti has never factored into the occupation of the territory. Inadequate scientific knowledge was not "in context" to allow the scientist to commit beyond the science. Some scientific information existed certainly, but very difficult to hear because it lacked available, particularly local seismologists. As the mechanism for dialogue between science and politics never existed the institutionalization of seismic risk reduction, where scientific knowledge has its place, has not been considered.
To reduce the risk, it is essential to understand the physical origin of the phenomena of the natural environment and to calculate the severity of extreme events. Scientific products evolve and their appropriate use requires the presence of scientists. Seismic risk reduction must be a partnership between scientists, institutions responsible for public policies and citizens. To achieve seismic risk reduction in a sustainable and structured way: i) technical structures and local scientists should be strengthened; (ii) observation system known to be implemented and maintained over the life; (iii) knowledge of the threat is changing; and new generations of geological risk specialists need to be trained.

Evaluation and mapping of seismic risk and operationalization of understanding risk
The focus of this session was on the sharing of mechanisms and tools to allow for better knowledge of seismic risk and better anticipate consequences of such a disaster.

**Damaging Earthquakes in the Insular Caribbean: Implications for Hazard and Risk**
Lloyd Lynch, Seismic Research Center

The Caribbean basin is one of the most active seismic regions of the world. From 1510 to 2010, empirical knowledge and scientific research have helped to identify not less than 180 events related to the seismicity in the region. Casualties were associated with 38 of the 180 reports and for 10 of them the number of victims has exceeded 100. The devastating effects of an earthquake depend on a set of factors other than the magnitude such as the distance from the epicentre, its depth and the type of rocks beneath the site.

Generally, the loss of human lives during earthquakes, whatever their intensity, are caused by the fragility of the buildings and their susceptibility to earthquakes. In the region, the majority of new buildings follow building codes. But the majority of buildings particularly informal ones do not adequately conform to codes. It is also true that much of the existing structures were built according to codes that are outmoded, constituting a serious threat to their occupants. The strengthening of existing structures can generate exorbitant costs and retrofitting is usually directed critical and strategic facilities.

It is urgent to revise construction practices to improve them. At the same time, the design and transformation of other approaches to reducing the loss damage and loss of human life in politics are required. There may also be a need to revise the emergency preparedness plans and training interventions. Since the region spends between 8 and 25% of its GDP on buildings and infrastructure, it would make sense to revise building codes to take into account the new realities. These building codes must be designed based on recent scientific knowledge produced from engineering research in the region.

**Seismic micro-zonation methodology and its application in Haiti**
Claude Prepetit, BME-Haiti/UNDP:

Conducted in the territory of the agglomeration of Port - au Prince of about 80 square kilometres, the study covered the following phenomena: i) the hazard regional / local hazard; (ii) the effects of site rock; (iii) the topographical effects of site; (iv) breaking on the surface of fault active; (v) the liquefaction of soils; and (vi) the ground movement.
The results of this study showed that: i) seismic hazard is a hazard on the settlement of Port - au Prince regardless of the site; (ii) regional hazard is more than to Pétion-Ville to Cité Soleil; (iii) the movements of land and effects of topographic sites are more important in areas with rough topography of the South of Port - au Prince. (iv) active faults are more present in the South; (v) the worst soils are on the coast and in the National Fort; (vi) the liquefaction hazard is high on the coast; (vii) the rock outcropping (class 0) is present on the southern edge of the study area in the towns of Port - au Prince and of Petion-Ville. 6 other classes of soils are defined; (viii) strong amplifications are possible for flexible buildings or high-rise on the soils of class 2. Conversely on the soils of classes 5 and 6, rigid buildings or low-rise, will suffer a stronger attack.

Earthquake-resistant construction is a necessity if there is to be significant reduction of the seismic risk in Haiti. The new seismic zoning must be promoted and applied by those responsible for national, regional and local decision-making structures. Also, the authorities have to decide what to do with the buildings built before the 2010 earthquake and at best require that they conform to the standards.

Seismic micro-zonation of in the Greater of Santo-Domingo Area, Dominican Republic
Santiago Muñoz, National Geological Service, Dominican Republic

The Greater Santo Domingo Area is exposed to the very marked site effects. In many cases the levels of amplification are higher than recommended under the current earthquake building codes. Studies have brought: i) a geo scientific knowledge of Greater Santo Domingo; (ii) knowledge of the physical vulnerability of urban areas and important structures of Greater Santo Domingo; (iii) measures of prevention and monitoring for the reduction of physical vulnerability and the actions of preparation in case of earthquake for people in urban areas and constructions; and (iv) the strengthening of national and local institutional capacity in the use and implementation of the risk studies carried out for Greater Santo Domingo.

A series of measures need to be taken, such as 1) structural measures to the individual character buildings as a way of strengthening 2) development of a collective consciousness for the application of the seismic code and more generally the application of the principal rules (good practices) for earthquake-resistant construction; and 3) development of plans of intervention and the seismic risk-specific emergency management.

Recommendations advanced relate to the planning and construction sectors. Actions by either sector must be based on such micro-zonation studies that dictate site-related uses and specifications. There is also a need for education of the community and strengthened capacity for preparedness, mitigation and response agencies and committees.

Evaluation and mapping of seismic risk and operationalization of understanding risk
The session focused on sharing mechanisms and tools to integrate seismic risk knowledge to better prevent negative consequences of earthquakes and seismic risk management.

Multi-risk prevention plans for priority neighbourhood of Port of Prince: contribution of risk knowledge for decision making to reduce vulnerability
Clément Belizaire, Construction of Housing and Buildings Unit (UCLBP)
By order of 1 July 2012 the Construction of Housing and Buildings Unit (UCLBP) was created to ensure the coordination and implementation of all the reconstruction projects of public buildings and housing on the national territory and to encourage private investment in the reconstruction of cities destroyed after the earthquake of 12 January 2010. A Plan of Multi-risk Prevention (PPR) was developed with authorities, ministries and affected communities that allows one to: i) identify and evaluate hazards; (ii) improve knowledge of areas exposed to risk while guiding decisions in the field of urban landscape; and (iii) regulate the use of land and construction areas. The elaboration of the PPR and its application allowed for delimiting zones according to characteristics (unbuildable, constructible or weakly exposed). PPR integrated into urban planning has provided concrete results in the housing sector as well as in the construction and development of infrastructure and public spaces. The PPR has proven to be an important tool in the mitigation of risk in urban areas.

Among the recommendations was the need for systematisation of the methodology for considering seismic risk in urban areas as well as the integration of multi-risk mechanisms in planning document and for construction. Important also is the serves. The way that consultations between ‘decision-makers’ and ‘managers’ are treated must be systematised. Greater participation by the population was also seen as a critical part of the process utilising participatory approaches for greater buy-in by the citizenry. In relation to the regional roadmap, it was suggested that there needs to be partnership between the countries of the Caribbean for enhanced cooperation on reduction of the seismic risk and transfer of skills but also at the level of other natural hazards.

**Taking into consideration seismic hazard for building designing and sizing**

Christopher Calixte, Quality Management Services, LNBTP/UEH

Despite the lessons learned from the disaster, bad building practices persist. This is not only the lack of generalization of codes of construction but also to their interpretation. Often the construction activities, in Haiti, are carried out in the informal sector. Professionals are not sufficiently involved in the design and construction of structures. The design of the buildings initially involves the skills of an architect, an engineer of structure and a geotechnical engineer or geophysics.

The design of a building should be realistic, safe and economic. The materials must be monitored to ensure their ductility prior to implementation. Emphasis should be placed on the dimensioning of the elements, such as walls, beams, poles, nodes while making constructive provisions to the transverse reinforcement, longitudinal reinforcement and resistance to sliding.

**Towards effective skills transfer in Haiti : Master of Geosciences syllabus**

Dominique Boisson, Lecturer at the Faculty of Sciences of the University of Haiti:

**Towards quality management for knowledge: The CST-RNH**

Yves Fritz Joseph, General Director, LNBTP-MTPTC

**Assessment of Haiti-led Seismic risk analysis**

Marc Raynal, Technical Advisor, CIAT:

With the mission to define the policy of the Government in land-use planning policy, among other things, the Interdepartmental Committee of Development of the Territory (CIAT) has taken inventory, with the help of the BRGM, and has commented of the risk studies carried out in Haiti from 1999 to 2015. A total of 36 studies were
conducted with 28 for the period post 2010 earthquake. It was not only an inventory but to assess the methodological tools and the relevance of these studies. All of these studies cannot be judged as a corpus that is usable for the needs of planning since all of them were subject to donor objectives, separate from national objectives.

In April 2014 the scientific and Technical Committee, whose jurisdiction extends to all the risks has the responsibility to officially approve risk studies. Recommendations were made concerning future studies and the role of institutions.

- **Education and Awareness Raising for Seismic Risk Reduction**

  Within this session initiatives at the national and regional levels on education and public awareness were presented. The priority aspects addressed were the transmission of knowledge, the strengthening of certain skills and awareness and behaviour change among the population.

  **The Haitian experience in masonry training**

  Yves Villefranche, National Vocational Training Institute (INFP)

  The National Vocational Training Institute (INFP) ensures supervision of the informal sector, control of the quality of the training of private operators and the direct provision of training services. The decision was taken to adapt the training system to the new earthquake-resistant building techniques and for cyclones in order to obtain a critical mass of trained and to likely change mentalities. With the support of the Cooperation of Switzerland, the INFP initiated training certification in techniques adapted to the needs of reconstruction for the attention of the masons of the informal sector from 2011. The first experiment proved a success. The Cooperation Switzerland (CCR) and the INFP have established, in 2013, the Coordination platform in the Construction industry. In 2016, the INFP launched the new national program of development of masonry trainees and good construction practices. Currently the INFP revises the initial training program by adding new concepts.

  It has been recommended that all stakeholders (engineers, architects, foremen, workers, materials dealers and municipal officers) are trained in addition to be made aware of the seismic risk. For the application codes and the spread of best practices, the State at the central and local levels, as well as civil society must commit to promote and demand the application of best practices. There should also incentives on the demand for persons trained (quota of trainees/certification of firms), without neglecting the integration of women in the construction sector as a vehicle for change in mentality.

  **Workshop experiences for building practices at the University**

  Evenson Calixte, Dean of the Faculty of Architecture of the University of Quisqueya:

  Before the earthquake on 12 January and following, the deficiencies engineering skills for seismic risk were observed. The Faculty of science of the University of Quisqueya implemented a series of training in earthquake engineering from May 2010 to May 2012. Not less than 700 construction professionals have benefited from this training in introduction to earthquake engineering and security assessment aftershock of damaged structures in nine levels. This experience has led to the setting up of an industry certification, master’s level and in collaboration with the University of Buffalo, earthquake engineering or certificate of studies in this area.
In parallel, a program in forms of practical experience on the linked masonry was launched with the help of Swiss Cooperation. 239 students from Quisqueya University, State of Haiti, GOC, USFAH and American of Cayes took this program to reduce the distance between them and the technicians as participants in practical sessions on masonry in the company of the masons and of the other construction trades.

There is a need for cooperation between partners in education and training at all levels and common language/terminology is needed among all construction stakeholders.

**Comprehensive Safe School Framework and seismic risk**

Jair Torres, Project Officer, UNESCO:

1300 teachers and 38,000 students perished and more than 4300 schools collapsed or severely damaged from the 2010 earthquake in Haiti. In 2015, during the regional workshop on disaster risk reduction, particular attention was paid to the policies and plans for safety of schools and the education sector as a whole. The purpose of this workshop was to promote the three pillars of the Global Initiative on the safety of schools in the Caribbean, while identifying achievements and priorities. The conclusions of the workshop recommended: i) increase the capacity of school curricula developers, administrators of the system to bring risk reduction education into school curricula; (ii) revise, develop or improve school-based disaster management plans; (iii) convince and help decision makers so they can allow upgrading school facilities; and (iv) assist in the development of action plans for the implementation of a comprehensive approach to school safety in every country of the region.

The workshop should convince the education ministers of the Caribbean to validate and adopt the regional roadmap on security in schools while ensuring its application. Efforts should be made to put in place a regional education for earthquake engineering that is able to design, run, and to rehabilitate (by standards) safer school facilities. Countries should initiate a regional assessment program of the schools for the entire region. Comparative and harmonized, this program must be operative in each country of the basin to be used as the basis for serious information by decision makers and funding agencies.

**Education and awareness lessons learned from a long-term volcanic eruption**

Roderick Stewart, Montserrat Volcanic Observatory

Since June 25, 1995, the volcano on the island of Montserrat the Soufrière remains active. With peaks of intensity, one of its eruptions in 1997, resulted in significant shifts of population covering of lava and mud the capital and the most populous city of the island. In 1995 the Volcanic Observatory was established and given the mandate to study seismic and volcanic island activity. The fundamental role of the Observatory is to anticipate the eruptions and to prepare for the evacuation of people who are exposed.

The Observatory uses a lot of live and recorded radio broadcasts, as well as the internet. The Observatory regularly attends training or information sessions of schools, businesses, groups and tourists while ensuring frequent interactions with the Government, businesses and communities. Finally, to ensure the popularity of its action, the Observatory also invests in the realization and the sponsorship of competitions and mass demonstrations.
As it relates to changing behaviours it was recommended that institutions that work on the risk reduction must: i) always tell the truth; (ii) consider that the message they disclose affect people; and (iii) never give speculative information although uncertainty should be conveyed.

**Families and communities at the heart of the seismic risk preparedness**

Edgard Célestin DPC Haiti/ Education and Public Awareness Thematic Committee

**Application of a the CDEMA awareness tool ‘Earthquake Readiness’**

Michelle Forbes, National Office of disaster management, Saint Vincent and the Grenadines

The islands of Saint Vincent and the Grenadines consist of 3 2 uninhabited islands and 9 inhabited. The islands are exposed to the risk of earthquakes, tsunamis and volcanoes, among others. The National Disaster Management Office of the archipelago is a member of the Caribbean Disaster Emergency Management Agency (CDEMA) and utilises the strategies developed by the Agency for public awareness.

Adapted to the national context, the CDEMA tool has helped to improve the knowledge of the risk and disaster risk management in priority areas such as education, health, economy, housing, tourism and the development of the country. The scientific information on risk, produced by regional institutions was used. Existing programs and strategies have been adapted locally.

With respect to seismic risk, the country has implemented programs for the safety of schools, awareness and training of the general public, the application of codes of construction as well as an annual awareness. A brochure about the tsunami risk has been adapted to the reality of the villages and communities. Since 2011, simulation exercises have been held regularly to facilitate backup tsunami protocols.

The archipelago experience based on the adaptation of existing tools, proves that it is not necessary to reinvent the wheel. Countries lacking the resources to produce scientific information and seismic risk reduction measures can adapt the regional tools. For awareness campaigns (multi hazard or seismic), countries should increase interventions in schools, because public education is able to change behaviour. Logically, good risk management should: i) support the awareness campaigns and school education; (ii) go beyond school age children to reach a larger portion of the population; (iii) have an integrated approach to programs of outreach and public education (e.g. safe schools policy and the Ministry of national education); (iv) integrate on a priority basis the concept of reducing the risk of disaster in the school curriculum; (v) work towards harmonization of public education programs at the regional level, thus allowing for learning from the experience of others and to share programs and tools; and (vi) always put the science at the heart of education and public awareness programs through national and regional institutions.

**Awareness of tsunamis and seismic risk**
Gregory Adams, Department of disaster management, British Virgin Islands

The British Virgin Islands is an archipelago of some 50 islands that are facing as high a seismic hazard as all the countries of the Caribbean basin. The risk of a tsunami of distant or close origin is also taken seriously due to exposure on the coasts. The British Virgin Islands have recently begun to integrate DRR into school programs to encourage the authorities concerned to combine theory and practice so that students receive a comprehensive education in this area. Since then, the overall strategic framework of risk management was adopted that speaks to seismic risk reduction in planning and construction as well as raising awareness among the general public. The accomplishments include mass communication campaign, building construction courses at the local community college, simulation exercises and engagement by the disaster management organisation in the review and approval of new facilities. In collaboration with the Ministry of education, the disaster management entity has developed criteria that allow them to assess and certify schools across the country.

Seismic risk reduction requires wide dissemination of information. For example, people interested in the acquisition of property must have the most relevant information on the risks that they face and to which the property is exposed. Local building codes must be updated so that they take into account the latest requirements in the design of seismic installations. Architects, engineers and contractors must ensure that their projects meet the standards and specifications in force by hiring trained professionals for the design and execution of construction work.

Reconstruction of the infrastructure of the Catholic Church
Stephan Destin, Catholic and Protestant Unit: Operational Construction Unit

The Catholic Church in Haiti has been severely affected by the earthquake in 2010. The Archbishop of Port-au-Prince, dozens of priests, nuns and seminarians died in the quake. All the major churches of Jacmel and Port-au-Prince including the Cathedral collapsed. 3 years later, a structure in charge of rebuilding the infrastructure of the Catholic Church in Haiti, supported by the Episcopal Conference of the United States of America has been implemented. The structure received mandate to ensure the delivery and financial management in order to support a transparent, accounting, and infrastructure reconstruction of the Church in Haiti damaged by the earthquake.

With an initial budget of $ 33 million, close began the reconstruction of the affected heritage, not without difficulties from which she has learned many lessons. In order to implement the project, there were challenges such as titles of properties, the poor quality of materials, research firms and labour skills, as well as the lack of construction standards. The infrastructure of the Catholic Church is the home of many of the faithful. They must be safe places integrating design standards for the reduction of vulnerability to seismic risk. CLOSE procedures are strict and go through the study of the ground before implementing seismic buildings and cyclone-ready. Building codes are also respected and materials and buildings are regularly inspected. It recommended that qualified engineers should be engaged in building projects in Haiti and the region.
Regional Roadmap for urban seismic risk management in the Caribbean

The Caribbean Urban Seismic Risk Forum provided an opportunity for Caribbean countries to jointly develop the Regional Roadmap on Urban Seismic Risk Management in the Caribbean. Prior to the Forum, regional seismic institutions and CDEMA were engaged in the review and provision of comments on the draft roadmap that was used during the workshop utilizing the expertise of regional and national partners in working groups for the thematic areas of seismic risk governance; understanding urban seismic risk; mitigation and preparedness; response, recovery and reconstruction; public awareness and education; and risk finance and transfer and business continuity planning.

The final version of the roadmap was launched in commemoration of the earthquake of 12 January, 2010 [Media Story]. It is intended that the roadmap will be executed at the policy and programmatic levels by various national, regional and international partners as detailed in the document. CDEMA among other actors have agreed to promote the implementation of the roadmap while CDEMA has indicated its willingness to monitor the progress made through its monitoring and reporting channels at national and regional levels.

4. Conclusions and Recommendations

The Caribbean Urban Seismic Risk Forum was deemed as a success with high quality presentations and discussions. Reflections on the past initiatives and associated outputs as well as inputs from all presenters in the Forum were taken into consideration for charting the way forward in the Regional Roadmap for Urban Seismic Risk Management in the Caribbean. Participants in discussing the way forward identified priority next steps under each of the six thematic areas of the roadmap that are reiterated below as recommendations for achieving progress on urban seismic risk management.
Seismic risk governance

- Development of model legislation, regulation and policy to manage seismic risk and advocate for the adoption at the national level.
- Leverage the international financial and insurance institutions to incentivize national adoption of standards.
- Establishment of Chairs at credible universities within the region to coordinate geohazard/earthquake engineering research specific to the region.

Understanding urban seismic risk

- Evaluate status and availability of geologic maps for urban seismic risk.
- Update and maintain a Homogeneous Regional Seismic Catalogue (historical and instrumental)
- Establish a standard mechanism/methodology for undertaking seismic risk and vulnerability assessments

Mitigation and preparedness

- Review planning legislation to incorporate Natural Hazard Impact Assessment (NHIA) as a consideration in the development approval process
- Adopt a modified French model of enforcement for building construction, considering it is a best practice of the region.
- Require all new investment projects (public and private) to be subject to the application of a seismic study including micro-zonation studies to be conducted for all existing critical infrastructure sites.

Response, recovery and reconstruction

- Build/establish SAR and specialized Emergency Response capacity including capacity for the conduct of quick assessment or building triaging in the aftermath of seismic events; Teams must be trained and adequately resourced.
- Promote rehabilitation and reconstruction in-keeping with existing standards and codes as well as promoting seismic retrofitting of existing vulnerable buildings.
Establish information sharing platform for dissemination of accurate/reliable information post-seismic events.

Public awareness and education

- Develop a multi-hazard, multi-pronged public awareness framework for the region, adaptable at the national level, under a regional coordination mechanism (CDMS).
- Implement the Global School Safety Framework throughout the region with a view to harmonization of approaches to school safety.
- Develop regulatory framework/standards for vocational and professional training adapted for local communities' needs.

Risk finance and transfer and business continuity planning

- Identify, assess, and prioritize critical infrastructure to facilitate risk sensitive planning.
- Work with the Association of Caribbean States (ACS) within the context of their cooperation initiatives with the Instituto Nacional de Estadística y Geografía (INEGI) of Mexico to complement the existing information platform to take it the required level of detail.
- Develop the Caribbean wide Disaster Resistant Business (DRB) Toolkit for Small and Medium Enterprises (SMEs) and Non-governmental Organizations (NGOs)/non-profits.

From the local to international level, stakeholders have critical roles to play in the management of urban seismic risk. An integrated approach to disaster risk management is required in order to achieve progress on the theme. There is also a role for policy makers in providing the institutional and policy framework for reducing risk. Risk financing and transfer provide opportunities both at the stages of mitigation and preparedness and recovery and reconstruction to make a difference in the creation and management of urban seismic risk. As reflected in the discussions, there are existing mechanisms that can be adapted and utilized in management. This Forum provided for the sharing of experiences and tools that can be utilized noting their potential and proven usefulness in risk management. It is clear that cooperation will be critical at the national and regional levels to achieve significant progress and partnerships will be an avenue for technical cooperation and capacity building.