IISEE Newsletter

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The 60th-Anniversary of the International Training Course in Seismology and Earthquake Engineering -some commemorative events will hold-

By Mr. Takahiro Yamada, Head of Administration Division, IISEE

IISEE training course begun in 1960 based on the agreement between the United Nations Special Fund and the Japanese government. IISEE contributes to disaster mitigation of the world with a focus on developing countries by acquiring the latest seismological knowledge and the technic of Earthquake Engineering for each period. In 2020 IISEE celebrates the 60th anniversary. To date, 1898 participants from 102 countries completed the training course.

In September 2020, 17th World Conference on Earthquake Engineering (17WCEE) will hold in Sendai.
International Institution of Seismology and Earthquake Engineering, which conducts the training course in Tsukuba city Ibaraki is planning to have an event in 17WCEE and some other commemorative events.

At the informal gathering for discussion, we are going to show the outline of IISEE and are organizing the 60th-anniversary event.

17th World Conference on Earthquake Engineering (17WCEE)
Date: Sep 13th - 18th, 2020.
Venue: Sendai International Center, Sendai, Japan. (Conference bldg. Exhibition bldg.)
Organizer: Japan Association for Earthquake Engineering
URL : http://www.17wcee.jp/greeting.html

A paper by Dr. Saeko Kita, Senior Researcher, published in Earth, Planets and Space journal.

By Mr. Takahiro Yamada, Head of Administration Division, IISEE

A paper written by Dr. Seako Kita, Senior Researcher, was published in Earth, Planets and Space journal on 14th November, 2019.
The title is ‘Characteristics of relocated hypocenters of the 2018 M6.7 Hokkaido Eastern Iburi earthquake and its aftershocks with a three-dimensional seismic velocity structure’ (Earth, Planets and Space volume 71, Article number: 122 (2019)). Full paper is available on Springer Open

website (Open Access). For further information, please visit the following link.
https://earth-planets-space.springeropen.com/articles/10.1186/s40623-019-1100-0

Selected abstract of 2018-19 training course

International Institute of Seismology and Earthquake Engineering

Our institution, International Institute of Seismology and Earthquake Engineering (IISEE), mainly conducts three following one-year training courses named (S) Seismology Course, (E) Earthquake Engineering Course and (T) Tsunami Disaster Mitigation Course.

This booklet is a collection of abstracts of individual study reports from the trainees of the 2018-2019 course. Regarding the trainees from S course and T course, only trainees who have volunteered wrote their abstracts. Therefore, please kindly note that not all the abstracts are posted in this booklet.

We hope this booklet will help you.

Tatsuya Azuhata (E Course leader)
Tatsuhiko Hara (S Course leader)
Bunichiro Shibazaki (T Course leader)

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Seismology Course

- Completeness Magnitude of Earthquakes and b-Value in Myanmar

Engineering Course

- Fragility evaluation of a RC building designed by Nepal Building Code considering deformation capacity
- Seismic retrofit of an existing residential building in Nepal to functionalize as a hospital using ferrocement
- A study on seismic performance and retrofit approach for current RC buildings with soft first story in Nepal
- Earthquake Performance Evaluation of Typical Bridge Structure Designed by a Force-Based Design Method in the Philippines

Tsunami Course

- Study of the bathymetric influence on tsunami propagation near the coast of Esmeraldas by tsunami simulation and ray tracing analysis
- Evaluation of possible locations of bottom pressure recorder for the Colombian north Pacific coast, using tsunami travel times and tsunami

Call for Papers

IISEE Bulletin is now accepting submissions of papers for the seismology, earthquake engineering, and tsunami. Developing countries are targeted, but are not limited.

Your original papers will be reviewed by the editorial members and some experts.

NO submission fee is needed.

Try to challenge!!

Enjoy, Now

Contact Us

The IISEE Newsletter is intended to act as a go-between for IISEE and ex-participants.

We encourage you to contribute a report and an article to this newsletter. Please let us know your current activities in your countries.

We also welcome your co-workers and friends to register our mailing list.

iiseenews@kenken.go.jp

Back Numbers

http://iisee.kenken.go.jp/nldb/

Completeness Magnitude of Earthquakes and b-Value in Myanmar

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The estimations of Mc and b-value are helpful to understand the characteristics of seismic activities and to evaluate the seismic observation network.

In order to estimate completeness magnitude of earthquakes and b-values, the NEDC local dataset was used during 2014-2018. This study aims to estimate the completeness magnitude of earthquakes in Myanmar and to examine the b-value with its relations: depth, faulting style, and stress accumulating in a sophisticated tectonic setting of Myanmar. The completeness magnitude Mc was estimated as ML 2.8 with a b-value 0.68±0.02 in the whole study region (Fig. 1). Regionally, the b-values vary from 0.52 to 1.0. The tendency relation between b-value and faulting styles was found along the Sagaing Fault. The southern part with a smaller b-value indicates a thrust mechanism, whereas the northern part with a larger b-value shows a strike-slip mechanism. The b-value generally increases with the increase of depth in the whole study region. In the active fault region, the b-value decreases with depth within the upper crust at depths of ~15 km (Fig. 2), which might be related to high-stress accumulation. Below at a depth of 15 km, the b-value then increases with a function of depth (Fig. 2). In contrast, a significant decrease of b-value with depth was observed at depths of 75-85 km in the subduction zone of the study region, which might be discussed with the process of dehydration in the ocean crust. The methodology of this study might be fruitful to understand the seismically complex tectonic system beneath Myanmar.

Figures

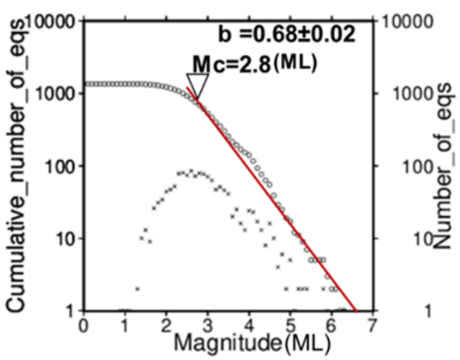

Fig. 1. Estimation of b-value and Mc in the whole study. Solid red line: the best-fit line. Circles: the cumulative number of events. Crosses: Event number of each magnitude.

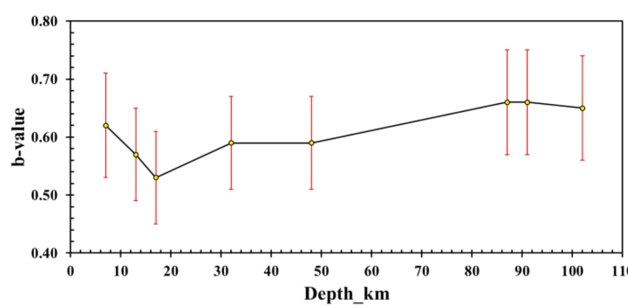

Fig. 2. Variation of b-values (yellow circles) with depth and its error (red vertical bar) in the Sagaing Fault region.

Department of Meteorology and Hydrology (DMH)

The Department of Meteorology and Hydrology (DMH) is under the Ministry of Transport and Communications. The DMH aims to take preventive measures against and reduce the effect of natural disasters, to advance safe transportations, to promote agriculture and food production, to ensure human society and national economy, and to bring sustainable development of natural resources.

Fragility evaluation of a RC building designed by Nepal Building Code considering deformation capacity

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Failure mode affects the fragility of buildings significantly

We carry out fragility evaluation of a reinforced concrete (RC) building to investigate the intensity of earthquakes that the buildings designed by the current building codes in Nepal can resist. In this study, we select the RC building shown in Fig. 1 with seven stories and five by three bays as a sample. For the preliminary process, we carried out the non-linear static analyses to judge failure modes and estimate the ultimate limit story drifts. The result showed that share failures might occur in this building. Therefore, we revised the arrangements and specifications of steel bars both in columns and beams to prevent share failures with no changing dimensions of them. We also evaluate the fragility of this revised model comparing with that of the original one. To evaluate the fragility of the building, we conduct incremental dynamic analyses (IDA) using 40 earthquake ground motions. We adjust the peak acceleration of them from 0.1 to 1.5 G in increments of 0.1 G. From the analysis results; we evaluate the relation of the probability of building collapse and the PGA, which is the fragility curve. For the original building model, the probability of the collapse was 30 % to the PGA of 0.4 G. Contrary, that of the revised model decreased to about 5%. The comparison of fragility evaluation of the models is depicted in Fig. 2. This result shows that the failure mode affects the fragility of buildings significantly. The results of this study indicate that RC frame structures designed by NBC can be achieved satisfactorily with some modification in the limit state of shear design.

Figures

Fig. 1. West elevations of the target building.

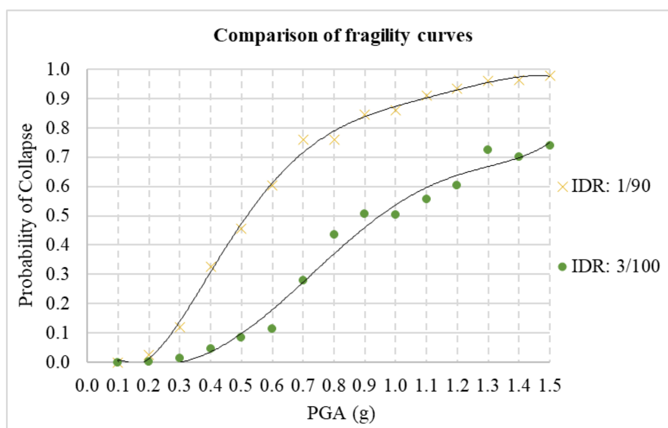

Fig. 2. Comparison of the fragility curves. Orange crosses and green solid circles in the figure show the probability of collapse of the fragility curves for IDR 1/90 (shear failure type) and 3/100 (bending failure type) respectively.

Department of Urban Development and Building Construction (DUDBC)

The DUDBC organization falls under the Government of Nepal via the Ministry of Urban Development. The functions and responsibilities of DUDBC are: formulation, planning and implementation of urban policies; formulation, planning and implementation of housing plans and policies; and design construction, repair and maintenance of the government buildings.

Seismic retrofit of an existing residential building in Nepal to functionalize as a hospital using ferrocement

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Ferrocement is an appropriate retrofitting technology in developing countries like Nepal.

Because of urbanization, the land price becomes high, and the space in the core cities of Nepal are not available for constructing new facilities. Therefore, the trend of converting residential buildings to public buildings is increasing. Here in this study, the existing non-engineered building that survived the 2015 Nepal Gorkha earthquake that intended to shift its occupancy from residential to the hospital was evaluated. The building was assessed considering the infilled and bare frame, and reevaluated the ferrocement retrofitted building using JBDPA, 2001 and nonlinear pushover analysis. Three different techniques of the retrofit were considered (1-partial retrofit, 2-whole wall retrofit, and 3-partial retrofit with some non-retrofitted additional walls). The structural performance of the third types of retrofitting techniques was found to be best. To elaborate on the necessity of retrofit for changing the functionality. Three different cases for the same target building were considered, using nonlinear pushover analysis. Case: A as a residential building without retrofit, Case B as a hospital building without retrofit (that depicts the current scenario of Nepal), and Case C as a hospital building with a retrofit. The recent 2015 earthquake and NBC 105 demand curves are used for this study. Case A found to be safe in the 2015 Gorkha earthquake and satisfied code provision, whereas case B could not satisfy any of the demand, and case C satisfied both. The result of analysis could capture the real field scenario of Gorkha earthquakes. Many buildings of case B types collapsed during the earthquake. However, Case C type building remain safer after the earthquake. The result of the case study implies that many existing non-engineered buildings by the recent earthquake are in a vulnerable state and needs a retrofit. In the same way, this thesis identifies the retrofitting is urgent need before switching the occupancy of the buildings.

Figure

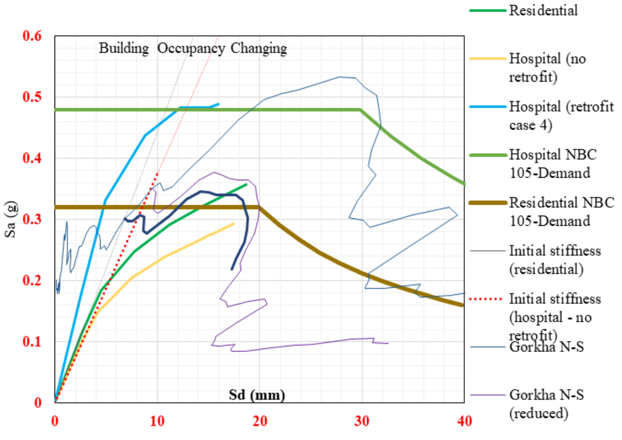

Figure 1. Capacity curve versus NBC & Gorkha earthquake 2015 demand curve for case A, B and C

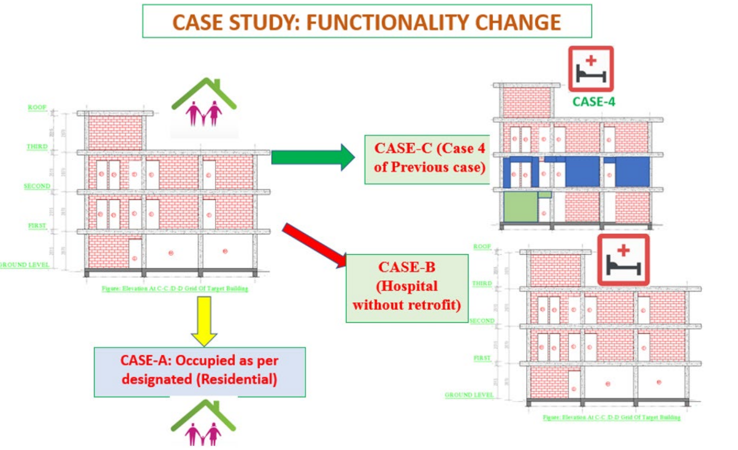

Figure 2. Different cases considered in case study

Bharatpur Metropolitan City, Office of Municipal Executive, Bharatpur Chitwan

Bharatpur is the fifth-largest and one of the fast-growing city as well as a separate Metropolitan authority in the central-southern part of Nepal. It is a district headquarter of the Chitwan district. One of the major responsibilities of metropolitan is to implement building code, issuing building permit certificates, and monitoring constructions work.

A study on seismic performance and retrofit approach for current RC buildings with soft first story in Nepal

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A combination of RC shear and wing wall as retrofit technique controls excessive drift keeping the usability of open space in the first story.

The soft first story RC buildings proved to be vulnerable in Nepal during the 2015 Gorkha earthquake. The RC buildings in Nepal are constructed with a weak frame, lack of ductile detailing, and brick masonry infill. In the city area, due to urbanization and lack of land area, the upper story is used as brick masonry, and the first story is used for shopping and parking purpose. This research intended to assess and compare the seismic vulnerabilities of RC buildings with soft story in Nepal namely, (i) building constructed by following NBC 205:1994 i.e. Mandatory Rule of Thumb (MRT) with poor detailing and modified later by adding story (NBC) and (ii) building constructed based on modified MRT of 2010 recommended by DUDBC, with poor detailing and modified later by adding story (NBC+). Seismic performance is evaluated by JBDPA guidelines of seismic evaluation, FEMA-356 and the seismic response is predicted by NBC1994, and nonlinear static pushover analysis to each model and dynamic analysis to the Gorkha Earthquake motion. The results are discussed in terms of story shear, capacity curve, maximum roof displacement, inter-story drift and damage pattern. Retrofit by wing wall and shear wall is proposed. The research found that seismic behavior, ductility demand, and inter-story drift pattern of RC building with the soft first story are different from those of the bare frame. The soft first story suffered extreme inter-story drift causing severe damage. Seismic vulnerability of both buildings before retrofit showed NBC+ building performed better than NBC building. Both model buildings sustain Gorkha earthquake motion. It reveals that the buildings collapsed during earthquake were of low concrete strength, poor detailing, lack of reinforcement constructed before the application of NBC. A combination of RC shear wall and wing wall proved to be effective in eliminating stiffness differences and controls excessive inelastic lateral drift to keep the usability of open space in the first story.

Figures

Fig. 1. The soft first stories collapsed in 2015 Gorkha Earthquake Nepal.

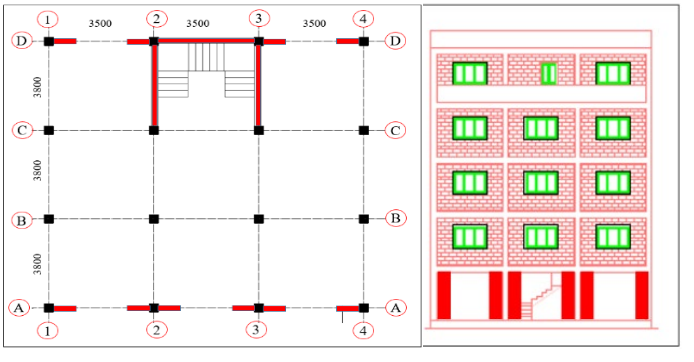

Fig. 2. Retrofit plan for the soft first story of model NBC+ building. A combination of RC shear wall and wing wall controls excessive inelastic drift to keep the usability of open space.

Department of Urban Development and Building Construction (DUDBC), Nepal

DUDBC, under the Ministry of Urban Development, is responsible for the policy-making in realms of urban development, housing and building construction of Nepal. Moreover, DUDBC is accountable for the implementation of government urban development works, building constructions projects, and research regarding new building technology. Besides, it acts as a monitoring agency for the implementation of building code.

Earthquake Performance Evaluation of Typical Bridge Structure Designed by a Force-Based Design Method in the Philippines

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Displacement-Based Design method is the new approach in evaluating the seismic performance of a bridge, which is more precise in terms of assessing damages.

The Philippines is an archipelagic country consisting of large and small islands. It is essential to have link structures like bridges. After a disaster like earthquakes, bridges must be maintained to give way for an effective rescue operation and transporting of relief goods to the affected area. Most of the bridges in the Philippines were built on designs using the old code, which is based on the traditional approach, the Force-Based Design Method. In this method, demand and capacity are compared in terms of forces. Currently, the Displacement-Based Design method is being recommended as the new approach in evaluating the seismic performance of a bridge, which is more precise for assessing damages, in which the seismic displacements are selected as demand parameters.
In this study, the author tries to apply the Displacement-Based Design methods to an existing typical bridge in the Philippines and to evaluate the damaged deformation capacity by Nonlinear Dynamic Analysis (Time History Analysis).
In conclusion, the author extracts some earthquake displacement response characteristics of typical bridges in the Philippines and suggests revised cross sections to improve the safety of the target bridge. Finally, the author summarizes analysis based on the results and clarifies the merits of the displacement-based design method.

Figure

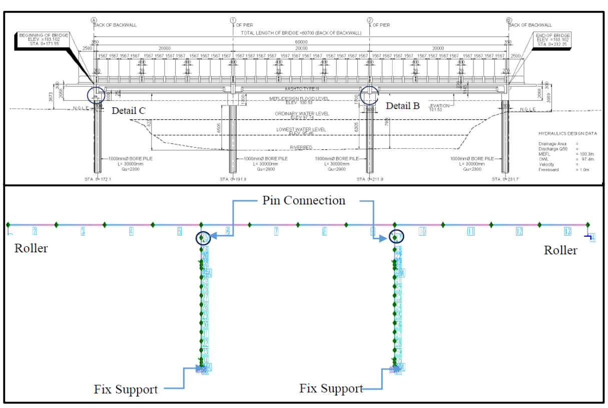

Fig. 1. Analyses Model of the target model bridge.

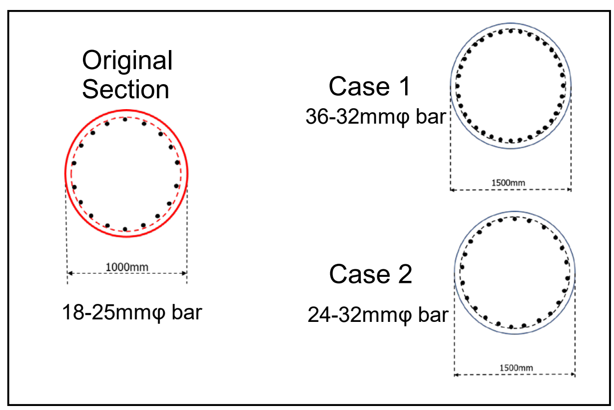

Fig. 2. Details of the Original Sections and the Revised Sections

Department of Public Works and Highways

The Department of Public Works and Highways (DPWH) functions as the engineering and construction arm of the Government is to continuously develop its technology for the purpose of ensuring the safety of all infrastructure facilities and securing for all public works at the highest efficiency and quality in construction. DPWH is currently responsible for the planning, design, construction, and maintenance of infrastructure, especially the national highways, flood control, and water resources development system, and other public works in accordance with the national development objectives.

Study of the bathymetric influence on tsunami propagation near the coast of Esmeraldas by tsunami simulation and ray tracing analysis

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The changes in the bathymetric gradient greatly influence the propagation of the tsunami wave in front of Esmeraldas

As a result of the subduction and other geological processes, there is the presence of some bathymetric features which significantly change the gradient of the seabed near Ecuador, such as the oceanic trench and the submarine Esmeraldas canyon. The main purpose of this study was to give a better understanding of how these alterations in the bathymetry affect the tsunami propagation by conducting ray tracing analysis and tsunami simulations using different bathymetry data sources of GEBCO, ETOPO, and INOCAR, for local and distant events along the Pacific and the coast of Ecuador. In addition, we conducted tsunami propagation simulation using TUNAMI code with a nested grid system of six domains. We used general and high resolution bathymetric data and analyzed the results in all six domains. From the results of both tsunami simulations and ray tracing analyses, we evaluated the consistency between the directivity of the rays and the wave's propagation for focusing areas such as Esmeraldas. We observed a faster propagation of the wave due to the particular bathymetric profile of the canyon in front of Esmeraldas, which made the first wave arrive at this city; with this result we confirmed the effect of local bathymetry along the tsunami path. This study can be used as a preliminary evaluation to determine the vulnerability of specific locations along the coast regarding the changes in the local bathymetry and topographic submarine features.

Figures

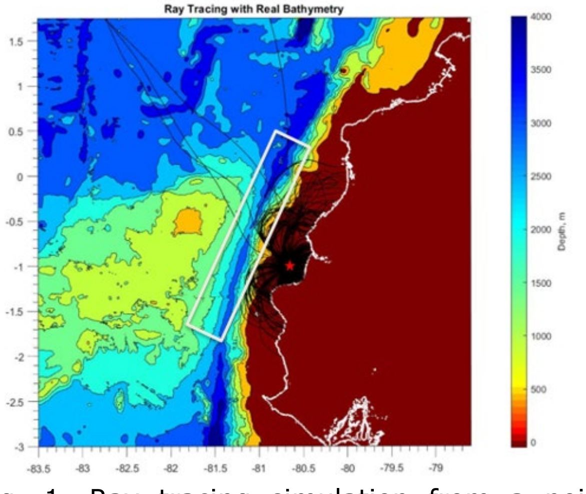

Fig. 1. Ray tracing simulation from a point source in central Ecuador located near the coast. Results show how the rays are trapped inside the trench refracting back to the coast.

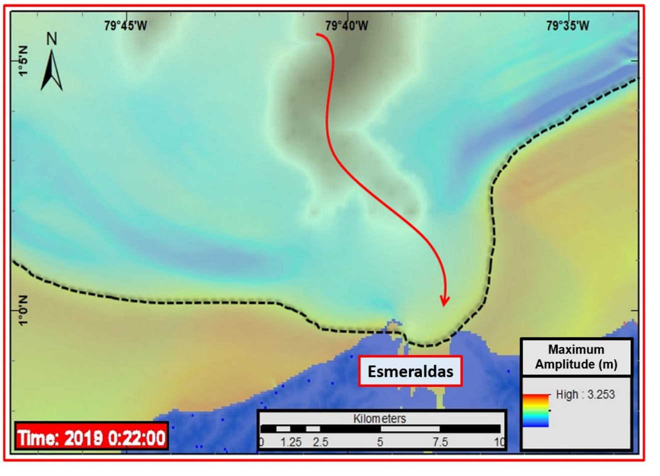

Fig. 2. Snapshot obtained from TUNAMI simulation model after 22 minutes propagation in Domain 4. From the results we observed a faster propagation of the wave arriving first to Esmeraldas city.

Oceanographic Institute of the Ecuador Navy (INOCAR)

INOCAR is a government institution that is responsible for developing the hydro-oceanographic characterization of the jurisdictional and non-jurisdictional maritime territory of national interest, the elaboration of nautical cartography, to monitor the oceanographic conditions and to give the service of safety to navigation.

As a member of the Pacific Tsunami Warning System since 1976, it is the official institution in charge of the study and issuance of the tsunami alert in case of a threat to the Ecuadorian coast.

Evaluation of possible locations of bottom pressure recorder for the Colombian north Pacific coast, using tsunami travel times and tsunami simulations

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To select a suitable Bottom Pressure Recorder (BPR) location for improvement of the tsunami early warning system in the north Pacific zone of Colombia.

The Colombian Pacific coast is prone to earthquakes and tsunamis, as registered in 1906, 1942, 1958 and 1979, in which most disastrous events were the 1906 and 1979 in terms of the casualties more than 1000 and 500, respectively. It is necessary for the National Tsunami Warning Center to improve the process of early warning for the populations in the coast of Colombia. In this study, we aim to provide a suitable location for a Bottom Pressure Recorders (BPR) to provide timely alerts for the north Pacific Colombian populated areas. We evaluated the possible locations of BPRs, which provide proper time to issue tsunami warning to the populated areas in the north pacific coast of Colombia. We made a preliminary analysis assuming an arrangement parallel to the subduction trench and then an improvement considering the technical recommendations given by the Pacific Marine Environmental Laboratory regarding the deployment of BPR. With the final arrangement of BPRs, we conducted Tsunami Travel Times (TTT) calculations for far-field events, and tsunami propagation simulations with TUNAMI code. Furthermore, we evaluated the effectiveness of BPR in case of local earthquakes. We classified the possible locations into three groups according to the lead time between tsunami detection on the BPR and the first arrival to the Virtual Observation Point (VOP) near the most populated areas, as: (1) best, (2) good and (3) not good. We found the best location for the selected arrangement of BPR in latitude 4.909° N, longitude 80.06° W, at the depth of 3,134 meters.

Figure

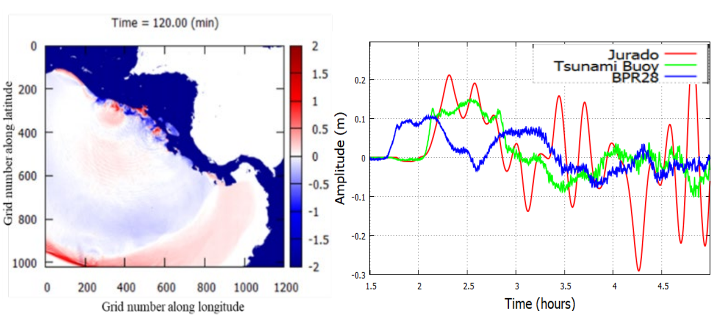

Fig. 1. (left) Snapshot of tsunami propagation from a Nicaragua case. (right) Comparison of simulated tsunami waveforms for the first detection points within the BPRs and VOPs near populated areas.

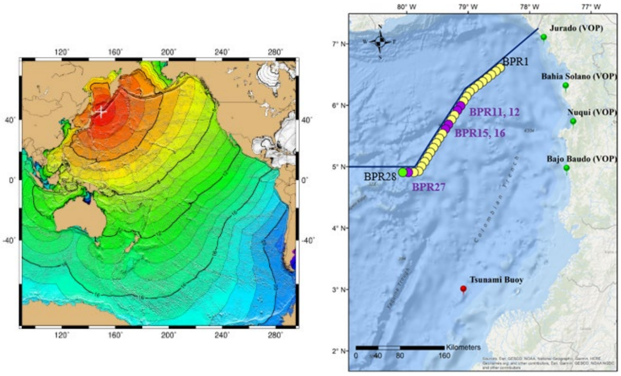

Fig. 2. (left) Calculated TTT for a far-field earthquake of Kuril. (right) Final arrangement of BPRs and classification for suitable location (green: best, purple: good, and beige: not good).

General Maritime Directorate

The General Maritime Directorate (DIMAR) was established in 1984 as the Colombian Maritime Authority in charge of executing the government policy in this matter, with a structure that contributes to the strengthening of the national maritime power, ensuring the maritime integral security, the protection of human life at sea, the promotion of the maritime activities and the scientific and technological development of the nation.