Enhancing Coastal Hazard Early Warning and Response:
Tools and Institutional Strengthening

WORKSHOP ON INSPIRE AND ESCAPE SOFTWARE APPLICATION FOR TSUNAMI HAZARD AND RISK ASSESSMENT AND EVACUATION PLANNING

25-28 September 2013
PHIVOLCS, Manila, Philippines

TRAINING REPORT

1. Background

For countries with inadequate resources for disaster preparedness, as is the case for most countries in the Indian Ocean and Southeast Asian region, identification of areas at high risk to tsunamis is crucial for prioritizing resource allocation. Tsunami risk assessment, which provides an estimate of potential losses in lives and cost of building damage, would reveal communities that would be highly vulnerable to the hazard and, hence, need to be prioritized for enhancing readiness. The assessment, however, entails detailed inundation modeling for a range of scenarios from most important source zones, and requires computational capability and good-quality near-shore bathymetric, topographic, and exposure datasets, which most countries in the region lack.

The project entitled *"Enhancing coastal hazard early warning and response: tools and institutional strengthening"*, supported by the United Nations Economic and Social Commission for Asia and the Pacific (ESCAP) through the Trust Fund for Tsunami, Disaster and Climate Preparedness, aims to build tsunami risk assessment capacities in Myanmar, Philippines, Sri Lanka, and Thailand, building on UNESCO/IOC efforts in the Indian Ocean region and taking advantage of low-cost methodologies developed at RIMES. RIMES shall build tsunami risk assessment capacity through training, demonstration of tool application, and transfer of equipment, software, systems, and training manuals to the countries to facilitate replication/upscaling. These tools are: a) low-cost near-shore bathymetric, topographic, and exposure survey methodologies; b) data processing tool to generate high-resolution data required for tsunami risk assessment; c) internet-based tool for tsunami risk assessment (named INSPIRE); and d) computer-based evacuation mapping tool (named ESCAPE).

For the Philippines, demonstration of near-shore bathymetric, topographic, and exposure survey methodologies was undertaken in January 2013 at the project's pilot site in Barrio Barretto, Olongapo City. Processing of field data to generate near-shore Digital Elevation Model (DEM) for tsunami inundation simulation and exposure data inventory for tsunami loss estimation and evacuation modeling was demonstrated in a workshop from 17 June to 20 July 2013 at RIMES Program Unit, involving technical officers from PHIVOLCS and NAMRIA.

2. Workshop Objective

This workshop aimed to enhance tsunami risk assessment and evacuation planning capacity in the country. Specifically, it introduced and trained participants on the functionalities and application of INSPIRE, or Internet-based Simulation Platform for Tsunami Inundation and Risk Evaluation, RIMES' web portal for identifying tsunami sources, simulating tsunami propagation and inundation, integrating exposure data, and performing tsunami loss estimation; and of ESCAPE, or Evaluation System for Computing Accessibility and Planning Evacuation, a tool to support evacuation planning, using INSPIRE outputs. The workshop used data generated from field surveys in January 2013, which were subsequently processed in workshops held from June-July 2013. This workshop included theory, practical exercises, interactive and participative lectures, discussion on case studies, and examples.

Outputs from this workshop include the following, presented in an accompanying report, entitled *Tsunami Hazard and Risk Assessment and Evacuation Planning: Barrio Barretto, Olongapo City, Philippines*:

- Tsunami inundation map
- Tsunami loss estimation and risk profile
- Evacuation zoning map
- Evacuation direction and route map
- Time required for evacuation
- Shelter capacity

3. Participants

The workshop was designed for technical officers who have responsibilities in tsunami hazard and risk mapping for tsunami early warning and/ or disaster mitigation, preparedness, response, and management. For Philippines, eleven (11) officers from Philippine Institute of Volcanology and Seismology (PHIVOLCS), two (2) officers from the Office of Civil Defense (OCD), and two (2) officers from the National Mapping and Resource Information Authority (NAMRIA) participated in the workshop. Table 1 provides the participant list.

Table1. List of workshop participants

Participant Name	Organization
1. Mr. Ericson B. Bariso	PHIVOLCS
2. Mr. Danikko John V. Rivera	PHIVOLCS
3. Mr. Julius M. Galdiano	PHIVOLCS
4. Mr. Erlinton B. Olavere	PHIVOLCS
5. Ms. Joan C. Salcedo	PHIVOLCS
6. Ms. Vilma C. Hernandez	PHIVOLCS
7. Ms. MA. Mylene M. Villegas	PHIVOLCS
8. Ms. Joan Beliran	PHIVOLCS
9. Mr. Rey Lumbang	PHIVOLCS
10. Dr. Arturo Daag	PHIVOLCS
11.Mr. Ishmael C. Narag	PHIVOLCS
12. Mr. Rodez G. Guarte	NAMRIA
13. Mr. Janer P. Sta. Ana	NAMRIA
14. Mr. Lorenzo Haveria	OCD
15. Mr. Ryan Paul P. Roxas	OCD

3.1 Participant Background

Participants from PHIVOLCS are technical officers working as science research specialists/assistants. Some have experience in tsunami simulation and background in GIS application. Participants from NAMRIA are technical officers having background and experience in survey, mapping, and GIS application; while participants from OCD are civil defense officers who, though not having background on modeling and GIS application, are users of tsunami risk assessment and evacuation modeling products.

4. Resource Persons

INSPIRE and ESCAPE application: The resource person for INSPIRE and ESCAPE application has a strong background and experience in tsunami hazard and risk assessment and evacuation modeling. Currently, she is working at the RIMES Earthquake Monitoring and Tsunami Watch division as coastal hydrodynamics scientist. She leads RIMES research and development activities in tsunami early warning, tsunami risk assessment, and tsunami forecast model and tsunami database development. Under the current project, she has developed INSPIRE and ESCAPE software for analysis tools and designed the field survey method to collect exposure data for tsunami loss estimation and evacuation planning.

GIS application support: The resource person for GIS application support has strong background and experience in surveying, mapping, remote sensing, and GIS. Currently, she is working at the RIMES Earthquake Monitoring and Tsunami Watch division as Technical Specialist for topographic survey, remote sensing, and GIS. As part of the tsunami risk assessment and mapping project team, her work includes data collection, field surveys, data preparation and quality checks, development of DEMs and gridded datasets, and development of database for GIS and research applications. She conducted research on the evaluation of different interpolation methods as well as survey intervals, and development of tools and methodologies using low cost equipment and optimization of survey work to generate bathymetric DEM, which was adopted for this workshop.

System analyst and IT support: The resource person for IT support has strong background and experience in computer engineering. Her field of expertise is scientific visualization, data warehouse and data mining, development of decision support system and expert system, and internet application and web engineering. Under the current project, she has supported INSPIRE web-portal development.

5. Workshop Highlights

The workshop started with an overview of the project's rationale and objectives, followed by presentations from PHIVOLCS and NAMRIA participants, who were involved in the field survey and data processing activities, on survey and data processing methodologies, including experiences gained from the project. Outputs from the data processing workshop in July, which includes near-shore DEM and exposure data, were used as inputs to INSPIRE and ESCAPE software applications, for tsunami hazard and risk assessment and evacuation modeling, respectively. Free GIS software (QGIS) and Google earth were introduced and used in the workshop, for overlay and visualizing results. Details of workshop content are listed in Table 2.

The workshop adopted a hands-on training approach, with detailed instruction and close supervision by resource persons. The interactive discussion fostered a good learning relationship between participants and resource persons. The training ended with a discussion on the use of tsunami hazard and risk maps, evacuation map, and shelter information in disaster preparedness and emergency response. At the end of the workshop, suggestions and comments were listed to guide the field validation activity at the pilot site, for verifying the analysis results from the workshop.

Table 2. Day-to-day workshop schedule

24 September 2013: Preparation	
Morning	Consultation meeting with PHIVOLS for ○ Selection of appropriate earthquake scenario for the assessment ○ Potential integration of the analysis products in warning and response ○ Planning on field validation
Afternoon	Setup ○ Internet connection ○ PCs ○ Room LCD projector Setup and test INSPIRE
25 September 2013: INSPIRE for tsunami inundation simulation	
08:30 – 09:00	Registration
09:00 – 09:15	Opening session
09:15 – 09:30	Overview on tsunami hazard and risk assessment project in the Philippines
09:30 – 10:45	Field surveys in Barrio Barreto: Experiences and Outcomes
10:45 – 11:00	Coffee break
11:00 – 12:00	Data requirements for INSPIRE and ESCAPE
12:00 – 13:00	Lunch
13:00 – 14:30	• Introduction to INSPIRE • Hands-on exercise: tsunami inundation simulation
14:30 – 14:45	Coffee break
14:45 – 17:30	Hands-on exercise (continued)
26 September 2013: INSPIRE for tsunami inundation simulation and loss estimation	
08:30 – 10:30	Hands-on exercise (continued from previous day)
10:30 – 10:45	Coffee break
10:45 – 12:00	Hands-on exercise (continued)
12:00 – 13:00	Lunch
13:00 – 14:30	Hands-on exercise: tsunami loss estimation
14:30 – 14:45	Coffee break
14:45 – 16:30	Hands-on exercise (continued)
16:30 – 17:30	Discussion on potential use of INSPIRE products
27 September 2013: ESCAPE for evacuation modeling	
08:30 – 10:00	Exercise on generation of tsunami fragility curves
10:00 – 10:15	Coffee break
10:15 – 12:00	Fundamentals of evacuation modeling
12:00 – 13:00	Lunch
13:00 – 14:30	Hands-on exercise
14:30 – 14:45	Coffee break
14:45 – 17:30	Hands-on exercise (continued)
28 September 2013: ESCAPE for evacuation modeling (continued)	
08:30 – 10:00	Hands-on exercise (continued from previous day)
10:00 – 10:15	Coffee break
10:45 – 12:00	Hands-on exercise (continued)
12:00 – 13:00	Lunch
13:00 – 15:00	Hands-on exercise (continued)
15:00 – 15:15	Coffee break
15:15 – 16:15	Discussion on potential use of ESCAPE products
16:15 – 16:30	Closing session

6. Workshop Outputs

Tsunami hazard and risk maps

Tsunami inundation maps for Barrio Barreto, Olongapo City were generated for three scenarios, namely rupture from Manila trench with earthquake magnitude (Mw) of a) 8.1; b) 8.3; and c) 8.6. The worst case scenario of Mw 8.6 was used as base information for estimating tsunami losses, in terms of building damage and probability of casualty. Under this scenario, tsunami arrival to the site is expected within 19 minutes from earthquake origin time. Maximum inundation depth is about 5.1 m, with extent of inundation of about 1 km inland. Potential losses were estimated for each *purok*, the smallest administration unit for the pilot site.

Evacuation routes, shelter locations and capacity

Using the inundation map output from INSPIRE as reference, locations of potential safe places outside of the inundation zone were identified. The potential shelters were then assessed against the expected number of evacuees. It was found that these shelters are not adequate to accommodate all evacuees. From discussions that ensued, the participants proposed a two-stage evacuation strategy: 1) people in the inundation zone should be guided to immediately evacuate to safe areas located along the borderline between the dry and inundation zones, for quickest response; 2) evacuees can be relocated to shelters further inland in case the event will prolong and damage along the coast has been observed.

The road network was overlaid on the tsunami inundation map to identify routes to safe areas. Based on analysis of required evacuation time, people in Baloy Long Beach will have difficulty reaching the safe places before the tsunami arrives. Locations of existing warning sirens were also evaluated; gaps in area coverage of the existing siren service were identified, to guide future installation of additional sirens.

Recommendations for field validation

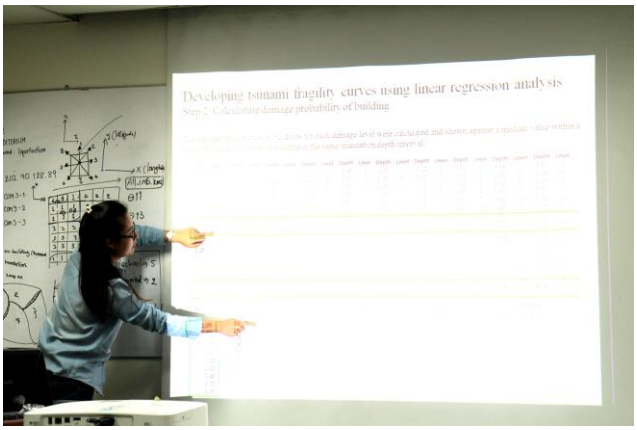
At the end of the workshop, participants discussed issues and identified recommendations for validating the outputs from INSPIRE and ESCAPE, through a field validation in Barrio Barretto. Among the items set for validation with the local government were:

- Extent of potential tsunami inundation zone
- Width of roads in the evacuation route
- Potential location of signages to guide evacuation
- Shelter capacity, distribution, and prioritization
- Acceptability of vertical structures as evacuation shelters
- Additional potential evacuation areas
- Condition of critical facilities in potential inundation zone
- Other potential hazard along the evacuation route and identified safe places (e.g. electrical posts, potential landslide)

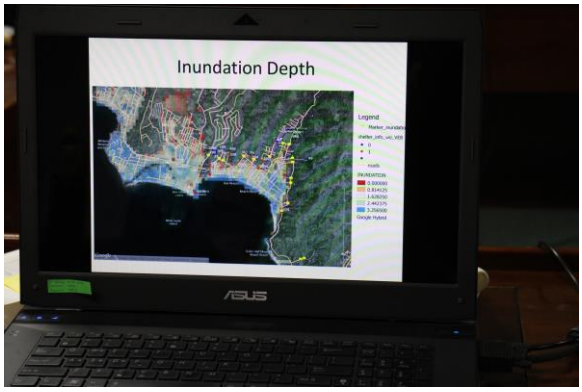
7. Participant Feedback

Participants found the quality and relevance of the training very satisfactory and the course content and materials useful. Time allocated for discussion of theoretical concepts and exercises was adequate. Participants expressed that they could confidently use INSPIRE and ESCAPE software for tsunami hazard and risk assessments and evacuation planning for other places in the Philippines. Participants who did not undergo the training on field survey and field data processing recommended the inclusion of these activities into the INSPIRE and ESCAPE training as one full training package. While this is ideal, limitations in time and funding resources would be a major constraint.

8. Workshop Photos



Lecture and hands on sessions



Presenting the results and discussion among the participants

Group photo: workshop participants and resource persons

Field validation of workshop outputs at Barrio Barretto

Field visit and discussion with Olongapo Disaster Risk Reduction and Management Office and Barrangay officials

ANNEX 1

Workshop on INSPIRE and ESCAPE Software Application for Tsunami Hazard and Risk Assessment and Evacuation Planning
25 – 28 September 2013
PHIVOLCS, Manila, Philippines

COURSE FEEDBACK

1. Presentations (in %)

	Good	Satisfactory	Needs Improvement	Comments
1) Content	67	33	-	
2) Method of delivery	50	50	-	
3) Question and answer	75	25	-	

2. Course materials (readings, course booklet, supplementary materials) (in %)

	Good	Satisfactory	Needs Improvement	Comments
Quality	58	42	-	More log-in account is required for the trainees
Relevance	83	17	-	

3. Time allocated to theoretical part (in %)

Too Much	Enough	Not Enough	Comments
-	92	8	

4. Time allocated to group discussions (in %)

Too Much	Enough	Not Enough	Comments
-	92	8	

5. Time allocated to exercises (in %)

Exercise	Too Much	Enough	Not Enough	Comments
INSPIRE inundation simulation	-	100	-	
INSPIRE risk assessment	-	100	-	
Generation of fragility curve	-	100	-	
Application on ESCAPE for evacuation modeling	-	100	-	
ESCAPE evacuation modeling	-	100	-	

6. Usefulness of the session covered (in %)

Sessions and Exercises	Very Useful	Useful	Not Useful	Comments (use additional sheets if necessary)
INSPIRE				
Grid Tool	83	17	-	
Tsunami inundation simulation	100	-	-	
Tsunami loss estimation	83	17	-	
Discussion on potential use of INSPIRE products	75	25	-	
ESCAPE				
Generation of inverse evacuation speed grid	58	42	-	
Main simulation program	75	25	-	
Escape route program	75	25	-	
Shelter capacity assessment program	58	42	-	
Discussion on potential use of ESCAPE products	75	25	-	

7. How much have you learned from this course? (%)

[67] more than expected **[33]** same as expected **[0]** less than expected

8. Subjects that could be deleted from the course:

- None

9. Subjects that could be added to the course:

- Subjects related to how to generate the needed file to be inputted to INSPIRE and ESCAPE and the conversion of raw data.
- Bathymetry data preparation
- Introduction about input data preparation
- Brief background on tsunami generation, tsunami properties, tsunami detection technologies
- Detail discussion on data processing, preparation for bathymetry and land survey mapping
- Basic use of GIS

10. Do you have any general comments about the workshop?

- The workshop is great opportunity for me. I am very thankful; it is very educational. All of us have gained knowledge from the workshop and I hope that this software can be a tool for saving lives in the future.
- If we can have some pilot site in our areas that can be great. Barrio Barretto can be the sample site of this course.
- I am very thankful for this workshop. I learned a lot and hoping for another training workshop in the future. Thank you RIMES!