

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

**WORKSHOP ON SURVEY DATA PROCESSING**  
22 July – 21 August 2013, RIMES Program Unit, Thailand

### **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).

A key project activity is capacity building on generation of near-shore bathymetric, topographic, and exposure data. Field surveys were undertaken in April 2013 in the project’s pilot site in Hambantota, Sri Lanka. 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 22 July to 21 August 2013 at RIMES Program Unit in Thailand.

#### **2. Training Objective**

The Workshop on Survey Data Processing aimed to demonstrate the generation of:

- a) near-shore DEM for use in tsunami inundation simulation; and
- b) exposure data inventory for use in tsunami loss estimation and evacuation modeling.

#### **3. Participants**

The workshop was designed for technical officers who have responsibilities in the generation of near-shore bathymetric, topographic, and exposure data, and tsunami hazard and risk mapping for tsunami early warning and/or disaster mitigation, preparedness, response and management. For Sri Lanka, the training targeted two (2) officers from the Coast Conservation Department (CCD), two (2) officers from

the National Aquatic Resource Research & Development Agency (NARA), two (2) officers from Survey Department, and one (1) officer from Disaster Management Center (DMC), as listed in Table 1.

Table 1. List of workshop participants

Participant Name	Organization
1. Ms. M. Rajitha Lakmini	CCD
2. Mr. K. Mahesha Sameera Perera	CCD
3. Mr. R.M. Ruchira Madusanka Jayathilaka	NARA
4. Ms. Dilhari Weragodathenna	NARA
5. Mr. S.D. Kelum Priyantha	Survey Department
6. Mr. W.J.K.A. Nishan Prabhath	Survey Department
7. Mr. K. Don Sampath	DMC

### 3.1 Participant Background

***Near-shore bathymetric DEM generation.*** One participant each from NARA and CCD were involved in near-shore bathymetric DEM generation. The participant from NARA, an oceanographer, has background and experience in sonar survey and survey data processing, while the participant from CCD is familiar with using high quality DEM data for his work but has no background in surveying and mapping. Both participants have no experience with GIS software, e.g. ArcGIS, QGIS.

***Near-shore topographic DEM generation.*** One participant each from Survey Department and NARA were involved in near-shore topographic DEM generation. The participant from Survey Department has background and experience in topographic surveys, and background in photogrammetry but no experience in photogrammetry work. The participant from NARA is an IT specialist, with background in remote sensing and GIS. Both participants have no background in cartography, but are proficient in mapping and using the GIS software.

***Exposure data inventory generation.*** One participant each from CCD, DMC and Survey Department were involved in exposure data inventory generation. The participants from CCD and Survey Department have good background and experiences in field survey, remote sensing, and GIS application; while the participant from DMC is an IT officer, with experiences in GIS application. All participants are proficient in using the commercial software, ArcGIS, but not much experience in using free software, in particular QGIS, which is the proposed main tool in the workshop.

## 4. Resource Persons

***Near-shore bathymetric DEM generation.*** The resource person for near-shore bathymetric DEM generation 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.

***Near-shore topographic DEM generation.*** The resource person for near-shore topographic DEM generation has strong background and experience in surveying, mapping, remote sensing, photogrammetry, and GIS. He is currently working as a pilot in the Aerial Survey Division of the Royal Thai Survey Department. At RIMES, his work includes data collection, field surveys, data preparation and quality checks, photogrammetry, development of DEMs and gridded datasets, and development of database for GIS and research applications. He conducted research on the evaluation of different topographic sources, such as maps, field survey, photogrammetry using aerial photographs and satellite

images, and freely available DEMs; and the development of methodologies to generate topographic DEM, which was adopted for this workshop.

***Exposure data inventory generation.*** The resource person for exposure data inventory generation 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.

## **5. Workshop Highlights**

Participants were divided into three (3) groups to work on near-shore bathymetric, topographic, and exposure field data, according to the work schedule presented in Table 2. The workshop started with an overall lecture on the project's rationale and objectives, followed by group-specific lectures on data processing methodologies and expected outputs. The workshop adopted a hands-on training approach, with close instructions by the resource persons. Discussion and feedback were exchanged during the course, which fostered a good learning relationship between the participants and the resource persons. The training ended with the presentation of outputs and identification of lessons learned by participants, including evaluation of the training activity.

### **5.1 Near-Shore Bathymetric DEM Generation**

Sessions aimed at building participants' capability to process bathymetric survey data to generate DEM, for use in tsunami inundation simulation. Data processed included sounding data, tidal data, and leveling survey data (for transferring MSL elevation from a known benchmark to the pilot site), as well as maps and ancillary data, such as nautical charts, topographic maps, etc. A script to automatically correct sounding data, using tidal and draft data, was developed in RIMES to assist the participants. Most of the data processing was done using the ArcGIS platform. The processed bathymetric data was combined with the processed topographic data for interpolation, to generate the digital elevation models needed for tsunami inundation modeling.

### **5.2 Near-Shore Topographic DEM Generation**

Sessions aimed at building participants' capability to process GPS field survey data and photogrammetry, using stereo pair images (aerial photos) for the pilot site. Aside from the RTK-DGPS survey conducted along the road network, fast static DGPS surveys were conducted to collect ground control and checkpoints necessary for photogrammetry. The main software used to perform photogrammetry is the Leica Photogrammetry Suite in ERDAS. Likewise, for combining topography with bathymetry data for interpolation to generate the DEMs, the ArcGIS software was used.

### **5.3 Exposure Data Inventory Generation**

Sessions aimed at building participants' capability to process field survey data and related information for generating exposure and town information, to support tsunami risk assessment and evacuation planning. Building images along the road, collected from the pilot site, were interpreted for the building properties (construction type and occupancy type) and linked to the building footprint map. Reference zones for risk assessment were managed in a format that can be further used in the analysis by INSPIRE. Information for evacuation modeling was adjusted to a format that can be inputted to ESCAPE. These data include topographic slope, land cover, transportation network, population density, population ratio for different age and gender, shelter locations and shelter capacities. Since the participants preferred to use ArcGIS software, ArcGIS was mainly used during the hands-on session, while QGIS was introduced in the supplementary exercises.



## 6. Workshop Outputs

### *Near-shore Bathymetric & Topographic DEM Generation:*

Final outputs from the near-shore bathymetric and topographic DEM generation sessions are digital elevations for four (4) regions, having varying resolutions and extents: 1) Region 1, having the coarsest resolution at approximately 3.5 km; 2) Region 2, with resolution of approximately 450 m; 3) Region 3, with resolution of approximately 150 m; and 4) Region 4, with resolution of approximately 50 m. Data for Region 4 was acquired from bathymetric and topographic surveys, while data for Region 3 is combination of survey data, map data, satellite DEMs, and other existing data. Data used for Regions 1 and 2 are from GEBCO data only. Final DEMs were validated by inputting to INSPIRE, for tsunami inundation simulation. Outputs are presented in the accompanying report entitled *Generation of Low-Cost Digital Elevation Models for Tsunami Inundation Modeling in Hambantota, Sri Lanka*.

### *Exposure Data Inventory Generation:*

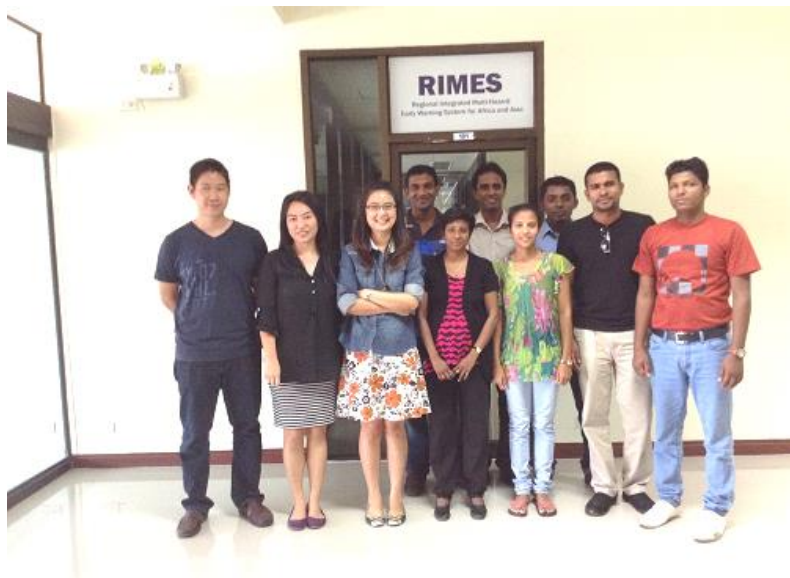
Final outputs from exposure data inventory generation session are: 1) building inventory map, with building construction type, building occupancy type, and number of daytime and nighttime residents as attributes; 2) land cover integrated with road network in grid format; 3) topographic slope in grid format; 4) GN map in grid format; 5) database of critical facilities and potential evacuation shelters; and 6) population data required for evacuation modeling. Final exposure data was validated as inputs to INSPIRE for tsunami loss estimation and ESCAPE for evacuation planning.

## 7. Participant Feedback

Participants found the training very relevant and useful in their work, with very good and appropriate training contents. They very much appreciated their learning on new methodologies for DEM and building data generation and use of new software – QGIS and ERDAS LPS. All participants expressed interest in participating in all sessions. The training was, however, very focused and targeted to specific participants.

Participants felt that the sessions on tsunami inundation modeling and risk assessment, using INSPIRE, were limited. INSPIRE was, however, used to test only the data products from the training workshop. A separate training on INSPIRE that is planned under the project shall address this concern.

## 8. Workshop Photos



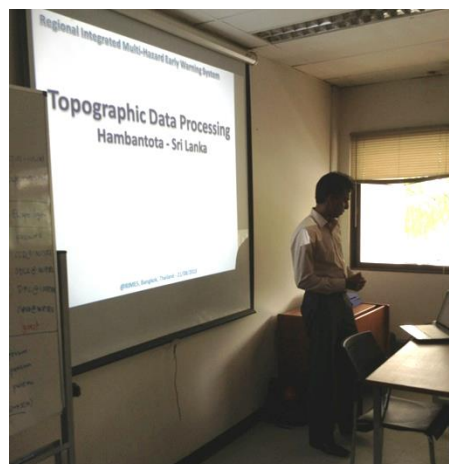
Workshop participants and resource persons



Hands-on session for data processing



Lecture and interactive discussion



Presenting results and lessons learnt



### 9. Updated Project Schedule (as of September 2013)

Project Schedule	2012					2013												2014							
	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	
<b>1. Project initiation</b>																									
1.1 Project initiation meeting				SL																					
<b>2. Capacity building in tsunami risk assessment</b>																									
2.1 Training on near-shore field surveys								SL																	
<b>2.2 Training on survey data processing and DEM generation</b>												SL	SL												
2.3 Training on tsunami risk assessment and evacuation mapping																									
<b>3. Improvement of response capabilities</b>																									
3.1 Evacuation map testing and exercise, manual adaptation																									
<b>4. Regional resource sharing policy and mechanism development</b>																									
4.1 Resource sharing policy and mechanism development																									

**ANNEX 1**  
**Workshop on Survey Data Processing**  
 22 July – 21 August 2013, RIMES Program Unit, Thailand

**COURSE FEEDBACK**

**1. Presentations (in %)**

	<i>Good</i>	<i>Satisfactory</i>	<i>Needs Improvement</i>	<i>Comments</i>
1) Content	100	-	-	Very good and relevant to application case for Sri Lanka
2) Method of delivery	100	-	-	
3) Question and Answer	83	17	-	

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

	<i>Good</i>	<i>Satisfactory</i>	<i>Needs Improvement</i>	<i>Comments</i>
Quality	67	33	-	
Relevance	100	-	-	Need more details in some parts

**3. Time allocated to theoretical part (in %)**

<i>Too Much</i>	<i>Enough</i>	<i>Not Enough</i>	<i>Comments</i>
-	100	-	It will be better if participants can join all groups (if time permits)

**4. Time allocated to group discussions (in %)**

<i>Too Much</i>	<i>Enough</i>	<i>Not Enough</i>	<i>Comments</i>
-	100	-	

**5. Time allocated to exercises (in %)**

<i>Exercise</i>	<i>Too Much</i>	<i>Enough</i>	<i>Not Enough</i>	<i>Comments</i>
Bathymetric data processing	-	100	-	
Topographic data processing	-	100	-	
Exposure data processing	-	100	-	
Application on ESCAPE for evacuation modeling	-	83	17	
Application on tsunami inundation modeling by INSPIRE	-	83	17	Need more exercises
Application on tsunami risk assessment by INSPIRE	-	83	17	Need more exercises

## 6. Usefulness of the session covered (in %)

<i>Sessions and Exercises</i>	<i>Very Useful</i>	<i>Useful</i>	<i>Not Useful</i>	<i>Comments (use additional sheets if necessary)</i>
<b>Topographic data processing</b>				
Orientation on bathymetric data processing; ERDAS LPS module installation	100	-	-	
Photogrammetry block (interior and exterior orientation)	100	-	-	
Elevation point extraction from photogrammetry	100	-	-	
Combination of elevation data from photogrammetry with bathymetric data and RTK GPS survey	100	-	-	
<b>Bathymetric data processing</b>				
Orientation on bathymetric data processing, and ArcGIS and analysis software installation	50	50	-	Useful for my future works
Survey data preparation (image and vector map)	50	50	-	
Survey route preparation	50	50	-	
Tidal and sonar data conversion	50	50	-	
Sonar data correction for tide and draft	50	50	-	Need to check other methods
Determination of local variation areas (locvar.exe)	50	50	-	
Sonar data editing (3D GIS software e.g. ArcScene)	50	50	-	
GEBCO data processing (GEBCO software & ArcMap)	50	50	-	
Interpolation by Natural Neighbor method (ArcMap)	50	50	-	
<b>Exposure data processing</b>				
Extract building construction type and building usage from VDO+ link to footprint	100	-	-	Got new ideas on method for building data collection
Generate reference zone grid for loss estimation	66	34	-	Need more detailed guide
Generate Land cover grid for evacuation modelling	34	66	-	
Estimate other inputs for evacuation modelling e.g. density of population and critical facility	34	66	-	
Generate Topographic slope grid for evacuation modeling	34	66	-	
<b>Test INSPIRE and ESCAPE</b>				
Test all inputs for INSPIRE	83	17	-	
Test all inputs for ESCAPE	83	17	-	

## 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:

- No, all sessions are necessary
- The course in the list is good

## 9. Subjects that could be added to the course:

- Add session on the mechanism used for development of INSPIRE and ESCAPE
- Add session on numerical modeling used for INSPIRE and ESCAPE e.g. tsunami wave propagation, FEM, FVM

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

- Satisfactory
- Got new ideas on method for building data collection
- Learn the new methodology for DEM generation
- Learn new software such as QGIS, ERDAS LPS
- Workshop is very useful, I can gain knowledge and experiences
- Accommodation is good

- It will be better if participants can join all groups (if the time permits)
- Need more exercises individually for INSPIRE and ESCAPE
- Workshop contents are good and appropriate