ESCAPE

Evaluation System for Computing Accessibility and Planning Evacuation

The 2004 Indian Ocean tsunami highlighted the need to raise awareness about the hazard and its risks to lives and livelihoods, as well as the need for preparedness for a similar event. Hazard and risk assessments identify areas that are exposed to the tsunami, quantify their risk to the hazard, and are used as basis in preparedness planning. To improve community preparedness for tsunami, information on evacuation procedures and shelters are essential in guiding emergency management agencies and communities on proper response during an event. Evacuation zones can be established at local level based on results from hazard analysis and risk assessment. Detailed tsunami evacuation maps, showing tsunami safe areas and escape routes can be consequently generated.

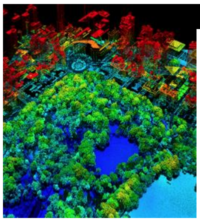
ESCAPE is a web portal developed to support evacuation planning for people in risk areas. With tsunami risks known, the fastest evacuation routes could be mapped, with due consideration of topographic condition, land use, location of critical facilities, and population density, age and gender. The system can provide information and guide on the fastest path and evacuation direction toward shelters. Evacuation basins can be determined to partition the area to several zones, which designated shelters can accommodate. Capacity of shelters can be evaluated if the number of people in the risk areas is known.

ESCAPE Components and Functionality

1. Evacuation surface modelling

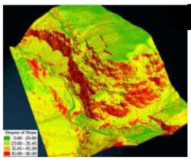
ESCAPE employs a cost-weighted distance approach in generating optimum evacuation routes from any point within the inundation zone to the nearest shelters.

Factors considered in evaluating evacuation speed include (i) land use, e.g. crossing a street would be more convenient than navigating through a mangrove area, (ii) topographic slope, e.g. walking in a flat area would be preferable to traversing a steep zone in terms of physical energy spent, (iii) age and gender, e.g. children and the elderly may have less speed than adults, (iv) population density, e.g. possibility of congestion, and (v) critical facilities, e.g. constraints associated with medical and educational facilities. Speed factors corresponding to these parameters may be specified by the user according to local condition.



Landcover	ID code	Speed factor (%)
Street	1	100
Open field, grassland	2	95
Sparse vegetation	3	90
Cropland, shrub	4	80
Settlement	5	75
Dense vegetation	6	50
Paddy field	7	40
River/Swamp	8	5
Mangrove	9	1

Figure 1. Speed factor for land use (ADPC, 2007)



Slope (degree)	Speed factor (%)
0	100
0-5	95
5-15	90
15-30	80
30-45	75
> 45	50

Figure 2. Speed factor for slope (Kawamura et al. 1991 and Horii, 2002)

Age/Gender	Evac speed (m/s)
Adult Male (15-62)	2.8
Adult Female (15-62)	2.7
Child (< 14)	2.1
Elderly (>62)	1.7

Figure 3. Evacuation speed based on age and gender (Thompson, 2004)

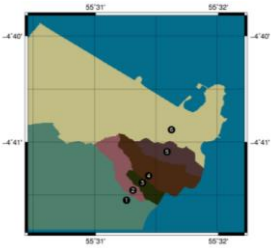
Population density	Evac speed (m/s)
0-2.5 (people/ha.)	2.8
2.5-7.5 (people/ha.)	2.7
> 7.5 (people/ha.)	2.1

Figure 4. Evacuation speed based on population density (Rogsch, 2005)

School	No hospital	Hospital>0
No KG+PS	100	50
Density up to 0.01 KG=PS/ha	100	50
Density up to 0.03 KG=PS/ha 3	70	45
Density > 0.03 KG=PS/ha.	50	40

Figure 5. Evacuation speed based on critical facilities (Klupfel, 2003)

Simulation outputs include (i) evacuation basin, which defines the evacuation zones with designated shelters; (ii) required evacuation time, which is the required time for evacuation from any point within the inundation zone to the designated shelter; and (iii) evacuation direction, which provides optimum direction for movement at any point within the inundation zone. Computation results can be downloaded by users for further processing and presentation in preferred formats.



Shelter number	Max.Evacuation Time (minute)
1	125.
2	73.
3	16.
4	53.
5	37.
6	127.

Figure 6. Evacuation basin (left) and maximum evacuation time (right)

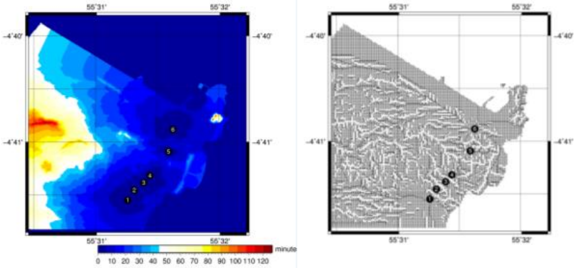


Figure 7. Evacuation time (left) and evacuation direction (right)
(Pointe Larue and Anse Aux Pins, Seychelles)

2. Route simulation

The route simulation component is designed for searching the fastest path from any selected starting point towards the designated shelter.

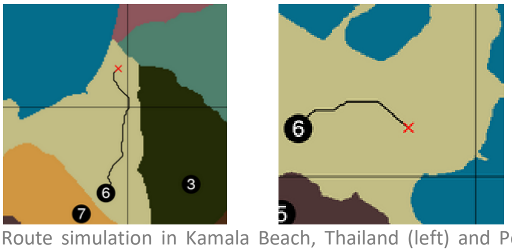


Figure 8. Route simulation in Kamala Beach, Thailand (left) and Pointe Larue, Seychelles (right)

3. Shelter capacity

The shelter capacity component is designed to evaluate the shelter capacity against the expected number of evacuees.

Shelter number	Max.Evacuation Time (minute)	Shelter Capacity (person)	Expected Evacuees (person)	Shelter Status
1	77.	1500	404	
2	72.	2500	401	
3	29.	500	722	
4	54.	500	0	
5	79.	500	0	
6	61.	500	2837	

4. Evacuation mapping

When designing evacuation maps, selection of worst case scenario in consultation with local authorities and with reference to historical events/previous studies on earthquake source parameters that have caused tsunamis in the country is highly recommended. Although the probability of occurrence for this scenario is low, its impact would always cover the lower earthquake magnitude scenarios.

Outputs generated from the tool may be used as a guidance in planning evacuation routes.

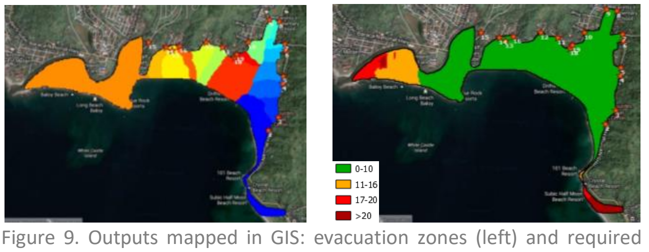


Figure 9. Outputs mapped in GIS: evacuation zones (left) and required evacuation time (right) for Barrio Barreto, Philippines


Figure 10. Validation of outputs at the site


Figure 11. Simplified evacuation routes and direction guides (left) and evacuation signage and location (right) for Barrio Barreto, Philippines

Figure 12. Further analysis and recommendations, e.g. area under existing tsunami alert sirens (left) and alternative route for connecting to inland areas (right)

Capacity building on ESCAPE

RIMES organizes training on ESCAPE for enhancing evacuation mapping capacity. Specifically, the training workshop introduces and demonstrates the functionalities and applications of ESCAPE. The workshop includes theory, practical exercises, interactive and participative lectures, discussion on case studies, examples, and field survey for output validation.

The workshop is designed for officers who have responsibilities in tsunami mitigation, preparedness, response, and management.

The **Regional Integrated Multi-Hazard Early Warning System** (RIMES) is an international and intergovernmental institution that is owned and managed by its Member States for the generation and application of early warning information. RIMES helps to build capacity of Member States in the observation and monitoring of seismic, tsunami, oceanic, meteorological, hydrological, and climate phenomena, and in the generation and communication of associated risks, for appropriate and timely user responses to warning.

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