ASSESSMENT OF TSUNAMI HAZARDS AND EXPOSURE OF SRI LANKA: CASE STUDY IN SOUTH-WESTERN COAST

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This research focuses on assessing the exposure of Sri Lanka's southwestern coast to tsunami hazards. Tsunamis are a series of ocean waves triggered by impulsive disturbances, such as undersea earthquakes, volcanic eruptions, landslides, and cosmic explosions. The catastrophic impact of tsunamis, as demonstrated by the devastating Indian Ocean tsunami (IOT) event in December 2004, underscores the urgent need for an effective early warning system to mitigate the loss of life and property in coastal regions.

The study specifically examines the vulnerability and exposure of the southern coastline ranging from Rathgama to Dadalla. The Community Model Interface for Tsunami (ComMIT) is used in the research's numerical simulation. Access to a precomputed tsunami scenario database and the MOST (Method of Splitting Tsunami) model created by the NCTR (National Center for Tsunami Research) is made possible through ComMIT, a user-friendly graphical interface. The model simulates tsunami waves with magnitudes ranging from 7.6 to 9.2 Mw, originating from selected unit sources along the Sunda trench in Indonesia and the Makran fault in Pakistan. The Sunda Arc is a volcanic arc that formed the islands of Java and Sumatra. Makran fault is located to the northwest off the coast of Pakistan. Makran trench is less affected relative to Sunda arc. For this research study five zones in Sunda trench and one zone in Makran fault are taken for segmentation of unit sources.

By combining the model's output with Green's law, the research calculates the maximum wave heights at a depth of 1 m. This data is crucial in identifying the levels of tsunami exposure along the coastal stretch. Furthermore, it enables the accurate projection of the exposure, facilitating the incorporation of lag-time effectively into early warning systems.

The findings of this study will contribute to enhancing the understanding of tsunami hazards in Sri Lanka and specifically the southwestern coastal region. Exposure assessment will aid in issuing timely and accurate warnings, minimising the potential for fatalities and injuries in future tsunami events. Ultimately, the research aims to improve disaster preparedness and enhance the resilience of coastal communities in Sri Lanka to mitigate the impacts of tsunamis.

Keywords: Tsunamis, Exposure assessment, ComMIT, Early warnings, Sunda trench

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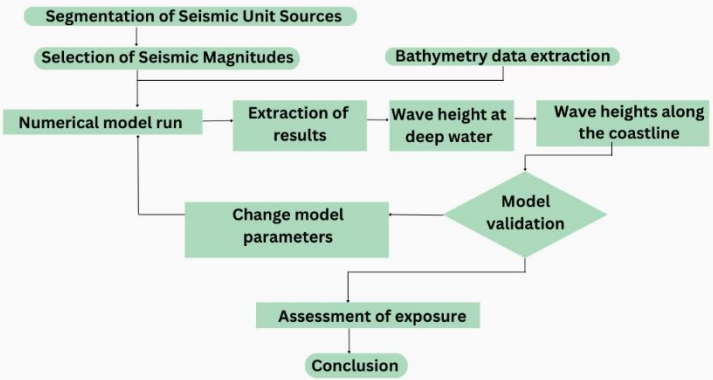
Objectives

To study potential tsunami hazards along the selected coastline

To analyze tsunami generation scenarios, unit source parameters and run a model for different scenarios

To assess the exposure using the wave heights and establishing a database to the selected coastal area

Methodology



Earthquake Parameters for Modelling

Leonard (2010)

$\log Mo = 2.5\log(L) + 7.96$

$\log W = 0.667\log(L) + 1.24$

Hanks and Kanamori (1979)

$Mw = \frac{2}{3} \text{ Log } (Mo) - 6.1$

Greenslade et al. (2011)

$Mo = \mu\ L\ W\ uo$

For Sunda trench, $\mu = 4.48 \times 10^{10}\ N/m^2$

Mw = Moment magnitude

Mo = Seismic moment

L = Fault length

W = Fault width

μ = Shear modulus / Rigidity of Earth

uo = Slip of rupture

Segmentation of Unit Sources

For this study five zones in Sunda trench and one zone in Makran fault have been taken for segmentation of unit sources.

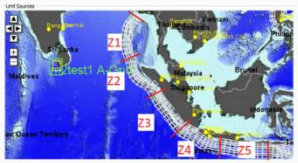


Figure 1: Unit source zones in Sunda trench

Figure 2: Unit source zones in Makran fault

Selected Locations

Figure 3 : Selected locations

Table 1: Selected locations

Point	Depth (m)	Latitude (° N)	Longitude (° E)
1	-46	6.066	80.096
2	-44	6.058	80.108
3	-44	6.044	80.12
4	-49	6.025	80.131
1a	-75	6.045	80.068

- Focused on the assessment of tsunami exposure along Rathgama to Dadalla.

Exposure Assessment

Table 2: Exposure Level at Location 1

Moment magnitude	Z1	Z2	Z3	Z4	Z5	Z6
7.6	None	None	None	None	None	None
7.8	None	None	None	None	None	None
8.0	None	None	None	None	None	None
8.2	None	None	None	None	None	None
8.4	None	Low	None	None	None	None
8.6	None	Medium	Low	None	None	None
8.8	None	High	Low	None	None	None
9.0	Low	High	Low	Low	None	None
9.1	Medium	High	Low	Low	None	None
9.2	High	High	Medium	Low	Low	None

Table 3: Exposure Level at Location 2

Moment magnitude	Z1	Z2	Z3	Z4	Z5	Z6
7.6	None	None	None	None	None	None
7.8	None	None	None	None	None	None
8.0	None	None	None	None	None	None
8.2	None	None	None	None	None	None
8.4	None	Low	None	None	None	None
8.6	None	Medium	None	None	None	None
8.8	None	High	None	None	None	None
9.0	Low	High	Low	Low	None	None
9.1	Medium	High	Low	Low	None	None
9.2	High	High	Medium	Low	Low	None

Table 4: Exposure Level at Location 3

Moment magnitude	Z1	Z2	Z3	Z4	Z5	Z6
7.6	None	None	None	None	None	None
7.8	None	None	None	None	None	None
8.0	None	None	None	None	None	None
8.2	None	None	None	None	None	None
8.4	None	Low	None	None	None	None
8.6	None	Medium	None	None	None	None
8.8	None	High	None	None	None	None
9.0	Low	High	Low	Low	None	None
9.1	Medium	High	Low	Low	None	None
9.2	High	High	Medium	Low	Low	None

Table 5: Exposure Level at Location 4

Moment magnitude	Z1	Z2	Z3	Z4	Z5	Z6
7.6	None	None	None	None	None	None
7.8	None	None	None	None	None	None
8.0	None	None	None	None	None	None
8.2	None	None	None	None	None	None
8.4	None	Low	None	None	None	None
8.6	None	Medium	Low	None	None	None
8.8	None	High	Low	None	None	None
9.0	Low	High	Low	Low	None	None
9.1	Medium	High	Low	Low	None	None
9.2	High	High	Medium	Low	Low	None