

**STUDY ON TSUNAMI INUNDATION SIMULATION IN THE NORTHWESTERN COAST  
OF SABAH, MALAYSIA**

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**1. Fault Parameters**

Table 1. List of parameters set for each segment (Salcedo, 2010).

Segment (No.)	Mag Mw	location of the fault		Length L (km)	Width W (km)	Strike $\phi$ ( $^{\circ}$ )	Dip $\delta$ ( $^{\circ}$ )	Rake $\lambda$ ( $^{\circ}$ )	Slip amount U (m)
		Long ( $^{\circ}$ E)	Lat ( $^{\circ}$ N)						
<b>MT1</b>	8.4	119.20	17.75	277	91.00	20	41	79	3.72
<b>MT2</b>	8.4	119.10	16.06	254	91.16	1	36	95	3.69
<b>MT3</b>	8.3	119.06	13.93	238	87.88	359	40	98	3.42
<b>MT4</b>	8.1	120.60	12.85	190	77.4	310	25	90	2.63

Table 2. Parameters for the scenario earthquakes.

Scenario	Single Segmentation	Mw	Slip amount, u (m)
1a	MT4	8.1	2.63
1b	MT4	8.4	10.0
1c	MT4	8.6	20.0
Scenario	Multi Segmentation	Mw	Slip amount, u (m)
2a	MT4+MT3+MT2	8.8	10.0 for all segments
2b	MT4+MT3+MT2	9.0	20.0 for all segments
3a	MT4+MT3+MT2+MT1	8.9	10.0 for all segments
3b	MT4+MT3+MT2+MT1	9.1	20.0 for all segments

The top depth for all scenarios is assumed to be 0 km.

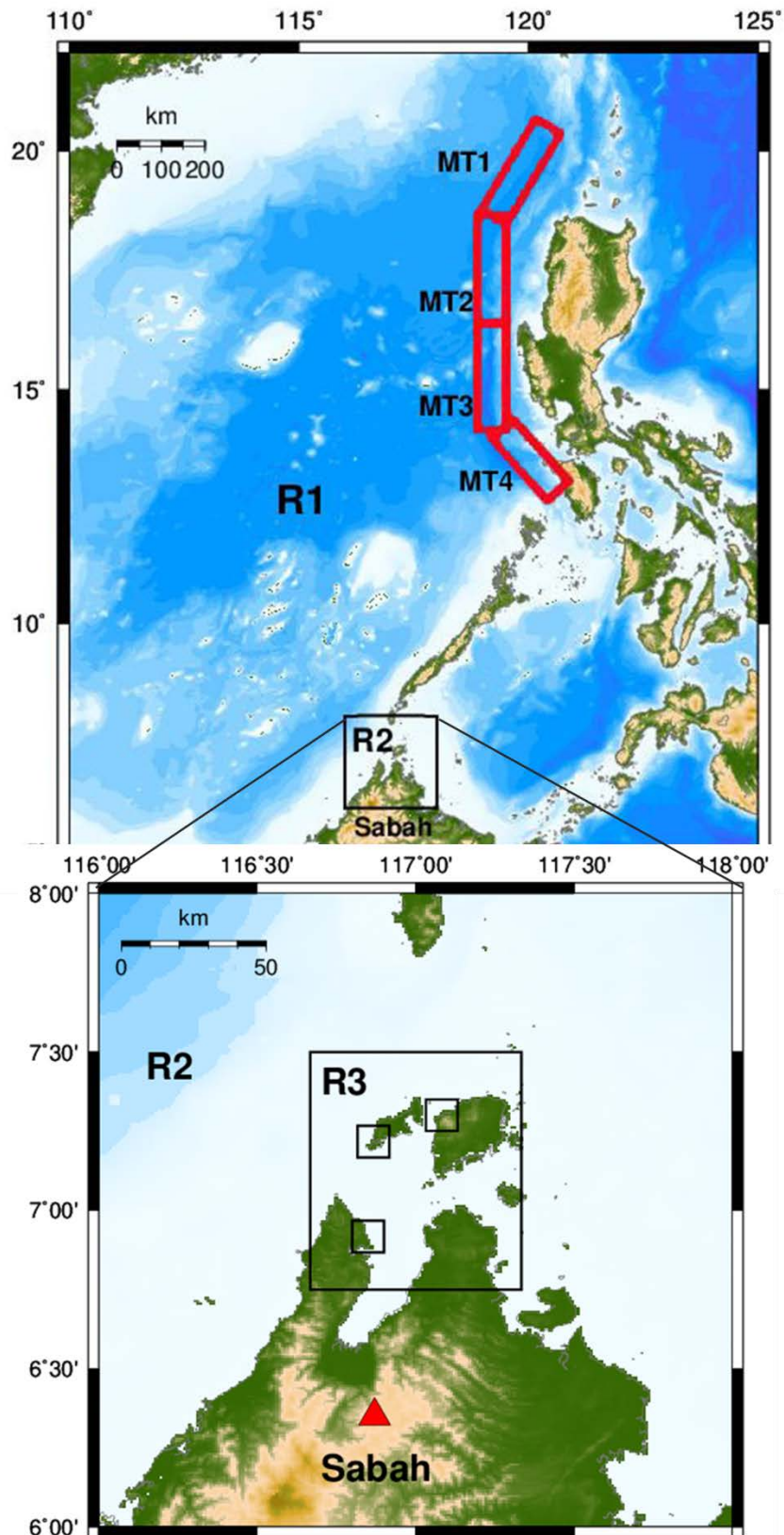


Figure 1. Computational domain Regions 1 (R1), 2 (R2) and 3 (R3). Earthquake source region in the Manila Trench (MT) is divided into four segments, MT1, MT2, MT3, and MT4 (Salcedo, 2010) (top).

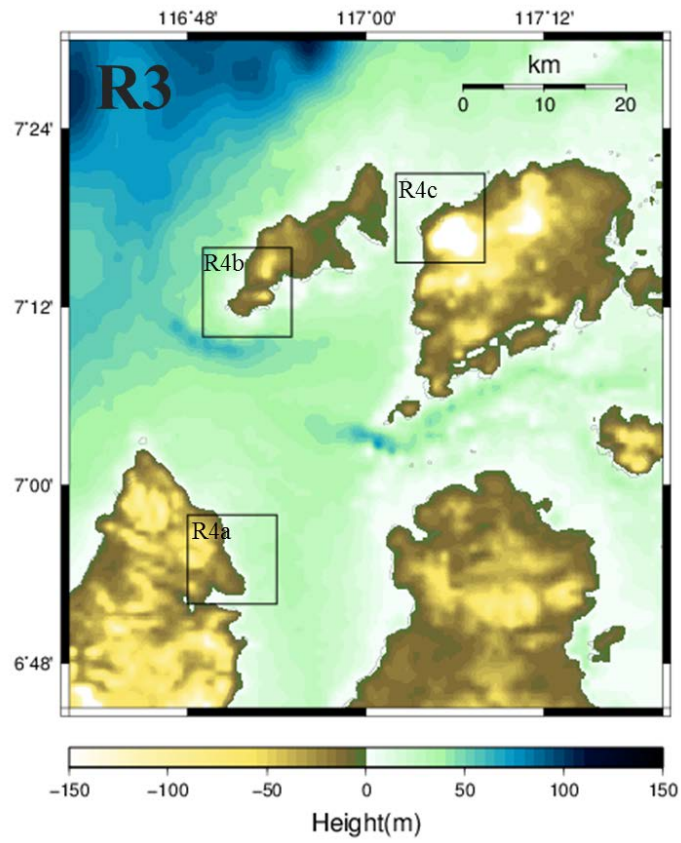


Figure 2. Computational domain Region 3 (R3) and Regions 4a (R4a), b (R4b) and c (R4c). Scale denotes the height and water depth in the regions. Water depth is indicated by positive scale and the land elevation is indicated by negative scale.

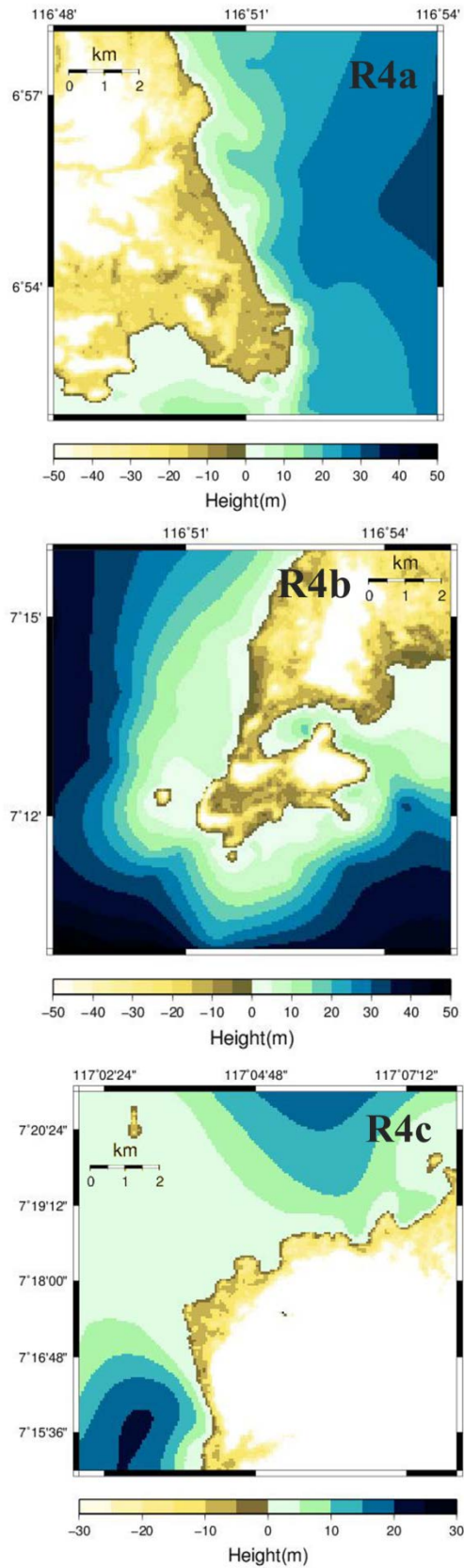


Figure 3. Same as Figure 2, but for the magnifications of Region 4a (top), 4b (middle) and 4c (bottom).

## 2. Tide Gauge Stations

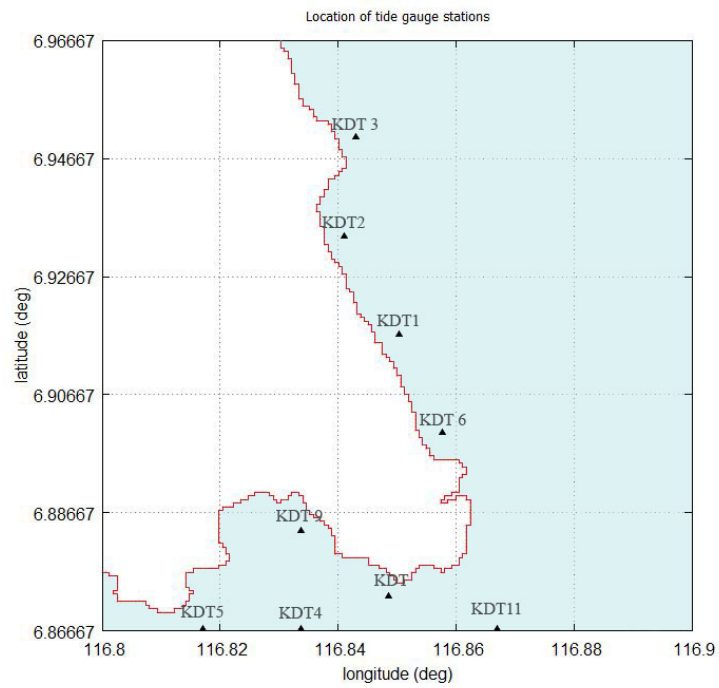


Figure 4. Tide Gauge locations along coastal area Kudat Peninsula for Region 4a (R4a).

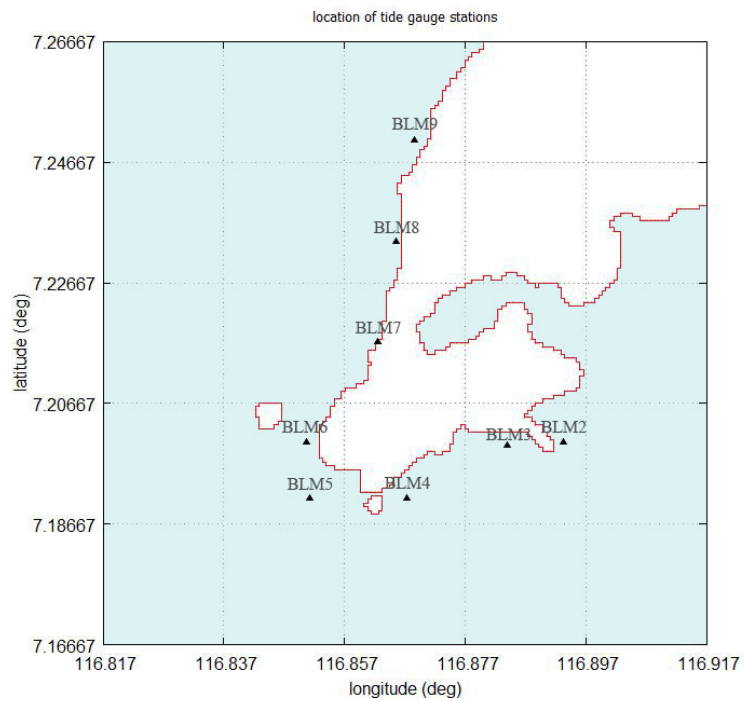


Figure 5. Tide Gauge locations along coastal area Balambangan Island for Region 4b (R4b).

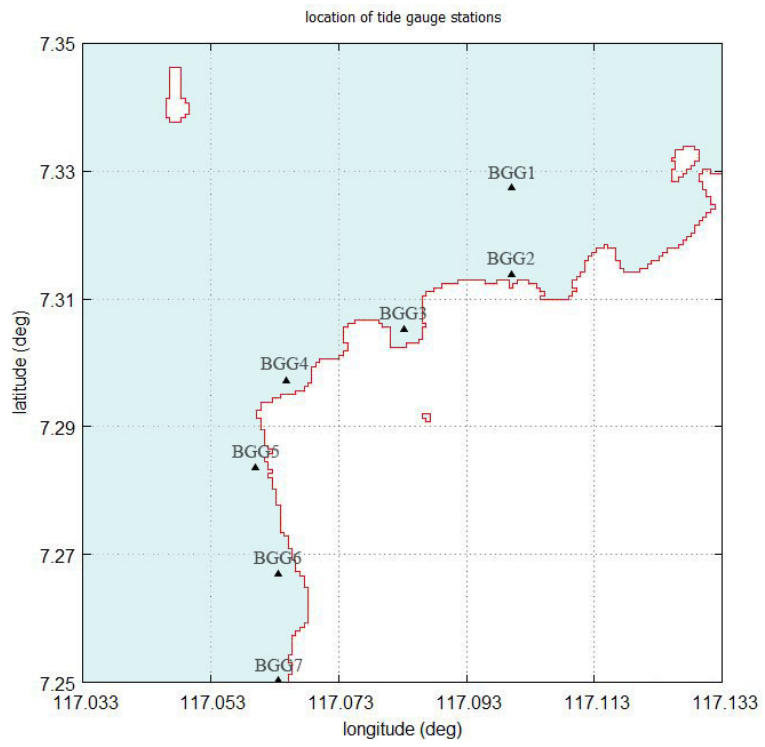


Figure 6. Tide Gauge locations along coastal area Banggi Island for Region 4c (R4c).

Table 3. Tide gauge stations along target area.

Name	Longitude (deg:min:sec)	Latitude (deg:min:sec)	Depth (m)	Assumed or Existing
KDT	116:50:38.45	06:52:44.50	12.84	Existing
KDT1	116:51:00	06:55:00	5.03	Assumed
KDT2	116:50:26.66667	06:56:00	7.52	Assumed
KDT3	116:50:33.33333	06:57:00	7.93	Assumed
KDT4	116:50:00	06:52:00	12.84	Assumed
KDT5	116:49:00	06:52:00	1.00	Assumed
KDT6	116:51:26.66667	06:54:00	11.13	Assumed
KDT9	116:50:00	06:53:00	1.12	Assumed
KDT11	116:52:00	06:52:00	19.07	Assumed
BLM2	116:53:33.33333	07:12:00	0.95	Assumed
BLM3	116:53:00	07:11:53.33333	5.09	Assumed
BLM4	116:52:00	07:11:00	7.71	Assumed
BLM5	116:51:00	07:11:00	21.96	Assumed
BLM6	116:51:00	07:12:00	1.00	Assumed
BLM7	116:51:00	07:13:00	7.30	Assumed
BLM8	116:51:53.33333	07:14:00	0.99	Assumed
BLM9	116:52:00	07:15:00	4.75	Assumed
BGG1	117:06:00	07:20:00	13.42	Assumed
BGG2	117:06:00	07:18:53.33333	1.67	Assumed
BGG3	117:05:00	07:18:53.33333	3.86	Assumed
BGG4	117:03:53.33333	07:18:00	1.00	Assumed
BGG5	117:03:33.33333	07:17:00	0.98	Assumed
BGG6	117:03:42.22222	07:16:00	12.51	Assumed
BGG7	117:03:46.66667	07:15:00	1.63	Assumed

### 3. Results (Tsunami Heights)

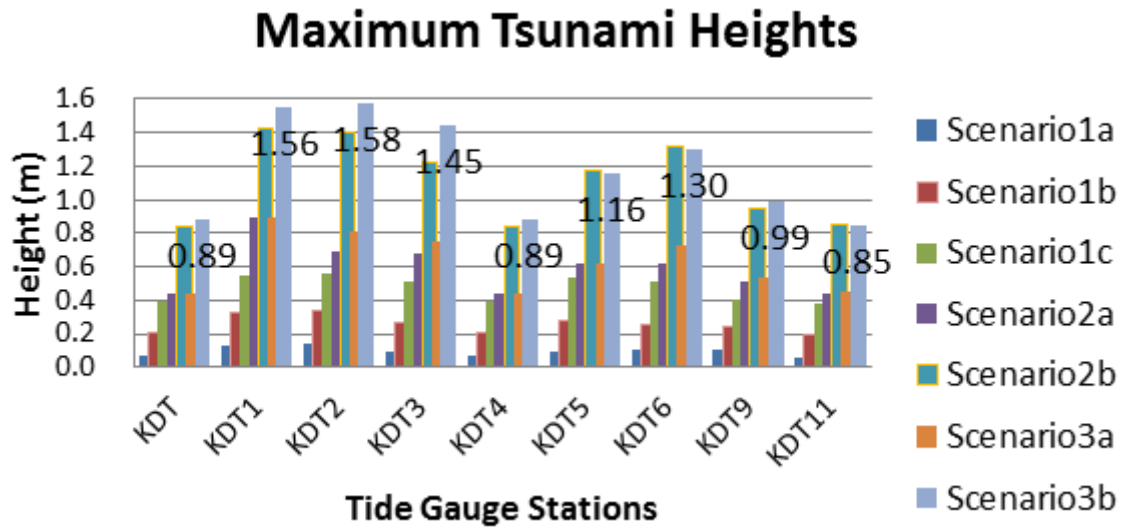


Figure 7. Maximum tsunami heights at tide gauge stations for all earthquake scenarios in Region 4a.

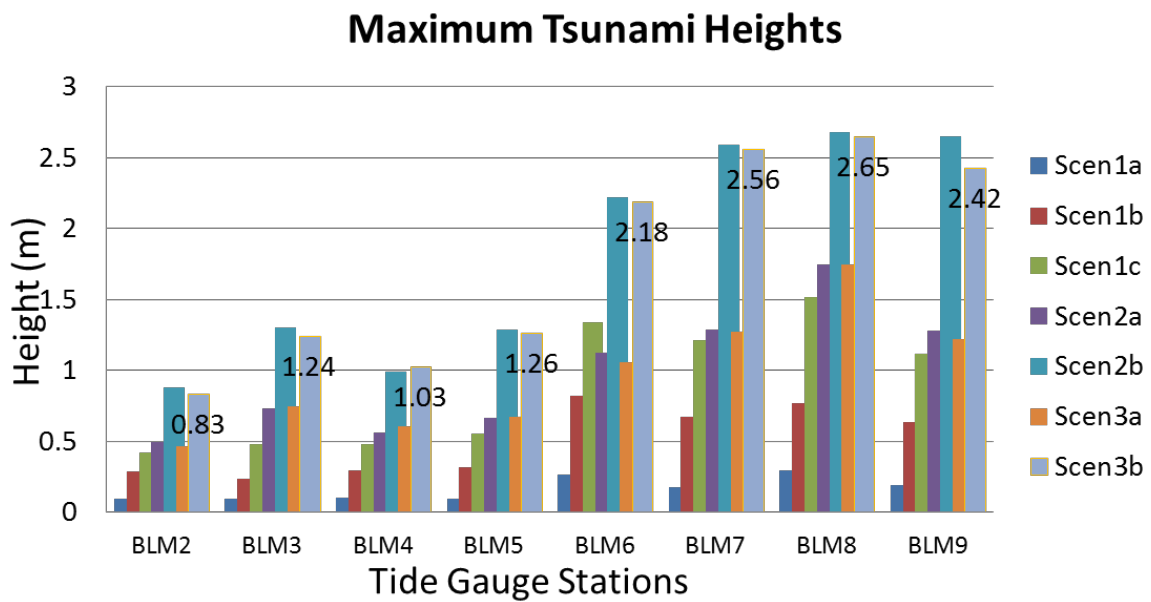


Figure 8. Same as Figure 11, but in Region 4b.



### Maximum Tsunami Heights

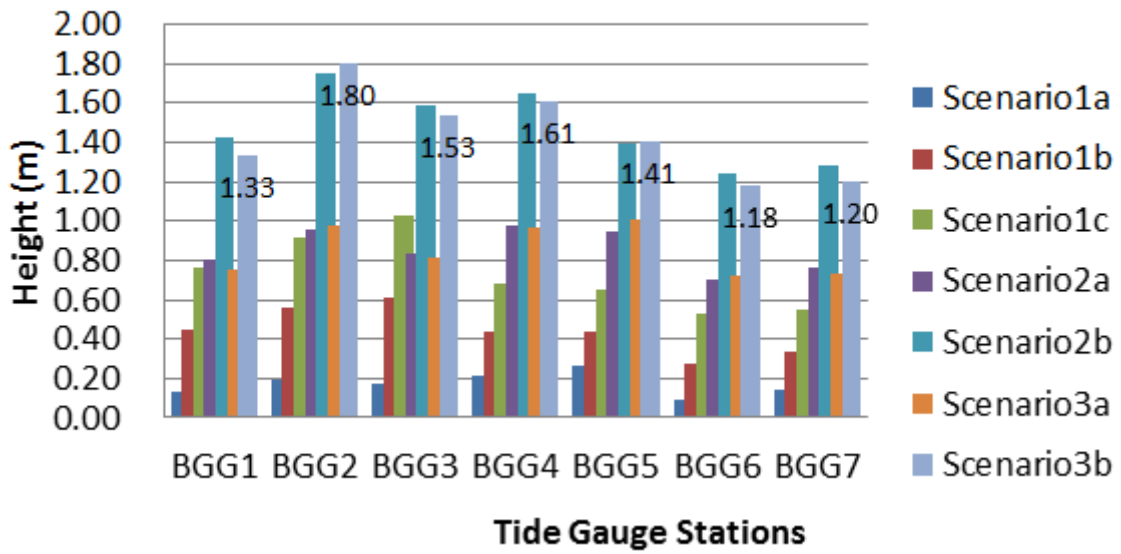


Figure 9. Same as Figure 11, but in Region 4c.

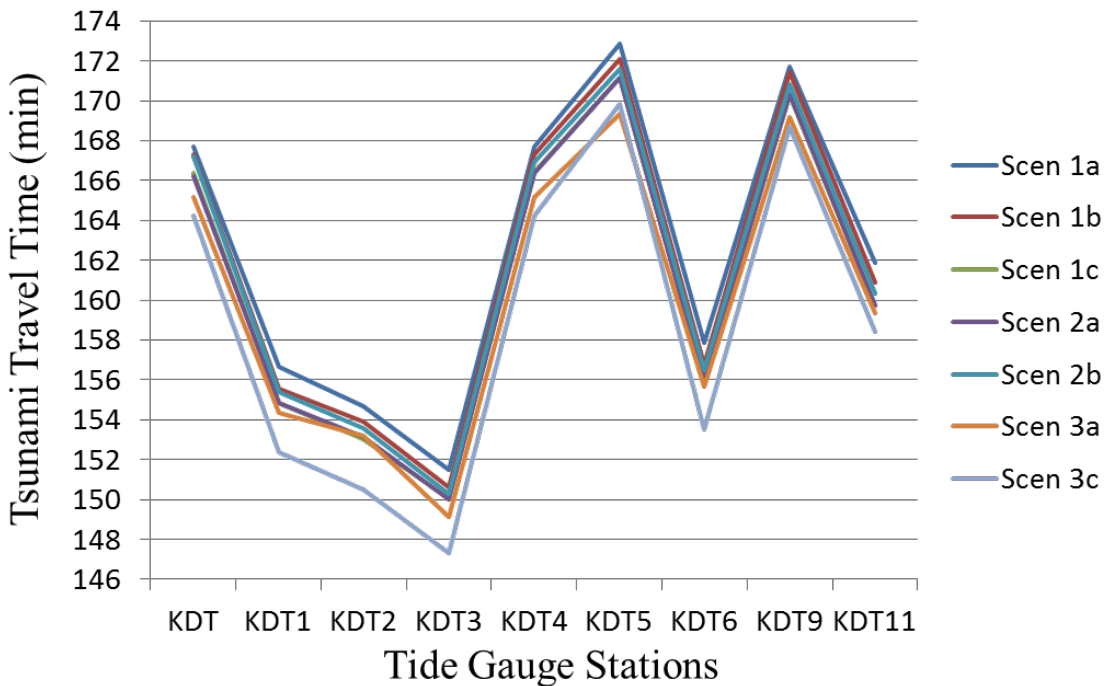


Figure 10. Tsunami travel time at tide gauge stations for all earthquake scenarios in Region 4a.

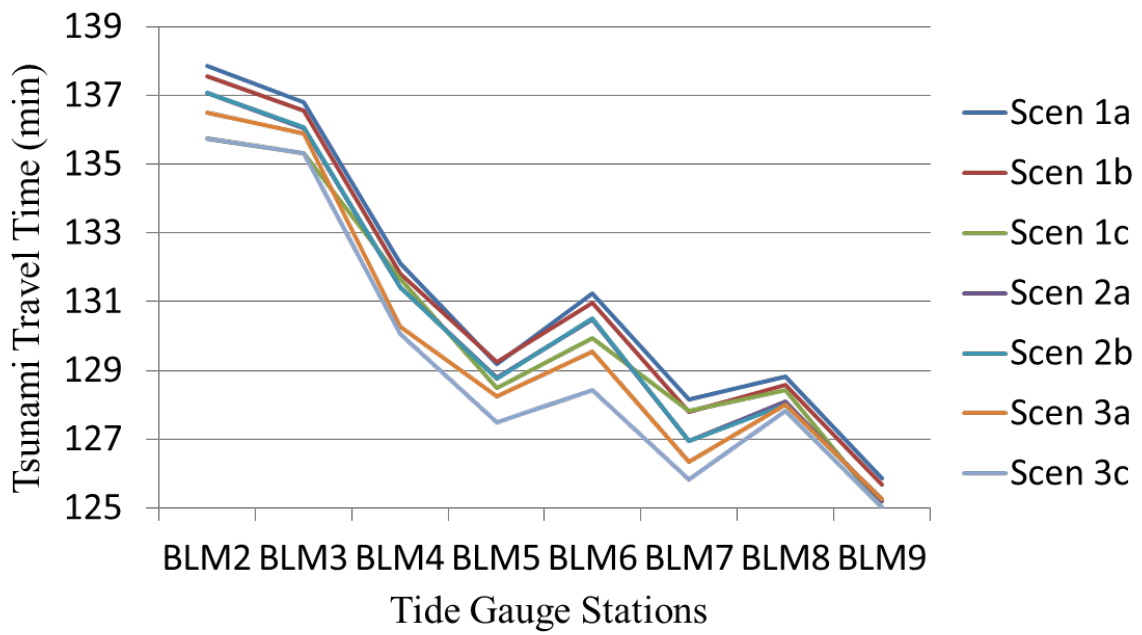


Figure 11. Same as Figure 21, but in Region 4b.

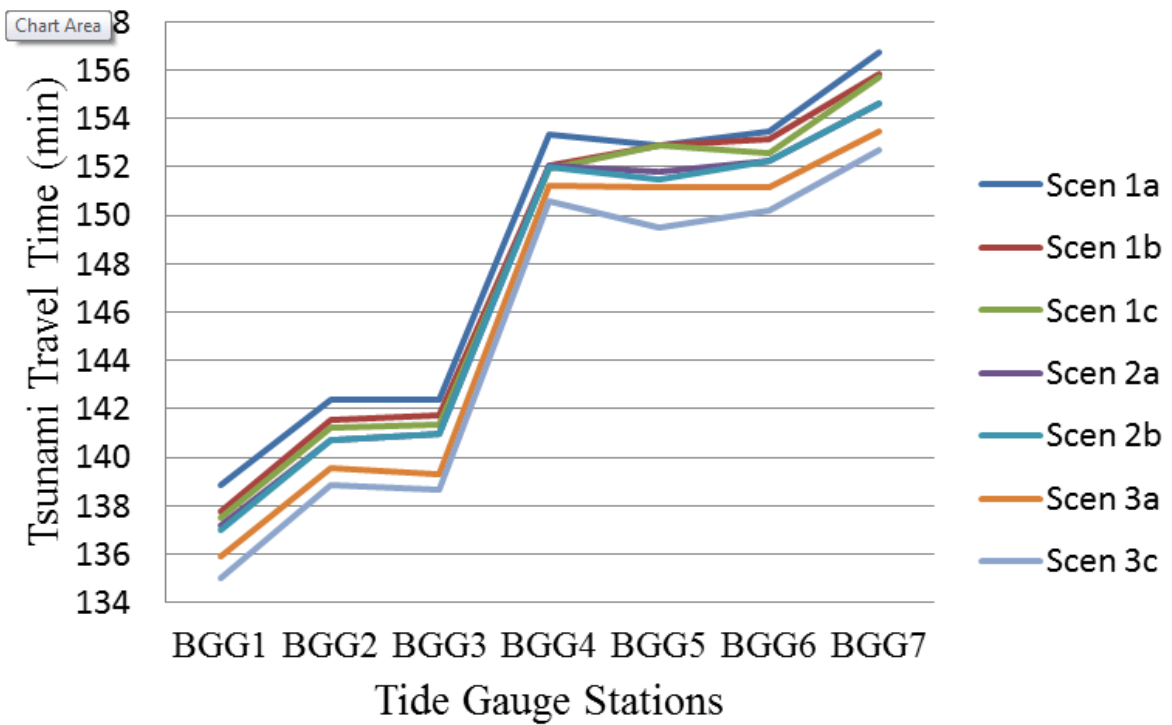


Figure 12. Same as Figure 21, but in Region 4c.

#### 4. Conditions for Computation

Table 4. Target area of 4 grid-size regions for this study.

Domain	Longitude	Latitude
Region 1	110°E-125°E	5°N-22°N
Region 2	116°E-118°E	6°N-8°N
Region 3	116°40'E-117°20'E	6°45'N-7°30'N
Region 4a - Peninsula Kudat	116°48'E-116°54'E	6°52'N-6°58'N
Region 4b - Balambangan Island	116°49'E-116°55'E	7°10'N-7°16'N
Region 4c - Banggi Island	117°02'E-117°08'E	7°15'N-7°21'N

Table 5. Settings for computational dimensions in each region.

	Region 1	Region 2	Region 3	Region 4a-c
Coordinate	Spherical	Spherical	Spherical	Spherical
Governing equation	Linear SWE	Non-linear SWE	Non-linear SWE	Non-linear SWE
Grid size	1 arc minute	20 arc seconds	6.6667 arc seconds	2.2222 arc seconds
Bottom friction	No	Yes	Yes	Yes
Coriolis Force	Yes	No	No	No
Manning's roughness coeff.	None	0.025	0.025	0.025
Grid no. in longitude	900	360	360	162
Grid no. in latitude	1020	360	450	162

Table 6. Region divided into 4 domains.

Region	Longitude		Latitude		Data Source	
	Min (°E)	Max (°E)	Min (°N)	Max (°N)	Bathymetry	Topography
<b>R1</b>	110.0	125.0	5.0	22.0	GEBCO 30sec	GEBCO 30sec
<b>R2</b>	116.0	118.0	6.0	8.0	GEBCO 30sec	GEBCO 30sec
<b>R3</b>	117.0	117.5	6.6	7.1	GEBCO 30sec	GEBCO 30sec
<b>R4a</b>	116.8	117.3	6.7	7.5	Nautical chart	SRTM
<b>R4b</b>	116.8	116.9	7.2	7.3	Nautical chart	SRTM
<b>R4c</b>	117.0	117.1	7.2	7.3	Nautical chart	SRTM

Temporal grid size ( $\Delta t$ ) of 1.0 s is used to stabilize the numerical computation.