



On the Job Training on

*Tsunami Inundation Modelling and Mapping and Development of Tsunami Hazards Maps for Implementation of UNESCO-IOC Tsunami Ready Pilot Sites in Madagascar, Maldives, Seychelles and Sri Lanka
Hyderabad – India, 16–21 March 2026*

TIMM 2.5: Preparations of grids and boundary conditions for COMMIT

Patanjali Kumar Chodavarapu, M.S (DM), Ph.D

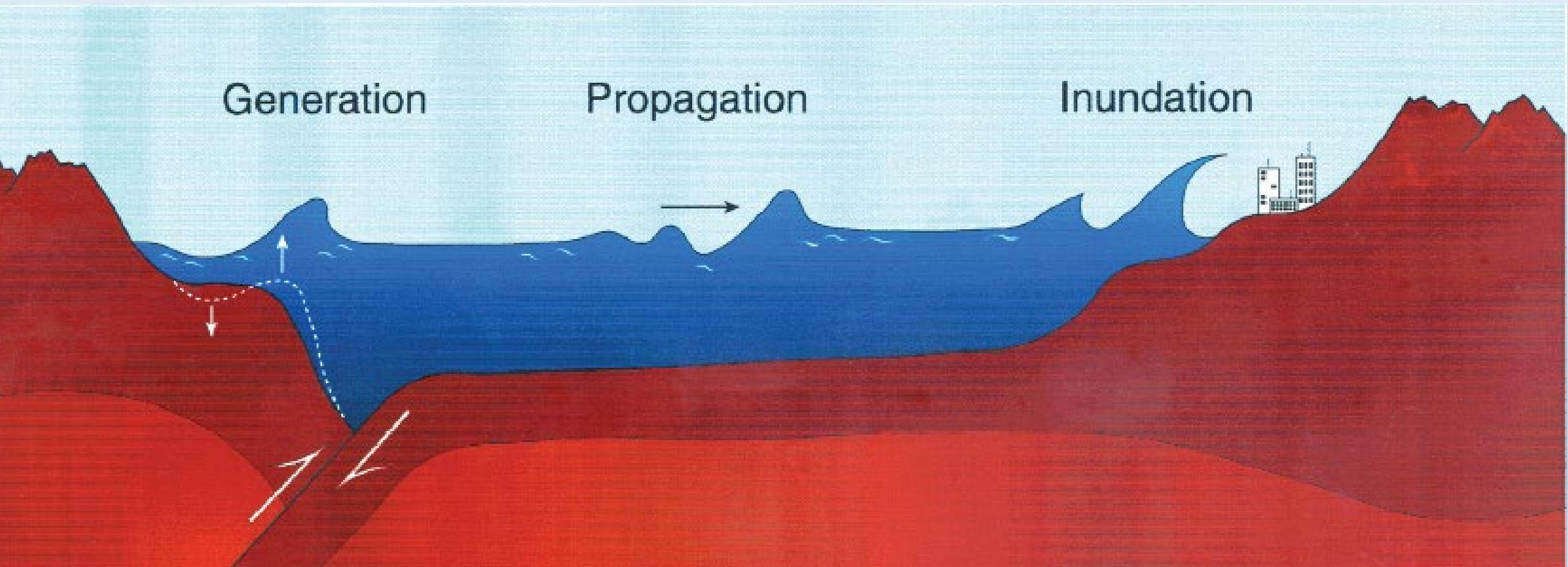
Scientist -F

Indian National Center for Information Services (INCOIS), MoEs, Hyderabad

patanjali@incois.gov.in

Tsunami Modelling and Forecasting

Tsunami models



Contents

1. How to create “Grid Bathymetry” in ComMIT?
2. Using ComMITserver bathymetry dataset for inundation
3. Using GEBCO 30 arc sec + SRTM 1 arc sec in “Cgrids” for inundation (given)

Target :

Comparison ComMITserver bathymetry and another “free” DEM source (GEBCO & SRTM) for inundation purpose.

ComMITserver dataset

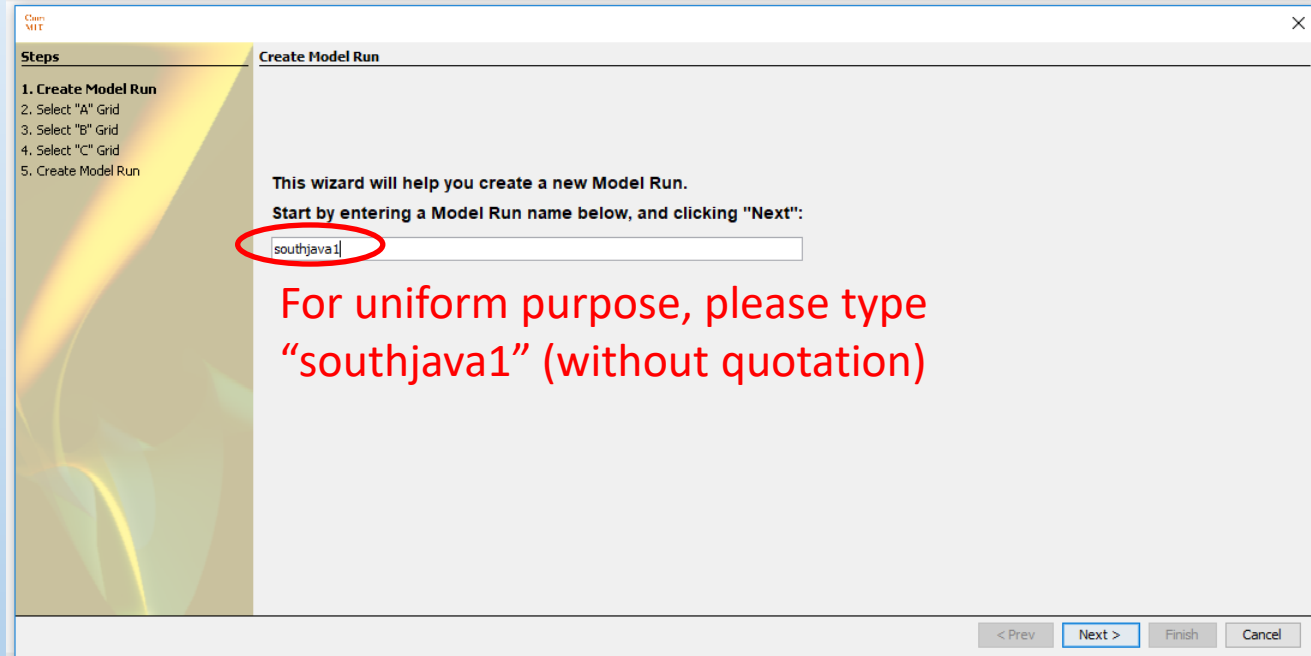
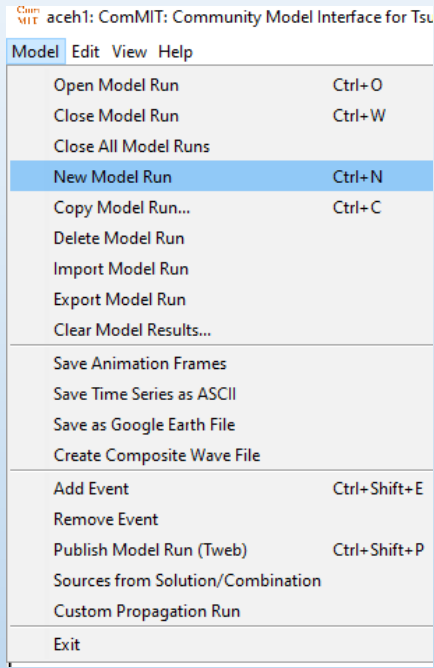
The ComMITServer bathymetry dataset is derived from two sources:

- Bathymetry is from the [ETOPO1 1 arc-minute gridded global relief model](#) produced by the NOAA National Geophysical Data Center. The ETOPO1 dataset is compiled from many different global and regional data sets, evaluated and edited, and shifted to reference mean sea level vertically, and WGS84 horizontally. This data has been INTERPOLATED FROM 60 ARC-SECONDS TO 3 ARC-SECONDS to match the topography data set. This makes it inappropriate for any use except training.
- Topography is from the [CGIAR SRTM 90m](#) version 4 digital elevation model produced by the CGIAR Consortium for Spatial Information. This 3 arc-second (~90 meters at the equator) dataset is a processed version of the Shuttle Radar Topography Mission (SRTM) data created by NASA.

Some Recommended Sources of DEM Data

Coverage	Sources	Type	Links
Global	ETOPO2	bathymetry, topography	http://www.ngdc.noaa.gov/mgg/global/global.html
	GEBCO	bathymetry, topography	http://www.ngdc.noaa.gov/mgg/gebco/gebco.html
U.S. and its territories	NOAA	bathymetry, topography, shoreline, datum	http://www.ngdc.noaa.gov/ http://www.nos.noaa.gov/
	USGS	topography, photography, bathymetry	http://seamless.usgs.gov/
	USACE	bathymetry, shoreline	http://www.usace.army.mil/
	State agencies, universities	various	various
Local region	Local Agencies	various	various

Create Grid Bathymetry Using ComMITserver



For uniform purpose, please type
"southjava1" (without quotation)

Create Grid Bathymetry Using ComMITserver

Com MIT

Steps

1. Create Model Run
- 2. Select "A" Grid**
3. Select "B" Grid
4. Select "C" Grid
5. Create Model Run

Select "A" Grid

Grid Extents: N
 W E
 S

Cell Size:
 (deg) (arcmin) (arcsec)

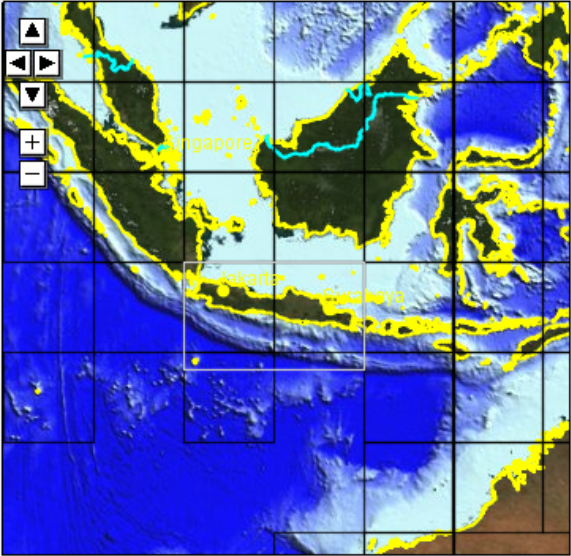
Number points, nx: 300 ny: 180 total: 54000

File Name:

Show Cities

Grid A

Interval Grid



Hold **Shift** and drag to select a grid extent.
High-resolution data is available in areas outlined by black boxes.

< Prev Next > Finish Cancel

Create Grid Bathymetry Using ComMITserver

Steps

1. Create Model Run
2. Select "A" Grid
- 3. Select "B" Grid**
4. Select "C" Grid
5. Create Model Run

Select "B" Grid

Grid Extents: W E
 N S

Cell Size:
 (deg) (arcmin) (arcsec)

Number points, nx: 143 ny: 131 to file:

Show Cities

Hold **Shift** and drag to select a grid extent.
High-resolution data is available in areas outlined by black boxes.

< Prev **Next >** Finish Cancel

Create Grid Bathymetry Using ComMITserver

ComMIT

Steps

1. Create Model Run
2. Select "A" Grid
3. Select "B" Grid
4. **Select "C" Grid**
5. Create Model Run

Select "C" Grid

Grid Extents: N
 W E
 S

Cell Size: (deg) (arcmin) (arcsec)

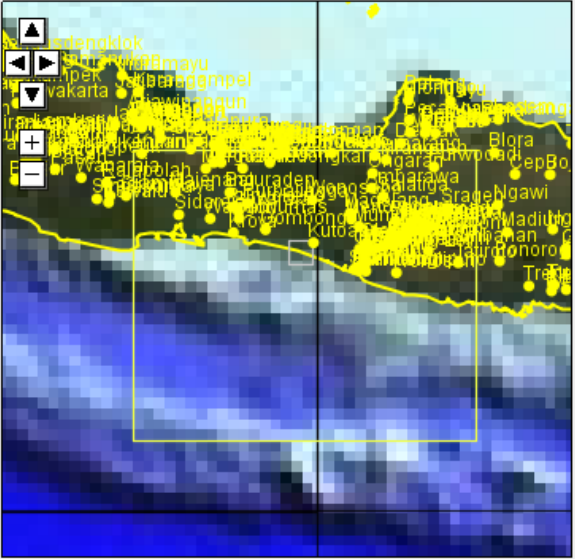
Number points, nx: 240 ny: 240 total: 57600

File Name:

Show Cities

Grid C

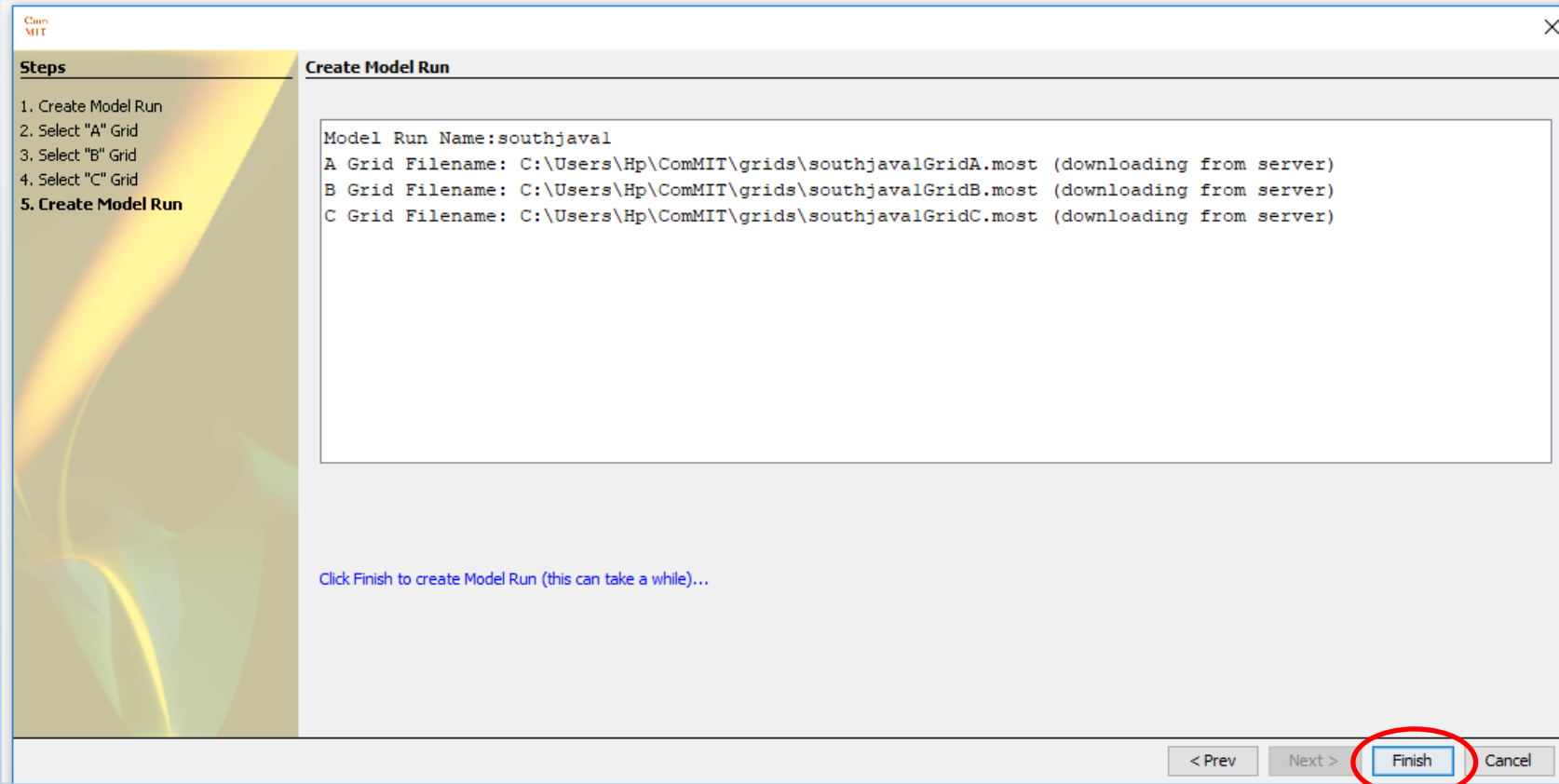
Interval Grid



Hold Shift and drag to select a grid extent.
High-resolution data is available in areas outlined by black boxes.

< Prev Next > Finish Cancel

Create Grid Bathymetry



Create Source Model

Model Edit View Help

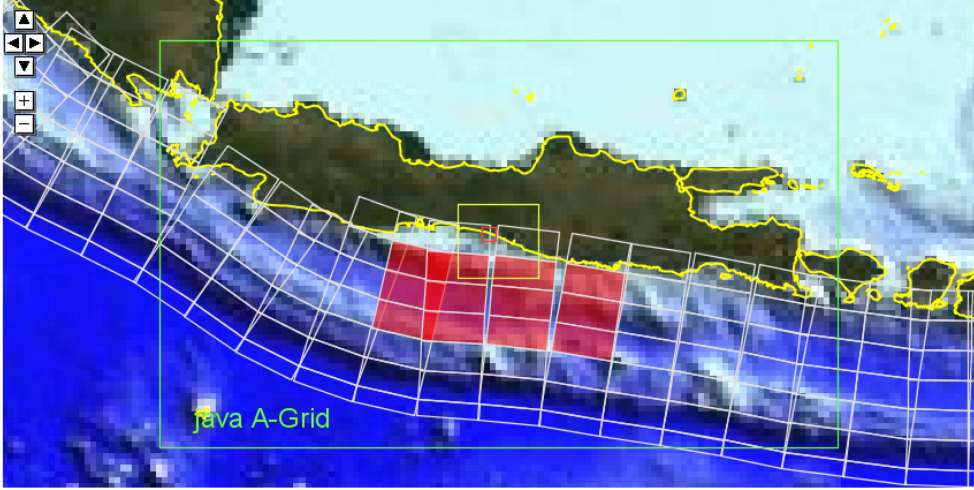
▶ **Start model** ▶ java stopped: step 0 of 933 java

Model Setup Propagation Max Amp Grid Bathymetry Results Animation Results Extrema

Model Run: C:\Users\Hp\ComMIT\scratch\java

Event:

Unit Sources



Total Magnitude: **Mw = 8.8** 8.8000 M

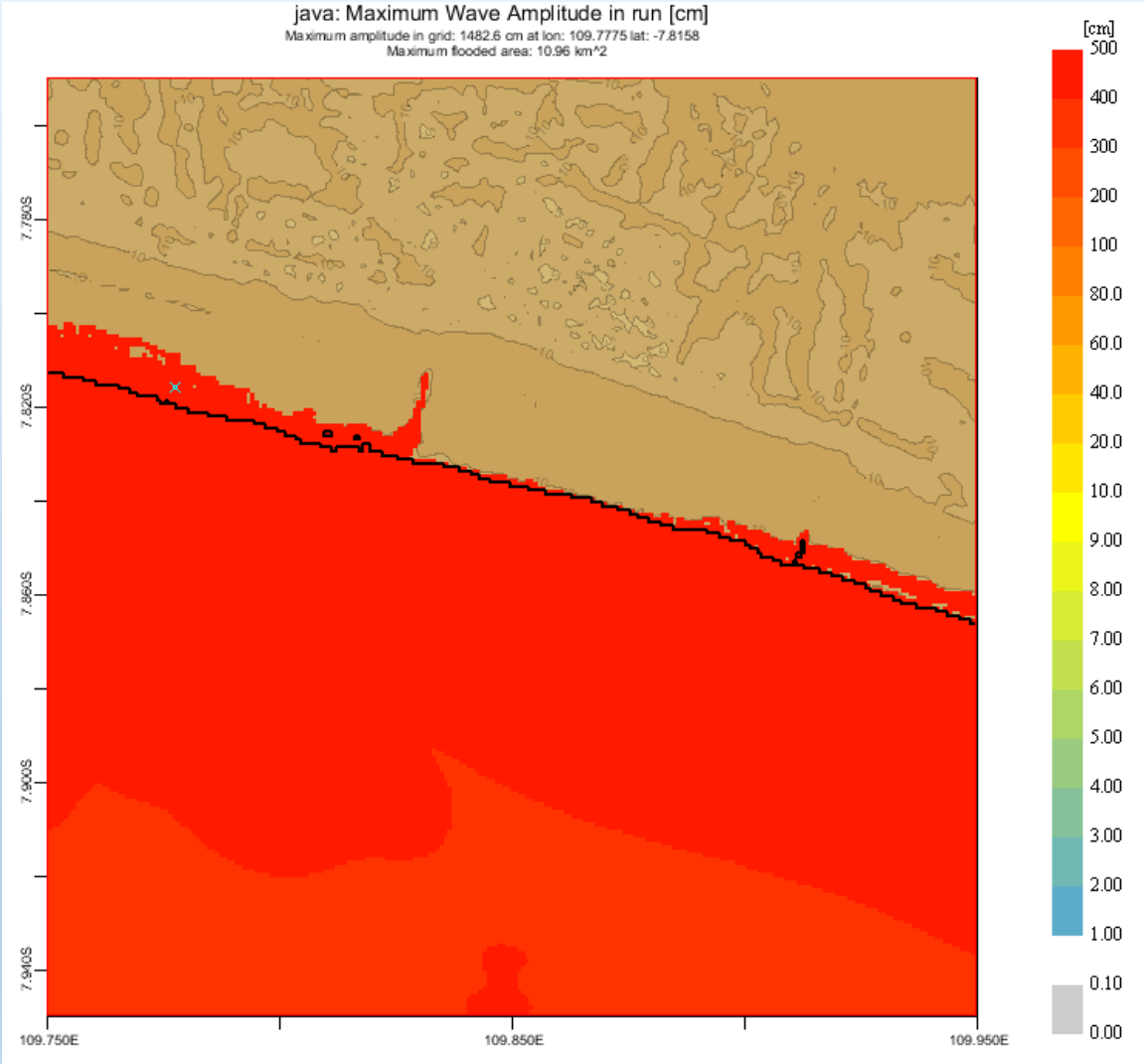
Name	% Mag	Alpha
io42x	8.3	7.409
io42y	8.3	7.409
io42z	8.3	7.409
io43x	8.3	7.409
io43y	8.3	7.409
io43z	8.3	7.409
io44x	8.3	7.409
io44y	8.3	7.409
io44z	8.3	7.409
io45x	8.3	7.409
io45y	8.3	7.409
io45z	8.3	7.409

Add/Del to Site

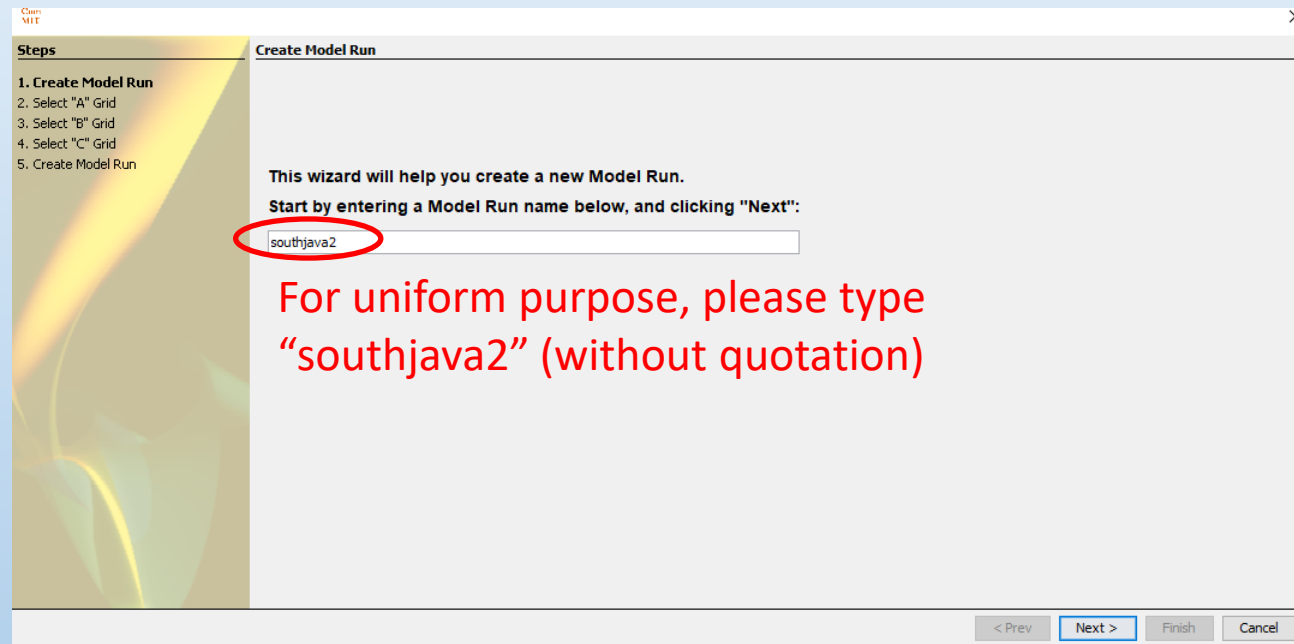
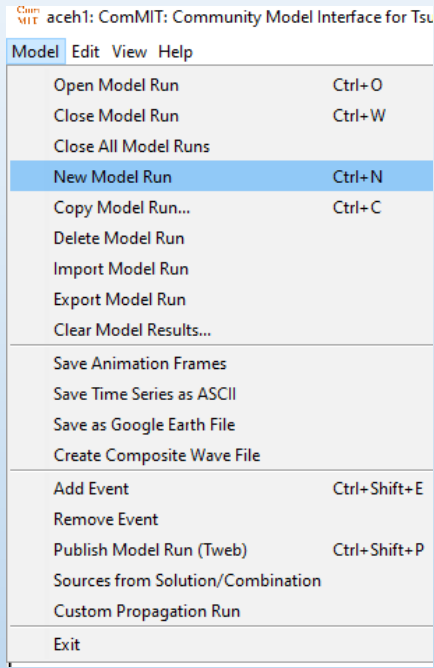
Model Parameters

- 0.0050 Minimum amp. of input offshore wave (m)
- 5.0 Minimum depth of offshore (m)
- 0.1 Dry land depth of inundation (m)
- 0.0009 Friction coefficient (n^2)
- Let A-Grid and B-Grid run up
- 300.0 Max eta before blow-up (m)
- 2.5700 Time step (sec)
- 11200 Total number of time steps in run
- 4 Time steps between A-Grid computations
- 2 Time steps between B-Grid computations
- 12 Time steps between output steps
- 0 Time steps before saving first output step
- 1 Save output every n-th grid point

Result Inundation using ComMITserver Bathymetry



Create Grid Bathymetry Using Gebco 30 arcsec and SRTM 1 arcsec (given)



Create Grid Bathymetry Using Gebco 30 arcsec and SRTM 1 arcsec in C grids (given)

Steps

1. Create Model Run
2. Select "A" Grid
3. Select "B" Grid
- 4. Select "C" Grid**
5. Create Model Run

Select "C" Grid

Grid Extents: [] N
[] W [] E
[] S

Cell Size:
[0.0008] (deg) [0.050] (arcmin) [3.0] (arcsec)

Number points, nx: 0 ny: 0 total: 0

File Name: southjava2GridC.most **Browse**

Show Cities

Hold Shift and drag to Items
High-resolution data is avail

Choose a grid extent to generate a new grid, or select "Browse" to open an existing MOST grid.

Look in: dipakai

gridC.asc

File name: gridC.asc **Open**

Files of type: MOST grid file **Cancel**

To create "A" and "B" grids using same previously steps

Start model

southjava2 stopped: step 0 of 941

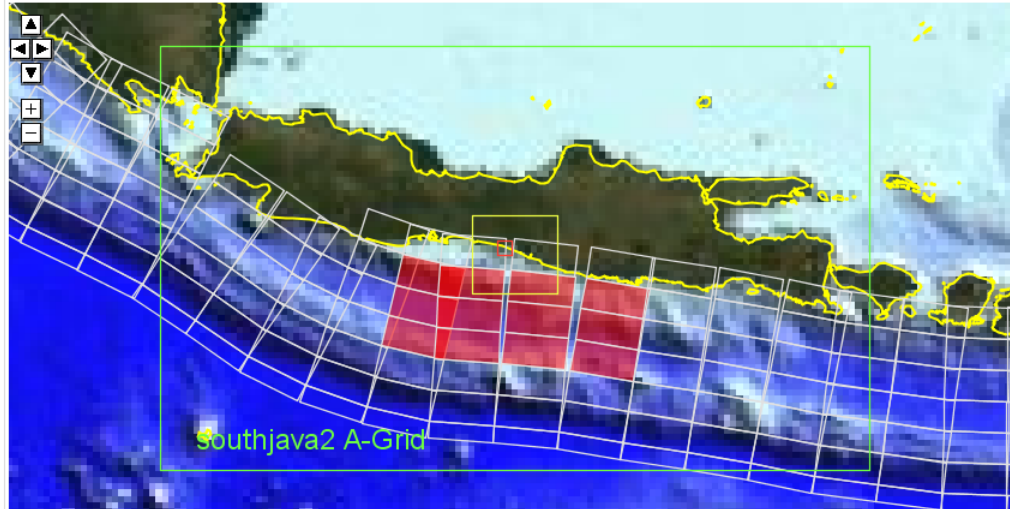
southjava2

Model Setup Propagation Max Amp Grid Bathymetry Results Animation Results Extrema

Model Run: C:\Users\Hp\ComMIT\scratch\southjava2

Event:

Unit Sources



Total Magnitude: 8.8 Mw

Name	% Mag	Alpha
io42x	8.3	7.409
io42y	8.3	7.409
io42z	8.3	7.409
io43x	8.3	7.409
io43y	8.3	7.409
io43z	8.3	7.409
io44x	8.3	7.409
io44y	8.3	7.409
io44z	8.3	7.409
io45x	8.3	7.409
io45y	8.3	7.409
io45z	8.3	7.409

Add/Del to Site

Model Parameters

- 0.0050 Minimum amp. of input offshore wave (m)
- 5.0 Minimum depth of offshore (m)
- 0.1 Dry land depth of inundation (m)
- 0.0009 Friction coefficient (n^2)
- Let A-Grid and B-Grid run up
- 300.0 Max eta before blow-up (m)
- 2.5400 Time step (sec)
- 11300 Total number of time steps in run
- 4 Time steps between A-Grid computations
- 2 Time steps between B-Grid computations
- 12 Time steps between output steps
- 0 Time steps before saving first output step
- 1 Save output every n-th grid point

Model output log

Create Source Model

Model Edit View Help

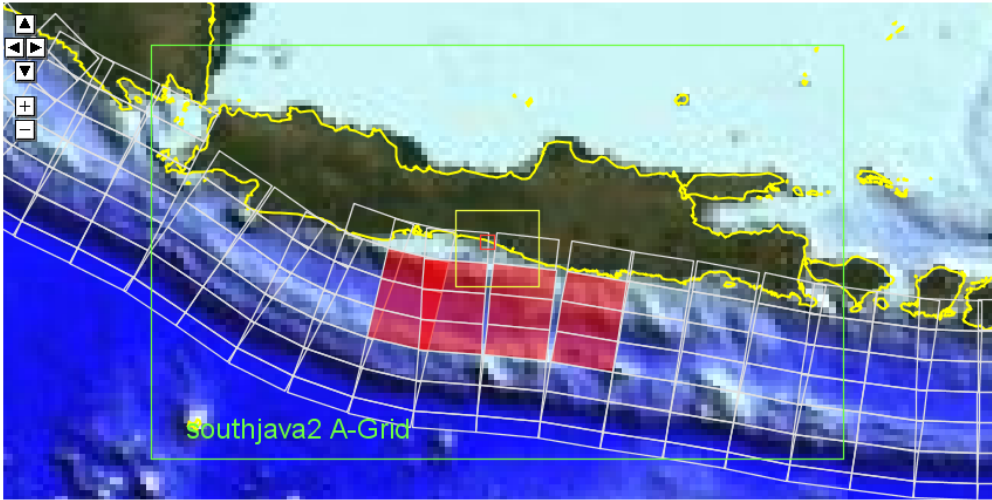
Start model southjava2 stopped: step 0 of 941 southjava2

Model Setup Propagation Max Amp Grid Bathymetry Results Animation Results Extrema

Model Run: C:\Users\Hp\ComMIT\scratch\southjava2

Event:

Unit Sources



Southjava2 A-Grid

Total Magnitude: **8.8** Mw

Name	% Mag	Alpha
io42x	8.3	7.409
io42y	8.3	7.409
io42z	8.3	7.409
io43x	8.3	7.409
io43y	8.3	7.409
io43z	8.3	7.409
io44x	8.3	7.409
io44y	8.3	7.409
io44z	8.3	7.409
io45x	8.3	7.409
io45y	8.3	7.409
io45z	8.3	7.409

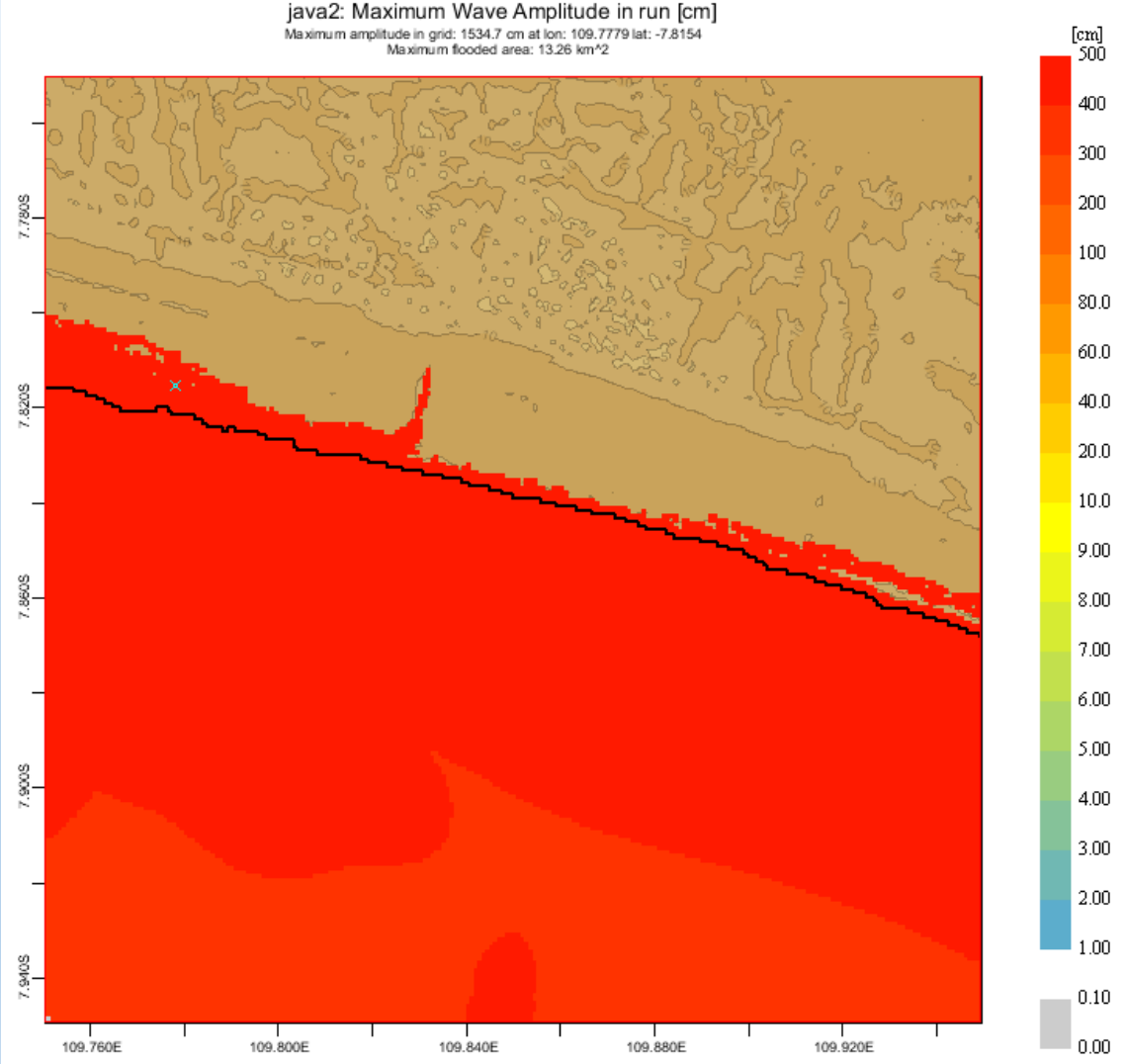
Add/Del to Site

Model Parameters

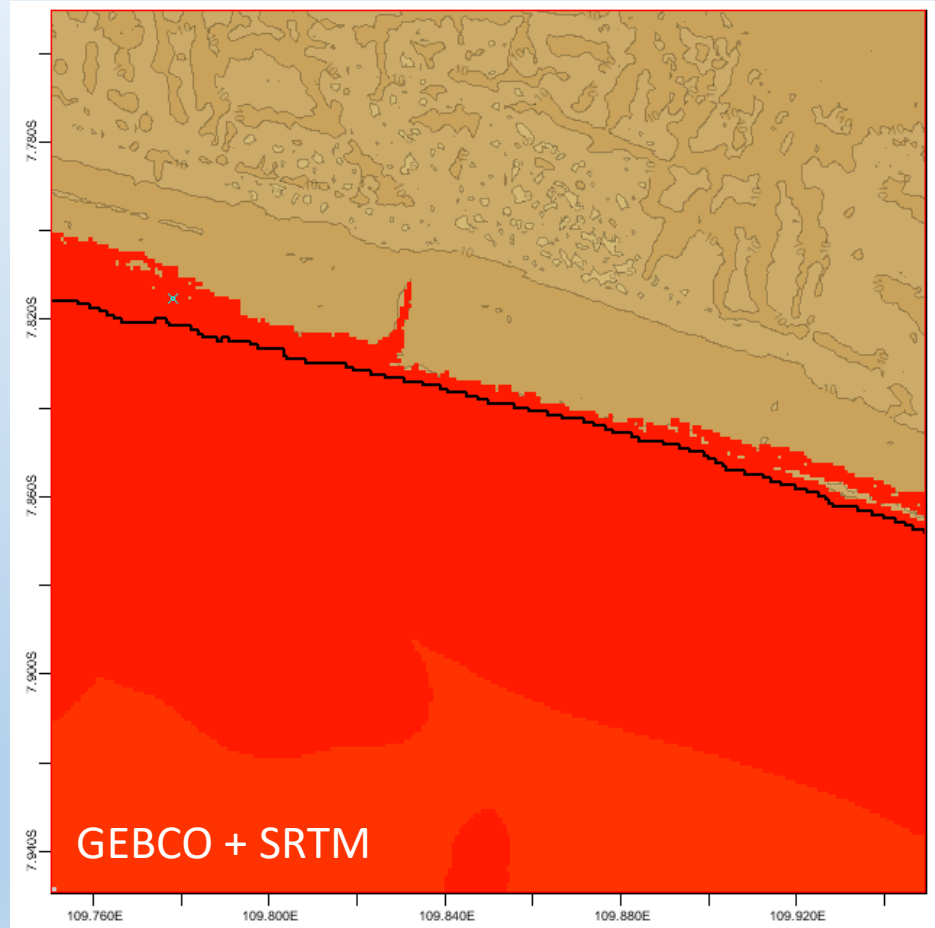
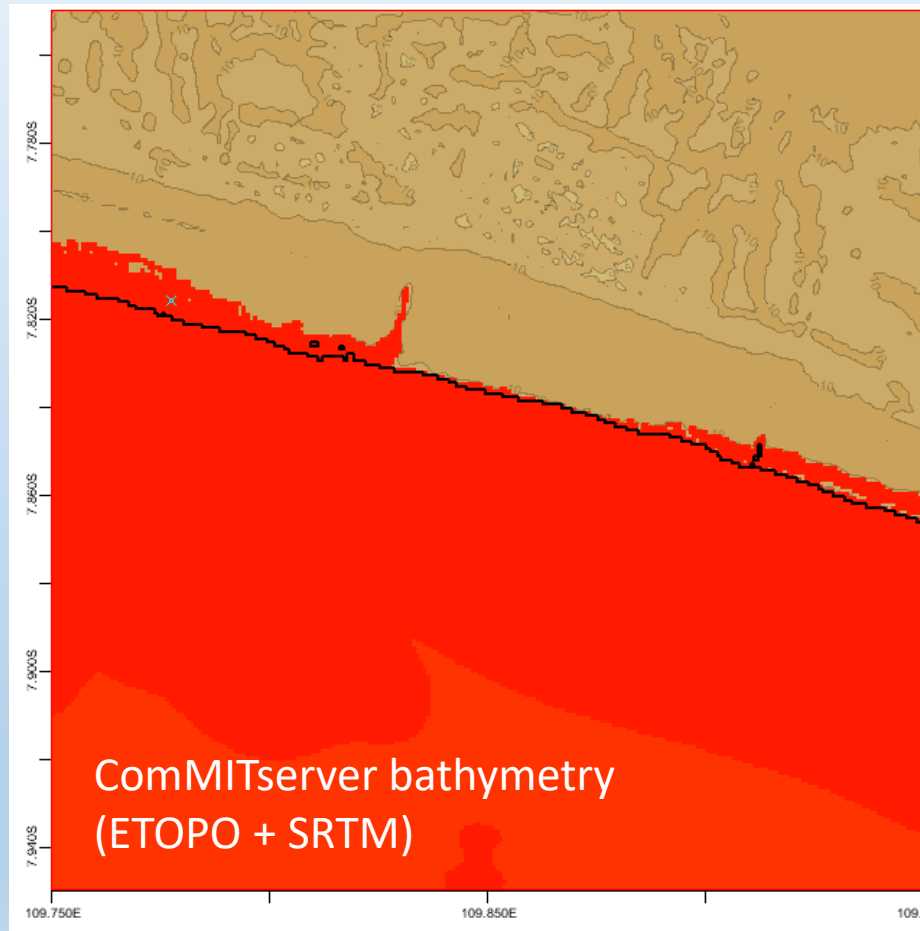
- 0.0050 Minimum amp. of input offshore wave (m)
- 5.0 Minimum depth of offshore (m)
- 0.1 Dry land depth of inundation (m)
- 0.0009 Friction coefficient (n^2)
- Let A-Grid and B-Grid run up
- 300.0 Max eta before blow-up (m)
- 2.5400 Time step (sec)
- 11300 Total number of time steps in run
- 4 Time steps between A-Grid computations
- 2 Time steps between B-Grid computations
- 12 Time steps between output steps
- 0 Time steps before saving first output step
- 1 Save output every n-th grid point

Model output log

Result Inundation using Gebco + SRTM



Comparison Inundation between ComMIT bathymetry with Gebco + SRTM

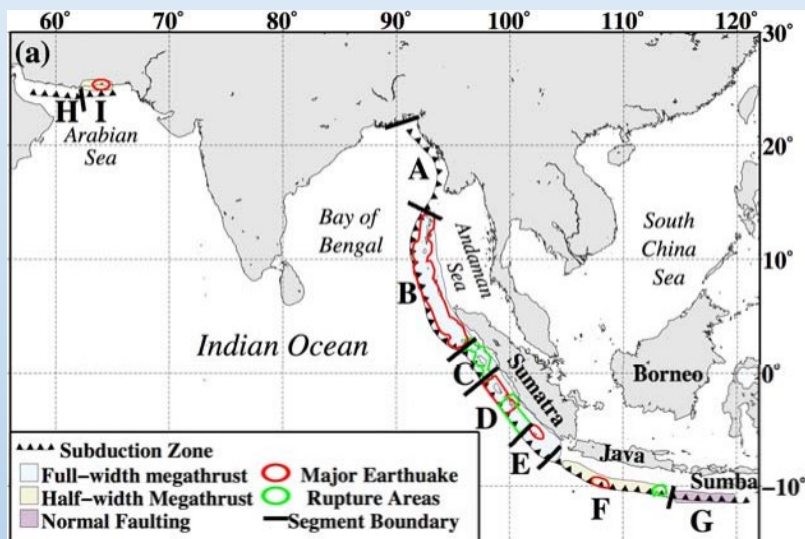


Subduction Zone	Segment	Maximum Magnitude (Mw)		
		Historical	Low Hazard	High Hazard
Andaman-Sunda Arc	A	unknown (1762 ¹)	0.0	9.5
	B	9.2 (1881 ² , 2004 ³)	9.2	
	C	8.7 (1861,2005 ⁴)	8.7	
	D	9.1 (1797,1833,2007 ⁵)	9.1	
	E	7.6 (2000 ⁵)	7.6	
	F	7.8 (1994 ⁷ ,2006 ⁸)	7.8	
	G	none	0.0	
Makran	H	unknown (1483 ⁸)	0.0	9.1
	I	8.1 (1945 ⁹)	8.2	
South Sandwich		none	0.0	9.0

Table 2: Summary of megathrust earthquake tsunami source zones used in the low-hazard and high-hazard maps. The three subduction zones considered are shown, along with the segmentation that was used for the low-hazard maps (see Fig. 5a). The maximum magnitude of the historical earthquakes listed in brackets is listed in the third column. The maximum magnitudes used to generate the low-hazard and high-hazard assessments are shown in columns four and five. Where the maximum magnitude for historical earthquakes is listed as ‘unknown’ that indicates that a large (possibly megathrust) earthquake occurred, but its magnitude is unknown. By contrast ‘none’ indicates that there is no known historical occurrence of a megathrust earthquake large enough to generate a destructive tsunami. The years of historical earthquakes are indicated in parentheses with superscripts to indicate the following references: 1 Cummins (2007), 2 Ortiz and Dillman (2002), 3 Stein

Low-Hazard Source Zonation

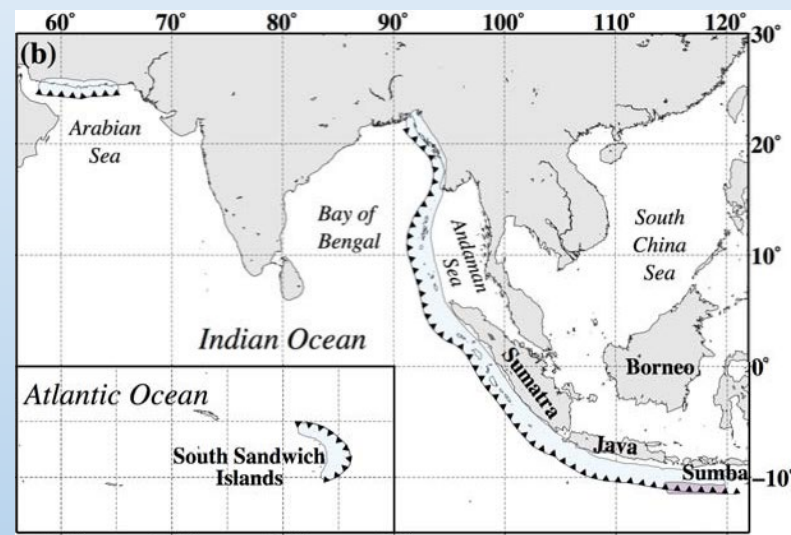
based on only those earthquake sources of tsunami for which there is definite evidence



Each subduction zone source characterized by historical tsunamigenic earthquake occurrence only

High-Hazard Source Zonation

based on all potential subduction zone earthquake sources, including hypothetical ones for which there is no historical or geological evidence



All potential subduction zones can rupture at full width, limited by lesser of magnitude 9.5 events or full subduction zone length

Subduction Zone	Segment	Maximum Magnitude (Mw)		
		Historical	Low Hazard	High Hazard
Andaman-Sunda Arc	A	unknown (1762 ¹)	0.0	9.5
	B	9.2 (1881 ² , 2004 ³)	9.2	
	C	8.7 (1861,2005 ⁴)	8.7	
	D	9.1 (1797,1833,2007 ⁵)	9.1	
	E	7.6 (2000 ⁵)	7.6	
	F	7.8 (1994 ⁷ ,2006 ⁸)	7.8	
	G	none	0.0	
Makran	H	unknown (1483 ⁸)	0.0	9.1
	I	8.1 (1945 ⁹)	8.2	
South Sandwich		none	0.0	9.0

Table 2: Summary of megathrust earthquake tsunami source zones used in the low-hazard and high-hazard maps. The three subduction zones considered are shown, along with the segmentation that was used for the low-hazard maps (see Fig. 5a). The maximum magnitude of the historical earthquakes listed in brackets is listed in the third column. The maximum magnitudes used to generate the low-hazard and high-hazard assessments are shown in columns four and five. Where the maximum magnitude for historical earthquakes is listed as ‘unknown’ that indicates that a large (possibly megathrust) earthquake occurred, but its magnitude is unknown. By contrast ‘none’ indicates that there is no known historical occurrence of a megathrust earthquake large enough to generate a destructive tsunami. The years of historical earthquakes are indicated in parentheses with superscripts to indicate the following references: 1 Cummins (2007), 2 Ortiz and Dillman (2002), 3 Stein

Guidance for Selection of Scenarios

- Selection of appropriate scenarios and magnitude may be based on the results of PTHA which provides a range of maximum tsunami amplitude with a 1 in 2000-year chance of being exceeded for each country for a low and high hazard source. The table also provides information on the subduction zone segments that contribute to tsunami hazard for each country.

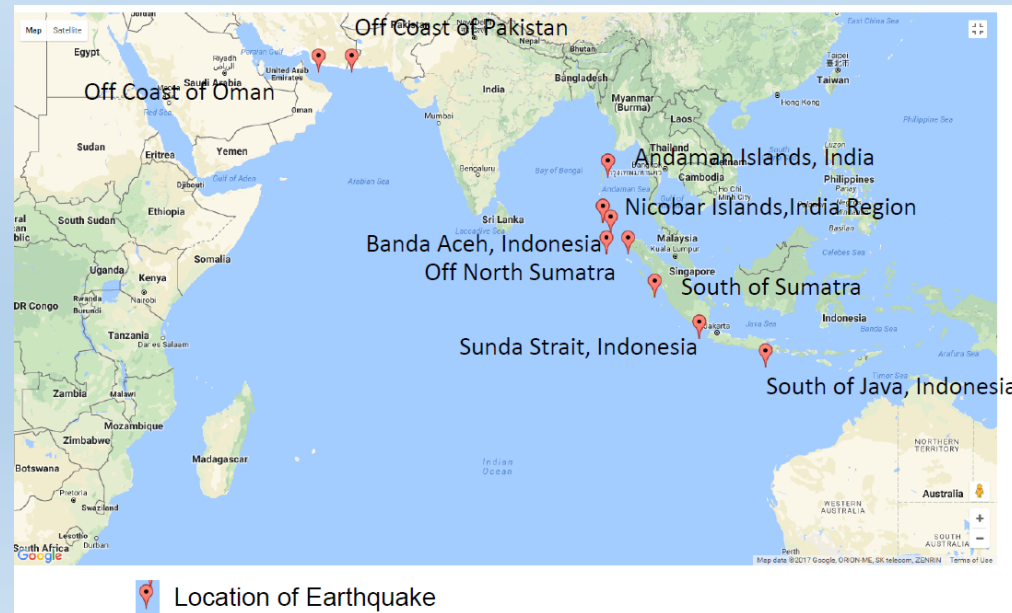
Indian Ocean nation	1/2000yr tsunami amplitude (m)		Most Important Subduction Zone Segments
	low	high	
Bangladesh	0.5	0.6	Andaman
British Ocean Territory	1.1	1.7	Andaman, Sumatra
Burma	1.1	1.5	Andaman, Sumatra
Comoros	0.3	0.5	Makran, Andaman, Sumatra
Djibouti	0.2	0.4	Makran
India	1.9	3.1	Makran, Andaman, Sumatra
Indonesia	5.6	7.1	Andaman, Sumatra, Java and Sumba
Iran	0.3	2.7	Makran
Kenya	0.5	0.8	Andaman, Sumatra
Madagascar	1.0	2.2	Andaman, Sumatra, Java, Sth Sandwich
Maldives	2.2	3.0	Andaman, Sumatra, Makran
Mauritius	1.2	1.7	Andaman, Sumatra, Makran
Mayotte	0.3	0.4	Andaman, Sumatra, Makran
Mozambique	0.5	1.4	Andaman, Sumatra, Sth Sandwich
Oman	0.6	3.8	Andaman, Sumatra, Makran
Pakistan	0.9	2.8	Makran
Reunion	0.7	1.4	Andaman, Sumatra, Sth Sandwich
Seychelles	0.8	1.2	Andaman, Sumatra, Makran
Somalia	0.7	1.1	Andaman, Sumatra, Makran
South Africa	0.6	1.6	Andaman, Sumatra, S Sandwich
Sri Lanka	2.9	3.7	Andaman, Sumatra
Tanzania	0.5	0.9	Andaman, Sumatra, Makran
Thailand	1.9	2.6	Andaman, Sumatra
United Arab Emirates	0.1	0.8	Makran
Yemen	0.8	1.3	Makran, Andaman, Sumatra

Table 1: Summary of results for all the nations considered in the study for one particular measure of the offshore tsunami hazard, the name of country is listed in the first column. The second and third columns show the maximum tsunami amplitude with a 1 in 2000 year chance of being exceeded for any point off the Indian Ocean nation shown in the first column for the low hazard and high hazard assessments, respectively. The nations shown in red have the highest (greater than 2m maximum tsunami amplitude in the high hazard map) hazard at this return period. The nations shown in green have the lowest (tsunami amplitude is less than 1m in the high hazard map) at the 2000 year return period. The fourth column lists the subduction zones which make the greatest contribution to the 1 in 2000 year hazard for that particular nation.

Guidance for Selection of Scenarios

- Each country may consider selecting 4 scenarios from the table below run inundation model using ComMIT. Based on the results of the model runs, a composite inundation line may be generated for further hazard assessment

S. No.	Latitude	Longitude	Magnitude	Region	Comments
1	24.8 N	62.2 E	9.0	Off Coast of Pakistan	
2	24.8 N	58.2 E	9.2	Off Coast of Iran	IOWave 18 Scenario ???
3	12.65 N	93.5 E	9.0 to 9.2	Andaman Islands	
4	7.2 N	92.9 E	9.0 to 9.2	Nicobar Islands	
5	3.3 N	96.0 E	9.3	Banda Aceh / Off North Sumatra	Dec 26, 2004 Event IOWave18 Scenario???
6	1.93 S	99.22 E	9.2	South of Sumatra	
7	6.94 S	104.7 E	9.0 to 9.2	Sunda Strait	
8	10.4 S	112.8 E	9.1	South of Java	



ComMIT Unit Sources for PTHA Suggested Scenarios

cut and paste into "Model->Sources from Solution/Combination"

- Off Coast of Pakistan
Mw 9.0, mk2-7, rows a-b, alpha=14.7839
14.7839*mk2b+14.7839*mk2a+14.7839*mk3b+14.7839*mk3a+14.7839*mk4b+14.7839*mk4a+14.7839*mk5b+14.7839*mk5a+14.7839*mk6b+14.7839*mk6a+14.7839*mk7b+14.7839*mk7a
- Off Coast of Iran
Mw 9.2, mk4-10, rows a-b, alpha=25.284
25.284*mk4a+25.284*mk4b+25.284*mk5a+25.284*mk5b+25.284*mk6a+25.284*mk6b+25.284*mk7a+25.284*mk7b+25.284*mk8a+25.284*mk8b+25.284*mk9a+25.284*mk9b+25.284*mk10a+25.284*mk10b
- Andaman Islands
Mw 9.2, io5-12, rows a-b, alpha=22.123
22.123*io5a+22.123*io5b+22.123*io6a+22.123*io6b+22.123*io7a+22.123*io7b+22.123*io8a+22.123*io8b+22.123*io9a+22.123*io9b+22.123*io10a+22.123*io10b+22.123*io11a+22.123*io11b+22.123*io12a+22.123*io12b
- Nicobar Islands
Mw 9.2, io11-18, rows a-b, alpha=22.123
22.123*io11a+22.123*io11b+22.123*io12a+22.123*io12b+22.123*io13a+22.123*io13b+22.123*io14a+22.123*io14b+22.123*io15a+22.123*io15b+22.123*io16a+22.123*io16b+22.123*io17a+22.123*io17b+22.123*io18a+22.123*io18b
- Banda Aceh, North Sumatra
Mw 9.3, io17-24, rows a-b, alpha=31.250
31.250*io17a+31.250*io17b+31.250*io18a+31.250*io18b+31.250*io19a+31.250*io19b+31.250*io20a+31.250*io20b+31.250*io21a+31.250*io21b+31.250*io22a+31.250*io22b+31.250*io23a+31.250*io23b+31.250*io24a+31.250*io24b
- South of Sumatra
Mw 9.2, io24-31, rows a-b, alpha=22.123
22.123*io24a+22.123*io24b+22.123*io25a+22.123*io25b+22.123*io26a+22.123*io26b+22.123*io27a+22.123*io27b+22.123*io28a+22.123*io28b+22.123*io29a+22.123*io29b+22.123*io30a+22.123*io30b+22.123*io31a+22.123*io31b
- Sunda Strait
Mw 9.2, io33-40, rows a-b, alpha=22.123
22.123*io33a+22.123*io33b+22.123*io34a+22.123*io34b+22.123*io35a+22.123*io35b+22.123*io36a+22.123*io36b+22.123*io37a+22.123*io37b+22.123*io38a+22.123*io38b+22.123*io39a+22.123*io39b+22.123*io40a+22.123*io40b
- South of Java
Mw 9.1, io44-49, rows a-b, alpha=14.7839
14.7839*io44b+14.7839*io44a+14.7839*io45b+14.7839*io45a+14.7839*io46b+14.7839*io46a+14.7839*io47b+14.7839*io47a+14.7839*io48b+14.7839*io48a+14.7839*io49b+14.7839*io49a

Conclusions

- Bathymetry and topography data (DEM) have important role for tsunami modelling
- DEM data with high resolution will generate more detailed and accurate inundation
- Detailed bathymetry and topography data is needed for tsunami inundation modelling

Thank you