SCENARIO EARTHQUAKES FOR BANGLADESH HAZARD ANALYSIS

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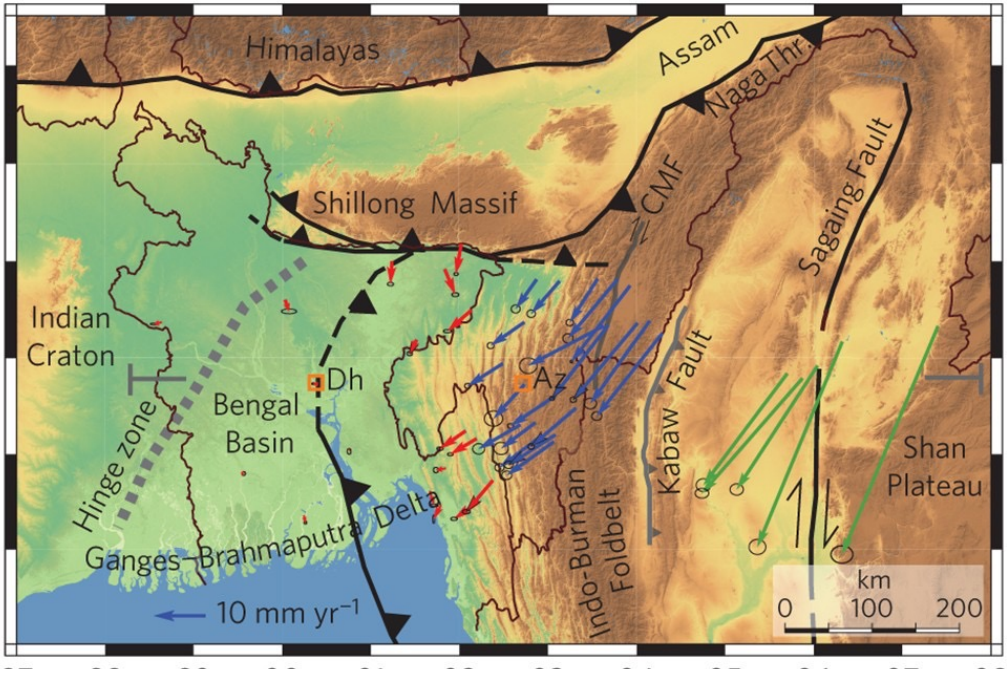
working together
to assess risk

GEM
GLOBAL EARTHQUAKE MODEL

OQ
OPENQUAKE

Fault system overview

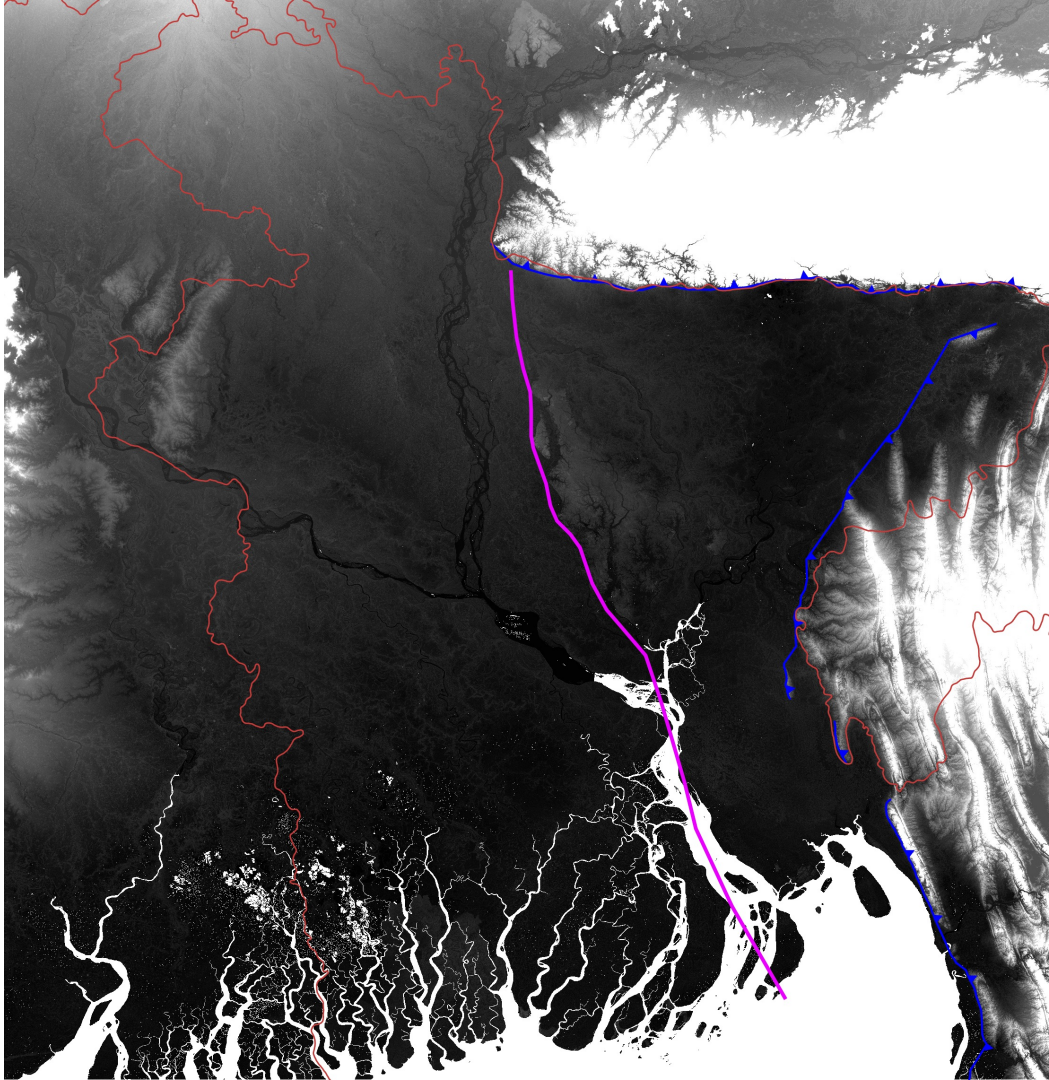
- Chittagong fold-thrust belt in east, accommodates > 1 cm/yr contraction, subduction farther south
- Slow-moving faults (Dauki, etc.) in north by Shillong Plateau
- Main Himalaya Thrust to north



Steckler et al. 2016

Western deformation front (Madhupur fault)

- Less neotectonic expression than other faults in/near Bangladesh
- Small but unambiguous topographic expression
- More likely location for western edge of thrust belt than mapped by Steckler and others

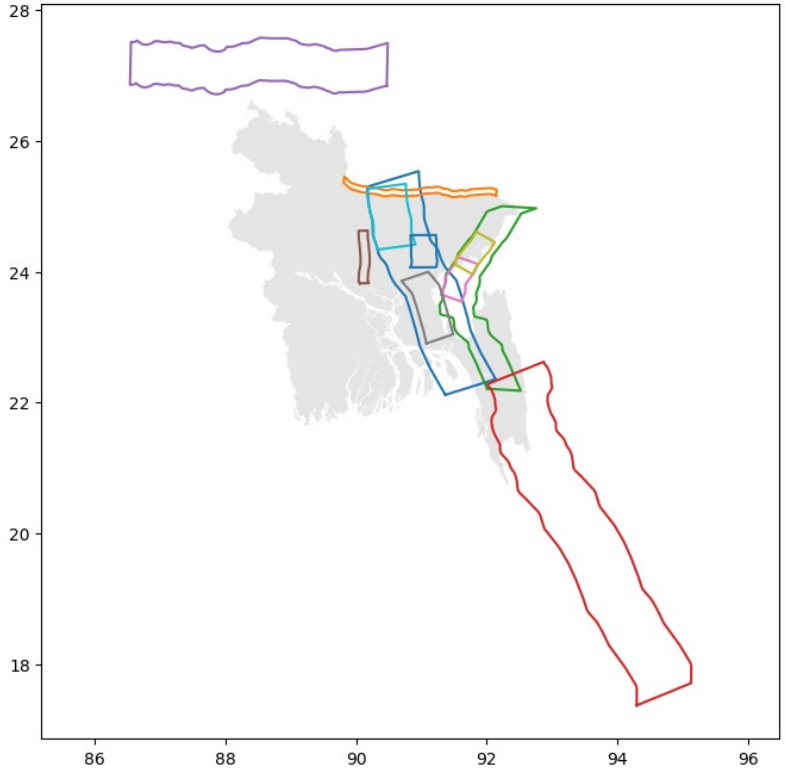


Scenario Ruptures

11 Scenario Ruptures

Based on historical and likely potential events

Faults from existing GEM research in region, or (for Madhupur, etc.) mapped for this project based on publications and topography



Historical Ruptures

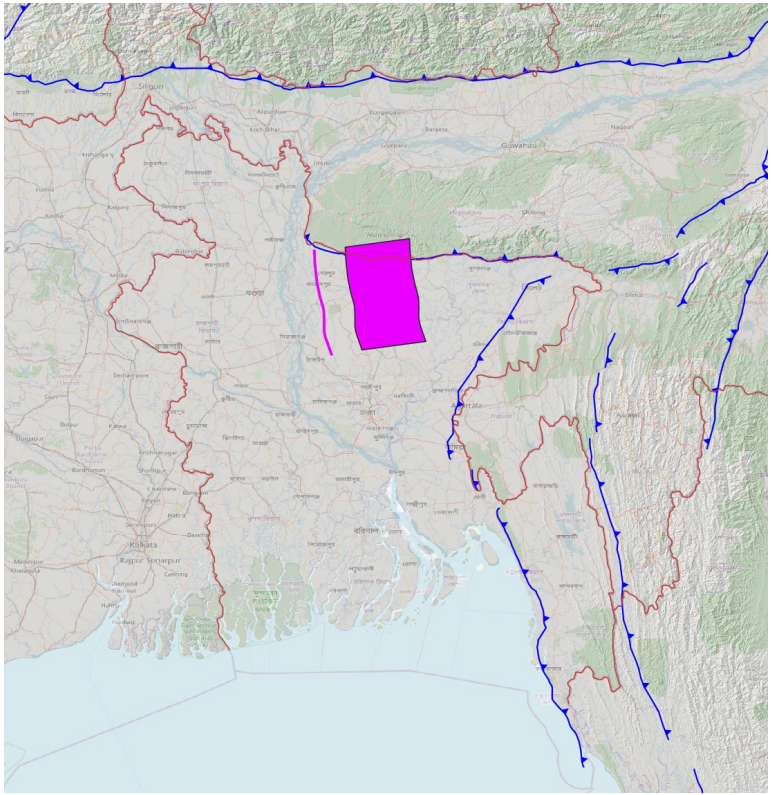
- 6 events chosen from 1664-1918 out of many in this time

- Locations and magnitudes may be poorly constrained

- All ruptures placed on known faults (rather than hypocenters from inversions of historical intensity data)

- Why so many earthquakes in 1800s, and so few since 1900?

1664 North Bangladesh (Mw 7.7)

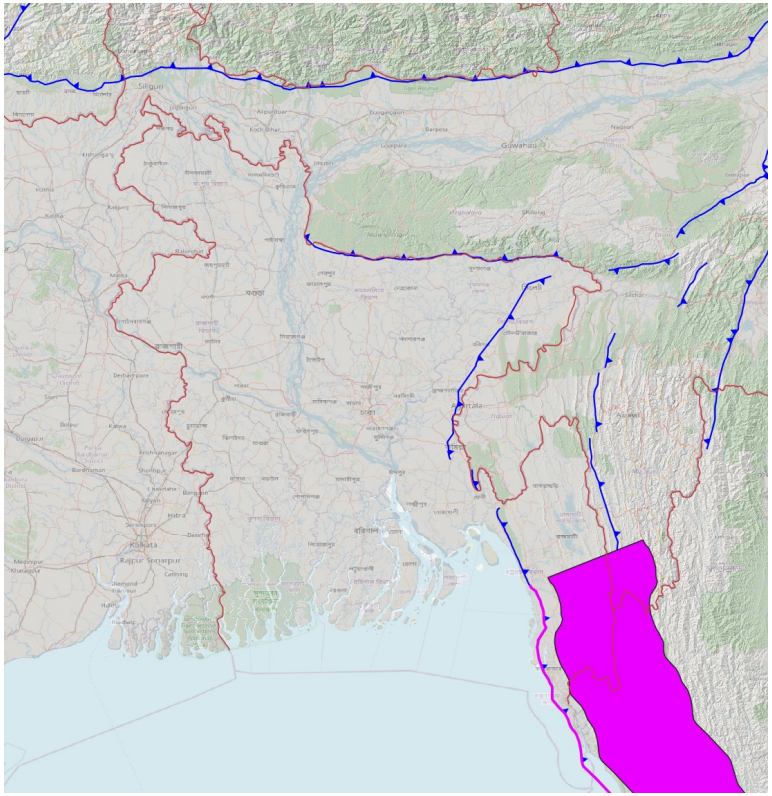


Notes

- Poorly known
- Sources: Ambrayses and Douglas, 2004

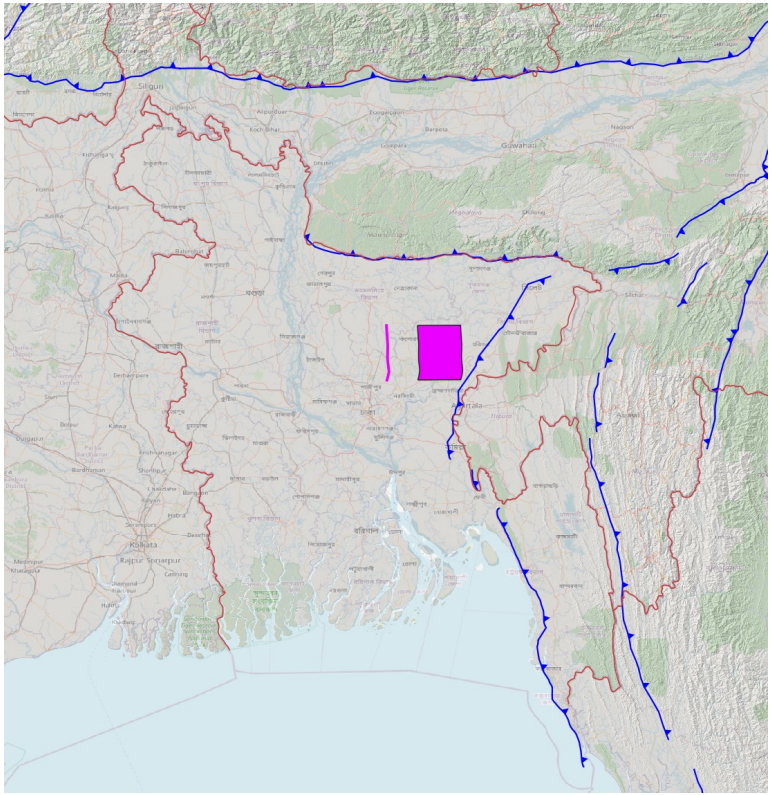
- Placed on Madhupur fault
- Blind

1762 Arakan (Mw 8.5)



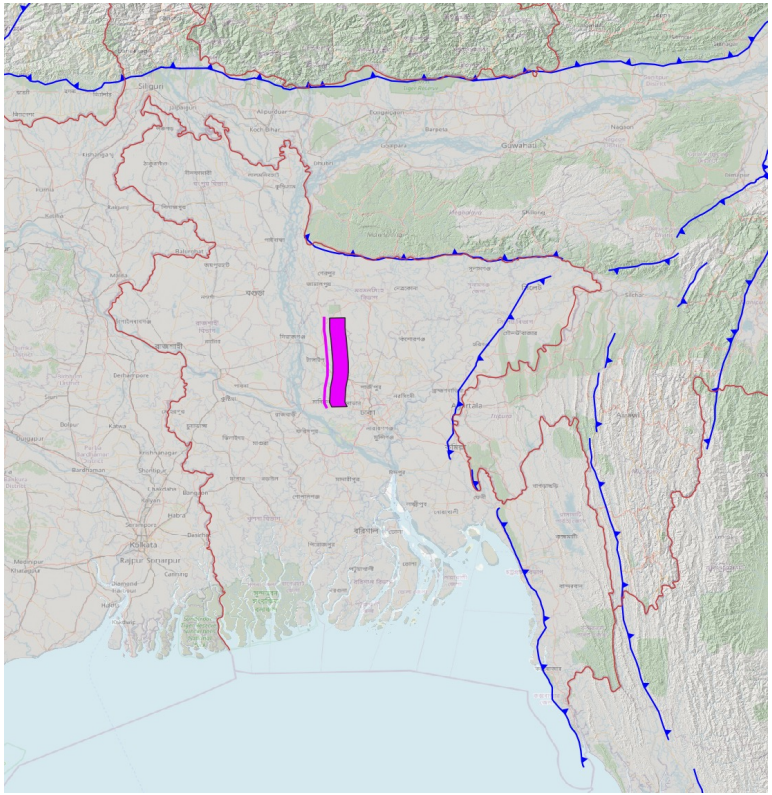
- Occurred on Chittagong thrust belt / Sunda subduction zone
- Rupture extent and coseismic uplift known (with some uncertainty) from coastal paleoseismology, very (Mondal et al., 2018; Wang et al. 2013)
- Area-magnitude scaling relationships suggest Mw 8.5+

1822 Kishoreganj (Mw 7.1)



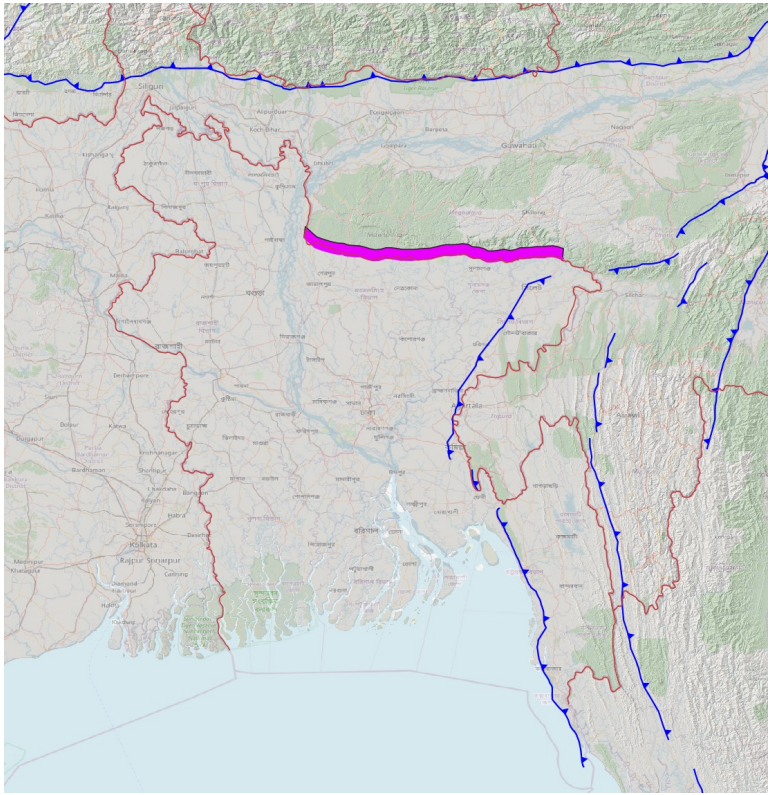
- Smaller, perhaps deeper event than others in region
- Mw 7.1 from Szeliga et al. 2010
- Placed on splay of Madhupur fault, farther east than other events

1885 Manikganj (Bengal) earthquake. (Mw 7.2)



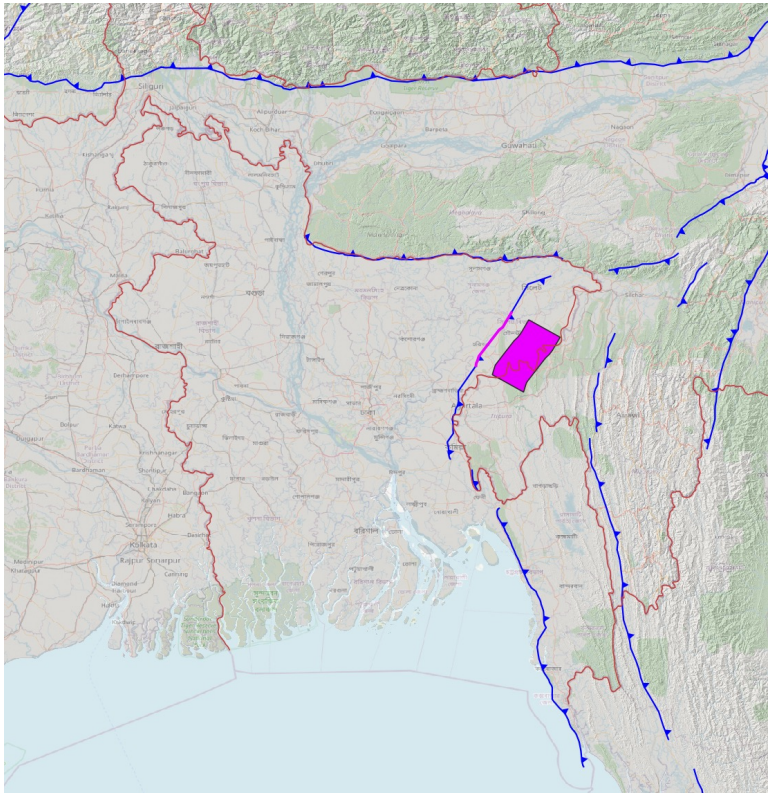
- Very damaging earthquake, widespread destruction in Dhaka
- Placed on the Madhupur fault
- Assigned Mw 7.2 based on area-magnitude scaling relationships
- Martin and Szeliga assigned M 7.1

1897 Shillong Plateau (Mw 8.7)



- Regionally devastating event
- Poorly located—most sources place on the Dauki fault, but could be on Oldham fault on north side of Shillong Plateau (in India)
- Magnitude estimated at M 8.7 by Richter (!), 8.4 by Szeliga et al. 2010

1918 Srimangal (Mw 7.4)

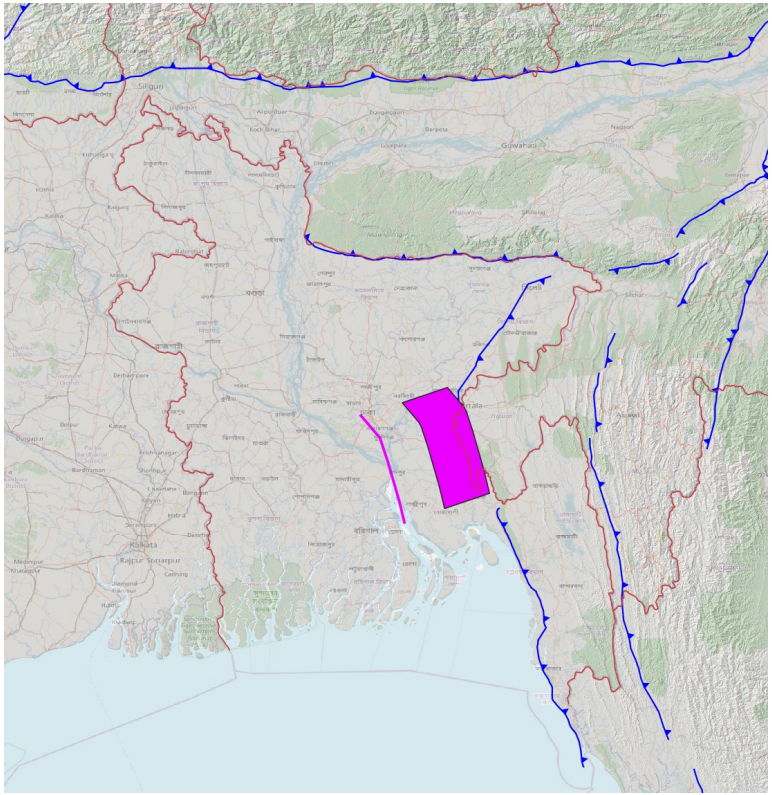


- Damage to Sylhet city
- Placed on Sylhet-Assam fault (North Chittagong decollement)
- Magnitude estimates from 7.2-7.6

Potential ruptures

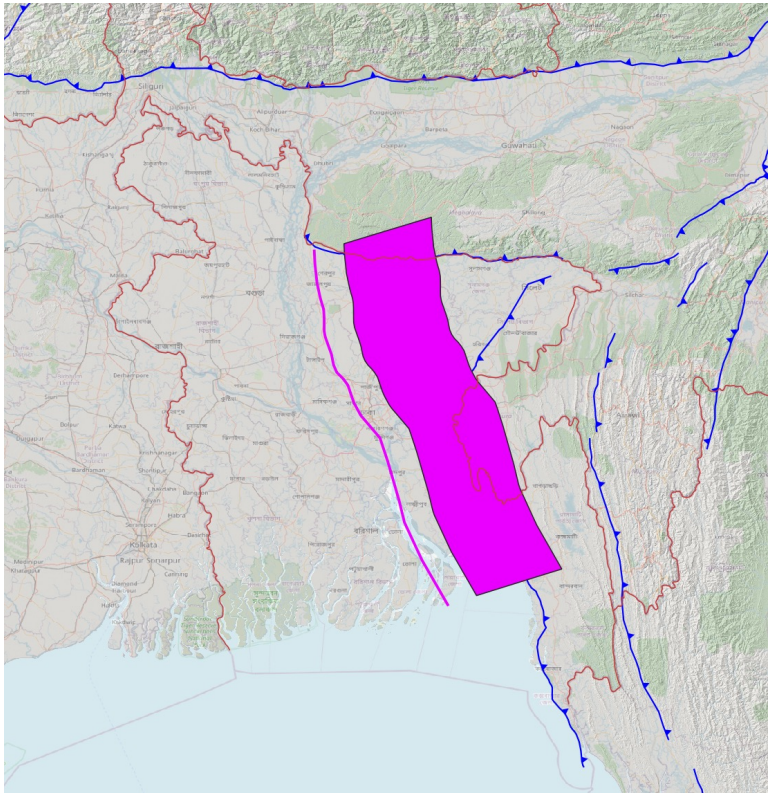
- 5 potential ruptures selected, mostly in the east
- Placed on well-known, fast-slipping faults

Western deformation front partial (Mw 7.7)



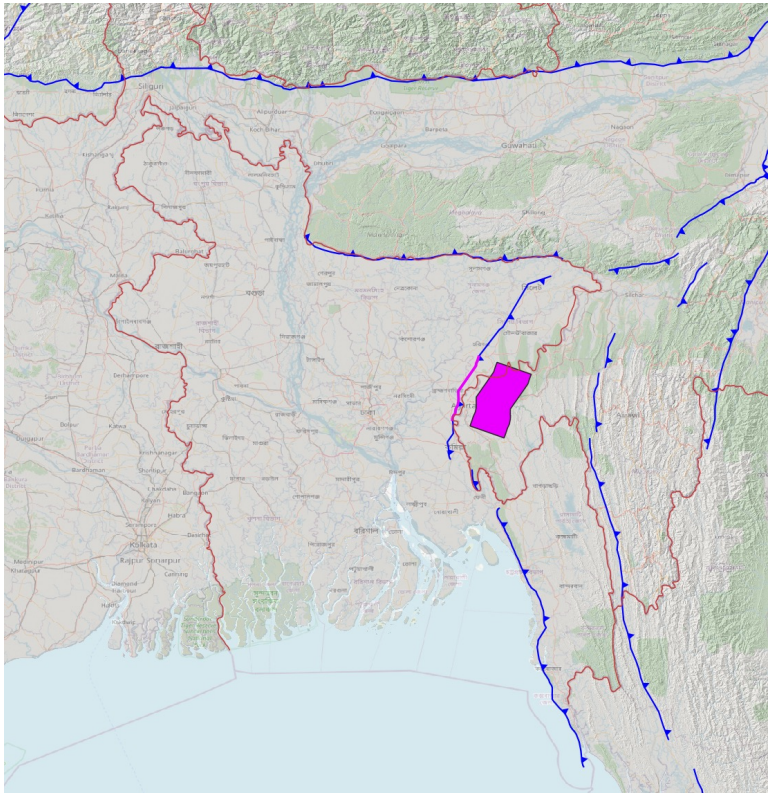
- Rupture of Western Deformation Front south of historical Madhupur earthquakes
- Mw 7.7 from scaling relationships
- Rupture from 7-15 km depths; shallower scenario possible

Western deformation front (Mw 8.5)



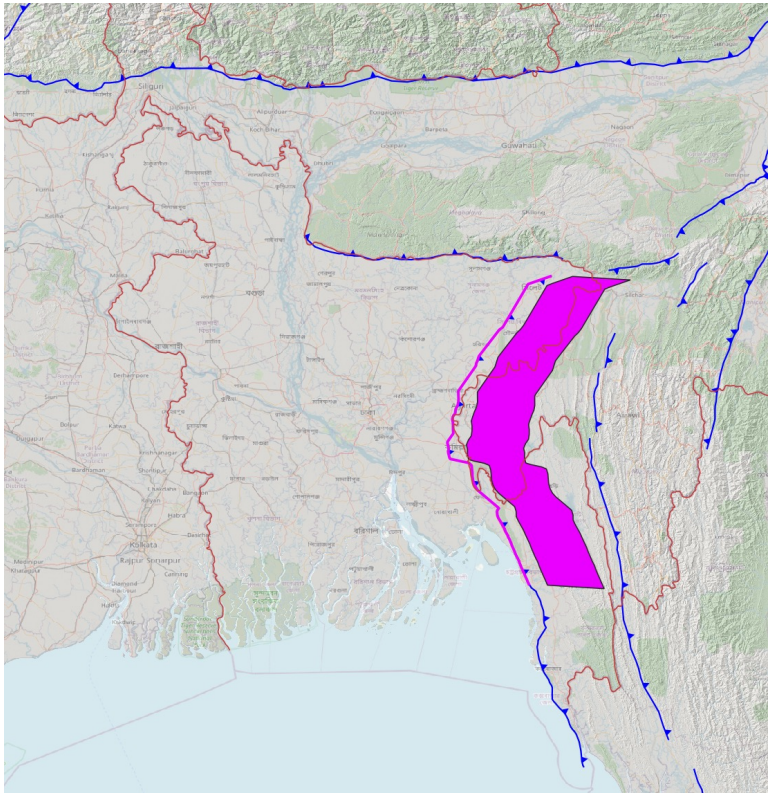
- Worst-case scenario for Dhaka
- Full rupture of Western Deformation Front (Madhupur fault and farther south to coast)
- Mw 8.7 from area-magnitude scaling relationships
- Depth of rupture from 5-20 km

Chittagong thrust moderate magnitude (Mw 7.25)



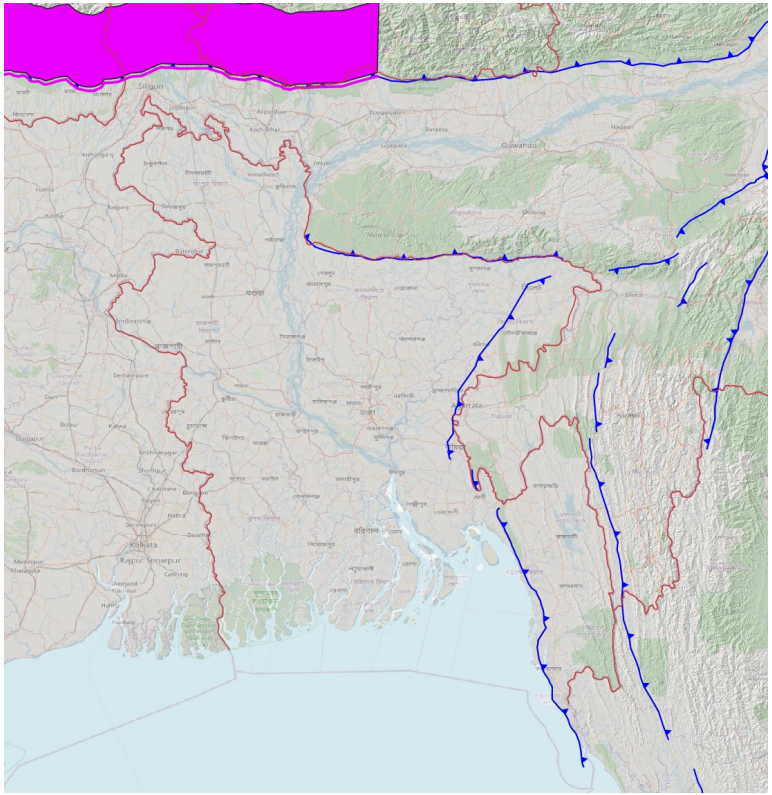
- Moderate (for region) earthquake on portion of Chittagong thrust
- Location selected somewhat arbitrarily

Chittagong/ Sylhet-Assam (Mw 8.2)



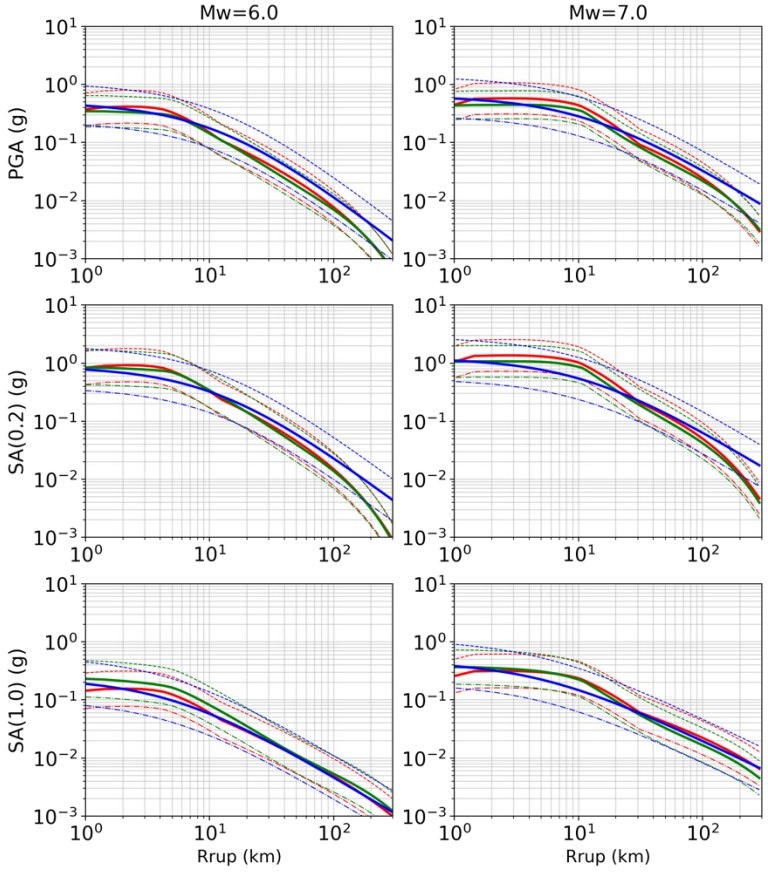
- Full rupture of Chittagong/Sylhet-Assam basal decollement north of 1762 Arakan rupture
- Mw 8.2 based on area-scaling relationships

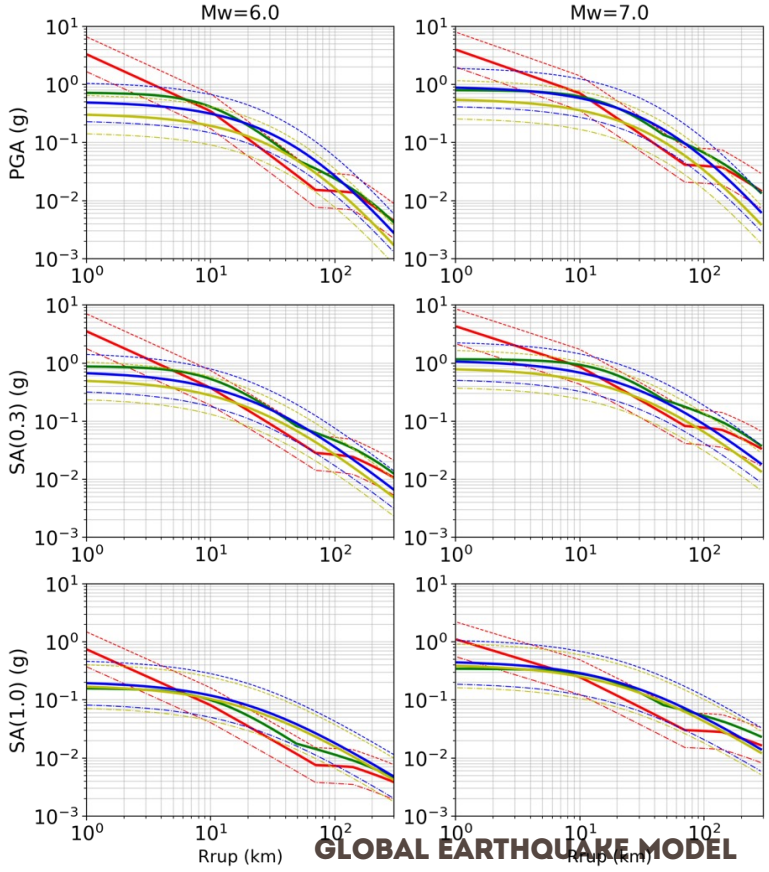
Sikkim Main Himalayan Thrust (Mw 8.5)



- Rupture of Sikkim section of Main Himalaya Thrust closest to Bangladesh
- Mw 8.6 based on area-magnitude scaling relationships
- Similar to 1934 Bihar Nepal earthquake (east Nepal)

Ground Motion Models: Active (left) vs. Stable (right) ?





Thank you!

Please attribute to the GEM Foundation with a link to:
https://www.globalquakemodel.org