The Abdus Salam International Centre for Theoretical Physics

United Nations Educational, Scientific and Cultural Organization

IAEA International Atomic Energy Agency

2016

Joint ICTP/IAEA Advanced Workshop on Earthquake Engineering for Nuclear Facilities

30 November - 4 December, 2009

Current Situation of Banglades

(Presentation)

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Bangladesh University of Engineering & Technology Department of Civil Engineering Dhaka 1000

BANGLADESH

Current Situation of Bangladesh

Munaz Ahmed Noor, PhD

Department of Civil Engineering, BUET

December, 2009

Exposed to

- ICTP and IAEA activities
- DSHA and PSHA
- Hazard scenarios
- Risk Analysis/Assessment of NPP
- Seismic safety re-evaluation of NPP
- PSA of NPP
- Fragility

Learned new

- Neo-DSHA
- Earthquake Prediction
- SMA and SPSA of existing NPP
- Shake table testing of NPP components

Kakarbhitta
Damak
Bhadrapur
Alisinga
Assam
Baihata Chariali
Guwahati
Roha
Hajo
Jorabat
Nellie
Bajengdoba
Birgani
Lalmonirhat
Rangpur
Bara Pani Secondary School

More...
Map
Architecture Dept
Sonali Bank BUET Branch
Old Academic Bldg
Zahir Raihan Rd
Bangladesh University of Engineering and Technology
Suhrawardy Hall
Sher-E-Bangla Hall
EME Dept
Shahid Minar Rd
Dr MA Rashid Hall
Titumir Hall
200 ft
50 m
©2009 Google - Imagery ©2009 DigitalGlobe, GeoEye, Map data ©2009 Europa Technologie

NPP situation

- Government Selected a site for NPP
- Appointed BUET perform site evaluation of the site for NPP

- That is why I am here you can say

Selected site for NPP

Ministries

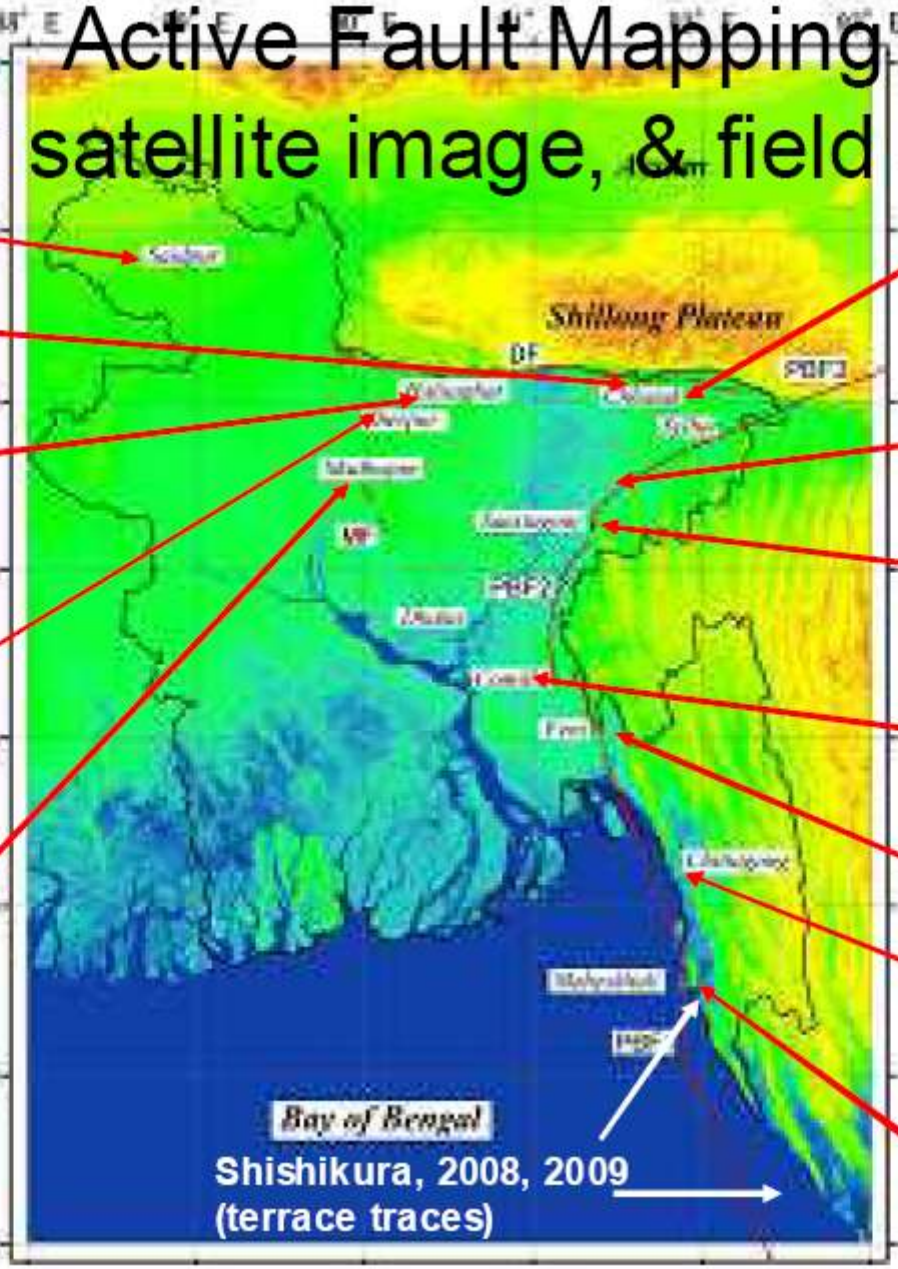
- Ministry of Science and ICT (information and communication Technology
  - Bangladesh Atomic Energy Commission (BAEC)
  - Process of establishing Regulatory Body
- Ministry of Food and Disaster Management
  - Disaster Management Bureau (DMB)
  - Comprehensive Disaster Management Programme (CDMP) – funded by EU, DFID and others…
  - Responsible for Hazard analysis and they performed it for three cities

BAEC (Facilities)

- A 3 MW TRIGA MARK` research reactor installed in 1986 at AERE, Savar for carrying out R&D activities and production of certain short-lived radioisotopes
- A 3 MeV positive ion Van de Graff accelerator (VDG) installed in 1964 at the Atomic Energy Center, Dhaka (AECD) for R&D activities
- A 14 MeV neutron generator installed at AERE, Savar for R&D activities

Active Fault Mapping using satellite image, & field survey

10 sites



Saidpur (low scarp)

Chhatak (low scarp, spring)

Haluaghat (uplifted alluvial plain)

Northwest of Sherpur (uplifted terraces

Madhupur (low scarp, concealed)

Sylhet (low scarp, but concealed)

Shazi Bazar (terrace but concealed)

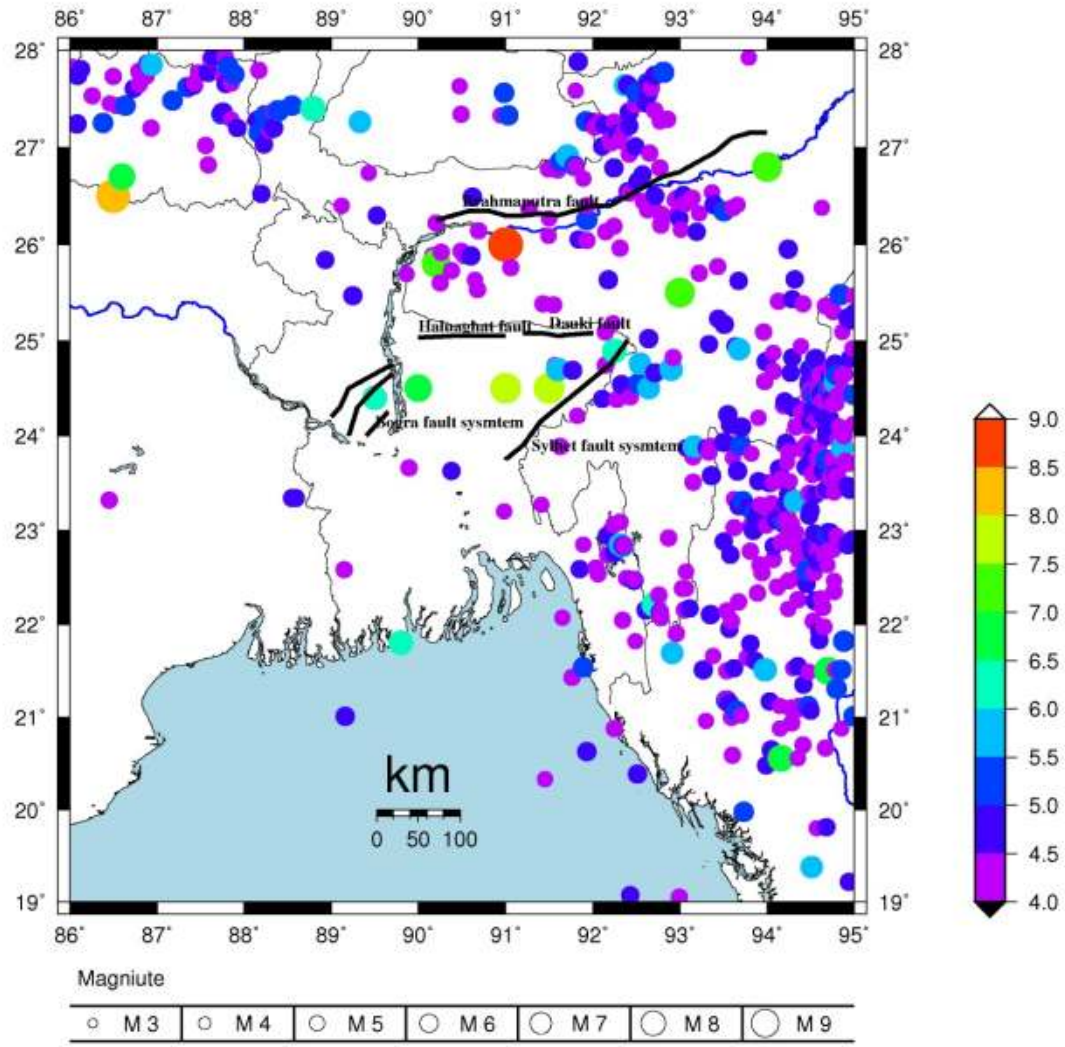
Saestagonj (low warping scarp, but concealed)

Comilla (terrace but concealed)

Feni (uplifted terrace)

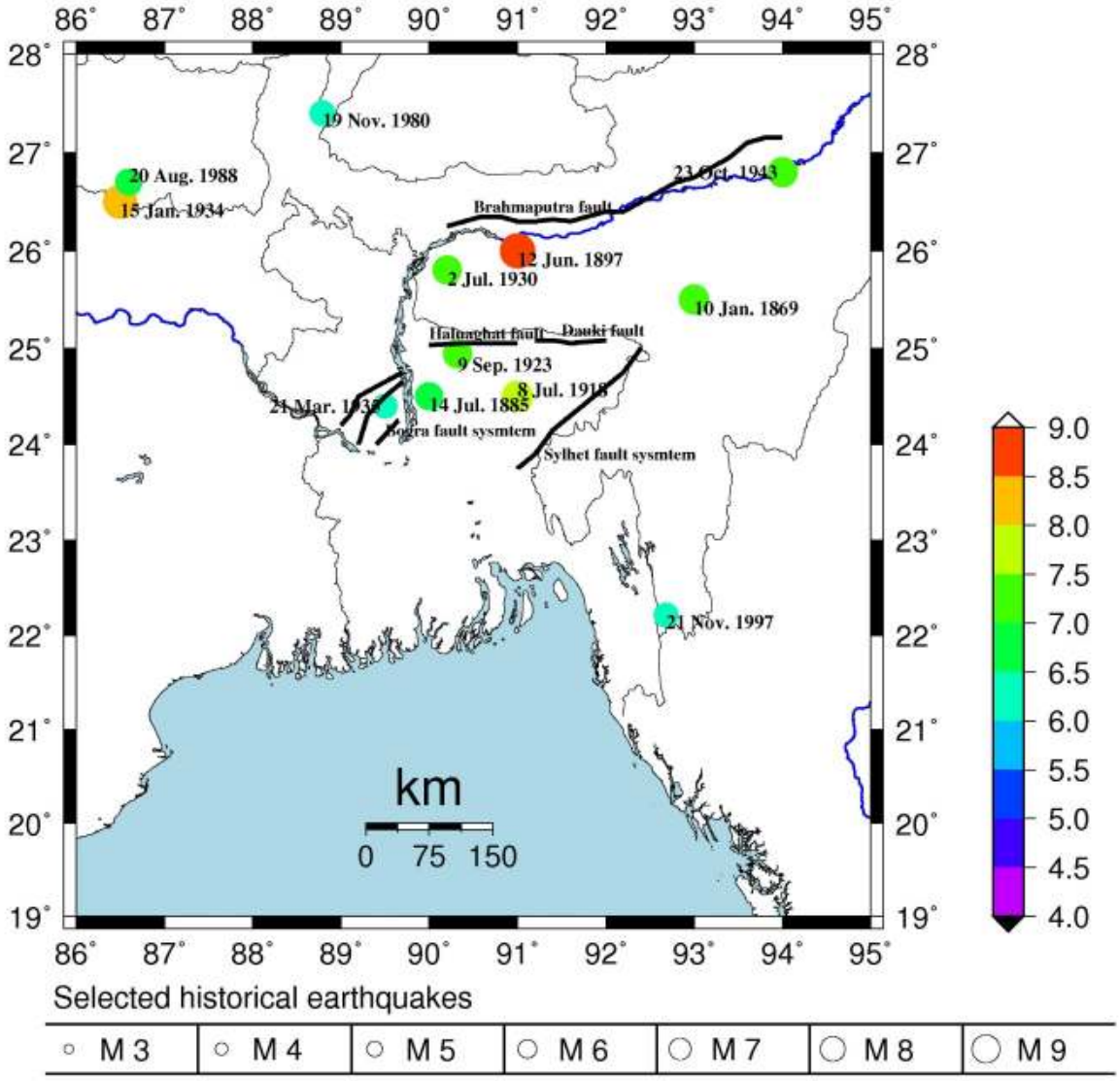
Chittagong (topo boundary, but concealed)

Maheskhali (fault scarp)



1548-2008 (including M<4 earthquakes, M>4: 2500)

Major earthquakes



M>6

1885 earthquake

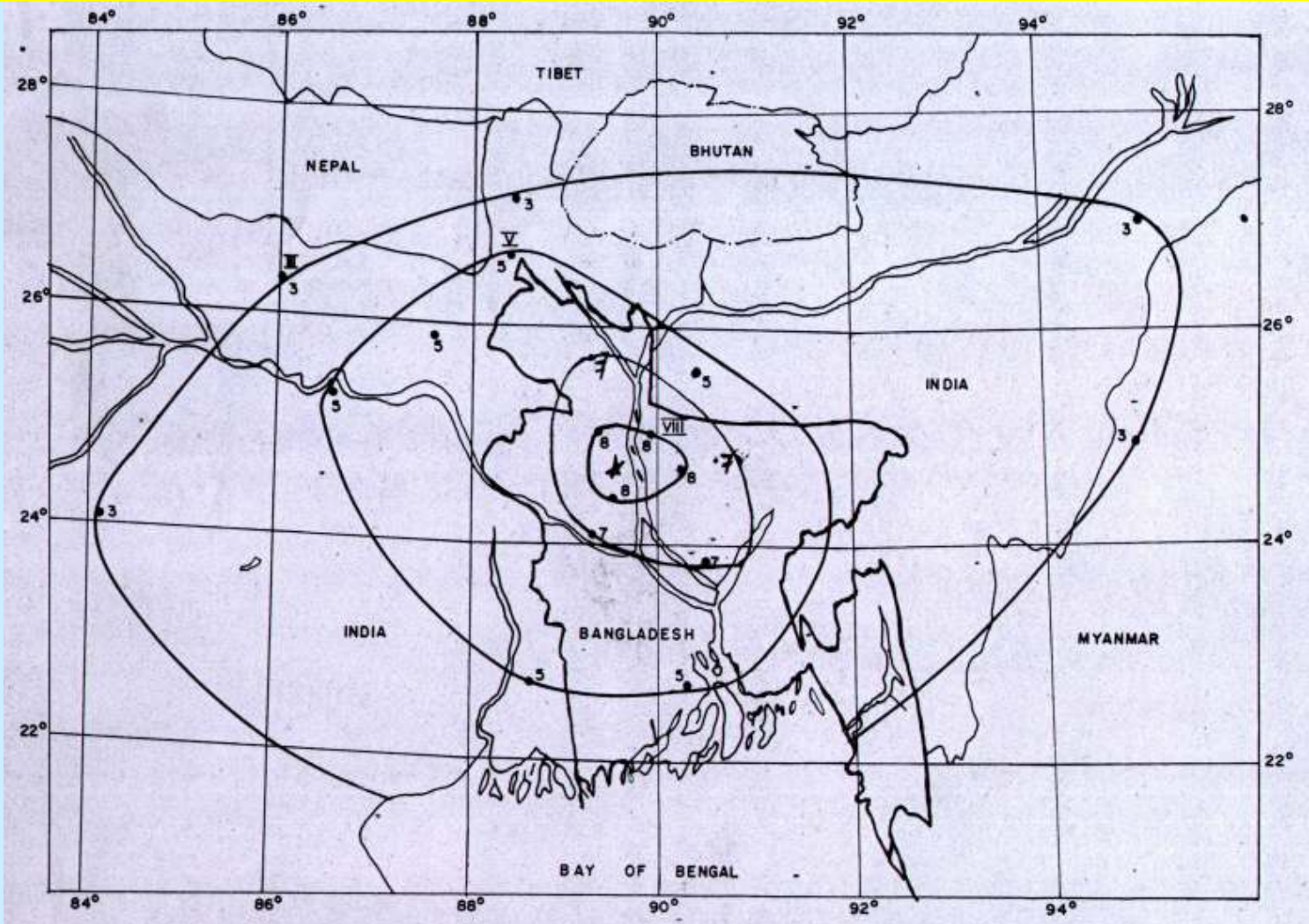
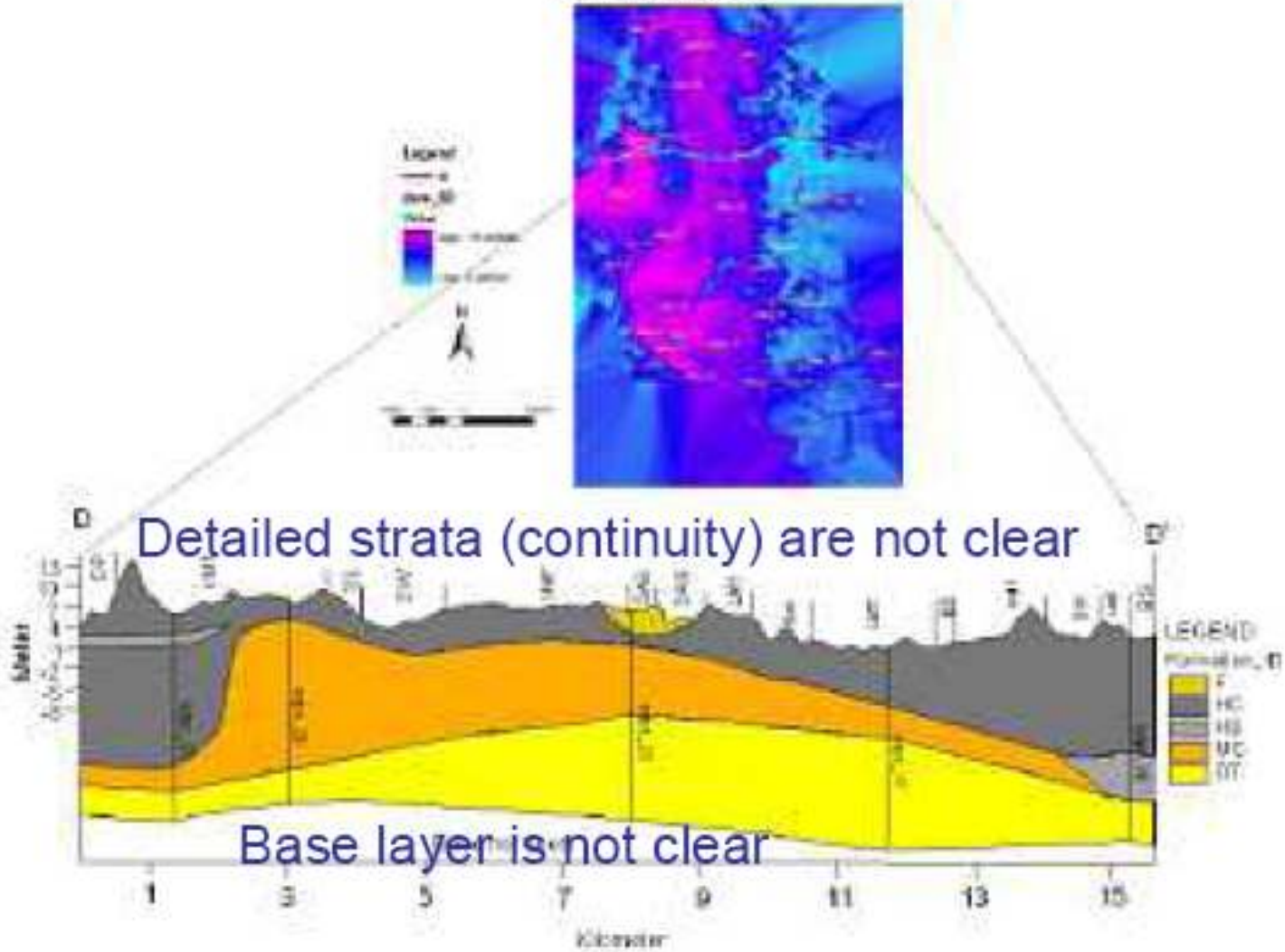
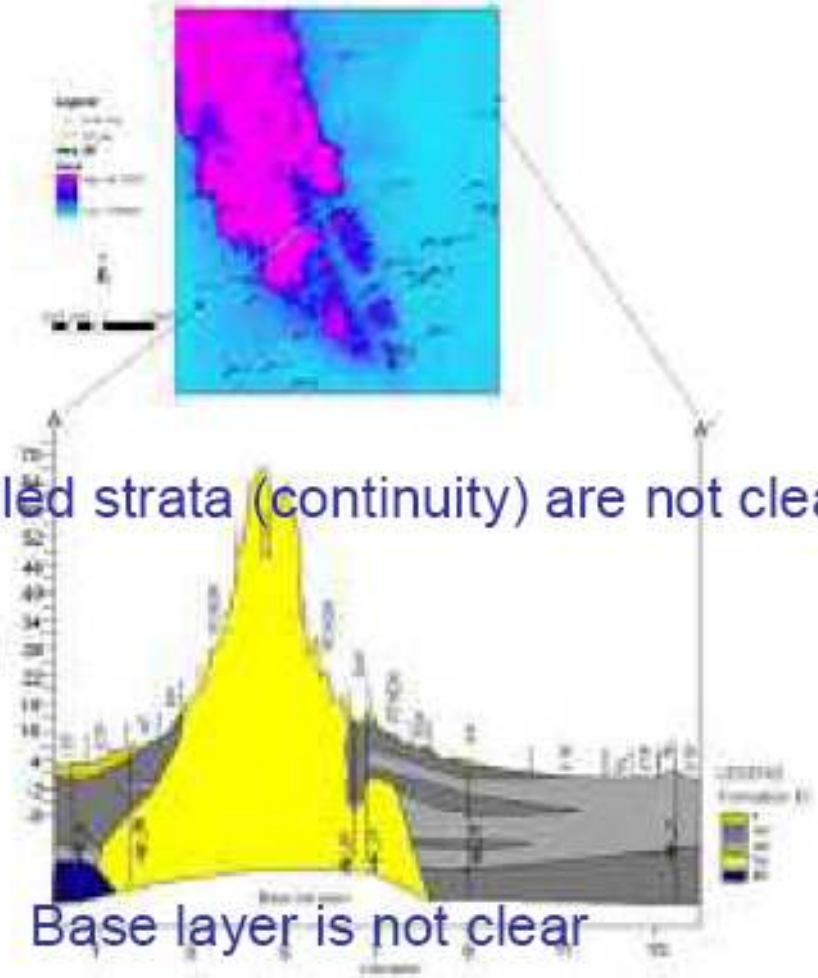


FIG. 2.2 ISOSEISMAL MAP (IN TERMS OF EMS SCALE) OF THE MAIN SHOCK OF JULY 14, 1885 EARTHQUAKE. THE STAR SHOWS THE MACROSEISMIC EPICENTRE.

Schematic Geological Cross Section in Dhaka



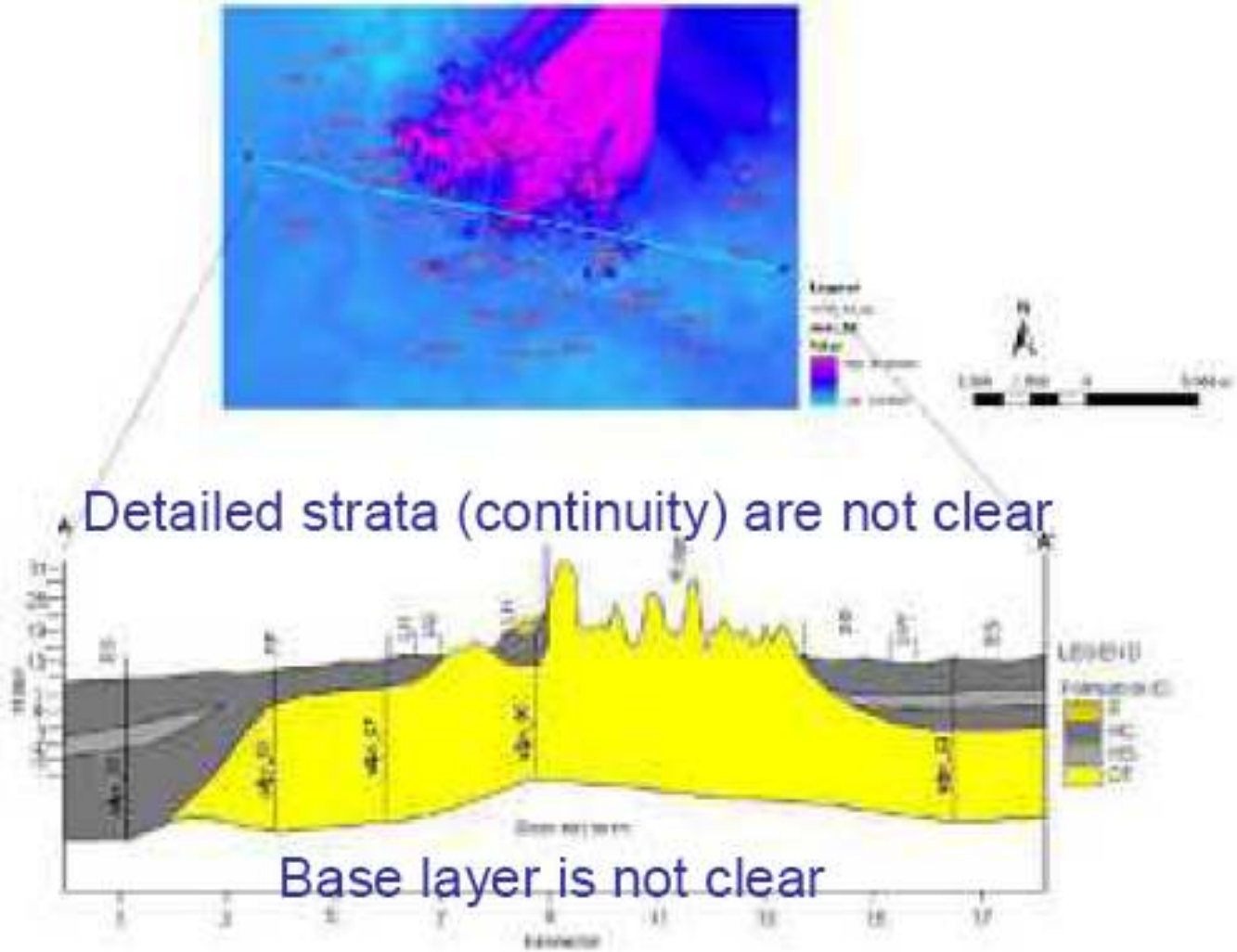
Schematic Geological Cross Section in Chittagong



Detailed strata (continuity) are not clear

Base layer is not clear

Schematic Geological Cross Section in Sylhet



Fault parameters

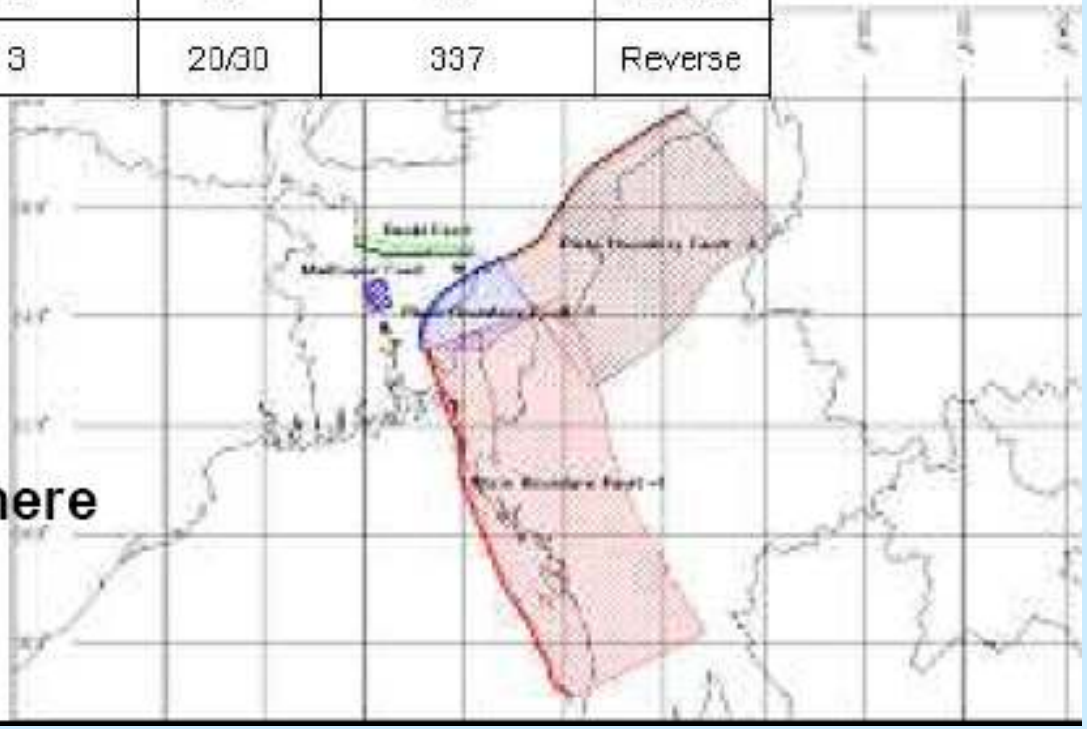
Fault	Mw	Depth to top of fault (km)	Dip (degree)	Down-dip rupture width (km)	Fault Type
Madhupur Fault (MF)	7.5	10	45	42	Reverse
Dauki Fault (DF)	8.0	3	60	43	Reverse
Plate Boundary Fault -1 (PBF-1)	8.5	3	20/30	337	Reverse
Plate Boundary Fault -2 (PBF-2)	8.0	3	20	137	Reverse
Plate Boundary Fault -3 (PBF-3)	8.3	3	20/30	337	Reverse

Deterministic:

5 Scenario Earthquakes

+ M=6 anywhere

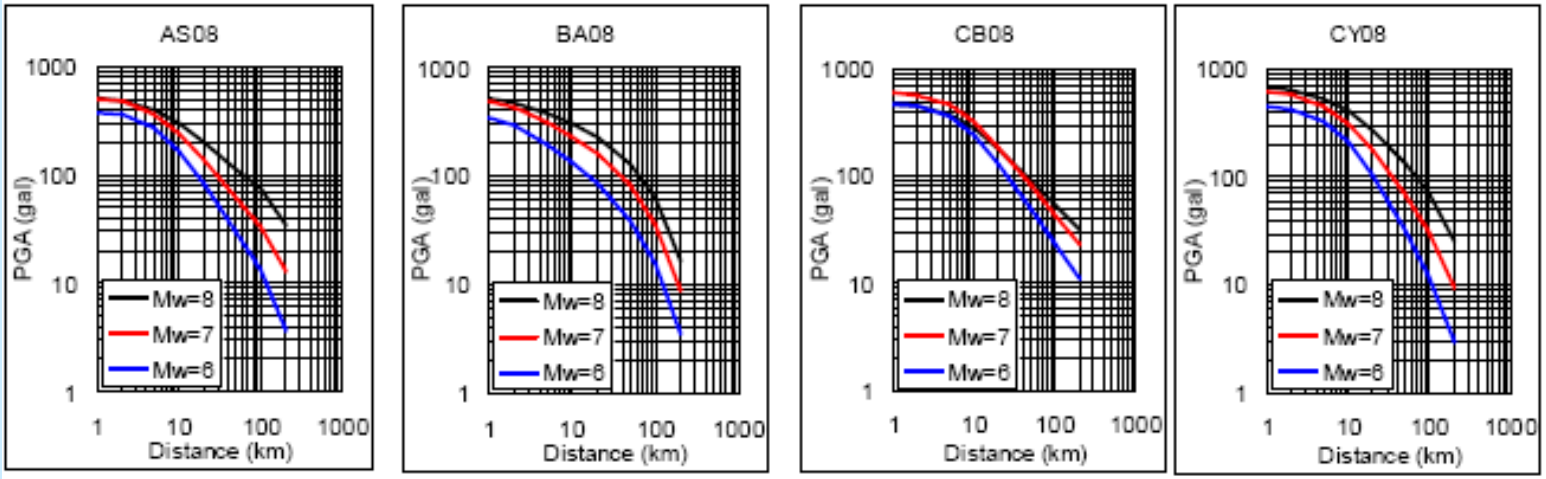
Probabilistic:



DSHA, CDMP (2009)

Attenuation equations (California) (1/2)

PGA (gal)



AS08: Abrahamson N. and W. Silva (2008)

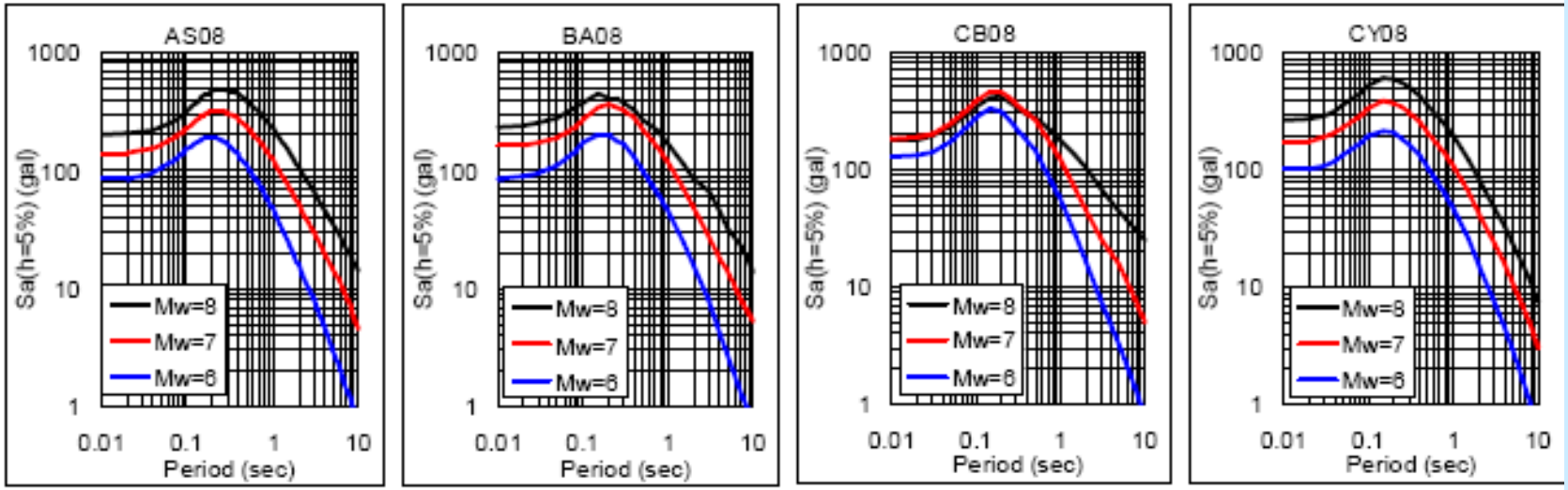
BA08: Boore D. M. and G. M. Atkinson (2008)

CB08: Campbell K. W. and Y. Bozorgnia (2008)

CY08: Chiou B. S.-J. and R. R. Youngs (2008)

Attenuation equations (California) (2/2)

PGV (cm/s)



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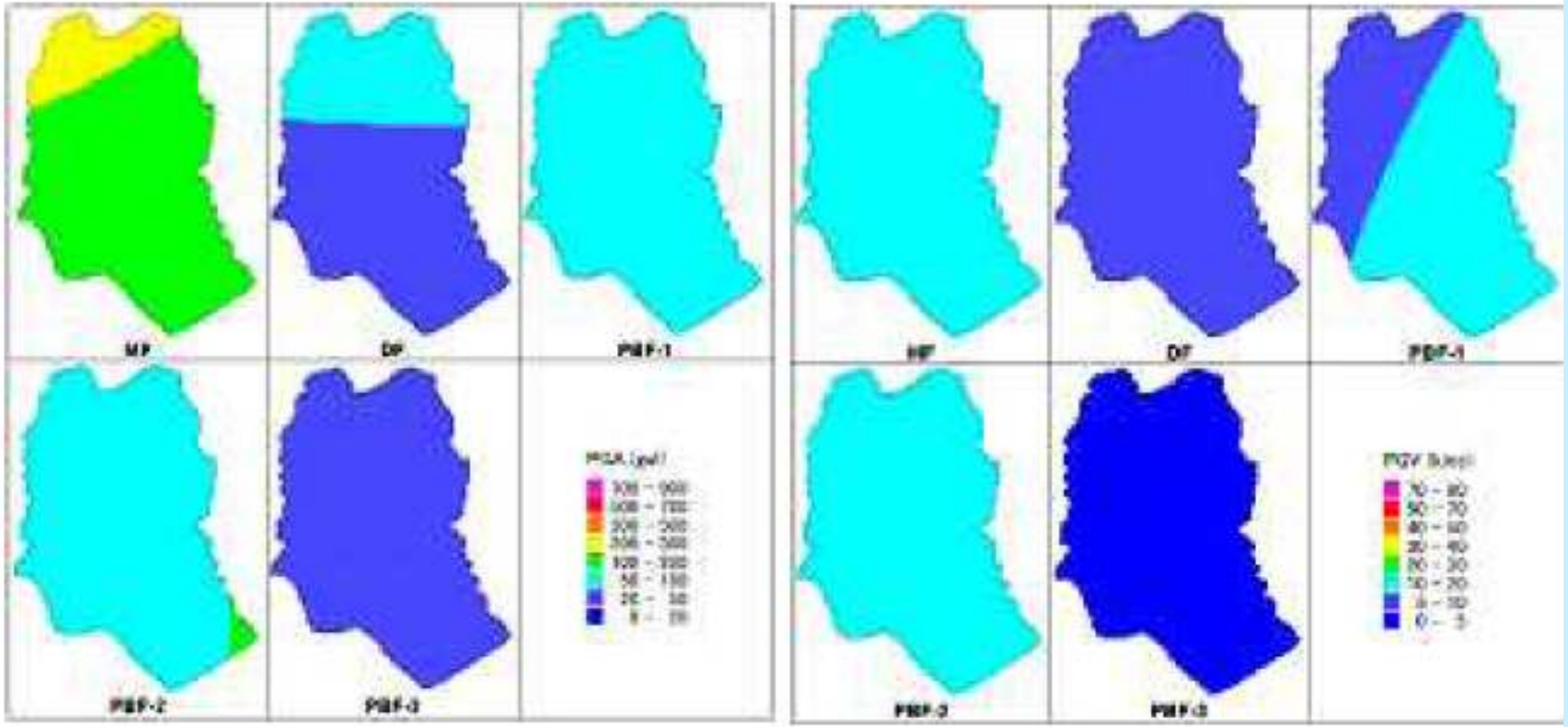
Baserock motion at Dhaka (1/2)

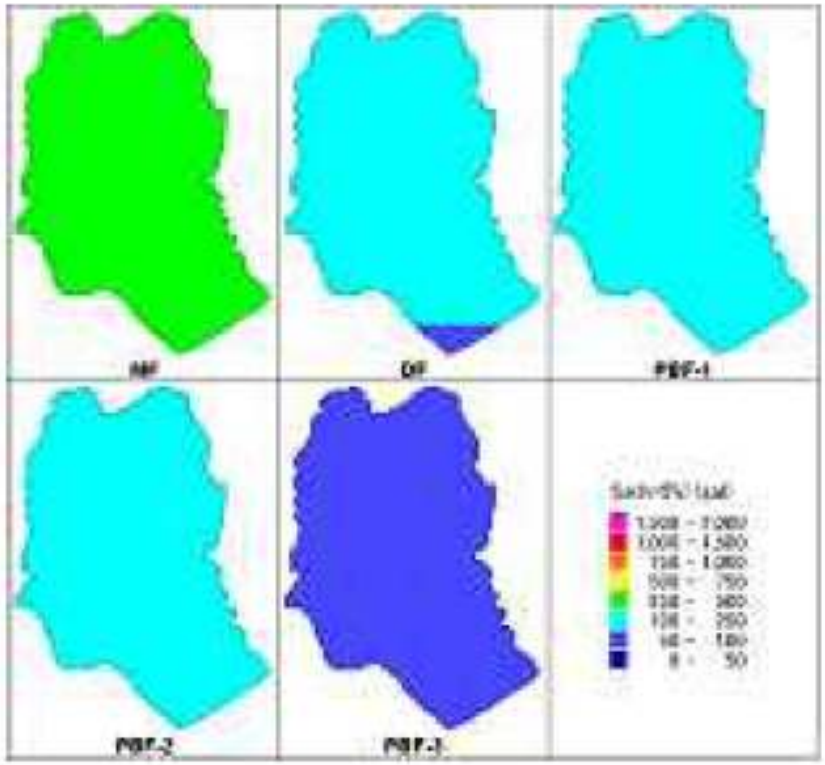
PGA (gal) **PGV (cm/s)**



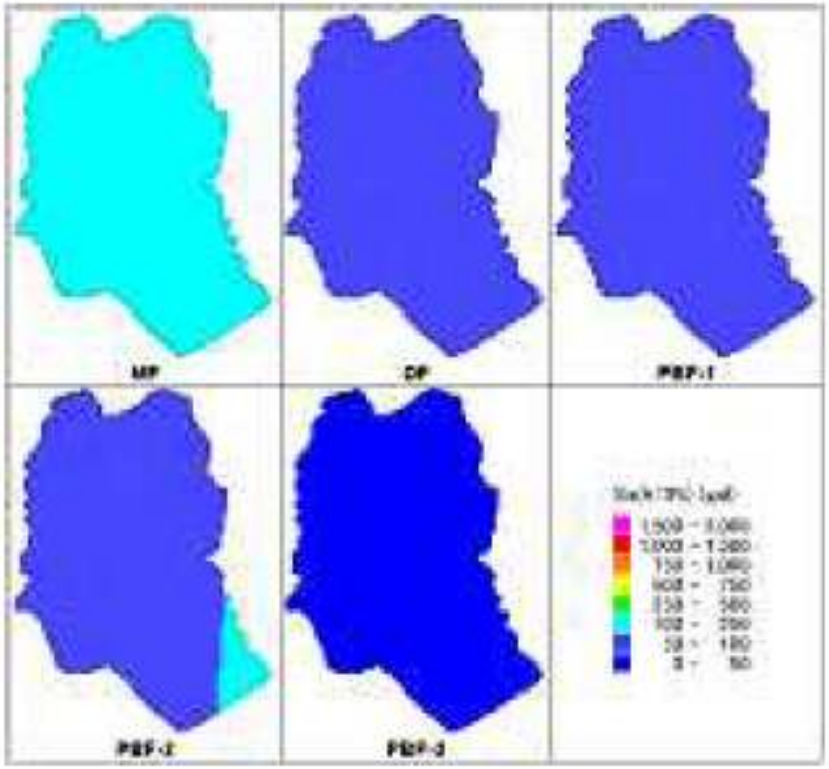
Baserock = Vs 760m/s

Baserock motion at Dhaka (2/2)

Sa(T=0.3): gal
h=5%



Sa(T=1.0): gal
h=5%



Baserock = Vs 760m/s

Amplification factors

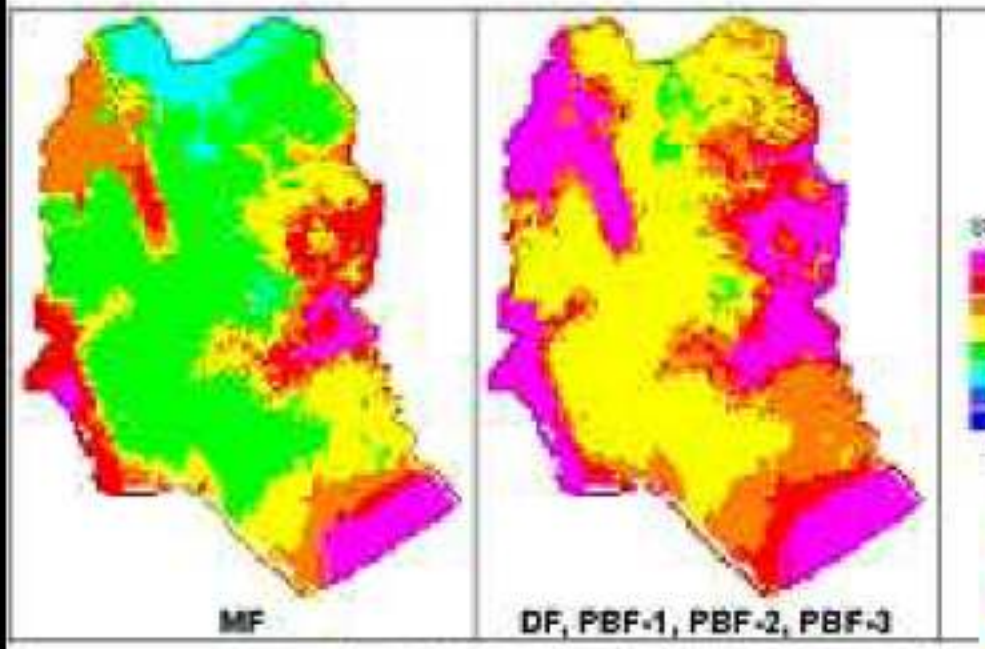


Figure 2-5 Amplification for PGA and Sa[0.3sec] in Dhaka

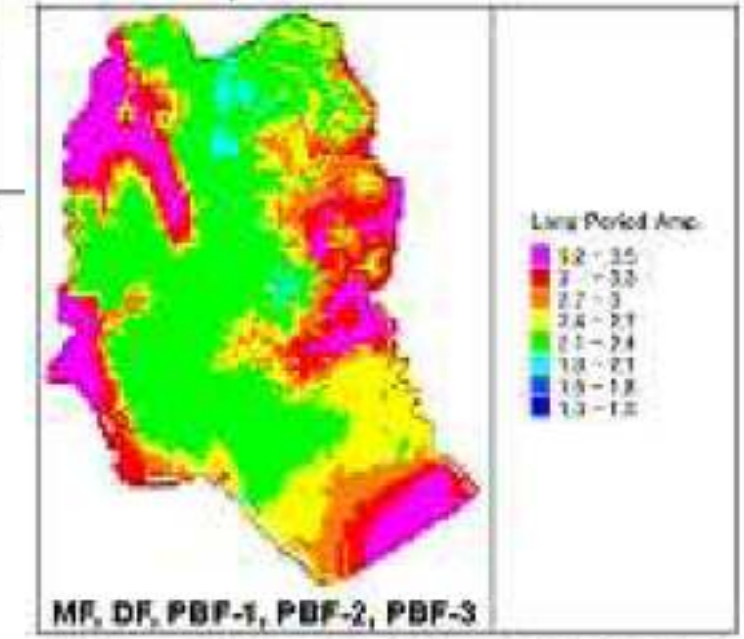
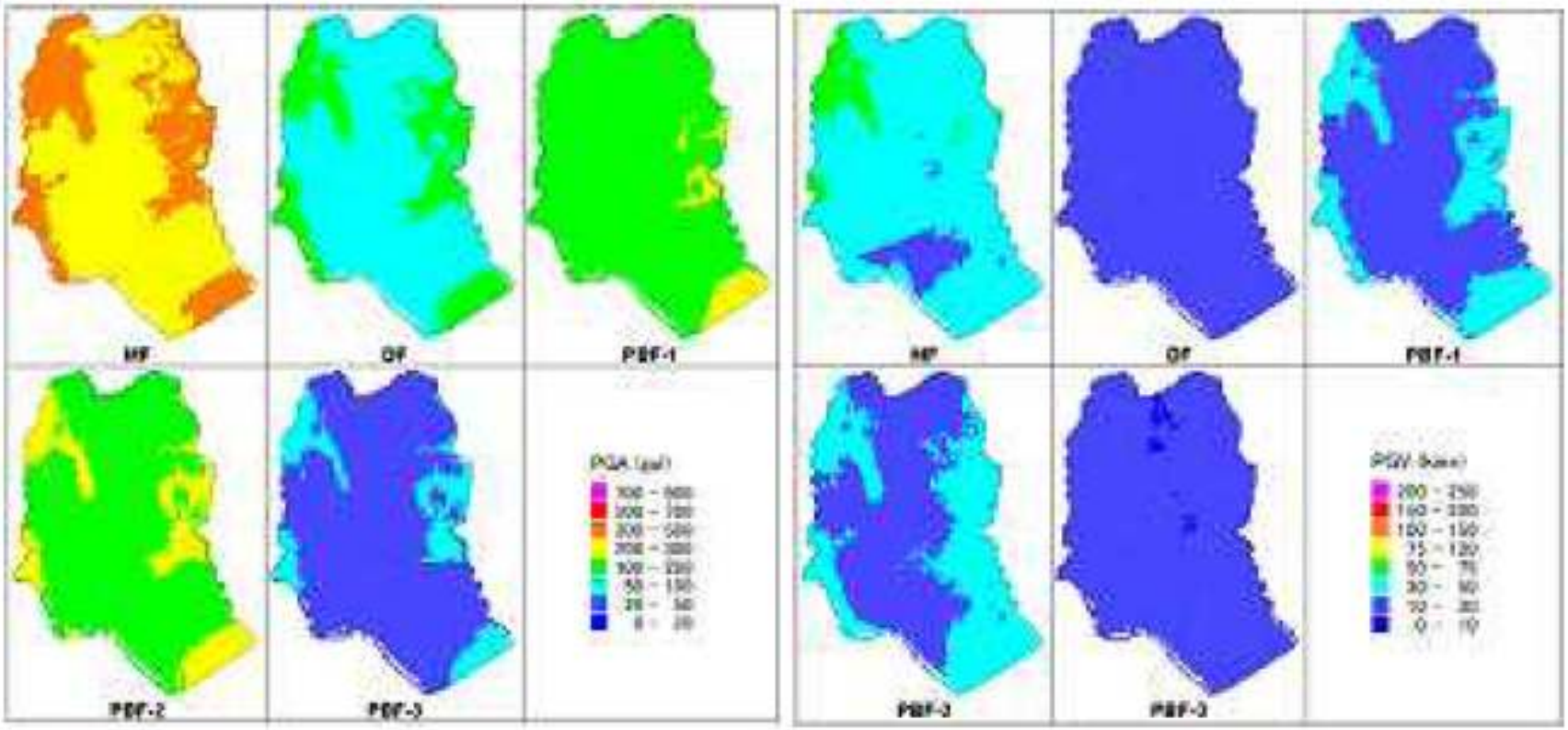


Figure 2-6 Amplification for PGV and Sa[1.0sec] in Dhaka

Amplification differs by input level and frequency component

Seismic motion in Dhaka

PGA (gal) **PGV (cm/s)**



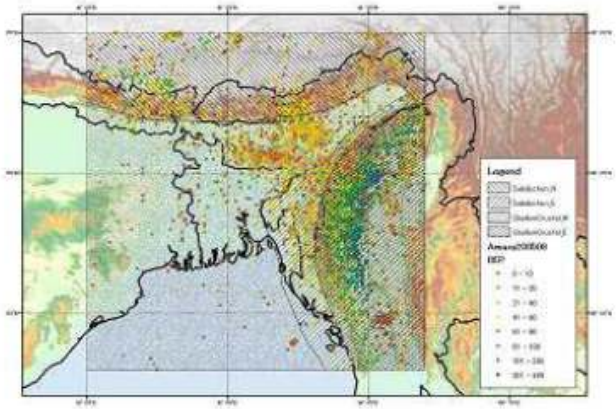
MD: 75-150gal: largest

ground surface

MD: 30-75kine: largest

PSHA, 2009

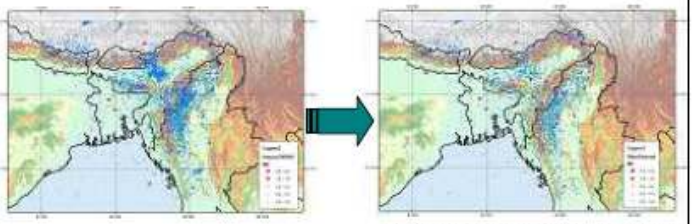
Type of Area Source



Earthquake Catalogue: Prepared by Prof.Ansary, BUET

Removal of dependent earthquakes

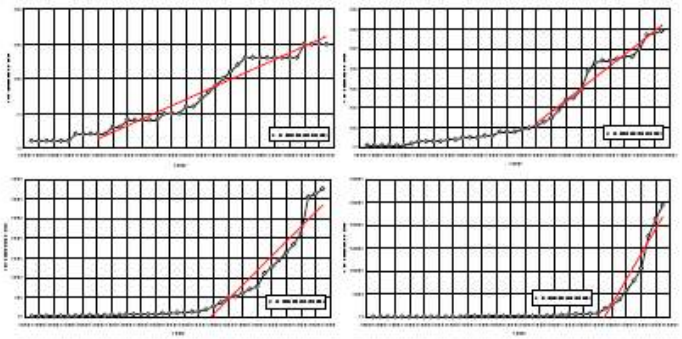
- Removal of foreshocks and aftershocks based on the methods by Gardner and Knopoff (1974)
  - originally 5116 events
  - Identified events; 4530
  - dependent earthquakes: 1442 (32%)
  - independent earthquakes : 3088



Earthquake Catalogue: Prepared by Prof.Ansary, BUET

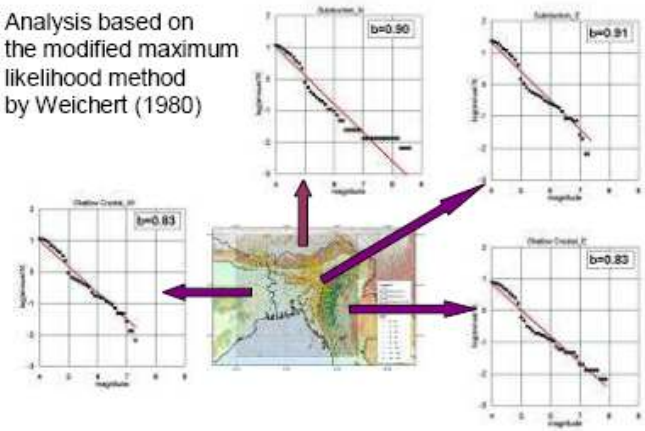
Check of completeness

Older data miss smaller events

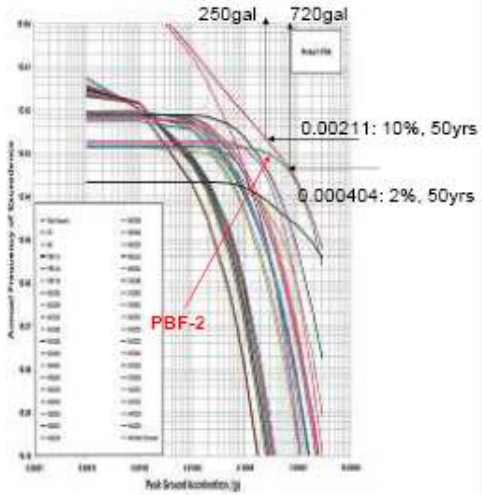


b-value

Analysis based on the modified maximum likelihood method by Weichert (1980)



Probabilistic value of PGA at baserock in Dhaka



$PE = 1 - e^{-\Delta t/T} = 1 - e^{-AFE\Delta t}$

$\therefore AFE = 1/T = -\frac{\ln(1-PE)}{\Delta t}$

PE : Probability of Exceedence

AFE : Annual Frequency of Exceedence

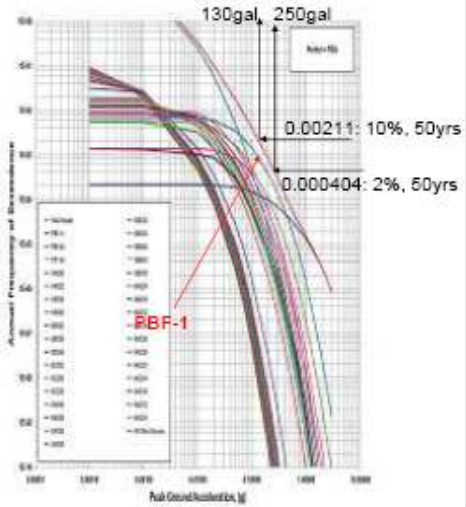
Δt : period to consider (years)

T : return period (years)

$0.00211 = 1/475 = -\frac{\ln(1-0.1)}{50}$

$0.000404 = 1/2475 = -\frac{\ln(1-0.02)}{50}$

Probabilistic value of PGA at baserock in Chittagong



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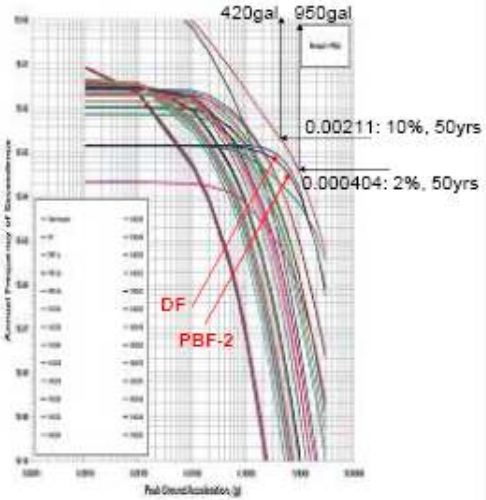
Probabilistic value of PGA at baserock in Sylhet



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Probabilistic Seismic Motion

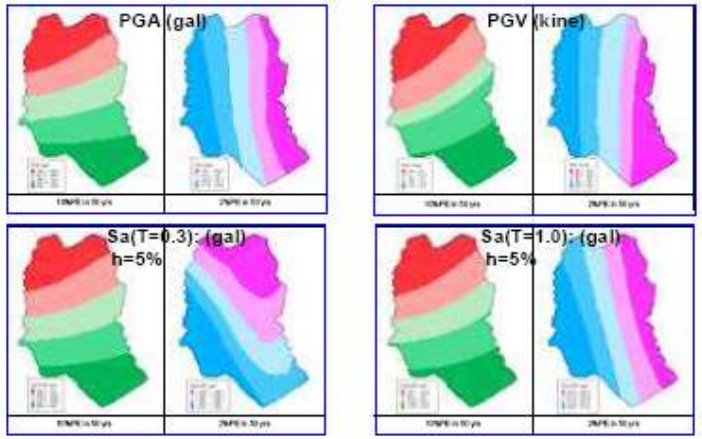
Baserock Motion (Vs=760m/s)

Probability of Exceedence	City	PGA (gal)	PGV (kine)	Sa(T=0.3sec) (gal)	Sa(T=1.0sec) (gal)
10% PE in 50 yrs	Dhaka	240 - 260	17 - 20	450 - 510	180 - 190
	Chittagong	120 - 150	10 - 11	230 - 280	100 - 110
	Sylhet	380 - 470	26 - 34	710 - 900	250 - 310
2% PE in 50 yrs	Dhaka	720 - 740	52 - 55	1460 - 1500	510 - 530
	Chittagong	240 - 280	18 - 20	470 - 540	210 - 230
	Sylhet	770 - 1100	59 - 95	1600 - 2500	600 - 870

Ground Surface

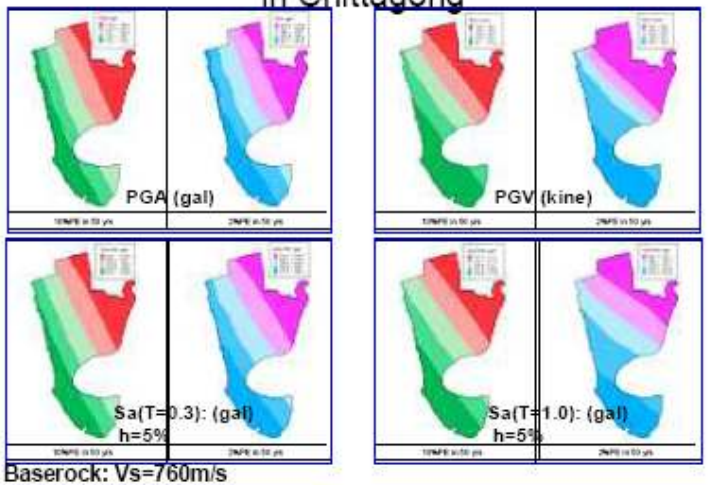
Probability of Exceedence	City	PGA (gal)	PGV (kine)	Sa(T=0.3sec) (gal)	Sa(T=1.0sec) (gal)
10% PE in 50 yrs	Dhaka	320 - 440	34 - 65	620 - 850	340 - 620
	Chittagong	150 - 350	17 - 37	300 - 670	180 - 390
	Sylhet	470 - 530	50 - 92	880 - 1000	460 - 850
2% PE in 50 yrs	Dhaka	650 - 740	75 - 130	1300 - 1500	730 - 1300
	Chittagong	300 - 450	30 - 61	590 - 860	340 - 690
	Sylhet	690 - 1100	98 - 230	1500 - 2500	970 - 2100

Baserock motion by probabilistic method in Dhaka



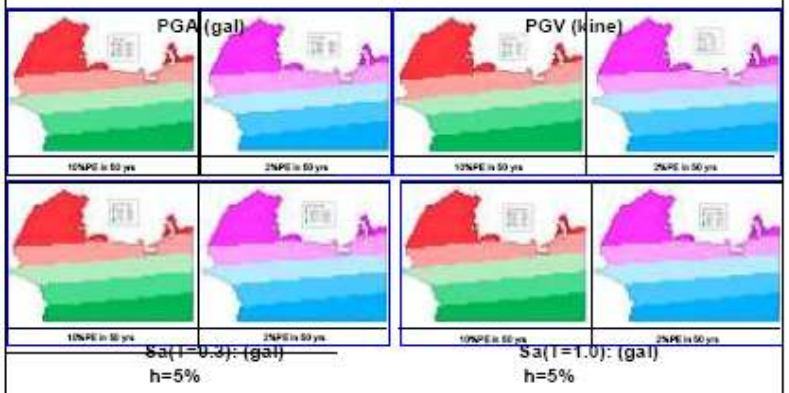
Baserock: Vs=760m/s

Baserock motion by probabilistic method in Chittagong



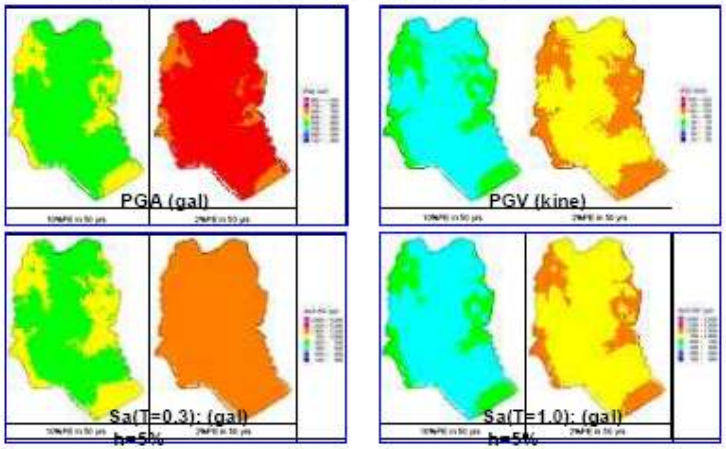
Baserock: Vs=760m/s

Baserock motion by probabilistic method in Sylhet

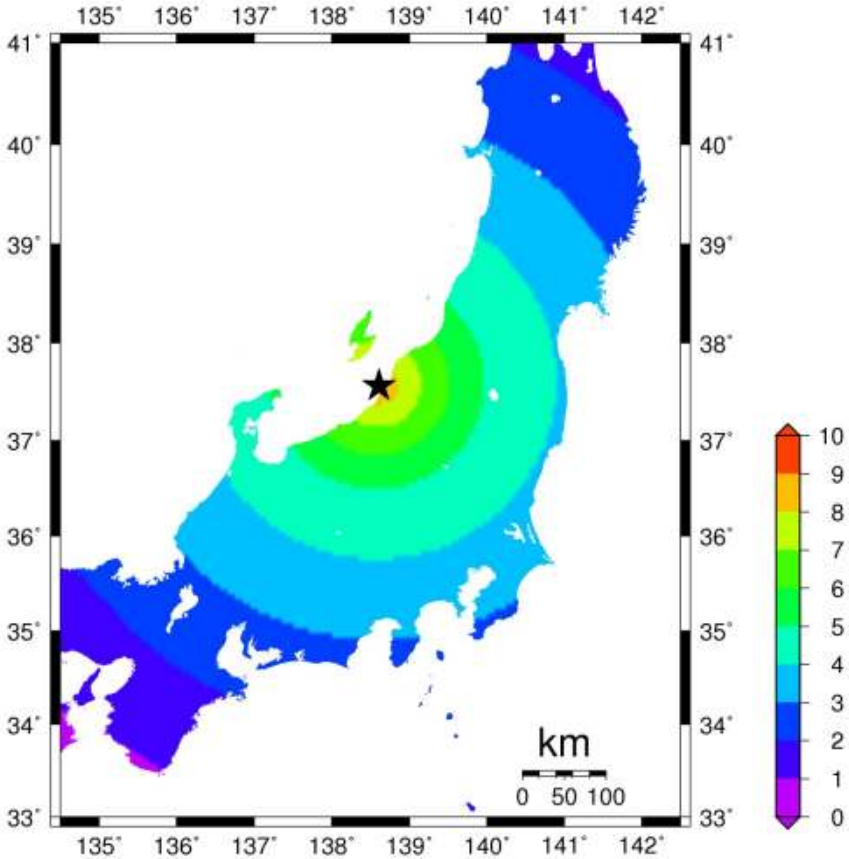


Baserock: Vs=760m/s

Seismic motion at ground surface by probabilistic method in Dhaka

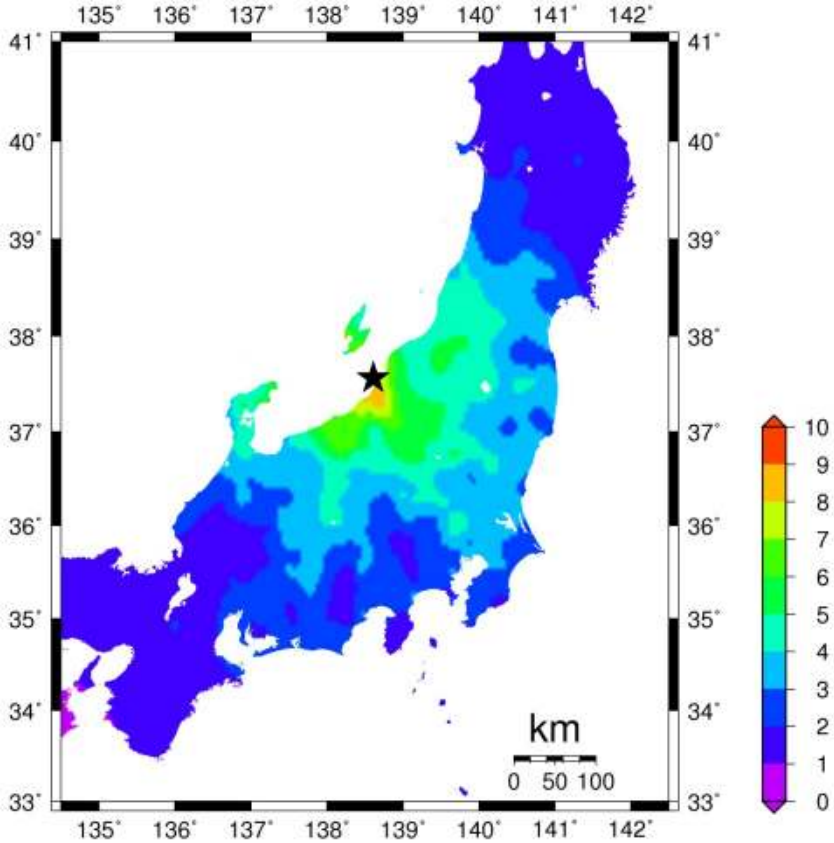


Intensity



INTENSITY (MMI) Contour Map

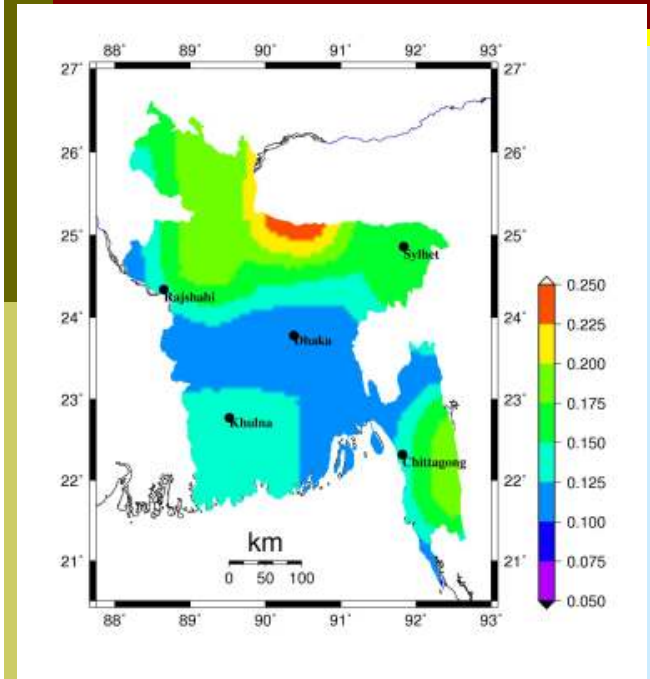
Year	Lat	Long	Depth	Mag	Ref
2007	37.56	138.61	17 km	6.6	JMA



INTENSITY (MMI) Contour Map

Year	Lat	Long	Depth	Mag	Ref
2007	37.56	138.61	17 km	6.6	JMA

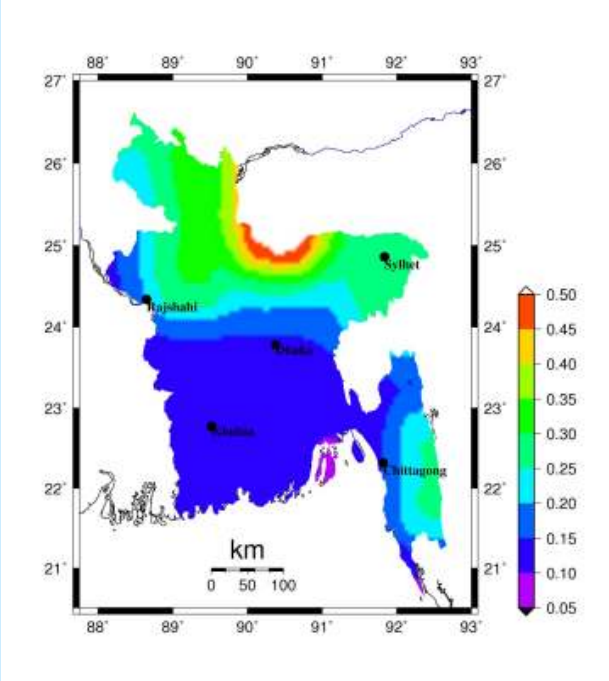
Noor, (2005) PSHA

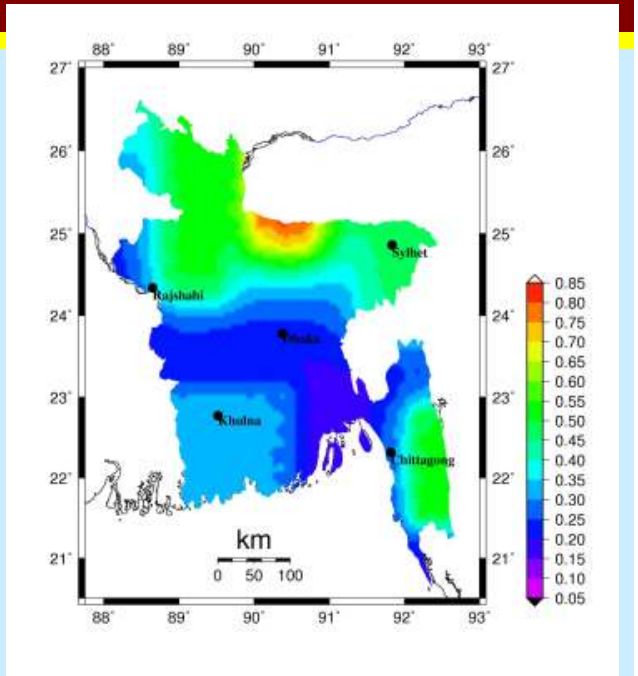


Boore et al (1993)
Rock site

2%, 50 Years

Duggal (1989)
Alluvial





McGuire (1978)
Alluvial

- I would Like to thank IAEA and ICTP for selecting and funding me for attending this workshop
- I hope they will continue their support in future

Thank You