Seismicity Pattern of Pakistan and Surrounding Areas

Pakistan Meteorological Department

National Seismic Monitoring Network, Islamabad

Dated: 5th January 2016
8th October, 2005 Kashmir Earthquake Mw 7.6 and Aftershocks Distribution
26th October, 2015 Hindukush Region Earthquake Mw 8.1 and Aftershocks Distribution

- 26th October, 2015 Hindukush Region Earthquake Mw 8.1
- 7th December, 2015 Mw 7.2
- 25th December, 2015 Mw 6.8
Last Five Years Frequency of Earthquake in and around Pakistan

<table>
<thead>
<tr>
<th>Years</th>
<th>No of Earthquakes</th>
</tr>
</thead>
<tbody>
<tr>
<td>2011</td>
<td>543</td>
</tr>
<tr>
<td>2012</td>
<td>754</td>
</tr>
<tr>
<td>2013</td>
<td>675</td>
</tr>
<tr>
<td>2014</td>
<td>771</td>
</tr>
<tr>
<td>2015</td>
<td>848</td>
</tr>
</tbody>
</table>
A Brief Seismicity Analysis of Pakistan & surroundings:

- 1900-2015
- 4.0 to 4.9 64% of the total events,
- 25% from 3.0 to 3.9 and
- 9% from 6.0 to 6.9
- Only 150 events with magnitude ≥ 6.0
- 28 events with magnitude range 7.0 to 7.9
- Only 3 events have magnitude ≥ 8.0
Seismicity Pattern in Hindukush Region

[Map of the Hindukush Region with seismic activity highlights and geographic markers such as Tienshan, Pamir, Tadik basin, Tajikistan, Pakistan, Afghanistan, MKT, MMT, MBT, and a color scale for distance in km.]
Source mechanism pattern in Hindukush Region and surroundings.
Depth Profile of Hindukush Region
Part – 2
General Seismicity Pattern of Pakistan
Seismicity Trend Analysis over Active Faults in Hazara-Kashmir Syntaxis
Active Faults and Source Mechanism of Earthquakes
(1970 – 2015, M > 5.5)

Himalaya Range

- Panjal Thrust
- Abbottabad Fault
- Nathia Gali Fault
- Margalla Thrust
- Islamabad
- Jhelum Fault
- Main Boundary Thrust
- India Kashmir Boundary Thrust
- Salt Range
Seismicity and Active Faults Near Islamabad

- Main Boundary Thrust
- M 5.3 2015
- Depth
- Mag
- M ≥ 5
- M 4–4.9
- M below 4

Map showing seismic activity and active faults near Islamabad.
Earthquake Frequencies for $M = 4 - 4.9$

Earthquake Frequencies for $M = 5 - 5.9$
‘a’ and ‘b’ value comparison on yearly basis between 2001 – 2015
Conclusion – 1

The Hazara/Kashmir Syntax

- Over all there is an increasing trend in Hazara-Kashmir Syntax area since last five years.

- Frequency of intermediate rang events increased,
Seismicity in Main Mantle Thrust and Nanga Parbat, Haramosh area
The Tectonic Map of the Area
Seismicity of the Region
Only one earthquake occurred on 2002 with Magnitude range 5.1-6.0
Conclusion – 2

The Main Mantle Thrust and Nanga Parbat Haramosh Syntaxes

This area has potential of intermediate range seismic activities (3.1-4.0).
Seismicity Trend in the Region of Salt Range
MAIN FAULTS IN THE REGION

• Kalabagh Fault  
  (North South)

• Jhelum Fault  
  (North South)

• Salt range thrust fault  
  (East-West)
Seismicity of Salt Range

- Kalabagh Fault
- Jhelum Fault
- Salt range thrust fault
- Chakwal
- Mangala
- Talagang
EARTHQUAKE FREQUENCY TREND WITH RESPECT TO MAGNITUDE FOR THE PERIOD 1975-2015
Conclusion – 3

The Region of Salt Range

1. Over all Earthquake occurrence frequency trend is same.
2. Area representing the moderate seismicity
Way forward

I. The risk of earthquakes has significantly increased due to the urbanization. A big earthquake hitting a densely populated city could have devastating impacts. Besides existing earthquake monitoring network, a dense network will be required particularly for **Northwest, northeast and southwest areas** of Pakistan.

II. Earthquake Early warning system is recommended for **Northwest, northeast and southwest areas**.

III. Increase the local capacity of earthquake prone areas for disaster resilience with series of training workshops for regarding **MEASURES TO MINIMIZE THE EFFECTS OF AN EARTHQUAKE**.

IV. For disaster Reduction planning is the best way for a more community to move toward Disaster Resilience.
Thanks
Local and International Broadband Stations Network

- Arabian Sea
- India
- China
- Pakistan
- Tajikistan
- Russia
- Iran
- Saudi Arabia
- USGS
- PMD
- BB Stations
- Local and International Broadband Stations Network
Magnitude and Intensity

• MAGNITUDE
  – Measure of earthquake size (energy)
  – Quantitative measure
  – Source Parameter
  – Remains same everywhere

• INTENSITY
  – Measure of the destruction caused by an earthquake
  – Qualitative measure
  – Site parameter
  – Different at different places (Attenuation and amplification phenomena)
  – Most commonly used intensity scale is “MMI or Modified Mercalli Intensity Scale.”
Magnitude and Intensity

• **DIFFERENCE BETWEEN MAGNITUDE & INTENSITY**

  – **Magnitude** remains unchanged with distance from the earthquake. **Intensity** decreases with distance from the earthquake epicenter.

  – **Magnitude** measurement requires instrumental monitoring for its calculation, however, assigning an **intensity** requires a sample of the felt responses of the population.
Different Magnitude Scales

Earthquake Magnitude

Richter Local Magnitude

- Surface Wave Magnitude
  \[ M_s = \log A + 1.66 \log \Delta + 2.0 \]
- Body Wave Magnitude
  \[ m_b = \log A - \log T + 0.01 \Delta + 5.9 \]

Other Instrumental Magnitude Scales

- Moment Magnitude (preferred)
  \[ M_w = (\log M_o)/1.5 - 10.7 \]