



**Ministry of Earth Sciences  
New Delhi, India**



**Seismological Observatory in Bergen  
University of Bergen, Norway**

## **2<sup>nd</sup> India-Norway Geohazards Workshop**

**13-14 February 2014, Ministry of Earth Science, New Delhi, India**

### **REPORT**

**Coordinators**

**Prof. Dr. Kuvvet Atakan  
Department of Earth Science, University of Bergen  
Bergen, Norway**

**Dr. Brijesh K. Bansal  
Ministry of Earth Science  
New Delhi, India**

**April 2014**

## **Background**

In February 2011, an official delegation led by the Research and Higher Education Minister Ms Tora Aasland visited a number of universities and research institutions in New Delhi, India. During one of the meetings held as a part of this official visit between the representatives from the Ministry of Earth Science, Government of India, University of Bergen (UiB) and the Norwegian Geotechnical Institute (NGI), it was decided to arrange a joint workshop on Geohazards between Indian and Norwegian scientists working in the field of Earth Science.

This initiative was later followed up by the UiB, NGI and the Ministry of Earth Science, Government of India and the workshop with the title “1<sup>st</sup> India-Norway Geohazards Workshop” was jointly organized by the Ministry of Earth Science, Government of India, Department of Earth Science, University of Bergen, Norway and the Norwegian Geotechnical Institute. The workshop was held in the India Habitat Centre in New Delhi, India during the period 12-14 September 2011. The main outcome was a list of topics within geohazards that were identified jointly by the Indian and Norwegian researchers during the workshop.

The “2<sup>nd</sup> India-Norway Geohazards Workshop” was arranged to follow up on the previously decided joint topics of interest. The main objective for this workshop would be to bring together researchers for developing future collaboration in concrete joint research projects. The 2<sup>nd</sup> India-Norway Geohazards Workshop was jointly organized by the Ministry of Earth Science in India and University of Bergen in Norway. The workshop was held in New Delhi at the headquarters of the Ministry of Earth Sciences during the period 13-14 February 2014.

## **Scientific Rationale**

Based on the number of destructive earthquakes in the history as well as the current seismicity in the region, it is obvious that the seismic hazard close to the plate boundary along the Himalayan front is significant as is also manifested in earlier seismic hazard studies. In addition, the topographic conditions in the foothills of the Himalaya mountain chain is inevitably susceptible to slope instabilities related to both gravitational forces, but more importantly also to earthquake triggered landslides. Based on the fact that the largest destructive earthquakes have occurred in the Himalayas especially in the NE-part, there is a need for detailed seismic hazard and risk studies in the region.

The choice of the two main topics of the workshop are *seismic hazard and risk in NE-India* as well as the *crustal deformation of Stable Continental Regions*, is therefore timely, especially seen in the perspective of the increased vulnerability of the society, built environment and not the least the concentration of population exposure in these areas. Regarding the latter, both Continental India and the Scandinavian Craton represent common scientific challenges in both India and Norway. It is therefore necessary to establish a joint focused research effort to address these challenges.

## **Geohazards Expertise in India and Norway**

The four institutions represented by the participant list from Norway (see Appendix), have a long record of research in the fields of earthquakes and landslides. While the seismological (earthquake) competence is concentrated at the Department of Earth Science, University of Bergen (GEO-UiB) and NORSAR, both the Geological Survey of Norway (NGU) and the Norwegian Geotechnical Institute (NGI) are the two leading institutions in Norway in problems related to slope instability (landslides).

In India, a number of research institutions as well as universities conduct research in seismology and slope stability-related problems. The Ministry of Earth Sciences is a manifestation of the political will of the Government of India in addressing issues related to natural disasters. The Ministry of Earth Science, Government of India, being the hosting institution and the local organizer of the workshop emphasize this dimension significantly.

### Summary from the 2<sup>nd</sup> India-Norway Geohazards Workshop

Based on the jointly identified research topics during the 1<sup>st</sup> workshop, the 2<sup>nd</sup> workshop aimed to address the two umbrella themes focusing on the: (i) seismic hazard (including both earthquake and landslide hazards) and risk in NE-India; and (ii) crustal deformation of Stable Continental Regions. The main purpose of this workshop was to deliberate upon the specific components of the two identified topics and to concretize these in the form of joint project proposals.

The program outline of the 2<sup>nd</sup> India-Norway Geohazards Workshop is given below. The venue for the workshop was at the **Ministry of Earth Sciences, Prithvi Bhavan, Lodhi Road, New Delhi**. The joint session on research and education on Friday Afternoon was held at the Ashok Hotel in New Delhi.

### Tentative program of the 2<sup>nd</sup> India-Norway Geohazards Workshop

Time	Sessions	Thursday, February 13, 2014	Organizers	Friday, February 14, 2014	Organizers
09:30-10:00	Registration				
10:00-10:30	Opening	Opening addresses			
10:30-11:15	Morning session 1	Theme1: Seismic hazard and risk in NE-India	MoES and UiB	Theme 2: Crustal deformation in Stable Continental Regions	MoES and UiB
11:15-11:30	Coffee break				
11:30-12:30	Morning session 2	Theme1: Seismic hazard and risk in NE-India	MoES and UiB	Discussion on joint research projects	MoES and UiB
12:30-13:30	Lunch			Transport to AH*	
13:30-14:30	Afternoon session 1	Theme1: Seismic hazard and risk in NE-India	MoES and UiB	14:00 - Joint session on research and education*	SiU, UGC, UoD, MoES and UiB
14:30-15:00	Coffee break				
15:00-16:30	Afternoon session 2	Theme 2: Crustal deformation in Stable Continental Regions	MoES and UiB	Joint session on research and education*	SiU, UGC, UoD, MoES and UiB
16:30-17:00	Closure			Closing remarks	
19:30	Social event	Dinner	MoES		

\*Joint session on research and education was held at the Ashok Hotel (AH), New Delhi.

The detailed program of the workshop as well as the participant lists from Norway and India are given below in *Appendix 1, 2 and 3*, respectively. The abstracts from the workshop are presented in a separate volume published by the Ministry of Earth Sciences, India (*Appendix 4*) and were distributed to the participants during the workshop. In total there were 23 presentations on various topics within the two themes of the workshop.

The workshop started with a general introduction to the seismotectonics of the NE-India given by Prof. Kuvvet Atakan. Here, the main elements of the deformation caused by the convergence between the Indian and the Eurasian Plates were discussed. The large earthquake occurrences and their relation to active tectonics were outlined. In this context the role of the Shillong Plateau in the generation of large destructive earthquakes such as the one in 1897 was considered important. Alternative explanations for the source of the 1897 event were elaborated. In addition, the second very large destructive earthquake in Assam in 1950 was also discussed. Dr. Saurabh Baurah has discussed various hypotheses regarding the location of the 1897 earthquake source area on the Shillong Plateau and the importance of using both 3D-tomography and InSAR data. Dr. M. Verma continued with a discussion on the characterization of active faults in NE-India and their importance in seismic hazard analyses.

Dr. Dinesh Kumar and Prof. S.S. Teotia have elaborated on the scenario-based ground motion modelling using a hybrid technique (envelope function combined with composite model) for large earthquakes in NE-Himalayas. Drs. B. Sharma and S. Chopra have continued the discussion on ground motion simulations in NE-India and have stressed the use of various simulation techniques. Dr. Prantik Mandal gave examples of ground motion modelling from a case study conducted at Kachchh in Gujarat. Data collected on the 2001 Bhuj earthquake and its aftershocks were used to understand the characteristics of the crustal deformation in this region.

Drs. D. Lang and Y. Singh have elaborated on the development of seismic risk-targeted ground motion maps and their use in NE-India. After the lunch break the session on seismic hazard and risk in NE-India continued with slope instabilities and other local site effects. Drs. J. Dehls and R. Hermanns have outlined the Norwegian methodologies used in the identification of unstable rock slope failures for hazard and risk computations. Dr. Y. Singh has discussed the collapse probabilities of buildings as a part of the risk-targeted hazard assessment approach. Drs. R. Bhasin and A. Kaynia have emphasized the importance of slope stability problems in association with large earthquakes and their effects on large infrastructures. The ongoing development of the NE-India involves a number of critical infrastructure and hence assessing seismic hazard and risk in this area was considered important. Dr. P. Jaiswal has continued the discussion on landslide hazard with perspectives and experiences from Western Ghats. Dr. Amir Kaynia together with Dr. R. K. Bhasin has explained the amplification of seismic wave amplitudes due to local site effects associated with unconsolidated sediments (soft soil) or topographic features. Dr. Sumer Chopra has outlined the latest microzonation studies conducted in India. Application of active and passive seismic experiments was discussed by Dr. A.K. Mahajan. Prof. S.K. Nath and his co-workers have presented the results from the probabilistic seismic hazard assessments conducted for the city of Guwahati, using both time dependent and time-independent assumptions. Dr. Suresh and co-workers have demonstrated the use of broad-band seismological data in delineating the lithospheric velocity structure of the Central Deccan Volcanic Province (DVP). The first day of the workshop was concluded with two presentations on induced seismicity by Dr. Rao on the Koyna area, and Dr. D. Lang. On behalf of his colleagues, Dr Lang has demonstrated experiences gained through microseismicity surveys conducted in Norway.

The workshop continued on the second day (Friday, February 14, 2014) with the Theme on Crustal deformation in Stable Continental Regions (SCR). The motion of the Indian plate was elaborated by Dr. V. Gahalaut. Dr. L. Ottemöller has presented a recent sequence of earthquakes in Western Norway at Stord area from the perspective of intraplate earthquakes. Finally, Dr. Gahalaut and co-workers have discussed the interaction with the Indo-Burmese deformation. Dr. S.K. Prajapati has discussed the crustal deformation in NE-India based on GPS data both from permanent and campaign-based field installations.

The general discussion before lunch was related to identifying the topics of interest from the Norwegian and Indian colleagues for possible future collaborative project(s). These are briefly outlined below.

**Recommendations for future collaborative research:**

During the workshop following subtopics were identified where future research is needed with regard to the two main themes of the workshop:

1. Seismic hazard and risk assessment in NE-India
  - Seismic source definitions through seismological and seismotectonic analyses
  - Local site effects due to earthquake ground shaking
  - Landslide hazard and its link to earthquakes
  - Integration of source, path and site characteristics and assessment of seismic hazard and risk of few vulnerable cities in NE-India
  
2. Crustal deformation in Stable Continental Regions (SCR)
  - Seismic and seismotectonic case studies in India and Norway
  - Reservoir triggered seismicity in intraplate areas
  - Understanding earthquake behavior using borehole seismology
  - Earthquake swarms
  - Earthquakes on extinct rifts
  - Improved earthquake locations using 3-D crustal velocity structures
  - Understanding the crustal deformation combining GPS and InSAR data

The institutions that were present in the workshop have clearly expressed their interest in future collaborative projects in the above mentioned two themes and the related subtopics. It was decided that further work on the development of individual project collaboration will be followed up by the coordination of the Centre for Seismology, MoES and Department of Earth Science, University of Bergen.

In an attempt to focus the future collaborative efforts in NE-India, following geographical locations were identified. For landslide hazard studies, Gangtok-Tsomgo/Gangtok-Chhangu lake corridor is proposed in which mapping of all landslides in this corridor can be carried out. Regarding seismic hazard, two cities, Gangtok and Shillong are proposed where seismic hazard assessment can be carried out completely with the aim of identifying on how the city can be made less vulnerable. In

these cities few important structures like schools and hospitals may be selected for a detailed structural assessment. If necessary, retrofitting and strengthening measures may be elaborated in order to improve the structural performance in future large earthquakes in the area.

Regarding the crustal deformation in SCR, characteristics of seismic events both triggered and natural may be studied for Indian shield and Norway to explore any similarity. It was agreed that comparison of attenuation relationships, source scaling, and velocity structure should be attempted. In addition, seismotectonic models developed for the Kachchh region could be tested at locations in Norway.

**APPENDIX:**

**Appendix 1:** Detailed program of the 2<sup>nd</sup> India-Norway Geohazards Workshop

**Appendix 2:** List of Participants from Norway

**Appendix 3:** List of Participants from India

**Appendix 4:** Abstract book for the 2<sup>nd</sup> Indo-Norwegian Workshop on Geohazards

**Appendix 1:**

**Program for the 2<sup>nd</sup> India Norway Geohazards Workshop**

**Venue:** Ministry of Earth Sciences, Prithvi Bhavan, Lodhi Rd, New Delhi, India

**Thursday, February 13, 2014**

09:30-10:00 Registration

**Opening Session:**

[http://www.norwayemb.org.in/News\\_and\\_events/Bilateral-Relations/Climate-and-Environment/2nd-Indo-Norway-Workshop-on-Geohazards-for-future-research/](http://www.norwayemb.org.in/News_and_events/Bilateral-Relations/Climate-and-Environment/2nd-Indo-Norway-Workshop-on-Geohazards-for-future-research/)

10:00 Welcome address by Shri Anand S. Khati, Jt. Secretary, Ministry of Earth Sciences (MoES)

10:03 About the Workshop by Dr. B.K. Bansal, Adviser, MoES and Prof. Dr. Kuvvet Atakan, University of Bergen, Norway

10:10 About the research framework for Indo-Norwegian cooperation by Dr. Jon Heikki Aas, The research Council of Norway

10:15 Remarks by Ambassador Eivind S. Homme, Royal Embassy of Norway, New Delhi

10:25 Remarks by Dr. Harsh K. Gupta, Member, National Disaster Management Authority (NDMA), New Delhi

10:35 Remarks by Dr. Shailesh Nayak, Chairman Earth System Science Organisation and Secretary, MoES

10:45 Tea break

**Theme 1: Seismic hazard and risk in NE-India**

11:00-11:15 Plate convergence and the regional tectonics in NE-India  
By Kuvvet Atakan

11:15-11:30 Source characterization and 3-D tomography to delineate the boundary faults of the Shillong Plateau, NE-India supplemented by InSAR technology  
By Surabh Baruah

11:30-11:45 Characterisation of active faults in northeast Indian region  
By M. Verma

11:45-12:00 Scenario ground motions from large to great earthquakes in northeast Himalaya  
By Dinesh Kumar and S.S. Teotia



- 12:00-12:15 Simulation of strong ground motion in North East (NE) region of India  
By Babita Sharma and Sumer Chopra
- 12:15-12:30 Ground motion modelling of the Katchchh rift basin, Gujarat, India, using available earthquake data and seismological constraints  
By Prantik Mondal
- 12:30-13:00 Towards seismic risk-targeted ground motion maps for India: combining probabilistic hazard with code-consistent fragility  
By Dominik Lang and Yogendra Singh
- 13:00-14:00 Lunch break
- 14:00-14:15 Recognition of large unstable rock slope failures and their follow up for hazard and risk classification: the Norwegian method  
By John F. Dehls and Reginald L. Hermanns
- 14:15-14:30 Estimating collapse probabilities of buildings designed following Indian Code provisions – towards risk-targeted hazard assessment  
By Yogendra Singh
- 14:30-14:45 The effect of earthquakes on infrastructures in the Himalayas with emphasis on slope stability, dams and underground structures  
By Rajinder K. Bhasin and Amir Kaynia
- 14:45-15:00 Landslide issues in Western Gaths  
By Pankaj Jaiswal
- 15:00-15:15 Amplification of earthquake motions by soil and topographic features  
By Amir Kaynia and Rajinder K. Bhasin
- 15:15-15:30 Site response studies in NE-India  
By Sumer Chopra
- 15:30-15:45 Application of active and passive seismic method for site characterization in active tectonic regions  
By A.K. Mahajan
- 15:45-16:00 Time dependent and time independent probabilistic seismic hazard of North East India with emphasis on site-specific HAZUS based Risk modelling for the city of Guwahati and Siliguri  
By Sankar Kumar Nath, Manik Das Adhikari and Sabayasachi Maiti
- 16:00-16:30 Coffee break

- 16:30-16:45 Delineation of lithospheric velocity structure of central Deccan Volcanic Province (DVP) through national broadband seismological network  
By G. Suresh, P.R. Baidya, J.L. Guatam and R.S. Dattatrayam
- 16:45-17:00 Induced seismicity at Koyna, India  
By N. Purnachandra Rao
- 17:00-17:15 Induced seismology  
By Volker Oye and Daniela Kühn (presented by Dominik Lang)
- 17:15-17:30 Closure
- 19:30 Dinner

**Friday, February 14, 2014**

**Theme 2: Crustal deformation in Stable Continental Regions (SRC)**

- 09:30-09:45 India plate motion and deformation  
By Vineet Gahalaut
- 09:45-10:00 The Storfjorden intraplate earthquake sequence  
By Lars Ottemöller
- 10:00-10:15 Tectonics of the Indo-Burmese arc  
By V.K. Ghahalaut, R.P. Tiwari, and Arun Kumar
- 10:15-10:30 Present day crustal deformation and Plate kinematics of seismically active regions of NE-India from permanent and campaign mode GPS observations  
By Sanjay K. Prajapati
- 10:30-11:00 Coffee break
- 11:00-12:30 Discussion on future joint collaborative research
- 12:30-13:30 Lunch break

**Joint Session on Education and Research**

Venue: Ashok Hotel, New Delhi

- 14:00-14:15    Bilateral collaboration on education: the Norwegian perspectives  
By Veena Gill (SiU)
- 14:15-14:30    Bilateral collaboration on research: the Norwegian perspectives  
By Jon Heikki Aas (RCN)
- 14:30-14:45    Bilateral collaboration on research and education: the Indian perspectives  
By B.R. Arora (MoES)
- 14:45-15:00    Collaborative projects on research and education: the researcher's perspectives  
By Kuvvet Atakan (UiB)
- 14:45-15:15    Tea/Coffee break
- 15:15-17:00    Open discussion on combining collaborative research and education

**Appendix 2:**

**List of Norwegian participants in the 2<sup>nd</sup> India-Norway Geohazards Workshop  
13-14 February 2014, Ministry of Earth Science, New Delhi, India**

	<b>Name</b>	<b>Institution</b>	<b>E-mail</b>
1	Kuvvet Atakan	University of Bergen	<a href="mailto:Kuvvet.Atakan@geo.uib.no">Kuvvet.Atakan@geo.uib.no</a>
2	Lars Ottemöller	University of Bergen	<a href="mailto:Lars.Ottemoller@geo.uib.no">Lars.Ottemoller@geo.uib.no</a>
3	Rajinder K. Bhasin	Norwegian Geotechnical Institute	<a href="mailto:Rajinder.Kumar.Bhasin@ngi.no">Rajinder.Kumar.Bhasin@ngi.no</a>
4	Amir M. Kaynia	Norwegian Geotechnical Institute	<a href="mailto:Amir.M.Kaynia@ngi.no">Amir.M.Kaynia@ngi.no</a>
5	John F. Dehls	Geological Survey of Norway	<a href="mailto:John.Dehls@ngu.no">John.Dehls@ngu.no</a>
6	Dominik Lang	NORSAR	<a href="mailto:dominik@norsar.no">dominik@norsar.no</a>
7	Jon Heikki Aas	Research Council of Norway	<a href="mailto:jhaa@forskningsradet.no">jhaa@forskningsradet.no</a>
8	Marianne Jensen	Royal Norwegian Embassy	<a href="mailto:marje@innovationnorway.no">marje@innovationnorway.no</a>
9	Signe Guro Gilen	Royal Norwegian Embassy	<a href="mailto:signe.guro.gilen@mfa.no">signe.guro.gilen@mfa.no</a>
10	Håvard Hugaas	Royal Norwegian Embassy	<a href="mailto:haavard.hugaas@mfa.no">haavard.hugaas@mfa.no</a>
11	Ingebjørd Birkeland	Norwegian Center for International Cooperation in Education	<a href="mailto:ingebjorg.birkeland@siu.no">ingebjorg.birkeland@siu.no</a>

**University of Bergen (UiB):**

Kuvvet Atakan, Professor, Dr. Scient.  
Department of Earth Science  
University of Bergen  
Allégt.41, N-5007, Norway  
Tel: +47 55 58 34 13  
Mobile: +47 958 77 982  
E-mail: [Kuvvet.Atakan@geo.uib.no](mailto:Kuvvet.Atakan@geo.uib.no)

Lars Ottemöller, Professor, Dr. Scient.  
Department of Earth Science  
University of Bergen  
Allégt.41, N-5007, Norway  
Tel: +47 55 58 34 14  
Mobile: +47 467 82 534  
E-mail: [Lars.Ottemoller@geo.uib.no](mailto:Lars.Ottemoller@geo.uib.no)

**Norwegian Geotechnical Institute (NGI):**

Rajinder Kumar Bhasin, Dr.Scient., Regional Manager for Asia  
Norwegian Geotechnical Institute  
P.O. Box 3930 Ullevål Stadion  
N-0806 Oslo, Norway  
Tel: +47 22 02 30 05  
Mobile: +47 920 60 847  
E-mail: [Rajinder.Kumar.Bhasin@ngi.no](mailto:Rajinder.Kumar.Bhasin@ngi.no)

Amir M. Kaynia, PhD, Discipline Leader Earthquake Engineering  
Adjunct Prof. of Earthquake Eng., Norwegian Univ. of Science and Technology (NTNU)  
Norwegian Geotechnical Institute  
P.O. Box 3930 Ullevål Stadion  
N-0806 Oslo, Norway  
Tel : +47 22 02 30 13  
Mobile : +47 926 18 644  
E-mail : [Amir.M.Kaynia@ngi.no](mailto:Amir.M.Kaynia@ngi.no)

**Geological Survey of Norway (NGU):**

John F. Dehls, PhD  
Geological Survey of Norway  
P.O. Box 6315  
N-7491 Trondheim, Norway  
Tel: +47 73 90 44 54  
Mobile: +47 908 68 176  
E-mail: [John.Dehls@ngu.no](mailto:John.Dehls@ngu.no)

**NORSAR:**

Dominik Lang, PhD  
Earthquakes and Environment  
NORSAR  
P.O. Box 53  
N-2027 Kjeller, Norway  
Tel: +47 63 80 59 36  
Mobile: +47 988 42 924  
E-mail: [dominik@norsar.no](mailto:dominik@norsar.no)

**Research Council of Norway (RCN):**

Jon Heikki Aas, Senior Adviser, INDNOR Programme Coordinator  
Division for Society and Health  
The Research Council of Norway  
P.O.Box 2700 St. Hanshaugen  
N-0131 Oslo, Norway  
Tel: +47 22 03 75 32  
Cell: +47 93 88 71 84 Fax: +47 22 03 70 01  
E-mail: [jhaa@forskningsradet.no](mailto:jhaa@forskningsradet.no)  
[www.rcn.no/indnor](http://www.rcn.no/indnor)

**Royal Norwegian Embassy in New Delhi, India:**

Marianne Jensen, Science and Technology Counsellor  
Royal Norwegian Embassy/ Commercial section  
92 Golf Links, New Delhi 110 003, India  
Mobile (India): +91 9910104731  
Mobile (Norway): +4795203599  
E-mail: [marje@innovationnorway.no](mailto:marje@innovationnorway.no)

Signe G. Gilen  
Royal Norwegian Embassy/ Commercial section  
92 Golf Links, New Delhi 110 003, India  
E-mail: [signe.guro.gilen@mfa.no](mailto:signe.guro.gilen@mfa.no)

Håvard Hugaas  
Royal Norwegian Embassy/ Commercial section  
92 Golf Links, New Delhi 110 003, India  
E-mail: [haavard.hugaas@mfa.no](mailto:haavard.hugaas@mfa.no)

**Norwegian Center for International Cooperation in Education (SiU):**

Ingebjørg Birkeland, Senior Adviser  
Norwegian Center for International Cooperation in Education  
P.O.Box 1093, 5809 Bergen, Norway  
Tel: +47 977 48 600 Fax: +47 55 30 38 01  
E-mail: [ingebjorg.birkeland@siu.no](mailto:ingebjorg.birkeland@siu.no)  
[www.siu.no](http://www.siu.no)

### Appendix 3:

#### List of participants from India

1. Dr. Harsh Gupta, National Disaster Management Authority (NDMA), Delhi
2. Dr. V.K. Ghahalaut, National Geophysical Research Institute (NGRI)
3. Dr. N. Purnachandra Rao, National Geophysical Research Institute (NGRI)
4. Dr. M. Ravi Kumar, National Geophysical Research Institute (NGRI)
5. Dr. Prantik Mondal, National Geophysical Research Institute (NGRI)
6. Prof. S.K. Nath, Indian Institute of Technology (IIT), Kharagpur
7. Prof. S.S. Teotia, Kurukshetra University
8. Dr. Dinesh Kumar, Kurukshetra University
9. Dr. Yogendra Singh, Indian Institute of Technology (IIT), Roorkee
10. Prof. R.P. Tiwari, Mizoram University
11. Prof. G. M. Batt, Jammu University
12. Dr. Saurabh Baruah, NEIST, Jorhat
13. Dr. B.K. Bansal, Ministry of Earth Sciences (MoES)
14. Dr. Vikram Gupta, Wadia Institute of Himalayan Geology (WIHG), Dehradun
15. Dr. Sujit Dasgupta, Former Director, geological Survey of India
16. Dr. H.N. Srivastava, Former ADGM, Indian Meteorological Department (IMD)
17. Dr. A.K. Mahajan, Central University, Himachal Pradesh
18. Prof. B.R. Arora, Former Director WIHG, Dehradun
19. Dr. Pankaj Jaiswal, Director, Geological Survey of India, Kolkata
20. Dr. R.S. Dattatrayam, Centre for Seismology, MoES
21. Mr. G. Suresh, Centre for Seismology, MoES
22. Dr. Sumer Chopra, Centre for Seismology, MoES
23. Dr. Babita Sharma, Centre for Seismology, MoES
24. Dr. Mithila Verma, Centre for Seismology, MoES
25. Dr. Arun Gupta, MoES
26. Dr. Sanjay Prajapati, Centre for Seismology, MoES
27. Mr. C.P. Singh, Centre for Seismology, MoES
28. Mr. Sowrav Saikia, Centre for Seismology, MoES
29. Mr. Anup Suthar, Centre for Seismology, MoES
30. Mr. Vamdev Phatak, Centre for Seismology, MoES
31. Mr. Vikas Kumar, Centre for Seismology, MoES
32. Mr. Ashok Kumar, Centre for Seismology, MoES
33. Dr. Sacchi Rajappa, Centre for Seismology, MoES
34. Mrs. Rashmi Pradhan, Centre for Seismology, MoES
35. Shazia Tabassum, Centre for Seismology, MoES