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# Applications and Challenges of Geospatial Technology

## Potential and Future Trends

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# Chapter 8
# Interactive Approach for Earthquake Scenario Development and Hazards Resource Estimation

**B. S. Chaudhary, Ram Kumar Singh, Nupur Bhatia, Ravi Mishra, Md Ataullah Raza Khan, Juhi Yadav, and Shashikanta Patairiya**

**Abstract** Indian subcontinent attained present physical form due to vast tectonic movements that resulted into large number of earthquakes. In studies it has been found that more than 50% area in the country is prone to damaging earthquakes. The northeastern part of India as well as the entire Himalayan belt is susceptible to earthquake of magnitude more than 8.0. The present study is principally aimed at understanding the intricate seismological processes in the study area, Sikkim which is on hilly terrain of Eastern Himalayas. Sikkim is situated in a region where major cause of earthquake is displacement of the Indian plate toward the Eurasian plate having complex geology. Remote sensing and GIS model builder and syntax were proven for hazard and vulnerable map creation used in earthquake scenarios development, planning, management, and resource estimation. In this study the preliminary factors including geology, topography, slope, relief, land use/cover, major roads, and historical epicenter were used with mechanical weightage, and overlay categorization was used for hazard index map and zone identification.

**Keywords** Earthquake scenarios management · Hazard index map · Overlay analysis

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# Seismic Hazard evaluation to National Capital (Delhi) Region due to Delhi Haridwar Ridge

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## Abstract

The National Capital Region (Delhi), India lies in the geological realm of Peninsular India and in Seismic Zone IV which implies that the region is exposed to severe seismic hazard. The records of strong ground motions from the past earthquakes can provide a wealth of information for this purpose but in NCR no record of accelerogram due to moderate/large size earthquake occurred in the region is available. Therefore, we have to simulate the strong ground motions time histories for future moderate/large size earthquakes using semi-empirical technique for the region. There are five possible source zones in the NCR but in present study we are simulating for the Delhi Haridwar Ridge. The Delhi-Hardwar Ridge zone is considered to represent shallow NNE-SSW trending extension of the Delhi folded belt towards the Himalayas. The Delhi-Hardwar ridge coincides with the extension of the Aravalli mountain belt beneath the alluvial plains of the Ganga basin to the north of Delhi towards the Himalayan Mountains. We have identified Delhi Haridwar ridge zone as source based on the past seismicity and generate the earthquake strong ground motions at bed rock due to scenario earthquake of M 6.0 in NCR at 144 sites distributed on a spatial grid with an interval of 0.4□ x 0.4□ using a semi empirical technique. The site effects have been incorporated to generate the accelerograms at the surface level. It has been observed that the site effects have changed the character of the accelerograms. We have obtained PGA values in the range of 0.1 -0.8 g at the surface. The high PGA values obtained at the sites near to the faults are found to be in agreement with those of reported in the literatures. The spatial distribution of peak ground acceleration as well as the spectral accelerations for different periods in the Delhi and surrounding regions for the scenario earthquake (M 6.0) due to the identified source zone have been estimated.

## Introduction

The National Capital Region (NCR) lies in the geological realm of Peninsular India and as per BIS (2002) it falls in the seismic zone IV in seismic zonation map of India. The region has been rocked by many strong earthquakes in the past (MMI ≤ IX) in 1742, 1803 and 1842 (Oldham, 1883; Narula et al., 2000). The Kutabminar was severely damaged in 1803 earthquakes (Ambraseys and Jackson, 2003). Several lives has been claimed by an earthquake occurred in 893 or 894 in the Delhi region (Srivastava and Roy, 1982). Srivasatava and Somayajulu, (1966) has discussed that some of the moderate size earthquakes occurred in the region which have caused significant damage to lives and economy like October 10, 1956 (M 6.7), August 27,

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# Time-dependent probabilistic tsunami hazard assessment in eastern Pacific tsunamigenic zones

**R. B. S. Yadav[1*], M. Sandhu[2], A. Sagar[3], Monika[4], Sonia[5] and Pooja[6]**

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## Abstract

The Pacific Ocean is one of the most tsunamigenic region of the world and has recently experienced catastrophic tsunamis in recent past (e.g. 2011 Japan tsunami etc.) which caused heavy destruction of lives and properties. In this study, probability of occurrence of large tsunamis with tsunami intensity $I \geq 2.0$ during a specific time interval has been calculated for three different tsunamigenic zones i.e. South America, Central America and Alaska Aleutian using weibull distribution model. For this purpose, a reliable homogenous and complete tsunami catalogue with Soloviev-Imamura intensity $I \geq 2.0$ (average wave heights $H \geq 2.83$ m) during time period 1513-2010 for the South America, 1700-1999 for Central America and 1788-1994 for Alaska Aleutian tsunamigenic zone has been prepared. The tsunami hazard parameters were estimated using the method of maximum likelihood. The estimated cumulative probability for tsunami intensity $I \geq 2.0$ reaches up to 0.9 after 36 years for South America, after 84 years for Central America and after 30 years for Alaska-Aleutian region. The estimated values of conditional probability for tsunami intensity $I \geq 2.0$ reaches up to 0.9 after 36 years (2046) for South America, after 85 years (2084) for Central America and 30 years (2024) for Alaska-Aleutian region. A high probability (> 0.9) of occurrence of large tsunamis with $I \geq 2.0$ in the next 30-36 years in Alaska-Aleutian region reveals high tsunami potential in near future in this zone.

## Introduction

A tsunami is one of the most damaging undersea natural hazards in the world which causes massive loss of human lives and properties in a very short time. Most tsunamis occur because of large, shallow submarine earthquakes that recur along the plate boundaries, which cause not only strong ground motions but also large tsunamis (Satake 2002). There is no any sophisticated technique to forecast great earthquakes, and therefore tsunamis. In the last one decade, there were several mega-tsunamis occurred in throughout the world (e.g. 26 December 2004 (Mw 9.2) in Sumatra in the Indian Ocean and 11 March 2011 (Mw 9.2) in Japan in the Pacific Ocean). These two tsunamis resulted unexpected enormous losses of lives and properties in the coastal countries of the Indian and Pacific oceans. After occurrence

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BOOK CHAPTER

# Structural and thermochronological studies of the Almora klippe, Kumaun, NW India: implications for crustal thickening and exhumation of the NW Himalaya

Author(s): M. K. Puniya ; R. C. Patel ; P. D. Pant

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## Abstract

Crystalline klippen over the Lesser Himalayan Metasedimentary Sequence (LHMS) zone in the NW Himalaya have specific syn- and post-emplacement histories. These tectonics also provide a means to understand the driving factors responsible for the exhumation of the rocks of crystalline klippen during the Himalayan Orogeny. New meso- and microscale structural analyses, and thermochronological studies across the LHMS zone, Ramgarh Thrust (RT) sheet and Almora klippe in the eastern Kumaun region, NW Himalaya, indicate that the RT sheet and Almora klippe were a part of the Higher Himalayan Crystalline (HHC) of the Indian Plate which underwent at least one episode...

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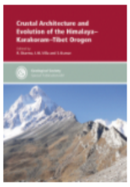

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## Crustal Architecture and Evolution of the Himalaya–Karakoram–Tibet Orogen

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This volume comprises 17 contributions that address the architecture and geodynamic evolution of the Himalaya–Karakoram–Tibet (HKT) system, covering wide aspects, from the active seismicity of the present day to the remnants of the

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