

List of Figures

1.1	Potential magnitude and potential slip along the Himalayan arc	4
1.2	Evolution of the Himalaya	6
1.3	Geological map of the Himalayan arc	7
1.4	Cross section of the Himalayan arc	8
1.5	Topographic map of the northwest Himalaya	12
1.6	Topographic map of the central Himalaya	13
1.7	Topographic map of the northeast Himalaya	15
1.8	Seismicity of the Himalaya	21
2.1	The moment accumulation and fault coupling along the MHT	32
2.2	The comparison between interseismic coupling and the Himalayan topography	33
2.3	The geological studies of paleoseismic events and slip rate estimation along the MFT	34
2.4	Geological studies along the northwest Himalaya	36
2.5	Surface velocity field along the northwest Himalaya	39
2.6	Surface velocity field along the Kumaun Himalaya	41
2.7	Interseismic coupling map of the northwest Himalaya	43
2.8	Geological studies along the central Himalaya	45
2.9	Interseismic coupling map of the central Himalaya	49
2.10	The down-dip extent of the interseismic coupling along the MHT in the central Himalaya	50
2.11	Geological studies along the northeast Himalaya	52
2.12	Surface velocity vector representation	54
3.1	GPS segments and satellite constellation	66
3.2	A typical setup of a continuous GPS station	68

3.3	GPS network along the northwest Himalaya	69
3.4	GPS stations along transect T1	71
3.5	GPS stations along transect T2	72
3.6	GPS stations along transect T3	74
3.7	GPS stations along transect T4	75
3.8	Time series plot of MUKE station	84
3.9	Time series plot of BRMR station	84
3.10	Time series plot of CHD1 station	85
3.11	Time series plot of THEO station	85
3.12	Time series plot of THKD station	86
3.13	Time series plot of DHLC station	86
3.14	Time series plot of SMPR station	87
3.15	Time series plot of IITK station	87
3.16	Time series plot of campaign stations in transect T1	88
3.17	Time series plot of campaign stations in transect T2	89
3.18	Time series plot of campaign stations in transect T3	90
3.19	Time series plot of campaign stations in transect T4	92
3.20	Surface velocities of GPS stations along the northwest Himalaya in the ITRF08 reference frame	97
3.21	Surface velocities of GPS stations along the northwest Himalaya in the India-fixed reference frame	98
3.22	Vertical velocities of GPS stations along northwest Himalaya	99
3.23	Surface velocity field in the ITRF08 reference frame along the Himalayan arc	100
3.24	Surface velocity field in the India-fixed reference frame along the Himalayan arc	101
3.25	Principal axes of strain rates along the Himalayan arc	104
3.26	Maximum shear strain rates along the Himalayan arc	105
3.27	Rotation strain rates along the Himalayan arc	107
4.1	Distribution of eight transects along the northwest Himalaya	112
4.2	Distribution of five transects along the central Himalaya	113
4.3	Distribution of two transects along the northeast Himalaya	115
4.4	Sketched map of the two-dimensional fault model	116

4.5	Posterior probability distributions of slip rates of the major thrusts from the Bayesian inversion model along the northwest Himalaya	118
4.6	Posterior probability distributions of slip rates of the major thrusts from the Bayesian inversion model along the central Himalaya	119
4.7	Posterior probability distributions of slip rates of the major thrusts from the Bayesian inversion model along the northeast Himalaya	120
4.8	Modeling results across eight profiles in the northwest Himalaya.	126
4.9	Modeling results across five profiles in central Himalaya	131
4.10	Modeling results across two profiles in the northeast Himalaya	134
4.11	Modeling results across all 15 profiles along the Himalayan arc using a single fault model	144
4.12	Smooth approximation to the MFT along the Himalayan arc	147
5.1	Seismotectonic map of the Himalayan arc	155
5.2	Geodetic strain rates along the Himalayan arc	156
5.3	Focal mechanism solution o Himalayan earthquakes since 1976	157
5.4	Distribution of 24 segments of the Himalayan arc	158
5.5	Distribution of earthquake potential and moment rate ratio along the Himalayan arc	163
6.1	Seismotectonic map of the northwest Himalaya and adjoining regions	190
6.2	Seismotectonic map of Nepal and surrounding regions	191
6.3	Population density map of northeast Himalaya, Bengal Basin, Indo-Burma ranges, and adjoining regions	192
6.4	Frequency-magnitude plot and magnitude-time graph for earthquake catalog in the northwest Himalaya	195
6.5	Frequency-magnitude plot and magnitude-time graph for earthquake catalog in the central Himalaya	196
6.6	Frequency-magnitude plot and magnitude-time graph for earthquake catalog in the northeast Himalaya	197
6.7	Flowchart of the nowcasting approach for earthquake hazard estimation	198
6.8	EPS scores along northwest Himalaya	207
6.9	EPS scores along central Himalaya	208
6.10	EPS scores along northeast Himalaya	209

7.1 Tree diagram of uncertainty quantification and propagation in the
[earthquake potential](#) 221

List of Tables

2.1	Comparison of geological and geodetic rates along the northwest Himalaya	58
2.2	Comparison of geological and geodetic rates along the central Himalaya	59
2.3	Comparison of geological and geodetic rates along the northeast Himalaya	60
3.1	Details of GPS stations in transect T1	70
3.2	Details of GPS stations in transect T2	73
3.3	Details of GPS stations in transect T3	73
3.4	Details of GPS stations in transect T4	74
3.5	GPS velocities along transect T1	92
3.6	GPS velocities along transect T2	93
3.7	GPS velocities along transect T3	94
3.8	GPS velocities along transect T4	95
3.9	GPS velocities of IGS stations in the ITRF08 reference frame	97
3.10	Variation in strain rate due to changes in the smoothing parameter value	103
4.1	The projection parameter and number of GPS velocity vector in each profile	113
4.2	Modeled fault parameters along eight transects of the northwest Himalaya	126
4.3	Modeled fault parameters along five transects in the central Himalaya	128
4.4	Modeled fault parameters along two transects of the northeast Himalaya	132
4.5	Modeled slip rate of MFT and MHT based on a single splay fault model	145
4.6	Earthquake potential in different segments of Himalayan arc	147
5.1	Summary of comparison between geodetic moment rate and seismic moment rate calculated at 25 km seismogenic depth for different segments	162
5.2	Geodetic and seismic moment rates, moment rate ratio, moment deficit, and earthquake potential using the seismogenic depth as 20 km	166

5.3	Geodetic and seismic moment rates, moment rate ratio, moment deficit, and earthquake potential using the seismogenic depth as 30 km	167
5.4	Geodetic and seismic moment rates, moment rate ratio, moment deficit, and earthquake potential using the seismogenic depth as 35 km	168
5.5	Summarization of earthquake potential at varying seismological depth (20 km to 35 km)	169
5.6	Geodetic and seismic moment rates, moment rate ratio, moment deficit, and earthquake potential using ≤ 200 years of earthquake catalog span . .	170
5.7	Geodetic and seismic moment rates, moment rate ratio, moment deficit, and earthquake potential using ~ 500 years of earthquake catalog span . .	172
5.8	Geodetic and seismic moment rates, moment rate ratio, moment deficit, and earthquake potential using ≥ 900 years of earthquake catalog span . .	173
5.9	Summarization of earthquake potential variation at different catalog span from ≤ 200 years to ≥ 900 years	174
5.10	Geodetic and seismic moment rates, moment rate ratio, moment deficit, and earthquake potential using the minimum of geodetic moment rate . .	175
5.11	Geodetic and seismic moment rates, moment rate ratio, moment deficit, and earthquake potential using the maximum of geodetic moment rate . .	176
5.12	Summarization of earthquake potential variation (when uncertainty in GPS horizontal velocities is considered)	178
5.13	Geodetic and seismic moment rates, and moment rate ratio using the seismic and aseismic contribution in the total strain accumulation	179
5.14	Geodetic and seismic moments and earthquake potential using the seismogenic depth as 25 km	180
6.1	Probability distribution models	198
6.2	Parameter estimation of selected probability distribution and model selection results corresponding to the observed natural times of the study region	199
6.3	Earthquake potential scores for $M \geq 6.0$ events in 14 major cities along the northwest Himalaya corresponding to $M_\alpha=4.0$ and $R=300$ km	201
6.4	Earthquake potential scores for $M \geq 6.0$ events in 24 major cities along the central Himalaya corresponding to $M_\alpha=4.0$ and $R=250$ km	202
6.5	Earthquake potential scores for $M \geq 6.0$ events in 14 major cities along the northeast Himalaya corresponding to $M_\alpha=4.0$ and $R=250$ km	204

List of Abbreviations

AT	Almora Thrust
BaT	Barsar Thrust
BBF	Balakot Bagh Fault
BMF	Black Mango Fault
CF	Chandigarh Fault
CKF	Central Kashmir Fault
DHR	Delhi-Haridwar Ridge
EBT	Eastern Boundary Thrust
EPS	Earthquake Potential Score
FZR	Faizabad Ridge
G-KF	Garampani-Kathgodam Fault
GNSS	Global Navigation Satellite System
GPS	Global Positioning System
HSB	Himlayana Seismic Belt
IGP	Indo-Gangetic Plains
InSAR	Interferometric Synthetic Aperture Radar
ITRF	International Terrestrial Reference Frame
ITSZ	Indus-Tsangpo Suture Zone
JMT	Jawalamukhi Thrust
KBF	Kashmir Basin Fault
KCR	Kaurik Chango Rift
KF	Kopili Fault
KVF	Kangra Valley Fault
LT	Lohit Thrust
MBT	Main Boundary Thrust
MCT	Main Central Thrust

MDT	Main Dun Thrust
MFT	Main Frontal Thrust
MHT	Main Himalayan Thrust
MSR	Munger-Saharsa Ridge
MT	Mishimi Thrust
MWT	Medilicott- Wadia Thrust
NaT	Nalagarh Thrust
NAT	North Almora Thrust
NTA	Natural Time Analysis
OF	Oldham Fault
PGF	Pinjor Garden Fault
RT	Ramgarh Thrust
RINEX	Receiver Independent Exchange Format
SAT	South Almora Thrust
SF	Sagaing Fault
STD	South Tibetan Detachment
TEQC	Translation, Editing, and Quality Check
TKR	Thakola Rift
TT	Tons Thrust
VL	Volcanic Line
YDR	Yodang Rift