Contents

List of contributors

1 Introduction
ANDREW S. GOUDIE

Part I Processes

2 Regional seismic shaking hazards in mountains
WILLIAM B. BULL
2.1 Introduction 5
2.2 Lichenometry site characteristics 5
2.3 Regional seismic shaking 8
2.4 Conclusions 11

3 Volcanic hazards and risks: a geomorphological perspective
JEAN-CLAUDE THOURET
3.1 Introduction 13
3.2 Direct volcanic hazards around active volcanoes 14
3.3 Indirect volcanic hazards and geomorphic impact 20
3.4 Post-eruption geomorphic impacts and responses 22
3.5 Long-term geomorphic hazards around inactive volcanoes 24
3.6 Methods and goals of volcano hazard and risk assessment 25
3.7 Concluding remarks and perspectives 28

4 Mountain hazards
OLAV SLAYMAKER
4.1 Introduction to mountain geomorphic hazards 33
4.2 Site scale 34
4.3 Drainage basin scale 35
4.4 Global scale 40
4.5 Conclusion in light of accelerating environmental change 43
4.6 Conclusions 44
Contents

9.8 Types of flood hazard and their location 105
9.9 Conclusions: flood hazards and climate change 107

10 Flood hazards: the context of fluvial geomorphology 111
GERARDO BENITO AND PAUL F. HUDSON
10.1 Introduction 111
10.2 Fluvial geomorphology in flood hazard assessment 112
10.3 Flood hazards in the context of global climate change 119
10.4 Geomorphological adjustment to flood management 120
10.5 Flood hazard management: an integrated approach 122
10.6 Conclusions 123

11 Geomorphology and coastal hazards 129
HARLEY J. WALKER AND MOLLY McGRAW
11.1 Introduction 129
11.2 Earthquakes, volcanic eruptions, and tsunami 133
11.3 Landslides 137
11.4 Meteorological events and coastal disaster 138
11.5 Other coastal hazards/disasters 139
11.6 Conclusions 142

12 Weathering hazards 145
ANDREW S. GOUDIE AND HEATHER VILES
12.1 Introduction 145
12.2 Salt weathering 146
12.3 Changing dimensions of the salt weathering hazard 148
12.4 Atmospheric pollution and weathering 149
12.5 Changing dimensions of the air pollution-induced weathering hazard 151
12.6 Fire, lightning and thermal fatigue 152
12.7 Mitigation 152
12.8 Conclusions 154

13 Hazards associated with karst 161
FRANCISCO GUTIÉRREZ
13.1 Introduction: why are hazards associated with karst important? 161
13.2 Sinkhole hazard 162
13.3 Other hazards associated with karst 170
13.4 Conclusions 173

14 Soil erosion 177
ANDREW S. GOUDIE AND JOHN BOARDMAN
14.1 Introduction: the nature of the problem 177
14.2 Forms of erosion 177
14.3 Rates of erosion: natural and anthropogenic 178
14.4 Assessment of current erosion 178
14.5 Consequences of erosion 179
14.6 Causation: soil erosion associated with deforestation and agriculture 180
14.7 Soil erosion produced by fire 180
14.8 Soil erosion associated with construction and urbanization 181
14.9 Humans or nature? 181
14.10 Soil erosion by wind 182
14.11 Global hotspots of erosion 183
14.12 Soil conservation: water erosion 183
14.13 Soil conservation: wind erosion 184
14.14 Conclusions 184

15 Desertification and land degradation in arid and semi-arid regions 189
YANG XIAOPING
15.1 Introduction 189
15.2 Regional-scale hazards and causes 190
15.3 Global-scale hazards 194
15.4 Conclusions 196

16 Dune migration and encroachment 199
ANDREW S. GOUDIE
16.1 Introduction 199
16.2 Methods of study 199
16.3 Rates of dune movement 199
16.4 Control 200
16.5 Conclusions 201

Part II Processes and applications of geomorphology to risk assessment and management 203

17 GIS for the assessment of risk from geomorphological hazards 205
CEES J. VAN WESTEN
17.1 Introduction 205
17.2 Spatial data requirements for risk assessment 206
17.3 Hazard assessment 212
17.4 Vulnerability and risk assessment 214
17.5 Risk management 216
17.6 Conclusions 218

18 Hazard assessment for risk analysis and risk management 221
MICHAEL CROZIER AND THOMAS GLADE
18.1 Approach 221
18.2 Basic concepts and issues 221
18.3 The contribution of geomorphology to hazard assessment 224
18.4 Conclusions and perspectives 229
## 19 Vulnerability analysis in geomorphic risk assessment

GABI HUFSCHMIDT AND THOMAS GLADE

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>19.1 Rationale</td>
<td>233</td>
</tr>
<tr>
<td>19.2 Different vulnerability approaches towards risk reduction</td>
<td>233</td>
</tr>
<tr>
<td>19.3 Science and technology</td>
<td>233</td>
</tr>
<tr>
<td>19.4 The human ecology approach</td>
<td>234</td>
</tr>
<tr>
<td>19.5 Vulnerability and the applied sciences</td>
<td>236</td>
</tr>
<tr>
<td>19.6 Vulnerability and the structuralist paradigm</td>
<td>237</td>
</tr>
<tr>
<td>19.7 Summary and perspectives</td>
<td>239</td>
</tr>
</tbody>
</table>

## 20 Geomorphological hazards and global climate change

ANDREW S. GOUDIE

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>20.1 Introduction</td>
<td>245</td>
</tr>
<tr>
<td>20.2 Coastal hazards</td>
<td>246</td>
</tr>
<tr>
<td>20.3 Hydrological hazards</td>
<td>248</td>
</tr>
<tr>
<td>20.4 Mass movement and soil erosion hazards</td>
<td>250</td>
</tr>
<tr>
<td>20.5 Glacial and permafrost hazards</td>
<td>250</td>
</tr>
<tr>
<td>20.6 Aeolian hazards</td>
<td>251</td>
</tr>
<tr>
<td>20.7 Conclusions</td>
<td>252</td>
</tr>
</tbody>
</table>

## 21 Geomorphic hazards and sustainable development

DAVID HIGGITT

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>21.1 Introduction</td>
<td>257</td>
</tr>
<tr>
<td>21.2 Challenges to the dominant paradigm of natural hazards</td>
<td>258</td>
</tr>
<tr>
<td>21.3 Vulnerability and resilience: Asian earthquakes</td>
<td>259</td>
</tr>
<tr>
<td>21.4 Geomorphology, hazards and sustainability</td>
<td>262</td>
</tr>
<tr>
<td>21.5 Flood hazards in Southeast Asia: links with sustainable management</td>
<td>265</td>
</tr>
<tr>
<td>21.6 Conclusions</td>
<td>266</td>
</tr>
</tbody>
</table>

## 22 Geomorphology and disaster prevention

IRASEMA ALCÁNTARA-AYALA

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>22.1 Geomorphological hazards</td>
<td>269</td>
</tr>
<tr>
<td>22.2 Disasters: the international framework</td>
<td>270</td>
</tr>
<tr>
<td>22.3 1900–2000: beyond a century of disasters</td>
<td>272</td>
</tr>
<tr>
<td>22.4 Geomorphology: a brief account of contributing research, methodologies and techniques</td>
<td>275</td>
</tr>
<tr>
<td>22.5 Conclusions: the future agenda</td>
<td>276</td>
</tr>
</tbody>
</table>

## 23 Geomorphology and the international agenda: concluding remarks

IRASEMA ALCÁNTARA-AYALA

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
</table>

Index

<table>
<thead>
<tr>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>282</td>
</tr>
</tbody>
</table>