

# Contents

*Preface* *page* xiii

## Part I The tropical environment

<b>1 Introduction</b>	3
1.1 Geomorphology in the tropics	3
1.2 Traditional tropical geomorphology	7
1.3 Modernisation of tropical geomorphology	8
1.4 Structure of tropical geomorphology	9
1.5 Structure of the book	11
<b>2 Geological framework of the tropical lands</b>	13
2.1 Introduction	13
2.2 A brief introduction to plate tectonics	13
2.3 Major landforms across the tropics	20
2.4 Interrelationships: plate tectonics, landforms, erosion and sediment production	27
Questions	29
<b>3 Tropical hydrology</b>	31
3.1 The tropical climate: a brief review	31
3.2 Temperature	31
3.3 Wind circulation	32
3.4 Precipitation	34
3.5 Tropical disturbances	37
3.6 Miscellaneous factors	43
3.7 Water balance	44
3.8 Climate and geomorphology in the tropics	47
Questions	48
<b>4 Erosion and land cover in the tropics</b>	49
4.1 Erosion from tropical rainfall	49
4.2 Distribution of natural vegetation in the tropics	52
4.3 Tropical rain forests	52
4.4 Tropical deciduous forests, grasslands and deserts	55

4.5 Anthropogenic alteration of the tropical vegetation	57
Questions	58
<b>Part II Process geomorphology in the tropics</b>	
<b>5 Weathering in the tropics</b>	61
5.1 Introduction	61
5.2 Sub-processes of weathering: a brief review	63
5.3 Products of weathering	69
5.4 Weathering and vertical zonation	75
5.5 Pans and crusts	77
5.6 Effects of weathering	78
5.7 Tropics and weathering	80
Questions	81
<b>6 Slopes: forms and processes</b>	82
6.1 Properties of a slope	82
6.2 Mass movement on hillslopes	84
6.3 Running water on hillslopes	93
6.4 Storage and transfer of surficial material on tropical slopes	94
6.5 A general description of tropical slopes	99
Questions	99
<b>7 Rivers in the tropics</b>	101
7.1 Components of a river system	101
7.2 Water in river channels	101
7.3 Sediment in river channels	104
7.4 Channel geometry	108
7.5 Channel network and nodes	119
7.6 River systems of the humid tropics	120
Questions	127
<b>8 Alluvial valleys</b>	129
8.1 Fluvial depositional environment	129
8.2 The alluvial valley	130
8.3 The channel alluvium	132
8.4 Bars	135
8.5 Floodplain	136
8.6 Terrace	139
8.7 Valley margins	140
8.8 Sediment transfer along the valley axis	141
Questions	141

<b>9 Large rivers in the tropics</b>	143
9.1 Introduction	143
9.2 Characteristics of a large river	143
9.3 The Amazon	147
9.4 The Zambezi	152
9.5 The Ganga–Brahmaputra system	155
9.6 The Mekong	164
9.7 The importance of major tropical rivers	169
Questions	169
<b>10 The tropical coasts</b>	170
10.1 Introduction	170
10.2 Types of coast	171
10.3 Moving water: tides, waves and currents	172
10.4 Rocky coasts	179
10.5 Non-rocky coast	181
10.6 Coastal sand dunes	186
10.7 Coastal tropics	186
10.8 Coral reefs	189
10.9 Tropical coasts and time	191
Questions	194
<b>11 Deltas in the tropics</b>	195
11.1 Introduction	195
11.2 Distribution of deltas in the tropics	196
11.3 Age and evolution of deltas	197
11.4 Delta morphology	201
11.5 Delta sediments and sedimentary structures	202
11.6 The Ganga–Brahmaputra Delta: a case study	203
11.7 Deltas in the tropics: a summary	207
Questions	208
<b>12 The arid tropics</b>	209
12.1 Arid areas	209
12.2 Geological characteristics of arid lands	210
12.3 Arid hydrology	211
12.4 Arid landforms	215
12.5 The rock desert	215
12.6 Running water in arid lands	216
12.7 Aeolian geomorphology of sandy areas	223
12.8 Conclusion	230
Questions	230

<b>13 Tropical highlands</b>	232
13.1 Importance of highlands	232
13.2 Glaciation in tropical mountains	234
13.3 Mechanics of mountain glaciation	236
13.4 Glacial forms and processes	240
13.5 Slopes and valley floors in high mountains	246
13.6 Rivers in the tropical mountains	247
13.7 Sediment from tropical mountains	249
13.8 Conclusion	251
Questions	252
<b>14 Volcanic landforms</b>	254
14.1 Introduction	254
14.2 Types of volcano and the related landscape	254
14.3 Lava and pyroclastic deposits	257
14.4 Volcaniclastic flows: debris avalanches and flows	262
14.5 Landscape on flood basalts	266
14.6 Conclusion	268
Questions	268
<b>15 Tropical karst</b>	270
15.1 Introduction to karst	270
15.2 Karst in the tropics: the geographical distribution	271
15.3 Karst hydrology	272
15.4 Dissolution of karst rocks	273
15.5 Karst landforms	274
15.6 Karst in the tropics	281
15.7 Tropical karst as an environment	284
Questions	286
<b>16 Quaternary in the tropics</b>	287
16.1 Introduction	287
16.2 History and structure of the Quaternary	288
16.3 Quaternary glaciation in the tropics	290
16.4 Climate change	292
16.5 Sea-level change	295
16.6 The Ganga River system: Quaternary adjustments	298
16.7 Quaternary changes around the Sunda Shelf	299
16.8 Conclusion	302
Questions	303

### Part III Anthropogenic changes

<b>17 Anthropogenic alteration of geomorphic processes in the tropics</b>	307
17.1 The beginning	307
17.2 Deforestation, land use changes and rural migration	311
17.3 Temporal and seasonal patterns of sediment transport	314
17.4 Spatial transfer of sediment	315
17.5 Impoundments along rivers and their effects	319
17.6 Application of geomorphology towards a better environment	323
Questions	324
<b>18 Urban geomorphology in the tropics</b>	325
18.1 Introduction to urban geomorphology	325
18.2 Urbanisation in developing countries	328
18.3 Three examples of geomorphic hazards and their amelioration	330
18.4 The general nature of urban geomorphological problems	337
18.5 Geomorphology and urban management	338
Questions	341
<b>19 The future with climate change</b>	342
19.1 Climate change and the future	342
19.2 A robust prediction of the effects of climate change in the tropics	343
19.3 Geomorphological adjustments in the tropics from climate and sea-level changes	345
19.4 The noise effect of anthropogenic changes	346
19.5 Tropical geomorphology in the near future	347
Questions	348
<i>References</i>	349
<i>Index</i>	374
<i>Colour plates appear between pages 212 and 213.</i>	