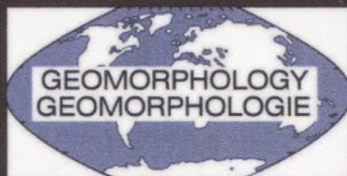


Paperback Re-issue

How will global environmental change affect the landscape and our interaction with it? Apart from climate change, there are other important catalysts of landscape change, including relief, hydroclimate and runoff, sea level variations and human activity. This 2009 volume summarises the geomorphic implications of global environmental change, analysing such effects on lakes, rivers, coasts, reefs, rainforests, savannas, deserts, glacial features, and mountains. Providing a benchmark statement from the world's leading geomorphologists on the state of, and potential changes to, the environment, this book is invaluable for advanced courses on geomorphology and environmental science, and as a reference for research scientists. Interdisciplinary in scope, with a primary audience of Earth and environmental scientists, geographers, geomorphologists and ecologists, it also has a wider reach to those concerned with the social, economic and political issues raised by global environmental change, and is useful to policy makers and environmental managers.



Designed by **Phil Treble**.

Cover illustration: a semi-false colour image of the Nile River valley including the regional governments of Kena and the southern part of Sohag, Egypt, with a population in excess of two million inhabitants. The contrast between the reddish coloured valley floor, indicating irrigated agricultural fields, and the light brown alluvial fans and the darker brown bedrock surfaces, receiving a mean annual precipitation of less than 10mm, emphasises the extent of the transformation of a desert landscape by human activity. Photograph courtesy of NASA/VSGS Landsat.

CAMBRIDGE
UNIVERSITY PRESS
www.cambridge.org

ISBN 978-0-521-29100-2



<i>List of contributors</i>	page x
<i>Preface</i>	xiii
<i>Acknowledgements</i>	xiv
<i>List of acronyms and abbreviations</i>	xv

I Landscape and landscape-scale processes as the unfilled niche in the global environmental change debate: an introduction

OLAV SLAYMAKER, THOMAS SPENCER AND
SIMON DADSON

1.1 The context	1
1.2 Climatic geomorphology	4
1.3 Process geomorphology	5
1.4 Identification of disturbance regimes	6
1.5 Landscape change	8
1.6 Systemic drivers of global environmental change (I): hydroclimate and runoff	10
1.7 Systemic drivers of global environmental change (II): sea level	14
1.8 Cumulative drivers of global environmental change (I): topographic relief	17
1.9 Cumulative drivers of global environmental change (II): human activity	19
1.10 Broader issues for geomorphology in the global environmental change debate	22
1.11 Landscape change models in geomorphology	25
1.12 Organisation of the book	28

2 Mountains

OLAV SLAYMAKER AND CHRISTINE EMBLETON-HAMANN

2.1 Introduction	37
2.2 Direct driver I: relief	42
2.3 Direct driver II: hydroclimate and runoff	44
2.4 Direct driver III: human activity, population and land use	45
2.5 Twenty-first-century mountain landscapes under the influence of hydroclimate change	49

2.6	Twenty-first-century mountain landscapes under the influence of land use and land cover change	55
2.7	Vulnerability of mountain landscapes and relation to adaptive capacity	61
3	Lakes and lake catchments	71
	KENJI KASHIWAYA, OLAV SLAYMAKER AND MICHAEL CHURCH	
3.1	Introduction	71
3.2	Lakes and wetlands	72
3.3	The lake catchment as geomorphic system	74
3.4	Internal lake processes	78
3.5	Hydroclimate changes and proxy data	80
3.6	Effects of human activity	86
3.7	Scenarios of future wetland and lake catchment change	92
4	Rivers	98
	MICHAEL CHURCH, TIM P. BURT, VICTOR J. GALAY AND G. MATHIAS KONDOLF	
4.1	Introduction	98
4.2	Land surface: runoff production	98
4.3	River channels: function and management	103
4.4	Fluvial sediment transport and sedimentation	109
4.5	Water control: dams and diversions	114
4.6	River restoration in the context of global change	121
4.7	Conclusions	125
5	Estuaries, coastal marshes, tidal flats and coastal dunes	130
	DENISE J. REED, ROBIN DAVIDSON-ARNOTT AND GERARDO M. E. PERILLO	
5.1	Introduction	130
5.2	Estuaries	133
5.3	Coastal marshes and tidal flats	136
5.4	Coastal sand dune systems	142
5.5	Managing coastal geomorphic systems for the twenty-first century	150
6	Beaches, cliffs and deltas	158
	MARCEL J. F. STIVE, PETER J. COWELL AND ROBERT J. NICHOLLS	
6.1	Introduction	158
6.2	Coastal classification	159
6.3	The coastal-tract cascade	162
6.4	Applications of the quantitative coastal tract	167
6.5	Risk-based prediction and adaptation	174
6.6	Conclusions	176

7 Coral reefs	180
PAUL KENCH, CHRIS PERRY AND THOMAS SPENCER	
7.1 Introduction	180
7.2 Carbonate production in coral reef environments: the reef carbonate factory	182
7.3 Coral reef landforms: reef and reef flat geomorphology	188
7.4 Reef sedimentary landforms	195
7.5 Anthropogenic effects on sedimentary landforms	202
7.6 Synthesis	205
 8 Tropical rainforests	 214
RORY P. D. WALSH AND WILL H. BLAKE	
8.1 The tropical rainforest ecological and morphoclimatic zone	214
8.2 Geomorphological characteristics of the rainforest zone: a synthesis	217
8.3 Recent climate change in the rainforest zone	231
8.4 Approaches and methods for predicting geomorphological change: physical models versus conceptual/empirical approaches	234
8.5 Potential ecological, hydrological and geomorphological responses to predicted future climate change in rainforest areas	235
8.6 Research gaps and priorities for improvement to geomorphological predictions in the humid tropics	243
8.7 Summary and conclusions	243
 9 Tropical savannas	 248
MICHAEL E. MEADOWS AND DAVID S. G. THOMAS	
9.1 Introduction	248
9.2 Key landforms and processes	255
9.3 Landscape sensitivity, thresholds and 'hotspots'	262
9.4 A case study in geomorphic impacts of climate change: the Kalahari of southern Africa	265
9.5 Concluding remarks	269
 10 Deserts	 276
NICHOLAS LANCASTER	
10.1 Introduction	276
10.2 Drivers of change and variability in desert geomorphic systems	278
10.3 Fluvial geomorphic systems in deserts	283
10.4 Aeolian systems	286
10.5 Discussion	291
 11 Mediterranean landscapes	 297
MARIA SALA	
11.1 Introduction	297
11.2 Geology, topography and soils	297
11.3 Climate, hydrology, vegetation and geomorphological processes	299
11.4 Long-term environmental change in Mediterranean landscapes	303

11.5 Traditional human impacts in Mediterranean landscapes and nineteenth- and twentieth century change	307
11.6 Contemporary and expected near-future land use changes	310
11.7 Global environmental change in Mediterranean environments and its interaction with land use change	312
11.8 Concluding remarks	315

12 Temperate forests and rangelands 321

ROY C. SIDLE AND TIM P. BURT

12.1 Introduction	321
12.2 Global distribution of mid-latitude temperate forests and rangelands	323
12.3 Potential climate change scenarios and geomorphic consequences	325
12.4 Types, trajectories and vulnerabilities associated with anticipated mass wasting responses to climate change	325
12.5 Anthropogenic effects on geomorphic processes	328
12.6 Techniques for assessing effects of anthropogenic and climate-induced mass wasting	334
12.7 Summary and conclusions	337

13 Tundra and permafrost-dominated taiga 344

MARIE-FRANÇOISE ANDRÉ AND OLEG ANISIMOV

13.1 Permafrost regions: a global change 'hotspot'	344
13.2 Permafrost indicators: current trends and projections	348
13.3 Permafrost thaw as a driving force of landscape change in tundra/taiga areas	350
13.4 Impact of landscape change on greenhouse gas release	354
13.5 Socioeconomic impact and hazard implications of thermokarst activity	356
13.6 Vulnerability of arctic coastal regions exposed to accelerated erosion	358
13.7 Discriminating the climate, sea level and land use components of global change	360
13.8 Lessons from the past	361
13.9 Geomorphological services and recommendations for future management of permafrost regions	362

14 Ice sheets and ice caps 368

DAVID SUGDEN

14.1 Introduction	368
14.2 Distribution of ice sheets and ice caps	369
14.3 Ice sheet and ice cap landscapes	374
14.4 Ice sheets and ice caps: mass balance	378
14.5 Ice flow and ice temperature	380
14.6 External controls and feedbacks	381
14.7 Landscapes of glacial erosion and deposition	384
14.8 How will ice sheets and ice caps respond to global warming?	389
14.9 Conclusion and summary	399

15 Landscape, landscape-scale processes and global environmental change: synthesis and new agendas for the twenty-first century 403

THOMAS SPENCER, OLAV SLAYMAKER AND CHRISTINE EMBLETON-HAMANN

- 15.1 Introduction: beyond the IPCC Fourth Assessment Report 403
- 15.2 Geomorphological processes and global environmental change 405
- 15.3 Landscapes and global environmental change 407
- 15.4 Conclusions: new geomorphological agendas for the twenty-first century 416

Index 424

*The plates are situated between pages 80 and 81**

*These plates are available for download in colour from
www.cambridge.org/9780521878128