



Tropical Rainforest Responses to Climatic Change

Second Edition

Mark B. Bush
John R. Flenley
William D. Gosling
(Editors)

 Springer

PRAXIS 

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Contents

Preface to Second Edition	xiii
Preface to First Edition	xv
List of figures	xix
List of tables	xxv
List of abbreviations and acronyms	xxvii
List of editors	xxix
List of contributors	xxxii
1 Cretaceous and Tertiary climate change and the past distribution of megathermal rainforests	1
<i>R. J. Morley</i>	
1.1 Introduction	1
1.2 Differences between Quaternary and Tertiary megathermal forests	3
1.3 Late Cretaceous expansion of megathermal forests	4
1.4 Megathermal rainforests during the Early Tertiary period of greenhouse climate	8
1.5 Middle Eocene to Oligocene climates	13
1.5.1 General trends	13
1.5.2 Climate change in low latitudes	14
1.6 Early and earliest Middle Miocene, return of greenhouse climates	17
1.6.1 General trends	17
1.6.2 Climate change in low latitudes	17

1.7	Later Middle Miocene to Pliocene, global cooling, and retraction of megathermal rainforests to the tropics	19
1.8	Trends in rainforest diversity based on the palynological record	23
1.9	Scenario for rainforest evolution and diversification	25
1.10	References	26
2	Andean montane forests and climate change	35
	<i>M. B. Bush, J. A. Hanselman, and H. Hooghiemstra</i>	
2.1	Introduction	35
2.2	Tectonic changes and the rise of the Andes	36
2.3	Sensitivity and quantifying cooling	38
2.4	Sites in space and time	39
2.5	Quaternary glacial–interglacial cycles	40
2.6	The last glacial period	44
2.7	Deglaciation	48
2.8	The Holocene	50
2.9	The past as a key to the future	51
2.10	Conclusions	52
2.11	Acknowledgments	53
2.12	References	53
3	Climate and vegetation change in the lowlands of the Amazon Basin	61
	<i>M. B. Bush, W. D. Gosling, and P. A. Colinvaux</i>	
3.1	Introduction	61
3.2	Evidence of temperature change	63
	3.2.1 The last glacial period	63
	3.2.2 The Holocene	65
3.3	Evidence of precipitation change	66
	3.3.1 The last glacial period	66
	3.3.2 The Holocene	67
3.4	Changes in atmospheric CO ₂	68
3.5	The periodicity of change	69
3.6	The type of forest	71
3.7	Phylogenies	74
3.8	Conclusions	77
3.9	Acknowledgments	78
3.10	References	78
4	The Quaternary history of Far Eastern rainforests	85
	<i>A. P. Kershaw, S. van der Kaars, and J. R. Flenley</i>	
4.1	Introduction	85
	4.1.1 Present setting	85
	4.1.2 Nature of the evidence	87
4.2	Modern pollen sampling	88

4.3	Regional taxon representation	94
4.4	Long-term patterns of change	97
	4.4.1 The South China Sea region	97
	4.4.2 The Coral Sea region	100
4.5	The Later Pleistocene	104
4.6	The Last Glacial Maximum to Holocene	106
	4.6.1 Last Glacial Maximum	107
	4.6.2 The Pleistocene–Holocene transition	113
	4.6.3 The Holocene	113
4.7	Vegetation responses to cyclical forcing	114
4.8	General discussion and conclusions	116
4.9	References	117
5	Rainforest responses to past climatic changes in tropical Africa	125
	<i>R. Bonnefille</i>	
5.1	Introduction	125
5.2	Vegetation units within the Guineo–Congolian rainforest	126
	5.2.1 Hygrophilous coastal evergreen forest	126
	5.2.2 Mixed moist semi-evergreen forest	127
	5.2.3 Single-dominant moist evergreen and semi-evergreen forest	127
	5.2.4 Drier peripheral semi-evergreen forest	128
	5.2.5 Secondary rainforest	128
	5.2.6 Swamp forest	129
	5.2.7 Edaphic and secondary grasslands	129
	5.2.8 Transitional and afro-montane evergreen forests	129
5.3	Modern pollen rain studies	130
	5.3.1 Tropical and equatorial forests north of the equator	130
	5.3.2 Mixed moist semi-evergreen forest	134
	5.3.3 Drier peripheral semi-evergreen forest north of the equator	136
	5.3.4 Drier peripheral semi-evergreen forest south of the equator	139
	5.3.5 Swamp forest	147
	5.3.6 Summary: Modern pollen rain	147
5.4	Quaternary history	147
	5.4.1 Ice age record	148
	5.4.2 Holocene record	158
	5.4.3 History of the rainforest during the last 5,000 years	166
	5.4.4 The oil palm, evidence for human impact?	168
	5.4.5 The last historical period (Gabon)	171
5.5	Conclusions	175
5.6	Acknowledgments	176
5.7	References	177

6	Prehistoric human occupation and impacts on neotropical forest landscapes during the Late Pleistocene and Early/Middle Holocene	185
	<i>Dolores R. Piperno</i>	
6.1	Introduction	185
6.2	Some brief comments on the Old World.	185
6.3	Human colonization of neotropical forests: An ice age entry . .	187
6.3.1	The evidence for early human occupation	187
6.3.2	Pleistocene landscapes and early human modification of them	191
6.3.3	After the Pleistocene: The origins and spread of tropical forest agriculture during the early Holocene	195
6.4	Human modification of forests by prehistoric farmers	199
6.4.1	Lake records and detecting human disturbance in them	199
6.4.2	Major trends and patterns of prehistoric tropical forest modification	203
6.4.3	The Amazon as a human-built landscape?	205
6.5	Summary	206
6.6	References	206
7	The past, present, and future importance of fire in tropical rainforests . .	213
	<i>M. A. Cochrane</i>	
7.1	Introduction	213
7.2	Rainforest fire in the past	215
7.2.1	The rise of anthropogenic fire	216
7.3	Rainforest fire in the present day	217
7.3.1	Fire within tropical rainforests.	217
7.3.2	Regional conditions of rainforest fires.	222
7.4	Rainforest fire and future climate change	223
7.4.1	Local and regional-scale phenomena	223
7.4.2	Global-scale phenomena	225
7.5	Tropical rainforest response to future climate change: Amazonia	227
7.5.1	Modeled versus real climate	229
7.5.2	Modeled versus real vegetation distribution	230
7.5.3	Modeled and real responses of vegetation to drought and temperature increases	230
7.6	Conclusions	232
7.7	References	233
8	Ultraviolet insolation and the tropical rainforest: Altitudinal variations, Quaternary and recent change, extinctions, and the evolution of biodiversity.	241
	<i>J. R. Flenley</i>	
8.1	Introduction	241
8.2	Altitudinal variations	241

8.3	The Massenerhebung effect.	244
8.4	Quaternary variations of vegetation	245
8.5	Present and possible future trends in UV insolation and their effects	248
8.6	Evolution of biodiversity: The tropical montane UV-B hypothesis	249
8.7	Conclusions	253
8.8	Acknowledgments.	254
8.9	References	254
9	Climate change in the Amazon Basin: Tipping points, changes in extremes, and impacts on natural and human systems	259
	<i>J. A. Marengo, C. A. Nobre, G. Sampaio, L. F. Salazar, and L. S. Borma</i>	
9.1	Introduction	259
9.2	Climate change and tipping point in Amazonia	261
9.3	Climate change impacts on Amazon vegetation	264
	9.3.1 Projected changes to the natural vegetation	264
	9.3.2 Dieback of Amazon forest	268
9.4	Extreme events in the Amazon Basin	271
	9.4.1 The drought of 2005	271
	9.4.2 The flood of 2009	273
	9.4.3 Climate change and extreme events in the Amazon Basin	275
9.5	Implications for ecosystem and environmental services in Amazonia.	275
9.6	Summary	277
9.7	Acknowledgments.	278
9.8	References	278
10	Plant species diversity in Amazonian forests.	285
	<i>M. R. Silman</i>	
10.1	Introduction	285
10.2	Study site: Overviews of Amazonian geography, geology, and climate	288
	10.2.1 Amazonian geography, geology, and soils	288
	10.2.2 Elevation	290
	10.2.3 Precipitation	290
	10.2.4 Species diversity and environmental gradients	292
10.3	Results	293
	10.3.1 Precipitation: patterns	293
	10.3.2 Latitudinal and longitudinal gradients in Amazonian diversity	294
	10.3.3 Diversity in relation to precipitation and geology	296
	10.3.4 Elevation and diversity	297
10.4	Discussion	300

10.4.1	Precipitation and diversity	300
10.4.2	Geology and diversity	303
10.4.3	Gamma diversity and range limits along environmental gradients	304
10.4.4	Elevation and diversity	305
10.4.5	Long-term climate change and Amazonian diversity: A Holocene minimum in western Amazonia?	306
10.4.6	The mid-domain effect	306
10.4.7	Discounting migration	307
10.4.8	Future efforts	307
10.5	References	308
11	Biogeochemical cycling in tropical forests	315
	<i>M. E. McGroddy and W. L. Silver</i>	
11.1	Introduction	315
11.2	Current and predicted climate characteristics	316
11.3	Tropical forest soils	318
11.4	Soil phosphorus	318
11.5	Soil nitrogen	322
11.6	Above-ground biomass and litter production	323
11.7	Decomposition	325
11.8	Root and microbial dynamics	326
11.9	Trace gas emissions	328
11.10	Summary and future directions	329
11.11	References	331
12	The response of South American tropical forests to recent atmospheric changes	343
	<i>O. L. Phillips, S. L. Lewis, T. R. Baker, and Y. Malhi</i>	
12.1	Introduction	343
12.2	The plot network	345
12.3	Structural changes	346
12.4	Dynamic changes	347
12.5	Functional changes	350
12.6	What is driving these changes?	352
12.7	The future	354
12.8	Acknowledgements	355
12.9	References	355
13	Ecophysiological response of lowland tropical plants to Pleistocene climate	359
	<i>S. A. Cowling</i>	
13.1	Introduction	359
13.2	Ecophysiological primer	360
13.3	Independent versus interactive climate effects	362

13.3.1	Global cooling	362
13.3.2	Decreased glacial precipitation	363
13.3.3	Low atmospheric CO ₂	364
13.3.4	Interactive effects of Pleistocene climate and atmospheric CO ₂	365
13.4	Ecological responses to Pleistocene climate change	366
13.4.1	Expansion of C ₄ grasslands	366
13.4.2	Rainforest versus seasonal forest	367
13.4.3	Vertical stratification of glacial forests	368
13.5	Soil processes and Pleistocene climate change	369
13.6	Conclusion	370
13.7	References	371
14	Tropical environmental dynamics: A modeling perspective	381
	<i>R. Marchant and J. C. Lovett</i>	
14.1	Introduction	381
14.2	Biosphere modeling	383
14.2.1	Biome modeling	388
14.2.2	Dynamic global vegetation models	392
14.2.3	Models of biogeochemical cycles	392
14.3	Climate modeling	393
14.4	Modeling the last glacial period	395
14.5	Testing models with data	397
14.6	Practical application of model output and future developments	398
14.7	Conclusions	401
14.8	References	402
15	Modeling future effects of climate change on tropical forests	411
	<i>L. Hannah, R. A. Betts, and H. H. Shugart</i>	
15.1	Introduction	411
15.2	Bioclimatic models	413
15.3	Process-based models	417
15.4	Physical indices	417
15.5	Gap models	418
15.6	Dynamic global vegetation models	420
15.7	Earth system models	421
15.8	Conclusion	425
15.9	References	425
16	Conservation, climate change, and tropical forests	431
	<i>L. Hannah and T. Lovejoy</i>	
16.1	Introduction	431
16.2	Conservation challenges	432
16.3	Conservation responses	434

xii **Contents**

16.4	Conservation strategies	436
16.5	Greenhouse gas stabilization	438
16.6	Reducing deforestation to help stabilize emissions.	440
16.7	Conclusion	440
16.8	References	441
Taxonomic index.		445
Subject index		449

Preface to the Second Edition

The First Edition of this book was well received and when a new print run was proposed we took the opportunity to revise, update, and expand the book. Our goal in the revision was to incorporate the most significant recent studies, yet retain the framework of the First Edition. Of course, the plight of tropical rainforests in response to climate change has not changed, and the political process that might have limited the effects of ongoing climate change appear to have faltered. For several decades the clarion call to save the rainforest biodiversity from the worst excesses of human exploitation has been loud. However, the threat to these systems from the synergy of climate change, logging, ranching, and other land use change appears to be cumulative. An investigation of the role that climate plays in shaping tropical rainforest biodiversity and, ultimately, how biodiversity may be lost is clearly needed. To that end we present chapters that deal with long-term climate and vegetation change, ecophysiology, and ecosystem processes in addition to considerations of how predictive models are constructed.

In this edition, we have added one entirely new chapter on fire, effectively replaced a chapter on Amazonian climate, and substantially modified most of the other chapters. We have attempted to minimize the period between author submission and printing of the book so that the most contemporary knowledge is portrayed. As part of that process of hastening the editing process we have been joined by William Gosling as an editor.

Mark Bush

Preface to the First Edition

Never before in human history has the need for an understanding of climatic change been so great. Nowhere in the world is that need so serious as in the tropics, where deforestation and extinction are at their most rapid, biodiversity greatest, and human lifestyles at their most precarious. We therefore hope and believe that this book will be timely and useful, as it attempts to describe and explain in scientific terms the past, present, and future changes in Earth's most complex terrestrial ecosystem, the Tropical Rain Forest.

The project grew from a discussion between Clive Horwood of Praxis and Mark Bush on the status of climate change research in Tropical Rain Forest settings. Mark's own involvement in attempting to apply lessons learned from the past to the formulation of conservation theory and practice led to a desire to move beyond a simple review of paleoclimatic data. The text aims to build upon and update the foundation of John Flenley's (1979) *The Equatorial Rain Forest: A Geological History* (Butterworth, London). In the intervening period our understanding of individualistic species migration, of potential interactions between climate and physical process, phylogenies, and of the looming impact of global climate change has revolutionized community ecology. In that same period the coverage of tropical paleoecological data has exploded—for example, there was not a single datum from Amazonia when John wrote his book.

John Flenley was called in to help when the sheer enormity of the task became evident to Mark. John had recently moved onto part time so was able to bring his experience of tropical regions fully into play, especially in the area of vegetational history.

We hope that the book will be used by scholars and senior students throughout the world, but especially in the developing countries of the Tropics, where climatic change may spell ecological and economic disaster very soon indeed. Perhaps it is not too much to hope that our book may contribute to influencing world policies

in relation to technology and economics, before the climatic changes become irreversible.

We are deeply indebted to all our contributors, a varied selection of excellent researchers, who have given their time and effort unstintingly to make this book possible. We are also grateful to those who have helped with the editing, especially Olive Harris. John Flenley wishes particularly to thank his wife, Helen, for her understanding and support. Our publishers, especially Clive Horwood, deserve exceptional thanks for their patience, tolerance and skill. Any remaining errors are of course our responsibility.

Mark Bush

John Flenley

To
VHB, HCF, and CHG

Figures

1.1	Ice age distributions of closed canopy megathermal rainforests has been a subject of debate.	3
1.2	Stratigraphic range of angiosperm and pteridophyte megathermal species, or species pairs, which can be identified on the basis of pollen and spores . .	5
1.3	Numbers of stratigraphically useful angiosperm pollen types per epoch	8
1.4	Leaf vein density reconstructed for key nodes of extant angiosperm phylogeny (circles) shows a dramatic increase during the Mid to Late Cretaceous.	9
1.5	Closed canopy megathermal rainforests first became widespread during the Paleocene	10
1.6	Generalized oxygen isotope curve for benthonic (bottom-dwelling) foraminifera through the Cenozoic.	11
1.7	Distribution of closed canopy megathermal rainforests during the Late Paleocene/Early Eocene thermal maximum	12
1.8	Distribution of closed canopy megathermal rainforests during the Oligocene, following the terminal Eocene cooling event	13
1.9	Present day distribution of megathermal (and tropical) rainforests in Southeast Asia, and probable distribution at <i>c.</i> 22 cal yr BP	15
1.10	Summary of Oligocene to Pliocene climatic change in relation to sea level change	16
1.11	Distribution of closed canopy megathermal rainforests during the Middle Miocene, coinciding with the Miocene thermal maximum	18
1.12	Palynological and foraminiferal record for Attaka Well B, located to the NW of Mahakam Delta	21
2.1	Modern pollen rain and elevation	39
2.2	The location of sites of paleoecological importance	40
2.3	A comparison of MIS 5e and the Holocene based on insolation and changes in community composition revealed through DCA.	43
2.4	Schematic diagram of a non-linear response to warming and a turning point reached in some Andean interglacials	44

2.5	Central Andean insolation, and the extent of physical and community change during deglaciation and the Holocene	49
3.1	The location of paleoecological sites mentioned in the text in relation to topography	62
3.2	CO ₂ concentrations from the Vostok core	69
3.3	Precipitation data for Amazonia based on satellite monitoring	70
3.4	Data for δO ¹⁸ from Brazilian speleothem records, downcore gamma radiation from Salar de Uyuni and K ⁺ concentration from Lake Pata, compared with mean insolation calculated in Analyseries 1.2 for 0°, 10°S, and 30°S	73
3.5	Summary phylogenies for a variety of Amazonian animal taxa	75
3.6	Summary diagram showing the relationship between flooding caused by a 100 m marine highstand and proposed known epicontinental seas in Amazonia, and biogeographic patterns.	76
4.1	Distribution of rainforest vegetation in the Far East and pollen-analyzed sites covering at least the last 6,000 years	86
4.2	Climatic ranges for highest representation of major rainforest taxa in relation to bioclimatic estimates for modern pollen samples from northeast Queensland rainforests	89
4.3	Representation of major pollen taxa in relation to vegetation along an altitudinal surface sample transect in Papua–New Guinea.	91
4.4	Relative abundance of major pollen groups, taxa, and charcoal derived from core-top samples	92
4.5	Relative abundance of major pollen groups and taxa derived from core-top samples in the South China Sea	93
4.6	Relative abundance of major taxa and taxon groups in the pollen record from ODP Site 1144, South China Sea	98
4.7	Representation of major and indicator taxa in pollen records	101
4.8	Selective features of the detailed Late Quaternary record from ODP Site 820	103
4.9	Selected features of the pollen and charcoal record from Banda Sea core SHI-9014 in relation to the marine isotope record.	105
4.10	Selected features of the pollen and charcoal record from the North Australian Basin core MD98-2167	107
4.11	Pollen diagram from Danau di Atas Swamp, West Sumatra	109
4.12	Pollen diagram from Lake Inim, boreholes C4 and C15, plotted on the same scales	111
4.13	Selected vegetation records derived from pollen diagrams from tropical Southeast Asia and the West Pacific	112
5.1	Distribution of different vegetation units within the Guineo-Congolian rainforest	126
5.2	Modern pollen rain from coastal evergreen forests, mixed moist semi-evergreen, and drier semi-evergreen forests from Cameroon	132
5.3	Results of correspondence analysis performed on pollen percentages of 80 modern pollen samples from the different forest types mapped in the equatorial region of Cameroon and Gabon.	135
5.4	Pollen diagram of modern surface soil samples from mature forest types of the mixed moist semi-evergreen mapping unit collected at different localities in Gabon	137
5.5	Modern pollen rain from the drier semi-evergreen forest in Cameroon, Kandara site.	140

5.6	Location map of sites for floristic inventories and modern pollen surface soil samples collected within the semi-evergreen forests from Congo	142
5.7	Frequencies of the main pollen taxa identified within modern soil surface samples from Southern Congo	143
5.8	Synthetic pollen diagram from core BM-6, Lake Barombi Mbo, Cameroon .	150
5.9	Detailed pollen diagram from core BM-6, Lake Barombi Mbo, Cameroon. .	153
5.10	Simplified pollen diagram from Ngamakala, presented according to depth . .	156
5.11	Simplified pollen diagram from Lake Ossa, Cameroon, presented according to calendar time scale	160
5.12	Simplified pollen diagrams from Lake Kitina and Sinnda, presented according to depth	164
5.13	Pollen diagram of a core recovered from the Nyabessan swamp	169
5.14	Comparison of percentage distribution of mature evergreen pollen taxa versus pioneer taxa	170
5.15	Synthetic pollen diagram from Kamalete, Gabon	173
5.16	Pollen diagram of the forest trees from Kamalete, Gabon.	174
6.1	Locations of archeological sites in the Neotropics that date to between 13,000 and 10,000 BP placed against a reconstruction of Central and South American Pleistocene vegetation	188
6.2	The frequencies of early successional phytoliths and burnt successional and arboreal phytoliths in modern tropical forests and through time at Lake La Yeguada.	194
6.3	Postulated domestication areas for various lowland crop plants as presently indicated by present molecular, archeological, and ecological evidence	196
6.4	Summary of charcoal, pollen, and phytolith data for vegetational history and human impacts on tropical forests in Central America from various paleoecological sites.	200
6.5	Summary of charcoal, pollen, and phytolith data for vegetational history and human impacts on tropical forests in South America from various paleoecological sites.	201
7.1	World fire in 2007	214
7.2	System linkages	218
7.3	Photo by the author of an initial fire in an unburned closed canopy forest . .	220
7.4	Schematic relationships between climate, land use, and fire	225
8.1	The Massenerhebung (mass elevation) effect illustrated by the occurrence of dwarf forest on mountains in Indonesia	242
8.2	Solar radiation on a day of broken cloud	245
8.3	The daily weather regime in the New Guinea Highlands	246
8.4	The Late Quaternary changes in vegetation on New Guinea mountains, as evidenced by palynology	247
8.5	The hypothesis that lack of upper montane rainforest in the Pleistocene may be explained by absence of a habitat with a suitable combination of mean annual temperature and UV-B insolation	248
8.6	Diagram to show how a combination of appropriate topography, Eocene warmth, and enhanced UV-B after volcanicity could lead to isolation, mutation, allopatric speciation, a species pump, and increased biodiversity. .	252
9.1	Simulated impacts of deforestation on rainfall in Amazonia	262
9.2	Projected distribution of biomes in South America for 2070–2099 from ETA CCS, RegCM3, and HadRM3P models under the A2 high-emission scenario	266

9.3	Carbon fluxes, CO ₂ concentration, and global mean temperature as derived by the HadCM3 and IPSL global coupled models until the end of the 21st century	269
9.4	Seasonal rainfall anomalies	272
9.5	Annual values of the levels of the Rio Negro in Manaus, Brazil	274
10.1	Overview of Amazonian geography.	286
10.2	Local (alpha) diversity derived from 423 1 ha Amazonian tree plots.	292
10.3	Latitudinal and longitudinal variation in Amazonian precipitation variability, dry-season length, total amount, and derived from TRMM measurements	294
10.4	Amazonian rainfall and three measures of variation in rainfall derived from 7 years of satellite measurements from the Tropical Rainfall Monitoring Mission	295
10.5	Local (alpha) diversity versus rainfall patterns and geologic age	298
10.6	Changes in dry-season length, precipitation variability, tree alpha diversity, and vascular plant gamma diversity with latitude for western Amazonian forests	300
10.7	Change in species richness with elevation in four Neotropical inventories	301
11.1	Relationships between soil organic matter content and exchangeable P	320
11.2	The relationship between total C and exchangeable P pools in sand and clay soils in a moist tropical forest in Brazil	321
11.3	The relationship between forest floor C and forest floor P pools in sand and clay soils in a moist tropical forest in Brazil	321
11.4	The potential effects of anthropogenic nitrogen deposition and increased precipitation in tropical forests	323
12.1	Plot locations used in this study	346
12.2	Above-ground biomass change of trees greater than 10 cm diameter in 59 Amazon plots and stem number change in 91 plots from across South American tropical forests	348
12.3	Annualized rates of stand-level basal-area growth, basal-area mortality, stem recruitment, and stem mortality from plots with two consecutive census intervals	349
12.4	Mean and 95% confidence intervals for stem recruitment and mortality rates against calendar year, for plots arrayed across Amazonia	350
12.5	Annualized rates of stand-level basal-area growth, basal-area mortality, stem recruitment, and stem mortality over consecutive census intervals for plots grouped into “slower growing less-dynamic” and “faster growing more-dynamic” forests	351
12.6	Five-year running means with 95% confidence intervals of liana stem density per hectare	352
14.1	Biogeochemical and physical links between the Earth’s atmosphere and ecosystems that need to be accounted for and parameterized within an earth system model	382
14.2	Indication of the amount of incoming and outgoing radiation and the percentage absorbed and reflected by the various atmospheric components.	384
14.3	Impact on the biogeochemical components of the modeled ecosystem following a change in below-ground and above-ground biomass	385
14.4	Schematic division to determine plant functional types based on a series of divisions, in this case on the growth form, tolerance to seasonal temperature, and physiology of the parent plant	386

14.5	The increasing impacts of migration and dispersal being incorporated within dynamic vegetation models as feedbacks in conjunction with other ecosystem impacts such as disturbance type	387
14.6	Biome model structure.	388
14.7	BIOME-3 run for the tropics with inputs of model climate	390
14.8	Leaf cross-section indicating the gaseous exchanges taking place	390
14.9	Schematic of the increasing level of detail being added to surface modeling approaches	391
15.1	Global changes in broadleaf tree cover illustrating importance of tropical forests in CO ₂ feedback effects	422
15.2	Decline of Amazon forest biomass in six different DGVMs, under a climate projection from the HadCM2 climate model	424

Tables

2.1	Inferred LGM moisture from described sites in the northern and southern Andes.	46
4.1	Common pollen taxa of major ecological groups in the Far East.	95
5.1	List of fossil pollen sites located within the African lowland rainforest. . . .	148
7.1	Tropical regional averages of temperature and precipitation projection from 21 global climate models for the A1B emissions scenario.	226
11.1	Magnitude of predicted changes in regional climates in tropical regions. . . .	317
11.2	Summary of potential effects of climate change on nutrient cycling in tropical forests	330

Abbreviations and acronyms

AP	Arboreal Pollen
AGCM	Atmospheric General Circulation Model
ALLJ	American Low-Level Jet
AMIP	Atmospheric Model Inter-comparison Program
AMS	Accelerator Mass Spectrometry
ANN	Artificial Neural Network
ATDN	Amazon Tree Diversity Network
BIOCLIM	BIOlogical CLIMate model
BIOME-3	BIOsphere Model
CBD	Convention on Biological Diversity
CDI	Climate Decomposition Index
CMIP	Coupled Model Intercomparison Project
DBH	Diameter at Breast Height
DCA	Detrended Correspondence Analysis
DGVM	Dynamic Global Vegetation Model
DIF	Differentials
DO2	Dansgaard–Oeschger event 2
ELA	Equilibrium Line Altitude
ENSO	El Niño–Southern Oscillation
EVI	Enhanced Vegetation Index
FATE	Functional Attributes in Terrestrial Ecosystems
FORCLIM	FORests in a changing CLIMate
FORET	FORests of East Tennessee
GAM	Generalized Additive Modeling; Generalized Additive Model
GARP	Genetic Algorithm for Rule-set Prediction
GCM	General Circulation Model; Global Climate Model; Global Circulation Model

GHG	GreenHouse Gas
GISP	Greenland Ice Sheet Project
GLM	Generalized Linear Modeling
IBIS	Integrated BIOSphere Simulator model
IPCC	Intergovernmental Panel on Climate Change
IPSL	Institute Pierre and Simon Laplace model
ITCZ	Inter Tropical Convergence Zone
kcal yr ⁻¹ BP	Kilo calibrated years before present
LAI	Leaf Area Index
LGM	Last Glacial Maximum
LPJ	Lund–Potsdam–Jena Dynamic Global Vegetation Model
LTM	Long-Term Mean
MAT	Mean Annual Temperature
MIS	Marine Isotope Stage
MWP	Medieval Warm Period
NAP	Non-Arboreal Pollen
NPP	Net Primary Productivity
PFT	Plant-Functional Type
PVT	Potential Vegetation Model
RAINFOR	<i>Red Amazónica de INventarios FORestales,</i> <i>Red Amazónica de INventarios FIORestais</i>
RCM	Regional Climate Model
REDD	Reducing Emissions from Deforestation and forest Degradation
SALLJ	South American Low-Level Jet
SASM	South American Summer Monsoon
SDGVM	Sheffield Dynamic Global Vegetation Model
SDM	Species Distribution Model
SENAMHI	Meteorological service of Peru
SPI	Standard Precipitation Index
SST	Sea Surface Temperature
TDF	Tropical Deciduous Forest
TEF	Tropical Evergreen Forest
TRIFFID	Top-down Representation of Interactive Foliage and Flora Including Dynamics
TRMM	Tropical Rainfall Measuring Mission
TSEF	Tropical Semi-Evergreen Forest
UKMO	United Kingdom Meteorological Office
UMRF	Upper Montane RainForest
UNFCCC	United Nations Framework Convention on Climate Change
VECODE	VEgetation CONTinuous DEscription Model
VPD	Vapor Pressure Deficit
WCRP	World Climate Research Program
WUE	Water-Use Efficiency

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