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# Terrestrial Ecosystems in a Changing World

With 104 Figures

 Springer

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## Preface

The GCTE project was born on the day the Berlin wall fell (November 10, 1989). It was the final day of the Planning Committee meeting for the IGBP, at Berlin's Wissenschaftskolleg. Co-ordinating Panel 4 had presented its recommendations to the IGBP Planning Committee during the preceding week, and on that day they were accepted as the basis for GCTE, ratified later at the general IGBP inaugural meeting in Paris, in 1990.

The first full meeting of GCTE was its Open Science meeting in Brighton, England, in February 1991. Much good science was defined and put into effect at that meeting. But one point remained unresolved – an appropriate name and acronym. Everyone was agreed that GCTE was dreadful and could never work. The topic was debated at (the end of) each subsequent meeting of the Steering Committee, and no agreement on a better (publishable) name and acronym was ever reached. Its clumsiness eventually made it distinctive and so, 15 years later, it is finally put to rest, with the project.

From its inception GCTE was marked by, and most fortunate in having, a group of outstanding scientists to lead its defined Activities. They constituted the GCTE Steering Committee and their performance and stature attracted the best researchers joining what has been an exemplary (yet essentially voluntary) scientific effort.

The evolution of GCTE is an interesting reflection of scientific progress and increasing awareness of what is needed to understand the functioning of the Earth System. It began with three “Foci”, ecophysiology (at various scales), vegetation dynamics (again at scales from patches to the globe) and agro-ecosystems. A fourth Focus, on biodiversity, but also involving linkages across the other three, was added as results from initial studies and models began to emerge. The evolution to a more integrated approach continued and the results presented in this volume show the level of awareness that has now been achieved.

Perhaps the most important achievement of GCTE has been to demonstrate the critical role that terrestrial ecosystems play in the functioning of the Earth System. When GCTE began, it was widely assumed that Earth System dynamics were dominated by the ocean-atmosphere system, and that terrestrial systems were just the recipients of changes in the dynamics of these two great fluids. Now the picture is much different, as the following examples demonstrate.

**Terrestrial processes in the carbon cycle.** Until very recently, projections of future atmospheric CO<sub>2</sub> concentration were determined only by estimated emissions from fossil fuel combustion and land-use change. Research within GCTE and elsewhere has elucidated the important role that feedback processes in terrestrial ecosystems – heterotrophic respiration, wildfires, permafrost melting – will play in determining the trajectory of atmospheric CO<sub>2</sub> concentration over the next few decades and centuries. This work has contributed to the issue of ‘sink saturation’ and the possibility that the terrestrial will switch later this century from being a net sink to a net source of carbon.

**Nonlinearities in the Earth System.** Within the IGBP framework, GCTE took the lead in analyzing the nature of nonlinear change in Earth System functioning. This work played a central role in the emergence of abrupt change, surprises and extreme events as unifying themes in the second phase of IGBP research.

**Dynamic Global Vegetation Models (DGVMs).** When GCTE began its implementation in 1991, the terrestrial surface was treated as a ‘big leaf’ or a ‘green slime’ in global climate models. One of the project’s highest priorities was to change this situation. Several research groups associated with GCTE produced prototype DGVMs by the mid-1990s, a model intercomparison was implemented later in the decade, and now DGVMs are recognized as an essential component – as important as the oceans and the atmosphere – in Earth System models.

Complementing this Earth System perspective, the last phase of GCTE also placed emphasis on the consequences of global change for the things that matter to people – captured in this book in the section on “Ecosystem Services”. These consequences are mostly reflected at regional scales and the regions under most stress are discussed in the final section of the book.

We are delighted and honored to have been asked to write this Preface. Brian was GCTE’s first Chair and Will the first full time Scientific Officer, before he took over as IGBP Director. We both greatly enjoyed our involvement, benefiting from it enormously, and this was in large measure thanks to all the fine people who were involved. We cannot mention them all but we want to acknowledge one person in particular, Rowena Foster, for the prodigious effort she has put in, throughout the 15 years of its existence, to making GCTE work. We know that every scientist who was involved in one of the many workshops organized by Rowena will join us in thanking her.

GCTE’s research over the past 15 years provides a sound base for the new Global Land Project, and the community that GCTE has built will make many further contributions to the GLP. This book highlights the exciting work that was carried out during the second half of GCTE and points towards the new challenges to be undertaken under the GLP banner. We congratulate the authors and editors on a fine effort. We thank the GCTE community for its many achievements and wish the GLP all the best for the future.

*Brian Walker and Will Steffen*

November 2006

Canberra

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## Acknowledgments

The implementation and success of GCTE was possible thanks to the commitment and contributions of many scientists from around the world who have volunteered for leading roles to drive activities, established networks, and run workshops and synthesis efforts for almost 15 years. Over 100 scientists played roles as members of the scientific steering committee, and as activity and task leaders. To all of them we want to show our appreciation and gratitude for their valuable time and intellectual contributions. Their willingness to contribute well beyond their own interest provided an invaluable service to the development of a globally coordinated understanding of science. Particular thanks go to the chairs of GCTE: Brian Walker, Ian Noble, and Louis Pitelka; and Harold Mooney for being such a motivating and inspiring leader.

We also want to thank to a smaller group of individuals who invested their careers in the roles of executive and project officers to support the implementation of the GCTE science plan. Without those individuals who were able to be full time facilitators, coordinators, and leaders, the GCTE would have not been able to operate successfully. Those individuals include: William Batista, Pep Canadell, Sara Duke, Pablo Inchausti, John Ingram, Elisabeth Huber-Sannwald, George Koch, Diane Pataki and Will Steffen. We also want to thank Rowena Foster who supported with great proficiency the International Project Office (IPO) in Canberra for the entire life of the project.

No GCTE activity or office would have been possible without the engagement and long term commitment of the many funding agencies which supported the offices and the development of networks, workshops, and synthesis efforts.

These long term funding relationships were key to the success of GCTE, enabling the establishment of an IPO and several focus offices that continuously supported the operations of GCTE. The IPO was based in Canberra, Australia and funded by the Australian Greenhouse Office (AGO) of the Department of the Environment and Heritage, and the Australian Commonwealth Scientific and Research Organization (CSIRO); initially in the Division of Sustainable Ecosystems and later on in the Division of Marine and Atmospheric Research. Both AGO and CSIRO Marine and Atmospheric Research are continuing their invaluable support to international research coordination through their support to the Global Carbon Project, a joint project of the Earth System Science Partnership (IGBP, IHDP, WCRP, and Diversitas).

The US-National Science Foundation (NSF), the National Aeronautics and Space Administration (NASA), Stanford University, and the University of Utah in Salt Lake City supported the focus 1 office on ecosystem physiology and biogeochemistry; the US-Department of Energy (DOE) funded many activities related to ecosystem physiology. The Natural Environment Research Council (NERC) through the Centre for Ecology and Hydrology in Wallingford, UK supported the focus 3 office on agroecology and production systems. The Inter-American Institute for Global Change based in Brazil, the University of Buenos Aires, and the CNRS-Ecole Normale Supérieure in Paris supported the focus 4 office on functional biodiversity.

On behalf of the GCTE and its sponsor program, the International Geosphere-Biosphere Program, we want to express our appreciation and thanks for the long

term commitment and significant contributions to the coordination of international science. This support has enabled the GCTE to leave behind a legacy of improved understanding of the effects of global change on terrestrial ecosystems, and a large community with the scientific capacity to continue this work into a new phase.

Finally we want to thank all the authors of chapters in this book for their time and valuable contributions towards this final GCTE effort.

*Josep Canadell, Diane Pataki, Louis Pitelka*  
The editors



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# Contents

<b>1</b>	<b>Global Ecology, Networks, and Research Synthesis</b>	<b>1</b>
1.1	Introduction	1
1.2	Carbon and Water Cycles in the 21 <sup>st</sup> Century	2
1.3	Changing Biodiversity and Ecosystem Functioning	3
1.4	Landscapes under Changing Disturbance Regimes	3
1.5	Managing Ecosystem Services	4
1.6	Regions under Stress	4
1.7	The Way Forward	4
	References	5
	<b>Part A</b>	
	<b>Carbon and Water Cycles in the 21<sup>st</sup> Century</b>	<b>7</b>
<b>2</b>	<b>CO<sub>2</sub> Fertilization: When, Where, How Much?</b>	<b>9</b>
2.1	Carbon a Limiting Plant Resource?	9
2.2	Long-Term Biomass Responses and Carbon Pools	10
2.2.1	Time Matters	10
2.2.2	Nutrients and Water Determine Biomass Responses at Elevated CO <sub>2</sub>	11
2.2.3	Scaling from Growth to Carbon Pools	13
2.3	Carbon to Nutrient Ratios and Consumer Responses	13
2.3.1	The C to N Ratio Widens	13
2.3.2	Consequences for Herbivory, Decomposition and Plant Nutrition	14
2.4	Plant Water Relations and Hydrological Implications	14
2.5	Stress Resistance under Elevated CO <sub>2</sub>	16
2.6	Biodiversity Effects May Outweigh Physiology Effects	16
2.6.1	Hydrology Implications of Elevated CO <sub>2</sub> Depend on Species Abundance	16
2.6.2	Biodiversity Effects on Forest Carbon Stocking and Grassland Responses	16
2.7	Summary and Conclusions	17
	References	18
<b>3</b>	<b>Ecosystem Responses to Warming and Interacting Global Change Factors</b>	<b>23</b>
3.1	The Multiple Factor Imperative in Global Change Research	23
3.2	Ecosystem Responses to Experimental Warming	23
3.2.1	The GCTE-NEWS Synthesis	24
3.2.2	The ITEX Synthesis	25
3.2.3	The Harvard Forest Soil Warming Experiment	26

---

3.3	Temperature and CO <sub>2</sub> Interactions in Trees: the TACIT Experiment .....	26
3.3.1	Experimental Design .....	26
3.3.2	Growth Responses .....	27
3.3.3	Higher-Order Responses .....	28
3.3.4	TACIT Summary .....	28
3.4	More Than Two Factors: the Jasper Ridge Global Change Experiment .....	28
3.4.1	Experimental Design .....	28
3.4.2	Net Primary Productivity .....	29
3.4.3	Community Composition .....	29
3.4.4	JRGCE Summary .....	30
3.5	Modeling Temperature, CO <sub>2</sub> and N Interactions in Trees and Grass .....	30
3.5.1	Global Change Simulations for a California Annual Grassland .....	30
3.5.2	Comparing Forest and Grassland with G'DAY .....	32
3.6	Summary and Conclusions .....	33
	Acknowledgments .....	34
	References .....	34
<b>4</b>	<b>Insights from Stable Isotopes on the Role of Terrestrial Ecosystems in the Global Carbon Cycle .....</b>	<b>37</b>
4.1	Introduction .....	37
4.2	Ecosystem Carbon Cycles .....	37
4.3	The Global Carbon Cycle .....	40
4.4	Future Directions .....	42
	Acknowledgments .....	42
	In Memoriam .....	42
	References .....	43
<b>5</b>	<b>Effects of Urban Land-Use Change on Biogeochemical Cycles .....</b>	<b>45</b>
5.1	Introduction .....	45
5.2	Urban Land-Use Change .....	46
5.3	Urban Environmental Factors .....	47
5.3.1	Climate and Atmospheric Composition .....	47
5.3.2	Atmospheric and Soil Pollution .....	49
5.3.3	Introductions of Exotic Species .....	49
5.4	Disturbance and Management Effects .....	50
5.4.1	Lawn and Horticultural Management .....	50
5.4.2	Management Effort .....	51
5.5	Effects of Built Environment .....	52
5.6	Assessing Biogeochemical Effects – the Importance of Scale .....	54
5.7	Summary and Conclusions .....	55
	Acknowledgments .....	56
	References .....	56
<b>6</b>	<b>Saturation of the Terrestrial Carbon Sink .....</b>	<b>59</b>
6.1	Introduction .....	59
6.2	Location of the Current Terrestrial Carbon Sinks .....	59
6.3	Dynamics of Processes that Contribute to Carbon Sink Saturation .....	60
6.4	Processes Contributing to Terrestrial Carbon Sink Saturation .....	60
6.4.1	Processes Driven by Atmospheric Composition Change .....	60
6.4.2	Processes Driven by Climate Change .....	64
6.4.3	Processes Driven by Land-Use Change and Land Management .....	66
6.5	Integration and Model Predictions .....	71
6.6	Summary and Conclusions .....	73
	Acknowledgments .....	74
	References .....	74

---

<b>Part B</b>	
<b>Changing Biodiversity and Ecosystem Functioning</b>	79
<b>7 Functional Diversity – at the Crossroads between Ecosystem Functioning and Environmental Filters</b>	81
7.1 Introduction	81
7.2 Environmental Filters Affect FD	82
7.3 FD effects on Global Change Drivers	82
7.3.1 The Traits of the Dominants	82
7.3.2 The Role of Interactions	87
7.4 Summary and Conclusions	89
Acknowledgments	89
References	90
<b>8 Linking Plant Invasions to Global Environmental Change</b>	93
8.1 Introduction	93
8.2 Plant Invasions and Elevated CO <sub>2</sub>	93
8.3 Plant Invasions and Climatic Change	95
8.4 Plant Invasions and Land Eutrophication	96
8.5 Plant Invasions and Changes in Land Use/Cover	97
8.6 Multiple Interactions	98
8.7 Summary and Conclusions	99
Acknowledgments	99
References	99
<b>9 Plant Biodiversity and Responses to Elevated Carbon Dioxide</b>	103
9.1 Ten Years of GCTE Research: Apprehending Complexity	103
9.1.1 Effects of CO <sub>2</sub> on Plant Diversity Through Alterations of the Physical Environment	103
9.2 Temporal Variation and Response to Elevated CO <sub>2</sub>	105
9.2.1 Reproductive and Evolutionary Aspects of the Response to Elevated CO <sub>2</sub>	105
9.2.2 Communities at Equilibrium Versus Dynamic Systems	105
9.3 Biodiversity Loss and Response to Elevated CO <sub>2</sub>	107
9.3.1 Species Diversity and Response to Elevated CO <sub>2</sub>	107
9.3.2 Ecosystem C Fluxes in a Species-Poor World	108
9.4 Summary and Conclusions	110
References	111
<b>10 Predicting the Ecosystem Consequences of Biodiversity Loss: the BiomeRGE Framework</b>	113
10.1 Biodiversity and Ecosystem Functioning: a Synthesis	113
10.1.1 Why Biodiversity Matters to Global Change Ecology	113
10.1.2 Linking Change in Biodiversity with Change in Ecosystem Functioning	114
10.1.3 Lessons Learned from Early Debates	114
10.1.4 What We Have Learned about the Relationship between Biodiversity and Ecosystem Function	115
10.1.5 The Scientific Framework for Linking Biodiversity and Ecosystem Functioning	115
10.2 The BioMERGE Framework	117
10.2.1 The BioMERGE Structural Sub-Framework	117
10.2.2 The BioMERGE BEF Sub-Framework: an Expansion of the Vitousek-Hooper Framework	117
10.2.3 The BioMERGE Research Implementation Sub-Framework	119
10.3 Discussion: Towards a Large Scale BEF	122
Acknowledgments	123
References	123

---

Part C	
Landscapes under Changing Disturbance Regimes .....	127
<b>11 Plant Species Migration as a Key Uncertainty in Predicting Future Impacts of Climate Change on Ecosystems: Progress and Challenges .....</b>	<b>129</b>
11.1 Introduction .....	129
11.2 Will Migration Be Necessary for Species Persistence? .....	130
11.2.1 Vegetation-Type Models .....	131
11.2.2 Species-Based Models .....	132
11.3 Measurements and Models of Migration Rates .....	133
11.4 Linking Migration and Niche Based Models .....	134
11.5 Summary and Conclusions .....	135
Acknowledgments .....	135
References .....	135
<b>12 Understanding Global Fire Dynamics by Classifying and Comparing Spatial Models of Vegetation and Fire .....</b>	<b>139</b>
12.1 Introduction .....	139
12.2 Background .....	140
12.3 Model Classification .....	140
12.4 Model Comparison .....	141
12.4.1 The Models .....	141
12.4.2 The Comparison Design .....	143
12.5 Results and Discussion .....	144
12.5.1 Model Classification .....	144
12.5.2 Model Comparison .....	145
12.6 Summary and Conclusions .....	145
Acknowledgments .....	146
References .....	146
<b>13 Plant Functional Types: Are We Getting Any Closer to the Holy Grail? .....</b>	<b>149</b>
13.1 In Search of the Holy Grail .....	149
13.2 Individual Plant Structure and Function .....	149
13.3 Traits and Environmental Gradients .....	152
13.3.1 Plant Functional Response to Mineral Resource Availability .....	152
13.3.2 Plant Functional Response to Disturbance .....	152
13.3.3 Projecting Changes in Plant Functional Traits in Response to Global Change .....	154
13.4 Scaling from Individual Plants to Communities: from Response Traits to Community Assembly .....	155
13.5 Scaling from Communities to Ecosystems: from Response Traits to Effect Traits .....	156
13.6 So, Are We Getting Closer to the Holy Grail? Scaling beyond Ecosystems .....	157
13.6.1 Plant Functional Traits and Landscape Dynamics .....	157
13.6.2 Regional to Global Models – Revisiting the Early Functional Classifications .....	157
13.6.3 Validation: the Contribution of Paleo-Data .....	158
13.7 Summary and Conclusions .....	159
Acknowledgments .....	159
References .....	159

<b>14</b>	<b>Spatial Nonlinearities: Cascading Effects in the Earth System</b>	165
14.1	Introduction	165
14.2	Conceptual Framework	166
14.3	Insights to Global Change Issues	166
14.3.1	Historical Example: the Dust Bowl of the 1930s	166
14.3.2	Wildfire	168
14.3.3	Invasive Species and Desertification	171
14.4	Forecasting Spatial Nonlinearities and Catastrophic Events	172
14.5	Summary and Conclusions	173
	Acknowledgments	173
	References	173
<b>15</b>	<b>Dynamic Global Vegetation Modeling: Quantifying Terrestrial Ecosystem Responses to Large-Scale Environmental Change</b>	175
15.1	Introduction	175
15.2	Historical Antecedents and Development of DGVMs	175
15.2.1	Plant Geography	176
15.2.2	Plant Physiology and Biogeochemistry	176
15.2.3	Vegetation Dynamics	177
15.2.4	Biophysics	177
15.2.5	Human Intervention	178
15.3	Principles and Construction of DGVMs	178
15.3.1	Model Architecture	178
15.3.2	Net Primary Production	179
15.3.3	Plant Growth and Vegetation Dynamics	179
15.3.4	Hydrology	180
15.3.5	Soil Organic Matter Transformations	180
15.3.6	Nitrogen (N) Cycling	180
15.3.7	Disturbance	180
15.4	Evaluating DGVMs	181
15.4.1	Net Primary Production	181
15.4.2	Remotely Sensed "Greenness" and Vegetation Composition	181
15.4.3	Atmospheric CO <sub>2</sub> Concentration	181
15.4.4	Runoff	182
15.4.5	CO <sub>2</sub> and Water Flux Measurements	182
15.5	Examples of Applications of DGVMs	182
15.5.1	Holocene Changes in Atmospheric CO <sub>2</sub>	182
15.5.2	Boreal "Greening" and the Contemporary Carbon Balance	182
15.5.3	The Pinatubo Effect	183
15.5.4	Future Carbon Balance Projections	183
15.5.5	Carbon-Cycle Feedbacks to Future Climate Change	183
15.5.6	Effects of Land-Use Change on the Carbon Cycle	185
15.6	Some Perspectives and Research Needs	185
15.6.1	Comparison with Field Experiments	185
15.6.2	Plant Functional Types	185
15.6.3	The Nitrogen Cycle	185
15.6.4	Plant Dispersal and Migration	186
15.6.5	Wetlands	186
15.6.6	Multiple Nutrient Limitations	186
15.6.7	Agriculture and Forestry	186
15.6.8	Grazers and Pests	186
15.6.9	Biogenic Emissions of Trace Gases and Aerosol Precursors	187
15.7	Summary and Conclusions	187
	References	187

---

<b>Part D</b>	
<b>Managing Ecosystem Services</b> .....	193
<b>16 Wheat Production Systems and Global Climate Change</b> .....	195
16.1 Introduction .....	195
16.2 Global Atmospheric Change, Climate and Yields .....	197
16.3 Impacts on Wheat Productivity .....	199
16.4 Addressing the Yield Gap .....	200
16.5 The Protein Gap .....	200
16.6 The Rice-Wheat System .....	201
16.7 The Effect of Climate Change on the Rice-Wheat System .....	202
16.8 The Contribution of the Rice-Wheat System to Climate Change .....	202
16.9 Carbon Dioxide .....	203
16.10 Methane .....	203
16.11 Nitrous Oxide .....	204
16.12 Comparative Greenhouse Gas Budgets for Rice-Wheat Farming Systems .....	204
16.13 Summary and Conclusions .....	207
References .....	208
<b>17 Pests Under Global Change – Meeting Your Future Landlords?</b> .....	211
17.1 Introduction .....	211
17.2 Methods .....	211
17.2.1 IPCC Processes .....	211
17.2.2 Monitoring, Benchmarks and Indicators for Measuring Impacts ...	212
17.2.3 Estimating Impacts .....	213
17.3 Impacts .....	216
17.3.1 Atmospheric CO <sub>2</sub> and Climate .....	216
17.3.2 Land Use, Land Cover and Biodiversity .....	219
17.3.3 Trade and Travel .....	219
17.4 Adaptation .....	220
17.4.1 Natural Adaptations .....	220
17.4.2 Adaptive Management Options .....	220
17.4.3 Adaptation of Control Measures in Response to Global Change ...	221
17.4.4 Threats to Sustainability of Adaptation Options .....	221
17.5 Vulnerability .....	222
17.6 Summary and Conclusions .....	222
References .....	223
<b>18 Greenhouse Gas Mitigation Potential in Agricultural Soils</b> .....	227
18.1 Introduction .....	227
18.1.1 Soil Carbon and Carbon Dioxide .....	227
18.1.2 Trade-Offs between GHGs in Agriculture .....	227
18.2 What Is Meant by GHG Mitigation Potential? .....	229
18.3 Regional Case Studies .....	230
18.3.1 Sustainable Soil Management in the Moscow Region to Enhance Soil Carbon .....	230
18.3.2 Soil Carbon Sequestration Potential in the US .....	231
18.4 Carbon Sequestration in the Future .....	232
18.5 Win-Win Strategies for Greenhouse Gas Mitigation by Agricultural Soils .....	232
18.6 Future Challenges .....	233
18.6.1 Improving Carbon Sequestration .....	233
18.6.2 Monitoring Soil Carbon Sequestration .....	233
18.7 Summary and Conclusions .....	234
References .....	235

<b>19</b>	<b>Carbon and Water Tradeoffs in Conversions to Forests and Shrublands</b>	237
19.1	Introduction	237
19.2	Afforestation	237
19.2.1	Afforestation: Carbon Storage Potential	237
19.2.2	Afforestation: Evapotranspiration and Water Yield	238
19.2.3	Afforestation: Potential Atmospheric Feedbacks	239
19.3	Woody Encroachment and Agriculture	240
19.3.1	Grassland Conversions with Woody Plant Encroachment and Agriculture	240
19.3.2	Processes Controlling Soil C Storage: Grassland Vs. Woodland	241
19.3.3	Uncertainties in Water and Carbon Balances with Woody Plant Encroachment	242
19.4	Summary and Conclusions	243
	References	244
<b>20</b>	<b>Natural and Human Dimensions of Land Degradation in Drylands: Causes and Consequences</b>	247
20.1	Introduction	247
20.2	Drylands, Desertification, Drivers, and Scales	247
20.2.1	Distribution of People and Land-Cover Types	247
20.2.2	Defining Land Degradation and Desertification	248
20.2.3	What Drives Land Degradation and Desertification?	249
20.2.4	Estimating the Extent of Desertification	249
20.2.5	Consequences of Desertification	250
20.2.6	Scale and Hierarchy	251
20.3	Joint GCTE-LUCC Desertification Initiative	252
20.3.1	Dahlem Desertification Paradigm	252
20.3.2	Initiatives to Test the Dahlem Desertification Paradigm	253
20.4	Management of Desertified Drylands	254
20.4.1	Avoidance	254
20.4.2	Monitoring	254
20.4.3	Restoration	254
20.5	Summary and Conclusions	255
	Acknowledgments	255
	References	255
	<b>Part E</b>	
	<b>Regions under Stress</b>	259
<b>21</b>	<b>Southeast Asian Fire Regimes and Land Development Policy</b>	261
21.1	Introduction	261
21.2	Underlying Causes of Land Fires	262
21.2.1	Explaining Fire Occurrence	262
21.2.2	Land Development Policies	262
21.2.3	Land Management Practices	263
21.2.4	Property Rights and Conflicts	265
21.3	Landscape, Regional and Global Interactions	265
21.3.1	Ecosystem Dynamics	265
21.3.2	Regional Haze Episodes	266
21.3.3	Greenhouse Gas Emissions	266
21.3.4	Interactions with Climate Variability and Change	267
21.4	Human Well-Being	267
21.4.1	Economic and Health Impacts	267
21.4.2	Livelihoods	267

---

21.5	Informed Decision-Making and Better Governance .....	268
21.5.1	Role of Expertise .....	268
21.5.2	Regional Cooperation .....	269
21.6	Summary and Conclusions .....	269
	Acknowledgments .....	270
	References .....	270
<b>22</b>	<b>Global Change Impacts on Agroecosystems of Eastern China .....</b>	<b>273</b>
22.1	Introduction .....	273
22.2	Chinese Terrestrial Transects .....	274
22.3	Physiological and Plant Responses to Multiple Global Change Forcing ..	275
22.4	Productivity and Its Responses to Global Change .....	276
22.5	Carbon Budget and Its Responses to Global Change .....	278
22.6	Summary and Conclusions .....	282
	Acknowledgments .....	282
	References .....	282
<b>23</b>	<b>Terrestrial Ecosystems in Monsoon Asia:</b>	
	<b>Scaling up from Shoot Module to Watershed .....</b>	<b>285</b>
23.1	Introduction .....	285
23.2	Responses of Plant Communities to the Global Change:	
	Scaling from Leaf to Landscape Through Individual Plant .....	285
23.2.1	Competition among Individual Plants	
	in Even-Aged Monospecific Stands at Elevated CO <sub>2</sub> .....	286
23.2.2	Shoot-Module-Based Simulator As a Tool	
	of Individual Tree Response .....	288
23.2.3	Modeling the Shift of Forest Zonation .....	289
23.3	Carbon Budget at the Forest Watershed Scale .....	289
23.3.1	Carbon Exchange between Atmosphere-Forest-Stream Boundaries .	290
23.3.2	Transport of Dissolved Organic Carbon Associated with	
	Dissolved Nitrogen from Terrestrial to Aquatic Ecosystems .....	290
23.3.3	Dynamics of Dissolved Organic Carbon at the Interface	
	of Stream and Lake Ecosystems .....	291
23.4	Carbon Budget and Functions of the Lake Biwa Ecosystem .....	292
23.4.1	Carbon Budget in the Lake .....	292
23.4.2	Metabolism in the Lake Sediments .....	293
23.4.3	Terrestrial Environment and Function of Lake Ecosystems .....	293
23.5	Summary and Conclusions .....	294
	References .....	294
<b>24</b>	<b>Responses of High Latitude Ecosystems to Global Change:</b>	
	<b>Potential Consequences for the Climate System .....</b>	<b>297</b>
24.1	Introduction .....	297
24.2	Recent Changes in Climate, Disturbance Regimes, and Land Cover .....	297
24.3	Responses of Radiatively Active Gases .....	300
24.3.1	General Issues .....	300
24.3.2	Responses of CO <sub>2</sub> Exchange to Climatic Change .....	300
24.3.3	Responses of CH <sub>4</sub> Exchange to Climatic Change .....	302
24.3.4	Responses to Changes in Disturbance and Land Cover .....	303
24.4	Responses of Water and Energy Exchange .....	304
24.4.1	General Issues .....	304
24.4.2	Responses to Changes in Climate, Disturbance, and Land Cover ....	304
24.5	Delivery of Freshwater to the Arctic Ocean .....	305
24.5.1	General Issues .....	305
24.6	Summary and Conclusions .....	305
	References .....	306



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<b>Part F</b>	
<b>Future Directions: the Global Land Project</b> .....	311
<b>25 The Future Research Challenge: the Global Land Project</b> .....	313
25.1 Introduction .....	313
25.2 Research Objectives .....	314
25.3 Emergent Concepts .....	315
25.3.1 Land-Use Decision Making and Adaptive Management .....	315
25.3.2 Ecosystem Services .....	316
25.3.3 Vulnerability and Sustainability Science .....	316
25.4 Research Framework .....	317
25.4.1 Theme 1: Dynamics of Land System .....	317
25.4.2 Theme 2: Consequences of Land-System Change .....	318
25.4.3 Theme 3: Integrating Analysis and Modeling for Land Sustainability .....	318
25.5 Implementation Strategy .....	319
25.6 Summary and Conclusions .....	320
References .....	321
<b>Index</b> .....	323



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