

Cambridge University Press

978-1-107-01124-3 - Land Use and the Carbon Cycle: Advances in Integrated Science, Management, and Policy

Edited by Daniel G. Brown, Derek T. Robinson, Nancy H. F. French, and Bradley C. Reed

Frontmatter

[More information](#)

LAND USE AND THE CARBON CYCLE

Advances in Integrated Science, Management, and Policy

As governments and international institutions work to ameliorate the effects of anthropogenic carbon dioxide emissions on global climate, there is an increasing need to understand how land-use and land-cover change is coupled to the carbon cycle, and how land management can be used to mitigate their effects. This book brings an interdisciplinary team of fifty-six international researchers to share novel approaches, concepts, theories, and knowledge on land use and the carbon cycle.

The book examines how the social, political, economic, and ecosystem processes associated with land use and land management drive carbon flux and storage in terrestrial ecosystems. The central theme is that land use and land management are tightly integrated with the carbon cycle, and thus it is necessary to study these processes as a single natural-human system to improve carbon accounting and mitigate climate change.

Land Use and the Carbon Cycle is an invaluable resource for advanced students, researchers, land-use planners, and policy makers in natural resources, geography, forestry, agricultural science, ecology, atmospheric science, and environmental economics.

DANIEL G. BROWN is a Professor in the School of Natural Resources and Environment at the University of Michigan. His work, published in more than 100 peer-reviewed publications, aims to understand human-environment interactions through a focus on land-use and land-cover changes, modeling these changes, and spatial analysis and remote sensing methods for characterizing landscape patterns. He has chaired the Land Use Steering Group under the auspices of the U.S. Climate Change Science Program and has served as a member of the Carbon Cycle Steering Group and the NASA Land-Cover and Land-Use Change Science Team, as well as on a variety of panels for the National Research Council, NASA, the National Science Foundation, and the European Research Council. He has served on the editorial boards for the journal *Landscape Ecology*; the journal *Computers, Environment, and Urban Systems*; and the journal *Land Use Science*. In 2009, he was elected a Fellow of the American Association for the Advancement of Science.

DEREK T. ROBINSON is an Assistant Professor in the Department of Geography and Environmental Management at the University of Waterloo. Dr. Robinson has been developing and publishing land-use research using geographical information science (GIS) and agent-based modeling approaches for ten years, which includes substantive contributions to research projects in Europe and North America. His research typically involves using agent-based models to integrate geographical information systems (GISystems) and ecological and human decision-making models to evaluate how socioeconomic contexts and policy scenarios affect changes in land use, ecological function, and human well-being.

NANCY H. F. FRENCH is a Senior Scientist at the Michigan Tech Research Institute of Michigan Technological University. Dr. French has been working on applications of remote sensing to ecology and vegetation studies for more than twenty years. Her primary interests are in the study of forest ecosystems and the application of remote sensing and geospatial analysis techniques to ecosystem studies. She serves on the editorial board and as an assistant editor for the *International Journal of Wildland Fire*. She is a member of the North American Carbon Program Scientific Steering Group and serves on the NASA Carbon Monitoring System Science Definition Team. She has authored or coauthored twenty-five journal articles and more than ten book chapters.

BRADLEY C. REED is Associate Program Coordinator in the Geographic Analysis and Monitoring Program of the U.S. Geological Survey (USGS), Reston, Virginia. Dr. Reed has been involved in a number of research endeavors, including developing a global land-cover map (DISCover) using Earth Observations, developing new methods for characterizing phenology from Earth Observation data, and assessing biological carbon sequestration for the United States. He worked at the USGS Earth Resources Observation and Science (EROS) Data Center for several years. He recently completed an assignment in Geneva, Switzerland, as the U.S. representative to the Group on Earth Observations (GEO), where he supported work in the Ecosystems and Biodiversity Societal Benefit Areas.

Cambridge University Press

978-1-107-01124-3 - Land Use and the Carbon Cycle: Advances in Integrated Science, Management, and Policy

Edited by Daniel G. Brown, Derek T. Robinson, Nancy H. F. French, and Bradley C. Reed

Frontmatter

[More information](#)

Cambridge University Press

978-1-107-01124-3 - Land Use and the Carbon Cycle: Advances in Integrated Science, Management, and Policy

Edited by Daniel G. Brown, Derek T. Robinson, Nancy H. F. French, and Bradley C. Reed

Frontmatter

[More information](#)

LAND USE AND THE CARBON CYCLE

Advances in Integrated Science, Management, and Policy

Edited by

DANIEL G. BROWN

University of Michigan

DEREK T. ROBINSON

University of Waterloo

NANCY H. F. FRENCH

Michigan Technological University

BRADLEY C. REED

United States Geological Survey



CAMBRIDGE
UNIVERSITY PRESS

Cambridge University Press

978-1-107-01124-3 - Land Use and the Carbon Cycle: Advances in Integrated Science, Management, and Policy

Edited by Daniel G. Brown, Derek T. Robinson, Nancy H. F. French, and Bradley C. Reed

Frontmatter

[More information](#)

CAMBRIDGE UNIVERSITY PRESS

Cambridge, New York, Melbourne, Madrid, Cape Town,
Singapore, São Paulo, Delhi, Mexico City

Cambridge University Press
32 Avenue of the Americas, New York, NY 10013-2473, USA

www.cambridge.org

Information on this title: www.cambridge.org/9781107648357

© Cambridge University Press 2013

Bradley C. Reed's contribution is a work of the United States Government and is not protected by copyright in the United States.

This publication is in copyright. Subject to statutory exception and to the provisions of relevant collective licensing agreements, no reproduction of any part may take place without the written permission of Cambridge University Press.

First published 2013

Printed in the United States of America

A catalog record for this publication is available from the British Library.

Library of Congress Cataloging in Publication data

Land use and the carbon cycle : advances in integrated science,
management, and policy / Daniel G. Brown...[et al].
p. cm.

ISBN 978-1-107-01124-3 (hbk.) – ISBN 978-1-107-64835-7 (pbk.)

1. Carbon cycle (Biogeochemistry). 2. Atmospheric carbon dioxide. 3. Landscape changes. 4. Land use – Environmental aspects. I. Brown, Daniel G.
QH344.L36 2013
577'.144–dc23 2012029081

ISBN 978-1-107-01124-3 Hardback

ISBN 978-1-107-64835-7 Paperback

Cambridge University Press has no responsibility for the persistence or accuracy of URLs for external or third-party Internet Web sites referred to in this publication and does not guarantee that any content on such Web sites is, or will remain, accurate or appropriate.

Cambridge University Press

978-1-107-01124-3 - Land Use and the Carbon Cycle: Advances in Integrated Science, Management, and Policy

Edited by Daniel G. Brown, Derek T. Robinson, Nancy H. F. French, and Bradley C. Reed

Frontmatter

[More information](#)

Contents

<i>Chapter Authors and Affiliations</i>	page ix
<i>Acknowledgments</i>	xix
<i>Acronyms</i>	xxi
I Introduction	
1. Linking Land Use and the Carbon Cycle	3
DEREK T. ROBINSON, DANIEL G. BROWN, NANCY H. F. FRENCH, AND BRADLEY C. REED	
2. An Introduction to Carbon Cycle Science	24
GALINA CHURKINA	
3. The Contribution of Land Use and Land-Use Change to the Carbon Cycle	52
R. A. HOUGHTON	
4. An Economic Analysis of the Effect of Land Use on Terrestrial Carbon Storage	77
ROBERT MENDELSON	
II Measurement and Modeling	
5. Remote Sensing for Mapping and Modeling of Land-Based Carbon Flux and Storage	95
NANCY H. F. FRENCH, LAURA. L. BOURGEOU-CHAVEZ, MICHAEL J. FALKOWSKI, SCOTT J. GOETZ, LIZA K. JENKINS, PHILIP CAMILL III, COLLIN S. ROESLER, AND DANIEL G. BROWN	
6. Atmospheric Observations and Inverse Modeling Approaches for Identifying Geographical Sources and Sinks of Carbon	144
ANNA M. MICHALAK	

Cambridge University Press

978-1-107-01124-3 - Land Use and the Carbon Cycle: Advances in Integrated Science, Management, and Policy

Edited by Daniel G. Brown, Derek T. Robinson, Nancy H. F. French, and Bradley C. Reed

Frontmatter

[More information](#)

vi	<i>Contents</i>	
7.	Limitations, Challenges, and Solutions to Integrating Carbon Dynamics with Land-Use Models	178
	TOM P. EVANS, DEREK T. ROBINSON, AND MIKAELA SCHMITT-HARSH	
8.	Modeling for Integrating Science and Management	209
	VIRGINIA H. DALE AND KEITH L. KLINE	
III	Integrated Science and Research Applications	
9.	Carbon Emissions from Land-Use Change: Model Estimates Using Three Different Data Sets	241
	ATUL K. JAIN, PRASANTH MEIYAPPAN, AND TOSHA RICHARDSON	
10.	A System to Integrate Multiscaled Data Sources for Improving Terrestrial Carbon Balance Estimates	259
	JORDAN GOLINKOFF AND STEVEN W. RUNNING	
11.	Simulating Biogeochemical Impacts of Historical Land-Use Changes in the U.S. Great Plains from 1870 to 2003	287
	WILLIAM J. PARTON, MYRON P. GUTMANN, MELANNIE D. HARTMAN, EMILY R. MERCHANT, SUSAN M. LUTZ, AND STEPHEN J. DEL GROSSO	
12.	Carbon Signatures of Development Patterns along a Gradient of Urbanization	305
	MARINA ALBERTI AND LUCY R. HUTYRA	
IV	Land Policy, Management, and the Carbon Cycle	
13.	Managing Carbon: Ecological Limits and Constraints	331
	R. CÉSAR IZAURRALDE, WILFRED M. POST, AND TRISTRAM O. WEST	
14.	Effects of Wildland Fire Management on Forest Carbon Stores	359
	MATTHEW D. HURTEAU	
15.	Soil Carbon Dynamics in Agricultural Systems	381
	CYNTHIA A. CAMBARDELLA AND JERRY L. HATFIELD	
16.	U.S. Policies and Greenhouse Gas Mitigation in Agriculture	403
	CAROL ADAIRE JONES, CYNTHIA J. NICKERSON, AND NANCY CAVALLARO	
17.	Opportunities and Challenges for Offsetting Greenhouse Gas Emissions with Forests	431
	TIMOTHY PEARSON AND SANDRA BROWN	

Cambridge University Press

978-1-107-01124-3 - Land Use and the Carbon Cycle: Advances in Integrated Science, Management, and Policy

Edited by Daniel G. Brown, Derek T. Robinson, Nancy H. F. French, and Bradley C. Reed

Frontmatter

[More information](#)

	<i>Contents</i>	vii
18. Opportunities and Challenges for Carbon Management on U.S. Public Lands		455
LISA DILLING, RICHARD BIRDSEY, AND YUDE PAN		
19. Design and Planning of Residential Landscapes to Manage the Carbon Cycle: Invention and Variation in Land Use and Land Cover		477
LAUREN LESCH MARSHALL AND JOAN IVERSON NASSAUER		
V Synthesis and Future Directions		
20. Forests, Carbon, and the Global Environment: New Directions in Research		505
DAVID L. SKOLE, JAY H. SAMEK, WALTER CHOMENTOWSKI, AND MICHAEL SMALLIGAN		
21. Ecosystem Sustainability through Strategies of Integrated Carbon and Land-Use Management		523
DENNIS OJIMA, JOSEP G. CANADELL, RICHARD CONANT, CHRISTINE NEGRA, AND PETRA TSCHAKERT		
22. Perspectives on Land-Change Science and Carbon Management		539
DANIEL G. BROWN, DEREK T. ROBINSON, AND NANCY H. F. FRENCH		
<i>Index</i>		549
<i>Color plates can be found after page 358.</i>		

Cambridge University Press

978-1-107-01124-3 - Land Use and the Carbon Cycle: Advances in Integrated Science, Management, and Policy

Edited by Daniel G. Brown, Derek T. Robinson, Nancy H. F. French, and Bradley C. Reed

Frontmatter

[More information](#)

Cambridge University Press

978-1-107-01124-3 - Land Use and the Carbon Cycle: Advances in Integrated Science, Management, and Policy

Edited by Daniel G. Brown, Derek T. Robinson, Nancy H. F. French, and Bradley C. Reed

Frontmatter

[More information](#)

Chapter Authors and Affiliations

Marina Alberti
Department of Urban Design and Planning
University of Washington
427 Gould Hall, Box 355740
Seattle, WA 98195-5740
Email: malberti@u.washington.edu

Richard Birdsey
U.S. Department of Agriculture Forest Service
Northeastern Forest Experiment
11 Campus Boulevard, Suite 200
Newtown Square, PA 19073
Email: rbirdsey@fs.fed.us

Laura L. Bourgeau-Chavez
Michigan Tech Research Institute
Michigan Technological University
3600 Green Court, Suite 100
Ann Arbor, MI 48105
Email: lchavez@mtu.edu

Daniel G. Brown
School of Natural Resources and Environment
University of Michigan
440 Church Street
Ann Arbor, MI 48109
Email: danbrown@umich.edu

Cambridge University Press

978-1-107-01124-3 - Land Use and the Carbon Cycle: Advances in Integrated Science, Management, and Policy

Edited by Daniel G. Brown, Derek T. Robinson, Nancy H. F. French, and Bradley C. Reed

Frontmatter

[More information](#)

x

Chapter Authors and Affiliations

Sandra Brown

Ecosystem Services Unit

Winrock International

2121 Crystal Drive, Suite 500

Arlington, VA 22202

Email: sbrown@winrock.org

Cynthia A. Cambardella

National Laboratory for Agriculture and the Environment

2110 University Boulevard

Ames, IA 50011-3120

Email: cindy.cambardella@ars.usda.gov

Philip Camill III

Department of Earth and Oceanographic Science

Bowdoin College

Brunswick, ME 04011

Email: pcamill@bowdoin.edu

Josep G. Canadell

Global Carbon Project

CSIRO Marine and Atmospheric Research

Canberra, Australian Capital Territory 2601, Australia

Email: pep.canadell@csiro.au

Nancy Cavallaro

U.S. Department of Agriculture

National Institute of Food and Agriculture (NIFA)

1400 Independence Avenue SW, Mail Stop 2210

Washington, DC 20250-2210

Email: ncavallaro@nifa.usda.gov or nancy.cavallaro@usda.gov

Walter Chomentowski

Global Observatory for Ecosystem Services

Department of Forestry

Michigan State University

101 Manly Miles Building

East Lansing, MI 48824

Email: chomento@msu.edu

Galina Churkina

Leibniz-Centre for Agricultural Landscape Research

Eberswalder Strasse 84

D-15374 Muencheberg, Germany

Email: churkina@zalf.de

Cambridge University Press

978-1-107-01124-3 - Land Use and the Carbon Cycle: Advances in Integrated Science, Management, and Policy

Edited by Daniel G. Brown, Derek T. Robinson, Nancy H. F. French, and Bradley C. Reed

Frontmatter

[More information](#)

Chapter Authors and Affiliations

xi

Richard Conant

Natural Resource Ecology Laboratory

Colorado State University

Campus Delivery 1499

Fort Collins, CO 80523-1499

Email: conant@nrel.colostate.edu

Virginia H. Dale

Landscape Ecology and Regional Analysis Group

Environmental Sciences Division

Oak Ridge National Laboratory

Oak Ridge, TN 37831-6036

Email: dalevh@ornl.gov

Stephen J. Del Grosso

Natural Resource Ecology Laboratory

Colorado State University

Fort Collins, CO 80523-1499

Email: delgro@nrel.colostate.edu

Lisa Dilling

Center for Science and Technology Policy Research

1333 Grandview Avenue, Campus Box 488

Boulder, CO 80309-0488

Email: ldilling@cires.colorado.edu

Tom P. Evans

Department of Geography

Indiana University

Student Building 120

Bloomington, IN 47405

Email: evans@indiana.edu

Michael J. Falkowski

School of Forest Resources and Environmental Science

Michigan Technological University

1400 Townsend Drive

Houghton, MI 49931

Email: mjfalkow@mtu.edu

Nancy H. F. French

Michigan Tech Research Institute

Michigan Technological University

3600 Green Court, Suite 100

Ann Arbor, MI 48105

Email: nhfrench@mtu.edu

Cambridge University Press

978-1-107-01124-3 - Land Use and the Carbon Cycle: Advances in Integrated Science, Management, and Policy

Edited by Daniel G. Brown, Derek T. Robinson, Nancy H. F. French, and Bradley C. Reed

Frontmatter

[More information](#)

xii

Chapter Authors and Affiliations

Scott J. Goetz

Woods Hole Research Center

149 Woods Hole Road

Falmouth, MA 02540-1644

Email: sgoetz@whrc.org

Jordan Golinkoff

Numerical Terradynamic Simulation Group (NTSG)

College of Forestry and Conservation

University of Montana

Missoula, MT 59812

Email: jgolinkoff@gmail.com

Myron P. Gutmann

Department of History

University of Michigan

1120A Perry Building

Ann Arbor, MI 48109

Email: gutmann@umich.edu

Melannie D. Hartman

Natural Resource Ecology Laboratory

NESB, A210

Colorado State University

Fort Collins, CO 80523-1499

Email: melannie@nrel.colostate.edu

Jerry L. Hatfield

National Laboratory for Agriculture and the Environment

2110 University Boulevard

Ames, IA 50011-3120

Email: jerry.hatfield@ars.usda

R. A. Houghton

Woods Hole Research Center

149 Woods Hole Road

Falmouth, MA 02540-1644

Email: rhoughton@whrc.org

Matthew D. Hurteau

School of Forest Resources

Pennsylvania State University

306 Forest Resources Building

University Park, PA 16802

Email: mdh30@psu.edu

Cambridge University Press

978-1-107-01124-3 - Land Use and the Carbon Cycle: Advances in Integrated Science, Management, and Policy

Edited by Daniel G. Brown, Derek T. Robinson, Nancy H. F. French, and Bradley C. Reed

Frontmatter

[More information](#)

Chapter Authors and Affiliations

xiii

Lucy R. Hutyra
Department of Geography and Environment
Boston University
675 Commonwealth Avenue
Boston, MA 02215
Email: lrhutyra@bu.edu

R. César Izaurralde
Joint Global Change Research Institute
PNNL and University of Maryland
8400 Baltimore Avenue, Suite 201
College Park, MD 20740
Email: cesar.izaurralde@pnl.gov

Atul K. Jain
Department of Atmospheric Sciences
University of Illinois
105 South Gregory Street
Urbana, IL 61801
Email: jain1@illinois.edu

Liza K. Jenkins
Michigan Tech Research Institute
Michigan Technological University
3600 Green Court, Suite 100
Ann Arbor, MI 48105
Email: liza.jenkins@mtu.edu

Carol Adaire Jones
Economic Research Service
U.S. Department of Agriculture
1400 Independence Avenue SW, Mail Stop 1800
Washington, DC 20250-2210
Email: cjones@ers.usda.gov

Keith L. Kline
Environmental Sciences Division
Oak Ridge National Laboratory
Oak Ridge, TN 37831-6038
Email: klinekl@ornl.gov

Cambridge University Press

978-1-107-01124-3 - Land Use and the Carbon Cycle: Advances in Integrated Science, Management, and Policy

Edited by Daniel G. Brown, Derek T. Robinson, Nancy H. F. French, and Bradley C. Reed

Frontmatter

[More information](#)

xiv

Chapter Authors and Affiliations

Lauren Lesch Marshall
School of Natural Resources and Environment
University of Michigan
440 Church Street
Ann Arbor, MI 48109-1041
Email: lelesch@umich.edu

Susan M. Lutz
Natural Resource Ecology Laboratory
Colorado State University
Fort Collins, CO 80523
Email: susy@nrel.colostate.edu

Prasanth Meiyappan
Department of Atmospheric Sciences
University of Illinois
105 South Gregory Street
Urbana, IL 61801
Email: meiyapp2@illinois.edu

Robert Mendelsohn
School of Forestry and Environmental Studies
Yale University
195 Prospect Street
New Haven, CT 06511
Email: robert.mendelsohn@yale.edu

Emily R. Merchant
Institute for Social Research
University of Michigan
426 Thomson Street
Ann Arbor, MI 48106-1248
Email: eklanche@umich.edu

Anna M. Michalak
Department of Global Ecology
Carnegie Institution for Science
260 Panama Street
Stanford, CA 94305
Email: michalak@stanford.edu

Cambridge University Press

978-1-107-01124-3 - Land Use and the Carbon Cycle: Advances in Integrated Science, Management, and Policy

Edited by Daniel G. Brown, Derek T. Robinson, Nancy H. F. French, and Bradley C. Reed

Frontmatter

[More information](#)

Chapter Authors and Affiliations

xv

Joan Iverson Nassauer
School of Natural Resources and Environment
University of Michigan
440 Church Street
Ann Arbor, MI 48109
Email: nassauer@umich.edu

Christine Negra
H. John Heinz III Center
900 17th Street NW, Suite 700
Washington, DC 20006
Email: negra@heinzctr.org

Cynthia J. Nickerson
Economic Research Service
U.S. Department of Agriculture
1400 Independence Avenue SW, Mail Stop 1800
Washington, DC 20250-2210
Email: cnickerson@ers.usda.gov

Dennis Ojima
Natural Resource Ecology Laboratory
Colorado State University
Fort Collins, CO 80523
Email: dennis@nrel.colostate.edu

Yude Pan
U.S. Department of Agriculture Forest Service
Northeastern Forest Experiment
11 Campus Boulevard, Suite 200
Newtown Square, PA 19073
Email: ypan@fs.fed.us

William J. Parton
Natural Resource Ecology Laboratory
Colorado State University
Fort Collins, CO 80523
Email: billp@nrel.colostate.edu

Timothy Pearson
Winrock International
2121 Crystal Drive, Suite 500
Arlington, VA 22202
Email: tpearson@winrock.org

Cambridge University Press

978-1-107-01124-3 - Land Use and the Carbon Cycle: Advances in Integrated Science, Management, and Policy

Edited by Daniel G. Brown, Derek T. Robinson, Nancy H. F. French, and Bradley C. Reed

Frontmatter

[More information](#)

xvi

Chapter Authors and Affiliations

Wilfred M. (Mac) Post
Environmental Sciences Division
Oak Ridge National Laboratory
Building 1000, Mail Stop 6335
Oak Ridge, TN 37831
Email: wmp@ornl.gov

Bradley C. Reed
Geographic Analysis and Monitoring Program
U.S. Geological Survey (USGS)
12201 Sunrise Valley Drive
Reston, VA 20192
Email: reed@usgs.gov

Tosha Richardson
Department of Atmospheric Sciences
University of Illinois
105 South Gregory Street
Urbana, IL 61801
Email: tkrichar5@illinois.edu

Derek T. Robinson
Department of Geography and Environmental Management
University of Waterloo
200 University Avenue West
Waterloo, ON N2L 3G1
Email: dtrobins@uwaterloo.ca

Collin S. Roesler
Department of Earth and Oceanographic Science
Bowdoin College
Brunswick, ME 04011
Email: croesler@bowdoin.edu

Steven W. Running
Numerical Terradynamic Simulation Group (NTSG)
College of Forestry and Conservation
University of Montana
Missoula, MT 59812
Email: swr@ntsg.umt.edu

Cambridge University Press

978-1-107-01124-3 - Land Use and the Carbon Cycle: Advances in Integrated Science, Management, and Policy

Edited by Daniel G. Brown, Derek T. Robinson, Nancy H. F. French, and Bradley C. Reed

Frontmatter

[More information](#)

Chapter Authors and Affiliations

xvii

Jay H. Samek
Global Observatory for Ecosystem Services
Department of Forestry
101 Manly Miles Building
Michigan State University
East Lansing, MI 48824
Email: samekjay@msu.edu

Mikaela Schmitt-Harsh
School of Public and Environmental Affairs
Indiana University
CIPEC, 408 North Indiana Avenue
Bloomington, IN 47408
Email: schmittm@indiana.edu

David L. Skole
Global Observatory for Ecosystem Services
Department of Forestry
Michigan State University
101 Manly Miles Building
East Lansing, MI 48824
Email: skole@msu.edu

Michael Smalligan
Global Observatory for Ecosystem Services
Department of Forestry
Michigan State University
101 Manly Miles Building
East Lansing, MI 48824
Email: smallig2@msu.edu

Petra Tschakert
Department of Geography
Pennsylvania State University
315 Walker Building
University Park, PA 16802
Email: petra@psu.edu

Tristram O. West
Joint Global Change Research Institute
PNNL and University of Maryland
8400 Baltimore Avenue, Suite 201
College Park, MD 20740
Email: tristram.west@pnl.gov

Cambridge University Press

978-1-107-01124-3 - Land Use and the Carbon Cycle: Advances in Integrated Science, Management, and Policy

Edited by Daniel G. Brown, Derek T. Robinson, Nancy H. F. French, and Bradley C. Reed

Frontmatter

[More information](#)

Cambridge University Press

978-1-107-01124-3 - Land Use and the Carbon Cycle: Advances in Integrated Science, Management, and Policy

Edited by Daniel G. Brown, Derek T. Robinson, Nancy H. F. French, and Bradley C. Reed

Frontmatter

[More information](#)

Acknowledgments

The editors wish to gratefully acknowledge the financial and material support of the U.S. Geological Survey in the preparation of this volume. The idea for the book grew from a June 2009 workshop held in Ann Arbor, MI that received their support, and the agency provided a contract to support the work of the editors on producing the book.

We would like to thank all of our chapter reviewers, who provided critical and insightful comments on the material contained within this volume:

Dr. Lilibeth Acosta-Michlik, Dr. Ken Andrasko, Dr. Chris Boone, Dr. Robert Cook, Dr. William S. Currie, Dr. Scott Goetz, Dr. Sam Goward, Dr. Lianhong Gu, Dr. Todd Hawbaker, Dr. Scott Heckbert, Dr. Geoffrey Henebry, Dr. Michael Hill, Dr. David Hulse, Sarah Kiger, Dr. Catherine Kling, Dr. Jeffrey Masek, Dr. Dave McGuire, Dr. Melissa McHale, Dr. Donald McKenzie, Dr. Kendra McLaughlan, Dr. Eleanor Milne, Dr. David Mladenoff, Dr. Michael Moore, Dr. Fraser Morgan, Dr. Laura Mussachio, Dr. Sara Ohrel, Dr. Brian O'Neill, Dr. R. Chris Owen, Dr. Genevieve Patenaude, Dr. Gil Pontius, Dr. Richard Pouyat, Dr. Navin Ramankutty, Dr. David Reay, Dr. Alistair Smith, Dr. Terry L. Sohl, Dr. Jane Southworth, Dr. Susan Stewart, Dr. Graham Stinson, Dr. Jason Taylor, Dr. Larry Tieszen, Dr. Billie Lee Turner, Dr. Yaxing Wei, Dr. Tristram West, and Dr. Bruce Wylie.

Cambridge University Press

978-1-107-01124-3 - Land Use and the Carbon Cycle: Advances in Integrated Science, Management, and Policy

Edited by Daniel G. Brown, Derek T. Robinson, Nancy H. F. French, and Bradley C. Reed

Frontmatter

[More information](#)

Cambridge University Press

978-1-107-01124-3 - Land Use and the Carbon Cycle: Advances in Integrated Science, Management, and Policy

Edited by Daniel G. Brown, Derek T. Robinson, Nancy H. F. French, and Bradley C. Reed

Frontmatter

[More information](#)

Acronyms

A/R:	afforestation and reforestation
A/R/AF:	afforestation, reforestation, and agroforestry
A/R Working Group:	Afforestation/Reforestation Working Group
ACR:	American Carbon Registry
AFOLU:	agriculture, forestry, and other land-use activities
AFTA:	Association for Temperate Agroforestry
AIRS:	Atmospheric Infrared Sounder, aboard the NASA Aqua Satellite
ANPP:	annual net primary productivity
APA:	American Power Act
ASCENDS:	Active Sensing of CO ₂ Emissions over Nights, Days, and Seasons satellite
BAU:	business as usual
BLM:	Bureau of Land Management
BMP:	best management practice
BNF:	biological nitrogen fixation
C:N:	carbon to nitrogen ratios, DayCent model variable
CAR:	Climate Action Reserve offset registry (California)
CarboNA:	Joint Canada-Mexico-USA Carbon Program
CASA:	Carnegie-Ames-Stanford Approach Model
CCBA:	Climate, Community, and Biodiversity Alliance
CCX:	Chicago Climate Exchange
CDIAC:	Carbon Dioxide Information Analysis Center
CDM:	Clean Development Mechanism
CDM EB:	Clean Development Mechanism Executive Board
CEQ:	Council on Environmental Quality
ChEAS:	Chequamegon Ecosystem-Atmosphere Study
CNH:	Dynamics of Coupled Natural and Human Systems
COBRA:	CO ₂ Budget and Regional Airborne Study
COP 15/MOP 5:	Convention of Parties 15 / Meeting of Parties 5 (United Nations Framework Convention on Climate Change, Copenhagen, 2009)

Cambridge University Press

978-1-107-01124-3 - Land Use and the Carbon Cycle: Advances in Integrated Science, Management, and Policy

Edited by Daniel G. Brown, Derek T. Robinson, Nancy H. F. French, and Bradley C. Reed

Frontmatter

[More information](#)

xxii

Acronyms

CRP:	Conservation Reserve Program
CRU TS:	Climate Research Unit Time-Series
CStP:	Conservation Stewardship Program
CT:	conventional tillage
CTCC:	Tree Carbon Calculator (from the Center for Urban Forest Research)
CWD:	coarse woody debris
DA:	data assimilation
dbh:	diameter at breast height
DDGS:	distillers dried grains with solubles
Death:	death rate of plant components, DayCent model variable
Decomp:	decomposition factor, DayCent model variable
Den:	denitrification, DayCent model variable
DGS:	wet distillers grains with solubles
DOC:	dissolved organic carbon
DoD:	Department of Defense
DSN:	distributed sensor network
DSS:	decision-support systems
ECV:	essential climate variable
EIA:	Energy Information Administration
EIS:	Environmental Impact Statement
EISA:	Energy Independence and Security Act
EM:	Ecological Modeling
EPACT:	Energy Policy Act
EPL:	ethical poverty level
EQIP:	Environmental Quality Incentives Program
ESA:	Endangered Species Act
ESA:	European Space Agency
ESRL:	Earth System Research Laboratory
ESSP:	Earth System Science Partnership
ET:	evapotranspiration, DayCent model variable
EU:	European Union
FAIR:	Federal Agriculture Improvement and Reform Act (Farm Act of 1997)
FAO:	Food and Agricultural Organization (United Nations)
FAPAR:	fraction of absorbed photosynthetically active radiation
FAPRI:	Food and Agricultural Policy Research Institute
FCPF:	Forest Carbon Partnership Facility (World Bank)
FIA:	Forest Inventory and Analysis Database
FLPMA:	Federal Land Policy and Management Act
FP:	Framework Programme
FPAR:	fraction of absorbed photosynthetically active radiation
FPS:	Forest Projection and Planning Systems
FRA:	Forest Resources Assessment

Cambridge University Press

978-1-107-01124-3 - Land Use and the Carbon Cycle: Advances in Integrated Science, Management, and Policy

Edited by Daniel G. Brown, Derek T. Robinson, Nancy H. F. French, and Bradley C. Reed

Frontmatter

[More information](#)*Acronyms*

xxiii

FSA:	Farm Service Agency, USDA
FWS:	Fish and Wildlife Service
GCB:	Global Change Biology
GCTE:	Global Change and Terrestrial Ecosystems
GDP:	gross domestic product
GEO:	Global Earth Observation
GEOBIA:	geographic object-based image analysis
GHG:	greenhouse gas
GIS:	geographic information system
GLP:	Global Land Project
GMES:	Global Monitoring for Environment and Security
GOSAT:	JAXA/NIES Greenhouse Gas Observing Satellite, also known as Ibuki
GPG-LULUCF:	Good Practice Guidance for Land Use, Land-Use Change, and Forestry
GPGPU:	general-purpose graphics processing units
GPP:	gross primary production
GRP:	Grassland Reserve Program
Gt C:	Gigatons (10 billion tons) carbon
GYM:	growth and yield model
H ₂ O soil:	soil moisture, DayCent model variable
HELIA:	Human-Environment Land-Integrated Assessment Model
HFT:	human functional type
HH:	Houghton and Hackler data set
HIPPO:	HIAPER Pole-to-Pole Observations
HPC:	high-performance computing
HYDE:	History Database of the Global Environment data set
IASI:	Infrared Atmospheric Sounding Interferometer, launched as part of the European Space Agency MetOp series of satellites
IGBP:	International Geosphere-Biosphere Programme
IHDP:	International Human Dimensions Programme on Global Environmental Change
IMAGE:	Integrated Model to Assess the Global Environment
IPCC:	Intergovernmental Panel on Climate Change
IPCC AR4:	Fourth Assessment Report of the Intergovernmental Panel on Climate Change
ISAM-NC:	Integrated Science Assessment Model's Carbon-Nitrogen Cycle Model
ITTO:	International Tropical Timber Organization
JI:	Joint Implementation
JLUS:	<i>Journal of Land Use Science</i>
LAI:	leaf-area index
LBA:	Large-scale Biosphere-Atmosphere Experiment, Amazonia
LCA:	life cycle assessment

Cambridge University Press

978-1-107-01124-3 - Land Use and the Carbon Cycle: Advances in Integrated Science, Management, and Policy

Edited by Daniel G. Brown, Derek T. Robinson, Nancy H. F. French, and Bradley C. Reed

Frontmatter

[More information](#)

xxiv

Acronyms

LiDAR:	Light Detection and Ranging
LPJ:	Lund-Potsdam-Jena vegetation model
LTM:	land transformation model
LUCC:	land-use and land-cover change
LUE:	light use efficiency
LULUCF:	land use, land-use change, and forestry
LUMP:	land-use modeling primitive
M&E:	monitoring and evaluation
MDB:	multilateral development bank
MDF:	model-data fusion
MODIS:	Moderate Resolution Imaging Spectroradiometer satellite data
MRV:	monitoring, reporting, and verification system
N Min:	soil N mineralization, DayCent model variable
NACP:	North American Carbon Program
NASA:	National Aeronautics and Space Administration
NECB:	net ecosystem carbon balance
NEE:	net ecosystem exchange
NEP:	net ecosystem production
NEPA:	National Environmental Policy Act
NFMA:	National Forest Management Act
NGO:	nongovernmental organization
Nit:	nitrification, DayCent model variable
NOAA:	National Oceanic and Atmospheric Administration
NOAA/ESRL/GMD CCGG:	National Oceanic and Atmospheric Administration, Earth System Research Laboratory, Global Monitoring Division, Carbon Cycle Greenhouse Gases Group
NPP:	net primary production
NPS:	National Park Service
NSF:	National Science Foundation
NT:	no-till method
OCO:	NASA Orbiting Carbon Observatory satellite
OCO-2:	NASA Orbiting Carbon Observatory Two satellite, an OCO replacement
OECD:	Organisation for Economic Co-operation and Development
PBL:	planetary boundary layer
PES:	payments for ecosystem services
POLYSYS:	Policy Analysis System
PPT:	precipitation, DayCent model variable
Pt C:	Petagrams (10 billion tons) carbon
R:	respiration
R-PP:	Readiness-Preparation Proposal
RA:	autotrophic respiration
RADAR:	Radio Detection and Ranging
REDD:	Reduced emissions from deforestation and forest degradation

Acronyms

xxv

REDD+:	Reduced emissions from deforestation and degradation with considerations of communities, livelihoods, and social science issues
RFS:	Renewable Fuel Standard, from EPACT
RFS2:	Renewable Fuel Standard Two, from EISA
RGGI:	Regional Greenhouse Gas Initiative
RH:	ecosystem respiration
RH:	heterotrophic respiration
Rh0:	heterotrophic respiration, DayCent model variable
RL:	reference level (forest reference emission level)
RS:	remote sensing
SAGE:	Sustainability and the Global Environment dataset
SBSTA:	Subsidiary Body for Scientific and Technological Advice (UNFCCC)
SCIAMACHY:	Scanning Imaging Absorption Spectrometer for Atmospheric Chartography, aboard the European Space Agency Envisat satellite
SiB:	Simple Biosphere Model
SIC:	soil inorganic carbon
SOC:	soil organic carbon
SOCCR:	<i>State of the Carbon Cycle Report</i>
SOM:	soil organic matter
SRWC:	short-rotation woody crop
STATSGO:	State Soil Geographic Database
STILT:	Stochastic Time-Inverted Lagrangian Transport Model
Stom:	stomatal conductance, DayCent model variable
TCCON:	Total Carbon Column Observing Network
TECM:	terrestrial ecosystem carbon model
TEM:	terrestrial ecosystem model
TES:	Tropospheric Emission Spectrometer, aboard the NASA Aura satellite
Tg C:	Teragrams (1 million tons) carbon
TOVS:	TIROS Operation Vertical Sounder
Tsoil:	soil temperature
UNFCCC:	United Nations Framework Convention on Climate Change
UNFCCC GPG-LULUCF:	United Nations Framework Convention on Climate Change Good Practice Guidance for Land Use, Land-Use Change, and Forestry
UNREDD:	United Nations Collaborative Programme on Reducing Emissions from Deforestation and Forest Degradation in Developing Countries
USAIJ:	U.S. Activities Implemented Jointly, from the Nature Conservancy
USCCSP:	U.S. Carbon Cycle Science Program

Cambridge University Press

978-1-107-01124-3 - Land Use and the Carbon Cycle: Advances in Integrated Science, Management, and Policy

Edited by Daniel G. Brown, Derek T. Robinson, Nancy H. F. French, and Bradley C. Reed

Frontmatter

[More information](#)

xxvi

Acronyms

USD:	U.S. dollars
USDA:	U.S. Department of Agriculture
USFS:	U.S. Forest Service
USGCRP:	U.S. Global Change Research Program
VCO:	Voluntary Carbon Offsets
VCS:	Verified Carbon Standard
VEMAP:	Vegetation/Ecosystem Modeling and Analysis Project
VMT:	vehicle miles traveled
WDC:	World Data Center for Paleoclimatology
WRF:	Weather Research and Forecasting Model
WRP:	Wetlands Reserve Program