

CHAPTER 8
LAND USE / LAND COVER CHANGE

from the

**Strategic Plan
for the
Climate Change Science Program**

By the agencies and staff of the
US Climate Change Science Program

Review draft dated 11 November 2002

Contents

- Letter from James R. Mahoney, Ph.D., Assistant Secretary of Commerce for Oceans and Atmosphere, and Director, U.S. Climate Change Science Program
- Instructions For Submission of Strategic Plan Review Comments
- Excerpts from the Strategic Plan:
 - Foreword
 - Table of Contents
 - Text of Chapter or Section
 - Authors & Contributors

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11 November 2002

Dear Colleague,

The Climate Change Science Program will hold the U.S. Climate Change Science Program Planning Workshop for Scientists and Stakeholders at the Marriott Wardman Park Hotel in Washington, D.C., from 3-5 December 2002. The purpose of the Workshop is to provide a comprehensive review of the discussion draft of the Strategic Plan for U.S. climate change and global change research. This Workshop will offer extensive opportunities for the scientific and stakeholder communities to provide comment and input to the Climate Change Science Program Strategic Plan. When finalized by April 2003, the Strategic Plan will provide the principal guidance for U.S. climate change and global change research during the next several years, subject to revisions as appropriate to respond to newly developed information and decision support tools.

We are writing to request your comments on the discussion draft of the Climate Change Science Program Strategic Plan. Comments on all elements of the plan from all communities are essential in order to improve the plan and identify gaps. In your review, we ask you to provide a perspective on the content, implications, and challenges outlined in the plan as well as suggestions for any alternate approaches you wish to have considered, and the types of climate and global change information required by policy makers and resource managers. We also ask that you comment on any inconsistencies within or across chapters, and omissions of important topics. For any shortcomings that you note in the draft, please propose specific remedies. To participate in the review it is not necessary that you review the entire plan.

We ask that comments be submitted by E-mail to <comments@climatescience.gov>. All comments submitted by 13 January 2003 will be posted on the <<http://www.climatescience.gov>> website for public review. While we are unable to promised detailed responses to individual comments, we confirm that all submitted comments will be given consideration during the development of the final version of the Strategic Plan.

Attached to this letter are instructions and format guidelines for submitting review comments. Following the instructions will ensure that your comments are properly processed and given appropriate consideration. If you wish to distribute copies of the plan to colleagues to participate in the review, please provide them with a copy of this letter as well as the attached instructions and format guidelines. We have posted the plan on the workshop website at <<http://www.climatescience.gov>>. PDF files for individual chapters of the plan can be downloaded from this site. If you have any questions, please contact: Sandy MacCracken at 1-202-419-3483 (voice), 1-202-223-3065 (fax), or via the address in the footer below.

We appreciate your contribution of time and expertise to this review, and look forward to your response.

Sincerely,

James R. Mahoney, Ph.D.
Assistant Secretary of Commerce for Oceans and Atmosphere, and
Director, U.S. Climate Change Science Program

Instructions For Submission of Strategic Plan Review Comments

Thank you for participating in the review process. Please follow the instructions for preparing and submitting your review. Using the format guidance described below will facilitate our processing of reviewer comments and assure that your comments are given appropriate consideration. An example of the format is also provided. Comments are due by **13 January, 2003**.

- Select the chapter(s) or sections of chapters which you wish to review. It is not necessary that you review the entire plan. In your comments, please consider the following issues:
 - **Overview:** overview on the content, implications, and challenges outlined in the plan;
 - **Agreement/Disagreement:** areas of agreement and disagreement, as appropriate;
 - **Suggestions:** suggestions for alternative approaches, if appropriate;
 - **Inconsistencies:** inconsistencies within or across chapters;
 - **Omissions:** omissions of important topics;
 - **Remedies:** specific remedies for identified shortcomings of the draft plan;
 - **Stakeholder climate information:** type of climate and global change information required by representative groups;
 - **Other:** other comments not covered above.
- Please do not comment on grammar, spelling, or punctuation. Professional copy editing will correct deficiencies in these areas for the final draft.
- Use the format guidance that follows for organizing your comments.
- Submit your comments by email to <comments@climatescience.gov> by 13 January, 2003.

Format Guidance for Comments

Please provide background information about yourself on the first page of your comments: your name(s), organization(s), area of expertise(s), mailing address(es), telephone and fax numbers, and email address(es).

- Overview comments on the chapter should follow your background information and should be numbered.
- Comments that are specific to particular pages, paragraphs or lines of the chapter should follow your overview comments and should identify the page and line numbers to which they apply.
- Comments that refer to a table or figure should identify the table or figure number. In the case of tables, please also identify the row and column to which the comment refers.
- Order your comments sequentially by page and line number.
- At the end of each comment, please insert your name and affiliation.

Format Example for Comments

I. Background Information

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II. Overview Comments on Chapter 5: Atmospheric Composition

First Overview Comment: (Comment)

Reviewer's name, affiliation: John Doe, University College

Second Overview Comment: (Comment)

Reviewer's name, affiliation: John Doe, University College

III. Specific Comments on Chapter 5: Atmospheric Composition

Page 57, Line 5: (Comment)

John Doe, University College

Page 58, Line 32 - Page 59, Line 5: (Comment)

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Table 1-4, Row 3, Column 6: (Comment)

John Doe, University College

Please send comments by email to <comments@climatescience.gov>

Foreword

In February 2002 President George W. Bush announced the formation of a new management structure, the Climate Change Science Program (CCSP), to coordinate and direct the US research efforts in the areas of climate and global change. These research efforts include the US Global Change Research Program (USGCRP) authorized by the Global Change Research Act of 1990, and the Climate Change Research Initiative (CCRI) launched by the President in June 2001 to reduce significant uncertainties in climate science, improve global climate observing systems, and develop resources to support policymaking and resource management.

The President's Climate Change Research Initiative was launched to provide a distinct focus to the 13-year old Global Change Research Program. The CCRI focus is defined by a group of uncertainties about the global climate system that have been identified by policymakers and analyzed by the National Research Council in a 2001 report requested by the Administration.

The Climate Change Science Program aims to balance the near-term (2- to 4-year) focus of the CCRI with the breadth of the USGCRP, pursuing accelerated development of answers to the scientific aspects of key climate policy issues while continuing to seek advances in the knowledge of the physical, biological and chemical processes that influence the Earth system.

This *discussion draft* strategic plan has been prepared by the thirteen federal agencies participating in the CCSP, with input from a large number of scientific steering groups and coordination by the CCSP staff under the leadership of Dr. Richard H. Moss, to provide a vehicle to facilitate comments and suggestions by the scientific and stakeholder communities interested in climate and global change issues.

We welcome comments on this draft plan by all interested persons. Comments may be provided during the US Climate Change Science Program Planning Workshop for Scientists and Stakeholders being held in Washington, DC on December 3 – 5, 2002, and during a subsequent public comment period extending to January 13, 2003. Information about the Workshop and the written comment opportunities is available on the web site www.climatescience.gov. A specially formed committee of the National Research Council is also reviewing this draft plan, and will provide its analysis of the plan, the workshop and the written comments received after the workshop. A final version of the strategic plan, setting a path for the next few years of research under the CCSP, will be published by April 2003. We appreciate your assistance with this important process.

James R. Mahoney, Ph.D.
Assistant Secretary of Commerce for Oceans and Atmosphere, and
Director, Climate Change Science Program

Table of Contents of the Strategic Plan for the Climate Change Science Program

Chapter 1. Introduction

Part I. The CCRI

- Overview
- Chapter 2. Research Focused on Key Climate Change Uncertainties
- Chapter 3. Climate Quality Observations, Monitoring, and Data Management
- Chapter 4. Decision Support Resources

Part II. The USGCRP

- Overview
- Chapter 5. Atmospheric Composition
- Chapter 6. Climate Variability and Change
- Chapter 7. Water Cycle
- Chapter 8. Land Use/Land Cover Change
- Chapter 9. Carbon Cycle
- Chapter 10. Ecosystems
- Chapter 11. Human Contributions and Responses to Environmental Change
- Chapter 12. Grand Challenges in Modeling, Observations, and Information Systems

Part III. Communication, Cooperation, and Management

- Chapter 13. Reporting and Outreach
- Chapter 14. International Research and Cooperation
- Chapter 15. Program Management and Review

Acronyms

Authors and Contributors

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CHAPTER 8

LAND USE/LAND COVER CHANGE

This chapter's contents...

Question 1: What are the primary drivers of land use and land cover change?

Question 2: What tools or methods are needed to allow for better characterization of historic and current land use and land cover characteristics and dynamics?

Question 3: What advances are required to allow for the projection of land use and land cover patterns and characteristics 10-50 years into the future?

Question 4: How can projections be made of potential land cover and land use change over the next 10-50 years for use in models of impacts on the environment, social and economic systems, and human health?

Question 5: What are the combined effects of climate and land use and land cover change and what are the potential feedbacks?

Key Linkages

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Land use and land cover change is perhaps the most prominent form of global environmental change since it occurs at spatial and temporal scales immediately relevant to our daily existence. The changes in land use and land cover, especially when coupled with climate change and variability, are likely to affect natural resources and ecosystems in complex ways. The National Research Council recently identified Land Use Dynamics as one of the grand challenges for environmental research (NRC, 2001d).

Determining the effects of land use and land cover change depends on an understanding of past land use practices, current land use and cover patterns, and projections of future land use and cover, as affected by human institutions, population size and distribution, economic development, technology, and other characteristics. The combination of climate and land use change may have profound effects on the habitability of the planet in more significant ways than either acting alone. While land use change is often a driver of environmental and climatic changes, a changing climate can in turn affect land use and land cover. Climate variability alters land use practices differently in different parts of the world, highlighting differences in societal vulnerability and resilience. The feedback between land use and climate change is poorly

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1 understood and will require the development of new models linking the geophysics of climate
2 with the socioeconomic drivers of land use. Providing a scientific understanding of the process
3 of land use change, the impacts of different land use decisions, and how they will be
4 complicated by a changing climate and increasing climate variability is a priority area for
5 research.

6
7 This research element provides the scientific underpinning for land use decisionmaking and
8 projections of future land use, and has substantial benefits beyond climate change assessment
9 and mitigation by supporting a wide array of issues important to public users of this information.
10 To meet multiple objectives, the land use and land cover change research element will address
11 two overarching questions:

- 12 • **What processes determine the temporal and spatial distributions of land cover**
13 **and land use change at local, regional, and global scales, and how can land use**
14 **and land cover be projected over time scales of 10-50 years?**
- 15 • **How may the dynamics of land use, management, and cover change affect the**
16 **global environment and national environmental and socioeconomic conditions,**
17 **including economic welfare and human health?**

18
19 To address these overarching questions and to make the science useful for decisionmaking will
20 require a focused research agenda that includes ongoing mapping, measurement, and monitoring
21 of land use and land cover change from local to global scales; identification of the driving forces
22 or agents of change; the capabilities to model and project future changes in land use and land
23 cover; and assessment of the implications of land use change. In addition, research
24 collaboration with other program elements will be necessary to gain detailed understanding of
25 the direct impacts of land use and land cover change on climate, as well as the combined effects
26 of land use and climate change on ecosystems and water and carbon cycles. Answers to the
27 overarching questions will require research focused on the five specific questions posed below.
28

Question 1: What are the primary drivers of land use and land cover change?

STATE OF KNOWLEDGE

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30 The ability to forecast land use and land cover change and, ultimately, to predict the
31 consequences of change, will depend on our ability to document and understand the past drivers
32 of land use and land cover change. Historical land use and cover change has occurred primarily
33 in response to population growth, technological advances, economic opportunity, and public
34 policy. Patterns of human settlement are shaped by both the interaction of environmental (e.g.,
35 climate, geology, topography, and vegetation) and social (e.g., cultural customs and ethnicity)
36 forces around the world. An improved understanding of historical land use and land cover
37 patterns provides a means to evaluate variations in past causal factors and responses as well as
38 a method for evaluating the trends of human activities present in the current baseline. The
39 systematic evaluation of these historical and contemporary factors will improve the ability to
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1 develop projections of future land use and management decisions. This type of analysis will
2 require the integration of various disciplines from the physical and social sciences.

4 **ILLUSTRATIVE RESEARCH QUESTIONS**

- 5 • How does the historical development and spread of land uses reveal the various events
6 and trends that shaped its expansion at different points in the past?
- 7 • Why and how have land use and land management systems (e.g., agriculture) spread
8 historically?
- 9 • How have the driving forces of change affected the rates and patterns of historical and
10 contemporary change at different (i.e., local, regional, and global) scales?
- 11 • How, and to what extent, do extreme events (e.g., natural hazards, public health
12 emergencies, and war) affect land use and land cover change?
- 13 • How will environmental, institutional, political, technological, demographic, and
14 economic processes determine the temporal and spatial distribution of land use and land
15 cover over the next 50 years?

17 **RESEARCH NEEDS**

18 Improvements are needed in process models of land use and land cover change dynamics in
19 space and time, combining field-level case studies for analysis of processes, statistical studies for
20 large regions, and empirical analyses using remote sensing change detection. This process-level
21 understanding of land use and cover dynamics will aid the analysis of land use and land cover
22 change across scales. Work will also be required to understand how, for example, one agent or
23 cause of land use change influences another. This comprehensive understanding of land use and
24 cover change processes also needs to consider interactions between socioeconomic factors and
25 biophysical factors, including synergies between land use dynamics and climate change and
26 variability.

28 **PRODUCTS AND PAYOFFS**

- 29 • Summary of the regional driving forces of US land use and land cover change (< 2
30 years).
- 31 • Contemporary (last 30 years) rates of US land cover change (2-4 years).
- 32 • Long-term (300 years) national land use and land cover history (2-4 years).
- 33 • Long-term (300 years) global land use and land cover history (>4 years).
- 34 • Analysis of the impact of major disturbances on land use and land cover (>4
35 years).

**Question 2: What tools or methods are needed to allow for better
characterization of historic and current land use and land cover
characteristics and dynamics?**

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1 **STATE OF KNOWLEDGE**

2 A significant component of this research element involves improvements in data collection
3 systems and data products. Research on current land use and land cover will provide new
4 information to enable the production of regular updates on the distribution of land cover at
5 scales relevant for global-scale analyses and resource management decisions. The information
6 will also provide the data needed to parameterize climate and other environmental factors in
7 models. Remote sensing provides quick and comparatively inexpensive information about land
8 cover changes over large areas. Ground-based networks in the United States also offer a
9 wealth of historical data (often with data records extending back 50-100 years), and can
10 provide detailed information on site conditions, including species composition, soil type, habitat
11 quality, tillage and crop rotation history, wildlife population statistics, and land use classification.
12 Integrating ground-based and remote sensing data collection systems provides an opportunity to
13 vastly improve the speed and overall quality of land use and land cover data for use in applied
14 research.

15
16 **ILLUSTRATIVE RESEARCH QUESTIONS**

- 17 • What are the current patterns and attributes of land use and land cover at national to
18 global scales that affect the carbon cycle, atmospheric processes, and ecosystem form
19 and function?
- 20 • What are the national and global rates, patterns, and characteristics of contemporary
21 land use and land cover change?
- 22 • Where are the current hot spots of rapid land use and land cover change at the national
23 and global levels?
- 24 • What improvements need to be made to current observing systems and what programs
25 need to be put in place to provide the necessary long-term data and information to
26 support the study of land use and land cover change at the global, regional, and national
27 scale?
- 28 • What are the methodological advances needed to improve land use and land cover
29 change analyses, including strategies for integrating ground-based data, socioeconomic
30 statistics (e.g., census information), and remotely sensed measurements?

31
32 **RESEARCH NEEDS**

33 Evolving public and private land management questions call for new types of data and
34 information and improved scientific bases for decisionmaking. They also require long-term
35 continuity in data collection, and the acquisition of data at the global scale. With the current
36 suite of satellite sensing systems and archived data sets available to the research community,
37 studies at the large spatial scales needed to depict land cover and management changes can
38 begin. While considerable progress has been made in mapping land cover characteristics, the
39 ability to accurately map the wide range of landscape attributes, including land use and biomass,
40 will require a considerable research effort. In addition, improvements in remotely-sensed data
41 quality and in algorithms for detection of local changes and their characteristics are needed.
42 Data integration will be a particularly important research strategy so that *in situ*, remotely
43 sensed, and other forms of data can be merged and used to derive the needed land use and land

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1 cover information. As scientific demands and needs for land use and land cover information
2 change, parallel innovation in the resulting data products will be essential.

4 **PRODUCTS AND PAYOFFS**

- 5 • National land cover database that includes attributes of land cover and vegetation
6 canopy characteristics (<2 years).
- 7 • Global moderate resolution land cover database with attributes required for
8 environmental parameterization (<2 years).
- 9 • Map of global land use and land cover change hot spots (<2 years).
- 10 • Quantification of rates of US land use and land cover change (<2 years).
- 11 • Improvements in land use and land cover change detection procedures that enable
12 accurate and real time detection of local to global change (2-4 years).
- 13 • Continued acquisition of calibrated coarse, moderate, and high-resolution remotely-
14 sensed data (2-4 years).
- 15 • Global high-resolution land cover database with attributes required for national to global
16 scale applications (>4 years).
- 17 • Operational global monitoring of land use and land cover conditions (>4 years).

**Question 3: What advances are required to allow for the projection of
land use and land cover patterns and characteristics 10-50 years into
the future?**

19 **STATE OF KNOWLEDGE**

20 In order to understand the historical and contemporary linkages between land use and land
21 cover change and its resulting effects on biogeochemical cycles, climate, ecosystem health, and
22 other systems, it will be necessary to make significant advances in documenting the rates and
23 causes of land use and land cover change. Our current understanding of historic land use and
24 land cover change is weak due to the anecdotal nature of past research in this area. Future
25 understanding of land use and land cover changes will be greatly improved due to new
26 systematic methods and study designs for land use change research. In order to understand the
27 forces of change that operate at different scales, it will be necessary to conduct studies that
28 explicitly reveal the regional variations in change characteristics. With this, the historical and
29 contemporary data needed to develop models that project land use and land cover for specific
30 intervals into the future will be produced.

32 **ILLUSTRATIVE RESEARCH QUESTIONS**

- 34 • What are the research challenges associated with developing a new generation of land
35 use models resulting from multiple and potentially interacting agents and causes and that
36 address environmental and socioeconomic impacts?
- 37 • Given specific climate, demographic, and socioeconomic projections, what is the
38 current level of skill in projecting characteristics of land use and land cover change 5,
39 10, 20, 40, and 50 years into the future?

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RESEARCH NEEDS

A new suite of models that combine physical, socioeconomic, and climate data to model projected changes at scales relevant to resource management are needed. This calls for a better understanding of the drivers of land use change and credible predictions of land cover and land use at decadal time scales. Integration among the Carbon Cycle (Chapter 9), Ecosystems (Chapter 10), and Human Contributions and Responses (Chapter 11) research elements will be needed to develop and test models needed to generate scenarios of land use and land cover change and projections of change that take into account the various influences of ecosystem functioning, carbon, water, and energy cycling as well as human managed systems. Model validation will be a particularly challenging element of this research area. Simulation of past conditions will be a necessary strategy for testing the performance of models, placing more significance on the need to understand land use and land cover change in both an historical and contemporary context.

PRODUCTS AND PAYOFFS

- Urban growth models (<2 years).
- Identification of the regional components of a US land use and land cover change model (<2 years).
- National land use and land cover change projection model.
- Identification of the regional components of a global land use and land cover change model (2-4 years).
- Global-scale land use and land cover change projection model (>4 years).

Question 4: How can projections be made of potential land cover and land use change over the next 10-50 years for use in models of impacts on the environment, social and economic systems, and human health?

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STATE OF KNOWLEDGE

There is clear evidence that changing land use and land cover has significant impacts on local environmental conditions and economic and social welfare. Some of the impacts are local while others have global ramifications. For example, estimates of trace gas emissions and removals by sinks depend strongly on land cover and land use practices, while the deposition of atmospheric constituents affects the potential rate and magnitude of terrestrial sinks. The water cycle depends heavily on vegetation, surface characteristics, and water resources development by humans (e.g., dam construction, irrigation, channeling, and drainage of wetlands), which in turn affect forecasts of water availability and quality. The other Climate Change Science Program (CCSP) research elements provide complementary information about the environmental and biophysical forces that influence potential land uses (e.g., atmospheric chemistry and processes, climate variability and change, water resources, nutrient flows, and ecological processes) and the anthropogenic pressures that will give rise to various land uses

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1 and processes (e.g., the Human Contributions and Responses element, Chapter 11). The land
2 use/land cover change element will develop projections of changes in land cover and use that
3 are critical to developing accurate forecasts in the other areas of the program. The following
4 research questions address the effects of changes in land use and land cover on other research
5 elements (i.e., Ecosystems, Water Cycle, and Carbon Cycle). Research will require
6 multidisciplinary cooperation to develop land use and land cover projections that address the
7 necessary spatial and temporal scales, and include the necessary physical, biological, and social
8 factors of interest, to ensure that projections of land use and land cover can be incorporated
9 into models of impacts.

10 11 **ILLUSTRATIVE RESEARCH QUESTIONS**

- 12 • How will acute land use change stress or enhance the productivity of our natural resource
13 base and the industries that depend on it, including agriculture and forestry?
- 14 • How will changes in urban and rural land use and land cover influence the spatial and
15 temporal distribution of wildlife and what are the resulting economic, social, and
16 ecological impacts?
- 17 • How will the form and use of public lands change given different climate change
18 scenarios, and how will those changes affect the management of the vital
19 economic and ecological resources of those lands?

20 21 **RESEARCH NEEDS**

22 In order to understand the impacts of land use and land cover change, there must be ongoing
23 close cooperation with other CCSP research elements that will improve understanding of the
24 interrelationships and dynamic feedbacks between land use/land cover change and carbon,
25 ecosystems, atmospheric chemistry, water resources, and climate variability. The challenge will
26 be to use contemporary impacts of land use and land cover change to calibrate impacts on
27 ecosystem goods and services; biogeochemical, water, and energy cycles; and climate
28 processes. These investigations must be undertaken on multiple scales so that the full
29 dimensions of the perturbations of environmental processes can be determined.

30 31 **PRODUCTS AND PAYOFFS**

- 32 • Report on the impacts of urbanization on other land uses (<2 years).
- 33 • Maps and evaluations of the relationship between US urban areas and wildfire hazards
34 (<2 years).
- 35 • Report evaluating the impacts of land use and land cover change in the coastal zones of
36 the United States on coastal resources (2-4 years).
- 37 • Reports on the relationship between land use and land cover change and human
38 health (with the Human Contributions and Responses research element) (2-4
39 years).

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Question 5: What are the combined effects of climate and land use and land cover change and what are the potential feedbacks?

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STATE OF KNOWLEDGE

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Land use and land cover change is linked in complex and interactive ways to other global environmental changes, human actions (both as causes of change and responses to impacts), and environmental feedbacks at multiple spatial and temporal scales. The outflow of soil nutrients, for example, has immediate impacts on land productivity, vegetation, and soil erosion rates; medium-term impacts on landscape fragmentation, land productivity, and downstream aquatic ecosystems; and possible long-term impacts on climate. Land use and land cover change, climate change, and other environmental changes all interact to affect natural resources. The research associated with this question will require collaboration with the Climate Variability and Change (Chapter 6), Ecosystems (Chapter 10), Water Cycle (Chapter 7), and Carbon Cycle (Chapter 9) research elements.

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ILLUSTRATIVE RESEARCH QUESTIONS

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- How will the combined effects of land use and climate change affect agriculture, aquatic ecosystems, rangeland, and forest extent and productivity, and what are the implications for land management and economics?
- How does the combined stress of climate and land use change affect our ability to mitigate and manage greenhouse gases?
- What is the impact of future changes in land use and land cover on water supply and quality, considering climate-induced changes in the patterns and characteristics of water resources (research will be undertaken with the Water Cycle team)?
- Using focused case studies, how can landholders, land managers, and decisionmakers formulate land use and land management decisions and practices at various scales in light of climate change?

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RESEARCH NEEDS

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Development of coupled climate-land use/cover models, that incorporate socioeconomic factors, should be accelerated. Simulation of climate-land use/cover feedbacks will require advancement of current understanding of multiple stress processes at local to global scales. Validation of the interacting climate-land use effects for specific regions of the globe will be particularly challenging. International cooperation will be needed to optimize the currently existing and emerging observational networks.

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PRODUCTS AND PAYOFFS

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- Climate models incorporating land use and cover data (<2 years).
- Identification of the regions in the United States where the combination of land use effects and climate change may be most pronounced (<2 years).

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- 1 • Report on how urban expansion of impermeable surfaces and associated "heat
2 islands" affect regional weather and climate, primarily with respect to temperature
3 and precipitation patterns (<2 years).
- 4 • Evaluation of how the type and distribution of land cover affects regional weather
5 and climate patterns (2-4 years).
- 6 • Global-scale, fully interactive climate-land use/cover model (>4 years).
- 7 • Report on trends in land cover or land use that are attributable to changes in climate
8 (e.g., changes in forest type, changes in specific agricultural crops, or changes in the
9 presence or absence of agriculture) (>4 years).
- 10 • National model with a coupled climate-land use system (>4 years).

Key Linkages

12
13 The implementation of the Land Use and Land Cover Change research element will require an
14 interdisciplinary approach involving scientists from physical, natural, and social science
15 communities. Crucial to these activities will be the transfer of accrued knowledge to policy and
16 decisionmaking communities. Success will depend on close linkages with other CCSP research
17 elements. In particular, collaboration with the Water Cycle (Chapter 7), Carbon Cycle
18 (Chapter 9), Ecosystems (Chapter 10), and Climate Variability (Chapter 6) research elements
19 will be needed to understand the larger effects of land use and land cover changes over time.

20
21 Regional observational and monitoring networks and associated case studies are key to
22 understanding phenomena at fine scales, and provide a test bed for models and a mechanism for
23 comparative analysis. In the next 10 years the establishment of international land use and land
24 cover science programs will augment ongoing efforts such as the International Geosphere-
25 Biosphere Programme to help bridge the gap between climate change researchers, land
26 managers, and decisionmakers. For example, Global Observation of Forest and Land Cover
27 Dynamics (GOFC-GOLD) is a new program for coordinating global land observations,
28 implemented through regional networks of data providers and users to address a combination of
29 global change and natural resource management questions, and engaging local scientists with
30 local and regional expertise and knowledge.

31
32 Another example is the United Nations (UN) Land Cover Network - an emerging cooperative
33 activity of the UN Food and Agriculture Organization (FAO) and the UN Environment
34 Programme (UNEP) to develop monitoring and measurement of land cover change in support
35 of their global environmental outlooks and assessments (e.g., the Millennium Ecosystem
36 Assessment). In addition to these activities, development agencies are attempting to address
37 questions concerning the societal impacts of global change through new programs such as the
38 US Agency for International Development's (USAID) Geographic Information and Sustainable
39 Development program. Such programs can help in strengthening the scientific underpinning for
40 the decisionmaking process.

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1 There are a number of programs that have identified land use and land cover change as part of
2 their individual agency research agendas (e.g., the National Aeronautics and Space
3 Administration, the US Geological Survey, the National Science Foundation, the US
4 Environmental Protection Agency, and the US Department of Agriculture) and have played an
5 active role in developing this research element. It will be important as the program proceeds to
6 engage multiple agencies and organizations working in this and related fields (e.g., the National
7 Institutes of Health, the Department of Transportation, the Bureau of Land Management, and
8 USAID). In the next decade of global change research it will be particularly important to
9 include stakeholders (e.g., the Council of Governors, non-governmental organizations, and state
10 and local land managers) in guiding this research element.

11

12 **References:**

13 NRC, 2001d. National Research Council, Committee on Grand Challenges in Environmental
14 Sciences, [Grand Challenges in Environmental Sciences](#) (Washington, DC: National Academy
15 Press).

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Authors and Contributors

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**PART II. THE U.S. GLOBAL CHANGE RESEARCH PROGRAM
(USGCRP)**

Chapter 8. Land Use/Land Cover Change

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