FINAL DOE GRANT REPORT, NOVEMBER 15, 1999

Title: Assessment Strategies for Global Environmental Change

Principal Investigators:

Professor Edward A. Parson

Professor William C. Clark

Period of time covered by report: 09/01/1995 - 08/14/1999

Recipient Organization:

President and Fellows of Harvard College

1350 Massachusetts Avenue

Cambridge, MA 02138

DOE award number: DE-FG02-95ER62122

Total Amount Awarded: \$482,924.

Amount of unexpended funds (as at 08/14/1999): zero

Project Objectives:

The objective of this project has been to investigate how scientific and technical assessments of global environmental issues have been designed, implemented, and used, and to investigate what strategies of assessment have been most useful in informing policy and decision. Drawing on both relevant theoretical literatures and detailed systematic review of assessment experience to date, the project has sought generalizable insights into the origins, conduct, and consequences of assessment, and into how each of these is shaped by the policy and knowledge context in which assessments are conducted. The project has sought to advance intellectual understanding of assessment as a political and knowledge-based process, to enhance communication among scholars and practitioners of global environmental assessments, and to provide practical insights into how to design and implement assessment and scientific advisory processes, to better integrated scientific understanding and decision-making. We believe that achieving this integration is one of the most fundamental challenges that must be met for societies to more effectively manage, and live with, global environmental change.

Project Strategy, Organization, and Accomplishments:

With this DOE grant and additional support obtained from the National Science Foundation, NOAA Office of Global Programs, and NIGEC, Harvard established an integrated program of work in global environmental assessment and management, the Global Environmental Assessment (GEA) project. The GEA project is a multi-year effort to shape an integrated understanding of the relationships among science, assessment, policy and management in social responses to global environmental change.

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The project is structured around a core group of faculty and senior researchers, from the natural sciences, social sciences and professional schools, at Harvard and elsewhere. The project has established institutional or individual collaborations with researchers from Carnegie-Mellon University's Center for Integrated Study of the Human Dimensions of Global Change,¹ Cornell University, Duke University, the International Institute for Applied Systems Analysis (IIASA) in Austria, the University of Oregon, Tufts University, the International Human Dimensions of Global Change Program. A list of GEA Project participants is provided in Appendix A.

To help build a next generation of professionals trained in the unique problems of linking science and policy on global environmental problems, the GEA project recruits roughly eight pre- and post-doctoral fellows from diverse disciplines and nationalities to join the project each year. Fellows spend the year as full collaborators with faculty in the project's research, outreach, and publication activities. An organized year-long program of advanced training and research provides systematic interdisciplinary instruction and guidance to fellows. A fall-term research seminar examines relevant scholarship from a wide range of disciplines and professional perspectives. Guest lectures throughout the year on current scholarship and practice supplement this research seminar. A partial listing of seminars and speakers presented by the project is provided in Appendix B. After identifying research topics in consultation with faculty in the fall, fellows conduct field research at various collaborating institutions in the winter. In March, fellows reconvene at Harvard to discuss and write up their research results. A network of alumni fellows is maintained by the project to encourage continuing collaboration. In the first four years of the project, it will have graduated 35 fellows from ten disciplines and nine nationalities. Of these, 18 have been pre-doctoral fellows, 14 post-doctoral, and 3 faculty fellows.

To serve our goal of enhancing communication between scholars, practitioners and users of assessment, and to discipline our investigations by subjecting our hypotheses and conclusions to critical feedback from sophisticated practitioners, the project has organized a series of workshops on specific assessment-related themes. These workshops seek to provide an opportunity for sustained international, interdisciplinary cross fertilization, criticism and collaboration. Research conducted by GEA project fellows and faculty during the year provide background materials for these workshops. Based on these materials, a small number of cross-cutting themes are identified each year, which are summarized in a series of background/scoping papers, each of which provides the input for one of a series of parallel intensive working groups. Syntheses of background papers, working group discussions, and other research are presented in the form of extended (non-attributed) rapporteurs' reports drafted by senior project faculty, and published in a monograph following each workshop. Together with fellows' research papers, these workshop reports provide a means to convey the project's findings to the wider community. Four project workshops conducted to date are summarized in Appendix C.

The project has produced more than 50 publications to date, including approximately ten workshop-related reports, thirty discussion papers, and (to date) fifteen publications in the peer-

¹ The Carnegie-Mellon center is funded under the National Science Foundations' Human Dimensions of Global Change initiative.

reviewed literature. A listing of publications associated with the project that have benefited from this grant is presented below in Appendix D.

Finally, as the GEA project has proceeded, participating faculty and fellows have increasingly been asked to contribute to ongoing assessment activities and to make presentations drawing on insights from the project to a wide range of senior audiences concerned with the conduct and management of global environmental assessments. A partial listing of these activities is presented below in Appendix E.

Empirical Cases and Substantive Themes:

Over the four years of the GEA project, we have focused on a successively broader set of empirical assessment cases, and on a set of cross-cutting thematic questions grounded in the literatures of various disciplines. We have usually taken a long-term perspective, focusing on interactions between science, assessment and management over periods of several years to a decade or more, rather than concentrating on single studies or negotiating sessions. In the first year (1995-96), we developed a set of tools and measures for describing assessment processes and outputs, applied these to a large preliminary set of approximately thirty assessments of stratospheric ozone depletion and thirty of global climate change, and developed a preliminary set of hypotheses regarding the determinants of assessment form, outputs, and effects. In the second year (1996-97), we strengthened our focus on global climate change with a series of in-depth studies of the role of early assessments in the emergence of climate change as a salient policy issue in the late 1980s, the establishment and design of the Inter-Governmental Panel on Climate Change (IPCC), and domestic assessments of climate change science, impacts, and responses in the United States, Europe, and India. In the third year (1997-1998), we continued our work on climate change and ozone, with additional studies of assessment and management of long range transport of tropospheric air pollutants in the United States and Europe. In the fourth year (1998-1999), we broadened our empirical studies further, continuing work on global climate change and long-range transport of air pollutants, and adding a new focus on biosafety issues in North America, Europe and South Asia.

Cutting across these empirical studies, four thematic areas have emerged as principal lines of inquiry. The first concerns international information institutions, and the credibility of the information they provide. International institutions provide information to decision makers, including but not restricted to leaders of national governments. The credibility of this information is likely to affect its impacts on policies and other actions taken by decision makers. Technological changes have only enhanced this effect, greatly altering the rate of transnational information flows, as well as relationships between producers and consumers of information. The present "information age" requires that students of global governance ask what institutional and contextual factors affect the credibility of certain types and sources of information to particular groups, and under what conditions credible information influences the policies and behavior of state and non-state actors. Research in this area has explored the pathways by which information affects the interests, agendas, policies, positions, and behavior of states and of non-state actors, as well as strategic interactions amongst them, and the conditions under which information produced by international institutions – including but not restricted to environmental

assessments – is in fact credible to decision makers. Faculty leading this line of inquiry have included Robert Keohane, Barbara Connolly, Ronald Mitchell, and Stacy VanDeveer.

The second thematic area has concerned information systems linking global assessments to local decision-making. Many of the decisions through which societies respond to global environmental issues are "local," occurring at the scale of families, firms, organizations and regional or state governments. Global environmental assessments largely inform these local decision makers only indirectly, through institutional networks and information systems that cross multiple scales. Research in this area has examined how the histories, issue linkages, and structures of such systems affect trust in, and utility of, the information they convey. Faculty leading this line of inquiry have included William Clark and Jill Jäger.

The third thematic area has concerned the social construction of scientific assessments. Assessment processes constitute sites within which knowledge about the environment is shaped, stabilized, transmitted and made relevant to political action. Research in this area has examined the simultaneous construction of environmental knowledge and social norms and institutions in international as well as comparative, cross-national settings. The project has taken a comparative perspective on the development of expert advisory institutions and processes in several areas of international environmental cooperation, including climate change, biodiversity, and desertification. Topics addressed have included strategies for globalizing nature and politics; credibility, legitimacy, and authority; transparency, openness, and participation; harmonization and standards; capacity building; and codifying and classifying indigenous and other local knowledges. Faculty leading this line of inquiry have included Sheila Jasanoff, Clark Miller, and Stacy VanDeveer. This line of inquiry has been supported both by the GEA project and by Sheila Jasanoff's NSF grant "Sustainable Knowledge about the Global Environment."

The fourth line of inquiry has been the most pragmatic, considering the design and management of effective assessments on global environmental issues. A wide variety of design and management options have been used in conducting assessments of global environmental issues. Our research in this area has sought to determine under what conditions particular assessment designs have been more and less effective. We have given special attention to the implications of choices regarding participation, the treatment of uncertainty, and the handling of consensus and dissent. The merits of large, comprehensive assessments relative to focused rapid-response assessments have also been evaluated. Faculty leading this line of inquiry have included William Clark, Jill Jäger, James McCarthy, Edward Parson, and Dan Schrag.

Appendix A: Project Participants:

1. Core Faculty and Senior Researchers

William Clark, Kennedy School of Government, Harvard University - Project Director
Barbara Connolly, Dept. of Political Science, Tufts University
Ellis Cowling, School of Forestry, North Carolina State University
Nancy Dickson, Kennedy School of Government, Harvard University - Project Associate Director
William Easterling, Dept. of Geography, Pennsylvania State University
Robert Frosch, Kennedy School of Government, Harvard University
John Holdren, Kennedy School of Government, Harvard University
Leen Hordijk, Environmental Systems Analysis Group, Netherlands
Jill Jäger, International Human Dimensions of Global Change Program, Bonn, Germany
Sheila Jasanoff, Kennedy School of Government, Harvard University
Robert Keohane, Dept. of Political Science, Duke University
James McCarthy, Depts. of Biology and Earth and Planetary Sciences, Harvard University
Ronald Mitchell, Dept. of Political Science, University of Oregon
Thomas Parris, Harvard College Library, Harvard University
Edward Parson, Kennedy School of Government, Harvard University
Daniel Schrag, Dept. of Earth and Planetary Sciences, Harvard University
Eileen Shea, East-West Center, Hawaii
Thomas Wilbanks, Oak Ridge National Laboratory

2. Global Environmental Assessment Fellows (1996-1999)

Pre-Doctoral Fellows

Shardul Agrawala, Woodrow Wilson School of Public Policy, Princeton University, '96
Pascal Bader, Dept. of Economics, University of Augsburg, Germany, '97
Silke Beck, Institute for Science and Technology Studies, University of Bielefeld, Germany, '99
Liliana Botcheva, Government Dept., Harvard University, '97
David Cash, Kennedy School of Government, Harvard University, '96, '97, '98
Noelle Eckley, Dept. of Earth and Planetary Sciences, Harvard University, '99
Karen Fisher-Vanden, Kennedy School of Government, Harvard University, '96
Cathleen Fogel, Environmental Studies Dept., University of California at Santa Cruz, '99
Wendy Franz, Government Dept., Harvard University, '96, '97
Aarti Gupta, Environmental Studies, Yale University, '98, '99
Alastair Iles, Law School, Harvard University, '96, '97
Wolfgang Jung, Dept. of Political Science, Free University of Berlin, Germany and Wuppertal Institute for Climate, Environment and Energy, '98
Chunglin Kwa, Dept. of Science Dynamics, University of Amsterdam, '99
Marybeth Long, Civil and Environmental Engineering Department and the Department of Urban and Studies and Planning, Massachusetts Institute of Technology, '96
David Lund, Office of Global Programs, National Oceanic and Atmospheric Administration, '99
Anthony Patt, Kennedy School of Government, Harvard University, '96, '97, '98

Post-Doctoral Fellows

Michele Betsill, Dept. of Political Science, University of Colorado at Boulder, '99
Frank Biermann, Dept. of Political Science, Free University of Berlin, Germany and German Advisory Council on Global Change, '98
Alexander Farrell, Dept. of Energy Management and Envt. Policy, Univ. of Pennsylvania, '97
Timothy Forsyth, Geography, University College London, and Inst of Devt Studies UK '99
Milind Kandlikar, Dept. of Engineering and Public Policy, Carnegie Mellon University, '96
Terry Keating, Environmental Science and Engineering, University of North Carolina, '97
Mojdeh Keykhah, School of Geography, Oxford University, '99
Jonathan Krueger, London School of Economics and Political Science, UK, '99
David Levy, College of Management, University of Massachusetts at Boston, '98
Clark Miller, Dept. of Science and Technology Studies, Cornell University, '96, '97
Susanne Moser, School of Geography, Clark University, '97, '98
Sandra Rothenberg, Sloan School of Management, Massachusetts Institute of Technology, '98
Paul Samson, University of Geneva, Switzerland and Intl. Academy of the Environment, '97
Stacy VanDeveer, Dept. of Government and Politics, University of Maryland, '97

Faculty Fellows

Barbara Connolly, Political Science Dept., Tufts University, '97
Oladele Ogunseitan, Dept. of Envt. Analysis & Design, University of California Irvine, '99
Walter Rosenbaum, Political Science Dept., University of Florida, '97

Appendix B: Global Environmental Assessment Seminars, 1997 - 1999

September 16, 1997

Jill Jäger, International Institute for Applied Systems Analysis
Knowledge and Action: Doing Better Assessments

September 16, 1997

Daniel Jacob, Division of Applied Sciences, Harvard University
The Chemistry of Acid Rain

September 18, 1997 Joint GEA/BSCIA/WCFIA Int'l Environmental Affairs Seminar

William Moomaw, Fletcher School of Law and Diplomacy, Tufts University
Avoiding Stranded Opportunities in Kyoto and DC: Policy for Global Environmental Change

September 23, 1997

James J. McCarthy, Harvard Departments of Biology and Earth and Planetary Sciences,
The Climate System: Fundamental Processes

September 25, 1997

William Dietrich, EIP Associates
Critical Levels: A Key Concept in the Policy Debate on Acid Deposition and Climate Change

October 1, 1997

Ellis Cowling, College of Forest Resources, North Carolina State University
Acidification: Lessons from History and Implications for Policy

October 7, 1997

Wendy Franz, Weatherhead Center for International Affairs, Harvard University
Processes, Communities, Policy and Political Outcomes

October 8, 1997

Clark Miller, Kennedy School of Government, Harvard University
Framing, Managing Uncertainty and Credibility

October 9, 1997 Joint GEA/BSCIA/WCFIA Int'l Environmental Affairs Seminar

Marc Levy, Environmental Studies and Political Science Departments, Williams College
Multilateral European Efforts to Control Acid Rain

October 10, 1997

Clark Miller, Kennedy School of Government, Harvard University
Features of Knowledge: Framing, Managing Uncertainty and Credibility

October 14, 1997

John Holdren, Kennedy School of Government, Harvard University
Providing Scientific Advice to the Highest Levels of Government: Climate Change and Plutonium

October 15, 1997 (Joint GEA and Economics and Environmental Policy Seminar)

Richard Schmalensee, Sloan School of Management, Massachusetts Institute of Technology
Economics and Environmental Policy: The View from the Council of Economic Advisors

October 16, 1997

Barbara Connolly, Weatherhead Center for International Affairs, Harvard University
The Comparative Dimension

October 21, 1997

Pascal Bader, Liliana Botcheva, Tony Rosenbaum, Kennedy School of Government, Harvard University: Research Proposals: Works in Progress

October 22, 1997

Barbara Connolly, Tony Patt, Ita Falk, Kennedy School of Government, Harvard University
Research Proposals: Works in Progress

October 23, 1997 Joint GEA/BSCIA/WCFIA Int'l Environmental Affairs Seminar

Nancy Dickson, Kennedy School of Government, Harvard University
Agenda Setting for Global Environmental Issues

October 24, 1997

Roger Kasperson, George Perkins Marsh Institute, Clark University
Cross-scale Analysis of Environmental Problems and Policies (held at Clark University).

October 28, 1997

Robert Stavins, Kennedy School of Government, Harvard University
What Can We Learn from the Grand Policy Experiment Lessons from SO2 Allowance Trading

October 29, 1997

Alex Farrell, Terry Keating, Alastair Iles, Kennedy School of Government, Harvard University
Research Proposals: Works in Progress

October 30, 1997

Clark Miller, Susanne Moser, David Cash, Kennedy School of Government, Harvard University
Research Proposals: Works in Progress

November 4, 1997

Wendy Franz, Paul Samson, Stacy VanDeveer, Kennedy School of Government, Harvard University: Research Proposals: Works in Progress

November 7, 1998

Robert Keohane, Dept of Political Science, Duke University
Information and the Transformation of World Politics

November 18, 1997

Barbara Connolly, Weatherhead Center for International Affairs, Harvard University
European Acid Rain Negotiations: Modeling States' Preferences

November 19, 1997 (Joint GEA and Economics and Environmental Policy Seminar)

Paul Portney, Resources for the Future
Economics and Environmental Quality: The View from the EPA Science Advisory Board

November 25, 1997

James J. McCarthy, Harvard Departments of Biology and Earth and Planetary Sciences,

Status of the IPCC Third Assessment Report: Who should vet the Synthesis Report?

December 2, 1997

David Cash and Susanne Moser, Kennedy School of Government, Harvard University
The U.S. National Climate Change Assessment: In Search of a New Paradigm for Assessment

December 11-12, 1997

CMU-Harvard Workshop on the Integrated Assessment of Acid Rain (Held at CMU Center for Integrated Study of the Human Dimensions of Global Change).

(GEA Fellows on field research, Jan 1 1998 – March 15, 1998)

March 5, 1998 (Joint GEA and STPP Seminar)

Daniel M. Kammen, Woodrow Wilson School, Princeton University
Use Inspired R&D in Developing Countries

March 11, 1998 (Joint GEA and Environmental Economics and Public Policy Seminar)

Albert McGartland, U.S. Environmental Protection Agency
Economics and Environmental Quality: The View from EPA

April 8, 1998 (Joint GEA and Environmental Economics and Public Policy Seminar)

Howard Gruenspecht, U.S. Department of Energy
Economics and Environmental Quality: The View from DOE

April 13, 1998

Christer Agren, Director, Swedish NGO Secretariat on Acid Rain
The Role of Scientific Assessments in the Formulation of European Policy on Acid Rain

May 3, 1998

Workshop on Ozone Transport Assessment Group: Lessons for the Future
Organized by Terry Keating, Alex Farrell and Ellis Cowling (Held at NCEDR, Knoxville, TN)

May 4, 1998

Helen L. McRae, Director, Environmental Systems Group
Perspectives on Asian Attitudes and Responses to Environmental Issues

May 21, 1998

Leen Hordijk, Director, Wageningen Institute for Environment and Climate Research
The RAINS Model: Why was it used in European Acid Rain Negotiations?

September 16-17, 1998

Jill Jäger, former Deputy Director, International Institute for Applied Systems Analysis
Designing Better Assessments (Respondent, James McCarthy)

October 16, 1998

Robert Keohane, Duke University, Ron Mitchell, University of Oregon, Barbara Connolly, Tufts University: Information Institutions in World Politics

November 9, 1998

Barbara Connolly, Dept of Political Science, Tufts University
The Concept of Embeddedness

November 12, 1998: Fellows Research Proposal Presentations

David Cash: Linking Institutions Across Scales: Climate and Water mgt in US Agriculture

Sandra Rothenberg and David Levy : Responses to Climate Change in the Automobile Industry

November 19, 1998: Fellows Research Proposal Presentations

Noelle Eckley: Principles For Science-Policy Institutions: POPs under the LRTAP Convention.

Wolfgang Jung: Advisory Systems in Int'l Env't Regimes: Structure and Sources of Change.

Aarti Gupta: A Contested Concept? Framing the "Biosafety Issue" in a Transnational Context.

November 24, 1998: Fellows research proposal presentation

Frank Biermann: Global Environmental Assessment in a Divided World: A Case Study in India

December 8, 1998

Robert Stavins, Kennedy School of Government, Harvard University

The IPCC Mitigation Working Group: Views of A Lead Author

December 10, 1998

Edward Parson, Associate Professor of Public Policy, Kennedy School of Government

Scenarios of Impact Assessment in the US National Assessment

December 16, 1998

Robert Watson, World Bank and Chairman of the Intergovernmental Panel on Climate Change

Designing Intergovernmental Environmental Assessments

(GEA Fellows on field research, Jan 1 1999 – March 15, 1999)

February 11, 1999

Howard Kunreuther, Wharton School, University of Pennsylvania

The Complementary Roles of Mitigation and Insurance in Managing Catastrophic Risks

March 10, 1999

Sheila Jasanoff, Kennedy School of Government, Harvard University

Reflections on GEA and STS research studies

March 17, 1999

Stacy VanDeveer and Clark Miller, GEA alumni:

Framing questions and issues: Meaning, history and conflict in assessment discourses

March 24, 1999

Calestous Juma, Visiting scholar Harvard, former Exec. Secretary, Convention on Biodiversity

Assessments of the status of biological diversity: Scientific imperatives and political realities

April 7, 1999

Sandra Rothenberg and David Levy, GEA Fellows

Industry response and influence in global climate assessments: The automobile industry

April 14, 1999

Raul Estrada-Oyuela, Stanford University and former Chair, Climate Treaty Negotiations.

Informal discussion with GEA group

April 19, 1999

Susanne Moser and David Cash, GEA Fellows:

Global science for local action: The case of climate change assessments

April 28, 1999: David Cash, GEA Fellow

Linking institutions across scales: Climate change and water management in US agriculture

April 30, 1999

Wolfgang Jung, GEA Fellow:

Advisory systems in international environmental regimes: Structure and sources of change

May 5, 1999

Aarti Gupta, GEA Fellow:

Biosafety: a contested concept? Framing the "biosafety issue" in a transnational context

May 7, 1999

Frank Biermann, GEA Fellow:

Global environmental assessment in a divided world: A case study on India

May 21, 1999

Frank Biermann, Aarti Gupta and Wolfgang Jung: Institutionalizing science in global environmental policy: (Rehearsal for IHDGEC Meeting)

June 2, 1999

Susanne Moser, Sandra Rothenberg and Alex Farrell: Global change science and decision-making: Linking international, national, and local institutions: (Rehearsal for IHDGEC Meeting).

June 9, 1999

Barbara Connolly, Tufts University: Global environmental assessments as general information institutions: The role of information in international relations (Rehearsal for IHDGEC Meeting).

Appendix C: Workshops Conducted by the GEA Project:

The project has conducted a series of workshops to engage practitioners, users, and scholars of assessment in off-the-record dialog that allows them to compare insights and experiences. These workshops have sought both to disseminate the project's insights to practitioners who might be able to make use of them, and to keep our efforts grounded in reality through the critical feedback of sophisticated practitioners.

Workshops on Global Environmental Assessment and Policy:

June 22-26, 1997 and June 17-24, 1998, College of the Atlantic, Bar Harbor Maine.

These two workshops, the most ambitious conducted by the project to date, sought to help us shape a critical understanding and evaluation of experience in global environmental assessment by drawing collectively on the perspectives of assessment producers, users, managers and scholars. The Workshops were modeled on the Dahlem Conferences. Instead of formal presentations, drafts of research reports and synthetic "theme" papers, plus a few background readings, were distributed before each Workshop. The Workshops themselves stressed intense small group discussions, summarized in non-attributed rapporteurs' papers t circulated soon after the meeting.

The 1997 workshop focused on the experience of assessments of global climate change. The first working group and background paper examined how the form of assessments is shaped by the context of policy and knowledge in which they are undertaken. A second working group and background paper considered how assessments become devices for multi-directional communication, one of whose main functions is the establishment and development over time of credibility (to various audiences) on topics permeated with uncertainty. Finally, a third group and background paper took a more applied approach, seeking to identify and categorize specific outcomes of assessments that contribute to their perceived effectiveness, and what aspects of an assessment's context, contents, and process shape the extent and manner in which it achieves these outcomes.

The 1998 workshop, in an attempt to accommodate diverse interests, was organized in two parts: the first focused on recent research findings concerning the role of assessment in managing global environmental issues, while the second explored how, and how much, these findings and practical experience in other areas can help inform current practical challenges of designing and implementing effective assessments of global environmental issues. Three parallel working groups ran through both parts of the workshop, focused on the cross-cutting themes of "Institutions," "Scale" and "Impacts." Each group used as its point of departure a synthetic theme paper, drawing on appropriate research studies conducted by GEA Project participants.

The "Institutions" group's first theme paper, *Information and Governance*,² examined assessments as social processes, conducted largely within international institutions that may create

² Barbara Connolly, Alex Farrell, Wendy Franz, Jill Jäger, Terry Keating, Robert O. Keohane, Ronald B. Mitchell, and Stacy VanDeveer.

socially legitimate knowledge: statements about scientific causality, and impacts on human society that are widely accepted as valid. Discussions in this group sought to understand how assessments affect political agendas, shared knowledge, state policies, and other outcomes. The group identified how institutions responsible for assessments differ from other international institutions; how they reflect their context, and what effects these international informational institutions have.

For Part 2 of the workshop, the "Institutions" group worked from a different theme paper, *The Science/Policy Interface and The Role of Participation in Assessment Processes*.³ This paper and session examined European and US experience with assessments of long range transport of tropospheric pollutants, and considered the implications of this experience for design of current assessments of acid rain, tropospheric ozone and climate change in the U.S. In doing so, it continued to address themes raised during the first half of the week: the characteristics of particular institutions and their influence on assessment process and outcomes; the extent of political influence over assessment process; and the ways that links between institutions, information and social/political actors influence assessment process and outcomes.

The "Scale" group worked from the theme paper, *Cross-Scale Interactions in Assessment, Information, and Decision-Making*.⁴ Environmental management and policy-making increasingly must recognize the importance of scale and cross-scale dynamics. Assessment and management challenges arise from the facts that biophysical phenomena and the processes of human causation and response are intricately linked, but incompletely understood, and that the scales at which they manifest are frequently mismatched. While several disciplines have identified the importance of scale in ecological, social, and human-environment interactions and begun to investigate selected cross-scale processes, these processes are so complex that few strong generalizable propositions have emerged to date. There is also little understanding of how assessments can support effective management of issues that span multiple scales. This group examined questions of cross-scale interactions in assessment, information systems, and decision-making, with a particular focus on the current National Assessment of the Consequences of Climate Variability and Change.

The "Impacts" group worked from the theme paper, *Assessing Impacts: Framing, Communication, and Credibility*.⁵ Impact assessments are among the most theoretically engaging and practically challenging topics in assessment. As the salience of global environmental issues rises, demand grows for high-quality impact assessments to enable policymakers to make more informed, efficient, and equitable policy choices, and considerable resources are being expended to this end. Experience suggests, however, that impact assessments are often deeply contested and routinely fall short in their efforts to inform, let alone meaningfully steer, policy decisions. The Impacts group sought to inform the problems besetting impact assessment by

³ Jill Jäger, Ron Mitchell and William Clark.

⁴ David W. Cash, Edward Parson, Susanne C. Moser, and William Easterling.

⁵ Sheila Jasanoff, Clark Miller, James McCarthy.

drawing on various theoretical resources and applying them to actual assessment contexts. The first part of the workshop focused primarily on "framing," "knowledge communication," and "credibility." More specifically, it explored how impacts are framed to highlight certain aspects as worthy of greater attention than others, and how such definitions change over time. It asked how impact framings came to be communicated among disparate social actors and how they are institutionalized in social practices and belief systems. Finally, it examined why impact assessments became controversial and how credibility is secured in processes of impact assessment. In the second part of the Workshop, this group explored practical consequences of the preceding discussion for design and conduct of impact assessments. It considered valuation methods in impact assessment, and how they incorporate tacit problem framings; procedural mechanisms that institutionalize particular ways of understanding impacts; and processes through which impact assessments are communicated to wider publics.

Local Response to Global Change: Strategies of Information Transfer and Decision Making for Cross-Scale Environmental Risks, January 29-30, 1998.⁶

This research planning workshop, convened at Harvard University, brought together 17 practitioners and scholars concerned with global change. The workshop explored the integration of scientific information and environmental policy and management processes through a focus on linkages between information and decision systems across different scales.

Designing effective assessments of global environmental issues: What is being learned? May 17-20, 1999, Airlie House, Warrenton Virginia.

This workshop was jointly convened by the GEA Project and NOAA's Office of Global Programs, with additional financial support provided by NOAA. The workshop reviewed past and continuing experience in some of the most successful efforts to provide policy-relevant, science-based assessments of large scale environmental issues, and attempted to extract general lessons from these examples about how an assessment's design is likely to influence its effects and effectiveness as a bridge between science and policy. Workshop discussions repeatedly considered three questions that GEA project work suggests are central to the relationship between assessment design and effectiveness:

- 1) The science/policy interface: How do assessments structure the interface between policy users and scientific experts, and how do these decisions influence their effectiveness?
- 2) Participation: By what criteria are participants in an assessment process chosen, and how do these decisions influence the effectiveness of the assessment?
- 3) Uncertainty and dissent: How do assessment processes handle uncertainty and dissent, and how do these decisions influence the effectiveness of the assessment?

⁶ Organized by Dave Cash, Susanne Moser and William Clark.

To provide a common base of experience, the workshop included background materials and participating experts from three assessments that are widely regarded as particularly effective in linking science to action: El Nino / Southern Oscillation (ENSO) assessments for agricultural planning in the Southern Hemisphere; the Technology and Economics Assessment Panels (TEAP) on ozone depleting chemicals operating under the Montreal Protocol; and integrated assessment models used to support European negotiations on transboundary air pollution.

Appendix E: Global Environmental Assessment Project Publications

(* = available on the GEA project Web page, at http://environment.harvard.edu/gea_

Fellows and faculty collaborate in empirical and theoretical research on particular aspects of assessment throughout the year. Papers from this research are initially circulated for review as Discussion Papers, before being submitted to relevant conferences and journals.

Workshop reports

- *Cash, David and Susi Moser. "Scale Working Group's Rapporteur's Report: Cross-scale interactions in assessment, information systems and decision-making". in Global Environmental Assessment Project. 1999. A critical evaluation of global environmental assessments: Tropospheric pollutants and climate change. Cambridge: Harvard University, 1998.
- *Cash, David. and Susanne C. Moser. 1998. "Information and Decision Making Systems for the Effective Management of Cross-Scale Environmental Problems: A Theoretical Concept Paper." Global Environmental Assessment Project Working Paper, Belfer Center for Science and International Affairs, John F. Kennedy School of Government, Harvard University.
- *Cash, David, Susanne C. Moser, Edward Parson and William Easterling. "Scale Working Group Theme Paper: Cross-Scale Interactions in Assessment, Information Systems, and Decision-Making". 1997-1998 GEA Working Paper.
- *Connolly, Barbara, Alex Farrell, Wendy Franz, Jill Jäger, Terry Keating, Robert O. Keohane, Ronald B. Mitchell and Stacy VanDeveer. "Institutions Working Group Theme Paper: Information and Governance". 1997-1998 GEA Working Paper.
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Appendix D: Selected Outreach and Advisory Activities

As the GEA project has proceeded, participating faculty and fellows have increasingly been asked to contribute to ongoing assessment activities and to make presentations drawing on insights from the project to a wide range of senior audiences concerned with the conduct and management of global environmental assessments. A selection of these activities includes the following:

- James McCarthy continues to serve as the co-convenor of Working Group II (Impacts) of IPCC's Third Assessment Report.
- Edward Parson continues to serve on the Synthesis Team of the US National Assessment of the Impacts of Climate Change.
- On request of the Office of Science and Technology Policy, William Clark represented the US at the OECD Megascience Forum (March 1998, Stockholm).
- At the First Workshop of the European Forum on Integrated Environmental Assessment, Jill Jaeger gave a keynote address on "Challenges and opportunities for interacting with policy from a scientific perspective" (March 1998, Amsterdam), which has subsequently appeared in *Environmental Modeling and Assessment* (1998, vol 3).
- William Clark briefed the NRC Committee on North American Research Strategy for Tropospheric Ozone (March 1998, Washington DC), and the NSF Director and National Science Board (January 1999, Los Angeles), on lessons from earlier assessments and current challenges and opportunities in assessment research (January, 1999, Los Angeles), on lessons learned from earlier assessment efforts.
- As part of GEA's collaboration with Carnegie-Mellon's Center for Human Dimensions of Global Change, William Clark, Sheila Jasanoff, Nancy Dickson, David Cash and Anthony Patt presented GEA results to the Center's 1998 and 1999 annual meetings.
- Jill Jäger co-organized a workshop for the European Forum on Integrated Assessment on "Treatment of Uncertainty in Integrated Assessments", Baden Austria, July 1999.
- Fellows David Cash and Susanne Moser participated in the U.S. National Assessment of the Impacts of Climate Change. They acted as facilitators or rapporteurs at three regional workshops (Great Plains, New England, and Hawaii/Pacific Islands) and two national meetings (July 1997, Aspen, CO; November 1997, Washington, DC), and contributed to the Great Plains and Hawaii/Pacific Islands regional reports.
- Fellows Alex Farrell and Terry Keating convened a workshop, "OTAG: Lessons for the Future," to identify and describe lessons that can be learned from the Ozone Transport Assessment Group (OTAG) experience and applied to future multijurisdictional environmental assessments (May 1998, Knoxville, TN).
- At the AAAS meetings in February 2000, Edward Parson will present "What makes a policy-relevant uncertainty? Lessons from twenty years of stratospheric ozone debates", based on his research on assessments of ozone depletion.