Theory and Knowledge Systems for Sustainability Science

Organized by Nina Federoff, Luis Bettencourt, and Molly Jahn

October 22-24, 2013

John Antle, *Oregon State University*

John Antle is a professor in the Department of Agricultural and Resource Economics at Oregon State University, Corvallis, Oregon, and a University Fellow at Resources for the Future, Washington, D.C. He received the Ph.D. in Economics from the University of Chicago in 1980, and was formerly a professor at UC Davis and Montana State University. He has served as a senior staff economist for the President's Council of Economic Advisers in Washington, D.C. (1989-90); as a member of the National Research Council's Board on Agriculture (1991 97); and was a lead and contributing author to the IPCC third and fourth assessment reports. He is a Fellow and past President of the American Agricultural Economics Association. His current research focuses on the sustainability of agricultural systems in industrialized and developing countries, including climate change impacts, adaptation and mitigation in agriculture; assessment of environmental and social impacts of agricultural technologies; and geologic carbon sequestration.

Luís M. A. Bettencourt, *SFI*

Luís M. A. Bettencourt is a Professor at the Santa Fe Institute and a former Senior Research Scientist at Los Alamos National Laboratory. He obtained his PhD from Imperial College, University of London, in 1996 for work on critical phenomena in the early Universe, and associated mathematical techniques of Statistical Physics, Field Theory and Non-linear Dynamics. He held postdoctoral positions at the University of Heidelberg, Germany, as a Director's Fellow in the Theoretical Division at LANL, and at the Center for Theoretical Physics at MIT. In 2000 he was awarded the distinguished Slansky Fellowship at Los Alamos National Laboratory for excellence in interdisciplinary research. Luís carries research in the structure and dynamics of complex systems, with an emphasis on dynamical problems in biology and society. Currently he works on real time epidemiological estimation, information processing in complex systems, innovation in science and technology and urban organization and dynamics. He is a member of advisory committees for international conferences and referees for journals in physics, mathematics, computer science, computational biology, urban studies and for international fellowship programs. He is the Principal Investigator of the Synthetic Cognition team at Los Alamos National Laboratory, which is pursuing new science and technology for image and video processing inspired by biological insights. He is also a consultant for the Office Science and Technology Information of the US Department of Energy on the subject of Scientific and Technological Innovation and Discovery

Stephen Russell (Steve) Carpenter, *University of Wisconsin*

Stephen Russell (Steve) Carpenter is a leader of whole-ecosystem experiments and adaptive ecosystem management focused on freshwaters. Topics include trophic cascades and their effects on production and nutrient cycling, contaminant cycles, freshwater fisheries, eutrophication, nonpoint pollution, ecological economics of freshwater, and resilience of social-ecological systems.

Carpenter serves as the Director of the Center for Limnology at the University of Wisconsin-Madison, where he is the Stephen Alfred Forbes Professor of Zoology. He is a member of the U.S. National Academy of Sciences, a Fellow of the American Academy of Arts and Sciences, and a foreign member of the Royal Swedish Academy of Sciences. Carpenter is the 2011 laureate of the Stockholm Water Prize. His other notable awards include a Pew Fellowship in Conservation and Environment, the G. Evelyn Hutchinson Medal of the American Society of Limnology and Oceanography, the Robert H. MacArthur Award from the Ecological Society of America, the Excellence in Ecology Prize from the Ecology Institute, and the Naumann-Thienemann medal of the International Society for Limnology.

Carpenter is Chair of the Science Committee for the Program on Ecosystem Change and Society of the International Council of Science. He is co-Editor in Chief of Ecosystems, and a member of governing boards for the Beijer Institute of Ecological Economics and the South American Institute for Resilience and Sustainability Studies. From 2000-2005 he served as co-chair of the Scenarios Working Group of the Millennium Ecosystem Assessment. He led the North Temperate Lakes Long-Term Ecological Research program at U.W.-Madison from 1999-2009. He is a former President of the Ecological Society of America. Carpenter has published 5 books and about 300 scientific papers, book chapters, reviewed reports and commentaries. He received a B.A. from Amherst College (1974), M.S. from University of Wisconsin-Madison (1976), and Ph.D. from U.W. Madison (1979). From 1979-1989 he served as Assistant and then Associate Professor at the University of Notre Dame. He joined the U.W.-Madison faculty in 1989. A full biographical sketch, publication list and contact information are posted on http://limnology.wisc.edu/personnel/carpenter/

Ilan Chabay, *Inst. Adv. Sustainability Studies, Potsdam*

Ilan Chabay is Professor and Senior Fellow at the Institute of Advanced Sustainability Studies in Potsdam, Germany and at the University of Stuttgart Department of Sociology in the Helmholtz Alliance on Sustainability and Social Compatibility of Future Energy Infrastructure. His primary responsibility is in IASS where he collaborates with individuals and groups in the clusters on Global Contract for Sustainability and on Sustainable Interactions with the Atmosphere. At University of Stuttgart, he is designing public engagement processes on the German energy transition.

He chairs an international 10-year (2012-2022) IHDP research alliance on Knowledge, Learning, and Societal Change (KLSC). As one of three projects in KLSC and also in conjunction with the European Commission coordination action on Global Systems Dynamics and Policy, he is developing an approach for understanding and catalyzing individual and collective behavioral change by considering modeling and narratives as analytical and affective components of decision making on complex system issues. He also is involved in the user interface, learning system, and participatory process aspects of a large US-based consortium on Knowledge Systems for Sustainable Landscape Governance. In 2012 Ilan was awarded honorary membership in the Swiss Academy of Humanities and Social Sciences. He was the Erna & Victor Hasselblad Chair in Public Learning and Understanding of Science for Sustainability at Chalmers University of Technology and the University of Gothenburg, Sweden from 2006-2011 in the departments of chemistry, applied IT, and sociology. Previously, he was research scientist at the US National Institutes of Standards and Technology conducting research in laser spectroscopy, associate director of the Exploratorium science center in San Francisco, and consulting professor of chemistry at Stanford University. He founded and for 18 years ran a unique company in Silicon Valley designing science learning experiences for more than 230 museums worldwide, including Disney's EPCOT Center,

the Science Museum in London, Smithsonian Institution in Washington, DC, and Mirador in Santiago Chile.

Bill Clark, *Harvard University*

William Clark is the Harvey Brooks Professor of International Science, Public Policy and Human Development at Harvard University's John F. Kennedy School of Government. His research focuses on sustainability science: understanding the interactions of human and environmental systems with a view toward advancing the goals of sustainable development. He is particularly interested in how institutional arrangements affect the linkage between knowledge and action in the sustainability arena. At Harvard, he currently co-directs the Sustainability Science Program. He is co-author of Adaptive environmental assessment and management (Wiley, 1978), Redesigning rural development (Hopkins, 1982); and The global health system: Institutions in a time of transition (Harvard, 2010); editor of the Carbon dioxide review (Oxford, 1982); coeditor of Sustainable development of the biosphere (Cambridge, 1986), The earth transformed by human action (Cambridge, 1990), Learning to manage global environmental risks (MIT, 2001), and Global Environmental Assessments (MIT, 2006); andco-chaired the US National Research Councils study Our Common Journey: A Transition Toward Sustainability (NAP, 1999). He serves on the editorial board of the Proceedings of the National Academy of Science. Clark is a member of the National Academy of Sciences and a Fellow of the American Association for the Advancement of Science. He is a recipient of the MacArthur Prize, the Humboldt Prize, the Kennedy School's Carballo Award for excellence in teaching, and the Harvard College Phi Beta Kappa Prize for Excellence in Teaching.

Maggie Collins, *IIASA*

Margaret Goud Collins holds the position of International Institute for Applied Systems Analysis (IIASA) Secretary, with responsibility for strengthening institutional coordination and research cooperation between IIASA, its NMOs, and the science communities in its National Member Organization (NMO) Countries. From 1997-2012, she served as the Program Director for the U.S. Committee for IIASA, the U.S. NMO, first with the American Academy of Sciences in Cambridge, MA, then with the National Academy of Sciences. She was also Program Officer for the U.S. National Committee for DIVERSITAS.

Dr. Goud Collins received her PhD in Geological Oceanography from the MIT/WHOI Joint Program in Oceanography in 1987, with a specialization in coastal ocean processes. She has held numerous positions related to science policy and international cooperation in scientific research, at the University of the Philippines Marine Science Institute in Manila, with the NOAA Chief Scientist, with the US Geological Survey Director, and as a AAAS Congressional Science Fellow with Senator Max Baucus and the Environment and Public Works Committee. She served 4 terms on the American Geophysical Union Committee on Public Affairs and represented Public Affairs on the AGU Program Committee. Dr. Goud Collins was elected an AAAS Fellow in 2007.

Ulf Dieckmann, *Program Leader of the Evolution and Ecology (EEP)*
Ulf Dieckmann is the Program Leader of the Evolution and Ecology (EEP) Program. He is working on the theory of adaptive dynamics, fisheries-induced evolution, speciation theory, spatial ecology, life- history theory, evolutionary algorithms, and on problems in theoretical evolutionary ecology. Dr. Dieckmann received his bachelor's degree in physics and his master's degree in theoretical physics from the University of Aachen, Germany. He completed his PhD research on theoretical biology at Leiden University, the Netherlands, and obtained his Habilitation (venia legendi) in biomathematics from the University of Vienna. He has worked at Stanford University and the Xerox Palo Alto Research Center, California, USA, the Research Center Julich, Germany, the University of York, UK, Leiden University, the Netherlands, and the University of Vienna, Austria. He has been a visiting professor at the University of Montpellier, France, and a research fellow at the Institute for Advanced Study, Wissenschaftskolleg zu Berlin, Germany.

Jennifer Dunne, *SFI*
Jennifer received a Ph.D. in Energy and Resources from UC Berkeley in 2000, held a NSF Postdoctoral Research Fellowship in Biological Informatics from 2000-2002, co-founded the Pacific Ecoinformatics & Computational Ecology Lab in 2004, and joined the faculty of the Santa Fe Institute in 2007.

My research interests are in analysis, modeling, and theory related to the organization, dynamics, and function of complex species interactions. Much of this work focuses on trophic interactions, which provide the basic architecture for the flow of energy and resources in ecosystems and thus play a central role in ecological and evolutionary dynamics. Drawing on cross-system analysis and computational modeling, my collaborators and I seek to identify fundamental patterns and principles of ecological network structure and dynamics at multiple spatial and temporal scales. Such research provides a useful framework for understanding the coexistence of species and the robustness, persistence, and stability of ecosystems given endogenous and exogenous effects. To move beyond a narrow focus on extant ecosystems and charismatic plants and animals, I am extending the scope and impact of this research agenda through interdisciplinary collaborations with researchers from fields such as archaeology, art, computer science, economics, evolutionary theory, microbiology, paleobiology, parasitology, physics, and social science. In addition to basic research, my colleagues and I are developing new ecoinformatic technologies to facilitate sharing, synthesis, visualization, analysis, and modeling of information related to biocomplexity research. For more information, go to www.foodwebs.org .

Doyne Farmer, *Oxford University and SFI*
J. Doyne Farmer is an External Professor at the Santa Fe Institute. He has broad interests in complex systems, and has done research in dynamical systems theory, time series analysis and theoretical biology. At present his main interest is in developing quantitative theories for social evolution, in particular for financial markets (which provide an accurate record of decision making in a complex environment) and the evolution of technologies (whose performance through time provides a quantitative record of one component of progress). He was a founder of Prediction Company, a quantitative trading firm that was recently sold to the United Bank of Switzerland, and was their chief scientist from 1991 - 1999. During the eighties he worked at Los

Alamos National Laboratory, where he was an Oppenheimer Fellow, founding the Complex Systems Group in the theoretical division. He began his career as part of the U.C. Santa Cruz Dynamical Systems Collective, a group of physics graduate students who did early research in what later came to be called "chaos theory." In his spare time during graduate school he led a group that designed and built the first wearable digital computers (which were used to beat the game of roulette). For popular press see The Newtonian Casino by Thomas Bass, Chaos by Jim Gleick, Complexity by Mitch Waldrup, and The Predictors by Thomas Bass.

Nina Fedoroff, *KAUST / PSU / SFI*

Nina V. Fedoroff received her Ph.D. in Molecular Biology from the Rockefeller University, and has served on the faculties of the Carnegie Institution of Washington, the Johns Hopkins University and the Pennsylvania State University, where she was the Director of the Biotechnology Institute and the founding Director of the Huck Institutes of the Life Sciences. Fedoroff has published two books and more than 140 papers in scientific journals. She is a member of several academies, including the U. S. National Academy of Sciences and the American Academy of Arts and Sciences. Among her awards is a 2006 National Medal of Science, the highest honor awarded to US scientists. Fedoroff served as the Science and Technology Adviser to the Secretary of State and to the administrator of the US Agency for International Development (USAID) from 2007 to 2010. She is an Evan Pugh Professor at Penn State, a member of the External Faculty of the Santa Fe Institute and Distinguished Professor of the King Abdullah University of Science and Technology (KAUST) in Saudi Arabia. She was President of the American Association for the Advancement of Science (AAAS) in 2011-12 and is currently Chair of the AAAS Board.

Mike Grundy, *CSIRO*

Mr Mike Grundy has recently established the new Landscape Systems and Trends Theme within the equally new Sustainable Agriculture Flagship.

The Theme brings together science in sensing, information management, modelling and integration to increase our ability to observe, monitor and manage change across landscapes, industries and regions.

CSIRO has been increasing our ability to do this in the water and climate space; it is also essential across our land. The Theme has science teams from eight Divisions – a real mix across the organisation. Previously, Mr. Grundy led the Managing Australia's Soil and Landscape Assets Theme (MASaLA) where he coordinated research designed to be responsive to, and anticipate the knowledge needs of land resource managers and decision makers across Australia. Overall, he has been a Theme Leader in CSIRO for three years. He has a long-standing personal research interest in spatial soil science and its application to agricultural and forest production, environmental protection and systems approaches to complex problems – and has led major multi-disciplinary natural resource assessment activities for nearly 20 years. Mike Grundy has recently established the new Landscape Systems and Trends Theme within the equally new Sustainable Agriculture Flagship. Prior to establishing the new Landscapes Theme and leading the MASaLA Theme, Mr Grundy was the Theme Leader for Healthy Water Ecosystems within the Water for a Healthy Country Flagship.

That theme concentrated CSIRO's water ecosystem research skills on to the national high priority issues in the Great Barrier Reef catchments, south-east Queensland, the Murray-Darling Basin and south-west Western Australia. Before joining CSIRO, Mr Grundy was the Leader of the Queensland Salinity Program. The program involved the:

- collection of fundamental information on the landscape drivers of the salinity process
- development of new and/or enhanced scientific approaches
- delivery through community-based natural resource management bodies.

Concurrently, he was also Principal Land Resources Officer for the Queensland Department of Natural Resources, Mines and Water. This role included the professional leadership, management and direction of the delivery of activities associated with research and development in land resource assessment across Queensland and through collaborative activities across Australia.

Bronwyn Harch, *CSIRO*
Dr. Bronwyn Harch is Chief of CSIRO Computational Informatics (CCI).

She provides research oversight for the division which applies digital technologies and mathematical sciences research methods to diverse scientific problems. Dr. Harch joined CSIRO in 1995 as a research statistician, and has held positions of research leadership in agri-environmental informatics since mid-2005.

She became Chief of CSIRO Mathematics, Informatics and Statistics in 2012 after serving as Deputy Director of the Sustainable Agriculture Flagship. She is now Chief of CSIRO Computational Informatics.

During her time with CSIRO, Dr. Harch has worked on the statistical design of landscape-scale sampling protocols and monitoring programs, as well as the statistical modelling of spatio-temporal agri-environmental systems.

Molly Jahn, *University of Wisconsin-Madison*
Molly Jahn is a professor at the University of Wisconsin-Madison, holding appointments in the Department of Agronomy, the Laboratory of Genetics, and the Center for Sustainability and the Global Environment. From 2006-2011, she served as dean of the University of Wisconsin's College of Agricultural and Life Sciences. In 2009-10, she was called to Washington, DC to provide interim leadership as Deputy and Acting Under Secretary of Research, Education and Economics at the U.S. Department of Agriculture. Her research programs at University of Wisconsin and Cornell University have produced vegetable varieties grown commercially and for subsistence on six continents. In 2011, she was selected to represent the U.S. on the Commission for Sustainable Agriculture and Climate Change. Jahn has published widely including a recent book on Biotechnology and Sustainable Agriculture, serves on numerous boards, and scientific advisory panels including the Board on Agriculture and Natural Resources at the U.S. National Research Council/National Academies of Science. She is a Co-editor in Chief of the new open access journal BMC Agriculture and Food Security, and she chairs the Scientific Advisory Committee for the Energy and Environmental Sciences Molly Jahn is a professor at the University of Wisconsin-Madison, holding appointments in the

Department of Agronomy, the Laboratory of Genetics, and the Center for Sustainability and the Global Environment. From 2006-2011, she served as dean of the University of Wisconsin's College of Agricultural and Life Sciences. In 2009-10, she was called to Washington, DC to provide interim leadership as Deputy and Acting Under Secretary of Research, Education and Economics at the U.S. Department of Agriculture. Her research programs at University of Wisconsin and Cornell University have produced vegetable varieties grown commercially and for subsistence on six continents. In 2011, she was selected to represent the U.S. on the Commission for Sustainable Agriculture and Climate Change. Jahn has published widely including a recent book on Biotechnology and Sustainable Agriculture, serves on numerous boards, and scientific advisory panels including the Board on Agriculture and Natural Resources at the U.S. National Research Council/National Academies of Science. She is a Co-editor in Chief of the new open access journal BMC Agriculture and Food Security, and she chairs the Scientific Advisory Committee for the Energy and Environmental Sciences.

Pavel Kabat, *Director, IIASA*

Professor Kabat remains a Professor of Earth System Science at Wageningen University, and Director and Chair of the Royal Dutch Academy of Arts and Sciences' Institute for Integrated Research on Wadden Sea Region. Professor Kabat has over twenty years' experience of leading interdisciplinary and international research teams investigating global environmental change. During this time with support from the European Commission and other large international agencies such as the National

Aeronautics and Space Administration (NASA), he has pioneered large-scale research on global change that has provided the foundation for a new generation of thinking in global change research. His roles have included being Co-Chair of two of the International Scientific Steering Committees of the International Geosphere-Biosphere Programmes, ILEAPS from 2004 to date and BAHC from 1994 to 2003; and the Science Director of the International Dialogue on Water and Climate and the International Cooperative Programme on Water and Climate from 2001 to 2009.

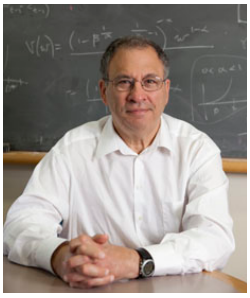
Omar Knio, *Pratt School of Engineering, Duke University*

Omar Knio is Edmund T. Pratt, Jr., Professor of Mechanical Engineering and Materials Science at Duke University. He received his Ph.D. in Mechanical Engineering in 1990 from MIT. He held a postdoctoral associate position at MIT, before joining the Mechanical Engineering Faculty at Johns Hopkins University in 1991. In 2011, he joined the MEMS Department at Duke, where he also serves as Director of the Pratt School of Engineering Initiative on Uncertainty and Risk, and as Associate Director of the Center for Material Genomics. Since 2012, he has held a Visiting Professor position at KAUST, where he also serves as Deputy Director of the SRI Center for Uncertainty Quantification in Computational Science and Engineering. O Knio held a visiting professor position at the Ecole Centrale de Lyon in 1993, 1994, 1995, and 2001, and at the Université du Havre in 1997. He was visiting lecturer at the Institut für Technische Mechanik in Aachen, Germany, in 1994, and also held visiting scientist positions at Sandia National Laboratories from 1996-2001, and at the Free University in Berlin in 1999 and 2000. O. Knio co-founded Reactive NanoTechnologies Inc., in 2001, and has served as its Senior Vice President from 2001-2008. He is the recipient of an Associated Western Universities Faculty Fellowship Award in 1996, a Friedrich Wilhelm Bessel Award in 2003, an R&D100 Award in 2005, and a Distinguished Alumnus Award from the American University of Beirut in 2005. He currently serves on

the Editorial Boards of Theoretical and Computational Fluid Dynamics, of ISRN Applied Mathematics, and of SIAM/ASA Journal on Uncertainty Quantification. He has co-authored over 100 archival journal papers, two books, and is an inventor on 12 patents. O Knio's research interests include uncertainty quantification, computational fluid mechanics, energetic materials, oceanic and atmospheric flows, physical acoustics, chemically-reacting flow, and asymptotic and stochastic techniques.

Harry Kolar, *IBM*
Dr. Kolar is an IBM Distinguished Engineer concentrating on sensor-based solutions in IBM Research. His recent focus has been environmental monitoring and management in the area of advanced water management. He has worked across several IBM divisions in technical, management, and executive roles to advance cross-industry application of new technologies, including advanced analytical methods, information and knowledge management, pervasive/embedded real-time intelligent systems, and sensor-based, cyberphysical systems. Dr. Kolar is actively involved in several sensor-based projects such as the Beacon Institute's River and Estuary Observatory Network (REON) in New York, the Marine Institute of Ireland's SmartBay Galway project, and a complex monitoring project for sustainable ocean energy with the Sustainable Energy Authority of Ireland. Dr. Kolar focuses on developing and applying new technologies to sensor-based applications to support IBM's global crossindustry Smarter Planet initiative.

Sander van der Leeuw, *Arizona State University*
Sander van der Leeuw is the 2012 United Nations Champion of the Earth for Science and Innovation. His expertise lies in the role of invention, sustainability, and innovation in societies around the world. He and his research team investigate how invention occurs, what the preconditions are, how the context influences it, and its role in society. An archaeologist and historian by training, Dr. Van de Leeuw has studied ancient technologies, ancient and modern man-land relationships, and Complex Systems Theory. He has done archaeological fieldwork in Syria, Holland, and France, and conducted ethno-archaeological studies in the Near East, the Philippines and Mexico. Since 1992 he has coordinated a series of interdisciplinary research projects on socio-natural interactions and modern environmental problems. The work spans all the countries along the northern Mediterranean rim. Dr. Van der Leeuw is an External Professor of the Santa Fe Institute and a Corresponding Member of the Royal Dutch Academy of Sciences. He teaches courses on the ethnography of innovation.



Simon Levin, *Princeton University*
My research interests have been in complexity, and in understanding how macroscopic patterns and processes are maintained at the level of ecosystems and the biosphere, in terms of ecological, behavioral, and evolutionary mechanisms that operate primarily at the level of the organisms. In recent years, I have turned my attention to the parallels between ecological systems and financial and economic systems, particularly with regard to what makes them vulnerable to collapse, and to the evolution and development of structure and organization. Of particular interest to me are discounting, intergenerational and intragenerational equity, cooperation and social norms. I have been especially interested in the management of public goods and common-pool resources. Much of my ecological research is concerned

with the evolution of diversification, the mechanisms sustaining biological diversity in natural systems, and the implications for ecosystem structure and functioning. The work integrates empirical studies and mathematical modeling, with emphasis upon how to extrapolate across scales of space, time, and organizational complexity. The essential mathematical challenge is the development of macroscopic descriptions for the collective behavior of large and heterogeneous ensembles that are subject to continual evolutionary modification. Specific attention is directed to the evolution and ecology of collective behavior, from the movements of flocks of birds and schools of fish to human decision-making. Current ecological systems of study include plant communities, as well as marine open-ocean and intertidal systems. In related work, I have been interested in the dynamics of infectious diseases, and in particular in the self-organization of strain structure in influenza A, and in the dynamics of antibiotic resistance. In addition, I have been involved in issues of sustainable development, with emphasis on the linkages between environmental and socio-economic systems. My book, Fragile Dominion:
Complexity and the Commons, is an introduction to my view of the issues underlying the dynamics and management of ecological systems, with broad analogies to socioeconomic systems.

Pam Matson, *Stanford University*
Matson studies the cycling of carbon, nitrogen, and other elements between soil, water, and atmosphere, focusing primarily on the effects of land use and climate change in tropical forest and agricultural systems. Together with hydrologists, atmospheric scientists, economists and agronomists, she and her students analyze the economic drivers and environmental consequences of land use and resource use decisions, with the objective of identifying practices that are economically and environmentally sustainable. They also evaluate management strategies that reduce greenhouse gas emissions, and develop indicators of vulnerability to global climate change. Honors and activities: Chair, NRC Panel on Advancing the Science of Climate Change (2008-present); member, NRC Committee on America's Climate Choices; Richard W. Lyman Award (2005); leader, Stanford Environmental Initiative (2004-present); director, Aldo Leopold Leadership Program (2004-present); trustee, World Wildlife Fund (2003-present); McMurtry University Fellow for Undergraduate Education (2002); co-chair, NAS Roundtable on Science and Technology for Sustainability (2002-present); founding editor-in-chief, Annual Review of Environment and Resources (2002-present); president, Ecological Society of America (2001-2003); Provost's Committee on the Environment
(1999-present); director, Earth Systems Program (1999-2002); fellow, American Association for the Advancement of Science (1997); MacArthur Fellowship (1995-2000); election to National Academy of Sciences (1994); election to American Academy of Arts and Sciences (1992)

Nebojsa Nakicenovic, *Deputy Director, IIASA*
Nebojsa Nakicenovic is Deputy Director and Deputy CEO of the International Institute for Applied Systems Analysis (IIASA), Professor of Energy Economics at the Vienna University of Technology, and Director of the Global Energy Assessment (GEA). Among other positions, Prof. Nakicenovic is member of the United Nations Secretary General High-Level Technical Group on Sustainable for Energy for All; Member of the Advisory Council of the German Government on Global Change (WBGU); Member of the Advisory Board of the World Bank Development Report 2010: Climate Change; Member of the International Council for Science (ICSU) Committee on Scientific Planning and Review, and Member of the Global Carbon Project; Member of the Mitigation Board of the Global Network for Climate Solutions (GNCS) at the

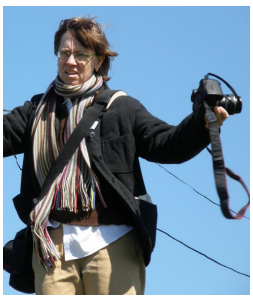
Earth Institute of Columbia University; Member of the Board, Climate Change Centre Austria (CCCA); Member of the Steering Committee of the Austrian Panel on Climate Change Assessment Report (APCC); Member of the Panel on Socioeconomic Scenarios for Climate Change Impact and Response Assessments; Lead Author of Fifth Assessment Report of the IPCC; Member of the Renewable Energy Policy Network for the 21st Century (REN21) Steering Committee; and Member of the International Advisory Board of the Helmholtz Programme on Technology. More at http://webarchive.iiasa.ac.at/Admin/DI/docs/deputy_director.html?sb=2)

Deb Niemeier, *UC Davis*

Deb Niemeier received her degree in Civil and Environmental Engineering from the University of Washington in 1994. Her research focuses on the impact of low income families' access to transport on jobs, healthcare, and schools. She has served as Dept. Chair and she recently served for four years as the Director of the John Muir Institute and Associate Vice Chancellor in the Office of Research at UC Davis. She is currently the Editor-in-Chief of Transportation Research, Part A and is a member of the MARs Corp. Scientific Advisory Council (Sustainability). She is also the Director of the UC Davis-Caltrans Air Quality Project, a continuing state and federally funded research program, which began in 1999, aimed at improving vehicle emissions modeling and developing regulatory responses for state and local agencies. She has received a number of awards including the Aldo Leopold Leadership Award (2005), the Chancellor's Fellow Award (2001-2004), an NSF CAREER award (1997), and UC Davis Outstanding Faculty Mentor (1997) and Faculty Advisor (1995) Awards.

Michael Obersteiner, *Program Leader, Ecosystems Services and Management, IIASA*

Michael Obersteiner is leader of the Ecosystems Services and Management (ESM) Program at the International Institute for Applied Systems Analysis (IIASA) in Laxenburg, Austria. He joined IIASA's Forestry Program (FOR) in 1993 and has been leading the Group on Global Land-Use Modeling and Environmental Economics since 2001. Dr. Obersteiner's research experience stretches from plant physiology and biophysical modeling in the areas of ecosystems, forestry and agriculture to environmental economics, bioenergy engineering and climate change sciences as documented in his publications record. More at:
http://www.iiasa.ac.at/staff/staff.php?type=auto&visibility=visible&search=true&login=obers



Katherine Richardson, *Sustainability Science Centre, University of Copenhagen*

Katherine Richardson is a professor of biological oceanography and vice dean of the faculty of science at the University of Copenhagen and the leader of University of Copenhagen's Sustainability Science Centre. Katherine was chairman of the Danish Commission on Climate Change Policy, which reported in 2010 and presented a roadmap for how Denmark can become independent of fossil fuels by 2050. She is a lead author on the book Climate Change: Global Risks, Challenges and Decisions (Cambridge University Press, 2011) and co-authored with Stefan Rahmstorf Our Threatened Oceans (2009). Katherine is a principle investigator in the Center for Macroecology, Evolution and Climate where her research focuses

on the importance of biological processes in the ocean for the uptake of CO2 from the atmosphere and how ocean biology, including diversity, contributes to ocean function in the Earth System. She is active as a member and/or chairperson of a number of national and international research committees, and advisory boards. She was vice president of the European Science Foundation from 2001-2008 and chairman of the Earth System Science evaluation panel for European Research Council starting grants from 2008-2010. She has published over 100 scientific papers and book chapters.

Elena Rovenskaya, *IIASA*

Elena Rovenskaya is the Acting Program Leader of the Advanced Systems Analysis (ASA) Program. She is also a Research Scholar at the Optimal Control Department of the Faculty of Computational Mathematics and Cybernetics, Lomonosov Moscow State University, Russia. Her scientific interests lie in the fields of theory of optimal control, ill-posed problems and economic-environmental modeling.

Dr. Rovenskaya graduated in 2003 from the Faculty of Physics, Lomonosov Moscow State University, Russia. She received her PhD in 2006 from the Faculty of Computational Mathematics and Cybernetics, Lomonosov Moscow State University, Russia. The title of her PhD thesis was “On solving the problem of finding the optimal compatibility parameter value for a class of equations in a normalized space.” In 2005, Dr. Rovenskaya participated in the Young Scientists Summer Program and since 2006 she has been collaborating with the Dynamic Systems Program (now Advanced Systems Analysis Program). In 2012 she was appointed Deputy Program Leader for the ASA Program.

Dr. Rovenskaya's current research is focusing on modeling of optimal forest management, exploring systemic risks in ecological networks, modeling economic growth with environmental constraints and agent-based modeling of regional development.

Jerry Sabloff, *SFI*

Before coming to the Santa Fe Institute, he taught at Harvard University, the University of Utah, the University of New Mexico (where he was Chair of the Department), the University of Pittsburgh (where he also was Chair), and the University of Pennsylvania (where he was the Williams Director of the University of Pennsylvania Museum from 1994-2004 [and Interim Director, 2006-2007] and Christopher H. Browne Distinguished Professor of Anthropology). He also was an Overseas Visiting Fellow at St. John's College, Cambridge, England. He is a past President of the Society for American Archaeology, a past Chair of Section H (Anthropology) of the American Association for the Advancement of Science, and past Editor of American Antiquity. He served as Chair of the Smithsonian Science Commission and currently is a member of the Visiting Committee for the Peabody Museum, Harvard University, the National Advisory Board of the National Museum of Natural History, and the Board of Trustees of the SRI Foundation, as well as a Senior Fellow Emeritus of the Kolb Foundation (of which he was President from 1994-2004 and 2006-2007).

Bob Scholes, *CSIR, South Africa*

Scholes has been employed by the CSIR since 1992. He trained under Professor Brian Walker at the University of the Witwatersrand and Professor Pedro Sanchez at North Carolina State University. He has over 25years of experience in many parts of Africa and has published widely in the fields of savanna ecology and global change, including in popular and scientific books. He has been involved in several high-profile environmental assessments and contributes to the formulation of national environmental policy. He is or has been a member of several steering committees of international research programmes, including the International Geosphere-Biosphere Programme and the Global Climate Observing System, and serves as a convening lead author for the Intergovernmental Panel on Climate Change. He was chairperson of the Global Terrestrial Observing System (2001-4), a member of the GEO Implementation Plan Task Team, board member of the International Centre for Research in Agroforestry, and co-chair of the Conditions and Trend Working Group of the Millennium Ecosystem Assessment. He is currently a member of the steering committees of Diversitas and a member of the South African National Parks Board. He is a Fellow of the South African Academy and the Royal Society of South Africa, member of several professional societies and serves on the editorial board of numerous journals.

Jessika Trancik, *MIT*

Assistant Professor of Engineering Systems, MIT. Prof. Trancik's research centers on evaluating the environmental impacts and costs of energy technologies, and setting design targets to help accelerate the development of these technologies in the laboratory. This work involves assembling and analyzing expansive datasets, and developing new quantitative models and theory. Projects focus on electricity and transportation, with an emphasis on solar energy conversion and storage technologies. Trancik was a postdoctoral fellow at the Santa Fe Institute and a fellow at Columbia University's Earth Institute. She earned a B.S. in materials science and engineering from Cornell University (1997), and a PhD in materials science from Oxford University (2002), where she studied as a Rhodes Scholar. She has also worked for the United Nations, and as an advisor to the private sector on investment in low-carbon energy technologies. She has published in journals such as the Proceedings of the National Academy of Sciences, Nano Letters, and Environmental Research Letters.

Brian Walker, *CSIRO*

Dr Walker is an Honorary Research Fellow with CSIRO Ecosystem Sciences and is also Chair of the Board of the International Resilience Alliance, an international research group working on sustainability of social-ecological systems.

A key focus of his work is the significance of resilience (the capacity of a system to absorb disturbance and to undergo change while still retaining essentially the same function, structure, identity, and feedbacks) in the sustainability of ecosystems and social-ecological systems.

Dr Walker co-authored the 2006 book *Resilience thinking: Sustaining ecosystems and people in a changing world*.

Dr. Walker began his scientific career in southern Africa, where he developed an interest in ecosystem function and dynamics in tropical savannas and rangelands.

His experience covers research, teaching and environmental science leadership including 15 years as Chief of the former CSIRO Division of Wildlife and Ecology (now CSIRO Ecosystem Sciences) after moving to Australia in 1985.

Tom Wilbanks, *Oak Ridge National Laboratory*

Thomas J. Wilbanks has been a Corporate Research Fellow at the Oak Ridge National Laboratory since 1986 and leads the Laboratory's Global Change and Developing Country Programs. He conducts research and publishes extensively on such issues as sustainable development, responses to environmental hazards and changes, and the role of geographical scale these regards. Co-edited recent books include Global Change and Local Places (2003), Geographical Dimensions of Terrorism (2003), and Bridging Scales and Knowledge Systems: Linking Global Science and Local Knowledge (2006). Recent invited presentations include Harvard, Yale, Minnesota, Iowa, the American Association for the Advancement of Science, the National Academies o Science (NAS), the National Science Foundation, and the Energy Modeling Forum. He played roles in the first U.S. National Assessment of Possible Consequences of Climate Variability and Change (1997-2000); the Intergovernmental Panel on Climate Change (IPCC) Working Group II (Impacts, Adaptation, and Vulnerability) Third Assessment Report; and aspects of the United Nations Environment Programme et al. Millennium Ecosystem Assessment related to issues of geographic scale and regional and local assessments. He served as Coordinating Lead Author for the IPCC's Fourth Assessment Report, Working Group II, Chapter 7: "Industry, Settlement, and Society," which includes summaries of knowledge about vulnerabilities, adaptation potentials, and resilience for communities and societies. He also led several "synthesis and assessment" reports for the U.S. Climate Change Science Program (CCSP) in recent years, including summaries of current knowledge about impact and resilience issues for human settlements in the U.S. and for energy production and use in the U.S. Wilbanks is Chair of National Research Council's (NRC) standing Committee on Human Dimensions of Global Change, and he serves on a number of other NRC committees and panels, including serving on the NAS Committee on America's Climate Choices and as vice-chair of the Committee's panel on adapting to climate change. Wilbanks is a past President of the Association of American Geographers (AAG), one of only three non-academics to serve as the president in its more than 100 years, and has been awarded a number of honors related to that field, including AAAS Fellow, 1985; AAG Honors, 1986, Distinguished Geography Educators Award, National Geographic Society, 1993; the Anderson Medal of Honor in Applied Geography, 1995; National Associate of the National Academies of Science, Engineering, and Medicine, 2003; and the AAG Presidential Achievement Award, 2009. In 2007, as a lead author of IPCC' Fourth Assessment Report, he was recognized as a Co-Laureate for the Nobel Prize for Peace.