now it's up to us

BOULDER, CO
AUGUST 24-27

CLIMATE CHANGE: FROM SCIENCE TO POLICY

THE 2011 STEPHEN H SCHNEIDER SYMPOSIUM

www.climatechange.net

Teach Your Children Well

Crosby, Stills, Nash & Young

You who are on the road
Must have a code that you can live by
And so become yourself
Because the past is just a good bye.

Teach your children well,
Their father's hell did slowly go by,
And feed them on your dreams
The one they picked, the one you'll know by.

> Don’t you ever ask them why, if they told you, you would cry,
> So just look at them and sigh and know they love you.

And you, of tender years,
Can't know the fears that your elders grew by,
So please help them with your youth,
They seek the truth before they can die.

Teach your parents well,
Their children's hell will slowly go by,
And feed them on your dreams
The one they picked, the one you'll know by.

> Don’t you ever ask them why, if they told you, you would cry,
> So just look at them and sigh and know they love you.

Teach your children well,
Their father's hell did slowly go by,
And feed them on your dreams
The one they picked, the one you'll know by.

> Don’t you ever ask them why, if they told you, you would cry,
> So just look at them and sigh and know they love you.

2011 Stephen Henry Schneider Symposium

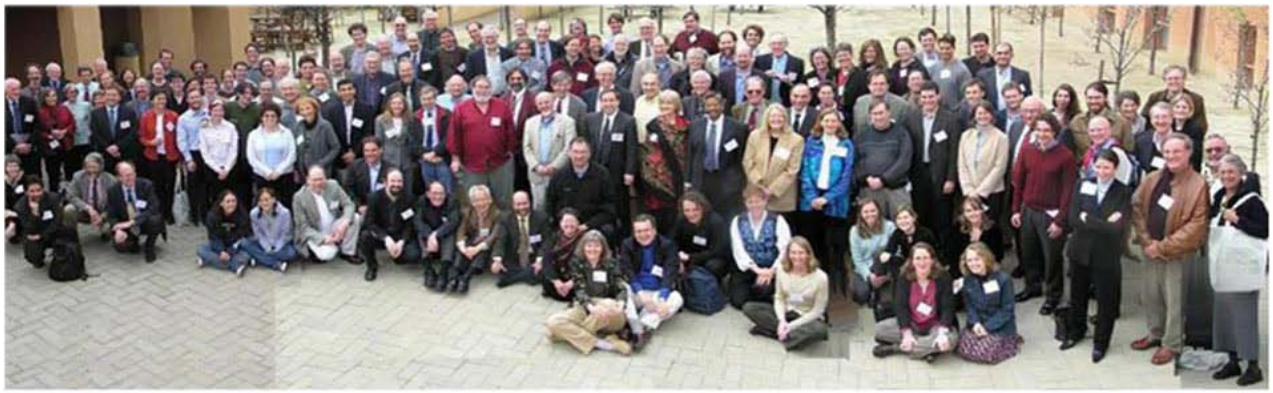
Climate Change: From Science to Policy

August 24-27, Boulder, Colorado

Ice-breaker reception (August 24, 2011) at Mesa Lab (1850 Table Mesa Drive Boulder, CO 80305)	6:00 – 9:00 p.m.
Day 1 (August 25, 2011) at NCAR Center Green Building 1, Main Auditorium (3080 Center Green Drive Boulder, Colorado 80301)	
Registration and Coffee	7:45 a.m.
Introduction to Symposium Terry Root/Linda Mearns/Jean-Pascal van Ypersele/Ben Santer	8:30 – 9:00 a.m.
MORNING SESSION Moderator: Kevin Trenberth (*National Center for Atmospheric Research*)	
Session 1: Aerosol effects on climate	
1: Phil Rasch (*Pacific Northwest National Laboratory*)	9:00 – 9:30 a.m.
2: Alan Robock (*Rutgers University*)	9:30 – 10:00 a.m.
Session 2: Cloud effects on climate	
3: Jeff Kiehl (*National Center for Atmospheric Research*)	10:00 – 10:30 a.m.
Mid-morning break	10:30 – 11:00 a.m.
4: Veerabhadran Ramanathan (*University of California, San Diego*)	11:00 – 11:30 a.m.
Session 3: The role of the ocean in climate change	
5: Warren Washington (*National Center for Atmospheric Research*)	11:30 – 12:00 p.m.
6: Frank Bryan (*National Center for Atmospheric Research*)	12:00 – 12:30 p.m.
Lunch and special presentation by Dr. R.K. Pachauri *(Chairman, IPCC)* "*The life and work of Steve Schneider: Inspiration for IPCC's future*"	12:30 – 2:00 p.m.
AFTERNOON SESSION Moderator: Jerry Meehl (*National Center for Atmospheric Research*)	
Session 4: Understanding uncertainties in estimates of future climate change	
7: Linda Mearns (*National Center for Atmospheric Research*)	2:00 – 2:30 p.m.
8: Alex Hall (*University of California, Los Angeles*)	2:30 – 3:00 p.m.
Session 5: Impacts of climate change on ecosystems	
9: Terry Root (*Stanford University*)	3:00 – 3:30 p.m.
Mid-afternoon break	3:30 – 4:00 p.m.
10: Bill Anderegg (*Stanford University*)	4:00 – 4:30 p.m.
Session 6: Integrated assessment modeling	
11: John Weyant (*Stanford University*)	4:30 – 5:00 p.m.
12: Christian Azar (*Chalmers University, Sweden*)	5:00 – 5:30 p.m.
Open discussion/wrap-up of Session 1-6	5:30 – 6:00 p.m.

Day 2 (August 26, 2011) at NCAR Center Green Building 1, Main Auditorium	
Registration and Coffee	8:00 a.m.
Introduction to Day 2 Linda O. Mearns (*National Center for Atmospheric Research*)	8:45 – 9:00 a.m.
MORNING SESSION Moderator: Kristie Ebi (*Stanford University*)	
Session 7: Paleoclimatology	
13: John Kutzbach (*University of Wisconsin*)	9:00 – 9:30 a.m.
14: Carolyn Snyder (*Delaware Dept. of Natural Resources and Environmental Control*)	9:30 – 10:00 a.m.
Session 8: The economics of climate change	
15: Larry Goulder (*Stanford University*)	10:00 – 10:30 a.m.
Mid-morning break	10:30 – 11:00 a.m.
Session 9: Role of the social sciences in climate change research	
16: Diana Liverman (*University of Arizona/Oxford University*)	11:00 – 11:30 a.m.
17: Kirstin Dow (*University of South Carolina*)	11:30 – 12:00 a.m.
Open discussion/wrap-up of Sessions 7 - 9	12:00 – 12:30 p.m.
Lunch	12:30 – 1:30 p.m.
AFTERNOON SESSION Moderator: Brenda Ekwurzel (*Union of Concerned Scientists*)	
Session 10: Decision-making in the face of scientific uncertainty	
18: Richard Moss (*Pacific Northwest National Laboratory*)	1:30 – 2:00 p.m.
19: Jean-Pascal van Ypersele (*Université catholique de Louvain, Belgium*)	2:00 – 2:30 p.m.
Session 11: Strategies for improving climate science communication	
20: Naomi Oreskes (*University of California San Diego*)	2:30 – 3:00 p.m.
21: Paul Edwards (*University of Michigan*)	3:00 – 3:30 p.m.
Announcement of first annual Stephen H. Schneider Award for Outstanding Climate Science communication (Greg Dalton, *Climate One, The Commonwealth Club*)	3:30 – 3:45 p.m.
Mid-afternoon break	3:45 – 4:15 p.m.
Session 12: Training the next generation of climate scientists	
22: Mike Mastrandrea (*IPCC Working Group II TSU*)	4:15 – 4:45 p.m.
23: Chris Still (*University of California Santa Barbara*)	4:45 – 5:15 p.m.
24: Jessica Hellmann (*University of Notre Dame*)	5:15 – 5:45 p.m.
Open discussion/wrap-up of Sessions 10 - 12	5:45 – 6:15 p.m.

Day 3 (August 27, 2011) at NCAR Center Green Building 1, Main Auditorium	
Registration and Coffee	8:00 a.m.
Introduction to Day 3	8:45 – 9:00 a.m.
Jean-Pascal van Ypersele (*Université catholique de Louvain, Belgium*)	
MORNING SESSION	
Moderator: Susan Solomon (*Earth System Research Laboratory*)	
Session 13: A brief history of the journal *Climatic Change*	
25: Gary Yohe (*Wesleyan University*)	9:00 – 9:30 a.m.
Session 14: Steve Schneider's contributions to the IPCC	
26: Michael Oppenheimer (*Princeton University*)	9:30 – 10:00 a.m.
Mid-morning break	10:00 – 10:30 a.m.
27: Chris Field (*Carnegie Institution for Science*)	10:30 – 11:00 a.m.
28: Ben Santer (*Lawrence Livermore National Lab*)	11:00 – 11:30 a.m.
Open discussion/wrap-up of Sessions 13 and 14	11:30 – 12:00 p.m.
Lunch	12:00 – 1:00 p.m.
AFTERNOON SESSION	
Moderator: Rick Piltz (*Climate Science Watch*)	
Session 15: The challenge of climate change mitigation and adaptation: How do we translate sound climate science into sound policies?	
29: Ana Unruh-Cohen (*Democratic Staff, Committee on Natural Resources*)	1:00 – 1:30 p.m.
30: Joe Romm (*Climate Progress*)	1:30 – 2:00 p.m.
31: Jay Gulledge (*Pew Center on Global Climate Change*)	2:00 – 2:30 p.m.
Mid-afternoon break	2:30 – 3:00 p.m.
32: Robert Watson (*Department for Environmental Food and Rural Affairs, U.K.*)	3:00 – 3:30 p.m.
Open discussion/wrap-up of Session 15	3:30 – 4:00 p.m.
Reports from rapporteurs/future of the Symposium	4:00 – 5:00 p.m.
Break	5:00 – 7:30 p.m.
Symposium dinner and after-dinner remembrances	7:30 – 10:00 p.m.



Attendees of the Whole Earth Systems Conference at Stanford University in February 2005, which celebrated Stephen H. Schneider's professional contributions and 60th birthday.

Speaker Abstracts

Anderegg, William
Stanford University

The Changing Emerald Planet: Plants and Climate Change

All across the planet, from the shallow waters of coral reefs to the high mountain forests, species are already responding to climate change. Species' responses to changes and how these responses and interactions scale to ecological communities and ecosystems will play an important role in the impacts of climate change on biodiversity and ecosystem feedbacks to climate change. I will present two example systems, western North America's mountain forests and California's flora, that explore the diversity and dynamics of these responses to changes in climate. Forests store approximately 45% of the carbon found in terrestrial ecosystems, but they are sensitive to drought and climate-induced dieback. Widespread and rapid forest die-off constitutes a major uncertainty in climate change impacts on terrestrial ecosystems and carbon cycle feedbacks. Current understanding of the physiological mechanisms mediating climate-induced forest mortality limits the ability to model or project these threshold events under climate scenarios. I will discuss the individual to regional scale direct tests of two broad physiological hypotheses underlying a recent and rapid trembling aspen (*Populus tremuloides*) forest mortality. We have combined observational tests of hydraulic conductance and carbohydrate reserves with experimental drought manipulations on potted and mature trees to examine the roles of carbon starvation and hydraulic failure due to water stress in this forest die-off. Second, I will present results from an ongoing project that examines the diversity and drivers of changes in California's flora over the past century.

Azar, Christian
Chalmers University, Sweden

Integrated assessment models and their role in science policy interactions

This paper offers a broad overview of how carbon emissions and policy have developed in Sweden over the past couple of decades. It then addresses how integrated assessment models may, or may, not help in developing appropriate abatement policies. Results from our GET model, the Global Energy Transition model, are presented concerning both fuel use in the global transport sector and the role of bioenergy with carbon capture and storage (BECCS) under stringent climate constraints. Interesting key questions, that should be posed by and to all researchers presenting results from integrated assessment models, include: (i) How robust are the results with respect to changes in parameter values and various structural assumptions? (ii) What did we learn from developing and running the model? What did we learn that we could not have learnt without running the model? (iii) Can the new insights be understood without the model? (iv) how should the modeling results be interpreted (are they descriptive,

predictive or prescriptive)? The concluding section addresses how the results from the GET model may be used in the context of science-policy interactions, using Sweden as an example. Particular focus is given the extent to which integrated assessment models are used to provide first best policy advice (the cost-effective solution) and whether, perhaps, more effort should be directed to analyze second-best options that although perhaps more costly, stand a better chance of getting wider political acceptance, i.e., the real-world trade-off that policy makers face.

A version of the GET model may be run interactively on www.chalmers.se/ee/getonline (this version "only" models the global energy system and the carbon cycle, the full version, not available online also include other greenhouse gases and aerosols, and a three box temperature response model).

Bryan, Frank
National Center for Atmospheric Research

Ocean Weather, Ocean Heat Uptake, and Transient Climate Change

The rate of climate change in response to radiative forcing from increasing greenhouse gases is strongly dependent on the efficiency of the processes transferring heat to the deep ocean. Much of the literature on this topic has been based on the vertical advection-diffusion paradigm, in which turbulent mixing processes transfers heat downward into the deep ocean, while high-latitude formation of cold deep waters and broad-scale upwelling serve to cool the deep ocean. It is now apparent that on global average this physical paradigm is incorrect. The global average heat balance of the deep ocean is dominated by processes in the Southern Ocean, where both vertical diffusion and the mean overturning circulation act to warm the deep ocean, while mesoscale eddies, i.e., the weather systems of the ocean, act to cool the deep waters. In this presentation we will illustrate this revised paradigm, and examine how it affects the uptake of heat during transient climate change. Results from a suite of standard resolution simulations, typical of IPCC AR5 class models, in which the mesoscale eddies are parameterized, will be contrasted with very high resolution experiments in which the mesoscale eddies are explicitly resolved.

Dow, Kirstin
University of South Carolina

The Role of Social Sciences in Climate Change Research

Understanding climate changes, anticipating the potential consequences, and evaluating possible responses requires interdisciplinary science and engagement with broad conversations taking place outside academia. Steve Schneider was a leader in helping scientists of all backgrounds to engage the challenges of interdisciplinary research and effectively

communicate that research and its uncertainties to diverse audiences. His efforts were critical to building the foundation we have for addressing the work ahead.
In this paper, I will focus on social sciences insights into understanding risks, uncertainties, and societal response. The discussion will address social science contributions to other societal debates over risks and uncertainty and consider the challenges in bringing these insights fully to bear in the context of climate change. As understanding of climate processes improves, there is growing potential and pressure to more fully explore potential impacts, to understand the relationship between climate changes, thresholds, and well-being, and to inform the design of response strategies. Advancing knowledge and capacity in social sciences is essential to continuing to integrate sciences and developing approaches to characterize and communicate knowledge and uncertainty of those integrations. Social sciences will also play a major role in advancing our ability to provide decision relevant science for adaptation and mitigation interactions and priorities.

Edwards, Paul
University of Michigan

Uncertain about Uncertainty: Talking about Climate Knowledge to Non-Scientists

Most people now take weather forecasting for granted as an imperfect but largely reliable source of knowledge. By contrast, climate knowledge — not only model predictions, but also historical climate data — obstinately fails to recede noiselessly into the background. Instead, climate controversies constantly seem to lead down into the guts of the climate knowledge infrastructure, inverting it, regenerating debates about the quality of historical data and simulation models.
This talk, from a historian of science and technology, will argue that beyond disinformation and the (very real) "war on science," these debates regenerate for a more fundamental reason. The climate knowledge infrastructure never disappears from view because the black box of climate history is never closed. Scientists are always opening it up again, studying the origins of data to find out more about how old numbers were made and revising their data accordingly. New metadata breed new data models; those in turn breed new pictures of the past. From the point of view of scientists, these changes improve the quality of knowledge, but to an outsider they can readily appear arbitrary. I will conclude with some reflections on how the changing information environment (blogs, open access to data and models, citizen science, etc.) may affect the future of climate science. Throughout, I will argue that the language of uncertainty has served the scientific community poorly in public communication.

Field, Chris
Carnegie Institution for Science

Building the Future of the IPCC

Steve was very careful about picking the big stages for his messages. He picked stages where he and his message got noticed, and where the notice could lead to concrete progress in science or policy. For Steve, the IPCC was definitely a favorite stage, one he considered worthy of his investing vast amounts of time and energy, as well as his tolerating substantial frustrations. Why was the IPCC so worthwhile for Steve and the entire climate science community? And what might be done to make it even more worthwhile in the future?

Several features make the IPCC unique, including the comprehensiveness of its assessments and the thoroughness of its multi-pass, monitored review process. But the feature that really makes the IPCC unique is the way it operates as a partnership between governments and the scientific community. The partnership is not mostly about the word by word approval of Summaries for Policymakers, though that is one component. The essence of the partnership is the agreement that, if the scientific community follows the rules, the governments will use the assessment as the scientific foundation for discussions on issues related to climate policy. This is the feature that makes the IPCC unique, uniquely powerful, and uniquely threatening.

The unique relationship between governments and the scientific community is a great asset of the IPCC, but the institution needs to keep evolving if it is to serve society as effectively as possible. Especially in the last two years, the IPCC has faced a wide range of wide range of challenges. In some cases, it has tested the limits of its relationship with both supporters and critics. Overall, the IPCC has proven itself resilient in the face of these challenges, but the challenges and the responses to them have revealed a number of questions yet to be addressed. Among the important questions the community is asking the IPCC, and the IPCC is asking itself are the following:

1) How can the IPCC be open and transparent while still protecting the interests of the individual contributors and also protecting the interest of the public in information that has been triple checked for accuracy and references, through several rounds of reviews?
2) How can the IPCC remain comprehensive in the face of the exploding quantity of scientific information on climate change?
3) Can the IPCC continue to simultaneously manage the mandates for including authors who are the leading scientists, authors with diverse views, and authors from all sections of the world?
4) How can the IPCC provide information that is both timely and responsive to the changing needs of policymakers while also adding the value from the IPCC review and approval process?
5) How can the IPCC take advantage of new technologies to enhance the effectiveness of its scientific and public outreach?

6) How can the IPCC address the full range of topics where scientific approaches are relevant without compromising its mandate that the work must be policy relevant but not policy prescriptive?
Finding good answers to these and other questions will be critical in sustaining an IPCC that meets the needs of a changing world.

Goulder, Larry
Stanford University

The Polymath Collaborates with the Economist: Schneider and Goulder on Policy-Induced Technological Change

This presentation is meant to serve both as a tribute to Steve and as a demonstration of how economic analysis can inform climate change policy. Here I'll illustrate some joint work that Steve and I conducted to assess alternative policy options for stimulating the invention of clean technologies. I'll go on to describe some very recent work and findings by other authors – analyses that might have been stimulated by our joint efforts.

Gulledge, Jay
Pew Center on Global Climate Change

Lost in Translation: Closing the Gap between Climate Science and National Security Policy

In a rare display of international leadership on climate policy, the United States military has adopted the official stance that climate change is a threat multiplier and likely a defining security challenge of the 21st century. Two primary needs of the national security/foreign policy community are to assess how climate change is likely to impact the national interest and to develop a risk-management framework that shapes a comprehensive response. However, national security decision makers lack climate-related information they deem "actionable" to formulate meaningful policy and practice. Even though the scope and quality of scientific information continues to increase and improve, this information is not often presented in a form that is both accessible and useful to decision makers. The same can be said for business decision makers, although that community is more fragmented and varied in how it responds limited information. Different needs, priorities, processes, cultures and philosophies separate the information producer and consumer communities and multiple barriers impede effective communication across this gap. A stovepiped producer community inhibits the interdisciplinarity required to produce actionable information. Producers are culturally and institutionally predisposed to achieving scholarly goals and aiding in governance is viewed as a secondary benefit. The consumer community is generally unaware of the variety of disciplines involved and the various archives of scientific information. A shortage of translators who understand both climate information and decision makers' needs also inhibits information

transfer. A lack of mutual trust may inhibit the formation of lasting relationships between consumer and producer groups. Fundamentally, bridging the information gap requires that consumer institutions incentivize the production of information tailored to their needs and that producer institutions value and reward work aimed at facilitating governance. Some cultural, philosophical and institutional adaptations are required of both producers and consumers, but wholesale reform is unlikely and probably unnecessary.

Hall, Alex
University of California, Los Angeles

A Methodology for Reducing Uncertainty in Climate Change Projections

There is great interest in finding metrics of climate model performance that help determine model trustworthiness for projections of future climate change. Here a method for identifying and employing such informative metrics of performance is presented. The method is based on physical understanding of the climate system. When successful, the method may lead to reductions in the spread of future climate change projections, climate model improvement, and more strategic observation of the current climate system. Under certain circumstances, the method may also be used to reduce uncertainty surrounding future climate change.

Hellmann, Jessica
University of Notre Dame

Integrative Climate Science for the Next Century: Interdisciplinary Training in Climate Change Biology

Federal funding agencies and students themselves are increasingly committed to bringing scientific knowledge to real-world applications. Graduate training has been transformed by the NSF-IGERT and other emerging interdisciplinary programs that call for students to pursue multidisciplinary research and form interdisciplinary collaborations. This vision of researchers who can move across fields in search of workable solutions was one of Steve's dreams, a dream increasingly realized at Stanford and implemented by his former students worldwide. As an example of recent progress in interdisciplinary training, I will present the University of Notre Dame's IGERT program, Global Linkages in Biology, Environment, and Society and give examples of how interdisciplinary thinking is increasingly important in climate science, broadly defined. As a case study, I will argue that climate change biology is growing from a science that diagnoses ecological impacts of climate change to a predictive science that informs decision-making and enables humans to intervene and help ecosystems adapt to changing climatic conditions.

Kiehl, Jeff
National Center for Atmospheric Research

The Long and Winding Road to Understanding Cloud Effects on Earth's Climate

These clouds stick to the sky
Like floating questions, why?

Cloudy by Simon and Garfunkel

Clouds are ubiquitous to Earth's atmosphere and play an important role in determining the amount of radiative energy available to Earth's climate system. Clouds reflect shortwave radiation, thus contributing to a cooling of the Earth's surface. Clouds also limit the escape of longwave radiation to space, which is a fundamental process by which Earth regulates surface temperature. Equally important is how clouds may change as Earth's climate warms due to increased greenhouse gases, in which cloud feedback processes may either amplify or dampen the greenhouse forced warming.

In this presentation, I look back at how our understanding of the role of clouds in Earth's climate has evolved over the past century. A number of interesting early studies identified clouds as a critical component to Earth's climate system and provided a heuristic framework to look at cloud climate interactions. I then consider the important contributions that Steve Schneider made to our understanding of the effects of clouds on climate. His methodology became the canonical framework for studying cloud climate problems. I discuss how Steve's contributions motivated and directed further cloud climate research up to the present. I conclude with some personal reflections on the challenges that cloud climate research presents to the research community.

Kutzbach, John
University of Wisconsin

Studies of Past Climates: Perspectives- Past, Present, Future; With Particular Emphasis on the Contributions of Steve Schneider

I review Steve Schneider's contributions to the study of paleoclimate including his pioneering collaborative work in developing early Earth System Models, in studying the response of climate to volcanic eruptions, in using models to examine the sensitivity of paleoclimates to changes in external forcing, in examining climate/ecology linkages, and in showing how studies of paleoclimate help inform studies of future climates. I then present examples of the evolution of paleoclimatic studies over the period of Steve's professional career – an evolution made possible by improved observations (more variables, more spatial coverage, improved dating), improved earth system models, and the growth in computer resources. I close with brief examples of future directions of paleoclimate studies.

Liverman, Diana
University of Arizona/Oxford University

The Role of the Social Sciences in Climate Change Research

We cannot understand climate change causes, consequences or responses without the social sciences. Steve understood this when he admitted me to NCAR's advanced study program in the 1970s - a geography student with interests in human responses to hazards – and when he encouraged me to take on the challenge of modeling how climate change and variability might affect food security. He was an early champion of integrating natural and social science approaches to climate change as, for example, a member of the Social Science Research Council Committee for Research on Global Environmental Change and as the editor of Climatic Change which published a number of social science articles in its first year (1977).
In my paper I will discuss the role of the social sciences in climate change research by reviewing key arguments about the importance and challenges of understanding vulnerability, socioeconomic scenarios, human perceptions/behaviors and climate governance. I will also flag some enduring myths and misunderstandings about the social sciences including those about the human causes of environmental change, the importance of the physical environment and environmental information, the effectiveness of different policy responses, and the role of social scientists in interdisciplinary climate research.

Mastrandrea, Mike
Stanford University

Learning and Communicating What We Know and What We Don't

One of Steve's great passions was the exploration of the complexities of the coupled human-natural systems of our planet. He devoted tremendous effort to the characterization of the uncertainties inherent in this scientific understanding in ways that enable communication of the state of knowledge. Such characterization, both of what is well established and where uncertainties remain, is essential for informing policy decisions. Steve imparted this passion for learning and communicating to the next generation of scientists, including myself, a student and collaborator with Steve for many years. I will discuss some of Steve's methods, with a specific focus on his role in the development of the first and subsequent guidance documents on the treatment of uncertainties in IPCC assessment reports. I will also present the elements of the recently developed guidance for the upcoming IPCC Fifth Assessment Report, and its linkages to the foundation built by Steve.

Mearns, Linda
National Center for Atmospheric Research

Uncertainties about Future Climate Change: Where to Place Our Efforts

There are three main uncertainties regarding the climate system in the future: 1) uncertainties regarding the future emissions (and concentrations) of greenhouse gases and aerosols in the atmosphere 2) the way the climate system will respond to the future forcing resulting from the changes in concentrations, on various spatial and temporal scales, and 3) the uncertainty based on the internal variability of the climate system. However, there are other uncertainties, which are harder to quantify, that include important climate processes that are not well modeled in climate models, and/or are poorly understood, as well as 'unknown processes' whose importance is not yet known. From the point of view of climate modelers and climate simulations, the uncertainties with which they are concerned are primarily the second and third as well the incomplete representation of some processes. An important debate regarding uncertainty is whether and by how much the various uncertainties can be reduced, assuming that reduction of uncertainty about physical systems is an important goal of physical science. Certainly, increased knowledge about future climate continues to accrue, and one can view this as a type of reduction of uncertainty. But that is quite different from reduction of uncertainty regarding, for example, by how much annual temperature and precipitation will change in the upper Colorado River Basin by 2050 compared to the current period. It is this latter type of uncertainty that is of particular interest to the many stakeholders who will be making decisions on a regional or finer spatial scale about how to manage future climate change. Furthermore there are important questions regarding by when different types of uncertainty can be reduced. I will discuss some of these issues, (e.g., the role of reducing uncertainty, quantification of poorly understood uncertainties) based on the most recent climate science and make suggestions on where we should go from here.

Moss, Richard
Pacific Northwest National Laboratory

Reducing Doubt about Uncertainty: Challenges at the Science-Policy Interface

Uncertainty, or more generally, debate about the level of certainty required to reach a "firm" conclusion, is a perennial issue in science. In "science for policy" in the global change arena, the challenges are particularly acute because of scientific complexity, long time horizons, and large political and economic stakes, among other factors. Moss and Schneider prepared uncertainty guidelines for the Third Assessment Report (TAR) of the Intergovernmental Panel on Climate Change (IPCC) that recommended a process to make expert judgments of levels of confidence and uncertainty more systematic, and provided calibrated textual qualifiers to improve communication of findings to users. In spite of the guidance and efforts to disseminate it, each of the three IPCC working groups approached the issue differently in the TAR, and a number of "medium confidence" findings were reported with qualifiers such as "could" or "some" that

made those conclusions essentially meaningless. So what did the guidance achieve? This presentation will review the recommendations, immediate results in the TAR, the evolution of uncertainty guidance in subsequent IPCC assessments, and ensuing debates that emerged in research on climate change, decision analysis, and risk communication. It will highlight emerging challenges in providing science for decision making in the era of increasing model resolution/complexity and burgeoning interest in adaptation at regional and finer scales.

Oppenheimer, Michael
Princeton University

Steve Schneider's Contribution to AR4: Evaluating Risk under Unprecedented Uncertainty

Chapters 19 of IPCC's Third and Fourth (and I hope, Fifth Assessment) reports, taken together, can be viewed as a an effort to construct a comprehensive and integrated framework for managing the risk of climate change, particularly in the context of Article 2 of the UN Framework Convention on Climate Change, and its long term objective of avoiding "dangerous anthropogenic interference with the climate system". Steve's research (with many colleagues) influenced the TAR's primary contribution to this framework, the Reasons for Concern. Under his leadership as one of three collaborating lead authors of chapter 19 in AR4, his conceptualization, research, and expert judgments were critical factors in elaborating the framework in terms of key vulnerabilities, a more disaggregated approach to risk management. There the definition of seven specific metrics of "danger" (magnitude, timing, persistence and reversibility, likelihood and confidence, distribution, potential for adaptation, and importance), allowed a detailed elaboration of his earlier attempt[1] to analyze vulnerability in terms of five "numeraries": lives lost, market impacts, biodiversity loss, distributional impacts, and quality of life. A particularly significant advance was the recognition that distribution of impacts should be analyzed in terms of a large variety of groupings or communities at different scales, not just political or geographic association. But transcending these particulars are Steve's two outstanding achievements of AR4: his strong and ultimately successful advocacy of the view that IPCC should adopt a risk management framework, a commitment made explicit in the Synthesis Report; and the success of chapter 19 as an important stepping stone toward interpreting Article 2, an achievement which is in large measure attributable to Steve's unique inspirational and leadership skills.

[1] Schneider SH, Kuntz-Duriseti K, Azar C (2000) Costing nonlinearities, surprises, and irreversible events, Pacific and Asian Journal of Energy: 10, 81-106.

Oreskes, Naomi
University of California San Diego

ESLD (Erring on the Side of Least Drama): A Source of Confusion in Climate Science Communication?

Naomi Oreskes, Keynyn Brysse, Jessica O'Reilly and Michael Oppenheimer
Numerous polls, studies, and daily life attest to the doubt, dismissal, and even outright denial of the scientific evidence of anthropogenic climate change. In previous work, one of us (NO) has examined sources of doubt and confusion external to the scientific community: doubt-mongering campaigns organized by think-tanks, and motivated by the intertwined political ideologies of libertarianism, neo-liberalism and free-market fundamentalism. Here, we turn to the question of how scientific communication may have contributed to public confusion, particularly the scientific tendency to downplay dramatic results. We call this tendency ESLD—Erring on the Side of Least Drama—a tendency that we suggest arises from the scientific virtues of skepticism, dispassion, and restraint, but which has perhaps inadvertently led scientists to under-estimate the tempo, mode, and severity of climate change, and given the public the impression that the scientific findings are less secure, and their implications less alarming, than they actually are.

Pachauri, Rajendra
Chairman, IPCC

The Life and Work of Stephen Schneider: Inspiration for IPCC's Future

It is extremely challenging and difficult to talk about a person who stands out as a titan in a society where genuine leaders are becoming a rarity. Stephen Schneider was a person about whom one could write volumes and yet not do justice. In some sense looking at Steve's life one is reminded of what Gandhi said: "my life is my message". It would not be inaccurate to state that Steve's life was also his message, and a message that has to be celebrated. All of us miss him greatly, but he has left us with so much that in some sense his life's work will not be finished for a very long time, and he has left it to all of us to continue with it. His life's work, his spirit, his inspiration – all of these are with us and will only grow as the relevance of his life and work assume even greater importance. It is for this reason I chose the title of my talk to focus on how Steve's life and work will inspire the IPCC in the future. I see the IPCC's future resting on four sets of attributes:

1. Excellence in science and every field of knowledge related to climate change.
2. Understanding the policy relevance of IPCC's work.
3. Creating communications skills and capacity.
4. Dedication to the IPCC and the values and practices it stands for.

These are requirements that Steve set benchmarks in fulfilling to a degree that far exceeds the record set by anyone else that I know of. Steve Schneider was a person who displayed throughout his life and career a consistency of commitment, courage of character and integrity of intellect. These are qualities that everyone working in the IPCC should strive to uphold, for the future of this organization would be secure as long as we treat these qualities of Steve as our beacon-light.

Ramanathan, Veerabhadran
University of California, San Diego

The Cloudy and Hazy World seen and predicted by Steve Schneider

I intend to compare the global cooling effect of Clouds as derived from NASA's Earth Radiation Budget Experiment (in 1989) with what Steve Schneider calculated in 1972. It was within 10% of what I and my NASA colleagues obtained with a $250 million experiment. Steve's model cost a lot less money, I am sure.

Then with respect to his work on aerosols... I plan to use that study (along with his nuclear winter soot) to go into Brown clouds in Asia, their effect on the Himalayan Glaciers and a Vatican report I co-chaired. I will conclude with Project Surya (cook stove-black carbon experiment in India see http://www.projectsurya.org/) to show how the two of us, while starting at the same place (radiation forcing; climate feedbacks; etc) took two different paths from science to climate mitigation... his was global scale influence of policy; mine was locally focused to translate knowledge into action.

Rasch, Phil
Pacific Northwest National Laboratory

Challenges in Understanding Aerosol's Role in Climate and Society

Steve Schneider started writing about the role of aerosols in climate during his post-doc at NASA GISS in 1971, with his first work considering the cooling produced by `dust' (scattering aerosols) on the planet. He subsequently worked on absorbing aerosols (nuclear winter), and in 1994 was considering the complexities of aerosol cloud interactions, aerosol feedbacks (the CLAW hypothesis), uncertainties in aerosol emissions, and the difficulty of teasing out the role of aerosols in the presence of natural variability, climate change and changing greenhouse gas forcing (the fingerprinting of aerosol forcing), Steve was also interested in and thinking about aerosols and society, contributing to discussions within the scientific community and in public and policy venues ideas about geoengineering and risk management. All of these scientific and policy questions remain relevant and pressing today. I will cover some of the progress over the last decade resulting in improvements in our understanding of aerosols and climate, issues associated with geoengineering by aerosols, and identify some remaining gaps in our understanding of aerosols and climate.

Robock, Alan
Rutgers University

Steve Schneider and Nuclear Winter

In the early 1980s, Steve Schneider was a pioneer in nuclear winter research, working with Curt Covey and Starley Thompson to conduct general circulation model simulations of the climate response to massive smoke injections. He described his results as "nuclear fall," in contrast to the description of "nuclear winter" of the results of Richard Turco, Brian Toon, Tom Ackerman, Jim Pollack, and Carl Sagan (TTAPS). Even though a nuclear fall would be a disaster, the public interpreted this result to mean that we need not worry about the climatic consequences of nuclear war, and the danger has further receded from the public mind with the end of the Cold War and continuing reduction of global nuclear arsenals. Steve felt justified in publicizing his results, as they came from a three-dimensional climate model that allowed the investigation of processes not considered in the original one-dimensional model results of TTAPS. But their model had no ocean, stratosphere, or mesosphere, and was limited by the speed of the Cray-1. Recently, using modern computers and climate models, colleagues and I have re-done the nuclear winter simulations, and found fundamentally new results. The smoke would be lofted into the upper stratosphere and climate effects would last for more than a decade, much longer than previously thought. For the same 1980s scenarios, there would indeed be nuclear winter and not nuclear fall. Furthermore, there would be massive ozone depletion with enhanced ultraviolet radiation reaching the surface. A nuclear war between Russia and the United States, using the reduced arsenals of 4000 total nuclear weapons that will result by 2017 in response to the New START treaty, could still produce nuclear winter. A nuclear war between India and Pakistan, with each country using 50 Hiroshima-sized atom bombs as airbursts on urban areas, could produce climate change unprecedented in recorded human history and global-scale ozone depletion. This scenario, using less than 0.03% of the explosive power of the current global nuclear arsenal, would produce so much smoke from the resulting fires, that it would plunge the Earth to temperatures colder than those of the Little Ice Age of the 16th to 19th centuries, shortening the growing season around the world and threatening the global food supply. Nuclear proliferation continues, with nine nuclear states now, and more working to develop or acquire nuclear weapons. The continued environmental threat of the use of even a small number of nuclear weapons must be considered in nuclear policy deliberations in Russia, the U.S., and the rest of the world.

Romm, Joe
Climate Progress

Mother Nature is Just Getting Warmed Up

It is increasingly unlikely that the nation and the world will take serious action to address global warming this decade, although it would be inexpensive to do so relative to the alternative. And so we keep our foot stuck on the gas, dramatically accelerating the risks of multiple catastrophes this century that individually would be enough to motivate WWII-scale action, but in combination – widespread Dust-Bowlification, 7 to 10°F warming (or more), sea level rise of several feet, ever-worsening extreme weather events, ocean acidification and the accompanying mass extinction of marine life -- are the gravest threat to human civilization we have ever known.
What the heck should we be saying and doing about this?

Root, Terry
Stanford University

Human-Modified Temperatures Induce Species Changes

Plants and animals around the globe are showing consistent patterns of detecting regional warming. The biological changes observed include: 1) shifts in ranges, either poleward or upward in elevation, 2) changes in the timing of events (phenology), such as when trees bloom or migrants arrive, 3) change of gene frequencies, 4) morphological changes such as longer wing length or larger egg sizes, 5) behavioral changes such as relocation of nests, and 6) extirpation or extinction. Changes in the phenologies of wild species can be used to attribute changes in regional temperatures to humans. This is accomplished by comparing associations between phenological shifts and actual temperature trends at particular study locations with associations between species shifts and modeled temperature trends. Had CM3 GCM was used to model the regional temperatures with natural, anthropogenic and combined forcings at the locations of the numerous sites where species changes were found. Even at a one-grid-cell scale, the associations between phenological shifts with three different modeled temperatures show that humans are likely to be contributing to the regional warming species detect at various study sites throughout the northern hemisphere.

Santer, Ben
Lawrence Livermore National Lab

Steve Schneider and the Genesis of the "Balance of Evidence" Statement

In November 1995, the Intergovernmental Panel on Climate Change (IPCC) held a plenary meeting in Madrid. The purpose of this meeting was to approve the Summary for Policymakers (SPM) of the Second Assessment Report of the IPCC's Working Group I, and to accept the 11 underlying chapters on which the SPM was based.

After three days of intense and sometimes acrimonious deliberation, the official delegates of all 96 countries represented in Madrid approved the SPM's historic finding that "The balance of evidence suggests a discernible human influence on global climate". This talk discusses the extraordinary events surrounding the genesis of this statement. It will highlight the critical role Steve Schneider played in persuading one Madrid delegate that the IPCC's "discernible human influence" finding had a sound scientific basis.

Snyder, Carolyn
Delaware Dept. of Natural Resources and Environmental Control

Steve Schneider's Contributions to our Understanding of Past Climates through Interdisciplinary Collaborations, Systems Thinking, and Uncertainty Analysis

I discuss several key themes from Steve Schneider's contributions to paleoclimate research. First, Steve led trail-blazing collaborations of climate modelers and earth scientists throughout his career. He demonstrated the need for a hierarchy of model complexity and was able to integrate climate models and data at different scales of time, space, and complexity. Second, Steve interpreted the Earth System using complex system science and showed that "systems thinking" is critical for climate research. He contributed insights to the fundamental behavior of the Earth System through his work on the coevolution of climate and life, the pacemaker of the glacial-interglacial cycles, and the Gaia hypothesis. He investigated the nonlinearities and abrupt changes in the Earth System's dynamics, focusing on the risks associated with abrupt ocean circulation changes, the path dependence of vegetation change, and the nonlinear impacts on species. Third, Steve demonstrated the importance of rigorous uncertainty analysis and the use of a risk assessment framework for making paleoclimate discoveries relevant and useful to decision-makers. Through structured probabilistic analysis, Steve was able to transparently communicate what is currently known about past climate dynamics and about the potential for future risks, including low-probability, high-impact events or "imaginable surprises." As an example, I discuss Steve's work on climate sensitivity. I conclude with reflections on future advancements in paleoclimate research.

Still, Chris
University of California Santa Barbara

Climate Science Education Lessons from Steve Schneider

A number of universities have established training programs in climate science, and a key feature of almost all these programs in an emphasis on interdisciplinary thinking. This focus on interdisciplinarity was a hallmark of Steve's work in climate science, and something that he often spoke about. In this talk, I will discuss such lessons in climate science education that I learned from Steve as his graduate student at Stanford University. I will also discuss how those lessons have influenced the ways that I and others train their students in climate science.

Unruh-Cohen, Ana
Democratic Staff, Committee on Natural Resources

Political Calculus: The Role of Science in Energy and Climate Policy

Climate and energy are amongst the top issues in domestic and international politics, necessitating increasing input from the science and technology spheres to policymakers. Science is just one component that influences policymaker's decisions. I will provide an insider's view on how lawmakers use science in energy and climate policymaking in an increasingly carbon-constrained world and discuss the latest developments in the U.S. Congress.

van Ypersele, Jean-Pascal
Université catholique de Louvain, Belgium

Climate Decisions and Uncertainty, a Few Lessons Based on Steve Schneider's Work

Uncertainty surrounds some aspects of climate issues, and Steve Schneider was a master at explaining its significance in a scientific perspective as well as in terms of policy. As Richard Moss explained, the IPCC guidance on the handling and communication of uncertainties owes a lot to Steve Schneider. In this talk, I will evoke some other aspects of the challenge of taking climate decisions under uncertainty, building on Steve's insights at every opportunity. One of the purposes of science is to reduce uncertainties, and climate scientists have succeeded bounding uncertainties in many areas, which I will briefly review. We know a lot already. But the remaining uncertainties are still used by some as an excuse for not acting, despite the precautionary principle which says that uncertainty should not prevent action when there is a risk of grave or irreversible consequences. Actually, most human decisions are taken in a context of uncertainty.

In economic, military, social, or human relations decisions, one has to act every day without certainty. Why should it be different for climate? Would it be easier to take climate mitigation or adaptation decisions, at home or under UNFCCC if scientific uncertainties had been eliminated? A thought experiment suggests this would certainly(!) not always be the case. The differing values, interests, and priorities would still be present. And Naomi Oreskes' merchants of doubt would continue to mislead. And the uncertainties related to human decisions would remain. So, we are stuck with uncertainties in the climate world.
As we cannot afford to lose the "planetary gamble" Steve discussed in "Laboratory Earth", it will remain extremely important for scientists and the IPCC to understand, qualify, and communicate uncertainties in the best way, so that good decisions can be taken. The work and life of Steve Schneider will continue to inspire this for a long time.
As Steve's family said: "Now it's up to us".

Washington, Warren
National Center for Atmospheric Research

The Role of Ocean in Climate Change: A Historical to Present Perspective

Some of the history of ocean model development and its role in climate change research will be presented. The early development of ocean models that would eventually be coupled to atmospheric and sea ice models can be greatly credited to the pioneering efforts of K. Bryan and his colleagues at GFDL. The approach taken towards developing coupled climate models by the various modeling groups was mostly incremental, partly due to the limitations of computer time as well as the lack of understanding of ocean processes. There was also a feeling that we should not make models overly complex but refined enough to capture the first order climate effects. The first coupled general circulation model approach was to simulate the ocean surface heating and evaporation in an annually averaged manner so that the ocean feedback would be a moisture source for the atmosphere. The community then moved to seasonal upper ocean heat storage all the while carrying out simple climate change simulations with increased concentrations of carbon dioxide and other forcings. Fully coupled climate models with fully three dimensional atmosphere, ocean, and sea ice components did not occur until the 1970s and early 1980s with very coarse resolution.

In addition to presenting the early history of ocean modeling, a few early climate change findings will be briefly discussed and compared with present day models.

Watson, Robert
Department for Environmental Food and Rural Affairs, U.K.

The Science-Policy Interface

I will discuss the role of national and international research programs, national and international assessments (e.g., the Intergovernmental Panel on Climate Change, the Stern Report, the UK Climate Change Risk Assessment, and the UK Go-Science Foresight Study of Climate Change) and advisory bodies (e.g., the UNFCCC SBSTA and the UK Climate Change Committee and its adaptation sub-committee) in translating sound science into "sound" climate change policy. I will also briefly discuss how assessments (e.g., the Millennium Ecosystem Assessment, the Ad-hoc Technical Advisory Group Assessments of the Convention on Biological Diversity, The Economics of Ecosystems and Biodiversity, and the proposed Intergovernmental Panel on Biodiversity and Ecosystem services) and advisory bodies on related issues such as biodiversity and ecosystem services are relevant to climate change mitigation and adaptation.

Weyant, John
Stanford University

The State of the Art in Integrated Assessment Modeling: An Overview

Integrated assessment models (IAMs) combine concepts and information from many scientific disciplines into systems of mathematical equations designed to facilitate the development of scientific conclusions and policy relevant insights that could not be obtained using methods from a single discipline. Over the last thirty plus years there have been a number of major efforts to construct IAMs to study climate change and climate change policies. Although these models are frequently used for policy analysis they generally have deep scientific roots often stretching the state of the art in each scientific discipline to its limits, and at the same time integrating interdisciplinary knowledge in ways that has never been done before. Stephen H. Schneider was a master assessor of the state of the art of these climate change oriented IAMs. This talk tries to provide a modest update of the work Schneider started with his classic 1997 paper which put forth a set of signposts for measuring the state of IA modeling with respect to what might ultimately be achievable and/or desirable. In true Schneider fashion we start with the basic building blocks of the underlying disciplines and their integration, and a set of design criteria to strive for. We then throw in a large dose of painful, but unavoidable, pragmatism in the form of simplifying assumptions and approximations that are required to implement the theory given our current state of information and about how our world actually works. Life is put into these abstract notions by through examples of results from IAMs over the years to show the types of problems that can be addressed. We end with some thoughts about what the future might bring in terms of better theory and practice in integrated assessment, again using the sign posts from the Schneider IAM global positioning system.

Yohe, Gary
Wesleyan University

This presentation will identify the most frequently cited papers published in Climatic Change since Volume 1 appeared in 1977 on the basis of the number of citations recorded in Google Scholar across three cohorts of papers (1977-1986); 1987-1996; and 1997-present). Working with three distinct cohorts accounts to some degree for differences in length of time that each paper had to be cited. The contributions of the five most cited papers to the knowledge base will be briefly described.

Speaker Bios

Anderegg, William
Stanford University

I am a Doctoral Candidate at Stanford University in the Department of Biology and a U.S. Department of Energy Office of Science and Technology Graduate Fellow. My research centers around the intersection of ecosystems and climate change. Born in southwest Colorado, I grew up hiking and backpacking in the Rocky Mountains and return there often for my scientific endeavors. I graduated from Stanford University in 2008 with a B.A. with honors and distinction in Human Biology. My previous research has explored how we communicate climate science to the public and policy-makers. I explored the dynamics of expert agreement and dissenting opinions in communicating the state of climate science. My current research focuses on the future of forests in the western United States. Massive mortality events of many tree species in the last decade prompt concerns that drought, insects, and wildfire may devastate western forests in the coming decades. I study how drought and climate change directly affect trembling aspen trees in the Rocky Mountains and what the future climate holds for the emblematic tree of the American West.

Azar, Christian
Chalmers University, Sweden

Christian Azar's background is in physics and he is currently a professor of energy and environment at Chalmers University of Technology, Sweden. His research focuses on climate change mitigation strategies (including energy systems modeling, technology assessment and policy analysis). He has been an advisor to the former EU commissioner for the environment, and to two Swedish prime ministers. In 2009 he was listed as the most influential person when it comes to environmental issues in Sweden by Miljömagasinet, a Swedish newspaper focusing on environmental affairs.

Bryan, Frank
National Center for Atmospheric Research

Frank Bryan is a scientist in, and head of, the Oceanography Section in the Climate and Global Dynamics Division of NCAR. He joined NCAR in 1985 as a postdoctoral fellow in the Advanced Study Program, after completing his PhD in the Geophysical Fluid Dynamics Program at Princeton University. His research focuses on the dynamics of the general circulation of the ocean, ocean tracer transport, and the role of the ocean in climate change.

Dow, Kirstin
University of South Carolina

Kirstin Dow is a Professor of Geography at the University of South Carolina. She has diverse policy and research experience related to vulnerability, hazards and human dimensions of global environmental change. Her long-term research addresses environmental hazards and the dynamics of vulnerability as broad social and environmental changes affect decisions, capabilities and options for climate adaptation. She has served as the Program Manager for the Poverty and Vulnerability Programme of the Stockholm Environment Institute and Faculty Principal of the USC Living-Learning Center for Sustainability. Currently, she is a co-PI of the Carolinas Integrated Sciences and Assessments, part of NOAA's Regional Integrated Sciences and Assessments (RISA) network, which works to bridge climate science and decision-making related to coastal and water management. Her publications include The Atlas of Climate Change with Tom Downing and address vulnerability to global environmental change, climate change adaptation, vulnerability of water systems to climate variability, response to hurricane hazards in the Southeastern US, urban ecology and environmental equity and justice. She serves on the National Academy of Sciences Board on Atmospheric Sciences and Climate, as an Editor for Weather, Climate, and Society, and as a Lead Author for the IPCC AR5 Working Group 2 Chapter on Adaptation Opportunities, Constraints, and Limits.

Edwards, Paul
University of Michigan

Paul N. Edwards is Professor of Information and History at the University of Michigan. He began researching the history and politics of climate science at Stanford University in 1993 under Steve Schneider, who became his mentor, colleague, collaborator, and friend. Edwards's book A Vast Machine: Computer Models, Climate Data, and the Politics of Global Warming (MIT Press, 2010) is dedicated to Steve's memory. Edwards is co-editor Changing the Atmosphere: Expert Knowledge and Environmental Governance (MIT Press, 2001) and author of The Closed World: Computers and the Politics of Discourse in Cold War America (MIT Press, 1996). His current projects include work with climate software developers on improving the governance of community Earth system modeling, a long-term comparative study of scientific cyberinfrastructures in the environmental sciences, and further studies of the history and politics of meteorology and climate science. Web: pne.people.si.umich.edu. Email: pne@umich.edu.

Field, Chris
Carnegie Institution for Science

Chris Field is the founding director of the Carnegie Institution's Department of Global Ecology, Professor of Biology and Environmental Earth System Science at Stanford University, and Faculty Director of Stanford's Jasper Ridge Biological Preserve. Field's research emphasizes impacts of climate change, from the molecular to the global scale. He has, for nearly two decades, led major experiments on responses of California grassland to multi-factor global change. Field has served on many national and international committees related to global ecology and climate change. He was a coordinating lead author for the fourth assessment report of the Intergovernmental Panel on Climate Change and a member of the IPCC delegation that received the Nobel Peace Prize in 2007. In September, 2008, he was elected co-chair of working group 2 of the IPCC, and will lead the next assessment on climate change impacts, adaptation, and vulnerability. He is a fellow of the American Association for the Advancement of Science and an elected member of the American Academy of Arts and Sciences and the National Academy of Sciences. Field received his PhD from Stanford in 1981 and has been at the Carnegie Institution for Science since 1984.

Goulder, Larry
Stanford University

Lawrence H. Goulder is the Shuzo Nishihara Professor in Environmental and Resource Economics at Stanford and Director of the Stanford Environmental and Energy Policy Analysis Center. He also is a Research Associate at the National Bureau of Economic Research and a University Fellow of Resources for the Future. Goulder's research examines the environmental and economic impacts of U.S. and international environmental policies, including policies to deal with climate change and pollution from power plants and automobiles. His work also explores the "sustainability" of consumption patterns in various countries. Goulder has conducted analyses for several government agencies, business groups, and environmental organizations. He recently chaired a committee to advise the California Environmental Protection Agency on the design of a cap-and-trade system to help meet the state's targets for greenhouse gas emissions reductions. At Stanford Goulder teaches undergraduate and graduate courses in environmental economics and policy, and co-organizes a weekly seminar in public and environmental economics. He graduated from Harvard College with an A.B. in philosophy and received his Ph.D. in Economics from Stanford.

Gulledge, Jay
Pew Center on Global Climate Change

Dr. Jay Gulledge is the Senior Scientist and Director for Science and Impacts at the Pew Center on Global Climate Change, a non-resident Senior Fellow at the Center for a New American Security, and a Next Generation Fellow of the American Assembly at Columbia University. He is a Certified Senior Ecologist and has two decades of experience teaching and conducting research in the biological and environmental sciences. His scientific research examines the biological mechanisms and social drivers of greenhouse gas exchange between ecosystems and the atmosphere. After earning a PhD in ecosystem science at the University of Alaska Fairbanks, he was a Life Sciences Research Foundation Postdoctoral Fellow at Harvard University and held faculty positions at Tulane University and the University of Louisville. Following 16 years in academic research, Dr. Gulledge joined the Pew Center and shifted his focus to informing policymakers, national security analysts, business leaders, the public, and the press about the science and impacts of global environmental change and approaches for managing the associated risks. In 2011, he received the American Geophysical Union's Charles S. Falkenberg Award and was nominated for George Mason University's Climate Change Communicator of the Year.

Hall, Alex
University of California, Los Angeles

Prof. Alex Hall (UCLA) studies the climate system from both regional and global perspectives. At the global scale, he develops methods to reduce the uncertainty surrounding the climate system's response to increases in greenhouse gases. At the regional scale, he has been active in the development and integration of regional climate models. He uses these simulations to examine mesoscale climate dynamics and interactions among earth-system components that are crucial for simulating and understanding regional climate but are largely unrepresented in current global climate models. At UCLA, Dr. Hall teaches climate-related courses at the undergraduate and graduate levels. He is a recipient of the NSF Graduate Fellowship (1993-1996), the NASA Earth System Science Fellowship (1996-1998), the Lamont Fellowship (1999-2001), and the NSF CAREER award (2002-2007). Dr. Hall was a contributing author to the 2007 IPCC 4th assessment Working Group I report, and is a Lead Author of the upcoming IPCC 5th Assessment. He was co-chair of US CLIVAR Climate Prediction and Applications Interface Panel, charged with making research and funding recommendations to US agencies regarding climate prediction and climate applications and was also a member of the overarching US CLIVAR committee (2002-2009). He is a member of the executive committee of the UCLA-JPL Joint Institute for Regional Earth System Science and Engineering, and the faculty director of the UCLA Center for Climate Change Solutions.

Hellmann, Jessica
University of Notre Dame

Jessica Hellmann is a population biologist and conservation ecologist specializing in the impacts of global climate change for species and ecosystems and identifying ways that humans might help ecosystems tolerate climatic change. She is Associate Professor of Biology at the University of Notre Dame. Hellmann holds a BS from the University of Michigan where she was mentored by Terry Root and a PhD from Stanford where she learned about climate science from the master, Steve Schneider. See http://www.nd.edu/~hellmann/ and http://adapt.crc.nd.edu.

Kiehl, Jeff
National Center for Atmospheric Research

Jeffrey T. Kiehl, Ph.D. is a senior scientist at the National Center for Atmospheric Research, where he heads the Climate Change Research Section. Over the past 30 years he has carried out research on a wide range of scientific questions regarding anthropogenic climate change. He has published over one hundred articles on the effects of greenhouse gases on Earth's climate, the effects of stratospheric ozone depletion on climate, and the effects of aerosols and clouds on the climate system. He is the co-author of Frontiers of Climate Modeling published by Cambridge University Press. His current research is on Earth's deep past climates and what they can tell us about future climate change. He is also participating in projects to better communicate climate change science to the public. He chaired the Community Climate System Model (CCSM) project at NCAR for a number of years. He has been a member of the National Research Council's Climate Research Committee and the Committee for Global Change and has served on a number of NRC panels over the past twenty years. He is a Fellow of both the American Meteorological Society and the American Geophysical Union. Research. Dr. Kiehl also holds two advanced degrees in psychology.

Kutzbach, John
University of Wisconsin

University of Wisconsin-Madison
Professor of Atmospheric and Oceanic Science, and Environmental Sciences (1966-2002)
Professor Emeritus and Senior Scientist (2002-

Research Interests
Studies of the earth's climate, past, present and future, focused on: (1) present-day climate variability and future climate changes; (2) the role of earth's orbital changes in producing the glacial/interglacial cycles and global monsoon cycles of the last few hundred thousand years; (3) the role of uplift of mountains/plateaus in producing climatic changes over the past ten million years; and (4) the role of tectonic plate movements in producing climate changes over the past 250 million years.

About 150 publications, see selected publications at:
http://ccr.aos.wisc.edu/about/Personnel/Faculty/kutzbach_john.php

Honors/Awards
Member of the National Academy of Sciences, 2006-. "Revelle Medal" of the American Geophysical Union, 2006. "Milankovitch Medal" of the European Geophysical Society, 2001. Fellow of the American Association for the Advancement of Science, 2009; Fellow of the American Geophysical Union, 1994; Fellow of the American Meteorological Society, 1981; Senior Scientist Award of the Alexander von Humboldt Foundation, Germany, 1978; NSF Postdoctoral Fellow, England, 1968.

Liverman, Diana
University of Arizona / Oxford University

Diana Liverman is the co-director of the Institute of the Environment at The University of Arizona and a Regents Professor in the School of Geography and Development. She is also affiliated with Oxford University as a visiting professor of Environmental Policy and Development and senior research fellow in the Environmental Change Institute. Her research focuses on the human and social dimensions of environmental issues including vulnerability and adaptation to climate change, environmental change and food security, climate policy and governance, climate and the arts, and environment and development. Her recent publications include edited books on environment and food security and on climate change, articles on the governance of adaptation, carbon offsets, and planetary boundaries, and an award winning textbook on world regional geography. She was recently awarded the Founders Gold medal of the Royal Geographical Society and distinguished scholarship honors from the Association of American Geographers. She has been an active member of national and international advisory committees on global environmental change including the US National Academy committees on the Human Dimensions of Global Environmental Change and Informing America's Climate Choices and international committees for the ICSU Global Environmental Change and Food Systems (GECAFS) program, the Inter American Institute and the IHDP Earth Systems Governance project.

Mastrandrea, Mike
Stanford University

Michael Mastrandrea is the Deputy Director of Science at the Intergovernmental Panel on Climate Change Working Group II TSU, and an Assistant Consulting Professor at the Stanford University Woods Institute for the Environment. His research focuses on top-down/bottom-up assessment of the impacts of climate change on physical, biological, and social systems and the evaluation of policy strategies for managing climate change risks; treatment of uncertainty in climate change impacts and policy analysis; and the accurate and effective communication of

scientific knowledge to the general public, policy makers, and the business community. Mastrandrea was the first graduate of the Interdisciplinary Graduate Program in Environment and Resources at Stanford University where he was a Department of Energy Global Change Education Program Fellow. He also serves on the Editorial Board and as Managing Editor of the journal Climatic Change.

Mearns, Linda
National Center for Atmospheric Research

Linda O. Mearns is Director of the Weather and Climate Impacts Assessment Science Program (WCIASP), Head of the Regional Integrated Sciences Collective (RISC) within the Institute for Mathematics Applied to Geosciences (IMAGe), and Senior Scientist at the National Center for Atmospheric Research, Boulder, Colorado. She served as Director of the Institute for the Study of Society and Environment (ISSE) for three years ending in April 2008. She holds a Ph.D. in Geography/Climatology from UCLA. She has performed research and published mainly in the areas of climate change scenario formation, quantifying uncertainties, and climate change impacts on agro-ecosystems. She has particularly worked extensively with regional climate models. She has been an author in the IPCC Climate Change 1995, 2001, and 2007 Assessments regarding climate variability, impacts of climate change on agriculture, regional projections of climate change, climate scenarios, and uncertainty in future projections of climate change. For the Fifth Assessment Report (due out in 2013) she is a lead author of Chapter 21 on Regions in WG2. She leads the multi-agency supported North American Regional Climate Change Assessment Program (NARCCAP), which is providing multiple high-resolution climate change scenarios for the North American impacts community. She has been a member of the National Research Council Climate Research Committee (CRC), the NAS Panel on Adaptation of the America's Climate Choices Program, and the NAS Human Dimensions of Global Change (HDGC) Committee. She currently is a member of the National Academy of Sciences Panel on Advancing Climate Modeling. She has worked extensively with resource managers (e.g., water resource managers and ecologists) to form climate change scenarios for use in adaptation planning. She was made a Fellow of the American Meteorological Society in January 2006.

Moss, Richard
Pacific Northwest National Laboratory

Richard H. Moss is a Senior Staff Scientist with the Pacific Northwest National Laboratory's Joint Global Change Research Institute and Visiting Senior Research Scientist at Maryland's Earth Systems Science Interdisciplinary Center. His research interests include development and use of scenarios, characterization and communication of uncertainty, and adaptation and vulnerability to climate change. He chairs the US National Academy of Science's standing committee on the "human dimensions" of global environmental change and serves on the editorial board of

Climatic Change. Moss is active in the Intergovernmental Panel on Climate Change (IPCC) and currently serves as a review editor for the Fifth Assessment Report. Previously Moss served as Director of the Office of the US Global Change Research Program/Climate Change Science Program (2000-06), Head of Technical Support Unit for the IPCC impacts, adaptation, and mitigation working group (1993-99), and on the faculty of Princeton University (1989-91). During a business leave of absence from PNNL in 2006-2009, he served as Vice President/Managing Director for Climate Change at the U.S. World Wildlife Fund and Senior Director for Energy and Climate at the U.N. Foundation. Moss is a fellow of the American Association for the Advancement of Science (AAAS), received the US Department of Energy's "Distinguished Associate" award in 2003, and was named a fellow of the Aldo Leopold Leadership Program in 2001. He received an M.P.A. and Ph.D. from Princeton University (Public and International Affairs) and his B.A. from Carleton College in Northfield, MN.

Oppenheimer, Michael
Princeton University

Michael Oppenheimer is the Albert G. Milbank Professor of Geosciences and International Affairs at Princeton University. He is also the Director of the Program in Science, Technology and Environmental Policy (STEP) at Princeton's Woodrow Wilson School. He joined the Princeton faculty in 2002 after more than two decades with the Environmental Defense Fund, a non-governmental environmental organization, where he served as chief scientist and manager of the Climate and Air Program. Oppenheimer is a long-time participant in the Intergovernmental Panel on Climate Change (IPCC) which won the Nobel Peace Prize in 2007, serving most recently as a lead author of the IPCC's *Fourth Assessment Report* and is now a coordinating lead author of an upcoming IPCC Special Report covering climate extremes and disasters, as well as IPCC's Fifth Assessment. He is also a 2010 Heinz Award winner. Currently, Oppenheimer is coeditor-in-chief of the journal *Climatic Change* and also editor-in-chief of the journal's *Letters* section. Oppenheimer serves on the US National Academies Board on Energy and Environmental Systems and is also a science advisor to the Environmental Defense Fund. His research interests include science and policy of the atmosphere, particularly climate change and its impacts. Much of his research aims to understand the potential for "dangerous" outcomes of increasing levels of greenhouse gases by exploring the effects of global warming on ecosystems such as coral reefs, on the ice sheets and sea level, and on patterns of human migration. Oppenheimer is the author of more than 100 articles published in professional journals and is co-author (with Robert H. Boyle) of a 1990 book, *Dead Heat: The Race Against The Greenhouse Effect.* He received his Ph.D. in chemical physics from the University of Chicago.

Oreskes, Naomi
University of California San Diego

Naomi Oreskes is Professor of History and Science Studies at the University of California, San Diego, Adjunct Professor of Geosciences at the Scripps Institution of Oceanography, and an internationally renowned historian of science and author. Having started her career as a geologist, received her B.S. (1st class Honours) from the Royal School of Mines, Imperial College London, and then worked for three years as an exploration geologist in the Australian outback. She returned to the United States to receive an inter-disciplinary Ph.D. in geological research and history of science from Stanford University, in 1991. Professor Oreskes has lectured widely in diverse venues ranging from the Madison, Wisconsin Civics Club to the Air Force Research Laboratory, and has won numerous prizes, including, most recently the 2011 Climate Change Communicator of the Year.

Her current research projects include completion of a book on the history of Cold War Oceanography, Science on a Mission: American Oceanography in the Cold War and Beyond (Chicago, forthcoming), and Assessing Assessments: A Historical and Philosophical Study of Scientific Assessments for Environmental Policy in the Late 20th Century, funded by the National Science Foundation.

Pachauri, Rajendra
Chairman, IPCC

Dr. Rajendra Kumar Pachauri is the Chair of the Nobel Peace Prize-winning Intergovernmental Panel on Climate Change (IPCC), the scientific intergovernmental body that provides decision-makers and the public with an objective source of information about climate change. He is also Director General of TERI (The Energy and Resources Institute), a major independent research organisation providing knowledge on energy, environment, forestry, biotechnology, and the conservation of natural resources. Dr Pachauri is a prominent researcher on environmental subjects, recognised internationally for his efforts to build up and disseminate greater knowledge about man-made climate change and to lay the foundations for the measures that are needed to counteract such change. Since July 2009 he has also been Director, Yale Climate and Energy Institute. He is active in several international forums dealing with the subject of climate change and its policy dimensions. He was awarded the second-highest civilian award in India, the 'Padma Vibhushan' in January 2008 by the President of India and received the 'Officier De La Légion D'Honneur' from the Government of France in 2006. He has been conferred with 'The Order of the Rising Sun, Gold and Silver Star' by His Majesty Akihito, Emperor of Japan, the 'Commander of the Order of the White Rose of Finland' by the Prime Minister of Finland and the 'Commander of the Order of Leopold II' by the King of the Belgians.

Ramanathan, Veerabhadran
University of California, San Diego

Dr. V. Ramanathan is a Distinguished Professor at the Scripps Institution of Oceanography, UCSD. In the 1970s, he discovered the greenhouse effect of CFCs and numerous other manmade trace gases and forecasted in 1980, along with R. Madden that the global warming would be detectable by the year 2000. He, along with Paul Crutzen, led an international team that first discovered the widespread Atmospheric Brown Clouds (ABCs). Dr. Ramanathan showed that ABCs led to large scale dimming, decreased monsoon rainfall and rice harvest in India and played a dominant role in melting of the Himalayan glaciers. His team developed unmanned aerial vehicles with miniaturized instruments to measure black carbon in soot over S Asia and to track pollution from Beijing during the Olympics. He has estimated that reduction of black carbon can reduce global warming significantly and is following this up with a climate mitigation Project Surya which will reduce soot emissions from bio-fuel cooking in rural India. He chaired a National Academy report that calls for a major restructuring of the Climate Change Science Program and it was received favorably by the Obama administration.
His numerous awards include the 2009 Tyler prize, the Volvo Prize, the Zayed prize, the Rossby Medal and the Buys-Ballot Medal for pioneering studies in climate and environment. He has been elected to the American Philosophical Society, the US National Academy of Sciences, the Pontifical Academy by Pope John Paul II and the Royal Swedish Academy of Sciences.
His personal website: http://www-ramanathan.ucsd.edu/
Project Surya website: http://www.projectsurya.org/

Rasch, Phil
Pacific Northwest National Laboratory

Dr. Philip Rasch serves as the Chief Scientist for Climate Science at the Pacific Northwest National Laboratory (PNNL), a Department of Energy Office of Science research laboratory. In his advisory role, he provides leadership and direction to PNNL's Atmospheric Sciences and Global Change (ASGC) Division. The Division conducts research on the long-term impact of human activities on climate and natural resources using a research strategy that starts with measurements and carries that information into models, with a goal of improving the nation's ability to predict climate change.

Robock, Alan
Rutgers University

Dr. Alan Robock is a Professor II (Distinguished Professor) of climatology in the Department of Environmental Sciences at Rutgers University. He also directs the Rutgers Undergraduate Meteorology Program. He graduated from the University of Wisconsin, Madison, in 1970 with a B.A. in Meteorology, and from the Massachusetts Institute of Technology with an S.M. in 1974 and Ph.D. in 1977, both in Meteorology. Before graduate school, he served as a Peace Corps

Volunteer in the Philippines. He was a professor at the University of Maryland, 1977-1997, and the State Climatologist of Maryland, 1991-1997, before coming to Rutgers. Prof. Robock has published more than 300 articles on his research in the area of climate change, including more than 170 peer-reviewed papers. His areas of expertise include geoengineering, climatic effects of nuclear war, effects of volcanic eruptions on climate, regional atmosphere-hydrology modeling, and soil moisture variations. He serves as Editor of Reviews of Geophysics, the most highly-cited journal in the Earth Sciences. His honors include being a Fellow of the American Meteorological Society, the American Association for the Advancement of Science, and the American Geophysical Union. Prof. Robock is a Lead Author of the upcoming Fifth Assessment Report of the Intergovernmental Panel on Climate Change, which was awarded the Nobel Peace Prize in 2007. He currently serves as Past-President of the Atmospheric Sciences Section of the American Geophysical Union and Retiring Chair of the Atmospheric and Hydrospheric Sciences Section of the American Association for the Advancement of Science.

Romm, Joe
Climate Progress

Dr. Joseph Romm is the editor of Climate Progress, which New York Times columnist Tom Friedman called "the indispensable blog" and Time magazine named one of the 25 “Best Blogs of 2010.''
In December 2008, Romm was elected a Fellow of the American Association for the Advancement of Science for “distinguished service toward a sustainable energy future and for persuasive discourse on why citizens, corporations, and governments should adopt sustainable technologies.” In 2009, Rolling Stone put Romm #88 on its list of 100 “people who are reinventing America.” Time named him a “Hero of the Environment'' and “The Web’s most influential climate-change blogger.”
Romm was acting assistant secretary of energy for energy efficiency and renewable energy in 1997, where he oversaw $1 billion in R&D, demonstration, and deployment of low-carbon technology. He holds a Ph.D. in physics from MIT and did his thesis work on the Greenland Sea with Dr. Walter Munk at the Scripps Institution of Oceanography.
He is senior fellow at the Center for American Progress and author of several books, including Hell and High Water: Global Warming—The Solution and The Politics and The Hype About Hydrogen: Fact and Fiction in the Race to Save the Climate, named one of the best science and technology books of 2004 by Library Journal.

Root, Terry
Stanford University

Dr. Root research has focused on the possible consequences of global warming on wildlife and plants, demonstrating that both flora and fauna have already begun to change, including shifting their ranges toward the poles and higher elevations, and earlier blooming, and migration patterns. Her research has served as wake-up call for conservationists and natural

resource managers around the world. She is now working at the science-management and policy level to identify measures that will help species survive in our warming climate. Root is well known for her capacity to reach decision-makers and the general public, having published extensively and received several awards, including being part of the Intergovernmental Panel for Climate Change, which shared the 2007 Nobel Peace Prize with former Vice President Al Gore. Dr. Root is a Professor, by courtesy, in the Biology Department and Senior Fellow at the Woods Institute for the Environment at Stanford University, and a fellow at the California Academy of Sciences. She earned her undergraduate degree in Mathematics and Statistics from the University of New Mexico, her master's degree in Biology from the University of Colorado and her doctorate in Biology from Princeton University.

Santer, Ben
Lawrence Livermore National Lab

Dr. Benjamin Santer is an atmospheric scientist at Lawrence Livermore National Laboratory (LLNL). His research focuses on such topics as climate model evaluation, the use of statistical methods in climate science, and identification of natural and anthropogenic "fingerprints" in observed climate records. Dr. Santer's early research on the climatic effects of combined changes in greenhouse gases (GHGs) and sulfate aerosols contributed to the historic "discernible human influence" conclusion of the 1995 Report by the Intergovernmental Panel on Climate Change (IPCC). He spent much of the last decade addressing the contentious issue of whether model-simulated changes in tropospheric temperature are in accord with satellite-based temperature measurements. His recent work has attempted to identify anthropogenic fingerprints in a number of different climate variables, such as tropopause height, atmospheric water vapor, the temperature of the stratosphere and troposphere, and ocean surface temperatures in hurricane formation regions.

Dr. Santer holds a Ph.D. in Climatology from the University of East Anglia, England, where he studied under Professor Tom Wigley. After completion of his Ph.D. in 1987, he spent five years at the Max-Planck Institute for Meteorology in Germany, and worked with Professor Klaus Hasselmann on the development and application of climate fingerprinting methods. In 1992, Dr. Santer joined Professor Larry Gates at LLNL's Program for Climate Model Diagnosis and Intercomparison.

Dr. Santer served as convening lead author of the climate-change detection and attribution chapter of the 1995 IPCC report. More recently, he was the convening lead author of a key chapter of the U.S. Climate Change Science Program's report on "Temperature Trends in the Lower Atmosphere". His awards include the Norbert Gerbier–MUMM International Award (1998), a MacArthur Fellowship (1998), the U.S. Department of Energy's E.O. Lawrence Award (2002), a Distinguished Scientist Fellowship from the U.S. Dept. of Energy, Office of Biological and Environmental Research (2005), a Fellowship of the American Geophysical Union (2011), and membership in the U.S. National Academy of Sciences (2011). Ben and his son Nicholas live in San Ramon, and enjoy exploring California.

Snyder, Carolyn
Delaware Dept. of Natural Resources and Environmental Control

Carolyn Snyder is the Director of Delaware's Division of Energy & Climate in the Department of Natural Resources and Environmental Control (DNREC). She leads Delaware's efforts to increase energy efficiency and renewable energy production in order to build new jobs and reduce the state's greenhouse gas emissions. She manages over $70 million in programs that help residents and businesses save money through clean energy and efficiency. She also leads programs that assess Delaware's vulnerability to climate change impacts and develop plans to help Delaware adapt to a changing climate.

Dr. Snyder has spent the last decade working on climate and energy policy at institutions around the world. She received her Ph.D. from Stanford University's Interdisciplinary Program in Environment and Resources, with a specialization in climate science and policy. Her advisors were IPCC leaders Stephen Schneider and Christopher Field. Her research sought to better characterize important uncertainties in our understanding and predictions of climate change. Her dissertation examined the Earth's sensitivity to climate change over the past million years. She also assessed the impacts of extreme weather events in California. Prior to Stanford, she completed a Marshall Scholarship, where she earned a Masters in Environmental Change and Management from the University of Oxford, and a Masters in Quaternary Science from the University of Cambridge.

Still, Chris
University of California Santa Barbara

Research Interests: Biogeochemistry, biogeography, earth system science, sustainability science, ecological climatology, climate change, carbon cycling, plant ecophysiology, and stable isotopes

Education: PhD, Stanford University (Biological Sciences), 2000
BS Colorado State University (Biochemistry)

Honors: Chris is a collaborative member of the Terrestrial Plant and Ecosystem Ecology group, an interactive coalition spanning the departments of Geography; Ecology, Evolution, and Marine Biology (EEMB); Environmental Studies; and the Bren School for Environmental Science and Management. He coauthored an article in Nature in 2006 on the relation of global warming to the extinction of amphibians, and he recently received a NASA New Investigator Program in Earth Sciences Award; his proposal being one of only 31 chosen nationally.

Unruh-Cohen, Ana
Democratic Staff, Committee on Natural Resources

Ana Unruh Cohen is the Deputy Staff Director of the House Natural Resource Committee Democratic staff. She previously served as the Deputy Staff Director of the Select Committee on Energy Independence and Global Warming. She has worked on a variety of energy and environmental issues, both on and off Capitol Hill, during her career. Prior to joining the Select Committee in 2007, she was the first Director of Environmental Policy at the Center for American Progress. She has also served a legislative aide to Congressman Edward J. Markey (D-MA), handling various issues pending before the Energy and Commerce Committee and the Natural Resources Committee. Dr. Unruh Cohen originally joined Congressman Markey's staff as the 2001-2002 Science and Technology Policy Fellow sponsored by the American Association for the Advancement of Science, the American Meteorological Society and the University Corporation for Atmospheric Research. She has a B.S. in Chemistry from Trinity University and received her Ph.D. in Earth Sciences from Oxford University, where she was a Rhodes Scholar.

van Ypersele, Jean-Pascal
Université catholique de Louvain, Belgium

Jean-Pascal van Ypersele (1957, Belgium), has a Ph. D. in physics from the « Université catholique de Louvain » (Louvain-la-Neuve, Belgium), where he is extraordinary professor of climatology and environmental sciences, and directs the Master programme in Science and Management of the Environment (http://www.uclouvain.be/envi). He made his doctoral research in climatology at NCAR (National Center for Atmospheric Research, Colorado, USA) in the Advanced Study Program directed then by Steve Schneider. He specialized in modeling climate and the climate effects of human activities, and has recently focused his research on climate change at the regional scale (modelling and impacts) and on integrated assessment of climate change. He chairs the Energy & Climate Working Group of the Belgian Federal Council for Sustainable Development (http://www.cfdd.be). In 2008, Jean-Pascal van Ypersele has been elected Vice-chair of IPCC (http://www.ipcc.ch, Intergovernmental Panel on Climate Change, which shared with Al Gore the 2007 Nobel Peace Prize), after participating in its work since 1995 (collaborating with Steve Schneider from 1998 on). In 2009, he was elected a Member of the Belgian Royal Academy. He has participated to a number of United Nations conferences on climate issues as scientific advisor, and was instrumental in creating in 2002 the UN work programme on climate communication and education (http://unfccc.int/cooperation_and_support/education_and_outreach/items/2529.php). Among other prizes, he received in 2006 the « Energy and environment award » from the International Polar Foundation, the “Francqui Chair” from the Université libre de Bruxelles in 2007-2008, and was made Honorary Member of the Club of Rome EU Chapter in 2010.

Washington, Warren
National Center for Atmospheric Research

Dr. Warren Washington is a Senior Scientist, former head of the Climate Change Research Section and former Director of the Climate and Global Dynamics Division at the National Center for Atmospheric Research (NCAR) in Boulder, Colorado. His group uses state-of-the-art computer climate models to study present and future climate change. His expertise is in atmospheric and climate research. These models are made up of atmospheric, ocean, land/vegetation, and sea ice components. He has engaged in research for more than forty years and he has given advice, testimony, and lectured on global climate change. He has served on numerous committees for the National Research Council and he has been a member the U.S. President's National Advisory Committee on Oceans and Atmosphere from 1978-1984. He has had Presidential Appointments under Carter, Reagan, Clinton, and Bush, Jr. Administrations. More recently, he served on the National Science Board from 1994 to 2006 and he was Chair from 2002 to 2006. He has over 150 publications and co-authored with Claire Parkinson a book considered a standard reference on climate modeling -- An Introduction to Three-Dimensional Climate Modeling"(2005) and an autobiography—Odyssey in Climate Modeling, Global Warming, and Advising Five Presidents. Dr. Washington has many awards including being a member of the National Academy of Engineering, Presidency of the American Meteorological Society (1994), a member of American Philosophical Society and the American Academy of Arts and Sciences. Members of his group at NCAR shared in the 2007 Nobel Peace Prize as significant contributors to the Inter-governmental Panel of Climate Change (IPCC) Assessment. He is a Distinguished Alumnus of Pennsylvania State University and Oregon State University (OSU) and has honorary degrees from OSU and Bates College. He has been the PI on the Department of Energy (DOE) INCITE proposal for the Climate End Station which coordinates computer time for development of state-of-art climate models and the use of such models for present and future climate change studies. He is also PI for the University for Atmospheric Research (UCAR) and DOE cooperative agreement which carried out climate research from the 1978 to present. In November 2010, he was awarded the National Medal of Science by President Obama, the nation's highest science award.

Watson, Robert
Department for Environmental Food and Rural Affairs, U.K.

Professor Watson's career has evolved from research scientist at the Jet Propulsion Laboratory: California Institute of Technology, to a US Federal Government programs manager/director at the National Aeronautics and Space Administration (NASA), to a scientific/policy advisor in the US Office of Science and Technology Policy (OSTP), White House, to a scientific advisor, manager and chief scientist at the World Bank, to a Chair of Environmental Sciences at the University of East Anglia, the Director for Strategic Direction for the Tyndall centre, and Chief Scientific Advisor to the UK Department for Environment, Food and Rural Affairs. In parallel to his formal positions he has chaired, co-chaired or directed international scientific, technical and economic assessments of stratospheric ozone depletion, biodiversity/ecosystems (the GBA and

MA), climate change (IPCC) and agricultural S&T (IAASTD). Professor Watson's areas of expertise include managing and coordinating national and international environmental programmes, research programmes and assessments; establishing science and environmental policies - specifically advising governments and civil society on the policy implications of scientific information and policy options for action; and communicating scientific, technical and economic information to policymakers. During the last twenty years he has received numerous national and international awards recognising his contributions to science and the science-policy interface, including in 2003 - Honorary "Companion of the Order of Saint Michael and Saint George" from the United Kingdom; 2010 – the Blue Planet Prize and 2011 being elected as a Fellow of the Royal Society.

Weyant, John
Stanford University

John P. Weyant is Professor of Management Science and Engineering, Director of the Energy Modeling Forum (EMF) and Deputy Director of the Precourt Institute for Energy Efficiency at Stanford University. He is also a Senior Fellow of the Precourt Institute for Energy and the Freeman-Spolgi Institute for International Studies at Stanford. His current research focuses on analysis of global climate change policy options, energy efficiency analysis, energy technology assessment, and models for strategic planning. Weyant has been a convening lead author, lead author and review editor for the Intergovernmental Panel on Climate Change. He has been active in the U.S. debate on climate change policy through the Department of State, the Department of Energy, and the Environmental Protection Agency. In California, he is a member of the California Air Resources Board's Economic and Technology Advancement Advisory Committee (ETAAC). Weyant was awarded the US Association for Energy Economics' 2008 Adelmann-Frankel award for unique and innovative contributions to the field of energy economics. He was acknowledged in 2007 as a major contributor to the Nobel Peace prize awarded to the Intergovernmental Panel on Climate Change and in 2008 by Chairman Mary Nichols for contributions to California's ETAAC report.

Yohe, Gary
Wesleyan University

Gary W. Yohe is the Huffington Foundation Professor of Economics and Environmental Studies at Wesleyan University. He is the author of more than 100 scholarly articles; most of his recent work has focused attention on the risk-management approach to the mitigation and adaptation sides of the climate change issue. He has been a senior member of the Intergovernmental Panel on Climate Change since the mid 1990's. Dr. Yohe also served as member of the New York City Panel on Climate Change, the National Research Council Committee on America's Climate Choices: Panel on Adapting to the Impacts of Climate Change Adaptation Panel and the National Research Council Committee on Stabilization Targets for Atmospheric Greenhouse Gas Concentrations. He is co-editor (along with Michael Oppenheimer) of Climatic Change and a Vice-Chair of the National Climate Assessment Development and Advisory Committee.

NOTES

NOTES

NOTES

NOTES

OFFICE OF AL GORE

June 8, 2011

Prof. Jean-Pascal van Ypersele
Université catholique de Louvain (UCL)
Earth and Life Institute (ELI)
Georges Lemaître Centre for Earth and Climate Research (TECLIM)
2, Chemin du Cyclotron (Bâtiment Marc de Hemptinne, tour B, 4e étage)
B-1348 Louvain-la-Neuve
BELGIUM

Dear Professor van Ypersele:

I'm writing to thank you for letting me know about the forthcoming Symposium in honor of our dear friend, Steve Schneider. Your and your colleagues' efforts to continue Steve's important contributions to the development of basic science, the creation of policy, and the career development of so many young scientists are crucial to the continued growth and vibrancy of the field.

As I reflect upon Steve's extraordinary contributions to climatology and his lifelong attempts to explain his work and basic science to the layperson, I'm always reminded of his passion for the field and the important legacy that continues to live on through his work.

Ongoing efforts like yours are reflective of the reverence that so many of us felt for Steve and his work. While deeply saddened by his passing, it's comforting to know that each of us can preserve his memory in our own way—in our hearts, our minds, and in our work.

I am motivated by the very words that Steve wrote in his final book, *Science as a Contact Sport.* "Take action while we still have time to be effective. Think about our children and grandchildren living in the world of the future, which is presently in our charge…and that, in a nutshell, is what we all need to do."

Thank you again for allowing me to be a small part of your tribute to Steve, and please accept my best wishes for a successful symposium.

Sincerely,

Al Gore

T 615-327-2227
F 615-327-1323
SUITE 250 • 3810 BEDFORD AVENUE
NASHVILLE, TN • 37215

2011 Stephen Henry Schneider Symposium
Student Scholarship Awardees:

Student scholarships for attending the 2011 Stephen Henry Schneider Symposium were provided by the
Advanced Study Program and the Weather and Climate Impacts Assessment Science Program at the National Center for Atmospheric Research.

Scholarships were awarded to:
Casey Kahn-Thornbrugh, University. Arizona
Duncan Nicholas Lubchenco Menge, Princeton University
Niel Bowerman, Oxford University
Chia-Ying Ko, Yale University
Mark Zelinka, Lawrence Livermore National Lab
Dan Griffin, University of Arizona
Lee Anderegg, Stanford University
Gigi Owen, University of Arizona
Zack Guido, University of Arizona
Bill Anderegg, Stanford University

This symposium was made possible by the financial contributions from the following people and organizations:

Tom Burns
Climate Central
Mike Haas
Klaus Hasselmann
Heinz Family Philanthropies
John Mashey
NCAR Advanced Study Program
NCAR Weather and Climate Impacts Assessment Science Program
Armand and Eliane Neukermans
Michael Oppenheimer
Lynn and Susan Orr
Ben Santer
UCAR