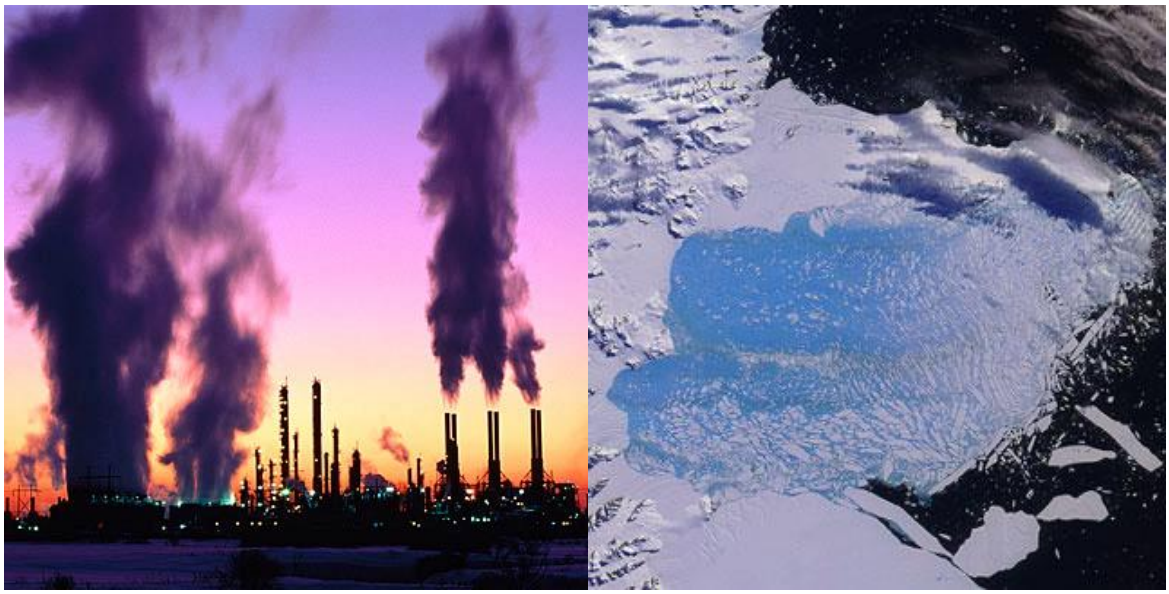
An Index to the Microfilm Edition of

Studies in Global Crisis

International Climatic Changes and Global Warming



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Studies in Global Crisis:
International Climatic Changes and Global Warming

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SCOPE AND CONTENT NOTE

Studies in Global Crises Series

When there can be little margin of error concerning the facts and recommendations on complex and volatile issues, key government officials and federal executive departments depend upon an elite group of private and governmental “think tanks,” military service schools, and private contractors to deliver the research studies and analyses that help mold U.S. policy.

The documents in the *Studies in Global Crises Series* are diverse in scope and emphasis. They dissect specific global crises--explore the historic and contemporary causes, illuminate the psychology behind the crisis, trace its origins, and address the formidable problem of developing feasible policies to alleviate the crisis.

The value of these materials is both immediate and historical. They provide up-to-date information, while documenting the manner the various crises have been perceived and addressed over the last decade. These seminal studies are important now and will remain of value in the future.

International Climatic Changes and Global Warming

The Earth's climate has changed many times during the planet's history, with events ranging from ice ages to long periods of warmth. Historically, natural factors such as volcanic eruptions, changes in the Earth's orbit, and the amount of energy released from the Sun have affected the Earth's climate. Beginning late in the 18th century, human activities associated with the Industrial Revolution have also changed the composition of the atmosphere and therefore very likely are influencing the Earth's climate.

Over the past 200 years, the burning of fossil fuels and deforestation has caused concentrations of heat-trapping "greenhouse gases" to increase significantly in our atmosphere. These gases prevent heat from escaping to space, somewhat like the glass panels of a greenhouse. Greenhouse gases are necessary to life as we know it, because they keep the planet's surface warmer than it otherwise would be. But, as the concentrations of these gases continue to increase in the atmosphere, the Earth's temperature is climbing above past levels. Most of the warming in recent decades is very likely the result of human activities. Other aspects of the climate are also changing such as rainfall patterns, snow and ice cover, and sea level.

Climate change affects people, plants, and animals. Scientists are working to better understand future climate change and how the effects will vary by region and over time. Scientists have observed that some changes are already occurring. Observed effects include sea level rise, shrinking glaciers, changes in the range and distribution of plants and animals, trees blooming earlier, lengthening of growing seasons, ice on rivers and lakes freezing later and breaking up earlier, and thawing of permafrost. Another key issue being studied is how societies and the Earth's environment will adapt to or cope with climate change.

This microfilm collection documents the U.S. response to the threat posed by climatic change and global warming. The research behind the studies, reports, and analyses represents an exhaustive review of the facts, causes, and economic and political implications of a phenomenon that threatens every region of the world.

REEL INDEX

The following is a listing of the folders comprising the microfilm publication entitled *Studies in Global Crises: International Climate Changes and Global Warming.* The Reel Index lists the frame number, document title, bibliographic information, as well as a brief abstract.

REEL 1

Frame #

0001 **McKittrick,David A.,** ***Climates of the World,*** **National Climatic Data Center, 1991. 35 pp.**

This publication updates similar data which appeared in "Climate and Man," the 1941 Yearbook of Agriculture. The principal features of climates of all continents are discussed briefly. Worldwide temperatures and precipitation are illustrated by maps. Monthly and annual temperatures and precipitation , including extreme temperatures, are presented in tabular form for approximately 800 stations throughout the world.

0039 **Sousounis, Peter J., and Jeanne M. Bisanz,** ***Preparing for a Changing Climate: The Potential Consequences of Climate Variability and Change -- Great Lakes,*** **Great Lakes Regional Assessment Group, October 2000. 109pp.**

This report summarizes the methods, findings, and recommendations from the Great Lakes Regional Assessment Team regarding the potential impacts of future climate change and variability in the Great Lakes region. It complements the national overview report that is being prepared by the National Assessment Synthesis Team (NAST) as part of the National Assessment of Climate Change. The report focuses on the years 2030 and 2090. These two times occur approximately 30 years before and after the time when atmospheric carbon dioxide is expected to have doubled from its current value.

0151 **Holtz-Eakin, Douglas,** ***The Economics of Climate Change: A Primer,*** **Congressional Budget Office, April 2003. 71 pp.**

This Congressional Budget Office (CBO) study-prepared at the request of the Ranking Member of the House Committee on Science-presents an overview of issues related to climate change, focusing primarily on its economic aspects. The study draws from numerous published sources to summarize the current state of climate science and provide a conceptual framework for addressing climate change as an economic problem. It also examines public policy options and discusses the potential complications and benefits of international coordination. In keeping with CBO's mandate to provide impartial analysis, the study makes no recommendations.

0224 **Boslough, Mark, et al.,** ***Climate Change Effects on International Stability: A White Paper,*** **Sandia National Laboratories, December 2004. 81pp.**

This white paper represents a summary of work intended to lay the foundation for development of a climatological/agent model of climate-induced conflict. The paper combines several loosely-coupled efforts and is the final report for a four-month late-start Laboratory Directed Research and Development (LDRD) project funded by the Advanced Concepts Group (ACG). The project involved contributions by many participants having diverse areas of expertise, with the common goal of learning how to tie together the physical and human causes and consequences of climate change. The authors performed a review of relevant literature on conflict arising from environmental scarcity. Rather than simply reviewing the previous work, they actively collected data from the referenced sources, reproduced some of the work, and explored alternative models. They used the unfolding crisis in Darfur (western Sudan) as a case study of conflict related to or triggered by climate change, and as an exercise for developing a preliminary concept map. They also outlined a plan for implementing agents in a climate model and defined a logical progression toward the ultimate goal of running both types of models simultaneously in a two-way feedback mode, where the behavior of agents influences the climate and climate change affects the agents.

0303 **Holtz-Eakin, Douglas,** ***Uncertainty in Analyzing Climate Change: Policy Implications,*** **Congressional Budget Office, January 2005. 47pp.**

This paper applies an earth systems model to describe the uncertainty in climate projections under two different policy scenarios. This study illustrates an internally consistent uncertainty analysis of one climate assessment modeling framework, propagating uncertainties in both economic and climate components, and constraining climate parameter uncertainties based on observation. The authors find that in the absence of greenhouse gas emissions restrictions, there is a one in forty chance that global mean surface temperature change will exceed 4.9 °C by the year 2100. A policy case with aggressive emissions reductions over time lowers the temperature change to a one in forty chance of exceeding 3.2 °C, thus reducing but not eliminating the chance of substantial warming.

0351 **Sathaye, Jayant, et al.,** ***GHG Mitigation Potential, Costs and Benefits in Global Forests: A Dynamic Partial Equilibrium Approach,*** **Lawrence Berkeley National Laboratory, March 22, 2005. 20pp.**

This paper reports on the global potential for carbon sequestration in forest plantations, and the reduction of carbon emissions from deforestation, in response to six carbon price scenarios from 2000 to 2100. These carbon price scenarios cover a range typically seen in global integrated assessment models. The world forest sector was disaggregated into ten regions, four largely temperate, developed regions: the European Union, Oceania, Russia, and the United States; and six developing, mostly tropical, regions: Africa, Central America, China, India, Rest of Asia, and South America. Three mitigation optionsÑlong-and short-rotation forestry, and the reduction of deforestationÑwere analyzed using a global dynamic partial equilibrium model (GCOMAP). Key findings of this work are that cumulative carbon gain ranges from 50.9 to 113.2 Gt C by 2100, higher carbon prices early lead to earlier carbon gain and vice versa, and avoided deforestation accounts for 51 to 78% of modeled carbon gains by 2100. The estimated present value of cumulative welfare change in the

sector ranges from a decline of $158 billion to a gain of $81 billion by 2100. The decline is associated with a decrease in deforestation.

0371 **Hoitink, D. J., et al.,** ***Hanford Site Climatological Summary 2004 with Historical Data,*** **Pacific Northwest National Laboratory, May 2005. 192pp.**

This document presents the climatological data measured at the U.S. Department of Energy's Hanford Site for calendar year 2004. Pacific Northwest National Laboratory operates the Hanford Meteorology Station and the Hanford Meteorological Monitoring Network from which these data were collected. This report contains updated historical information for temperature, precipitation, wind, normal and extreme values of temperature and precipitation, and other miscellaneous meteorological parameters.

0556 **Ackerman, T.P.,** ***The Role of Global Observations for Climate and Other Applications,*** **Pacific Northwest National Laboratory, May 2005. 9pp.**

Most of the current earth-observing systems have been designed primarily for the needs of weather forecasting. Weather forecasting is an initial condition problem; the success of the forecast is heavily dependent on the quality of the specified initial state of the atmosphere. Climate, on the other hand, is a boundary condition problem, i.e., climate simulation depends on knowing the energy fluxes into and out of the system, and quantities such as CO2 that affect the flow of those energy fluxes in the system. Consequently, climate-observing systems must extend beyond measurements of state variables to flux measurements of radiation energy and water. This paper focuses on these two cycles because the dominant forms of energy transfer in the climate system (solar energy, thermal infrared energy, evaporation, and condensation) involve these two quantities. Further, because climate is a search for small system trends and imbalances in the midst of large weather variability, climate observations require a much higher degree of precision than do weather observations.

0565 **Thompson, Jonathan,** ***Climate Change and California: Potential Implications for Vegetation, Carbon, and Fire*** **Pacific Northwest National Laboratory, August 2005. 5pp.**

Nineteen scientists from leading research institutes in the United States collaborated to estimate how California's environment and economy would respond to global climate change. A scientist from the PNW Research Station led efforts to estimate effects on vegetation, carbon, and fire. To quantify the range of the possible effects of climate change over the next century, researchers used state-of-the-art climate change simulations coupled with a dynamic vegetation model to gauge sensitivity of natural ecosystems in California under several climate scenarios. The results suggest that climate change would have a more pervasive impact on the vegetation community diversity than would urbanization. Vegetation is estimated to migrate to higher elevations, which would result in reductions in the area covered by alpine meadows and subalpine forests. The area of commercially-important softwood tree species and the state's signature woodlands and shrublands are predicted to decline with warming.

0570 **n/a, *Vision and Framework for Strategy and Planning,* U.S. Climate Change Technology Program, August 2005. 51pp.**

The CCTP strives, through the R&D programs of its participating agencies, to provide Federal leadership in climate change technology development. Through its plans, partnerships, and research progress, the CCTP hopes to stimulate innovation more broadly, outside the Federal community, and inspire private sector interest and enhanced international cooperation in the global quest to develop, commercialize and employ such technology to reduce GHG emissions.

0623 **Schwartz, S.E., *Aerosols, Clouds, and Climate Change,* Brookhaven National Laboratory, September 2005. 18pp.**

Earth's climate is thought to be quite sensitive to changes in radiative fluxes that are quite small in absolute magnitude, a few watts per square meter, and in relation to these fluxes in the natural climate. Atmospheric aerosol particles exert influence on climate directly, by scattering and absorbing radiation, and indirectly by modifying the microphysical properties of clouds and in turn their radiative effects and hydrology. The forcing of climate change by these indirect effects is thought to be quite substantial relative to forcing by incremental concentrations of greenhouse gases, but highly uncertain. Quantification of aerosol indirect forcing by satellite- or ground-based remote sensing has proved quite difficult in view of inherent large variation in the pertinent observables such as cloud optical depth, which is controlled mainly by liquid water path and only secondarily by aerosols. Limited work has shown instances of large magnitude of aerosol indirect forcing, with local instantaneous forcing upwards of 50 W m-2. Ultimately it will be necessary to represent aerosol indirect effects in climate models to accurately identify the anthropogenic forcing at present and over secular time and to assess the influence of this forcing in the context of other forcings of climate change. While the elements of aerosol processes that must be represented in models describing the evolution and properties of aerosol particles that serve as cloud condensation particles are known, many important components of these processes remain to be understood and to be represented in models, and the models evaluated against observation, before such model-based representations can confidently be used to represent aerosol indirect effects in climate models.

0639 **Conover, David W., *U.S. Climate Change Technology Program: Strategic Plan*, U.S. Climate Change Technology Program, September 2005. 245pp.**

This Strategic Plan affords an auspicious moment of opportunity in the climate change technology arena. Through an integrated framework of sound guidance, clear goals and next steps, the Plan will guide and galvanize the Federal Government's extensive and diverse technical efforts. Moreover, the Plan provides a long-term planning context that illuminates the nature of the challenge, as well as the opportunities for technology, which will better inform future Federal R&D planning. The Plan, along with a companion document, Vision and Framework for Strategy and Planning*, lays the foundation for setting priorities through its technology strategies and criteria for investment. In its sections about our current portfolio, the Plan highlights what we regard as the more important investment opportunities at this time. Since the Plan is forward-looking, and because current priorities will evolve over time, we are also seeking public input on future research directions.

0892 **Long, J.C.S., *The "Athena Framework": Solving the World-Wide Climate and Energy Problem,* Lawrence Livermore National Laboratory, October 10, 2005. 13pp.**

The energy systems we have enjoyed for the last 100 years has resulted in the advanced standard of living in the developed world and a major emerging problem with climate change. Now we face a simultaneous realization that our reliance on fossil fuels is a source of conflict and economic disruption as well as causing potentially catastrophic global climate change. It is time to give serious thought to how to collectively solve this problem. Collective action is critical since individual effort by one or only a few nations cannot adequately address the issue.

0905 **Simpson, Michael, *Global Climate Change: Federal Research on Possible Human Health Effects,* Congressional Research Service, February 10, 2006. 12pp.**

It appears likely that global mean temperature increases will continue, and projections into the future predict a variety of possible related impacts, such as more volatile weather patterns, increased incidence of hot spells, and changing precipitation patterns that may include more intense rainfall patterns, as well as changing and intensified drought patterns. Extensive research is underway concerning the links between climate and human health; however, much of this research is being done for reasons unrelated to climate change per se. This report does not address the underlying question of climate change itself. Rather, it identifies the array of climate-relevant human health research and discusses the interconnections.

0917 **Yacobucci, Brent D., and Larry Parker, *Climate Change: Federal Laws and Policies related to Greenhouse Gas Reductions,* Congressional Research Service, February 22, 2006, 21pp.**

This report provides background on the evolution of U.S. climate change policy, from ratification of the UNFCCC to the Bush Administration's 2001 rejection of the Kyoto Protocol to the present. The report focuses on major regulatory programs that monitor or reduce greenhouse gas emissions, along with their estimated effect on emissions levels. In addition, legislation in the 109th Congress calling for monitoring or reducing greenhouse gas emissions is identified and examined.

0938 **Croley, Thomas E, II, *Modified Great Lakes Hydrology Modeling System for Considering Simple Extreme Climates,* National Oceanic and Atmospheric Administration, April 2006. 31pp.**

The Great Lakes Environmental Research Laboratory report simulates Great Lakes hydrology for simple hypothetical climate scenarios to understand the extremes necessary to cause closed (terminal) lakes, suspected to have occurred about 7,900 radiocarbon years ago. They use the Advanced Hydrologic Prediction System with some conditions estimated for this period.

REEL 2

Frame #

0001 **Karl, Thomas R., *Temperature Trends in the Lower Atrmosphere: Steps for Understanding and Reconciling Differences,* U.S. Climate Change Science Program, April 2006. 177pp.**

This Synthesis and Assessment report is an important revision to the conclusions of earlier reports from the U.S. National Research Council and the Intergovernmental Panel on Climate Change. For recent decades, all current atmospheric data sets now show global-average warming that is similar to the surface warming. While these data are consistent with the results from climate models at the global scale, discrepancies in the tropics remain to be resolved. Nevertheless, the most recent observational and model evidence has increased confidence in our understanding of observed climatic changes and their causes.

0178 **Brown, Marilyn, et al., *Results of a Technical Review of the U.S. Climate Change Technology Program's R & D Portfolio,* Oak Ridge National Laboratory, May 2006. 112pp.**

This report discusses Energetics structured review of the federal government's climate change technology research and development portfolio across more than a dozen agencies, resulting in a detailed review that guided investments across more than a dozen federal agencies.

0296 **Justus, John R., and Susan R. Fletcher, *Global Climate Change,* Congressional Research Service, May 12, 2006. 19pp.**

There is concern that human activities are affecting the heat/energy-exchange balance between Earth, the atmosphere, and space, and inducing global climate change, often termed "global warming." Human activities, particularly the burning of fossil fuels, have contributed to increased atmospheric carbon dioxide (CO2) and other trace greenhouse gases. If these gases continue to accumulate in the atmosphere at current rates, most scientists believe significant global warming would occur through intensification of Earth's natural heat-trapping "greenhouse effect." Possible impacts might be seen as both positive and negative, depending on regional or national variations. This report provides information on Global Climate Change Science, International Action, and Congressional Interest and Activities.

0315 **Lucier, Alan, et al., *Ecosystems and Climate Change: Research Priorities for the U.S. Climate Change Science Program,* University of Maryland Center for Environmental Science, Chesapeake Biological Laboratory, June 2006. 54pp.**

In 2003, the Ecosystems Interagency Working Group (EIWG) of the U.S. Climate Change Science Program (CCSP) convened a small group of scientists to plan a workshop and encourage participation by leading ecologists and resource managers in the public and private sectors. The goal of the workshop was to identify critical research needs that address the complex linkages and feedbacks between climate and ecological systems. The Ecosystems and Climate Change workshop was held in 2004 in Silver Spring, MD, and was attended by

over 100 participants. This report summarizes and interprets the workshop discussions and outcomes with a focus on the key research needs that were identified within each of three areas: Feedbacks between ecological systems and global change; Consequences of global change for ecological systems; and, Sustaining and improving ecological systems in the face of global change.

0370 **Delhotal, Casey, and Christa Clapp, *Global Mitigation of Non-Co2 Greenhouse Gases*, U.S. Environmental Protection Agency, June 2006. 439pp.**

The analysis in this report is the latest refinement of the methodology on mitigation of various non-CO2 gases, which has been underway since 1999. A significant contribution to the climate change mitigation literature is Stanford University's Energy Modeling Forum Working Group 21 (EMF-21), which focused on mitigation of multiple greenhouse gases and resulted in the publication of a special issue of the Energy Journal. The specific non-CO2 mitigation papers in the EMF-21 study include energy- and industry-related CH4 and N2O; agricultural-related CH4 and N2O; and industry-related fluorinated gases. Much of the original work comes from three previous USEPA studies for the United States (2006, 2001, 1999) and a study conducted by the European Commission (EC) (2001) that evaluated technologies and costs of CH4 abatement for European Union (EU) members from 1990 to 2010. These studies provided estimates of potential CH4 and N2O emissions reductions from major emitting sectors and quantified costs and benefits of these reductions. Building on the baseline non-CO2 emissions projections from the USEPA's Global Anthropogenic Non-CO2 Greenhouse Gas Emissions: 1990–2020 (2006), this analysis applies mitigation options to the emissions baseline in each sector. Across all the emitting greenhouse gas sectors, for each mitigation option, the technical abatement potential and cost are calculated. This report makes no explicit assumption about policies that would be required to facilitate and generate adoption of mitigation options. Therefore, this report provides estimates of technical mitigation potential.

0797 **Yacobucci, Brent D., *Climate Change Legislation in the 109th Congress*, Congressional Research Service, August 4, 2006. 19pp.**

Climate change and greenhouse gas (GHG) emissions are an issue in the 109th Congress, as they have been in past Congresses. Bills directly addressing climate change issues range from those focused primarily on climate change research to comprehensive emissions cap-and-trade programs for the six greenhouse gases covered under the United Nations Framework Convention on Climate Change. Additional bills focus on GHG reporting and registries, or on power plant emissions of carbon dioxide, as part of wider controls on pollutant emissions. This report briefly discusses the basic concepts on which these bills are based and compares major provisions of the bills in each of the following categories: climate change research, technology deployment, GHG reporting and registries, and emissions reduction programs.

0816 **Clarke, L.E., et al., *Climate Change Mitigation: An Analysis of Advanced Technology Scenarios,* Pacific Northwest National Laboratory, September 2006. 129pp.**

This report documents a scenario analysis exploring the role of advanced technology in stabilizing atmospheric greenhouse gas concentrations. The analysis was conducted by staff members of Pacific Northwest National Laboratory (PNNL), working primarily at the Joint

Global Change Research Institute, in support of the U.S. Climate Change Technology Program's (CCTP's) strategic planning process.

0937 **Wagner, Fabian, et al.,** ***Sharing the Burden of Climate Change Stabilization: An Energy Sector Perspective,*** **Lawrence Berkeley National Laboratory, October 2006. 29pp.**

This paper discusses long-term least cost CO2 stabilization scenarios based on the SRES AIM A1B scenario in the context of an international burden-sharing regime. Starting from a stabilization target, regional emission caps are formulated dynamically on the basis of past emissions. With these regional caps, the cost-optimal supply fuel mix in the energy sector in the four SRES world regions is calculated, and lower bounds on the volume of traded carbon are estimated. The allocation scheme provides incentives for early mitigation action. The paper estimates additional regional costs incurred by the allocation scheme, and assesses the sensitivity of results to changes in the concentration ceiling, discount rates, and start date for burden sharing.

0967 **Menge-Richter, J., et al.,** ***State of the Arctic,*** **Pacific Marine Environmental Laboratory, October 2006. 40pp.**

This State of the Arctic Report presents a review of recent data by an international group of scientists who developed a consensus on the information content and reliability. The report highlights data primarily from 2000 to 2005 with a first look at winter 2006, providing an update to some of the records of physical processes discussed in the Arctic Climate Impact Assessment.

1006 **Burd, Michael L.,** ***Global Warming and the Combatant Commander: Engaging the Arctic Region,*** **Naval War College, October 23, 2006. 26pp.**

The National Military Strategy (NMS) describes how the U.S. Joint Force will support the National Security Strategy (NSS) and National Defense Strategy (NDS) through the establishment and execution of three military objectives. "Protect, Prevent, Prevail" is a condensed summation of the principles behind this guidance. U.S. forward posture and presence in the global maritime environment are essential in meeting these objectives, particularly in preventing conflict and surprise attack. In describing some key aspects of a future security setting, the NMS predicts potential battle spaces far different from any in which U.S. forces currently train. The Arctic region is not specifically addressed in current versions of the NSS, NDS, or NMS. This battle space of Cold War significance, however, fits the Chairman of the Joint Chiefs of Staff's description and is reemerging as a potential theater of operations because of changes brought forth by the phenomenon known as global warming. A characteristic that clearly distinguishes the Arctic from other U.S. geographic combatant commander (GCC) areas of responsibility is that its landscape is literally changing in physical composition. This reality brings with it many significant and far-reaching security implications. GCCs and their 21st century successors will need to broaden their appreciation of the Arctic beyond its historical significance and prepare for complex security threats that could rival those of the previous century's bipolar strategic environment. GCC engagement in the region, a challenge in today's theater-strategic continuum, is necessary to prepare tomorrow's joint force for the challenges and opportunities that lie in the Arctic's not so distant future. There is an assortment of theater-strategic matters pertaining to the Arctic's

future that warrant GCC attention. This paper focuses on a short list: increased maritime access, territorial disputes, and oil exploration.

REEL 3

Frame #

0001 **n/a, *USA: Energy Needs, Clean Development, and Climate Change;* Partnerships in Action, November 2006. 31pp.**

The United States is working in partnership with other governments, non-governmental organizations, and the private sector to transform how energy is produced and consumed. These partnerships promise to improve the lives of billions of people in all parts of the world. Our approach draws upon the best scientific research, fosters the creativity of entrepreneurs, and involves developing world partners in order to meet our shared aspirations for our people, our economy, and our environment.

0032 **Stephenson, John, *Climate Change: Financial Risks to Federal and Private Insurers in Coming Decades are Potentially Significant,* U.S. Government Accountability Office, March 2007. 72pp.**

Weather-related events have cost the nation billions of dollars in damages over the past decade. Many of these losses are borne by private insurers and by two federal insurance programs—the National Flood Insurance Program (NFIP), which insures properties against flooding, and the Federal Crop Insurance Corporation (FCIC), which insures crops against drought or other weather disasters. GAO was asked to (1) describe how climate change may affect future weather-related losses, (2) determine past insured weather related losses, and (3) determine what major private insurers and federal insurers are doing to prepare for potential increases in such losses. In response, among other things, GAO reviewed key scientific assessments; analyzed insured loss data; and contacted private insurers, NFIP, and FCIC.

0104 **Rong, F., et al., *Climate Change and the Long-Term Evolution of the U.S. Buildings Sector,* Pacific Northwest National Laboratory, April 2007. 43pp.**

Buildings account for 40 percent of U.S. energy use and are the dominant driver of daily and seasonal electric load cycles. Understanding the possible long-term evolution in these energy demands, their potential response to climate policies, and the potential benefits of advances in the technologies that provide them are critical for informing climate-based policy decisions. This document presents a new, service-based approach to understanding the long-term evolution of the U.S. buildings sector within the context of a long-term, global, integrated-assessment model called MiniCAM. The buildings module explicitly represents the demands for energy services, such as heating, cooling, and lighting along with the technologies to supply these services. Future scenarios for U.S. building energy service and energy use are presented. Building final energy use increases over the 21st century with a concurrent increase in the fraction of energy supplied by electricity. Constraining carbon emissions lowers natural gas and fuel oil use, but results in little change in electricity use.

0144 **Grosshans, Ray, et al.,** ***Sustainable Harvest for Food and Fuel: Preliminary Food & Fuel Gap Analysis Report,*** **Idaho National Laboratory, April 2007. 23pp.**

To promote economic growth and energy security, and to protect the environment, the U.S. is pursuing a national strategy of energy independence and climatic protection in which domestic renewable carbon-neutral biofuels displace 30 percent of U.S. oil consumption by the mid-21st century. Such fuels, including ethanol and biodiesel, will be produced from biological feed stocks (biomass). The availability of this billion-ton biomass will hinge on the application of modern scientific and engineering tools to create a highly-integrated biofuel production system. Efforts are underway to identify and develop energy crops, ranging from agricultural residues to genetically engineered perennials; to develop biology-based processing methods; and, to develop large-scale bio-refineries to economically convert biomass into fuels.

0167 **Parfomak, Paul W., and Peter Folger** ***Carbon Dioxide (CO2) Pipelines for Carbon Sequestration: Emerging Policy Issues,*** **Congressional Research Service, April 19, 2007. 21pp.**

In the 110th Congress, a number of bills include aspects of CCS, but do not discuss in any detail proposals for pipeline infrastructure to transport captured CO2 from sources to storage sites. Many bills that mention some form of CCS focus on incentives for enhancing CO2 capture and/or on characterizing geologic reservoirs. Some bills, such as S. 962 and H.R. 931, include sections on promoting the development of technologies needed to separate and capture CO2 at its source, often as part of research and development provisions. Other bills, such as H.R. 1267 and S. 731, call for enhancing or expanding the national capability to assess potential U.S. capacity for safe and long-term CO2 storage in geologic reservoirs.

0188 **Leggett, Jane A.,** ***Climate Change: Science and Policy Implications,*** **Congressional Research Service, May 2, 2007. 54pp.**

The continuing scientific process has resulted in a better understanding of climate change and generally confirms the broad conclusions made in previous decades by the preponderance of scientists: that human activities emit greenhouse gases that influence the climate, with potentially serious effects. Details have been revised or refined, but the basic conclusion of the risks persists. The principal questions remaining for the majority of scientists concern not whether greenhouse gases will result in climate change, but the magnitude, speed, geographic details, and likelihood of surprises, and the appropriate timing and options involved in addressing the human components of climate change.

0242 **Stephenson, John,** ***Climate Change: Financial Risks to Federal and Private Insurers in Coming Decades are Potentially Significant,*** **U.S. Government Accountability Office, May 3, 2007. 22pp.**

This additional testimony is based on a report entitled Climate Change: Financial Risks to Federal and Private Insurers in Coming Decades are Potentially Significant (GAO-07-285) released on April 19, 2007.

0264 **n/a, *Arctic Observing Network: Toward a U.S. Contribution to Pan-Arctic Observing,* Interagency Arctic Research Policy Committee, June 2007. 96pp.**

The Arctic environment is changing. The changes are large, rapid and system-wide. They have few equals elsewhere on Earth, and some are occurring at greater rates than predicted by computer models. Arctic Change has regional and global implications, and continued changes will have significant Arctic and worldwide environmental and societal consequences. This report focuses on US Federal observing activities in the Arctic as they relate to the development of AON to advance the goals of SEARCH. The report also describes many sub-Arctic observing activities. The Arctic is not isolated from the rest of the world, and AON must include the sub-Arctic observing sites. They are a vital to documenting northern environmental variation and change, and improving the understanding of interactions and feedbacks that occur between the Arctic and the rest of the world. The report also shows that Federal Arctic observing activities extend beyond US territory. The need for enhanced Arctic observing capabilities is recognized by all Arctic countries, and also by many outside the Arctic. AON will be the US contribution to a multinational, pan-Arctic observing network to be developed in collaboration with other countries.

0360 **Mielbrecht, Eric E., and Jordan M. West, *Climate Change and Interacting Stressors: Implications for Coral Reef Management in American Samoa,* U.S. Environmental Protection Agency, June 2007. 71pp.**

Climate variability and change can negatively impact sensitive coral reef ecosystems by altering sea surface temperatures, ocean carbonate concentrations, sea level, storm surges, precipitation patterns, stream flows to the coast, salinity, and pollution loads. This report focuses on the coral reefs of American Samoa as a case study for how managers can approach (1) assessments of reef vulnerabilities to climate change and interacting stressors, (2) identification of adaptive management strategies in response, and (3) integration of management options with existing decision processes and mandates. Large-scale climate stressors are reviewed along with information on localized stressors in American Samoa to assess reef vulnerabilities to climate-related impacts such as coral bleaching. Based on this information, this report presents some adaptive management strategies that could be implemented immediately (e.g., water quality improvements), in the near-term (e.g., enhanced strategic monitoring), and in the long-term (e.g., resilience planning). In each case, management options are considered in a decision making context – i.e., in terms of how such strategies relate to existing plans, processes, and mandates.

0431 **Folger, Peter, *The Carbon Cycle: Implications for Climate Change and Congress,* Congressional Research Service, June 25, 2007. 14pp.**

Huge quantities of carbon are actively exchanged between the atmosphere and other storage pools, including the oceans, vegetation, and soils on the land surface. The exchange, or flux, of carbon among the atmosphere, oceans, and land surface is called the global carbon cycle. Comparatively, human activities contribute a relatively small amount of carbon, primarily ascarbon dioxide (CO2), to the global carbon cycle. Despite the addition of a relatively small amount of carbon to the atmosphere, compared to natural fluxes from the oceans and land surface, the human perturbation to the carbon cycle is increasingly recognized as a main factor driving climate change over the past 50 years. Congress is considering legislative strategies to reduce U.S. emissions of CO2 and/or increase the uptake of CO2 from the atmosphere. Congress may also opt to consider how land management practices, such as afforestation,

conservation tillage, and other techniques, might increase the net flux of carbon from the atmosphere to the land surface. Some land management practices may be eligible to receive carbon offsets in cap-and-trade legislation that is under consideration. A cap-and-trade system designed to include carbon offsets would likely need an accurate and precise accounting for the tons of carbon sequestered deliberately by land management practices. How the ocean sink could be managed to store more carbon is unclear. Iron fertilization and deep ocean injection of CO2 are in an experimental stage, and their promise for long-term enhancementof carbon uptake by the oceans is not well understood.

0445 **Kathmann, Loel, *Scenarios of Greenhouse Gas Emissions and Atmospheric Concentrations* U.S. Climate Change Science Program, July 2007. 159pp.**

This and a companion report constitute one of twenty-one Synthesis and Assessment Products called for in the Strategic Plan for the U.S. Climate Change Science Program. These studies are structured to provide high-level, integrated research results on important science issues with a particular focus on questions raised by decision-makers on dimensions of climate change directly relevant to the U.S. One element of the CCSP's strategic vision is to provide decision support tools for differentiating and evaluating response strategies. Scenario-based analysis is one such tool. The scenarios in this report explore the implications of alternative stabilization levels of anthropogenic greenhouse gases (GHGs) in the atmosphere, and they explicitly consider the economic and technological foundations of such response options. Such scenarios are a valuable complement to other scientific research contained in the twenty-one CCSP Synthesis and Assessment Products. The companion to the research reported here, Global-Change Scenarios: Their Development and Use, explores the broader strategic frame for developing and utilizing scenarios in support of climate decision making. This report contributes to and enhances the ongoing and iterative international process of producing and refining climate-related scenarios and scenario tools. It was developed with broad scientific input and in accordance with the Guidelines for Producing CCSP Synthesis and Assessment Products, Section 515 of the Treasury and General Government Appropriations Act for Fiscal Year 2001 (Public Law 106-554), and the Information Quality Act guidelines issued by the Department of Energy pursuant to Section 515. The CCSP Interagency Committee relies on Department of Energy certifications regarding compliance with Section 515 and the Guidelines for Producing CCSP Synthesis and Assessment Products.

0604 **Johnson, Stephen L., *EPA Analysis of the Climate Stewardship and Innovation Act of 2007,* U.S. Environmental Protection Agency, July 16, 2007. 100pp.**

On February 5, 2007 Senators Lieberman and McCain requested that EPA estimate the economic impacts of S. 280, the Climate Stewardship and Innovation Act of 2007. This report covers the analysis of S.280 based on discussions with U.S. Senate staff and internal EPA considerations.

0704 **n/a, *Adapting to Climate Variability and Change,* U.S. Agency for International Development, August 2007. 29pp.**

Climate change may pose risks and/or create opportunities for development efforts in many countries. The USAID Global Climate Change Team developed this Adaptation Guidance Manual to assist Missions and other partners to understand how climate change may affect their project outcomes and identify adaptation options to integrate into the design for more resilient projects.

0733 **Leggett, Jane A., *Climate Change: Federal Funding and Tax Incentives,* Congressional Research Service, August 2, 2007. 30pp.**

Key policy issues associated with federal climate change funding include prioritizing spending among individual programs, and articulating measurable goals and milestones against which to track progress; improving clarity in reporting of funding, including changes in accounting that make comparisons from year to year difficult; and the relationship of stability of funding and incentives to program effectiveness.

0763 **Ramseur, Jonathan L., *Greenhouse Gas Reductions: California Action and the Regional Greenhouse Gas Initiative,* Congressional Research Service, August 31, 2007. 23pp.**

In the absence of a federal program requiring greenhouse gas (GHG) emission reductions, a growing group of U.S. states are taking action in this arena. Significant actions have been undertaken in California and by a coalition of states from the Northeast and Mid-Atlantic regions. California has undertaken several initiatives that seek to reduce GHG emissions. In 2004, the state issued regulations to reduce GHG emissions from motor vehicles. At least 14 other states have indicated that they plan to implement California's new vehicle requirements. In 2006, California passed two climate change statutes. The first establishes a statewide cap on GHG emissions. The second, once it becomes applicable, effectively limits the use of coal-generated electricity in California. The state has also taken action to reduce the carbon intensity in its transportation fuels. The RGGI and climate change activities in California are aggressive, but the resulting emission reductions may be offset by increased emissions in states without such requirements. This is a primary limitation of state climate change programs. Legal challenges to the state actions, particularly those that may affect interstate commerce, represent another obstacle.

0786 **Stephenson, John, *Climate Change Research: Agencies Have Data-Sharing Policies but Could Do More to Enhance the Availability of Data from Federally-Funded Research,* U.S. Government Accountability Office, September 2007. 60pp.**

Much of the nearly $2 billion annual climate change research budget supports grants from the Department of Energy (DOE), National Aeronautics and Space Administration (NASA), National Oceanic and Atmospheric Administration (NOAA), and National Science Foundation (NSF). Some of the data generated by this research are stored in online archives, but much remains in a less accessible format with individual researchers. As a result, some researchers are concerned about the availability of data. GAO analyzed (1) the key issues that data-sharing policies should address; (2) the data-sharing requirements, policies, and practices for external climate change researchers funded by DOE, NASA, NOAA, and NSF; and (3) the extent to which these agencies foster data sharing. GAO examined requirements, policies, and practices and surveyed the 64 officials managing climate change grants at these agencies. GAO recommends the agencies explore opportunities in the grants process to better ensure the availability of data to other researchers and determine if additional archiving strategies are warranted. In commenting on a draft of this report, the four agencies generally agreed with our findings and recommendations. We incorporated technical clarifications as appropriate.

0846 **Akbari, Hashem, *Global Cooling: Effect of Urban Albedo on Global Temperature,* Lawrence Berkeley National Laboratory, September 2007. 5pp.**

In many urban areas, pavements and roofs constitute over 60% of urban surfaces (roof 20-25%, pavements about 40%). The roof and the pavement albedo can be increased by about 0.25 and 0.10, respectively, resulting in a net albedo increase for urban areas of about 0.1. Many studies have demonstrated building cooling-energy savings in excess of 20% upon raising roof reflectivity from an existing 10-20% to about 60%. It is estimated that U.S. potential savings are in excess of $1 billion (B) per year in net annual energy bills. Increasing albedo of urban surfaces can reduce the summertime urban temperature and improve the urban air quality. For more than two decades, the Heat Island Group (HIG) at Lawrence Berkeley National Laboratory (LBNL) has performed research to quantify the effect of increasing urban albedo on reducing cooling energy use, cooling urban areas, and improving urban air quality.

0851 **Orszag, Peter R., *The Potential for Carbon Sequestration in the United States,* Congressional Budget Office, September 2007. 26pp.**

The atmospheric concentration of greenhouse gases—notably carbon dioxide (CO2)—has gradually increased over the past century and is warming the Earth's climate. Various analyses suggest that starting to stabilize or reduce that concentration to avoid some future climate-related damage would have greater benefits than costs. Ways to lower the atmospheric concentration of CO2 include not only reducing emissions but also encouraging carbon sequestration—the capture and storage of CO2 to prevent its release into the atmosphere, and the absorption of atmospheric CO2 by vegetation and soil. This Congressional Budget Office (CBO) paper—prepared at the request of the Chairman of the Subcommittee on Private Sector and Consumer Solutions to Global Warming and Wildlife Protection of the Senate Committee on Environment and Public Works—examines the methods, technological potential, and possible costs of carbon sequestration in the United States.

0881 **Meyer, David W., *Relationships between Global Warming and Tropical Cyclone Activity in the Western North Pacific,* Naval Postgraduate School, September 2007. 163pp.**

In this work, the authors investigate the relationships between global warming and tropical cyclone activity in the Western North Pacific (WNP). Their hypothesis is that global warming impacts on TC activity occur through changes in the large scale environmental factors (LSEFs) known to be important in determining the formation and intensity of TCs. The LSEFs on which they focus are: Sea surface temperature (SST) exceeding 26C Weak vertical shear in horizontal winds Large positive absolute vorticity at low levels Mean upward motion High mid-level humidity. The authors separate the data into weekly 5x5 region averages. Using a least squares fit, we identify global warming signals in both the SST and vertical wind shear data across the WNP. These signals vary significantly on a 5x5 scale. Logistic regression was used to determine the LSEFs/TC formation probability relationship. Linear regression was performed to determine the LSEF/ACE relationship. Through the two regression models, they determined that each of the LSEFs is important for both TC formation and ACE. Independent data from that used in the regression modeling was used to validate the models. Their results support the hypothesis, and indicate that global warming has increased TC numbers and intensities in the WNP via the LSEFs.

REEL 4

Frame #

0001 ***Our Changing Planet: The U.S. Climate Change Science Program for Fiscal Year 2008*** **Brennan, William J. U.S. Climate Change Science Program, October 2007. 213pp.**

Climate plays an important role in shaping the environment, natural resources, infrastructure, economy, and other aspects of life in all countries of the world. Therefore, variations and changes in climate can have substantial environmental and socioeconomic implications. The Climate Change Science Program (CCSP) was established in 2002 to empower the Nation and the global community with the science-based knowledge to manage risks and opportunities of change in the climate and related environmental systems. CCSP incorporates and integrates the U.S. Global Change Research Program (USGCRP) with the Administration's U.S. Climate Change Research Initiative (CCRI). The USGCRP was mandated by Congress in the Global Change Research Act of 1990 (P.L. 101-606, 104 Stat. 3096-3104) to improve understanding of uncertainties in climate science, expand global observing systems, develop science-based resources to support policymaking and resource management, and communicate findings broadly among scientific and stakeholder communities.

0214 **Orszag, Peter R.,** ***Approaches to Reducing Carbon Dioxide Emmissions,*** **Congressional Budget Office, November 1, 2007. 15pp.**

Testimony of Peter Orszag that global climate change is one of the nation’s most significant long-term policy challenges. Human activities are producing increasingly large quantities of greenhousegases, particularly CO2. The accumulation of those gases in the atmosphere is expected to have potentially serious and costly effects on regional climates throughout the world. The magnitude of such damage remains highly uncertain. But there is growing recognition that some degree of risk exists for the damage to be large and perhaps even catastrophic.

0230 ***Ramseur, Jonathan L., Climate Change: Action by States to Address Greenhouse Gas Emissions, Congressional Research Service, November 23, 2007. 28pp.***

In the absence of a federal climate change program, a number of states have taken actions that directly address greenhouse gases (GHGs). States efforts cover a wide range of policies. Although much of the early activity was largely symbolic, the more recent state actions have been more aggressive. Twenty-three states have joined one of the three regional partnerships that would require GHG (or just carbon dioxide) emission reductions. Set to take effect in 2009, the Regional Greenhouse Gas Initiative (RGGI) is a partnership of 10 Northeast and Mid-Atlantic states that creates up a cap-and-trade system aimed at limiting carbon dioxide emissions from power plants. Seven western states (and two Canadian provinces) have formed the Western Climate Initiative, which set an economy-wide GHG emissions target of 15% below 2005 levels by 2020. In addition, six states (and one Canadian province) signed the Midwestern Greenhouse Gas Reduction Accord, which would establish a multi-sector, GHG cap-and-trade program in the Midwest. The latter two programs are still in the early development stages, while many of RGGIs logistics have been decided by the participants. Three states California, Hawaii, and New Jersey have passed laws establishing mandatory, economy-wide GHG emission limits. However, the critical elements of these programs are still being developed. California has addressed GHG

emissions on several fronts. To complement its statewide emissions reduction regime, California established GHG performance standards that would effectively limit the use of coal-generated electricity in California. In 2004, California issued regulations to reduce greenhouse gases from motor vehicles. At least 14 other states have indicated they intend to follow California's new vehicle requirements. In addition, the state has also taken action to reduce the carbon intensity in its transportation fuels.

0258 **Fletcher, Susan R., et al.,** ***Climate Change: Issues Underlying Negotiations at the Bali Conference of Parties,*** **Congressional Research Service, November 26, 2007. 13pp.**

"As climate change has gained widespread attention as a critical issue facing the nations of the world, the negotiations to be held in Bali, Indonesia, December 3-14, 2007, are widely regarded as a critical next step in continuing to chart an international course to mitigate global warming and deal with its impacts. This report provides background on the negotiations in four sections: (1) a summary of the status of the 1992 United Nations Framework Convention on Climate Change (UNFCCC) and the 1997 Kyoto Protocol that established mandatory limits on the six major greenhouse gases for the major developed nations (listed in "Annex I" of the UNFCCC and generally referred to as "Annex I countries"); (2) a brief review of the science and economics underlying concerns about climate change and related possible future goals to reduce greenhouse gases; (3) the progress to date of Annex I and non-Annex I nations under the Kyoto Protocol; and (4) an overview of the upcoming negotiations at the 13th conference of the parties of the UNFCCC (COP-13) and third meeting of the parties to the Kyoto Protocol (MOP-3) in Bali. At a preliminary meeting leading up to the December COP/MOP, four key elements were outlined as the focus for a "Bali road map": 1) mitigation of climate change (agreeing on emission reduction commitments); 2) adaptation to impacts of climate change; 3) financial assistance issues; and 4) technology development and transfer. It is very likely that, while future negotiations will grapple with the effort to obtain some form of legally binding, mandatory commitments from all parties, the recognition of differing national circumstances and differing abilities of nations to take on various types of commitments will be major elements in the discussions."

0271 **Sisiopiku, Virginia P., and Aymeric Rousseau,** ***Global Assessment of Hydrogen Technologies: Technology Evaluation of Hydrogen Light-Duty Vehicles,*** **Argonne National Laboratory, December 2007. 60pp.**

The goal of this study was to assess selected hydrogen technologies for potential application to transportation and power generation. Specifically, this study evaluated scenarios for deploying hydrogen technologies and infrastructure in the Southeast.

0331 **Metz, Robert,** ***Climate Change Litigation: A Growing Phenomenon*** **, Congressional Research Service, December 26, 2007. 36pp.**

"The scientific, economic, and political questions surrounding climate change have long been with us. This report focuses instead on a relative newcomer: the legal debate. Though the first court decisions related to climate change appeared over a decade ago, such litigation has proliferated in recent years."

0367 **n/a, *National Security and the Threat of Climate Change*, CNA Corporation, 2007. 35pp.**

Climate change can act as a threat multiplier for instability in some of the most volatile regions of the world, and it presents significant national security challenges for the United States. The purpose of this study was to examine the national security consequences of climate change. It presents suggestions for mitigating the severity of some of emergent challenges.

0402 **n/a, *U.S. Actions to Address: Energy Security, Clean Development, and Climate Change* Partnerships in Action, 2007. 44pp.**

Climate change is a serious challenge, the scale and scope of which will require a global response. The United States is committed to doing its part, working at home and abroad on a range of initiatives, to strengthen energy security and effectively address climate change. We are fully engaged in the United Nations Framework Convention on Climate Change (UNFCCC) and we are committed to developing an environmentally effective and economically sustainable post-2012 framework to address climate change." The major topics covered in this Address include: the major economies process, current U.S. climate policies as a part of the sustainable development agenda, domestic measures, international approaches, and the look ahead.

0445 **Peterson, Thomas C., et al, *Climate Variability and Change with Implications for Transportation*, National Climatic Data Center, January 2008. 90pp.**

The U.S. transportation system was built for the typical weather and climate experienced locally. Moderate changes in the mean climate have little impact on transportation. However, changes in weather and climate extremes can have considerable impact on transportation. Transportation relevant measures of extremes have been changing over the past several decades and are projected to continue to change in the future. Some of the changes are likely to have a positive impact on transportation and some negative. As the climate warms, cold temperature extremes are projected to continue to decrease. Milder winter conditions would likely improve the safety record for rail, air and ships. Warm extremes, on the other hand, are projected to increase. This change would likely increase the number of roadbed and railroad track bucklings and adversely impact maintenance work. As the cold season decreases and the warm season increases, northern transportation dependent upon ice roads and permanently frozen soil would be adversely affected while the projected commercial opening of the Northwest Passage would result in clear benefits to marine transportation. The warming would also produce a side benefit of shifting more of the precipitation from snow to rain. But not all precipitation changes are likely to be beneficial. Heavy precipitation events are projected to increase, which can cause local flooding. At the same time, summer drying in the interior of the continent is likely to contribute to low water levels in inland waterways. Strong storms, including hurricanes, are projected to increase. Coastal transportation infrastructure is vulnerable to the combined effects of storm surge and global sea-level rise. Transportation planning operates on several different time scales. Road planners typically look out 25 years. Railroad planners consider 50 years. And bridges and underpasses are generally designed with 100 years in mind. In all cases, planning that takes likely changes into consideration will be important.

0535 **n/a, *Ecological Impacts of Climate Change,* Committee on Ecological Impacts of Climate Change, January 2008. 33pp.**

The world's climate is changing, and it will continue to change throughout the 21st century and beyond. Rising temperatures, new precipitation patterns, and other changes are already affecting many aspects of human society and the natural world. In this report, the National Research Council provides a broad overview of the ecological impacts of climate change, and a series of examples of impacts of different kinds.

0567 **n/a, *Latest Findings on National Air Quality: Status and Trends through 2006,* U.S. Environmental Protection Agency, January 2008. 35pp.**

For more than 35 years, EPA has been working to reduce pollution and make the nation's air cleaner and healthier to breathe. This summary report highlights the agency's most recent evaluation of status and trends in our nation's air quality.

0602 **n/a, *Understanding and Responding to Climate Change,* National Academy of Science January 2008. 24pp.**

This report highlights findings and recommendations from National Academies' reports on climate change. This report is the result of the National Academies' consensus study process, which brings together leading scientists, engineers, public health officials, and other experts to address specific scientific and technical questions. This report evaluates climate change science, identifies new avenues of inquiry and critical needs in the research infrastructure, and explores opportunities to use scientific knowledge to more effectively respond to climate change.

0626 **Harrison, D.E., and Mark Carson, *Upper Ocean Warming: Spatial Patterns of Trends and Interdecadal Variability,* National Oceanic and Atmospheric Administration, January 2008, 34pp.**

There is great interest in World Ocean temperature trends, yet the historical global ocean database has very uneven coverage in space and time. Previous work on 50-yr upper ocean temperature trends from the NOAA ocean data archive is extended here. Trends at depths from 50 to 1000 m are examined, based on observations gridded over larger regions than in the earlier study. Despite the use of larger grid boxes, most of the ocean does not have significant 50-yr trends at the 90% confidence level (CL). In fact only 30% of the ocean at 50 m has 90% CL trends, and the percentage decreases significantly with increasing depth. As noted in the previous study, there is much spatial structure in 50-yr trends, with areas of strong warming and strong cooling. These trend results are compared with trends calculated from data interpolated to standard levels and from a highly horizontally interpolated version of the dataset that has been used in previous heat content trend studies. The regional trend results can differ substantially, even in the areas with statistically significant trends. Trends based on the more interpolated analyses show more warming. Together with major temporal and spatial sampling limitations, the previously described strong interdecadal and spatial variability of trends makes it very difficult to formally estimate uncertainty in World Ocean averages, but these results suggest that upper ocean heat content integrals and integral trends may be substantially more uncertain than has yet been acknowledged.

0661 **Phillips, T., et al, Armospheric Climate Model Experimentgs Performed at Multiple Horizontal Resolutions, Lawrence Livermore National Laboratory, January 3, 2008. 30pp.**

This report documents salient features of version 3.3 of the Community Atmosphere Model (CAM3.3) and of three climate simulations in which the resolution of its latitudelongitude grid was systematically increased. For all these simulations of global atmospheric climate during the period 1980-1999, observed monthly ocean surface temperatures and sea ice extents were prescribed according to standard Atmospheric Model Intercomparison Project (AMIP) values. These CAM3.3 resolution experiments served as control runs for subsequent simulations of the climatic effects of agricultural irrigation, the focus of a Laboratory Directed Research and Development (LDRD) project. The CAM3.3 model was able to replicate basic features of the historical climate, although biases in a number of atmospheric variables were evident. Increasing horizontal resolution also generally failed to ameliorate the large-scale errors in most of the climate variables that could be compared with observations. A notable exception was the simulation of precipitation, which incrementally improved with increasing resolution, especially in regions where orography plays a central role in determining the local hydroclimate.

0691 **Brennan, William J., *Effects of Climate Change on Energy Production and Use in the United States,* U.S. Climate Change Science Program, February 2008. 93pp.**

This report summarizes what is currently known about effects of climate change on energy production and use in the United States. The report concludes that there are reasons to pay close attention to possible climate change impacts on energy production and use and to consider ways to adapt to possible adverse impacts and take advantage of possible positive impacts.

0785 **Parker, Larry, and John Blodgett, *Global Climate Change: Three Policy Perspectives*, Congressional Research Service, February 7, 2008. 38pp.**

The 1992 U.N. Framework Convention on Climate Change requires that signatories, including the United States, establish policies for constraining future emission levels of greenhouse gases, including carbon dioxide (CO2). The George H. W. Bush, Clinton, and George W. Bush Administrations each drafted action plans in response to requirements of the convention. These plans have raised significant controversy and debate. This debate intensified following the 1997 Kyoto Agreement, which, had it been ratified by the United States, would have committed the United States to reduce greenhouse gases by 7% over a five-year period (2008-2012) from specified baseline years. Controversy is inherent, in part, because of uncertainties about the likelihood and magnitude of possible future climate change, the consequences for human wellbeing, and the costs and benefits of minimizing or adapting to possible climate change. Controversy also is driven by differences in how competing policy communities view the assumptions underlying approaches to this complex issue. This paper examines three starting points from which a U.S. response to the convention was framed. These starting points, or policy "lenses," led to divergent perceptions of the issue with respect to uncertainty, urgency, costs, and government roles. They also implied differing but overlapping processes and actions for possible implementation, thus shaping recommendations of policy advocates concerning the federal government's role in reducing greenhouse gases.

0823 **Rea, Anne W.,** ***Draft Scope and Methods Plan for Risk/Exposure Assessment: Secondary NAAQS Review for Oxides of Nitrogen and Oxides of Sulfur,*** **U.S. Environmental Protection Agency, March 2008. 102pp.**

This report reviews the primary NAAQS for NO2 and SO2 addressed in separate plans released during the winter of 2006–2007. It discusses the secondary NAAQS review process, which contains four major components: an integrated review plan, a science assessment, a risk/exposure assessment, and a policy assessment/rulemaking. This Scope and Methods Plan is the first phase of the risk/exposure assessment and describes the scope of the analyses to performed and the tools and methods that ere used for the joint review of the secondary NAAQS for these pollutants.

0925 **Hansen, Dennis J., et al.,** ***Ecological Monitoring and Compliance Program: 2007 Report,*** **National Security Technologies and National Nuclear Security Administration, March 2008. 141pp.**

In accordance with U.S. Department of Energy (DOE) Order 450.1, 'Environmental Protection Program', the Office of the Assistant Manager for Environmental Management of the DOE, National Nuclear Security Administration Nevada Site Office (NNSA/NSO) requires ecological monitoring and biological compliance support for activities and programs conducted at the Nevada Test Site (NTS). National Security Technologies, LLC (NSTec), Ecological Services has implemented the Ecological Monitoring and Compliance (EMAC) Program to provide this support. EMAC is designed to ensure compliance with applicable laws and regulations, delineate and define NTS ecosystems, and provide ecological information that can be used to predict and evaluate the potential impacts of proposed projects and programs on those ecosystems. This report summarizes the EMAC activities conducted by NSTec during calendar year 2007. Monitoring tasks during 2007 included eight program areas: (a) biological surveys, (b) desert tortoise compliance, (c) ecosystem mapping and data management, (d) sensitive plant monitoring, (e) sensitive and protected/regulated animal monitoring, (f) habitat monitoring, (g) habitat restoration monitoring, and (h) biological monitoring at the Nonproliferation Test and Evaluation Complex (NPTEC). The following sections of this report describe work performed under these eight areas.

REEL 5

Frame #

0001 **Savonis, Michael J., et al.,** ***Impacts of Climate Change and Variabilityon Transportation Systems and Infrastructure: Gulf Coast Study, Phase I,*** **U.S. Climate Change Science Program, March 2008. 439pp.**

Climate affects the design, construction, safety, operations, and maintenance of transportation infrastructure and systems. The prospect of a changing climate raises critical questions regarding how alterations in temperature, precipitation, storm events, and other aspects of the climate could affect the nation’s roads, airports, rail, transit systems, pipelines, ports, and waterways. Phase I of this regional assessment of climate change and its potential impacts on transportation systems addresses these questions for the region of the U.S. central Gulf Coast between Galveston, Texas and Mobile, Alabama. This region contains

multimodal transportation infrastructure that is critical to regional and national transportation services. Historical trends and future climate scenarios were used to establish a context for examining the potential effects of climate change on all major transportation modes within the region.

0423 **n/a, *Summary Report for the Workshop on Integrating Climate Change Adaptation into Air Quality Decision Making,* National Risk Management Research Laboratory, March 2008. 49pp.**

Over the past few decades, air quality planners have forecasted future air pollution levels based on information about changing emissions from stationary and mobile sources, population trends, transportation demand, natural sources of emissions, and other pressures on air quality. However, our future climate will likely differ from present conditions and that climate change can affect both emissions sources and atmospheric fate and transport processes that determine air pollution levels. To develop an understanding of the highest-priority science questions regarding adaptation and the effects of climate change on air quality, EPA held a "Workshop on Integrating Climate Change Adaptation into Air Quality Decision Making." This report documents the discussions at the workshop, which was intended to (1) determine the highest-priority needs with respect to decision support for climate change adaptation and (2) identify which ORD research initiatives and products will be most useful in addressing the stakeholders' needs.

0472 **n/a, *Independent Review of Simulation of Net Infiltration for Present-Day and Potential Future Climates,* Oak Ridge Institute for Science and Education, April 2008. 45pp.**

The DOE Office of Civilian Radioactive Waste Management (OCRWM) tasked Oak Ridge Institute for Science and Education (ORISE) with providing an independent expert review of the documented model and prediction results for net infiltration of water into the unsaturated zone at Yucca Mountain. The specific purpose of the model, as documented in the report MDL-NBS-HS-000023, Rev. 01, is “to provide a spatial representation, including epistemic and aleatory uncertainty, of the predicted mean annual net infiltration at the Yucca Mountain site ...” (p. 1-1) The expert review panel assembled by ORISE concluded that the model report does not provide a technically credible spatial representation of net infiltration at Yucca Mountain. Specifically, the ORISE Review Panel found that: A critical lack of site-specific meteorological, surface, and subsurface information prevents verification of (i) the net infiltration estimates, (ii) the uncertainty estimates of parameters caused by their spatial variability, and (iii) the assumptions used by the modelers (ranges and distributions) for the characterization of parameters. The paucity of site-specific data used by the modeling team for model implementation and validation is a major deficiency in this effort. The model does not incorporate at least one potentially important hydrologic process. Subsurface lateral flow is not accounted for by the model, and the assumption that the effect of subsurface lateral flow is negligible is not adequately justified. This issue is especially critical for the wetter climate periods. This omission may be one reason the model results appear to underestimate net infiltration beneath wash environments and therefore imprecisely represent the spatial variability of net infiltration. While the model uses assumptions consistently, such as uniform soil depths and a constant vegetation rooting depth, such assumptions may not be appropriate for this net infiltration simulation because they oversimplify a complex landscape and associated hydrologic processes, especially since the model assumptions have not been adequately corroborated by field and laboratory observations at Yucca Mountain.

0517 **n/a, *Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2006,* U.S. Environmental Protection Agency, April 15, 2008. 394pp.**

This report presents estimates by the United States government of U.S. anthropogenic greenhouse gas emissions and sinks for the years 1990 through 2006. A summary of these estimates is provided in Table 2-1 and Table 2-2 by gas and source category in the Trends in Greenhouse Gas Emissions chapter. The emission estimates in these tables are presented on both a full molecular mass basis and on a Global Warming Potential (GWP) weighted basis in order to show the relative contribution of each gas to global average radiative forcing. This report also discusses the methods and data used to calculate these emission estimates.

0904 **Stephenson, John, *Climate Change: Expert Opinion on the Economics of Policy Options to Address Climate Change,* U.S. Government Accountability Office, May 2008. 80pp.**

Elevated levels of greenhouse gases in the atmosphere and the resulting effects on the earth's climate could have significant environmental and economic impacts in the United States and internationally. Potential impacts include rising sea levels and a shift in the intensity and frequency of floods and storms. Proposed responses to climate change include adapting to the possible impacts by planning and improving protective infrastructure, and reducing greenhouse gas emissions directly through regulation or the promotion of low-emissions technologies. Because most U.S. emissions stem from the combustion of fossil fuels such as coal, oil, and natural gas, much of this report centers on the effect emissions regulation could have on the economy. In this context, GAO was asked to elicit the opinions of experts on (1) actions the Congress might consider to address climate change and what is known about the potential benefits, costs, and uncertainties of these actions and (2) the key strengths and limitations of policies or actions to address climate change. GAO worked with the National Academy of Sciences to identify a panel of noted economists with expertise in analyzing the economic impacts of climate change policies and gathered their opinions through iterative, Web-based questionnaires. The findings reported here represent the views of the 18 economists who responded to both questionnaires.

REEL 6

Frame #

0001 **May 2008 The Effects of Climate Change on Agriculture, Land Resources, Water Resources, and Biodiversity in the United States Backlund, Peter, et al U.S. Climate Change Science Program 247pp.**

"This report provides an assessment of the effects of climate change on U.S. agriculture, land resources, water resources, and biodiversity. It is one of a series of 21 Synthesis and Assessment Products (SAP) that are being produced under the auspices of the U.S. Climate Change Science Program (CCSP)."

0249 **Shaw, Denice, et al.,** ***EPA's Report on the Environment, 2008,*** **U.S. Environmental Protection Agency, May 2008, 366pp.**

The Environmental Protection Agency's 2008 Report on the Environment, also referred to as the EPA 2008 ROE, provided the American people with an important resource from which they could better understand trends in the condition of the air, water, land, and human health of the United States. The report used scientifically sound measures, called indicators, to address fundamental questions relevant to the EPA's mission to protect the environment and human health. To accomplish its mission to protect human health and the environment, EPA must pay close attention to trends in the condition of the Nation's environment. This kind of information, which is captured in EPA's 2008 ROE, can help EPA to prioritize its work and to focus on human health and ecological activities that can lead to improvements in the conditions of the Nation's environment.

0609 **n/a,** ***Revised Research Plan for the U.S. Climate Change Science Program,*** **U.S. Climate Change Science Program, May 2008. 83pp.**

This Revised Research Plan is an update to the 2003 Strategic Plan of the U.S. Climate Change Science Program (CCSP), a document that was developed via a thorough, open and transparent multi-year process involving a wide range of scientists and managers. The Strategic Plan has long-term value to CCSP, but like any strategic plan, it must be supplemented by shorter-term revisions that take into account both advances in the science and changes in societal needs, and CCSP has an ongoing long-range strategic planning process to ensure that these needs are met. The Revised Research Plan draws on CCSP's long-range planning process, in compliance with the terms of the Global Change Research Act (GCRA) of 1990.

0692 **n/a,** ***Scientific Assessment of the Effects of Global Change on the United States,*** **National Science and Technology Council, May 2008. 269pp.**

The climate is changing, and these changes are affecting the world around us. In order to deal with the changes that are taking place now and to prepare for those that are likely to happen in the future, decisionmakers need information about global change and its effects on the Nation and the world we live in. This national scientific assessment integrates, evaluates, and interprets the findings of the U.S. Climate Change Science Program (CCSP) and draws from and synthesizes findings from previous assessments of the science, including reports and products by the Intergovernmental Panel on Climate Change (IPCC). It analyzes current trends in global change, both natural and human-induced, and it projects major trends for the future. It analyzes the effects of these changes on the natural environment, agriculture, water resources, social systems, energy production and use, transportation, and human health. It is intended to help inform discussion of the relevant issues by decisionmakers, stakeholders, and the public. As such, this report addresses the requirements for assessment in the Global Change Research Act of 1990. This assessment addresses not only climate change, but also other change in the global environment including water resources, oceans, atmospheric chemistry, land productivity, and ecological systems that may alter the capacity of Earth to sustain life. This broader set of changes is referred to as 'global change,' as defined in the Global Change Research Act. Over the past several years, our understanding of climate variability and change and our ability to estimate their future effects has improved significantly. The conclusions in this assessment build on the vast body of observations,

modeling, decision support, and other types of activities conducted under the auspices of CCSP and from previous assessments of the science. This assessment and the underlying assessments have been subjected to and improved through rigorous peer reviews.

0961 **n/a, *A Business Guide to U.S. EPA Climate Partnership Programs,* U.S. Environmental Protection Agency, June 2008. 49pp.**

This 2008 guide was developed by the U.S. Environmental Protection Agency (EPA) and BSR, and is designed to help companies and nonprofits identify EPA Partnership Programs appropriate for their needs. Thirty-six programs and 24 industry sectors are outlined in a table showing overlapping areas of interest. For each program, the guide quickly summarizes the business value, services provided and most applicable industries. This guide is a useful tool for helping industry find funding and partnership opportunities with the EPA. It concisely summarizes all the programs and what they do. It also provides the business case necessary to convince management that these programs are a worthwhile investment of time and assets.

REEL 7

Frame #

0001 **Julius, Susan Herrod, and Jordan M. West, *Preliminary Review of Adaptation Options for Climate-Sensitive Ecosystems and Resources,* U.S. Climate Change Science Program, June 2008. 550pp.**

This report finds that climate change can increase the impact of traditional stressors (such as pollution or habitat destruction) on ecosystems, and that many existing best management practices to reduce these stressors can also be applied to reduce the impacts of climate change. For example, current efforts to reverse habitat destruction by restoring vegetation along streams also increase ecosystem resilience to climate change impacts, such as greater amounts of pollutants and sediments from more intense rainfall. In addition, this report finds that America's ability to adapt to climate change will depend on a variety of factors including recognizing the barriers to implementing new strategies, expanding collaboration among ecosystem managers, creatively re-examining program goals and authorities, and being flexible in setting priorities and managing for change.

0548 **Karl, Thomas R., et al., *Weather and Climate Extremes in a Changing Climate. Regions of Focus: North America, Hawaii, Caribbean, and U.S. Pacific Islands,* U.S. Climate Change Science Program, June 2008. 175pp.**

Changes to weather and climate extremes are likely to become the most vivid and disruptive manifestations of climate change over the course of this century. While it is already understood that human-induced global warming increases the intensity and occurrence of extreme temperatures and precipitation, evidence suggests that hurricanes will also become more ferocious as the world warms. This report constitutes the first specific assessment of observed and projected changes in weather and climate extremes across North America--it details what is already known about extreme climate and weather, explains the understood

causes of those events, offers projections of future weather and climate extremes, and suggests how scientific efforts can be better directed to increase understanding of this subject.

0723 **Reagan, Matthew T., and George J. Moridis, *Modeling of Oceanic Gas Hydrate Instability and methane Release in Response to Climate Change,* Lawrence Berkeley National Laboratory , July 2008. 9pp.**

Paleooceanographic evidence has been used to postulate that methane from oceanic hydrates may have had a significant role in regulating global climate, implicating global oceanic deposits of methane gas hydrate as the main culprit in instances of rapid climate change that have occurred in the past. However, the behavior of contemporary oceanic methane hydrate deposits subjected to rapid temperature changes, like those predicted under future climate change scenarios, is poorly understood. To determine the fate of the carbon stored in these hydrates, we performed simulations of oceanic gas hydrate accumulations subjected to temperature changes at the seafloor and assessed the potential for methane release into the ocean. Our modeling analysis considered the properties of benthic sediments, the saturation and distribution of the hydrates, the ocean depth, the initial seafloor temperature, and for the first time, estimated the effect of benthic biogeochemical activity. The results show that shallow deposits—such as those found in arctic regions or in the Gulf of Mexico—can undergo rapid dissociation and produce significant methane fluxes of 2 to 13 mol/yr/m2 over a period of decades, and release up to 1,100 mol of methane per m2 of seafloor in a century. These fluxes may exceed the ability of the seafloor environment (via anaerobic oxidation of methane) to consume the released methane or sequester the carbon. These results will provide a source term to regional or global climate models in order to assess the coupling of gas hydrate deposits to changes in the global climate.

0732 **n/a, *Our Changing Planet: The U.S. Climate Change Science Program for Fiscal Year 2009,* U.S. Climate Change Science Program, July 2008. 238pp.**

This report describes the activities and plans of the Climate Change Science Program (CCSP), which incorporates the U.S. Global Change Research Program established under the Global Change Research Act of 1990, and the Climate Change Research Initiative that was established by the President in 2001. This Fiscal Year 2009 edition highlights recent advances and progress supported by CCSP-participating agencies in each of the programs research and observational elements, as called for in the Strategic Plan for the U.S. Climate Change Science Program released in July 2003, and later modified in the 2008 CCSP Revised Research Plan.

0971 **Stephenson, John B., *Climate Change: Federal Actions Will Greatly Affect the Viability of Carbon Capture and Storage as a Key Mitigation Option,* U.S. Government Accountability Office, September 2008. 70pp.**

[no abstract found in documents found]Key scientific assessments have underscored the urgency of reducing emissions of carbon dioxide (CO2) to address climate change. Many have cited carbon capture and storage (CCS) as an essential technology because it has the potential to greatly reduce CO2 emissions from power plants while allowing for projected increases in electricity demand. CCS involves capturing CO2 from a power plant's emissions, transporting it to an underground storage location, and then injecting it into a geologic

formation for long-term storage. As requested, GAO examined (1) key economic, legal, regulatory, and technological barriers impeding commercial-scale deployment of CCS technology and (2) actions the Department of Energy (DOE), Environmental Protection Agency (EPA), and other agencies are taking to overcome barriers to commercial-scale deployment of CCS technology. Among other things, GAO examined key studies and contacted officials from pertinent agencies, companies, and environmental groups, as well as research and other organizations.

REEL 8

Frame #

0001 **Gamble, Janet L.,** ***Analyses of the Effects of Global Change on Human Health and Welfare and Human Systems*****, U.S. Climate Change Science Program, September 2008. 214pp.**

"Climate change, interacting with changes in land use and demographics, will affect important human dimensions in the United States, especially those related to human health, settlements and welfare. The challenges presented by population growth, an aging population, migration patterns, and urban and coastal development will be affected by changes in temperature, precipitation, and extreme climate-related events. In the future, with continued global warming, heat waves and heavy downpours are very likely to further increase in frequency and intensity. Cold days and cold nights are very likely to become much less frequent over North America. Substantial areas of North America are likely to have more frequent droughts of greater severity. Hurricane wind speeds, rainfall intensity, and storm surge levels are likely to increase. Other changes include measurable sea-level rise and increases in the occurrence of coastal and riverine flooding. The United States is certainly capable of adapting to the collective impacts of climate change. However, there will still be certain individuals and locations where the adaptive capacity is less and these individuals and their communities will be disproportionally impacted by climate change. This report – the Synthesis and Assessment Product 4.6 (SAP 4.6) – focuses on impacts of global climate change, especially impacts on three broad dimensions of the human condition: human health, human settlements, and human welfare. The SAP 4.6 has been prepared by a team of experts from academia, government, and the private sector in response to the mandate of the U.S. Climate Change Science Program's Strategic Plan (2003). The assessment examines potential impacts of climate change on human society, opportunities for adaptation, and associated recommendations for addressing data gaps and near- and long-term research goals."

0215 **Backus, George A., and James H. Strickland,** ***Climate-Derived Tensions in Actic Security,*** **Sandia National Laboratories, September 2008. 44pp.**

Globally, there is no lack of security threats. Many of them demand priority engagement and there can never be adequate resources to address all threats. In this context, climate is just another aspect of global security and the Arctic just another region. In light of physical and budgetary constraints, new security needs must be integrated and prioritized with existing ones. This discussion approaches the security impacts of climate from that perspective,

starting with the broad security picture and establishing how climate may affect it. This method provides a different view from one that starts with climate and projects it, in isolation, as the source of a hypothetical security burden.1 That said, the Arctic does appear to present high-priority security challenges. Uncertainty in the timing of an ice-free Arctic affects how quickly it will become a security priority. Uncertainty in the emergent extreme and variable weather conditions will determine the difficulty (cost) of maintaining adequate security (order) in the area. The resolution of sovereignty boundaries affects the ability to enforce security measures, and the U.S. will most probably need a military presence to back-up negotiated sovereignty agreements. Without additional global warming, technology already allows the Arctic to become a strategic link in the global supply chain, possibly with northern Russia as its main hub. Additionally, the multinational corporations reaping the economic bounty may affect security tensions more than nation-states themselves. Countries will depend ever more heavily on the global supply chains. China has particular needs to protect its trade flows. In matters of security, nation-state and multinational-corporate interests will become heavily intertwined.

0259 **Levy, Hiram, II, et al.,** ***Climate Projections Based on Emissions Scenarios for Long-Lived and Short-Lived Radiatively Active Gases and Aerosols,*** **U.S. Climate Change Science Program, September 2008. 112pp.**

This Synthesis and Assessment Report provides a more comprehensive and updated assessment of the relative future contributions of long and short-lived gases and particles, with special, explicit focus on the short-lived component. This study encompasses a realistic time frame over which available technological solutions can be employed, and this study, in particular, focuses on those gases and particles whose future atmospheric levels are also subject to reduction due to air pollution control.

0371 **n/a,** ***Contributions of the Atmospheric Radiation Measurement (ARM) Program and the ARM Climate Research Facility to the U.S. Climate Change Science Program,*** **Atmospheric Radiation Measurement Climate Research Facility, Department of Energy, September 2008. 29pp.**

The Earth's surface temperature is determined by the balance between incoming solar radiation and thermal (or infrared) radiation emitted by the Earth back to space. Changes in atmospheric composition, including greenhouse gases, clouds, and aerosols can alter this balance and produce significant climate change. Global climate models (GCMs) are the primary tool for quantifying future climate change; however, there remain significant uncertainties in the GCM treatment of clouds, aerosol, and their effects on the Earth's energy balance. The 2007 assessment (AR4) by the Intergovernmental Panel on Climate Change (IPCC) reports a substantial range among GCMs in climate sensitivity to greenhouse gas emissions. The largest contributor to this range lies in how different models handle changes in the way clouds absorb or reflect radiative energy in a changing climate (Solomon et al. 2007). In 1989, the U.S. Department of Energy (DOE) Office of Science created the Atmospheric Radiation Measurement (ARM) Program within the Office of Biological and Environmental Research (BER) to address scientific uncertainties related to global climate change, with a specific focus on the crucial role of clouds and their influence on the transfer of radiation in the atmosphere. To address this problem, BER has adopted a unique two-pronged approach: * The ARM Climate Research Facility (ACRF), a scientific user facility for obtaining long-term measurements of radiative fluxes, cloud and aerosol properties, and

related atmospheric characteristics in diverse climate regimes. * The ARM Science Program, focused on the analysis of ACRF data to address climate science issues associated with clouds, aerosols, and radiation, and to improve GCMs. This report describes accomplishments of the BER ARM Program toward addressing the primary uncertainties related to climate change prediction as identified by the IPCC.

0400 **Aragon, Carlos, and Enrique R. Vivoni, *Development and Testing of a Semi-Distributed Watershed Model: Case Studies Exploring the Impact of Climate Variability and Change in the Rio Salado*, New Mexico Water Resources Research Institute, October 2008. 155pp.**

Water supply problems in the Middle Río Grande are increasing as New Mexico's population grows and new demands are placed on finite amounts. Policy and decision makers require tools, such as hydrologic models, to assist in the management of water resources. To exacerbate the problem, anticipated variations induced by global warming will have an uncertain impact on water resources. In this work, we develop and test a semi-distributed watershed model for simulating hydrologic conditions in semiarid river basins. The model is applied to the Río Salado and tested at the point, regional and basin-scales using a range of different atmospheric forcings and a set of plausible climate change scenarios. The model performed well at simulating point-scale soil moisture and gave plausible results for other hydrological variables at the scale of different Hydrologic Response Units (HRUs). Reproducing historical streamflow in the Río Salado with the model was difficult due to an underestimation of high elevation precipitation in the basin. Nevertheless, forcing the model with stochastically-generated, coarse precipitation fields showed improved results during long-term simulations. More importantly, the climate change scenarios demonstrate the usefulness of the semi-distributed watershed model as a tool for assessing hydrologic impacts of seasonal precipitation and temperature changes.

0555 **Orszag, Peter, *Preparing for Our Common Future: Policy Choices and the Economics of Climate Change,* Congressional Budget Office, October 27, 2008. 50pp.**

This presentation was made by Peter Orszag, Director, Congressional Budget Office, at the Goldman Lecture in Economics at Wellesley College on October 27, 2008. The presentation discusses climate change from greenhouse gases and the economics of various policy responses, in particular Cap and Trade emissions trading in greenhouse gases.

0605 **Wilcox, Steve, et al., *Solar Radiation Data Sets,* National Renewable Energy Laboratory, October 29, 2008. 51pp.**

This presentation was made by Steve Wilcox, Ray George, Daryl Myers at the Solar Resources Assessment Workshop on October 29, 2008. The presentation discusses the development of the National Solar Data Base and its uses in climate analysis.

0656 **Voyles, J., *ACRF Instrumentation Status: New, Current, and Future,* Atmospheric Radiation Measurement Climate Research Facility, Department of Energy, November 2008. 23pp.**

The purpose of this report is to provide a concise but comprehensive overview of Atmospheric Radiation Measurement (ARM) Climate Research Facility (ACRF) instrumentation status. The report is divided into the following four sections: (1) new instrumentation in the process of being acquired and deployed, (2) existing instrumentation and progress on improvements or upgrades, (3) proposed future instrumentation, and (4) SBIR instrument development.

0681 **Boslough, Mark, et al., *The Arctic as a Test Case for an Assessment of Climate Impacts on National Security,* Sandia National Laboratories, November 2008. 81pp.**

"The Arctic region is rapidly changing in a way that will affect the rest of the world. Parts of Alaska, western Canada, and Siberia are currently warming at twice the global rate. This warming trend is accelerating permafrost deterioration, coastal erosion, snow and ice loss, and other changes that are a direct consequence of climate change. Climatologists have long understood that changes in the
Arctic would be faster and more intense than elsewhere on the planet, but the degree and speed of the changes were underestimated compared to recent observations. Policy makers have not yet had time to examine the latest evidence or appreciate the nature of the consequences. Thus, the abruptness and severity of an unfolding Arctic climate crisis has not been incorporated into longrange
planning. The purpose of this report is to briefly review the physical basis for global climate change and Arctic amplification, summarize the ongoing observations, discuss the potential consequences, explain the need for an objective risk assessment, develop scenarios for future change, review existing modeling capabilities and the need for better regional models, and finally to make recommendations for Sandia's future role in preparing our leaders to deal with impacts of Arctic climate change on national security. "

0760 **n/a, *Integrating Climate Change into Development,* U.S. Agency for International Development, November 2008. 12pp.**

Climate change is one of the great global challenges of our time, affecting each and every nation. USAID sees climate change and development as inextricably linked. Since 1991, USAID's Global Climate Change Program has implemented solutions that provide climate-related benefits while meeting sustainable development objectives. This report provides an overview of those objectives.

0772 **Stephenson, John B., *International Climate Change Programs,* U.S. Government Accountability Office, November 2008. 68pp.**

International policies to address climate change have largely relied on market-based programs; for example, under the European Union's Emissions Trading Scheme (ETS) phase I (2005 to 2007) carbon dioxide emissions reductions were sought by setting a cap on each member state's allowable emissions and distributing tradable allowances to covered entities, such as power plants. Beginning operation in 2002, the Kyoto Protocol's Clean Development Mechanism (CDM) has relied on offsets, allowing certain industrialized nations to pay for

emission reduction projects in developing countries—where the cost of abatement may be less expensive—in addition to reducing emissions within their borders. Legislative proposals to limit greenhouse gas emissions are under consideration in the United States. In this context, GAO was asked to examine the effects of and lessons learned from (1) the ETS phase I and (2) the CDM. GAO worked with the National Academy of Sciences to identify experts in market-based programs and gathered their opinions through a questionnaire, interviewed stakeholders, and reviewed available information.

0840 **n/a, *National Air Quality: Status and Trends through 2007,* Environmental Protection Agency, November 2008. 42pp.**

This summary report highlights EPA's most recent evaluation of the status and trends in America's air quality.

0882 **Osborn, Thor D., et al., *Preliminary Systems Engineering Evaluations for the National Ecological Observatory Network,* Sandia National Laboratories, November 2008. 176pp.**

The National Ecological Observatory Network (NEON) is an ambitious National Science Foundation sponsored project intended to accumulate and disseminate ecologically informative sensor data from sites among 20 distinct biomes found within the United States and Puerto Rico over a period of at least 30 years. These data are expected to provide valuable insights into the ecological impacts of climate change, land-use change, and invasive species in these various biomes, and thereby provide a scientific foundation for the decisions of future national, regional, and local policy makers. NEON's objectives are of substantial national and international importance, yet they must be achieved with limited resources. Sandia National Laboratories was therefore contracted to examine four areas of significant systems engineering concern; specifically, alternatives to commercial electrical utility power for remote operations, approaches to data acquisition and local data handling, protocols for secure long-distance data transmission, and processes and procedures for the introduction of new instruments and continuous improvement of the sensor network. The results of these preliminary systems engineering evaluations are presented, with a series of recommendations intended to optimize the efficiency and probability of long-term success for the NEON enterprise.

REEL 9

Frame #

0001 **Ravishankara, A.R., et al., *Trends in Emissions of Ozone-Depleting Substances, Ozone Layer Recovery, and Implications for Ultraviolet Radiation Exposure,* U.S. Climate Change Science Program, November 2008. 233pp.**

The report offers a glimpse into expectations for recovery of the ozone layer in a changing climate, as well as the first detailed look at U.S. role in emitting and reducing the emissions of the chemicals that deplete the ozone layer.

0234 **McGeehin, John P., et al.,** ***Abrupt Climate Change,*** **U.S. Geological Survey, December 2008. 475pp.**

The United States faces the potential for abrupt climate change in the 21st century that could pose clear risks to society in terms of our ability to adapt. "Abrupt" changes can occur over decades or less, persist for decades more, and cause substantial disruptions to human and natural systems. This report, based on an assessment of published science literature, makes the following conclusions about the potential for abrupt climate changes from global warming during this century: Climate model simulations and observations suggest that rapid and sustained September arctic sea ice loss is likely in the 21st century; The southwestern United States may be beginning an abrupt period of increased drought; It is very likely that the northward flow of warm water in the upper layers of the Atlantic Ocean, which has an important impact on the global climate system, will decrease by approximately 25-30 percent; An abrupt change in sea level is possible, but predictions are highly uncertain due to shortcomings in existing climate models; There is unlikely to be an abrupt release of methane, a powerful greenhouse gas, to the atmosphere from deposits in the earth. However, it is very likely that the pace of methane emissions will increase. The U.S. Geological Survey led the new assessment, which was authored by a team of climate scientists from the federal government and academia. The report was commissioned by the U.S. Climate Change Science Program with contributions from the National Oceanic and Atmospheric Administration and the National Science Foundation.

0709 **Ferrell, Wanda R., et al.,** ***Annual Report for the Atmospheric Radiation Measurement (ARM) Program, 2008,*** **Atmospheric Radiation Measurement Climate Research Facility, Department of Energy, December 2008. 39pp.**

Scientists from around the world use the ARM Climate Research Facility (ACRF) ground-based climate measurement capabilities for studies ranging from short-term field campaigns to long-term data analyses, model comparisons, and measurement validation efforts. This annual report presents the activities and programs that have been undertaken by the ACRF during 2008, including the cloud survey work.

0748 **Graber, Joseph, et al.,** ***Carbon Cycling and Biosequestration: Integrating Biology and Climate Through Systems Science,*** **Office of Biological and Environmental Research, Department of Energy, December 2008. 141pp.**

One of the most daunting challenges facing science in the 21st Century is to predict how Earth's ecosystems will respond to global climate change. The global carbon cycle plays a central role in regulating atmospheric carbon dioxide (CO{sub 2}) levels and thus Earth's climate, but our basic understanding of the myriad of tightly interlinked biological processes that drive the global carbon cycle remains limited at best. Whether terrestrial and ocean ecosystems will capture, store, or release carbon is highly dependent on how changing climate conditions affect processes performed by the organisms that form Earth's biosphere. Advancing our knowledge of biological components of the global carbon cycle is thus crucial to predicting potential climate change impacts, assessing the viability of climate change adaptation and mitigation strategies, and informing relevant policy decisions. Global carbon cycling is dominated by the paired biological processes of photosynthesis and respiration. Photosynthetic plants and microbes of Earth's land-masses and oceans use solar energy to transform atmospheric CO{sub 2} into organic carbon. The majority of this organic carbon is

rapidly consumed by plants or microbial decomposers for respiration and returned to the atmosphere as CO{sub 2}. Coupling between the two processes results in a near equilibrium between photosynthesis and respiration at the global scale, but some fraction of organic carbon also remains in stabilized forms such as biomass, soil, and deep ocean sediments. This process, known as carbon biosequestration, temporarily removes carbon from active cycling and has thus far absorbed a substantial fraction of anthropogenic carbon emissions.

0889 **Ibarraran, M.E., et al, *Climate Change Vulnerability and Resilience: Current Status and Trends for Mexico,* Pacific Northwest Laboratory, December 2008. 30pp.**

Climate change alters different localities on the planet in different ways. The impact on each region depends mainly on the degree of vulnerability that natural ecosystems and human-made infrastructure have to changes in climate and extreme meteorological events, as well as on the coping and adaptation capacity towards new environmental conditions. This study assesses the current resilience of Mexico and Mexican states to such changes, as well as how this resilience will look in the future. In addition, this paper presents two sets of results. First the application of the VRIM to determine state- level resilience for Mexico, building the baseline that reflects the current status. The second part of the paper makes projections of resilience under socioeconomic and climate change and examines the varying sources and consequences of those changes.

0920 **n/a, *Comparative Climatic Data for the United States through 2008,* National Climatic Data Center, December 2008. 153pp.**

This report consists of tables of meteorological elements that outline the climatic conditions at major weather observing stations in all 50 states, Puerto Rico, and Pacific Islands. The data are from active or former sites comparable in exposure. Stations with less than three years of data were omitted. Data in this report is from the Normal Means and Extremes table contained in the Local Climatological Data Annual Summary, published for individual stations.

REEL 10

Frame #

0001 **Mastin, Mark C., *Effects of Potential Future Warming on Runoff in the Yakima River Basin, Washington,* U.S. Geological Survey, December 2008. 17pp.**

The Bureau of Reclamation has implemented a long-term planning study of potential water-storage alternatives in the Yakima River Basin, which includes planning for climate change effects on available water resources in the basin. Previously constructed watershed models for the Yakima River Basin were used to simulate changes in unregulated streamflow under two warmer climate scenarios, one representing a 1ºC increase in the annual air temperature over current conditions (plus one scenario) and one representing a 2ºC increase in the annual air temperature over current conditions (plus two scenario). Simulations were done for water years 1981 through 2005 and the results were compared to simulated unregulated runoff for the same period using recorded daily precipitation, and minimum and maximum air

temperatures (base conditions). Precipitation was not altered for the two warmer climate change scenarios.

0017 **Lockwood, Steve, *Operational Responses to Climate Change Impacts*, Transportation Research Board, December 2008. 36pp.**

Systems Operations and Management activities of transportation agencies–both state and local–have the objective of making the most effective use of the existing roadway capacity by improving efficiency (throughput, speed, safety), minimizing the service impacts of any disruption (crashes, weather), and providing special emergency services (evacuation). At the same time, maintaining and improving operational conditions has significant safety impacts, related both to roadway physical conditions (traction, visibility) and operating conditions (stop-and-go and tailback collision risks). The ongoing transportation agency involvement in systems operations includes three basic streams of development: The gradually increasing commitment in many states to systematic congestion management–utilizing the evolving concepts and technology of freeway and arterial operations such as ramp metering, roadside variable message signs, speed and lane use controls, rapid clearance of crashes and breakdowns (including detours around problems), traveler information broadcast, and dial-up services; The routinized snow and ice control activities that already constitute a major and institutionalized maintenance responsibility in snowbelt regions; The clarification of transportation agencies' roles in supporting a more organized approach to emergency response–spurred by increased federal attention to standardizing preparation and response in natural disaster and security events in the post-9/11 and post-Katrina environment. A key challenge facing the transportation community is combining these three streams of activity into an integrated all-hazard approach to accommodate the full range of incidents, hazards and emergencies and overcoming the current fragmentation among state and local transportation and public safety agencies. As climate-induced changes take place, weather is likely to play a larger role in this process.

0053 **Coughlin, Katie, and Charles Goldman, *Physical Impacts of Climate Change on the Western U.S. Electricity System: A Scoping Study*, Lawrence Berkeley National Laboratory, December 2008. 29pp.**

This paper presents an exploratory study of the possible physical impacts of climate change on the electric power system, and how these impacts could be incorporated into resource planning in the Western United States. While many aspects of climate change and energy have been discussed in the literature, there has not yet been a systematic review of the relationship between specific physical effects and the quantitative analyses that are commonly used in planning studies. The core of the problem is to understand how the electric system is vulnerable to physical weather risk, and how to make use of information from climate models to characterize the way these risks may evolve over time, including a treatment of uncertainty. In this paper, to provide the necessary technical background in climate science, we present an overview of the basic physics of climate and explain some of the methodologies used in climate modeling studies, particularly the importance of emissions scenarios. We also provide a brief survey of recent climate-related studies relevant to electric system planning in the Western US. To define the institutional context, we discuss the core elements of the resource and reliability planning processes used currently by utilities and by the Western Electricity Coordinating Council. To illustrate more precisely how climate-related risk could be incorporated into modeling exercises, we discuss three idealized

examples. Overall, we argue that existing methods of analysis can and should be extended to encompass the uncertainties related to future climate. While the focus here is on risk related to physical impacts, the same principles apply to a consideration of how future climate change policy decisions might impact the design and functioning of the electric grid. We conclude with some suggestions and recommendations on how to begin developing this approach within the existing electric system planning framework for the West.

0082 **n/a, *Potential Impacts of Climate Change on U.S. Transportation,* Transportation Research Board, December 2008. 293pp.**

This report provides an overview of the scientific consensus on the current and future climate changes of particular relevance to U.S. transportation, including the limits of present scientific understanding as to their precise timing, magnitude, and geographic location; identifies potential impacts on U.S. transportation and adaptation options; and offers recommendations for both research and actions that can be taken to prepare for climate change. It also summarizes previous work on strategies for reducing transportation-related emissions of carbon dioxide--the primary greenhouse gas--that contribute to climate change.

0376 **Lewin, Keith F., and John Nagy, *Structural Design Feasibility Study for the Global Climate Experiment,* Brookhaven National Laboratory, December 2008. 68pp.**

Neon, Inc. is proposing to establish a Global Change Experiment (GCE) Facility to increase our understanding of how ecological systems differ in their vulnerability to changes in climate and other relevant global change drivers, as well as provide the mechanistic basis for forecasting ecological change in the future. The experimental design was initially envisioned to consist of two complementary components; (A) a multi-factor experiment manipulating CO{sub 2}, temperature and water availability and (B) a water balance experiment. As the design analysis and cost estimates progressed, it became clear that (1) the technical difficulties of obtaining tight temperature control and maintaining elevated atmospheric carbon dioxide levels within an enclosure were greater than had been expected and (2) the envisioned study would not fit into the expected budget envelope if this was done in a partially or completely enclosed structure. After discussions between NEON management, the GCE science team, and Keith Lewin, NEON, Inc. requested Keith Lewin to expand the scope of this design study to include open-field exposure systems. In order to develop the GCE design to the point where it can be presented within a proposal for funding, a feasibility study of climate manipulation structures must be conducted to determine design approaches and rough cost estimates, and to identify advantages and disadvantages of these approaches including the associated experimental artifacts. NEON, Inc requested this design study in order to develop concepts for the climate manipulation structures to support the NEON Global Climate Experiment. This study summarizes the design concepts considered for constructing and operating the GCE Facility and their associated construction, maintenance and operations costs. Comparisons and comments about experimental artifacts, construction challenges and operational uncertainties are provided to assist in selecting the final facility design. The overall goal of this report is to provide a cost and technological basis for selection of the appropriate GCE Facility design.

0443 **Remmer, Lorraine A., et al.,** ***Atmospheric Aerosol Properties and Climate Impacts,*** **U.S. Climate Change Science Program, January 2009. 124pp.**

This report critically reviews current knowledge about global distributions and properties of atmospheric aerosols, as they relate to aerosol impacts on climate. It assesses possible next steps aimed at substantially reducing uncertainties in aerosol radiative forcing estimates. Current measurement techniques and modeling approaches are summarized, providing context. This assessment builds upon recent related assessments from the Intergovernmental Panel on Climate Change and the Climate Change Science Program. The objectives of this report were (1) to promote a consensus about the knowledge base for climate change decision support, and (2) to provide a synthesis and integration of the current knowledge of the climate-relevant impacts of anthropogenic aerosols for policy makers, policy analysts, and general public, both within and outside the U.S government and worldwide.

0567 **Morgan, M. Granger, et al.,** ***Best Practice Approaches for Characterizing, Communicating and Incorporating Scientific Uncertainty in Climate Decision Making,*** **U.S. Climate Change Science Program, January 2009. 156pp.**

The purpose of this report was to synthesize and communicate the current state of understanding about the characteristics and implications of uncertainty related to climate change and variability to an audience of policymakers, decision makers, and members of the media and general public with an interest in developing a fundamental understanding of the issue. It was developed with broad scientific input and in accordance with the CCSP guidelines, the Information Quality Act , and the guidelines issued by the Department of Commerce and the National Oceanic and Atmospheric Administration pursuant to Section 515.

0723 **n/a,** ***Synthesis of Adaptation Options for Coastal Areas,*** **Environmental Protection Agency, January 2009. 26pp.**

Climate change is being observed in many of our nation's natural systems. Estuaries and other coastal systems are particularly vulnerable to many of the projected impacts of climate change. Regardless of future action to reduce emissions, the atmospheric buildup of greenhouse gases has committed the earth to some level of future climate change. Projected effects on estuaries include sea level rise, altered frequencies and intensities of precipitation, increased water temperatures, and more intense storm events. This report analyzes the effect and impact on the health of coastlines, including the people and species that inhabit them.

0750 **Committee on Climate Change Science and Technology Integration,** ***Strategies for the Commercialization and Deployment of Greenhouse Gas Intensity-Reducing Technologies and Practices,*** **Department of Energy, January 2009. 190pp.**

This report identifies and analyzes more than 300 Federal policies, programs, and other activities that are in place to encourage greater market application of Greenhouse Gas(GHG)-reducing technologies. These activities are led by more than a dozen agencies and include actively funded provisions contained in legislation such as the Energy Independence and Security Act (EISA). By examining these measures, the report provides a broad context for evaluating the adequacy of current policy and the potential need for additional measures that might be undertaken by government or industry. The report considers the current state of

technologies, barriers, and remedies, discusses gaps and opportunities, and suggests principles that could be applied to assess policies and measures to accelerate the commercialization and deployment of GHG-reducing technologies.

REEL 11

Frame #

0001 **n/a, *Coastal Sensitivity to Sea Level Rise: A Focus on the Mid-Atlantic Region* U.S. Climate Change Science Program, January 2009. 784pp.**

This Synthesis and Assessment Product (SAP), developed as part of the U.S. Climate Change Science Program, examines potential effects of sea-level rise from climate change during the twenty-first century, with a focus on the mid-Atlantic coast of the United States. Using scientific literature and policy-related documents, the SAP describes the physical environments; potential changes to coastal environments, wetlands, and vulnerable species; societal impacts and implications of sea-level rise; decisions that may be sensitive to sea-level rise; opportunities for adaptation; and institutional barriers to adaptation. The SAP also outlines the policy context in the mid-Atlantic region and describes the implications of sea-level rise impacts for other regions of the United States. Finally, this SAP discusses ways natural and social science research can improve understanding and prediction of potential impacts to aid planning and decision making.

0785 **Fagre, Daniel B., and Colleen W. Charles, *Thresholds of Climate Change in Ecosystems* U.S. Climate Change Science Program, January 2009. 169pp.**

Ecological thresholds occur when external factors, positive feedbacks, or non linear instabilities in a system cause changes to propagate in domino-like fashion that is potentially irreversible. This report reviews threshold changes in North American ecosystems that are potentially induced by climatic change and addresses the significant challenges these threshold crossings impose on resource and land managers. Sudden changes to ecosystems and the goods and services they provide are not well understood, but they are extremely important if natural resource managers are to succeed in developing adaptation strategies in a changing world. The report provides an overview of what is known about ecological threshold and where they are likely to occur. It also identifies those areas where research is most needed to improve knowledge and understand the uncertainties regarding them. The report suggests a suite of potential actions that land and resource managers could use to improve the likelihood of success for the resources they manage, even under conditions of incomplete understanding of what drives thresholds of change and when changes will occur.

REEL 12

Frame #

0001 **U.S. Geological Survey, *Past Climate Variability and Change in the Arctic and at High Latitudes,* U.S. Climate Change Science Program, January 2009. 533pp.**

This report addresses current capabilities to integrate observations of the climate system into a consistent description of past and current conditions through the method of re-analysis. In addition, the report assesses present capabilities to attribute causes for climate variations and trends over North America during the reanalysis period, which extends from the mid-twentieth century to the present. This report reviews Past Climate Variability and Change in the Arctic and at High Latitudes. Paleoclimate records play a key role in our understanding of Earth's past and present climate system and in our confidence in predicting future climate changes. Paleoclimate data help to elucidate past and present active mechanisms of climate change by placing the short instrumental record into a longer term context and by permitting models to be tested beyond the limited time that instrumental measurements have been available. Recent observations in the Arctic have identified large ongoing changes and important climate feedback mechanisms that multiply the effects of global-scale climate changes. As discussed in this report, paleoclimate data show that land and sea ice have grown with cooling temperatures and have shrunk with warming ones, amplifying temperature changes while causing and responding to ecosystem shifts and sea-level changes.

0533 **Dempsey, Matthew, *U.S. Senate Minority Report: More than 700 International Scientists Dissent Over Man-Made Global Warming Claims Scientists Continue to Debunk "Consensus" in 2008 & 2009,* U.S. Senate Environment and Public Works Committee, March 16, 2009. 255pp.**

This updated U.S. Senate Minority Report — updated from 2007's groundbreaking report of over 400 scientists who voiced skepticism about the so-called global warming "consensus" — features the skeptical voices of over 700 prominent international scientists, including many current and former United Nations Intergovernmental Panel on Climate Change (UN IPCC) scientists, who have now turned against the UN IPCC. This updated report includes an additional 300 (and growing) scientists and climate researchers since the initial release in December 2007. The over 700 dissenting scientists are more than 13 times the number of UN scientists who authored the media-hyped IPCC 2007 Summary for Policymakers. The chorus of skeptical scientific voices grew louder in 2008 and 2009 as a steady stream of peer-reviewed studies, analyses, real world data and inconvenient developments challenged the UN's and former Vice President Al Gore's claims that the "science is settled" and there is a "consensus." On a range of issues, 2008 and 2009 proved to be challenging for the promoters of man-made climate fears. Promoters of anthropogenic warming fears endured the following: global temperatures failing to warm; peer-reviewed studies predicting a continued lack of warming; a failed attempt to revive the discredited "Hockey Stick"; inconvenient developments and studies regarding rising CO2; the Spotless Sun; Clouds; Antarctica; the Arctic; Greenland's ice; Mount Kilimanjaro; Global sea ice; Causes of Hurricanes; Extreme Storms; Extinctions; Floods; Droughts; Ocean Acidification; Polar Bears; Extreme weather deaths; Frogs; lack of atmospheric dust; Malaria; the failure of oceans to warm and rise as predicted.

0788 ***Adapting to Coastal Climate Change: A Guidebook for Planners,* U.S. Agency for International Development, May 2009. 164pp.**

This Guidebook provides information to U.S. Agency for International Development (USAID) Missions and development partners in an effort to understand the diversity of climate change impacts expected to affect the coastal zone throughout the developing world, and the options that exist for coastal planners and managers to assist coastal communities to begin to adapt to these impacts.

0950 **Elmendorf, Douglas W., *Potential Impacts of Climate Change in the United States,* U.S. Congressional Budget Office, May 2009. 29pp.**

This paper summarizes the current state of scientific understanding of the potential effects of projected changes in climate and related developments. It describes the wide range of potential impacts, including changes in: seasonal weather patterns; the amount and type of precipitation; storms and sea level; regular climate fluctuations; ocean acidity; ecosystems and biodiversity; agriculture, forestry, and fishing; water supply and other infrastructure; and human health. The paper's discussion focuses mainly on projections of impacts in the United States but also refers to impacts elsewhere that could be particularly severe and could indirectly affect the United States. The paper draws from various primary and secondary sources, particularly the Fourth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC) and a number of surveys published by the U.S. Climate Change Science Program.

0979 **Nesbit, Jeff, *Solving the Puzzle: Researching the Impacts of Climate Change Around the World,* National Science Foundation, May 2009. 111pp.**

This report addresses some of the major questions facing climate change researchers, and how those puzzles are being addressed by National Science Foundation-funded activities. Complex computer models are being developed and refined to predict Earth's future climate. Observations of climate conditions from observatory networks distributed in Earth's oceans, Polar regions, land masses, and near-Earth orbit improve the accuracy of the climate models. Records of Earth's past climate provide important insights into the mechanisms involved in climate cycles of the past, and can help to refine computational models by allowing researchers to simulate past climate.

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