

# Understanding Climate Change and Its Impacts

Pacific Northwest National Laboratory's expertise in the scientific, technical, and socioeconomic aspects of climate change research provides accurate, comprehensive information for regional, national, and global analysis. Insights gained through our activities inform our sponsors in government, industry, universities, and foundations as well as shaping climate strategies worldwide.

Our researchers are known for their contributions to national and global climate programs. For example, 20 scientists from PNNL contributed as lead or co-authors in the Intergovernmental Panel on Climate Change (IPCC) reports. The IPCC was awarded the 2007 Nobel Peace Prize. We also serve prominent roles in the U.S. Climate Change Science Program, the U.S. Carbon Cycle Scientific Steering Group, the International Geosphere-Biosphere Programme, and the Global Observations of Forest and Land Cover Dynamics Program.

The Joint Global Change Research Institute, a PNNL collaboration with the University of Maryland, is internationally recognized as a leader in interdisciplinary research on climate change and potential solutions. The Institute, which draws on a wide variety of domestic and international collaborations, integrates science, technology, economics, and policy to model future greenhouse gas emissions and analyze the impact of mitigation strategies.

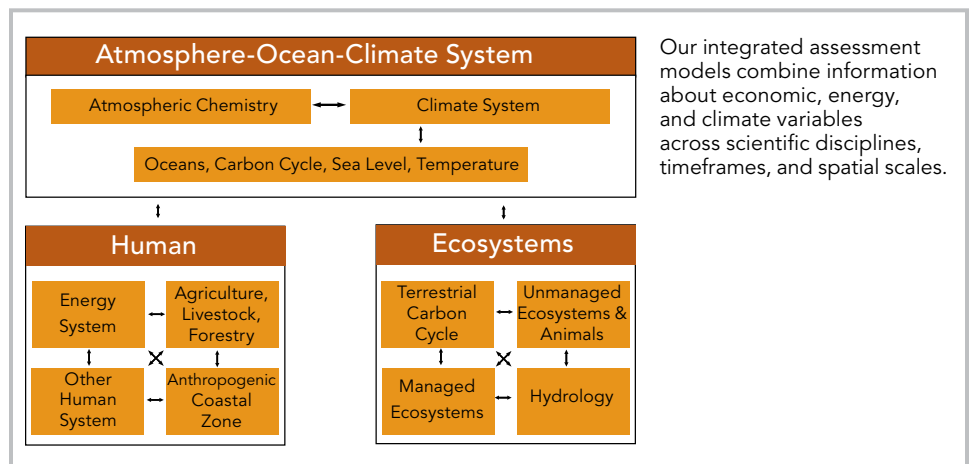
## INTEGRATED ASSESSMENT

To inform decisions on climate change issues, our researchers use an analysis method known as integrated assessment. This method models economic, physical, and ecological systems to explore the consequences of human/climate system interactions under various scenarios. We focus on understanding ways to stabilize greenhouse gas emissions over time and increasingly, the potential impacts of climate change and strategies to adapt to them.

Technologies can help stabilize atmospheric carbon concentrations while also enabling economic growth and energy security that society demands. But today's technology decisions can become tomorrow's wasted investments without a sound understanding of the existing energy infrastructures worldwide and the role of innovation in pacing change.



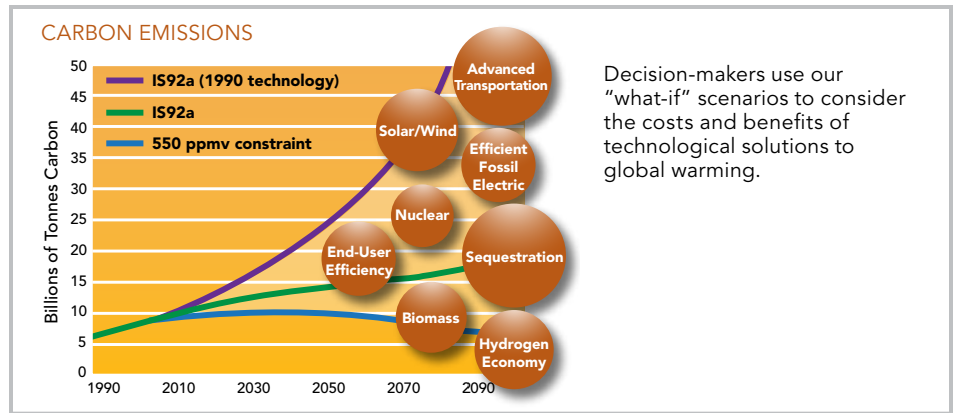
Dr. Anthony Janetos is one of many PNNL scientists who brief Congress on climate change research. Insights from PNNL staff also appear in landmark reports from the Intergovernmental Panel on Climate Change, the U.S. Climate Change Science Program, and the National Research Council of the National Academies.



Organizations interested in managing their risks and preserving long-term flexibility in a carbon-constrained world come to us to help them understand their options and the global energy-economic systems within which these technologies are deployed. Our computer-based, integrated assessment modeling system combines energy, economic, and technology models of greenhouse gas sources with models of agriculture, land-use, land-cover, atmospheric chemistry, ecosystem processes, and climate. We analyze the effects of adopting alternative mitigation strategies ranging from energy efficiency and biofuels to carbon capture and sequestration.

One of our Integrated Assessment Models, MiniCAM, simulates energy consumption and greenhouse gas emissions in a 14-region geopolitical disaggregation worldwide in 15-year time steps through 2095. The U.S. Climate Change Science Program and the IPCC use MiniCAM emission scenarios to help assess potential mitigation solutions.

Capturing and storing carbon dioxide emissions underground is gaining attention as a way to curtail global warming. We designed a unique geographic-information-based model to examine the large-scale deployment of carbon management technologies in the United States. The model shows geographic-based emissions and potential geological storage capacity. Decision-makers are using the results to evaluate suitable sites for carbon dioxide capture and storage.



Decision-makers use our "what-if" scenarios to consider the costs and benefits of technological solutions to global warming.

## ADAPTATION AND VULNERABILITY

Conditions such as water availability, public infrastructure, economic productivity, and the sensitivity of natural resources all can affect the ability of countries or regions to adapt to climate change. Our researchers develop and apply methods for assessing the vulnerability of natural resources and socio-economic systems to climate variability.

Our vulnerability/resilience indicators model aggregates social and environmental values into sectors, sensitivity, adaptive capacity, and then into a vulnerability index. For example, our researchers ranked 160 countries on eight different indicators, including settlements, food security, human health, ecosystem sensitivity, and water security. They combined this with each country's ability to adapt its economic, environmental, and human resources. The resulting ranking of population groups revealed patterns of vulnerability.

PNNL researchers helped the United Nations Development Programme provide guidance for developing nations to assess their climate change resilience and form adaptation-related policies. In 2007, the IPCC and international media highlighted a study that used our data and other measurements to predict whether climate change would overwhelm any country's ability to adapt.

## ABOUT PNNL

Pacific Northwest National Laboratory, a DOE Office of Science laboratory, delivers science and technology to address complex problems in science, energy, the environment, and national security. With more than 4,000 staff, we conduct a wide range of research and development projects for clients, representing more than \$850 million in budget outlays annually. PNNL has been managed by Ohio-based Battelle since the Laboratory's inception in 1965.

*For more information about Atmospheric Sciences and Climate Change, contact:*

**Dr. Charlette Geffen**  
 Pacific Northwest National Laboratory  
 P.O. Box 999, MSIN K9-34  
 Richland, WA 99352  
 (509) 375-3646  
 ca.geffen@pnl.gov  
<http://www.pnl.gov/atmospheric/>



Researchers assess the vulnerability of natural resources and socio-economic systems to climate variability and change. Areas that appear more resilient on face value could actually suffer more severe economic impacts.