Science.

Technology.

Innovation.

Understanding Climate Change

Impacts and Adaptation

Pacific Northwest National Laboratory's expertise in the scientific, technical, and socio-economic 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 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.

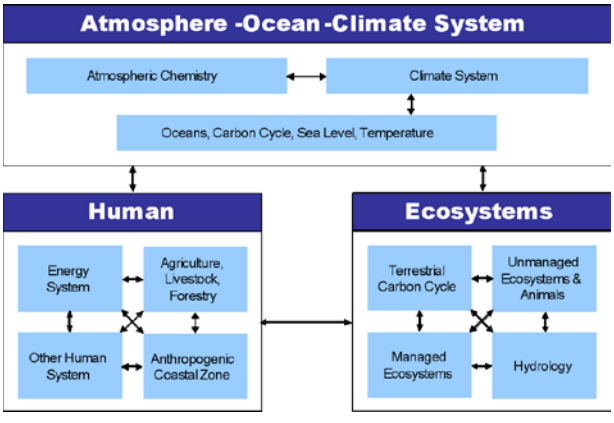
The Joint Global Change Research Institute, a PNNL collaboration with the University of Maryland, is internationally recognized as a leader in interdisciplinary research on climate change and potential solutions. The Institute, which draws on a wide variety of domestic and international collaborations,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

Insights from the work of Dr. Anthony Janetos 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.

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. We analyze the effects of adopting alternative mitigation strategies ranging from energy efficiency and biofuels to carbon capture and sequestration, including considerations such as technology maturity, deployment costs, required resources, and land use impacts.

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. 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



Our integrated assessment models combine information about economic, energy, and climate variables across scientific disciplines, timeframes, and spatial scales.

Pacific Northwest National Laboratory
Operated by Battelle for the U.S. Department of Energy

Change Science Program and the IPCC use MiniCAM emission scenarios to help assess potential mitigation solutions.

Looking ahead, we're investigating how to couple a regional modeling system with a human factors model, to transform integrated assessment from the global scale to a high-resolution, grid-based activity.

Adaptation and Vulnerability

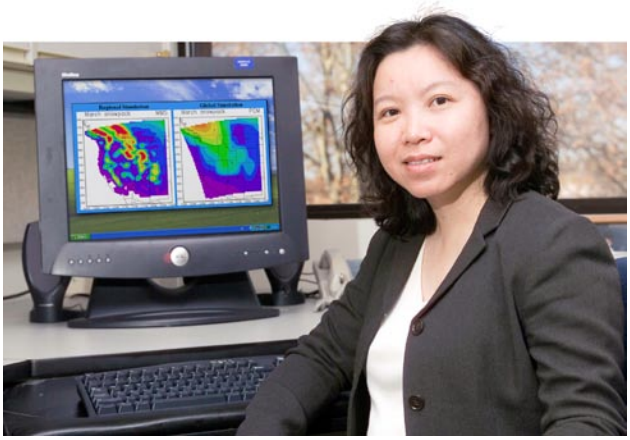
Conditions such as water availability, public infrastructure, economic productivity, and the sensitivity of natural resources all can affect the ability of countries or regions to adapt to climate change. Our researchers develop and apply methods for assessing the vulnerability of natural resources and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

Regional Climate Modeling

Local features such as topography and land-sea contrast can cause dramatic variations in climate change across regions. PNNL researchers develop and apply regional climate models that are based on atmospheric processes, weather, and physical features. The models are widely used to investigate ways climate features may affect regional systems such as water and agriculture.



Dr. Ruby Leung's mesoscale models revealed that global models underpredicted and misplaced snowpack areas.

PNNL improved upon the mesoscale atmospheric model developed by the National Center for Atmospheric Research. The enhanced regional model, known as the Weather Research and Forecasting Model, includes chemical reactions, aerosol representations, and climate physics from global models. The regional model is among those being used in the North American Regional Climate Change Assessment Program. This collaborative project is aimed at projecting climate change in North America and assessing uncertainties.

Regional modeling is applied to a range of geographic areas. In a state-funded project with the University of Washington, PNNL researchers are providing high-resolution climate change scenarios to assess potential climate effects on water resources, agriculture, economics, and other regional conditions. In past work, a global model with a subgrid representation of mountains was used to predict snowpack changes in mountain ranges in six countries and deteriorating air quality west of the Rocky Mountains.

New research directions include developing a coupled regional earth system model that will add new insights to climate feedback processes and regional predictions.

About PNNL

PNNL is a DOE Office of Science national laboratory that solves complex problems in energy, national security and the environment and advances scientific frontiers in the chemical, biological, materials, environmental and computational sciences. PNNL employs 4,000 staff, has a $750 million annual budget, and has been managed by Ohio-based Battelle since the lab's inception in 1965.

PNNL's Atmospheric Science & Global Change Division supports DOE's energy mission by conducting basic and applied research in climate physics, regional climate modeling, meteorology, integrated assessment and policy analysis, and atmospheric chemistry, transport and diffusion.

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.

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