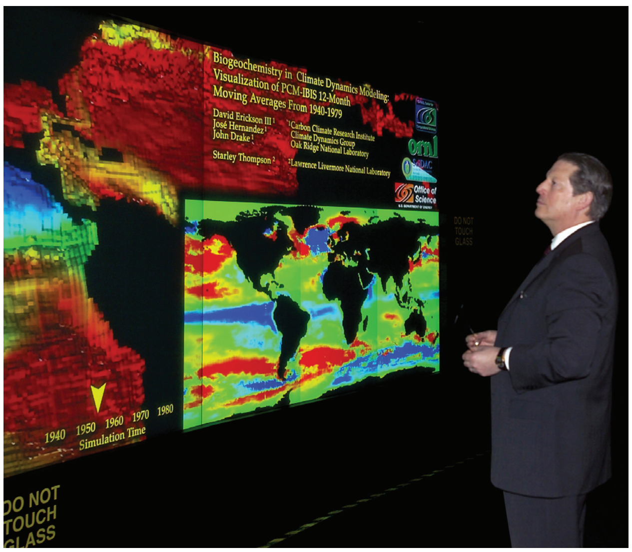
ORNL Researchers Contribute to 2007 Nobel Peace Prize



Al Gore views climate data on the EVEREST PowerWall at the NCCS.

Computer at ORNL a key player in U.N. report

When you think of winners of the Nobel Peace Prize, you're more likely to think of Mahatma Ghandi than the IBM pSeries Cheetah high performance computing system at the NCCS, a DOE Office of Science user facility housed at ORNL.

Gandhi never won the peace prize, though he was nominated in 1937, 1938, 1939, 1947, and a few days before his assassination in 1948. And true, a supercomputer can never be a Nobel laureate. But Cheetah provided more than one-third of the simulation data for the joint DOE/National Science Foundation (NSF) data contribution to the United Nation's Intergovernmental Panel on Climate Change (IPCC) Fourth Assessment Report (AR4), a feat that earns it a place in world history.

This year the IPCC—a group of more than 2,000 scientists and policy experts—will share the 2007 Nobel Peace Prize with former Vice President Al Gore "for their efforts to build up and disseminate greater knowledge about man-made climate change, and to lay the foundations for the measures that are needed to counteract such change," according to the Nobel announcement.

The IPCC AR4 effort is an unprecedented coordinated climate change assessment study involving 16 climate modeling centers from 11 countries around the world running the same set of climate change scenarios with 23 different models (see Figure 1). The IPCC AR4 produced four reports in 2007 that featured the involvement of ORNL scientists such as Corporate Fellows Tom Wilbanks and David Greene and the Environmental Sciences Division's Paul Hanson, Virginia Dale and Gregg Marland. The 31 terabytes (31 trillion bytes) of model data collected and distributed by the Program for Climate Model Diagnosis and Intercomparison at Lawrence Livermore National Laboratory using DOE's Earth System Grid have been accessed by more than 1,200 scientists, resulting in the more than 200 refereed papers that went into the IPCC AR4.

The ORNL Cheetah IPCC simulations were led by computational scientist John B. Drake of ORNL and atmospheric scientist Lawrence Buja of the National Center for Atmospheric Research (NCAR, an NSF center). In 2004, the NCCS granted the scientists a huge allocation of supercomputing time to run simulations on Cheetah, a system that performed calculations at a rate of 4 teraflops, or 4 trillion floating point operations per second. The runs occupied half of Cheetah's processors for the better part of a year and required the efforts of five ORNL staff members to help develop the model and two dozen NCCS staff members to move enormous amounts of simulation data. "We don't always know what the answer will be when we start a large computational study, or that anyone will pay much attention to the results, but in the case of the climate change modeling for the IPCC, it has had a big impact," Drake says. "Having the computer resources at ORNL made it possible to carry out a more comprehensive and detailed study

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than ever before. This improved the level of certainty for some of the conclusions in the IPCC reports and enabled breakthroughs to new climate results such as the prediction of regional heat waves."

These runs were part of a collaborative DOE/NSF project headed by NCAR's Warren Washington. Washington's project involved running the IPCC simulations at three centers—NCAR, ORNL's NCCS, and the National Energy Research Scientific Computing Center (NERSC, a DOE Office of Science user facility at Lawrence Berkeley National Laboratory). International collaborators extended these simulations using Japan's Earth Simulator Center, the most powerful supercomputer at the time. The IPCC runs were made with the Community Climate System Model (CCSM), a fully coupled global climate model that provides state-of-the-art simulations of the Earth's past, present, and future climate states. The CCSM is an open, communitywide, collaborative project involving NCAR, DOE (Los Alamos National Laboratory, ORNL, Lawrence Berkeley National Laboratory, Pacific Northwest National Laboratory, and Argonne National Laboratory), the National Aeronautics and Space Administration, and many university and industrial partners. With more than 10,000 model years simulated, at a higher resolution than had ever before been attempted at this scale of production, Washington's group made the largest data contribution to the IPCC project of any other center in the world.

"Access to DOE leadership-class, high-performance computing assets at ORNL and NERSC significantly improved model simulations," says NCAR's Buja. "These computers made it possible to run more realistic physical processes at higher resolutions, with more ensemble members, and longer historical validation simulations. We simply couldn't have done this without the strong DOE/NSF interagency partnership."

The DOE studies climate because of the close link between energy production, energy use, and carbon dioxide concentrations in the atmosphere. Climate simulations require the fastest computers because the projections must cover hundreds to thousands of years. The skill of the model projections is checked by comparing with the historical climate data of the past 100 years. Today's atmospheric carbon dioxide levels are 380 parts per million—and rising. "Even if levels were to stabilize at their current numbers, warming is projected to continue over the next century before achieving a steady state in following centuries," Drake says.

The IPCC AR4 is the culmination of a six-year international effort. It concludes the 1.5 degrees Fahrenheit of planetary warming observed during the 20th century has a more than 90 percent chance of being the result of human activities. The authors predict large scale changes in food and water availability, dramatic changes in ecosystems, and increased flooding and extreme weather. They advise quick action to avoid some devastating effects and say existing technologies can balance climate risks with economic competitiveness.

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