NERSC NEWS

News from the National Energy Research Scientific Computing Center June 2005

NERSC's Bill Kramer Is Honored by NASA, Cited by HPCwire

NERSC Center General Manager Bill Kramer received two very different honors recently: a NASA Group Achievement Award for the Advanced Air Transportation Technologies (AATT) Project Team, and inclusion in the HPCwire newsletter's annual list of "People to Watch" in HPC.

Bill, who came to Berkeley Lab from NASA Ames in 1996, was one of the original seven members of the AATT Project team from September 1994 to February 1996. He became the first AATT Program Office Director in 1995. Bill's citation, signed by the NASA Deputy Administrator on April 5, 2005, reads, "For highly successful research and technology transfer leading to improved operation of the National Airspace System."

The AATT Project was completed on September 30, 2004, after nine years of

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Climate Models Show That Sea Level Rise from Thermal Expansion Is Inevitable

Even if all greenhouse gases had been stabilized in the year 2000, we would still be committed to a warmer Earth and greater sea level rise in the present century, according to a new study by a team of climate modelers at the National Center for Atmospheric Research (NCAR). The models were run on supercomputers at NCAR and several DOE labs, including NERSC, and on the Earth Simulator in Japan. The findings were published in the March 18, 2005 issue of the journal Science.

The modeling study quantifies the relative rates of sea level rise and global temperature increase that we are already committed to in the 21st century. Even if no more greenhouse gases were added to the atmosphere, globally averaged surface air temperatures would rise about a half degree Celsius (one degree Fahrenheit) and global sea levels would rise another 11 centimeters (4 inches) from thermal expansion alone by 2100.

"Many people don't realize we are committed right now to a significant amount of global warming and sea level rise because of the greenhouse gases we have already put into the atmosphere," said lead author Gerald Meehl. "Even if we stabilize greenhouse gas concentrations, the climate will continue to warm, and there will be proportionately even more sea level rise. The longer we wait, the more climate change we are committed to in the future."

The half-degree temperature rise is similar to that observed at the end of the 20th century, but the projected sea level rise is more than twice the 3-inch (5-centimeter) rise that occurred during the latter half of the previous century (Figure 1). These numbers do not take into account fresh water from melting ice sheets and glaciers, which could at least double the sea level rise caused by thermal expansion alone.

The North Atlantic thermohaline circulation, which currently warms Europe by transporting heat from the tropics, weakens in the models. Even so, Europe heats up with the rest of the planet because of the overwhelming effect of greenhouse gases.

Though temperature rise shows signs of leveling off 100 years after stabilization in the study, ocean waters continue to warm and expand, causing global sea level to rise unabated.

"With the ongoing increase in concentra-

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NERSC Reaches Another Checkpoint/Restart Milestone

On the weekend of June 11 and 12, IBM personnel used NERSC's Seaborg supercomputer for dedicated testing of IBM's latest HPC Software Stack, a set of tools for high performance computing. To maximize system utilization for NERSC users, instead of "draining" the system (letting running jobs continue to completion) before starting this dedicated testing, NERSC staff checkpointed all running jobs at the start of the testing period. "Checkpointing" means stopping a program in progress and saving the current state of the program and its data — in effect, "bookmarking" where the program left off so it can start up later in exactly the same place.

This is believed to be the first full-scale use of the checkpoint/restart software with an actual production workload on an IBM SP, as well as the first checkpoint/restart on a system with more than 2,000 processors. It is the culmination of a collaborative effort between NERSC and IBM that began in 1999. Of the 44 jobs that were checkpointed, approximately 65% checkpointed successfully. Of the 15 jobs that did not checkpoint successfully, only 7 jobs were deleted from the queuing system, while the rest were requeued to run again at a later time. This test enabled NERSC and IBM staff to identify some previously undetected problems with the checkpoint/restart software, and they are now working to fix those problems.

In 1997 NERSC made history by being the first computing center to achieve successful checkpoint/restart on a massively parallel system, the Cray T3E. For the original news story, see <http://www.nersc.gov/news/newsroom/checkpoint10-21-97.php>.

NERSC News

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NERSC's Nick Cardo Helps IBM Refine System Software Testing

Nick Cardo, NERSC's IBM SP project lead, was invited earlier this year to give a customer perspective to staff at IBM's test lab in Poughkeepsie, NY. Cardo spent two days at the facility, demonstrating how he runs various systems tests regularly on Seaborg, NERSC's IBM supercomputer.

For two days, Cardo worked side by side with IBM staff on their test SP, showing them how he runs tests on a daily basis. The result was that the IBM staff were able to see what a user encounters.

"By sitting down with the testers at their internal test machine, I was able to give them a customer's perspective of a production environment, running the checkouts I would normally run during the course of the day," Cardo said. "This effort, which was unique, is a reflection of the working partnership we have developed with IBM over the years."

Curtis Vinson, Cardo's contact at IBM, summarized the results of the testing at the SP-XXL meeting held recently in Edinburgh, Scotland. The SP-XXL user group focuses on large-scale scientific and technical computing on IBM hardware.

For his part, Cardo produced a seven-page report describing some of the problems he encountered during the March 29–30 testing stint and outlining ways to fix them.

The overall objective, Cardo said, was to help IBM find ways to prevent "field escapes," the term for software bugs that make it out of the testing lab and into the user community.

"Our concern is that sometimes when we do system updates, we hit problems that should have been caught in the test lab," Cardo said. "By showing IBM how we use the system, we were able to help them refine their testing procedures and take steps to eliminate the bugs before they become field escapes."

As part of his responsibilities at NERSC, Cardo runs certain tests twice a day on Seaborg. This helps the Computational Systems Group find and fix problems quickly, before they become major hindrances to running users' jobs.

What Cardo and the IBM testers realized is that while each software component may have been well tested at the lab individually, the components were not always tested together for overall compatibility.

"The benefit of all this is that the software upgrades produced by IBM will be more stable right out of the box," Cardo said. "Users of all IBM systems will benefit from this work."

New PITAC Report Cites Research at NERSC

The President's Information Technology Advisory Committee (PITAC) has issued a new report titled "Computational Science: Ensuring America's Competitiveness" (see <http://www.nitrd.gov/pitac/reports/20050609_computational/computational.pdf>). The report finds that computational science has become critical to the nation's scientific leadership, economic competitiveness, and national security.

However, the report warns that much of the promise of computational science remains unrealized due to inefficiencies within the R&D infrastructure and lack of strategic planning and execution. PITAC's primary recommendations address these deficiencies, calling for a rationalization and restructuring of computational science research within universities and Federal agencies, and the development and maintenance of a multi-decade roadmap for computational science R&D investments.

In Appendix A to the report, "Examples of Computational Science at Work," four of the seven physical science examples come from projects that compute at NERSC: lattice QCD predictions of particle masses by the MILC Collaboration and others; fusion plasma simulations using the NIMROD code by collaborators at Lawrence Livermore National Laboratory and the University of Wisconsin; laser wakefield compact particle accelerator research at Lawrence Berkeley National Laboratory; and supernova modeling by the SciDAC Terascale Supernova Initiative.

Kramer Is Honored

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highly successful research, development, and technology transfer to the FAA and the airline industry. The major focus of the AATT Project was to improve the capacity of transport aircraft operations at and between major airports in the National Airspace System by developing decision support tools and concepts to help air traffic controllers, airline dispatchers, and pilots improve the air traffic management and control process from gate to gate. AATT addressed some of the most difficult air traffic management issues, including operations in complex airspace and the implementation of distributed air/ground responsibilities for separation.

The program involved research and concept demonstrations in areas such as modeling, real- and fast-time simulation, human factors, visualization, large-scale information management, software engineering, wireless communication, and automation and decision support tools. A summary of the AATT is at <http://www.asc.nasa.gov/aatt/overview.html>.

When the HPCwire newsletter issued its annual list of People to Watch in HPC on June 10, 2005, Bill was one of 15 people making the list. HPCwire Editor Tim Curns introduced the list as chronicling "the year's most influential and interesting luminaries in the HPC field. Several of the notables made the list by making waves in the past year or so. Others seem to be building steam and should be noted for their potential impact on the industry. But above all, our list, compiled by HPCwire with the help of past winners and a cast of industry insiders, represents the foundation of a new era in high-performance computing."

Read why Bill was picked as watchable and see the full list at <http://www.taborcommunications.com/hpcwire/features/people05/>.

Climate Models Show That Sea Level Rise from Thermal Expansion Is Inevitable (continued from page 1)

tions of greenhouse gases, every day we commit to more climate change in the future," Meehl explained. "When and how we stabilize concentrations will dictate, on the time scale of a century or so, how much more warming we will experience. But we are already committed to ongoing large sea level rise, even if concentrations of greenhouse gases could be stabilized."

The inevitability of the climate changes described in the study is the result of thermal inertia, mainly from the oceans, and the long lifetime of carbon dioxide and other greenhouse gases in the atmosphere. Thermal inertia refers to the process by which water heats and cools more slowly than air because it is denser than air.

The new study is the first to quantify future committed climate change using "coupled" global three-dimensional climate models. Coupled models link major components of Earth's climate in ways that allow them to interact with each other. Meehl and his NCAR colleagues ran the same scenario a number of times and averaged the results to create ensemble simulations from each of two global climate models. Then they compared the results from each model.

The scientists also compared possible climate scenarios in the two models during the 21st century in which greenhouse gases continue to build in the atmosphere at low, moderate, or high rates. The worst-case scenario projects an average temperature rise of 3.5°C (6.3°F) and sea level rise from thermal expansion of 30 centimeters (12 inches) by 2100 (Figure 2). All scenarios analyzed in the study will be assessed by international teams of scientists for the next report by the Intergovernmental Panel on Climate Change, due out in 2007.

The NCAR team used the Parallel Climate Model (PCM), developed by NCAR and the Department of Energy, and the new Community Climate System Model (Version 3). The CCSM3 was developed at NCAR with input from university and federal climate scientists around the country and principal funding from the National Science Foundation (NCAR's primary sponsor) and the Department of Energy. The CCSM3 shows slightly higher temperature rise and sea level rise from thermal expansion and greater weakening of the thermohaline circulation in the North Atlantic. Otherwise, the results from the two models are similar.

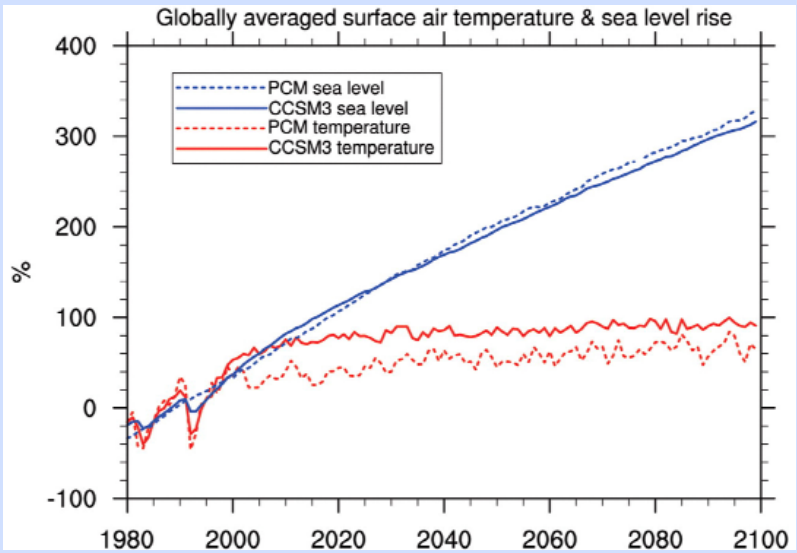

Figure 1. Ensemble mean percent increase of globally averaged surface air temperature and sea level rise from the two models computed relative to values for the base period 1980–1999 for the experiment in which greenhouse gas concentrations and all other atmospheric constituents were stabilized at the end of the 20th century.

For the full study, see G. A. Meehl et al., "How Much More Global Warming and Sea Level Rise?" Science **307**, 1769 (2005).

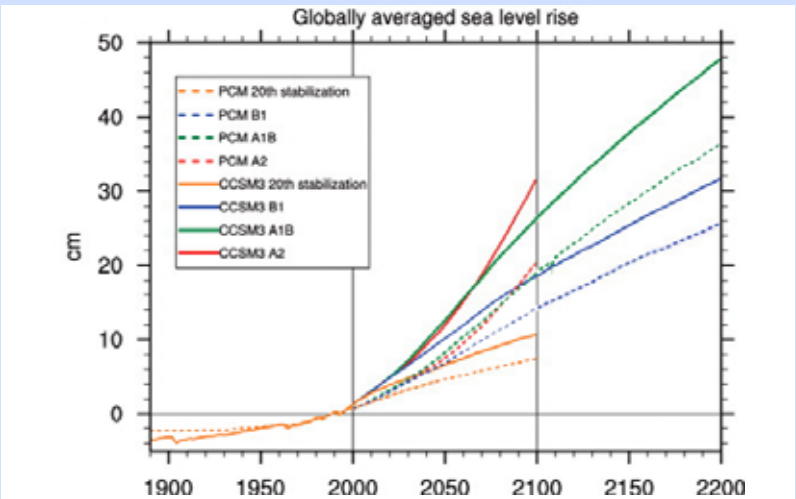

Figure 2. Globally averaged sea level rise for the various scenarios from thermal expansion only.