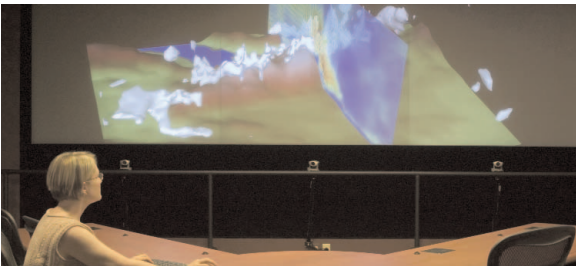
Success Story

Desert Research Institute



SGI® Altix® 3000 and SGI® InfiniteStorage Systems

forecast regional fire and smoke behavior

"Environmental science disciplines are very data-intensive, and we saw this as an opportunity to greatly advance our capabilities."

— *Dr. Vanda Grubišic, Statewide Coordinator for ACES*

Making accurate forecasts for agricultural burning and wildland fire is a very critical issue in the western U.S.

As a partner with the newly formed California and Nevada Smoke and Air Committee, or CANSAC, the Desert Research Institute (DRI) in Reno, Nevada, is now delivering twice-daily forecasts of fire weather and smoke behavior to meteorologists and firefighters in California and Nevada via the Internet. To compute the mountains of data needed to deliver meteorological products from a mesoscale meteorology model, DRI, a long-time Silicon Graphics customer, has added a 32-processor SGI® Altix® 3000 computing system and 1.7 TB SGI® InfiniteStorage TP9100 Fibre Channel storage array to its arsenal of SGI® high-performance compute (HPC) systems.

Mesoscale modeling simulates atmospheric phenomena (e.g., fronts, mountain waves, precipitation bands, thunderstorms and land/sea breezes) typically on a horizontal scale of a few to several hundred kilometers over a few hours to a day. These models calculate analytic solutions from a set of simplified equations governing atmospheric motion, and are scaled for a particular geographic region.

DRI has now fully implemented the 64-bit Linux® OS-based SGI Altix 3000, based on Intel® Itanium® processors, and SGI® InfiniteStorage system for this specific CANSAC project, part of the Climate, Ecosystem and Fire Applications (CEFA) program (www.cefa.dri.edu). Six CEFA scientists and graduate students at DRI are assigned the mission of providing fire weather, fire danger, and fire behavior products, as well as smoke movement and air quality information, and research studies to support the product development. The CANSAC group and DRI are

SGI®

Altix® 3000 and SGI® InfiniteStorage Systems

forecast regional fire and smoke behavior

focused on helping meteorologists, scientists, managers and fire specialists visually predict fire weather conditions for up to 72 hours. These predictions may include how a fire might burn under certain conditions, how the smoke will disperse and who it could impact, such as local hospitals, schools and others in a community. DRI also forecasts optimum times for prescribed burns to meet various land management objectives.

CANSAC comprises approximately a dozen federal, state, county and loca agencies within the two states. CANSAC members include the U.S.D.A. Forest Service, Bureau of Land Management, National Park Service, U.S. Fish and Wildlife, California Division of Forestry and Fire Protection, California Air Resources Board and San Joaquin Valley Air Pollution Control District. Other agencies such as the County of Los Angeles Fire Department are expected to come on board soon. CANSAC is also a member of the U.S.D.A. Forest Service National Fire Plan Fire Consortia for Advanced Modeling of Meteorology and Smoke. CANSAC members will be evaluating and assessing DRI's regional forecasting products this year in both test runs and possibly in real-life wildland fire incidents. By next year they hope to have fully implemented widespread use of the products.

Calculating Weather Every 108 Seconds

DRI begins their efforts by downloading output from another forecast model run by the National Centers for Environmental Prediction, which is part of the National Oceanic and Atmospheric Administration (NOAA). That grid is used as the initialization to start the Pennsylvania State University/National Center for Atmospheric Research (NCAR) mesoscale model version 5 (MM5) on the SGI Altix 3000 computing system and SGI InfiniteStorage. MM5 is designed specifically for regional forecasting. Its main function is to simulate and predict mesoscale atmospheric circulation, and is set up to calculate weather every 108 seconds for three spatial domain areas.

These domains are three different-sized grids, with varying ranges of grid points. The first, and most highly detailed domain, has a grid point every 4 kilometers over all of California and Nevada, and a small coastal part of the Pacific Ocean. The second spatial domain area contains grid points at every 12 kilometers, and covers roughly three times the area of the first. The third domain has grid points every 36 kilometers, and covers three times the size of the 12-kilometer grid-point domain, including a major portion of the eastern Pacific Ocean, the entire western U.S. and parts of southwestern Canada and northwestern Mexico. In addition to calculations within all these grid points in the three spatial domains, the SGI Altix is also required to make calculations at 33 different levels in the atmosphere, from the ocean or ground surface up to

"And this one machine, SGI Altix 3000, is doing all of this in remarkably good time. We're actually able to achieve all this—the 4, 12, and 36 kilometer readings and the 33 levels of atmospheres—in two hours of real clock time…" *—Dr. Tim Brown, director of DRI's CEFA program*

approximately 60,000 to 70,000 feet. "And this one machine, SGI Altix 3000, is doing all of this in remarkably good time," said Dr. Tim Brown, director of DRI's CEFA program. "We're actually able to achieve all this—the 4, 12, and 36 kilometer readings and the 33 levels of atmospheres—in two hours of real clock time, with additional time taken by pre- and post-processing. Our minimum run is 7GB of data and we're doing it twice a day. But we're thinking about a set of runs that would actually be about 45 gigs a day."

Using the new SGI Altix 3000 system and the MM5 model, DRI produces two-dimensional maps using a graphics package called RIP from the National Center for Atmospheric Research, specifically designed for MM5 meteorological model output. Data is currently visualized on a variety of desktop systems and workstations. Eventually the output will be linked to Web-based software that will allow end-users, such as incident meteorologists and fire behavior analysts, to interactively add layers on top of fires for real-time field calculations and decision-making.

"When we first began developing the project, we knew that we were going to need a lot of crunching power so I initially proposed a 128-processor PC cluster," added Dr. Brown. "When we began testing this system, we ran the models on a couple of different SGI machines, including a 40-processor Altix 3000 system we already had within DRI. We also tested on PC clusters and although the timing results were about the same, I preferred SGI because we know the MM5 model runs really well on it. We also know we don't have to spend a lot of time tweaking or doing adjustments on the Altix system, which I consider a stable and reliable system. We feel we have a better sense of scalability on the SGI system than we would have on a PC cluster. I like the fact that on Altix, because of the SGI NUMAflex global shared memory architecture, we can run the computer with all of the processors sharing the job or we can distribute the job to individual processors."

SGI® Altix® 3000 and SGI® InfiniteStorage Systems

forecast regional fire and smoke behavior

"I like the fact that on Altix, because of the SGI NUMAflex global shared memory architecture, we can run the computer with all of the processors sharing the job or we can distribute the job to individual processors."

— Dr. Tim Brown, director of DRI's CEFA program

SGI Throughout DRI

At DRI, the 40-processer SGI Altix 3000 system to which Dr. Brown refers was acquired as part of a $3.4 million grant from the National Science Foundation's Experimental Program to Stimulate Competitive Research (EPSCoR). DRI atmospheric scientist Dr. Vanda Grubisic used the grant to create the Advanced Computing in Environmental Sciences, or ACES, Program. SGI Altix 3000 has been used to create the core of the Nevada Environmental Computing Grid, a statewide distributed computational infrastructure—accessible from DRI campuses in Reno and Las Vegas, and from University of Nevada, Reno, and University of Nevada, Las Vegas—that will give researchers a new level of excellence for computational environmental science research and education.

"Environmental science disciplines are very data-intensive, and we saw this as an opportunity to greatly advance our capabilities," says Grubisic, who serves as the Statewide Coordinator for ACES. "The ACES computing grid will allow the 40-plus users to spread their computations over multiple machines, and run much larger jobs than they could run on any single machine on the grid, by tapping into unused computational resources shared on the grid."

The computational and visualization capabilities of the Altix 3000 system are also the basis of DRI's new ACES VisLab, a unique visualization facility in Nevada, used to visualize results obtained by running models (such as MM5, COAMPS) on Altix.

Other faculty at DRI run meteorological models on a 16-processor, SGI® IRIX® OS-based SGI® Origin® 2000 server. The first server system for Dr. Brown's group was an SGI® Origin® 200 server; it is currently doing some real-time processing, and will be handling some post-processing from the output of the new SGI Altix 3000 system.

Future plans at DRI's CEFA program include adding terabytes of storage to its SGI InfiniteStorage TP9100 as well as a tape-based archive. DRI will assess an SGI® Reality Center® environment as the graphics delivery system for a planned virtual reality six-wall visualization facility for research and development.

sgi

Corporate Office
1500 Crittenden Lane
Mountain View, CA 94043
(650) 960-1980
www.sgi.com

North America +1 800.800.7441
Latin America +55 11.5509.1455
Europe: +44 118.925.7500
Japan +81 3.5488.1811
Asia Pacific: +1 650.933.3000

3765 [02.05]

J14800