Climate Research 'Hots' Up with Blue Ice HPC System

At a Glance

a new OCF-built HPC system at the Mike Barnsley Centre for Climate Research:

- greatly enhances the ability of Swansea University researchers to contribute to climatic change science
- enables more accurate features in virtual models; enables researchers to link the individual components of climate change to see how the components affect one another and enables researchers to run different models, multiple times leading to more robust research findings – all otherwise impossible
- ranks as the most energy efficient in Wales
- is capable of running 10,000 "model years" per week
- is approximately 300 times more powerful than the average desktop PC, with 100 times more disc space

Background

The Mike Barnsley Centre for Climate Research, opened in October 2008 and based at the Technium Pembrokeshire innovation centre, was set-up to more effectively process research data and virtually 'model' climate change and its effects on the ice caps and ocean levels, and support research into climatic change science, environmental sciences and renewable energy.

Run by Scientific Director Professor Tavi Murray, the centre is a joint venture between the Swansea University, Pembrokeshire County Council, IBM and Technium Pembrokeshire.

Although Professor Murray herself is based at Swansea University and researchers from the University are major users, the Centre itself is available to all tenants at Technium Pembrokeshire and individuals and organisations in the climate research sector**.**

Challenge

The impact of human activity on global climate is profound. However, the ability of researchers to model key components of the Earth system, for example ice mass stability, plant-atmosphere interactions and ocean circulation, remains uncertain. Because of this uncertainty, well-informed planning for future environmental change remains a major challenge. Considerable computational model development is consequently required.

Two groups at Swansea University - the Global Environmental and the Earth Observation (GEMEO) group and the Glaciology group - have ambitious aims to reduce uncertainty in future climate simulations, including predictions of temperature, sea-level rises, and climate variability, through improved modelling and data assimilation techniques, and improved understanding of the Earth system.

The availability of the High Performance Compute system (HPC system) at the Centre will greatly enhance the ability of Swansea University researchers within these two groups to contribute to climatic change science.

Solution

In October 2008, the Centre went live with Blue Ice, an HPC System which enables researchers to process vast quantities of research data quickly, create representative simulation models and display those models on large visualisation screens, leading to a better and quicker interpretation of results.

Working in close partnership with IBM, OCF, the UK's premier High Performance Computing integrator, is responsible for the overall bespoke design, rapid implementation and ongoing support of the HPC system.

Delivered to site by OCF distribution partner, Interface Solutions (ISI), the unique design consists of 80 IBM HS21 Blades running dual quad core processors – totalling 640 cores, and 8 CELL processor blades with Voltaire Infiniband interconnect. In addition, 5 DCV workstations and 4 CUBE displays provide visualization capabilities to the facility.

There is 10TB of IBM DS4700 storage with IBM GPFS (General Parallel File System) a high-performance shared-disk file system that can provide fast, reliable data access from all nodes in a homogenous or heterogeneous cluster.

Blue Ice is housed in a brand new ‘green’ data centre and boasts energy efficient CPUs, which provide the high performance computing within a small physical footprint. Indeed, were Blue Ice to feature in the 'Green 500 List' announced by The Green500.org in June 2008* it would rank as the most energy efficient supercomputer in Wales.

Ongoing support, using OCF’s Cluster Management and Support Service, enables the IT staff at the centre to focus all available IT resources on non-cluster related queries and user issues.

The service provides remote and next day on-site support. Using the remote support, the cluster can be accessed and day-to-day management tasks can be performed instantly by OCF - such as adding new users and monitoring performance of the overall system. If, for example, updates to the system are required this can also been completed remotely by OCF.

“This ground-breaking HPC system has been made possible thanks to an increasingly effective collaboration between IBM and Swansea University using EU funds,” says David G. Lewis, Director of Research Supercomputing at the School of Medicine’s Innovation and Enterprise Team, Swansea University. “The launch of Blue Ice follows other similar successful projects with IBM such as the implementation of the ‘Blue C’ High Performance Compute system at Swansea University and puts us well on our way to building a network of similar facilities.

In this instance, the bespoke design, rapid implementation and configuration of Blue Ice has been made successful by drawing on the deep HPC knowledge, technical expertise and delivery & implementation skills of staff at IBM’s premier HPC partner, OCF.”

Results

Approximately 300 times more powerful than the average desktop PC, with 100 times more disc space; the HPC system is capable of running 10,000 "model years" per week. This enables researchers to more quickly understand the impact of environmental changes past, present and future - such as melting glaciers, melting ice sheets and rising sea-levels - on today's World.

Researchers using the Centre can now input vast quantities of complex data which, when processed quickly by the HPC system, leads to more accurate features in virtual models, such as the outlet glaciers of the Greenland Ice Sheet, making analysis and research easier, quicker and more effective.

Using the same process, researchers can now create, for the first time, specific models which link the individual components of climate change - such as ice sheets, vegetation, or cities - to create a single model. This enables researchers to see how the components affect one another and their collective effect on climate change. This enables researchers to see the wider picture, complete more informed research and complete research more quickly.

"Previously we had only worked on individual components of a climate change model," says Tavi Murray, the Centre's Scientific Director. "The HPC system enables us to put them together and see how they affect one another. We have a particular expertise in climate change components – such as the effect of ice sheets, vegetation, or cities on climate change. It's coupling them and examining feedbacks that we will be able to do now. Without the HPC system this would all be impossible."

Researchers can also now run different models, multiple times. By changing the initial conditions within a specific model and running simulations multiple times concurrently, scientists can produce a mean result. This means, in the case of the Mike Barnsley Centre, finding the most likely effect of the melting glaciers on the planet. This leads to more robust answers, rather than just running one simulation model with one set of initial conditions.