Accurate Forecasting Models at ZAMG

Using the SGI® ICE™ X high-performance computer, this renowned institution is expanding its infrastructure for climate models and weather forecasts

Background information

Organization:
Zentralanstalt für Meteorologie und Geodynamik (ZAMG)

Location:
Vienna, Austria

Field:
Research & teaching

ZAMG observatory at Sonnblick, Salzburg. (Source ZAMG/Hynek)

Glacier measuring station at Kleinfleisskees at Sonnblick (source ZAMG/Weyss)

Overview

Austria's Central Institution for Meteorology and Geodynamics (Zentralanstalt für Meteorologie und Geodynamik – ZAMG) in Vienna is the national agency for meteorological and geophysical services. The institution performs meteorological, climatological and geophysical research and an earthquake service which provides weather forecasts for the all of Austria and creates expert environmental and meteorological reports.

Founded back in 1851, ZAMG maintains a tight meteorological and seismic measuring network with around 280 stations and several observatories, including the unique underground Conrad Observatory. This station forms the center of a seismological network in Austria continuously monitoring earthquake activities (seismology), changes in mass (gravimetry) and variations in the earth's gravitational pull.

ZAMG is the leading meteorological institution in the country which provides its services to the media, local communities, insurance companies and commercial undertakings.

The Challenge

Weather models are the most important tool for daily forecasts and investigations into climate change. However, global models with spatial resolutions of around 9 miles quickly reach their limits in the Alps. Vigorously outlined by mountains and valleys, each alpine region has its own particular meteorological features that have to be captured as accurately as possible using high-resolution regional forecasting models. These are developed and refined on a continuous basis by increasing volumes of observation data, increasingly accurate geographical information and ever more complex physical and chemical processes.

However, the growing precision of the models goes hand in hand with an exponential increase in data volumes. As a result, the weather stations run by ZAMG supply almost two million pieces of data every day, a volume that can only be processed with correspondingly high-performance computers. "We have increasing amounts of measurement data available and know more and more about the physical and chemical interactions", explains ZAMG Director, Michael Staudinger. "However, in an area like the Alps, we can only simulate this knowledge in a realistic manner using extremely high-performance computer systems", he states.

The Solution

ZAMG's high-performance computer system consists of an SGI ICE X cluster, featuring Intel® Xeon® Processor E5-2670, with 252 nodes and two access nodes. A connected Panasas cluster file system provides rapid mass storage, and the system also benefits from system administration nodes (SAC) designed to be redundant with joint hardware RAID for the cluster management database.

The computer nodes are operated in batches, with interactive access and file management carried out using access nodes. The system is integrated into the ZAMG network with a bandwidth of 4 x 10GB/s.

The blades with processor are connected to a blocking network based on FDR-InfiniBand. The switch blades are designed for SGI enhanced hypercube topology and contain 18 internal and 48 external ports.

intel inside XEON

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The system is based on the Linux Novell®/SUSE®, SLES11 SP1 operating system and is supplemented with standard administration and monitoring software such as the Moab® HPC suite or Intel® Fortran Composer 2011.

SGI Technology

The Dakota blades in the computer nodes are equipped with Intel® Xeon® Processor E5-2670 with a total of 4,032 cores. In its most compact version, each SGI ICE X Dakota blade has 2 processor bases, 64 gigabytes of storage, an InfiniBand adapter and board management controller. The compact architecture uses internal InfiniBand hardware in full bandwidth and with very low latencies.

Each node can also be configured with the Intel® Power Node Manager (IPNM). The IPNM forms part of the cluster management software and enables the power consumption of various component groups in a node to be controlled. This represents an important cost control mechanism irrespective of the relevant operating procedure.

The blades in the system are mounted in blade chassis, which form independent rack units (IRU), with 18 slots for blades, network components, backplanes for electricity, signal transmission and chassis manager, plus a set of fans.

Groups of four IRUs are pooled in a 19" D-rack which can thus hold 72 blades. Cooling is provided by a combined air and water system. Cold air enters on the front site and is drawn to the reverse side by large fans positioned behind the IRUs. Processors with cooling units and other components emit their heat to this airflow. Water-cooled back doors cool the escaping warm air using heat exchangers. This concept works so well that 95% of the heat produced can be diverted using the heat exchangers.

The Benefits

Calculations for weather models using this new machine run up to 20 times faster than the previous system. This not only enables considerably higher resolutions for simulations and considerable improvements in models: As multiple simulations can be computed at the same time, a whole range of requirements can be reacted to more quickly and the results can be made available much more easily.

The SGI ICE X System not only enables considerable improvements in climate modelling and simulation for the highly complex alpine region, simulations for urban areas also benefit from the improved performance. New urban climate models enable high-resolution simulations in real time and improve forecasts considerably.

In addition, to producing highly accurate forecasting models for Austria several times a day, the high-performance computer also represents the core infrastructure for climate change research.

Tunnels in the seismic/gravimetric section of ZAMG's Conrad Observatory at Trafelberg, Lower Austria (source ZAMG/Leonhardt)

Furthermore, the computer also plays a crucial role in national crisis management, as Staudinger explains: "In order to be able to react in the right way to crises and disasters, government offices require quick and accurate information on which to base a decision. This is where the ZAMG plays a key role". The applications cover warnings of extreme weather events to dispersal forecasts following incidents involving hazardous substances, for example in cases such as the ash cloud from the Eyjafjallajökull volcano or Fukushima.

All agencies that rely on forecasts benefit from these improvements, from state warning offices and energy suppliers to winter services.

"The high-performance computer from SGI represents a major stride in weather forecasting, crisis management and climate research in Austria."

Dr. Georg Kaindl
Head of IT at ZAMG

About SGI

As a recognized market leader in high performance computing (HPC), SGI offers solutions for the most demanding challenges. SGI develops high-end systems in the fields of technical computing, big data and cloud computing.

With experienced partners across a strong network, SGI supports the development of efficient and high-performance solutions to meet the requirements of each individual customer.

With its qualified experts, SGI can advise its customers on applications with any level of complexity and provides a comprehensive customer service to meet the highest demands.

To purchase an SGI ICE X, please contact SGI Sales: 1-800-800-7441.

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