Success Story

KNMI

Forecasting Today's Weather – and 100 Years into the Future

"We're now producing a lot more data – around 20x as much each time we run one of our models. This has meant an enormous increase in the number of compute cycles we need to generate the data within a limited timeframe, because the one thing that hasn't changed is that we still need the results within the hour!"

– Rene van Lier, Project Manager, KNMI

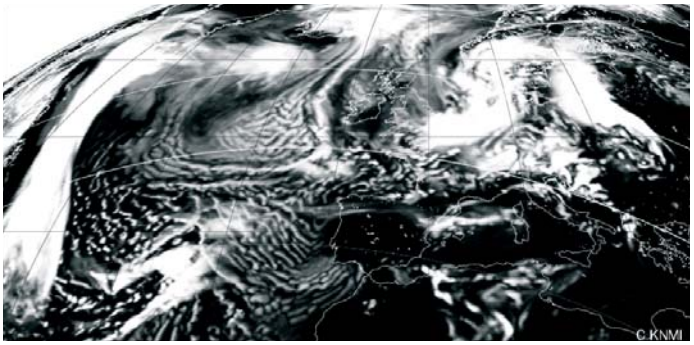
KNMI (the Royal Netherlands Meteorological Institute), based in De Bilt, Holland, is the Dutch counterpart of the UK Meteorological Office. Its primary activity is the provision of weather forecast data on an hourly basis to government agencies, commercial weather bureaus, broadcasters and the media; and the Institute also has a very strong research group specializing in climate research and seismology.

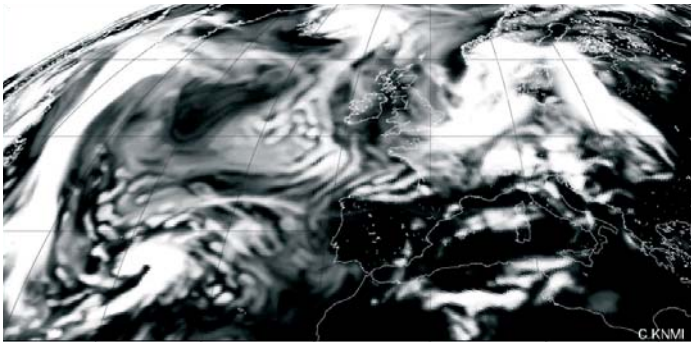
KNMI has approximately 450 employees – around 100 of whom are involved in daily weather forecasting, with another 50 providing hourly weather data on a 7x24 basis, and a further 100-150 working in research.

KNMI's critical success factors are twofold: to provide high quality, accurate weather forecasts; and to increase the level of available knowledge regarding the Earth's climate – including climate change. Achieving these objectives means maximizing the resolution at which the Institute's weather and climate models are able to operate (to enable them to provide increasingly detailed information), which in turn has meant that KNMI has a long history of investing in high performance computing (HPC).

KNMI's History in HPC

This began in the late 1980s, when KNMI bought its first Convex vector-based machine. The Institute focused initially on optimizing its predictive modelling, and then in 1996 purchased its first Silicon Graphics system – a six-processor Power Challenge™ L, dedicated to weather forecast modelling. This was followed six months later by a 16-processor Power Challenge™ XL – KNMI's first dedicated climate research machine.





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"This was a major step forward for us, as we gained an enormous amount of processing power, and it was also the moment when things really started to happen in KNMI in relation to modelling," remembers Rene van Lier, Project Manager. "We chose HIRLAM (High Resolution Limited Area Model) – which is used particularly in the Nordic countries – for our weather forecasting, and we've been involved in the joint development of the model ever since.

"We decided we wanted to increase the resolution of our models so that the information we could get out of them would get better and better. This is why every few years we've tried to make a major leap forward in the performance of the systems we use for our weather forecasts and climate research."

As a result of this commitment, in 1998 KNMI upgraded to a 24-procesor SGI® Origin® 2000; in 2001 to a 68-processor Sun Fire 15K; and in June 2006 to an SGI® Altix® configuration with a total of 240 Intel® Itanium® 2 processors – which, according to van Lier, has given KNMI a solution with 10-15x the compute power of its predecessor.

"Over the last ten years, the resolution of our weather forecasting models have improved by an order of magnitude," he says. "Ten years ago we had a resolution of 40-55km within the models; with the Sun system we had a resolution of 11km, and with the Altix we want to go to 2km.

"That's quite an effort, and means we're producing a lot more data – around 20x as much each time we run one of our models. All of this is three-dimensional, and we want to increase not only the grid points but also the number of levels at which we do our calculations. We now have more data within the same column of air, making it more accurate, and enabling us to predict the weather longer into the future – which is obviously very important for the agencies we provide our data to. Not only has this meant an enormous increase in the amount of data we produce, but also in the number of compute cycles we need to generate the data within a limited timeframe, because the one thing that hasn't changed is that we still need the results within the hour!

"The Altix also enables us to make much longer simulation runs in order to have more detailed information about climate

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KNMI Location. Photography by Raul Somers. © KNMI.

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– Rene van Lier, Project Manager, KNMI

change. The longest run we've had on our models is for a 100 year period, but what we've most wanted to achieve is to have a higher resolution over a longer period of time – so improving our quality both ways."

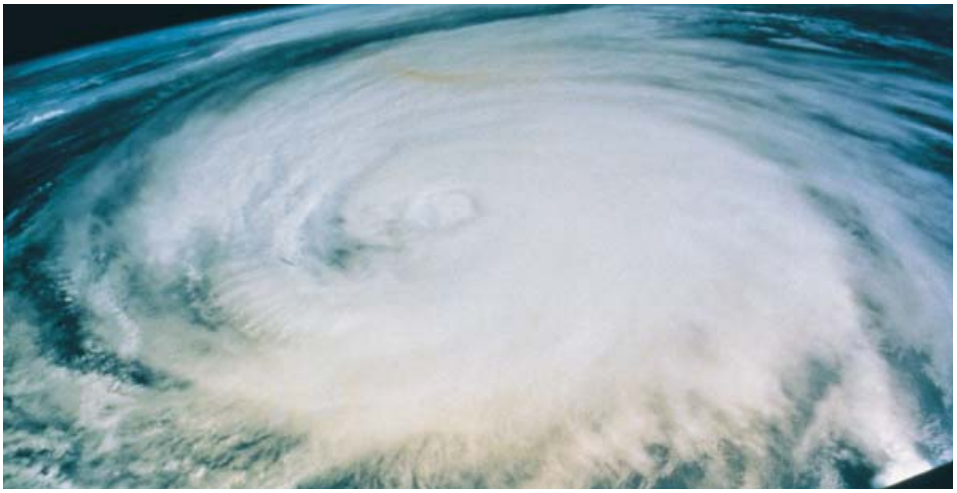
Data Sharing is the Key

KNMI's new Altix-based solution is split into three elements – an interactive head node with 16 CPUs; dedicated weather forecasting node with 104 CPUs; and climate research node with 120 CPUs. The interactive head node enables users to prepare their jobs which are then submitted to the appropriate node to be run in batch mode – guaranteeing throughput times, and in particular ensuring that weather forecast data is available when it is needed.

Both batch nodes run SUSE® Linux Enterprise Server with LSF as the master control program, together with the SGI® InfiniteStorage Shared Filesystem CXFS™.

"CXFS is a very important tool, one of the major components of the system, and was a major deciding factor in our choice of SGI," continues van Lier. "It's very important for us to be able to share data, not only amongst our researchers, but also between our weather forecasting and climate research systems. We're now sharing much more data than we have ever done before, because we have a global file system that makes it much easier for us to do this."

To manage its data, KNMI also uses two different levels of storage. These are 7TB of online storage, managed by CXFS, and



dedicated to the HPC environment; and a 150TB near-line tape archive, based on a tape silo and the SGI® InfiniteStorage Data Migration Facility (DMF), which is used mainly for research purposes.

"Weather forecast data doesn't have a very long lifespan: a couple of days and then it's obsolete," explains van Lier. "Data that is four or five days old isn't very interesting for weather forecasting, because we don't want to look to the past - we want to look into the future. This data is however very interesting for climate research, which is why it's all stored in our near-line tape archive, together with a lot of our model output, to enable us to make comparisons between different model runs and so improve the quality of our models."

Why SGI?

When KNMI issued its Request for Proposal for the new system, several manufacturers were able to offer machines with the performance needed to run the Institute's models. What differentiated SGI, however, was its ability to deliver a complete set of hardware, together with all the tools needed to optimize its operation, and all within an environment that was easy for KNMI to maintain.

"We have a range of performance benchmarks relating to all the various disciplines we're involved in within the Institute, and we worked with several vendors to run these on their machines and show us what their systems were capable of," concludes van Lier. "Next we looked at the architecture of the machines, the way in which they could be implemented within our current infrastructure, and how they suited our level of technological experience.

"Through this process we found that the SGI team had a good understanding of what we needed to do and how best to help us to achieve it. We also felt that what was different from other vendors was that SGI's overall technical solution was the one that suited us best. Maintaining 240 different systems, each with their own operating system, for example, would have meant a lot of work. By comparison, SGI offered us a machine with a Single System Image, giving us a system that's reliable, capable of doing the job, and easy to maintain – all of which were major issues for KNMI.

"Looking to the future, I think it's very possible we'll be expanding the system within the next one or two years. This was another of the issues when we purchased the system – that it should be capable of being enlarged as quickly and easily as possible. There's no fuss about that – it's just 'one click and play'. The architecture SGI offers us is excellent, and enables us to extend the system easily. Whether we do this depends on the development of our models and our need for extra performance, but I'm pretty sure it will happen."

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