

## CASE STUDY

Intel® Xeon® Processor E5 Family

Public Sector

High-Performance Computing



# Unleashing a Tornado

## Russian weather forecaster underpins forecasts with Intel® Xeon® processor E5 family

Russia's Federal Service for Hydrometeorology and Environmental Monitoring (Roshydromet) solves a wide range of complex tasks in atmospheric and oceanic hydro-meteorological data processing, simulation and forecasting. The data it generates provides the Russian Meteorological Office with the basis for its weather forecasts. It is also used by the World Meteorological center in Moscow, together with centers in Melbourne, Australia, and Washington DC, U.S., as part of a data exchange that aims to chart changing weather conditions across the world. To increase the accuracy and refinements of its weather forecasts, Roshydromet implemented an energy-efficient computing cluster based on RSC Tornado\* architecture with direct liquid-cooled servers powered by the Intel® Xeon® processor E5 family. As a result, calculation times for weather models fell by 30 percent.



"The Intel Xeon processor E5 family met Roshydromet's strict requirements for computing systems and provides a platform to develop the scientific endeavors of Russia's weather centers so we can forecast faster and with greater accuracy weather patterns across Russia and globally."

Vladimir Antsyovich,  
Director of Roshydromet Main Computer Center

### CHALLENGES

- **Next-generation forecasting.** Roshydromet needed to develop its weather computer modeling to reduce economic damage from changing weather patterns
- **Energy conscious.** Given the enormous increase in computing capacity required to achieve this, it was concerned about energy efficiency and operating costs

### SOLUTIONS

- **Bespoke platform.** The organization implemented a high performance computing (HPC) mini data center (miniDC) powered by the Intel Xeon processor E5 family
- **High standards.** The platform is characterized by remarkable levels of energy efficiency and computing effectiveness

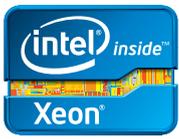
### IMPACT

- **Future-proof.** Roshydromet now has a cost-efficient platform that enables it to move up to computing at the petabyte scale (a thousand trillion floating point operations per second)
- **Predictions.** Roshydromet can now develop faster and more accurate weather predictions across Russia and the globe

### Flood, snow and storms

The work Roshydromet carries out is vitally important for Russia. Its research has revealed climate conditions in Russia have changed significantly. For example, winters are characterized by significant temperature increases, lower rain falls during the warm season, and changes in annual river flows and ice coverage in the Arctic Ocean and northern river creeks. This trend, set to continue over the next five to 10 years, has important social and economic implications. Increasing floods, snow avalanches, mudflows, hurricanes and storms are having adverse impacts on agriculture, water consumption, river and sea traffic and the utilities industries. As a result of a drought in 2010, the economy lost approximately RUB 250 billion [EUR 6.2 billion] while direct annual damage is estimated to be about RUB 60 billion [EUR 1.5 billion].

The damage from dangerous climatic conditions could be minimized with early information about the natural hazards. Roshydromet already has accurate regional weather models and, during 2011, issued over 1,800 storm alerts with a 91 percent accuracy rate. Its models have a spatial resolution of several kilometers and a timescale that ranges from several minutes to several days. This means it can predict, with reasonable geographical accuracy and up to 10 days before the event, potential weather changes such as atmospheric fronts, rain, hail, snowfall and strong winds as well as storm surges and fast floods, especially in mountain regions. Working with its sister organizations in Melbourne and Washington, it also produces global three-day weather forecasts. And its seasonal forecasts provide useful information about large-scale anomalies such as El Nino, an abnormal warming of surface ocean waters in the eastern tropical Pacific.



## Weather forecasting receives a turbo boost

### Next-generation weather predicting

Roshydromet wanted to create next-generation weather models that would take into account physical, chemical and biological processes in the Earth's atmosphere, oceans and the ground. The models must also be capable of analyzing non-linear interaction among the different components that influence and create weather. The overall aim is to create a weather forecasting system with a timescale ranging from minutes to several decades.

Technically, this means, among other things, increasing the spatio-temporal resolution of existing models and their physical saturation, which requires computing power measured in petaflops (one petaflop is equivalent to a thousand trillion floating point operations per second). Roshydromet's existing computing resources were capable of 300 to 500 teraflop calculations (a teraflop is one trillion floating point operations per second), but to create the new models, this needed to be increased by a factor of 10 to 15.

While this was certainly possible, Roshydromet needed to consider power usage and energy efficiency requirements and operational expenses. Its main data center is in a densely populated area of Moscow, which significantly restricts power supply. The cost of new energy cables and the price of energy were also restricting factors.

### Powerful punch from tornado

To counter these issues, the organization chose a computing cluster from the RSC Group ([www.rscgroup.ru](http://www.rscgroup.ru)). This innovative platform, RSC Tornado\*, is based on the Intel Xeon processor E5 family and liquid cooling. It's a high-density architecture characterized by high levels of energy efficiency and scalable performance and reliability.

Roshydromet used a specific HPC platform, RSC miniDC\*, based on the RSC Tornado architecture. Developed for rapid deployment, RSC miniDC includes all subsystems required by a modern data center including a powerful server farm based on Intel® Server Board S2600JF Family, communication networks, data storage systems as well as power supply, cooling and fire-fighting subsystems.

The system has several compelling features including an industry-record power usage effectiveness (PUE) of less than 1.06. This means that a maximum of 5.7 percent of the consumed energy is used for cooling the system. It also has a record-breaking 92 percent computing effectiveness ratio thanks to the Intel Xeon processor E5 family in LINPACK\* benchmarks.

Intel® Turbo Boost Technology 2.0, a feature of the Intel Xeon processor E5 family, is always on, which provides a clock speed gain of up to 400 MHz to optimize the handling of peak workloads and the distribution of

### Spotlight on Roshydromet

Russia's Federal Service for Hydrometeorology and Environmental Monitoring (Roshydromet) provides invaluable data for weather forecasting. Besides providing weather data across Russia, it also supplies the Russian arm of the World Meteorological Organization with data for global forecasting. This information comes via the Russian Meteorological Office, Roshydromet Main Computing Center (MCC) and Roshydromet Aviamettelecom, but is largely generated by Roshydromet's computer models.

power consumption among processor cores. For example, if all the computing tasks are processed by a single core, then the processor can increase its performance by redirecting power from an unused core to an active one.

Vladimir Antsyrovich, Director of Roshydromet Main Computer Center, said: "As we prepare for the next state of modernization to increase our computing power 10 to 15 times, we needed a solution that met our energy efficiency and cost concerns. A high-performance RSC solution, based on Intel Xeon processors E5-2690 and liquid cooling, is very compact, has low power consumption and provides significant performance scalability."

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