

Case Study: Alinea Software Saves Climate Change Researchers Precious Time

Snapshot

Client: The German Climate Computing Center (DKRZ) provides computing power, data management and support to researchers studying the Earth's climate.

Challenge: Climate scientists need to focus on their urgent research and have no time to waste learning difficult tools for software debugging.

Solution: Alinea DDT can pinpoint software problems on massive supercomputers in minutes instead of days.

Results: Climate scientists save many hours wading through print statements to find bugs in their code.

Summary quote: "Alinea DDT is a real time-saver." – Hendryk Bockelmann from DKRZ's Application Support department.

Researchers have no time to lose in their quest to divine the future of the Earth's climate and its effects on humanity. When a problem arises, one of the world's top centers for climate research relies on Alinea DDT.

The clock is ticking when it comes to finding solutions to global climate change. Only one tool can possibly model a system as complex and dynamic as the entire planet Earth: a supercomputer.

The German Climate Computing Center (Deutsches Klimarechenzentrum or DKRZ for short) gives researchers access to one of the world's most powerful supercomputers devoted exclusively to climate research.

DKRZ's Blizzard is an IBM Power6 with a peak performance of 158 TeraFlops, and a 7 Petabyte GPFS disk storage system. In total, the system puts about 8,000 cores at the service of climate scientists. Blizzard is particularly effective because it was purpose-built to provide optimal performance for state-of-the-art climate modeling.

Alinea DDT's easy-to-use, intuitive graphical interface allows DKRZ's researchers to spend more time focusing on the Earth's changing climate than debugging.

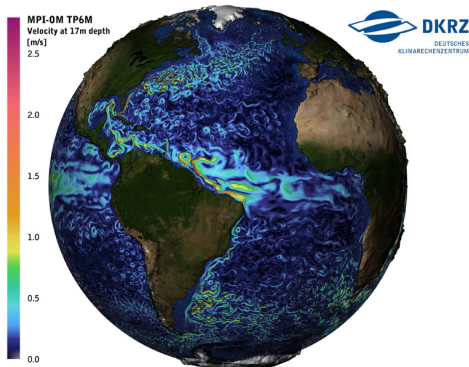
The Urgent Problem of Climate Change

Powerful systems with devoted personnel make DKRZ one of the world's top climate change research centers.

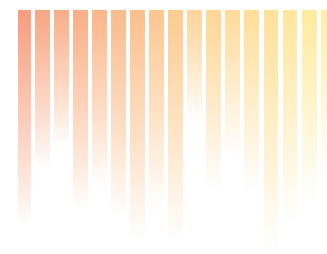
"Our scientists have simulated 13,000 years of climate history in more than 350 experiments, which corresponds to 30 million processing hours for conventional computers," says DKRZ Director Dr. Thomas Ludwig.

DKRZ's resources are dedicated exclusively to climate simulations by the research community, including the UN's prestigious Intergovernmental Panel on Climate Change (IPCC).

With the polar ice caps thinning, devastating storms lashing populated areas, and a string of record-breaking hot summers, researchers working on such an urgent problem have no time to waste.



Climate research visualization from DKRZ



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Their work can be time-consuming. For example, long-term simulations involve the complex interactions between earth, air, water, and ice. In fact, a long climate event such as an ice age can take months to simulate. No one can tolerate bugs or crashes partway through a run that long.

Allinea DDT Saves Time and Energy

DKRZ is also committed to running an efficient shop, with its staff conscious of the center's own environmental footprint. One of its stated goals is to tune all applications to reduce time-to-solution as well as watt-hours-to-solution. Hence, DKRZ turned to Allinea Software and its debugging tool to allow for an efficient development cycle.

Allinea DDT is a powerful debugging package for supercomputers that gives users a single view of every process in a parallel job, along with exactly what line of code is being executed. It can typically find bugs in minutes, saving many hours or even days of frustrating effort.

With so many interconnected processes on the go, Allinea DDT's clear GUI makes life simpler for researchers when problems arise in their simulations.

As a costly alternative, they would have to revert to the traditional debugging method of using print statements to examine critical variables in a slow, brute-force approach.

"Using print statements is not a pleasant option," says Hendryk Bockelmann from DKRZ's Application Support department. "A parallel debugger like Allinea DDT is a real time-saver for big applications."

happened only in this context on one particular task."

The researchers didn't know if the error was coming from a wrong message being passed by the MPI middleware, from a memory error, or from some other problem hidden in all that code, such as an unusual load imbalance.

As soon as they turned on Allinea DDT's multi-dimensional array



Image courtesy of DKRZ

Allinea DDT Reveals Bug Instantly

Most recently, DKRZ was running a climate simulation using four different binaries to model land, ice, ocean, and a coupler to tie everything together. At a small scale, everything was fine. But, when the model ran in the batch queue in a coupled context, it crashed for no apparent reason.

"Core dumps were useless. The crash was not related to the bug location," says Bockelmann. "The problem was particularly difficult to understand because it

viewer, researchers saw the bug immediately. Without looking at any actual values, they spotted the error.

"With Allinea DDT, it only took a few minutes to see this bug," says Bockelmann. "Once we knew the location, it was very easy to fix."

Quick diagnoses and easy fixes help DKRZ provide efficient supercomputing to climate change scientists. In this way, Allinea DDT helps to fulfill the center's mission of helping scientists understand our climate and improve their models.