

Increasing Computing Power to Understand the Earth's Climate

Mercury Computer Systems Visualization Sciences Group (Chelmsford, Mass)



The Imaging Challenge

Understanding what the earth's climate will be in the upcoming decades and centuries is one of the most critical challenges today. The German Climate Computing Center (*Deutsches Klimarechenzentrum, DKRZ*) provides high-performance computing power required for extensive numerical simulations with coupled models of the climate system. However, due to the quickly growing size of the simulation data, analysis and visualization of the time-dependent multivariate 3D results is an increasingly difficult task.

The Solution

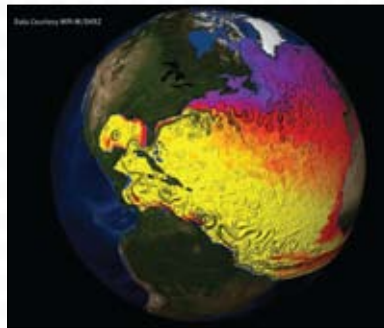
Visual data analysis is a powerful tool to handle the challenges of these large datasets. For interactive 3D visualization of climate data, *DKRZ* selected an advanced visualization server system equipped with a remote 3D-rendering solution based on Hewlett Packard's Scalable Visualization Array and Remote Graphics Software technologies. The visualization software solution comprises Avizo from Mercury Computer Systems' Visualization Sciences Group, which provides unique visualization capabilities:

A powerful NetCDF-CF1 file interface capable of reading and visualizing the typical long-time series of multivariate 3D data produced by weather and climate models using the most common native file formats. Depending on the local hardware configuration, large files can be cached in memory to accelerate the interactive access. Very large time-dependent files can be visualized immediately from the hard disks.

A topography and map module, complemented by a geographic projection module with user-definable exaggeration of the vertical axis, enables users to interactively explore data in the correct geographic context.

A wide range of state-of-the-art visualization methods and features such as line integral convolution, illuminated streamlines, and particle advection for visualizing vector fields like wind and ocean currents.

Through its Xscreen extension, Avizo visualizations can be easily ported to volume-rendering equipment such as *DKRZ's* VR-Powerwall or autostereoscopic displays.



Above: The system tracks relative humidity.

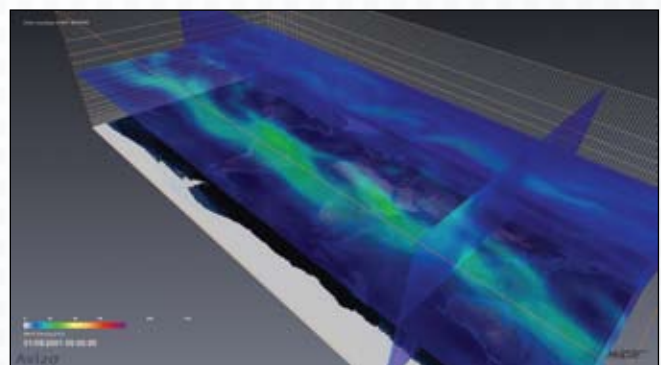
Left: A model of the Earth using Mercury's Avizo 5.1 visualization tool. Images courtesy Mercury Computer Systems)

The Tools Used

- Hewlett-Packard (HP) xw9300 pool of eight clustered workstations (dual-core Opteron).
- HP Scalable Visualization Array
- Mercury Computer Systems Avizo 5.1.

The Difference it Made

DKRZ was using an assembly of freeware and lower-level 3D imaging software, with limited climate data support, no scalability, and no support for specific visualization types. The Avizo-based solution brought an integrated, scalable platform providing advanced, remotely accessible data visualization and analysis services. By means of remote rendering software, all users potentially can interactively use the system from their desktop workstation, without the need to transfer large data sets from the *DKRZ* archive to the local PC.



A graphic look at wind velocity.