# Collaboration, Analysis, and Visualization of the Future

[1]Dave Semeraro, [1,2]Bob Wilhelmson, [1,2]Dan Bramer, [3]Jason Leigh, [4]David Porter, [5]Jim Ahrens

[1]National Center for Supercomputing Applications
University of Illinois
Champaign-Urbana, Illinois
[2]University of Illinois
Champaign-Urbana, Illinois
[3]University of Illinois at Chicago
Chicago, Illinois
[4]University of Minnesota
Minneapolis, Minnesota
[5]Lawrence Livermore National Laboratory
Berkeley, California

Advances in networking, computing, data storage, visualization hardware, and grids are enabling new modes of collaboration, analysis, and visualization. In this presentation we will provide an overview of new capabilities being developed and/or explored in the National Computational Science Alliance and how they are being applied to the atmospheric sciences. More specifically, his overview highlights efforts within the Scientific Workspaces of the Future Expedition as well as those at the National Center for Supercomputing Applications (the Alliance central site). These efforts are partnerships between technology developers and end users and include scientific collaboration using Access Grid, animation through the use of TeraVision, stereo display using the GeoWall and IDV, parallel visual rendering using ParaView, volume rendering using HVR, and high resolution desktop and tiled wall display. Several examples of the use of these different workspace components in atmospheric research and education are shown. Further examples and text will be available in January at http://www.ncsa.uiuc.edu/AboutUs/FocusAreas/MEADExpedition.html .

The Access Grid is an ensemble of resources including multimedia large-format displays, desktop displays (PIGs, Fig. 1), presentation and interactive environments, and interfaces to Grid middleware and to visualization environments. These resources are being used to support group-to-group and person-to person- interactions across the Grid. For example, the Access Grid (AG) is used for large-scale distributed meetings, collaborative work sessions, seminars, lectures, tutorials, and training, and now scientific collaboration. AG 2 software provides the framework for integrating data, applications and devices within the scope of a "virtual venue". It is a secure system that provides messaging and collaboration software interfaces to enable the creation of collaborative applications. Further, it is being extended to support access to high-performance remote visualization services such as tiled displays.

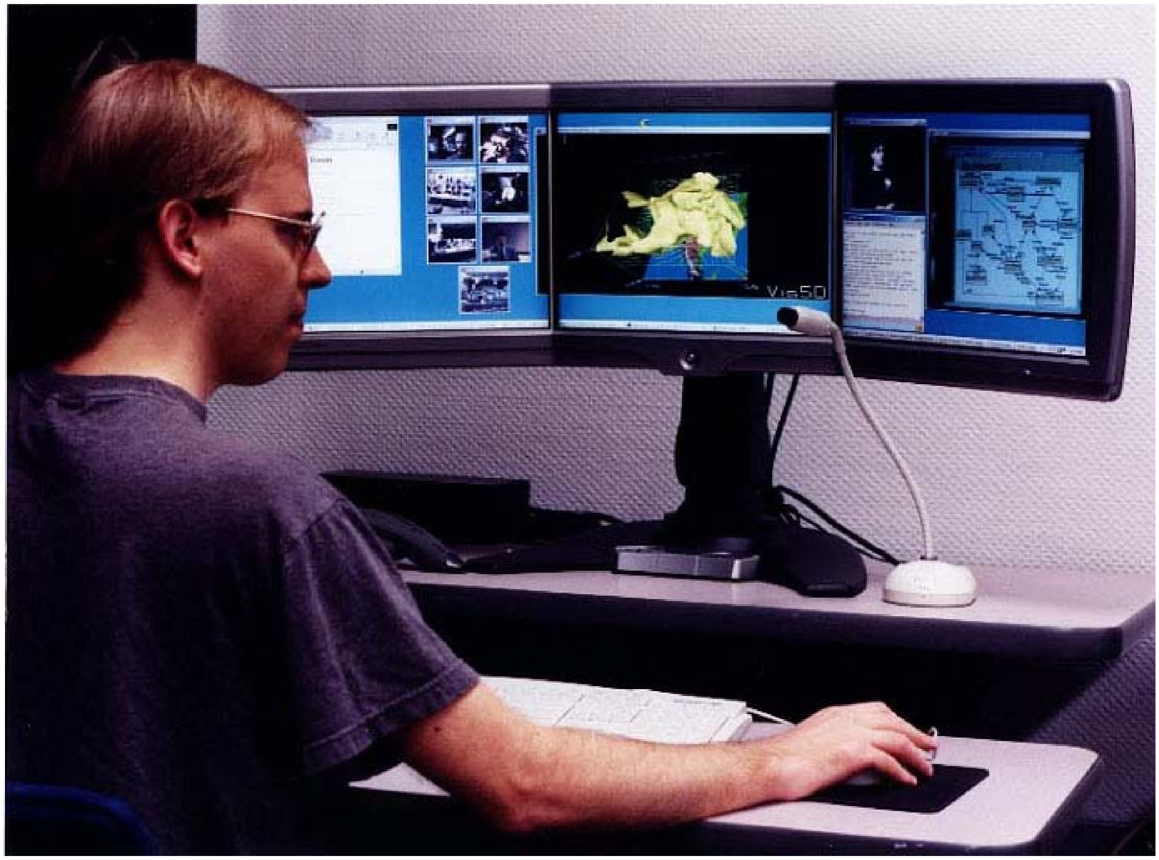

Fig. 1: The PIG display. Further information on the Access Grid can be found at http://www.accessgrid.org/

TeraVision provides a platform independent solution to the transmission of multiple high resolution video streams to one or more destinations. It is a completely hardware oriented solution, where no special software/hardware has to be installed on the source or destination machines to enable them to transmit their video. These multiple streams can either be independent of each other or they might be component streams of a video system, such as a tiled display or stereoscopic display. TeraVision also enables shared collaborative visualization of data with the Access Grid. The URL is http://www.evl.uic.edu/cavern/optiputer/teravision.html

The GeoWall is a low cost, "build-it-yourself" passive stereo PC-based projection system. It can be used for stereo display with IDV (built on VisAD) and Vis5D and provides an in-depth view of observational and model data. Stereo display with IDV has recently been enabled with Alliance support on the local GeoWall in the Department of Atmospheric Sciences at the University of Illinois and will be used in weather briefing this fall as well as to display research results. The URL is http://www.geowall.org/ . The IDV URL is http://my.unidata.ucar.edu/content/software/IDV/index.html The Vis5D URL is http://www.ssec.wisc.edu/~billh/vis5d.html The VisAD URL is http://www.ssec.wisc.edu/~billh/visad.html

Tiled display walls provide a large-format environment for presenting high-resolution visualizations by tiling together the output from a collection of projectors and linked computers (Fig. 2). Multiple projectors allow display of images much larger than possible on standard computer display screens. The use of these walls enables researchers to step back and get an overall picture of a dataset or move in and study fine details without changing the visible image. For example, very high resolution satellite data sets can be displayed as a single image. In addition, the large display screen can be blocked and used to display images from multiple sources such as ensemble model simulations or current weather data. The latter is how the storm group in the Department of Atmopsheric Sciences is using the system.

High resolution desktop displays and projection systems are now becoming available and are being tested at NCSA for use in displaying atmospheric observational and model data. For example, IBM offers a desktop display with 3840 x 2400 pixels – enough to mimick a modest tiled display wall but in a much smaller desktop setting. Projection capabilities are being prototyped with similar resolution. These systems can replace tiled walls and eliminate the tile color problems that typically occur across tiles on these systems due to small differences that come with individual projectors.

Visualization tools are also being tested at NCSA for research and educational purposes. This includes the IDV previously mentioned. In addition, interactive remote visualization is being explored with the VTK ParaView software. This software is a cluster based parallel visualization application that allows the user to interactively generate isosurface, slice plane, hedgehog, and other visual interpretations of scientific data easily and efficiently. It is being used to render large time series atmospheric data (Fig. 3). Another parallel visualization approach that is being used is the Heirarchical Volume Renderer (HVR) from the University of Minnesota. This software is able to handle efficiently billions of model zones in creating picture from a model variable. It can also be used to create animations using key frames (Fig. 4).

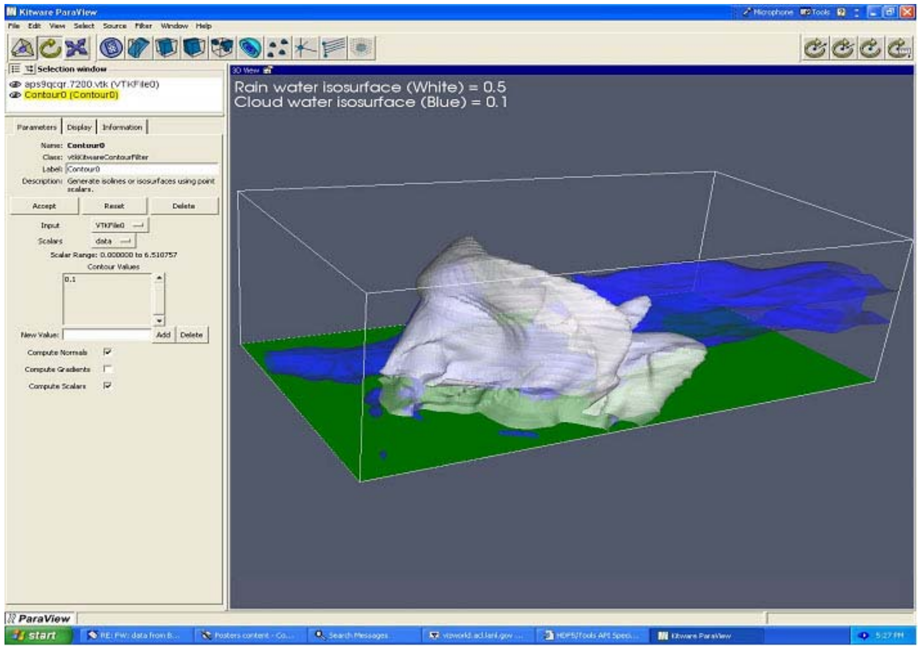


Fig. 3: A screen shot of a cloud rendered using ParaView. The URL for ParaView is http://public.kitware.com/ParaView/HTML/Index.html

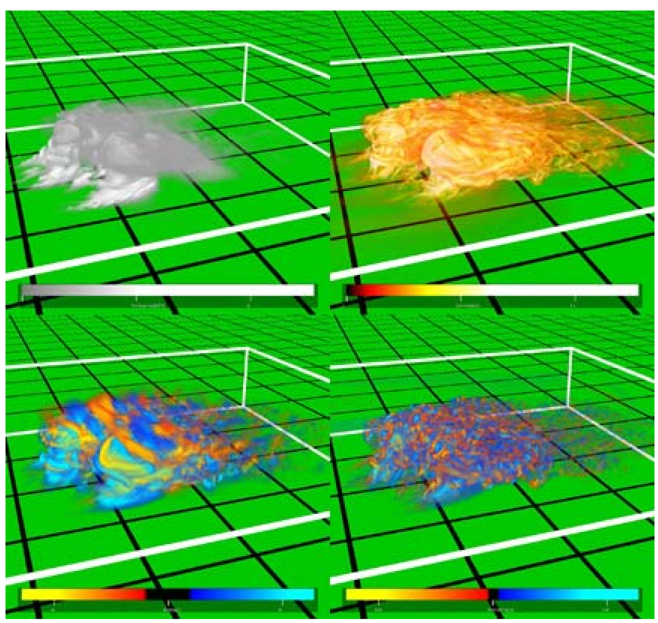

Fig. 4: A 4-panel figure of a thunderstorm using HVR. Upper left – the cloud, upper right – the vorticity, lower left – the vertical velocity, and lower right – the vertical vorticity. The URL for HVR is http://www.lcse.umn.edu/hvr/hvr.html