THE SEQUOIA 2000 SHOWCASE

An S2K Technical Report, 3/20/94

C. L. Norris, S.-C. Chen, J.O. Roads

Climate Research Division
Scripps Institution of Oceanography
University of California, San Diego, Dept. 0224
La Jolla, CA 92093-0224

Showcase Contributors

Tim Barnett[1] , Juan Castañeda[1], Dan Cayan[1] , Shyh-Chin Chen[1], Frank Davis, Terry Figel[2], Catherine Gautier[2], Michael Ghil[4], Sam Iacobellis[1], D. Jourdan[2], Charles Norris[1], John Roads[1], Niklas Schneider[1], Jonathan Shade[3], Richard Somerville[1], Sabrina Speich[4], Tao Wang[3], Bill Weibel[4]

[1]Scripps Institution of Oceanography, [2]University of California, Santa Barbara,
[3]San Diego Supercomputing Center, [4]University of California, Los Angeles

1. Introduction

Environmental investigators view space and time differently, mainly through emphasis on different environmental variables and data sets. In fact, because it has been so difficult to fully develop any data set, many investigators have spent their lifetimes emphasizing a single data set. Different data sets and variables are sometimes compared with each other in review articles or in modeling studies, but truly comprehensive comparisons await development of proposed S2K-like database systems. In these databases, we will be able to go to a generic environmental data base and extract all manner of relevant data sets and environmental variables which will then be merged and output with a set of graphics packages under the control of the person doing the merge. These integrated views will undoubtedly give us new insight into how our world works.

Along with the database development, there are a number of graphics questions that will ultimately have to be answered. How can we best view environmental data? What environmental viewpoint do we emphasize? What graphics technique do we use? Answers to questions are some of the goals of the S2K project. In short, S2K will help us to discover how to do graphics better than we do now.

To help us to better understand just how well we currently do environmental graphics, we have established the S2K Showcase where S2K scientists can show graphical displays of their environmental views of the world. We have also provided some public domain tools that can be used to manipulate, animate, print, and cut and paste images into various electronic or hard-copy documents. We are using a top down approach by showing what we can now represent via our individual data sets. As the S2K database becomes more widely accepted, more of these investigations will ultimately include the S2K database feeding into an integrated set of graphics tools.

Views in the Showcase include still images as well as sequences of images or animations. Originally, we had proposed that the Showcase should be centered on California, but given the sparsity of contributions, we have ultimately welcomed any images that show current graphics techniques at any geographical location. For convenience, we will reference the views by the directory names. Further references to each of the Showcase contributions are to be found in the individual README files in the directories of each user.

The Showcase also contains a public presentation file that can be viewed on Macintosh computers using Microsoft PowerPoint. This PowerPoint presentation includes QuickTime movies as well as individual images. These QuickTime movies can be viewed separately. The presentation includes most of the

Showcase contributions up to the time of the August 1993 S2K retreat in Del Mar. Now that QuickTime, as well as PowerPoint for Windows is available, a DOS version of the public presentation that can also be viewed on portable DEC PCs will soon be made available on the Showcase.

The purpose of this report, then, is to give a general overview of the Showcase and to discuss some of the graphical techniques. Section 2 describes the current Showcase directory. Section 3 describes some of the public domain tools provided in the Showcase. Section 4 discusses some of the graphical techniques used in the Showcase. Section 5 describes our beginning efforts to place the Showcase within Mosaic. Section 6 then summarizes our present progress.

2. Showcase Directory

Physically, the S2K Showcase is a simple directory structure on the S2K machine heel.s2k.berkeley.edu disk /data/10/showcase. (Fig. 1). On the top level Showcase directory are the README files explaining the Showcase (including this S2K report, SHOWCASE.REPORT). The top-level directory also includes various user directories, as well as a bin directory that contains several useful Showcase utilities. Each user contributing to the showcase maintains his or her own directory structure and is responsible for maintaining README files documenting the contents of directory and how to view the datasets.

3. Showcase Utilities

For convenience and to allow Showcase contributions to be viewed by the widest number of people, utility software for viewing Showcase contributions is provided in showcase/bin. These programs are an ad-hoc compilation of public domain software, which reflects the individual preferences of the various Showcase contributors.

We have not limited in any way the use of display software by Showcase contributors. We have merely asked that if the donated visualization requires special software that special software be added to the bin directory along with a README file describing its use and options. If the visualization requires proprietary software which cannot be easily made available on heel.s2k, we have suggested that the visualization be converted so that it can be viewed using one of the provided public domain tools. Major features of these public domain software tools are discussed below, with additional information provided in the Appendix.

One Showcase utility that has proven to be a versatile interactive image display tool is XV (Bradley 1992). This program can display and manipulate a large variety of bitmap formats such as GIF, TIFF, JPEG, Sun Raster, and X11 Bitmap files. This program is also useful for graphic format conversion. Although XV doesn't support CGM, a vector graphic format used by NCAR graphics (Clare and Kennison 1989 and Clare et al 1987), the NCAR graphic translator ctrans can convert CGM format to XV readable Sun Raster files. XV can also be used as a rather crude animation engine by specifying the -wait N and -wloop options.

Another image display program with a similar focus is Ximage from the National Center for Supercomputing Applications (NCSA). Ximage is useful for manipulating colors of an image as well as animating HDF format images. The animation utility is especially useful in conjunction with NCAR graphics.

A useful C-shell, Rasmovie, converts NCAR gmeta files to Sun raster images. These raster images can be readily animated with XV. This shell is portable to any UNIX machine so long as NCARG ctrans and ImageTool imconv and imcopy are supported on the workstation.

We have made one exception to the above public domain request. Although the Showcase can be viewed and animated on the DEC-stations using XV, we have found it convenient for public presentations to be able to transfer the movies and images to a Macintosh PowerBook that can be carried to the site of the lecture and displayed on an active matrix LCD panel. We began this public presentation development using Microsoft PowerPoint presentation software and Apple QuickTime software for presentation of animation. Therefore, most of the Showcase movies have also been converted to QuickTime format; most of the images are also available in a Macintosh PowerPoint presentation file. Now that QuickTime for Windows has been released, PowerPoint for Windows can be used with these same data files. We hope to be able to soon present the Showcase images and movies using portable DEC PCs or other compatible machines..

For creating Macintosh QuickTime movies from NCAR graphics gmeta files, a C shell script called macmovie is included in the this utility directory. This program converts NCAR gmeta files to PICT images which can then be converted to QuickTime format using the Movie Converter utility which is part of the QuickTime distribution.

4. Showcase Contributions

The Showcase is built around the individual contributions of various investigators. For public presentation, we have organized the Showcase as a progression from global views to views centered on California. In this document, we attempt to describe some of the different kinds of environmental views and the different graphics techniques used to illustrate a variety of environmental data sets. We highly recommend that if you are interested in specific views that you contact the individual contributors to the Showcase.

4.1 Color

All contributions in the Showcase emphasized color. However, the effective use of color is a trial-and-error process of discovering which combinations are effective means of conveying information to a particular audience. The Sequoia Showcase acts as a testing ground for display schemes. By browsing through the best ideas of the Showcase contributors, one can find ideas for one's own work. By contributing to the Showcase, one can understand better how ones graphics fit in with other scientists graphics. An excellent tutorial on the many aspects of color is available as a Macintosh document from the San Diego Supercompution Center. It can be obtained through anonymous ftp from (ftp.sdsc.edu, with the access path of /pub/sdsc/graphics/interactive_color/interactive_ color.sit.hqx.

The images in gautier/lh are a good example of common color scheme which uses all of the colors in the color spectrum in the order found in the spectrum from a prism. The cooler colors, magenta and blue are used to denote low data values, progressing smoothly through progressively warmer colors cyan, green, yellow and then red for the highest values. In roads/hydroscenario/climmovie, color is used in a more physical representation. The natural association of the color blue with water is used such that darker blues represent greater amounts of water, reds indicate the lack of water.

4.2 Domains

A number of contributors showed global views (See Showcase directory chen/gcmdrought, roads/sstq and gautier/lh). The global views ranged from satellite projections of the sphere to cylindrical projection maps of the sphere. Higher resolution regional views were shown in Showcase subdirectories cnorris/jan_precip_event, fdavis, iacobellis/hires, roads/hydroscenario and ucla. All of these graphics require geographical background, i.e. coastal, political country and states outline. The ability of overlapping these outlines ranging from simply drawing lines to actually separating the plotting fields over continents and ocean. Mapping scientific fields over ocean or continent are quite common in environmental sciences as shown in many examples of Showcase (e.g. iacobellis/hires, gautier/sw, roads1/hydroscenario, chen/sstq and ucla). NCAR graphics appears to be the only package providing this ability (see iacobellis/hires, roads1/hydroscenario and chen/sstq) but the usage of NCAR graphics can be complicated.

4.3 Intercomparisons

Environmental scientists would like to be able to easily compare and manipulate a variety of variables. For example, in showcase/chen/sstq, the COADS sea-surface-temperature (SST) anomalies in the 80' are compared to the NMC analyzed precipitable water (vertically-integrated water vapor) anomalies during the same period. Also in showcase/roads/hydroscenario the climatologies of surface evaporation over U.S. are compared to the vertically integrated precipitable water and moisture convergence. Efforts in collecting data and organizing them into a uniform or comparable formats is usually quite laborious. The proposed S2K-like data base will reduce this effort significantly, and these intercomparisons will become more commonplace in the future.

Data manipulations are not necessarily limited to digitized grid point data only. For example in showcase/cnorris/jan_precip_event, the satellite infrared black/white cloud images from GOES spacecraft were cropped (SDSC ImageTools were used) to emphasize California area. The pixel images are subsequently color-enhanced using public domain software called Imagic on the Macintosh. The rain-gauge precipitation data from surface stations at San Diego and Nevada City, California, and the time bar, which are converted to bitmap type images from series of CGM frames, were generated by NCAR graphics. The text were produced using Macintosh Canvas graphic utility and used as the background template. All these components are finally combined using ImageTool, frame by frame, into an animation file.

4.4 Animation

Animation is becoming a popular research as well as presentation tool. In addition to the previous animation view of the California cloud pictures, showcase/chen/gcmdrought shows a global and regional view of a general circulation model (GCM) simulated 500 mb heights and precipitation fields using NCAR graphics. The series of CGM frames are subsequently converted to HDF format using NCAR ctrans. The HDF data can be animated invoking NCSA Ximage. The same animation in sun raster format in showcase/roads/sstq can be viewed using XV. These raster images are generated using Rasmovie in the Showcase utility directory. Other tools are also useful for generating animated pictures. For example, showcase/nschneider shows an animated SST and the depth of warm pool from a 2 years integration of a ocean model. The frame sequence was generated in IDL, saved as a series of CGM files from IDL, and then converted to a series of SUN Raster files using Rasmovie as described previously. These raster files can then be animated using XV.

4.5 3-D Graphics

In the /showcase/shade directory, a three-dimensional picture of a cloud over the western United States is shown. The image was generated using AVS graphics. 3-d graphics, especially animated 3-d graphics are future developments of S2K graphics and the Showcase. Much development is still needed in order for 3-d graphics to have the same functionality of 2-d graphics. For example, as shown in roads/regclimscenario/030393/slide7.gif, state lines and continental outlines are common features of 2-d graphics. Boundary clipping, as shown in roads/regclimscenario/030393/slide4.gif is another common 2-d feature. Both of these features are missing in the present AVS software. We are currently exploring ways to add these functionalities so that, at the very least, AVS will be able to display 3-d graphics, with the same ability now possessed by 2-d NCAR graphics and IDL.

5. Mosaic

Recent developments in the arena of network data access by the software package, Mosaic, make it possible for the Showcase to widely expand its reach and utility. Mosaic was created by the National Center for Supercomputing Applications to provide a visual means of navigating through a wide variety of network information. For example, rather than having a single Showcase home directory, on a central server, Mosaic uses network references. Only the "home page" for the Showcase need reside in a central location; the contributions to the Showcase by individual researchers or labs could reside wherever the contributor finds most convenient. This location could be a Mosaic server at the researcher's lab, or a centralized S2K server, much like the current Showcase setup.

This decentralization provides greater flexibility in the structure, adaptability, and maintenance of the Showcase. In particular, the decentralized Mosaic architecture makes it easy for each of the S2K participating institutions to take full control over the "look" of their Showcase contributions. Another benefit is that the standardized visualization tools used with Mosaic for viewing still and animated images, as well as sound, make it unnecessary for Showcase contributors to provide special software for viewing the contributions; problems with obtaining executable versions of the various Showcase utilities are avoided.

As network access utilities like Mosaic evolve, we envision that access to the S2K databases could be greatly simplified by using this user friendly technology as the top interface. Common types of database queries could be made using standard Mosaic forms with the results delivered as mosaic pages. In fact, Mosaic provides all the tools, as well as the basic philosophy of our original goals for the Showcase. Therefore, we are currently in the process of converting the current version of the Showcase to Mosaic form. We also envision that the present emphasis on environmental science in the Showcase could be augmented to include other aspects of the S2K project.

6. Summary

We have briefly described the Showcase directory on the disk /data/10/showcase, which is mounted on the S2K machine, heel.s2k.berkeley.edu. The original purpose of the Showcase was to contrast samples of some of environmental images generated by some of the scientists working on the Sequoia project. Another purpose was to describe some of the current tools that could be used to manipulate and display these images.

These Showcase environmental images make effective use of color and two-dimensional animation. Examples of different kinds of data and graphic techniques being compared side by side were shown. Some three dimensional environmental views were also shown. Further development of these graphics, and associated graphics tools will lead to new insights into environmental science.

In the near future, the Showcase will be converted to Mosaic form. Mosaic will improve access to the Showcase for both the S2K community and to the world at large. Such improved access will provide additional inducements to participate in the Showcase presentation.

Finally, the public presentation of the Showcase has been made on a portable Macintosh PowerBook connected to a portable active matrix LCD panel. We will soon be converting the presentation to a portable DEC PC. These kinds of presentations are currently limited by a screen resolution of 640x480 pixels. This limitation is related to both the PC capability and the LCD display. Future development of portable PCs supporting higher screen resolutions or more portable workstations supporting increased screen resolution, and higher resolution LCD displays will have a large impact on public Showcase-like presentations using this kind of presentation technology.

Appendix 1: Showcase Public Domain Software

The purpose of this appendix is to provide some additional details about some of the public domain software provided in the Showcase. For more complete descriptions, see the README files provided along with the programs in the bin directory. In the case of commercial (NCAR, IDL) or well-supported shareware (XV, for example), see the documentation which is provided with the software.

A 1.1 XV

XV is a public domain image display and manipulation program which has seen wide use in recent years. It is quite flexible in the types of image files it can read and write. It provides rudimentary image editing and enhancement functions, but it's primary strength is as an image display utility. One site where XV can be obtained is the anonymous ftp server at the National Center for Supercomputing Applications (ftp.ncsa.uiuc.edu); the path is Mosaic/Mosaic-viewers/xv-3.00.tar.Z. See the XV documentation distributed along with the source code for more in-depth discussion.

XV supports many commonly used graphic formats, e.g., GIF, TIFF, JPEG, Sun Raster, and X11 Bitmap files, except CGM format. However, the CGM file can be converted to Sun Raster image using NCAR CGM translator with "-d sun" and "-resolution" options (see Clare et al 1987). The "-resolution" option selects the desire pixel resolution of the image. This option is particularly useful in maximizing the view window or to crop an interested portion from a CGM image. Example usage can be found in Macmovie and Rasmovie described in A.3.

A 1.2 Ximage

Ximage is a versatile HDF image display tool developed by NCSA. (Ximage is available through ftp.ncsa.uiuc.edu) Ximage does actual data values display, color enhancement ability, contouring and shad data plots; it also analyzes frequency distribution of the data set, load and manipulate palettes to change the color mapping of the raster images, and animate the images. To convert the NCAR series of CGM images into HDF format, use the NCAR ctrans with "-hdf" option. This animation tool provides many playback functions that allow to adjust the animation speed, to skip frames and to revert the animation sequence. More detailed information can be found in January issue of NCAR SCD Computing News (1991). the CGM gmeta file to the required HDF format for Ximage.

A 1.3 Macmovie and Rasmovie

NCAR graphic CGM files can be converted to animation by using either of the two C-shells, Macmovie and Rasmovie. Macmovie converts NCAR Graphics gmeta files to a series of PICT images which can be converted to a QuickTime movie using Apple's QuickTime Converter program. It makes use of the imtools package developed at SDSC, so imtools must be available on your computer before Macmovie can be used. Imtools package can be obtained from SDSC (ftp to ftp.sdsc.edu, path /pub/sdsc/graphics/imtools). Type macmovie with "help" as argument for usage information. Rasmovie converts NCAR GRAPHICS gmeta files to raster images which can be animated using XV, otherwise it is similar to Macmovie. Both shells have the ability to process a portion of image from each frame in the CGM file.

A 1.4 SIOanimate (no more)

SIOanimate was a Showcase utility that had previously been provided for animating still images. This program used the file translation routines from XV in order to be able to animate any image file format readable by XV. However, the file translation routines are copyrighted by John Bradley, the author of XV, and the copyright states that the code may be distributed and used freely as long as no modifications are made. Unfortunately, using the translation routines so that SIOanimate could animate a wide variety of raster images required small modifications to be made to the read routines. E-mail communications made it clear that some sort of licensing fee would then be required. Therefore, we did not pursue this any further and have eliminated SIOanimate from the available software tools. XV animation is now the current recommended procedure for animating raster files on heel. XV will soon be superseded, however, by Mosaic animation tools.

A 1.5 USEFUL REFERENCES

NCAR Graphics

Clare, F., and D. Kennision, 1989: NCAR Graphics Guide to New Utilities. NCAR/TN-341+STR.

Clare, F., D. Kennision, and B. Lackman, 1987: NCAR Graphics User's Guide. NCAR/TN-283+IA. Available from scdinfo@ncar.ucar.edu.

Mosaic

National Center for Supercomputing Applications, University of Illinois, Urbana-Champaign. Available via anonymous ftp from ftp.ncsa.uiuc.edu path /Web/Mosaic-binaries. Connect via mosaic to http://www.ncsa.uiuc.edu for a Mosaic introduction.

XImage

SCD Computing News, 1991: SCD Computing News, January 1991. Scientific Computing Division, National Center for Atmospheric Research, P.O. Box, Boulder, CO 80307-3000. Available through anonymous ftp to ftp.ncsa.uiuc.edu, path /UNIX/XImage.

xv

Bradley, 1992: XV: Interactive image display for the X windows system. Univ. of Pennsylvania. Available through anonymous ftp to ftp.cis.upenn.edu, path pub/xv.

Appendix 2: Showcase Presentation Slides

The following pages contain printouts of the slides used in the PowerPoint presentation about the Showcase given at the March 20 Sequoia 2000 retreat at Lake Tahoe.