

Advanced Visualization Techniques

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Coimbra, Portugal

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Topics Covered

- Remote and Collaborative Visualization
- EnVision – simplified Interface for Visualization
- Visualizing and Animating a Time Series in Paraview
- VisIt
- Parallel Visualization

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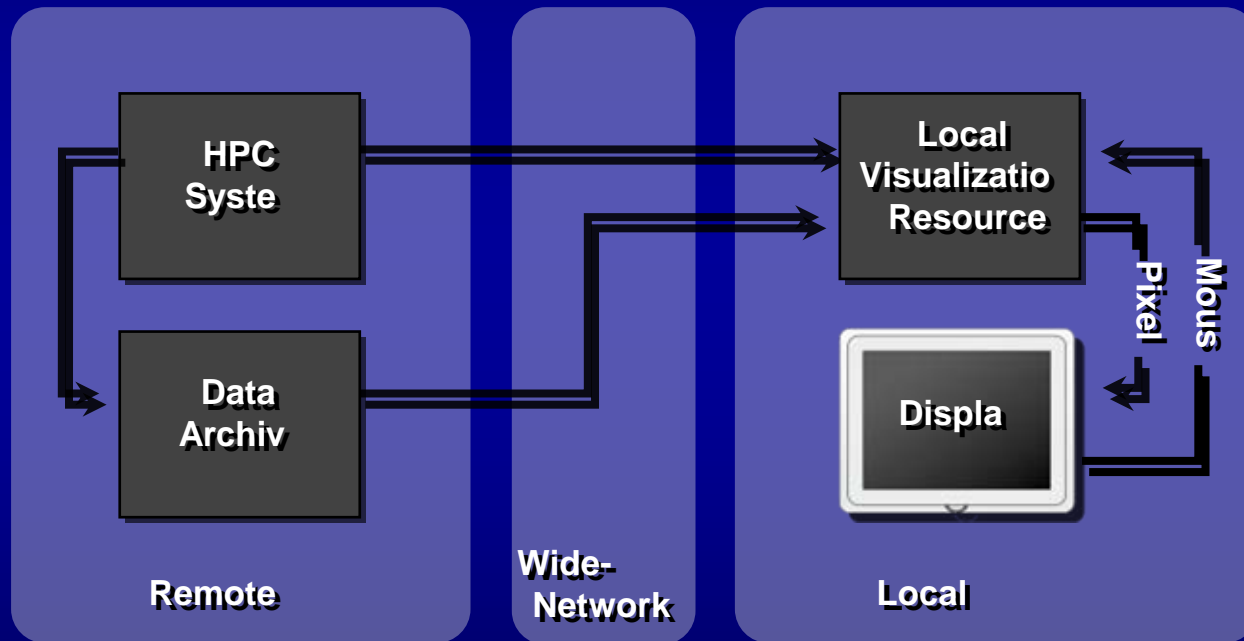
Remote Visualization Motivation

- It is no longer necessarily practical to move tera and peta-scale data from instruments or HPC systems to user's local site
- Certain data is sensitive (e.g. data from industry, government, academia)
- Growth of data has outstripped the graphics capabilities of single GPUs and aggregation of GPUs requires specialized knowledge

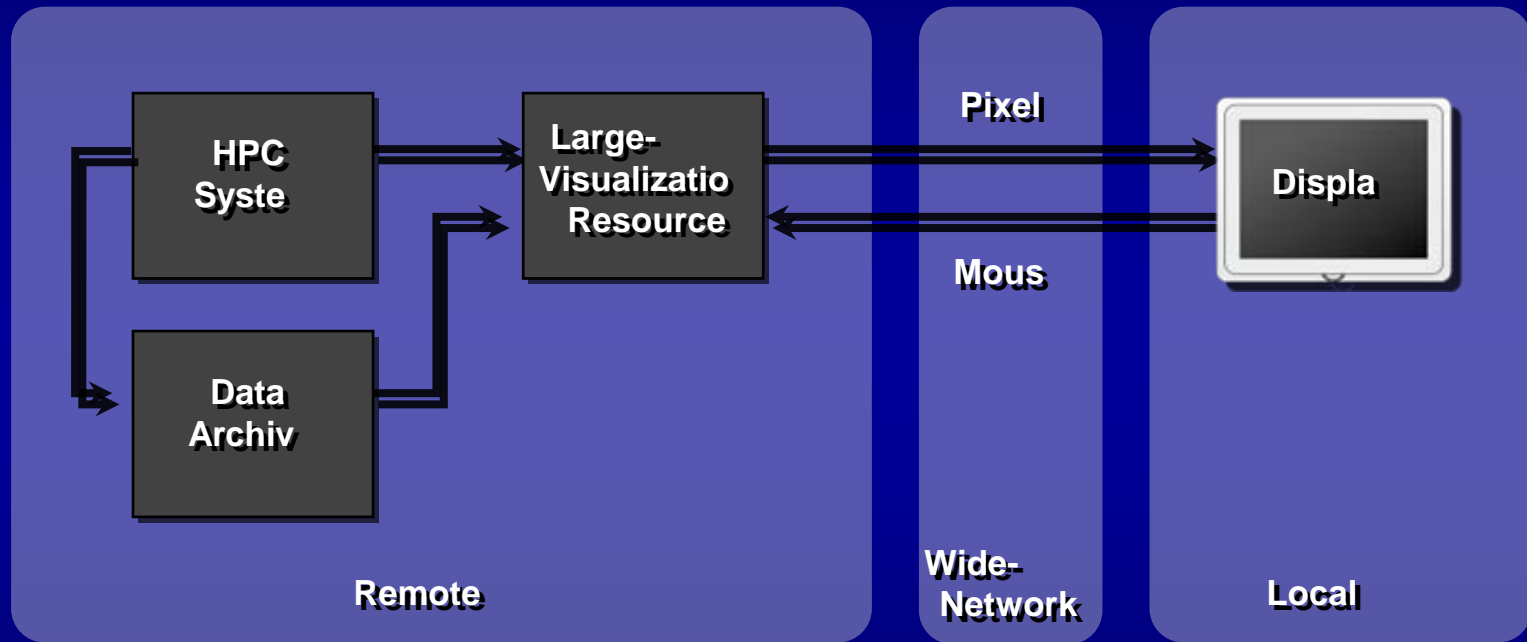
Remote Visualization Challenges

- Latency (wide-area network and GPU read-back)
- Quality of service and the user interface (scheduling, ease of access, and usability)
- Wide-area network bandwidth
($1280 * 1024 * 12 * 24 = 360$ MBps uncompressed)

Old Model (No Remote Capability)

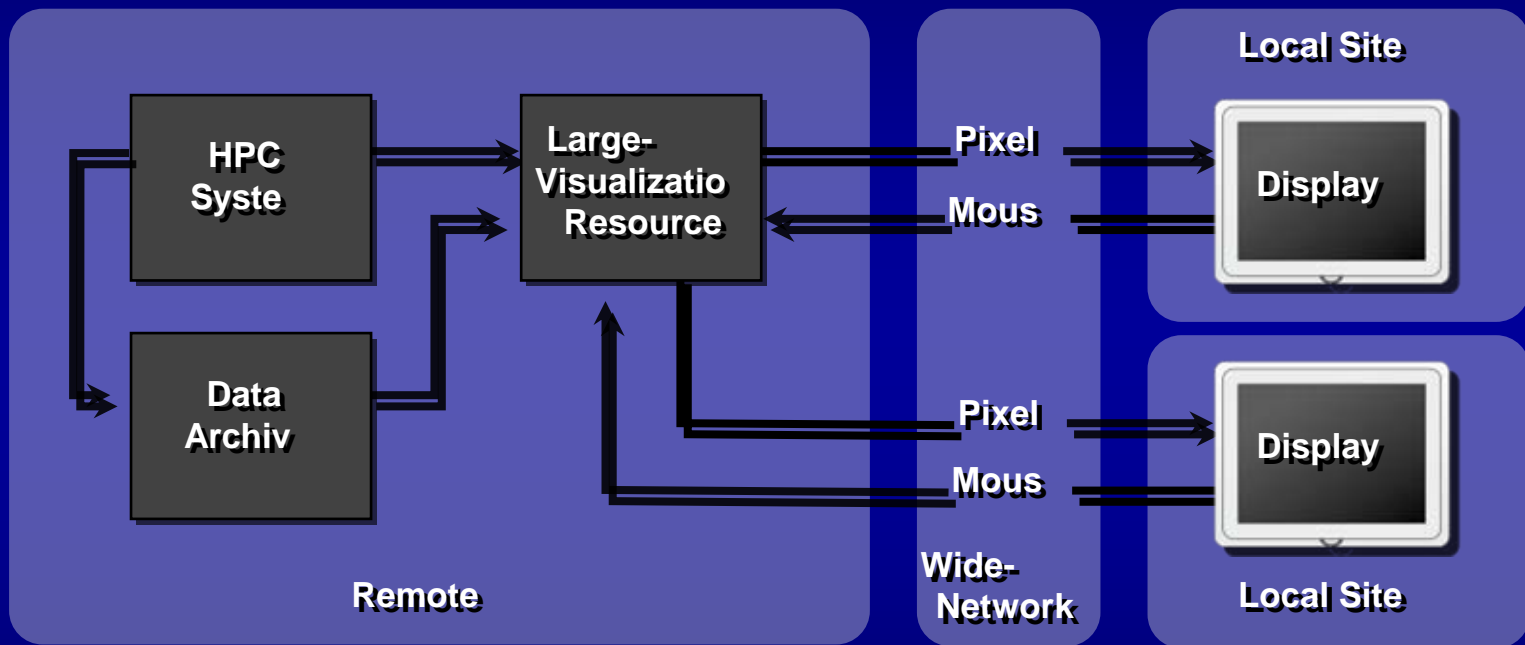


New Model Remote Capability



New Model

Multi-User and Collaborative Capability



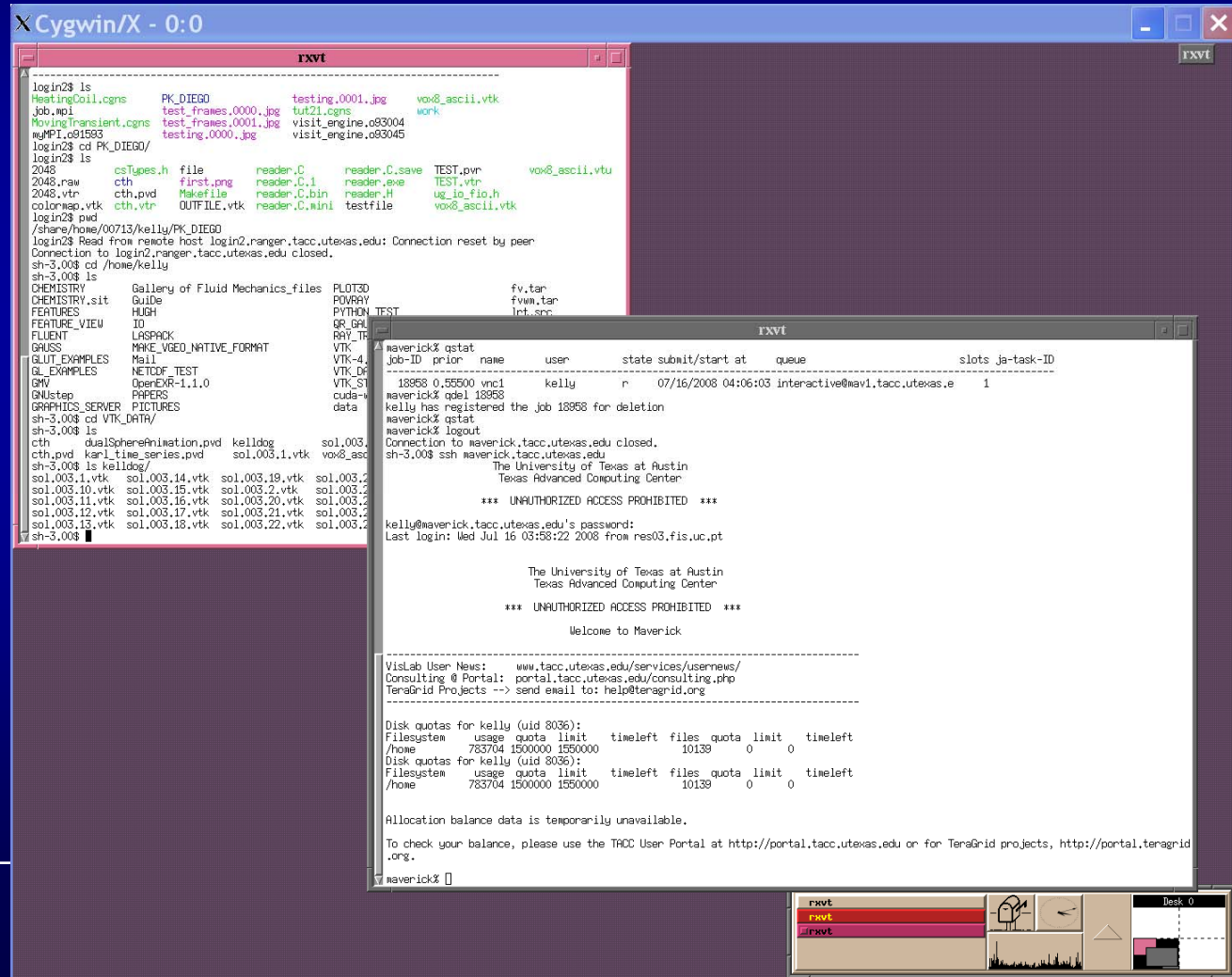
Starting a Remote Visualization Job on Maverick (Lab Exercise)

Step 1: Download a vnc client. Recommended option
is TurboVNC which can be downloaded from:

<http://www.virtualgl.org/Downloads/TurboVNC>

Starting a Remote Visualization Job on Maverick (Lab Exercise)

Step 2: ssh maverick.tacc.utexas.edu



```
Cygwin/X - 0:0
login2$ ls
HeatingCoil.cgns      PK_DIEGO      testing.0001.jpg    vox8_ascii.vtk
job.wpl               test_frames.0000.jpg  tut21.cgns         work
MovingTransient.cgns  test_frames.0001.jpg  visit_engine.093004
myMPI.091593          testing.0000.jpg     visit_engine.093045
login2$ cd PK_DIEGO/
login2$ ls
2048      csTypes.h  file      reader.C      reader.C.save  TEST.pvr      vox8_ascii.vtu
2048.raw  cth        first.png  reader.C.i    reader.exe     TEST.vtr
2048.vtr  cth.pvd    Makefile  reader.C.bin  reader.H       ug_io_fio.h
colormap.vtk  cth.vtr    OUTFILE.vtk  reader.C.mini  testfile      vox8_ascii.vtk
login2$ pwd
/home/kelly/00713/kelly/PK_DIEGO
login2$ Read from remote host login2.ranger.tacc.utexas.edu: Connection reset by peer
Connection to login2.ranger.tacc.utexas.edu closed.
sh-3.00$ cd /home/kelly
sh-3.00$ ls
CHEMISTRY      Gallery of Fluid Mechanics_files  PLOT3D      fv.tar
CHEMISTRY.sit  Guide                             POVRAY
FEATURES       HUGH                              PYTHON TEST  fwm.tar
FEATURE_VUE    ID                                GR_GAU      lnt.spc
FLUENT         LASPACK                           RAY.TR
GAUSS          MAKE_VGED_NATIVE_FORMAT          VTK-
GLUT_EXAMPLES  Mail                             VTK-4.
GL_EXAMPLES    NETCDF_TEST                      VTK_Df
GWS            OpenEXR-1.1.0                   VTK_ST
GWS            PAPERS                           cuda
GWS            PICTURES                        data
GRAPHICS_SERVER
sh-3.00$ cd VTK_DATA/
sh-3.00$ ls
cth      dualSphereAnimation.pvd  kelldog      sol.003.1.vtk  vox8_ascii.vtk
cth.pvd  karl_line_series.pvd    sol.003.1.vtk
sh-3.00$ ls kelldog/
sol.003.1.vtk  sol.003.14.vtk  sol.003.19.vtk  sol.003.2
sol.003.10.vtk  sol.003.15.vtk  sol.003.2.vtk  sol.003.2
sol.003.11.vtk  sol.003.16.vtk  sol.003.20.vtk  sol.003.2
sol.003.12.vtk  sol.003.17.vtk  sol.003.21.vtk  sol.003.2
sol.003.13.vtk  sol.003.18.vtk  sol.003.22.vtk  sol.003.2
sh-3.00$
```

```
maverick% qstat
Job-ID prior name user state submit/start at queue slots ja-task-ID
-----
18953 0.55500 vnc1 kelly r 07/16/2008 04:06:03 interactive@mav1.tacc.utexas.e 1
maverick% qdel 18953
kelly has registered the job 18953 for deletion
maverick% qstat
maverick% logout
Connection to maverick.tacc.utexas.edu closed.
sh-3.00$ ssh maverick.tacc.utexas.edu
The University of Texas at Austin
Texas Advanced Computing Center

*** UNAUTHORIZED ACCESS PROHIBITED ***

kelly@maverick.tacc.utexas.edu's password:
Last login: Wed Jul 16 03:58:22 2008 from res03.fis.uc.pt

The University of Texas at Austin
Texas Advanced Computing Center

*** UNAUTHORIZED ACCESS PROHIBITED ***

Welcome to Maverick

-----
VisLab User News: www.tacc.utexas.edu/services/usernews/
Consulting @ Portal: portal.tacc.utexas.edu/consulting.php
TeraGrid Projects --> send email to: help@teragrid.org

-----
Disk quotas for kelly (uid 8036):
Filesystem usage quota limit timeleft files quota limit timeleft
/home 783704 1500000 1550000 10139 0 0
Disk quotas for kelly (uid 8036):
Filesystem usage quota limit timeleft files quota limit timeleft
/home 783704 1500000 1550000 10139 0 0

Allocation balance data is temporarily unavailable.

To check your balance, please use the TACC User Portal at http://portal.tacc.utexas.edu or for TeraGrid projects, http://portal.teragrid.org.

maverick%
```

Starting a Remote Visualization Job on Maverick (Lab Exercise)

Step 3: On maverick, set up your vnc password. This only needs to be done once, but is attached to the machine you are currently logged into.

Type 'vncpasswd' and hit return. This will prompt you for a password. Type in something that you can easily remember and hit enter. You will then be asked to verify the password.

Step 4: type

qsub = Method to submit job to the queue

-l h_rt=1:00:00 sets the job run time to 1 hour

-l gfx=1 requests 1 graphics card

/usr/local/qsub/RUN.vnc is the script to start the vnc session



Starting a Remote Visualization Job on Maverick (Lab Exercise)

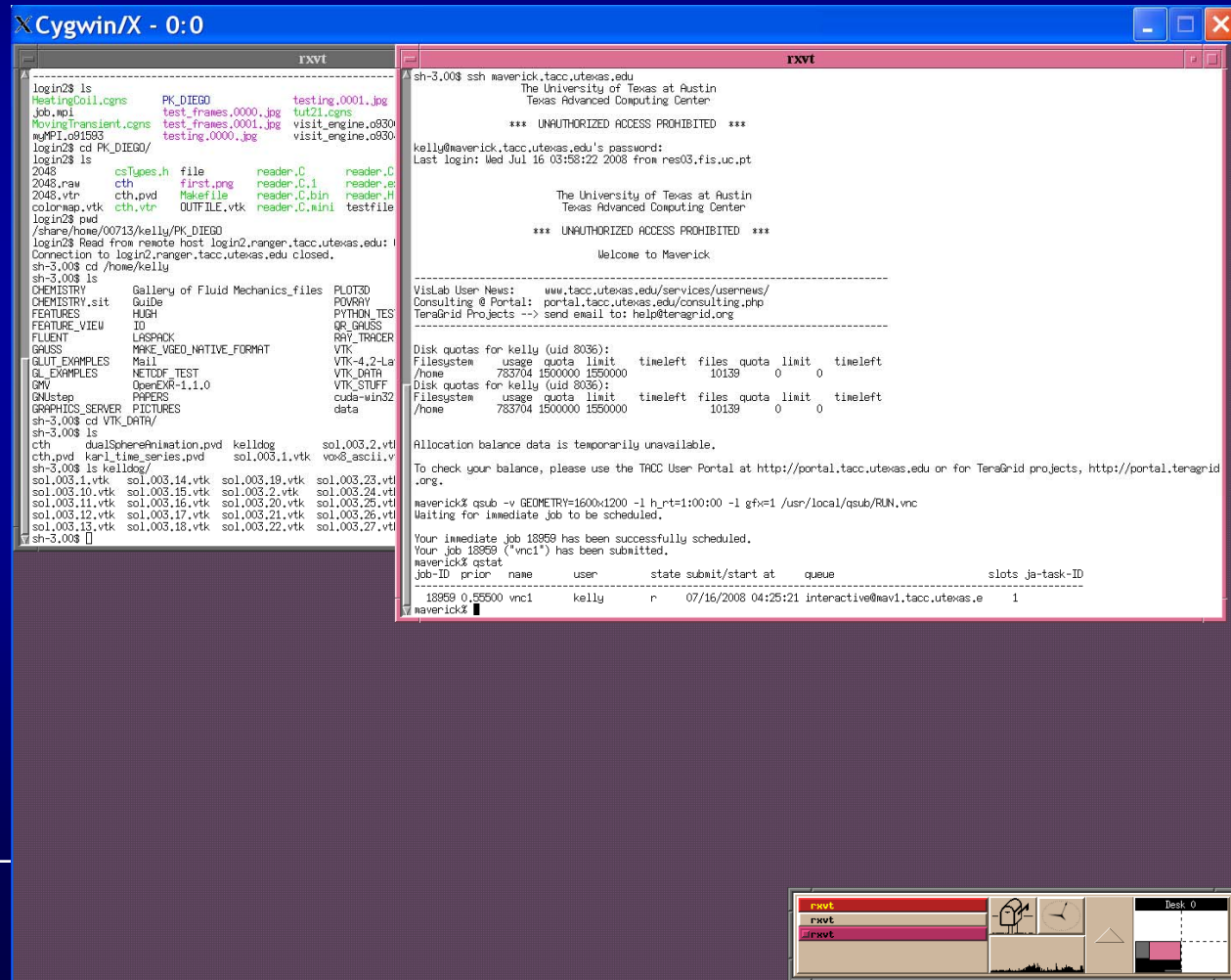
Step 5: type 'qstat' to see the status of your job

q = job is still queued

t = job is still being transferred to the SGE manager

e = job has errored out and possible causes can be found in the file vnc.log in your home directory

r = job is running



```
Cygwin/X - 0:0
login2$ ls
heatingCoil.cgns      PK_DIEGO      testing.0001.jpg
job.mp1               test_frames.0000.jpg  tut21.cgns
movingTransient.cgns  test_frames.0001.jpg  visit_engine.o930
myMPI.o91593          testing.0000.jpg      visit_engine.o930
login2$ cd PK_DIEGO/
login2$ ls
2048.ctypes.h         file           reader.C        reader.C
2048.raw              cth            first.png       reader.C.1      reader.e
2048.vtr              cth.pvd        Makefile        reader.C.bin    reader.H
colorMap.vtk          cth.vtr        OUTFILE.vtk     reader.C.mini   testfile
login2$ pwd
/shane/home/00713/kelly/PK_DIEGO
login2$ Read from remote host login2.ranger.tacc.utexas.edu:
Connection to login2.ranger.tacc.utexas.edu closed.
sh-3.00$ cd /home/kelly
sh-3.00$ ls
CHEMISTRY      Gallery of Fluid Mechanics_files  PLOT3D
CHEMISTRY.sit  Guide                             POVRAY
FEATURES       HUGH                              PYTHON_TES
FEATURE_VIEW   ID                                QR_GAUSS
FLUENT         LASPACK                           RAY_TRACER
GAUSS          MAKE_VGED_NATIVE_FORMAT          VTK
GLUT_EXAMPLES Mail                             VTK-4.2-La
SL_EXAMPLES   NETCDF_TEST                      VTK_DATA
QW            OpenEXR-1.1.0                   VTK_STUFF
QWstep        PAPERS                           cuda-win32
GRAPHICS_SERVER PICTURES                        data
sh-3.00$ cd VTK_DATA/
sh-3.00$ ls
cth      dualSphereAnimation.pvd  kelldog      sol.003.2.vtk
cth.pvd  karl_time_series.pvd    sol.003.1.vtk  vox8_ascii.v
sh-3.00$ ls kelldog/
sol.003.1.vtk  sol.003.14.vtk  sol.003.19.vtk  sol.003.23.vtk
sol.003.10.vtk sol.003.15.vtk  sol.003.2.vtk  sol.003.24.vtk
sol.003.11.vtk sol.003.16.vtk  sol.003.20.vtk sol.003.25.vtk
sol.003.12.vtk sol.003.17.vtk  sol.003.21.vtk sol.003.26.vtk
sol.003.13.vtk sol.003.18.vtk  sol.003.22.vtk sol.003.27.vtk
sh-3.00$

sh-3.00$ ssh maverick.tacc.utexas.edu
The University of Texas at Austin
Texas Advanced Computing Center

*** UNAUTHORIZED ACCESS PROHIBITED ***

kelly@maverick.tacc.utexas.edu's password:
Last login: Wed Jul 16 03:58:22 2008 from res03.fis.uc.pt

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Welcome to Maverick

-----
VisLab User News: www.tacc.utexas.edu/services/usernews/
Consulting @ Portal: portal.tacc.utexas.edu/consulting.php
TeraGrid Projects --> send email to: help@teragrid.org
-----

Disk quotas for kelly (uid 8036):
Filesystem          usage quota limit   timeleft files quota limit   timeleft
/home               783704 1500000 1550000      10139      0      0
Disk quotas for kelly (uid 8036):
Filesystem          usage quota limit   timeleft files quota limit   timeleft
/home               783704 1500000 1550000      10139      0      0

Allocation balance data is temporarily unavailable.

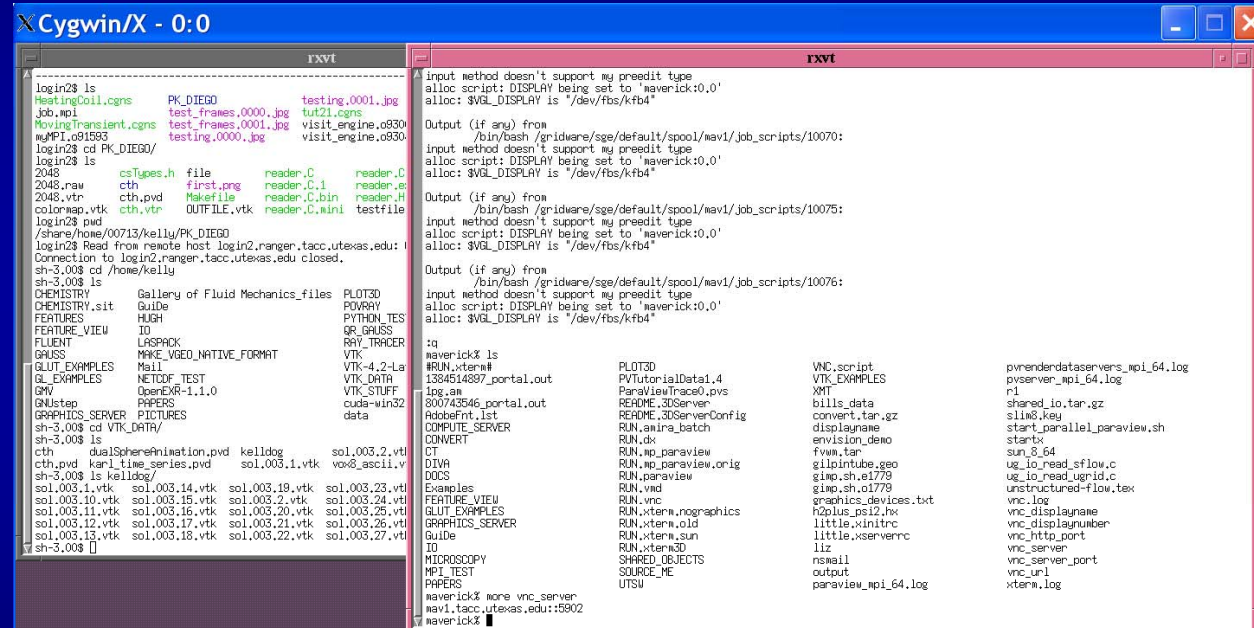
To check your balance, please use the TACC User Portal at http://portal.tacc.utexas.edu or for TeraGrid projects, http://portal.teragrid.org.

maverick% qsub -v GEOMETRY=1600x1200 -l h_rt=1:00:00 -l gfs=1 /usr/local/qsub/RUN.vnc
Waiting for immediate job to be scheduled.

Your immediate job 18959 has been successfully scheduled.
Your job 18959 ("vnc1") has been submitted.
maverick% qstat
job-ID prior    name     user      state submit/start at   queue                          slots ja-task-ID
-----
18959 0.55500 vnc1     kelly     r      07/16/2008 04:25:21 interactive@nav1.tacc.utexas.e 1
maverick%
```

Step 6: Find the display that your job is running on by looking in the file `vnc_server` in your home directory

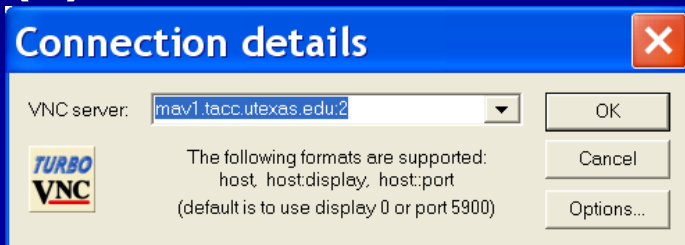
**This tells you to connect to
display 2 on
mav1.tacc.utexas.edu**



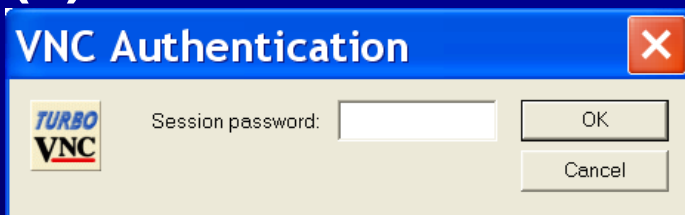
Starting a Remote Visualization Job on Maverick (Lab Exercise)

Step 7: Connect to that display by using a vnc client

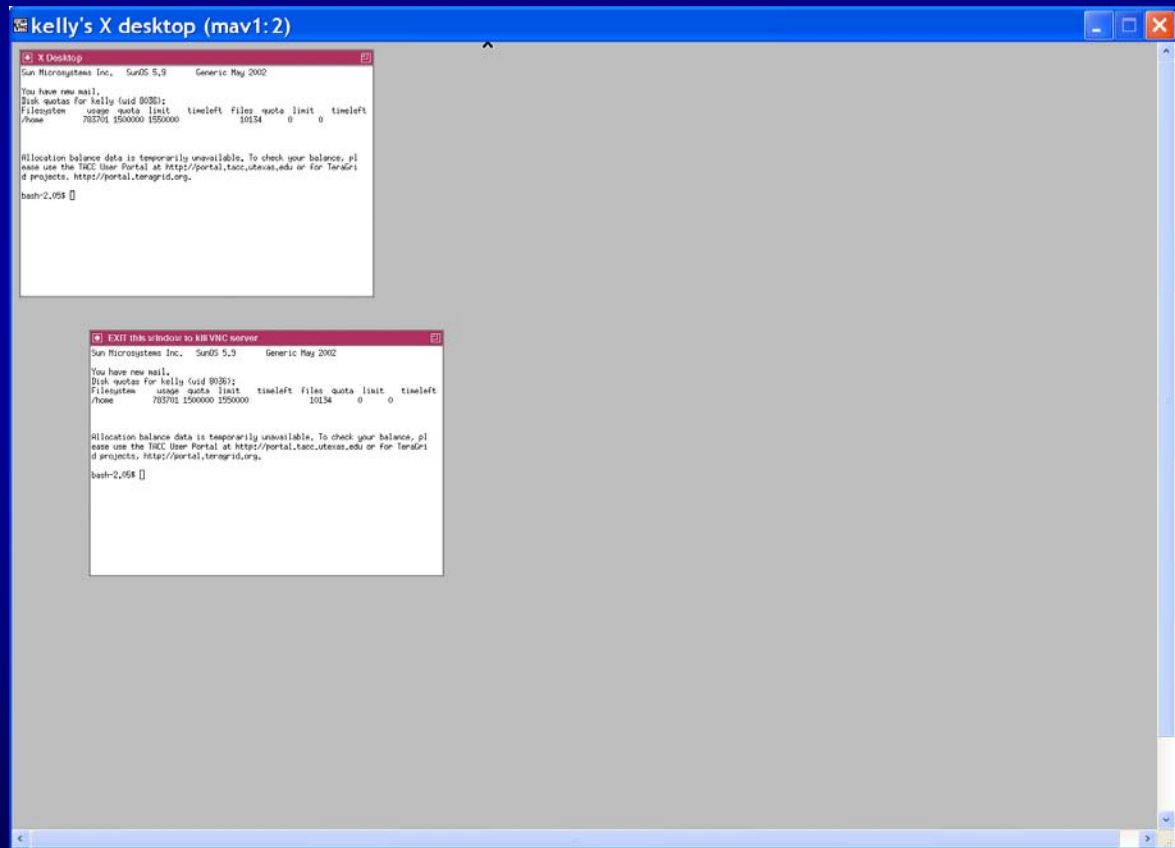
(1)



(2)



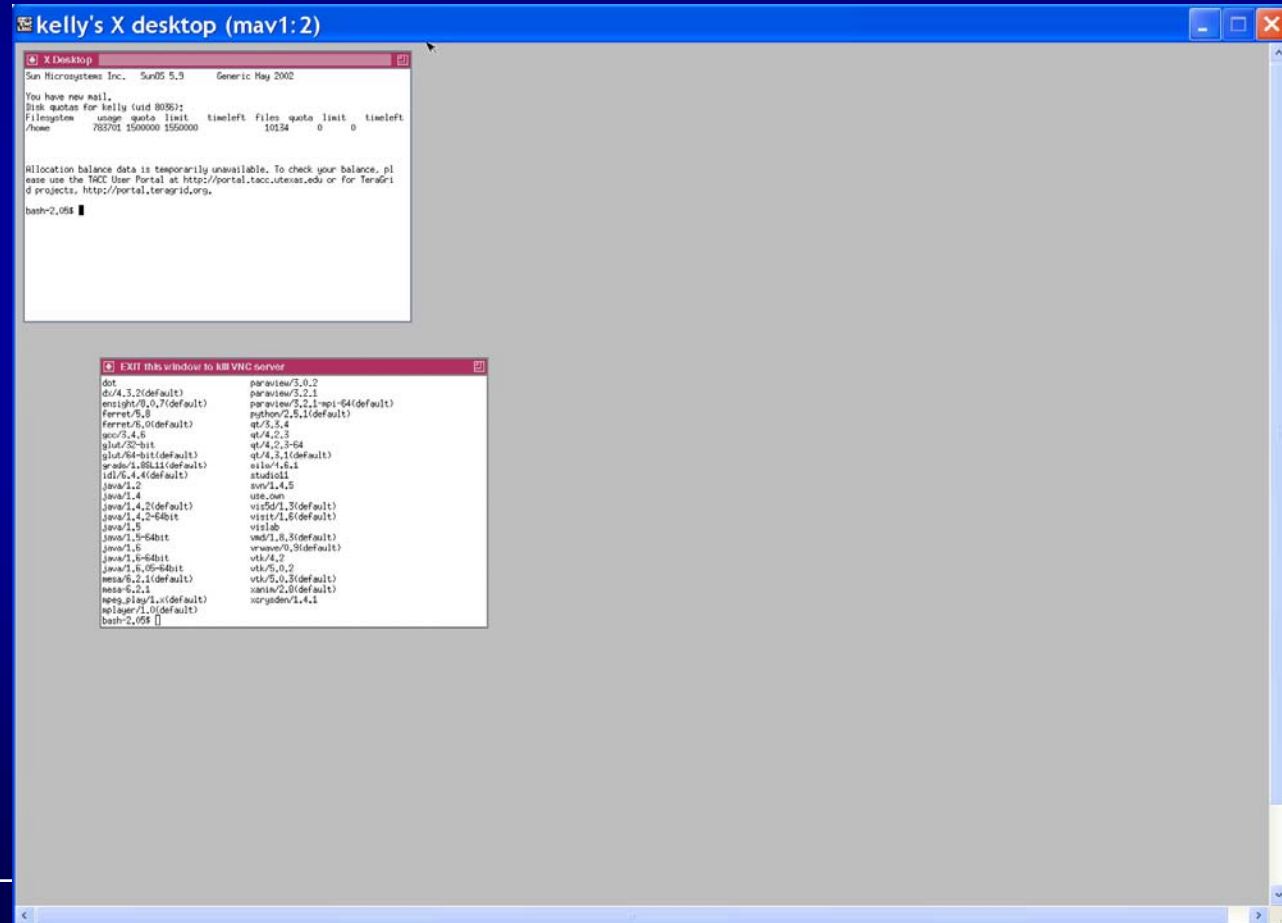
(3)



Starting a Remote Visualization Job on Maverick (Lab Exercise)

Step 8: Type 'module avail' in the xterm.

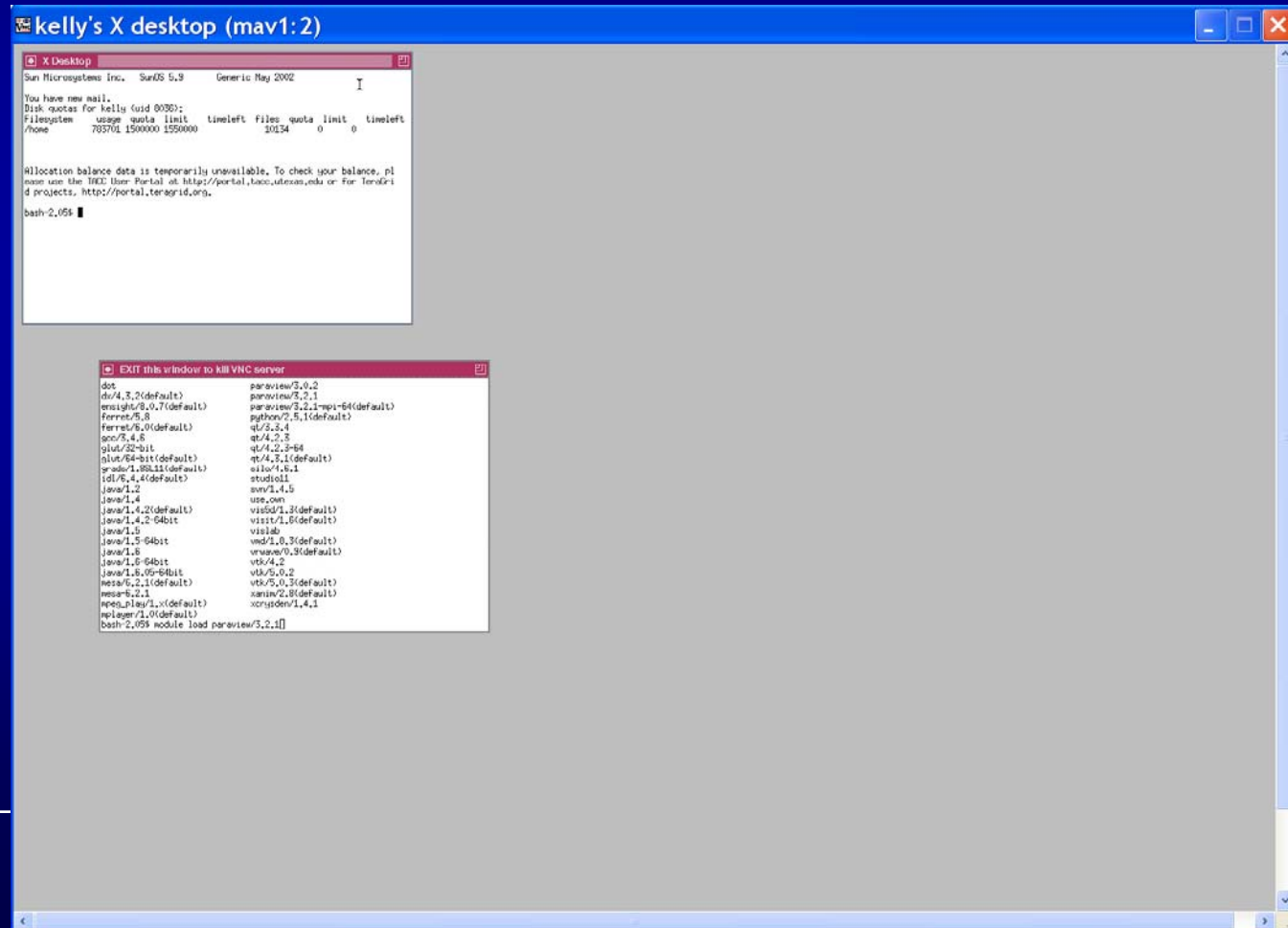
This will tell you which
programs are available to load
and run.



Starting a Remote Visualization Job on Maverick (Lab Exercise)

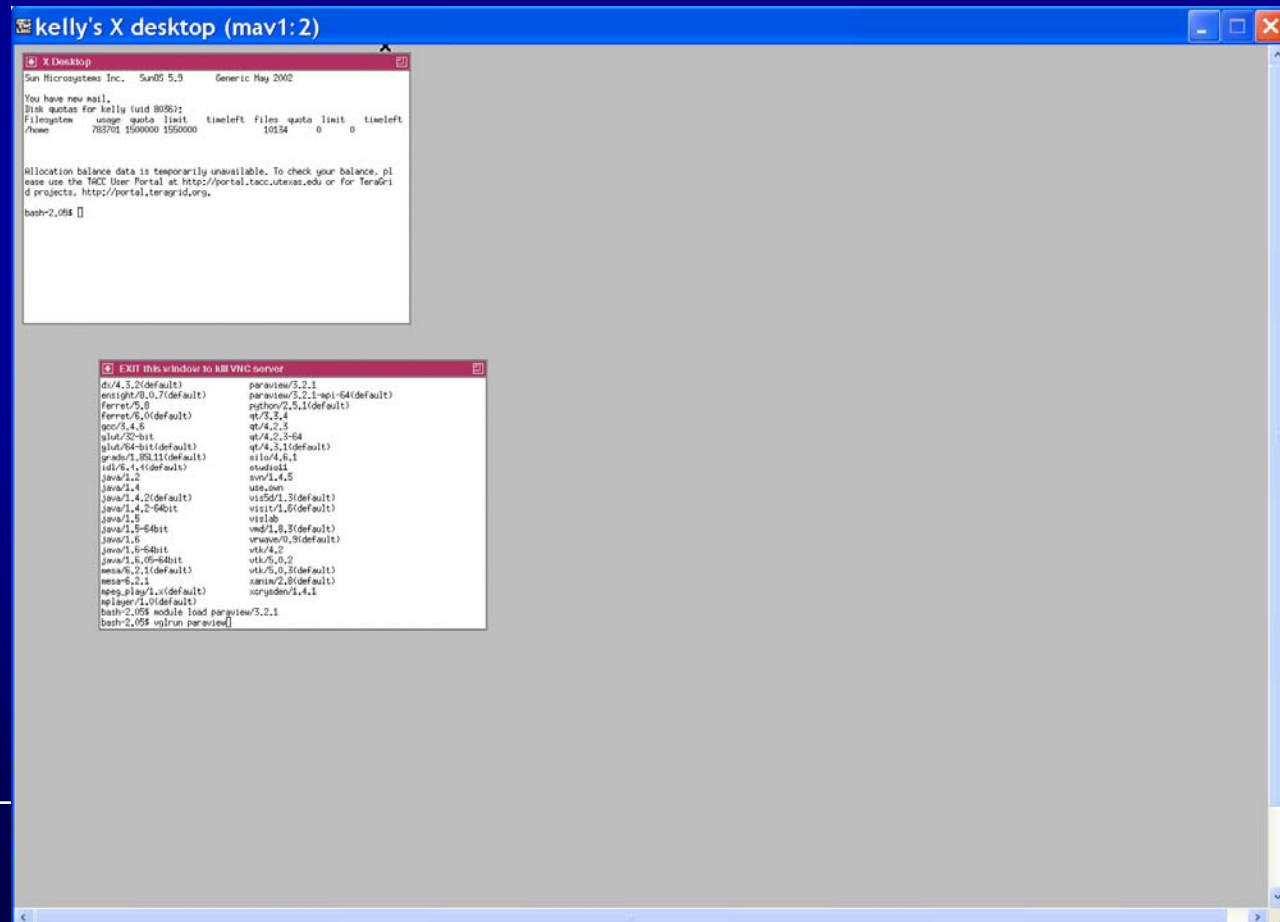
Step 9: Type 'module load paraview/3.2.1'

This will load paraview 3.2.1
and make it available for
running.

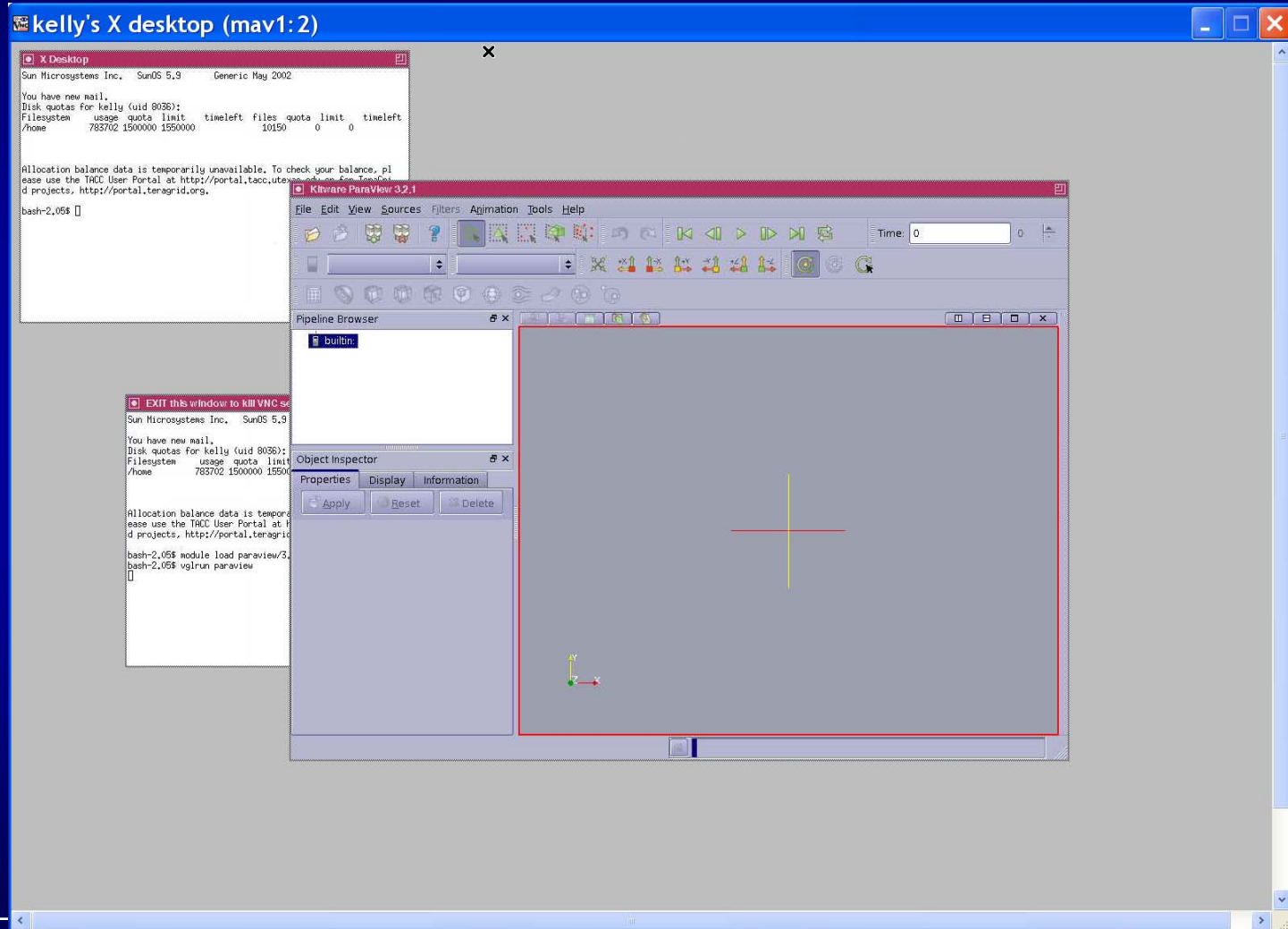


Starting a Remote Visualization Job on Maverick (Lab Exercise)

Step 10: Type 'vglrun paraview'. vglrun is necessary to run any OpenGL based applications through the vnc viewer.

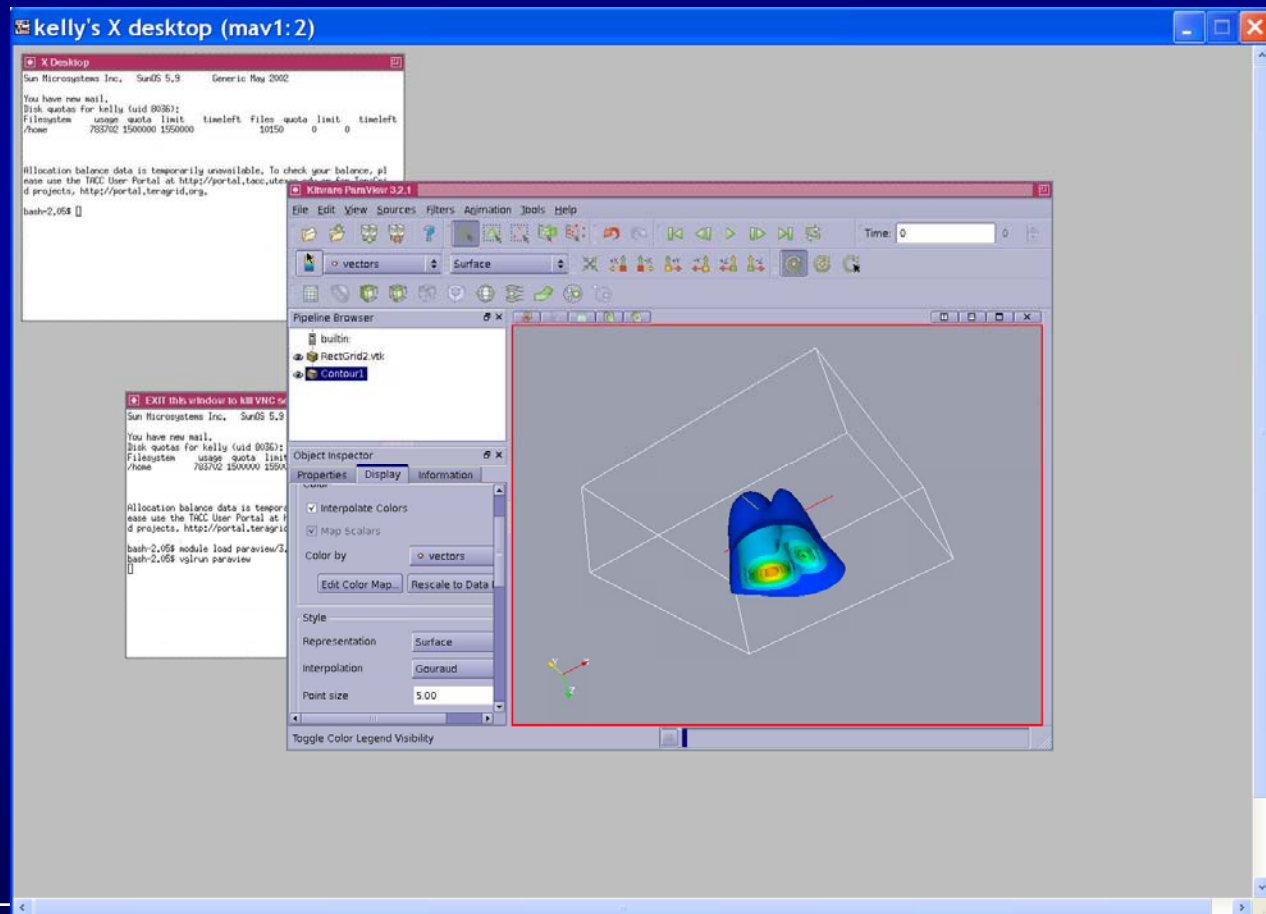


Starting a Remote Visualization Job on Maverick (Lab Exercise)



Starting a Remote Visualization Job on Maverick (Lab Exercise)

Step 11: Load the RectGrid2.vtk dataset. It can be found in /work/utexas/staff/kelly/PORTUGAL



Starting a Remote Visualization Job on Maverick (Lab Exercise)

Step 12: You can also view through a web browser. The web address can be found in vnc_url in your home directory.

The screenshot displays a remote desktop session titled "kelly's X desktop (mav1:2) - Mozilla Firefox". The browser window shows the URL `http://mav1.tacc.utexas.edu:5802/` and a TACC portal page. Overlaid on the browser is the Kltware ParaView 3.2.1 application. The ParaView interface includes a Pipeline Browser with "builtin", "RectGrid2.vtk", and "Contour1" (selected). The Object Inspector shows "Interpolate Colors" and "Map Scalars" checked, with "Color by" set to "vectors". The main 3D view displays a blue and yellow contour plot within a wireframe box. A terminal window in the background shows system messages and a command prompt.

EXIT this window to kill VNC session

Sun Microsystems Inc. SunOS 5.9 Generic May 2002

You have new mail.

Disk quotas for kelly (uid 8036):

Filesystem	usage	quota	limit	timeleft	files	quota	limit	timeleft
/home	783702	1500000	1550000		10150	0	0	

Allocation balance data is temporarily unavailable. To check your balance, please use the TACC User Portal at <http://portal.tacc.utexas.edu> for TACC Grid projects, <http://portal.teragrid.org>.

bash-2.05\$

module load paraview/3.2.1

vglrun paraview

Applet VncViewer started

Topics Covered

- Remote and Collaborative Visualization
- **EnVision – simplified Interface for Visualization**
- Visualizing and Animating a Time Series in Paraview
- VisIt
- Parallel Visualization



EnVision: Web-Based Remote Scientific Visualization

EnVision Team: Greg P. Johnson, Stephen Mock, Greg S.

Motivation for EnVision

- Most visualization software takes significant time and effort to learn effectively
- EnVision was created with these audiences in mind:
 1. Computational scientists with little to no visualization experience
 2. Users who want to quickly import and visualize their data from anywhere

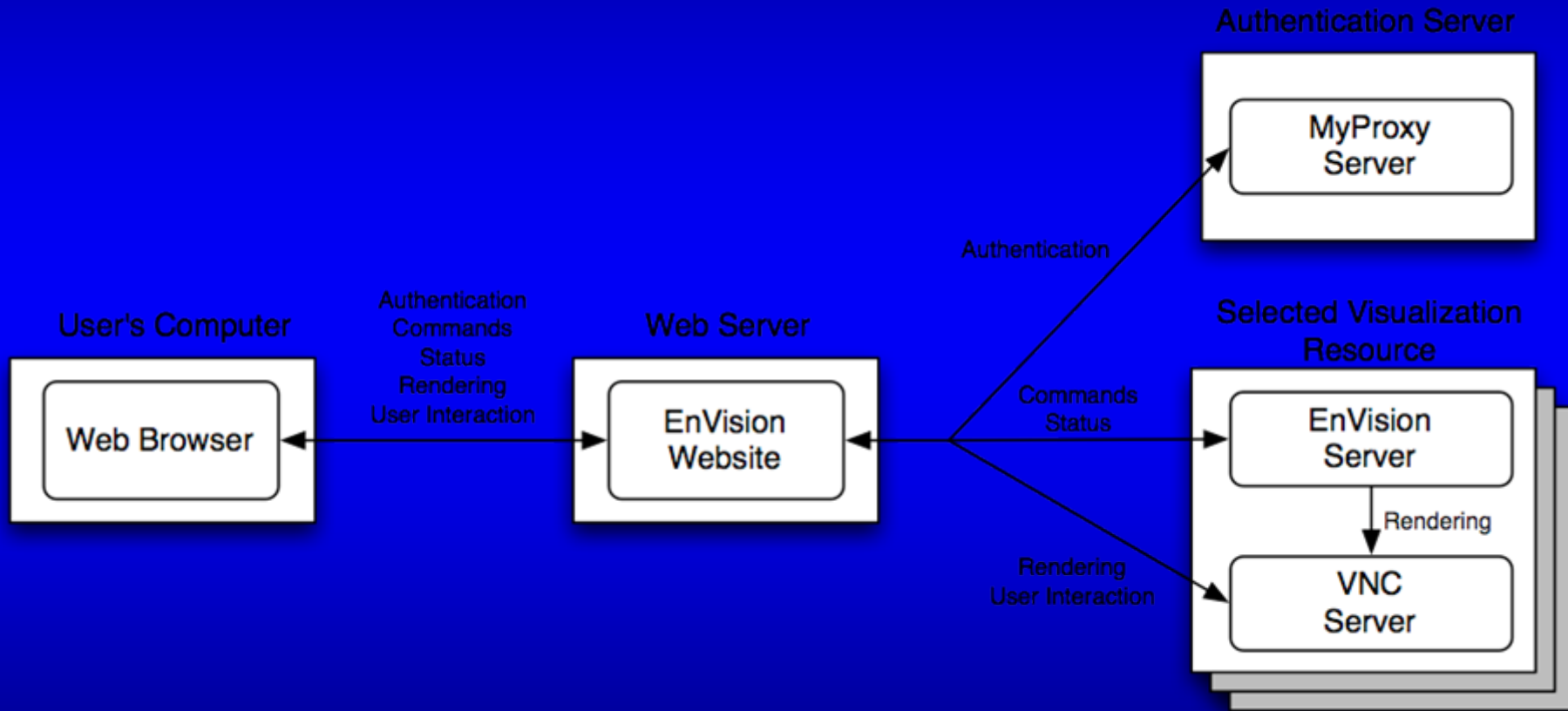
EnVision Goals: Simple, Intuitive, Immediate

- Web-based visualization application with a wizard-style interface
- Does not aim to supersede or replace current visualization applications
- Focus is on simplicity and ease-of-use
- Semi-automates the data importation process
- Presents visualization methods, with examples, that are applicable to their data set

EnVision Guides the User Through the Process

1. Authenticates user, shows visualization resources, and automatically starts a remote visualization job on selected resource
2. Imports data in nearly any format based on a series of intuitive questions
3. Presents user with examples of visualization methods to add
4. Builds the visualization using reasonable defaults for color mapping, etc.
5. Renders the visualization and allows user to interact with it and save snapshots

EnVision General Architecture



Current State and Future Plans

- Version 2.0b1 released June 9, 2008
- Current capabilities:
 - TACC Maverick visualization resource
 - supports any VTK formatted data set
 - structured and point arbitrarily formatted data importation through interview
 - basic visualization methods
- Future capabilities include:
 - additional visualization resources
 - additional visualization methods (e.g. volume rendering)
 - collaborative visualization sessions
 - unstructured arbitrarily formatted data importation through interview
 - automated data staging

EnVision Demo

<https://envision2.tacc.utexas.edu>

EnVision Demo

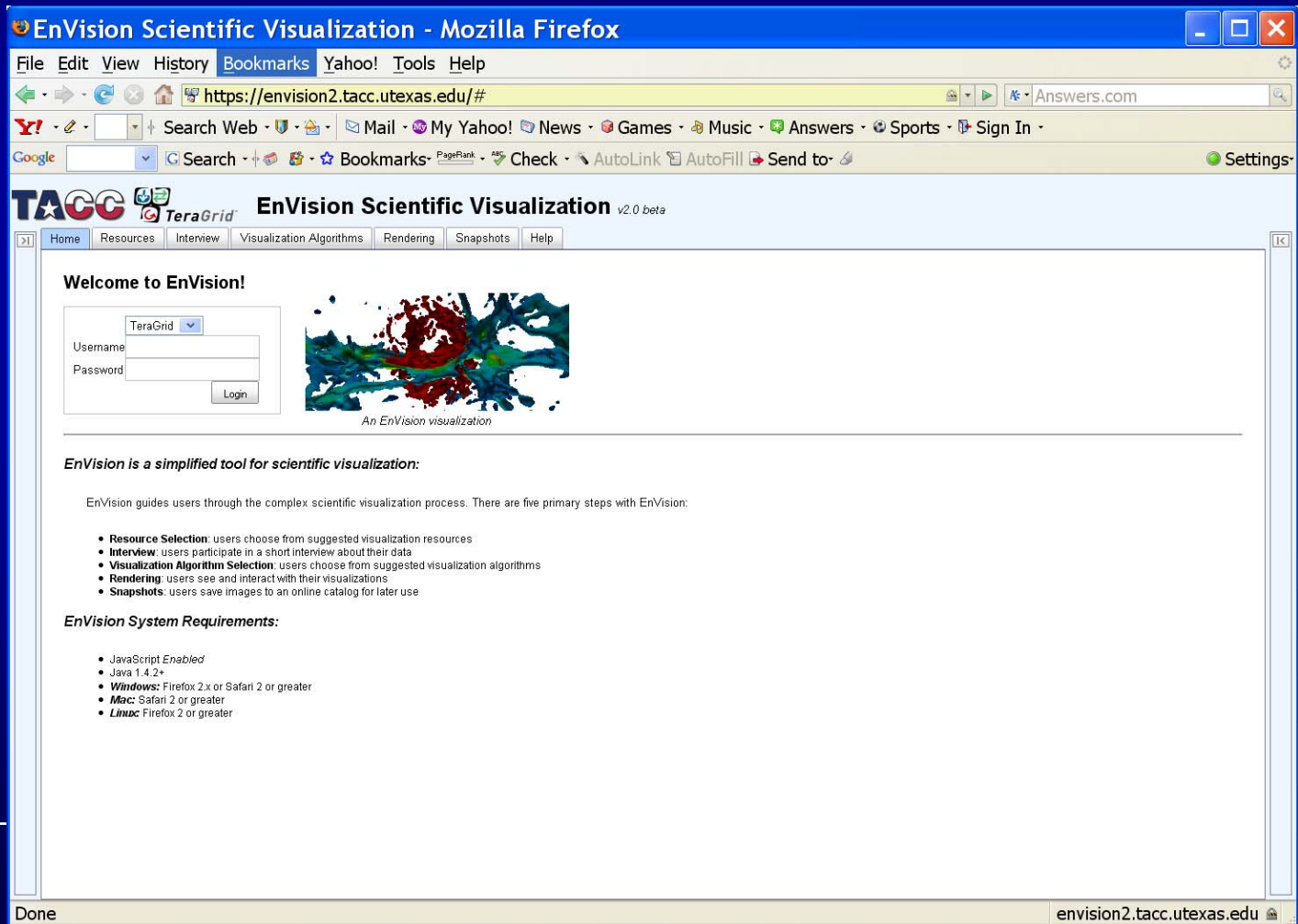
Step 1: Login in to your maverick account and type the following command:

```
cp -R ~train00/envision_demo ./
```

Then log out of maverick

EnVision Demo

Step 2: Login and authenticate: goto
<http://envision2.tacc.utexas.edu>



EnVision Demo

Step 3: Select the resource. (Maverick)

The screenshot shows a Mozilla Firefox browser window displaying the EnVision Scientific Visualization web application. The browser's address bar shows the URL `https://envision2.tacc.utexas.edu/#`. The application's header includes the TACC and TeraGrid logos, the title "EnVision Scientific Visualization v2.0 beta", and a user login "Dev:kelly | Logout". A navigation menu contains links for Home, Resources, Interview, Visualization Algorithms, Rendering, Snapshots, and Help. The main content area is titled "Select a Resource" and features a dropdown menu currently set to "Dev" and a "Select" button. Below this, under the heading "Available Resources:", there is a single resource listed: "Maverick". A detailed description of the Maverick system follows, stating it is a Sun E25K server with 64 dual-core 1.05 GHz UltraSPARC IV processors and 512 gigabytes of shared memory, providing access to 16 high-end graphics devices. A link to the "Maverick User Guide" is provided. The status bar at the bottom of the browser shows "Done" and the URL "envision2.tacc.utexas.edu".

EnVision Scientific Visualization - Mozilla Firefox

File Edit View History Bookmarks Yahoo! Tools Help

`https://envision2.tacc.utexas.edu/#` Answers.com

Search Web Mail My Yahoo! News Games Music Answers Sports Sign In

Google Search Bookmarks PageRank Check AutoLink AutoFill Send to Settings

TACC TeraGrid EnVision Scientific Visualization v2.0 beta Dev:kelly | Logout

Home Resources Interview Visualization Algorithms Rendering Snapshots Help

Select a Resource

Dev Select

Available Resources:

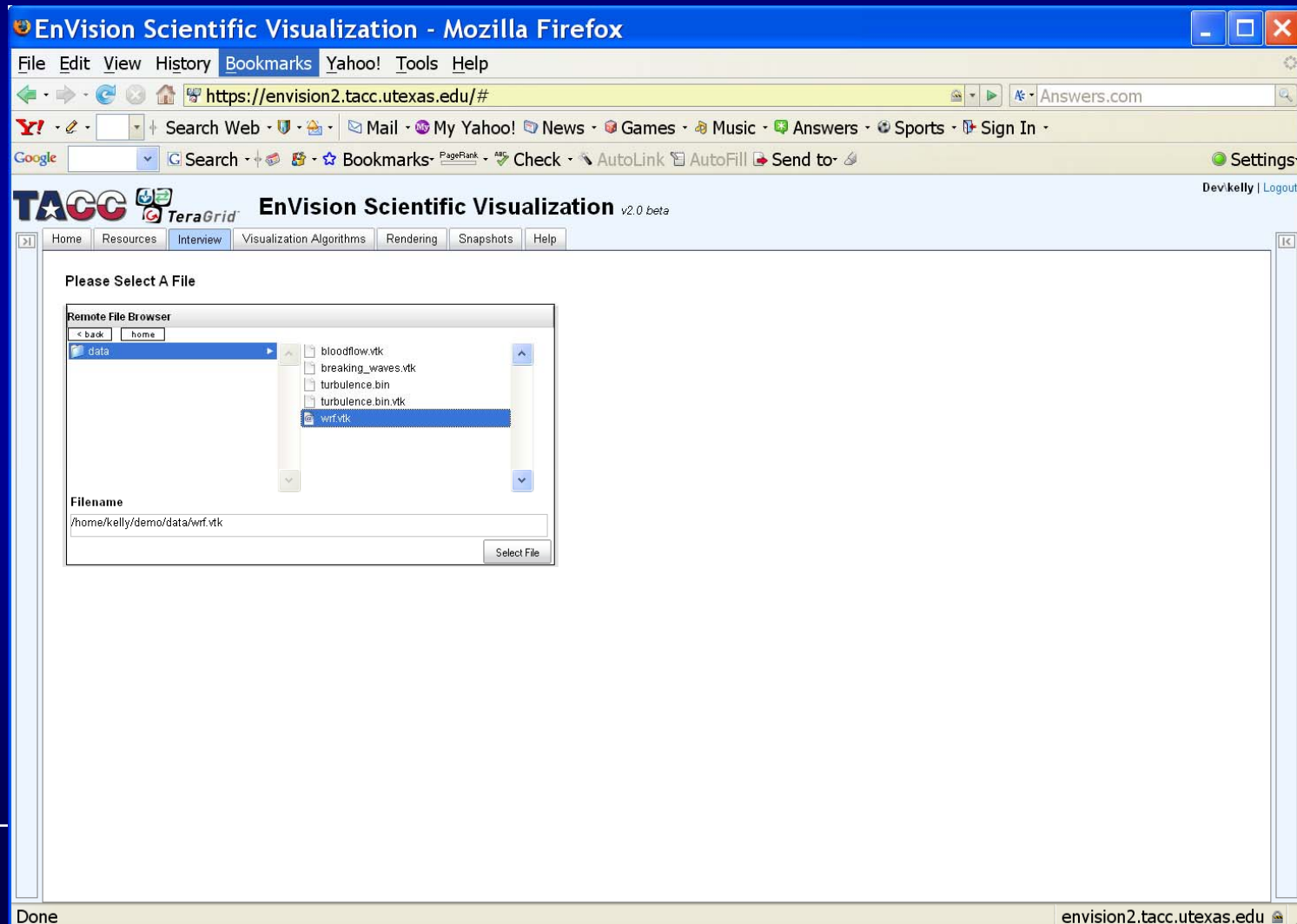
- Maverick

The Maverick terascale visualization system is a Sun E25K server with 64 dual-core 1.05 GHz UltraSPARC IV processors and 512 gigabytes of shared memory. Maverick provides users with access to 16 high-end graphics devices, and is available to TACC and TeraGrid users. For more detailed information on Maverick, please see the [Maverick User Guide](#).

Done envision2.tacc.utexas.edu

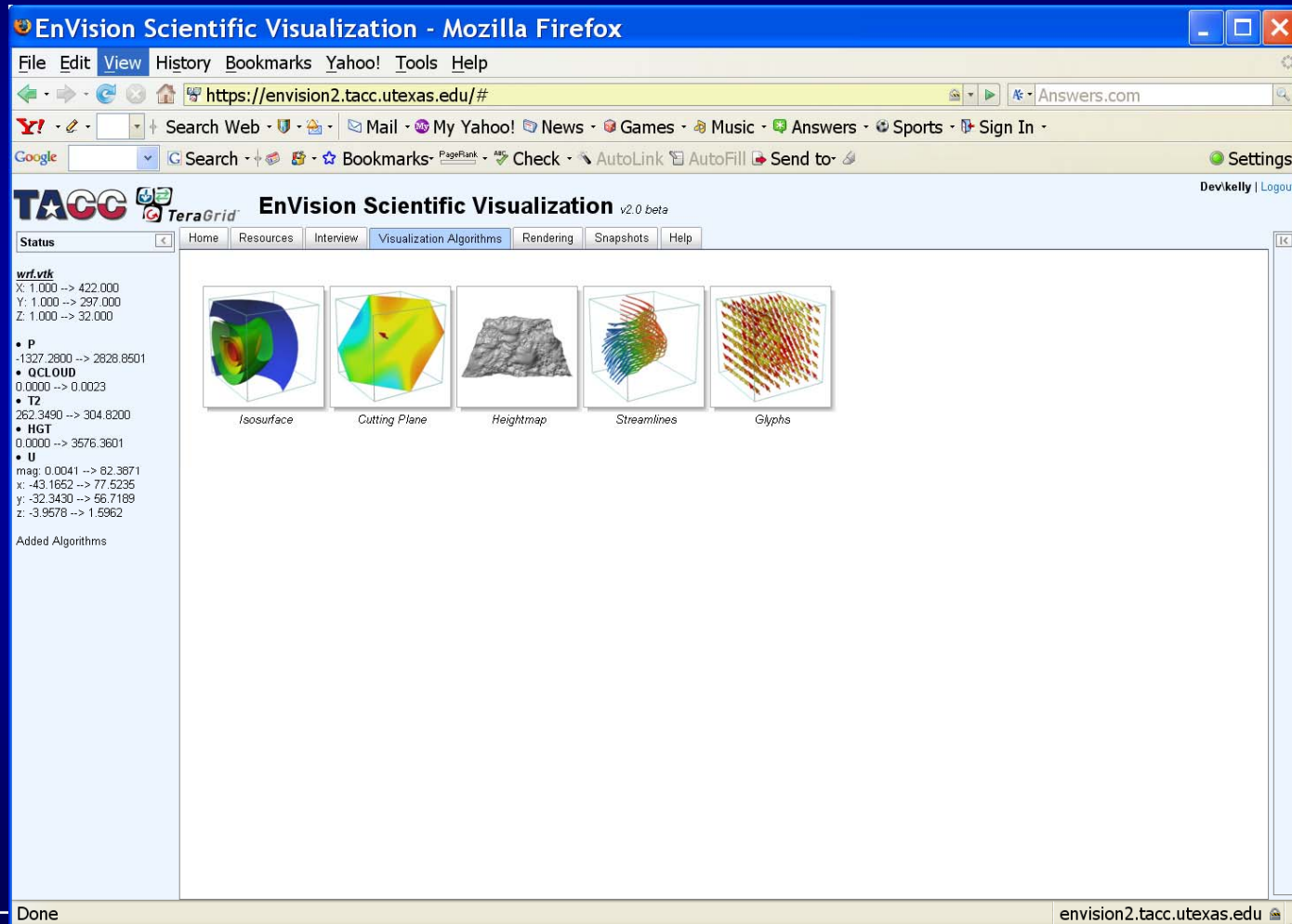
EnVision Demo

Step 4: Load the data.



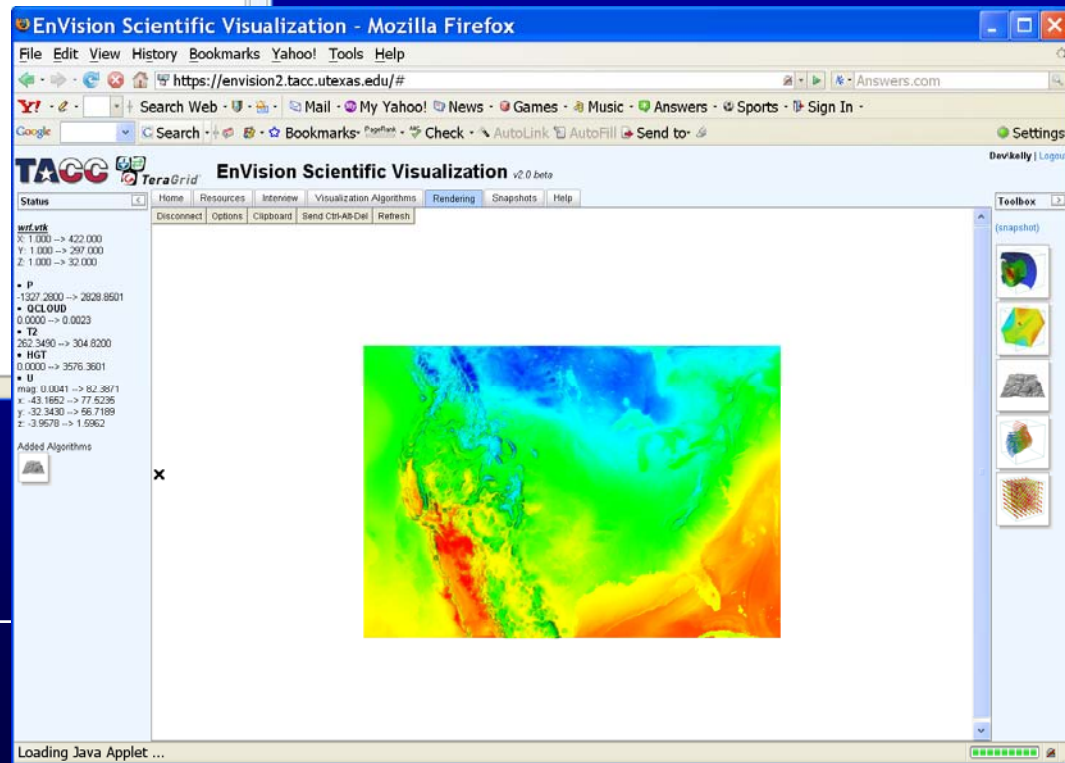
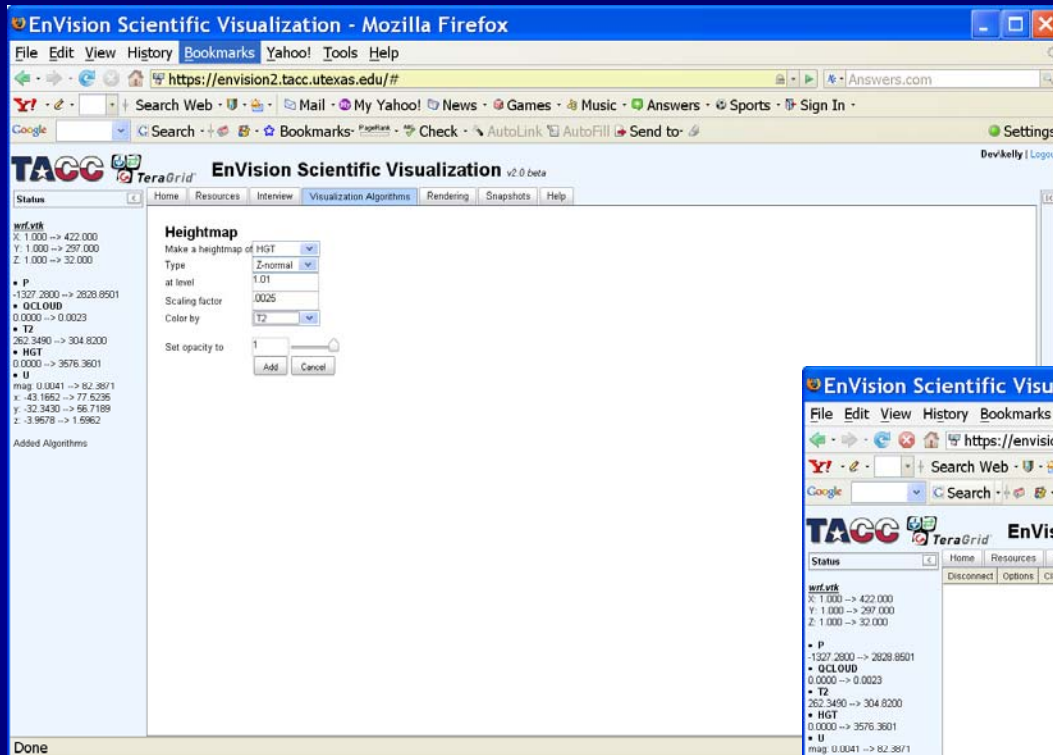
EnVision Demo

Step 5: Select the type of visualization you want to see.



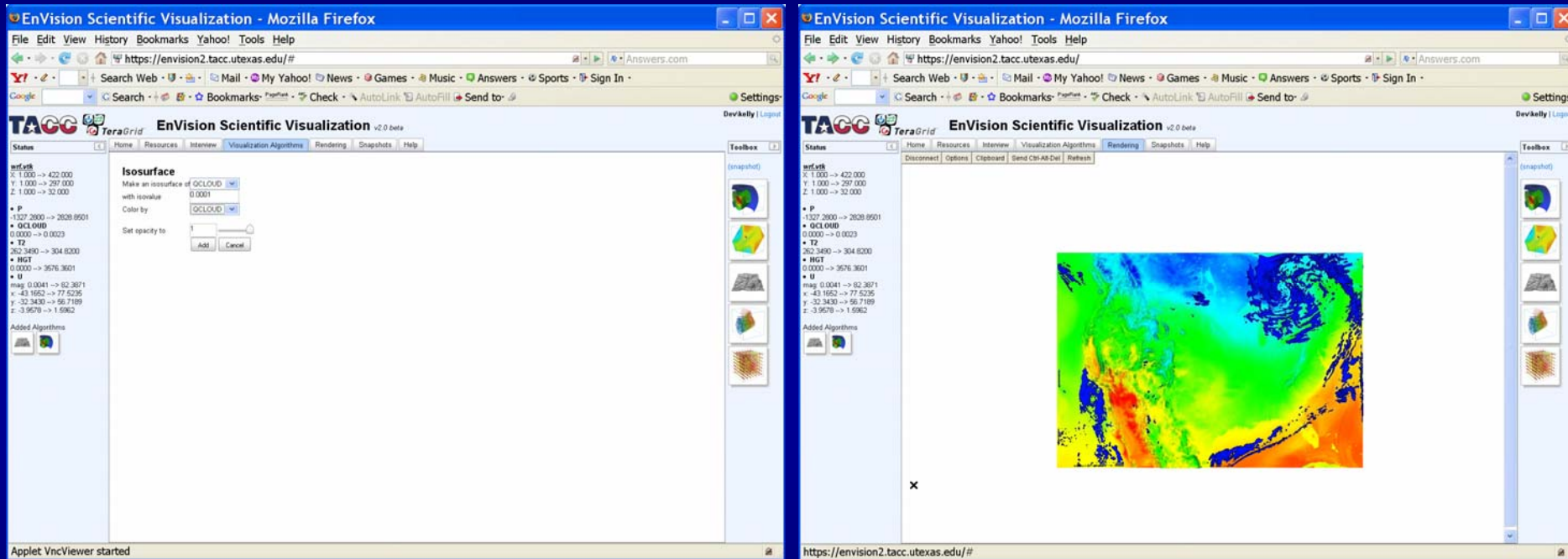
EnVision Demo

Step 6: Create a heightmap.



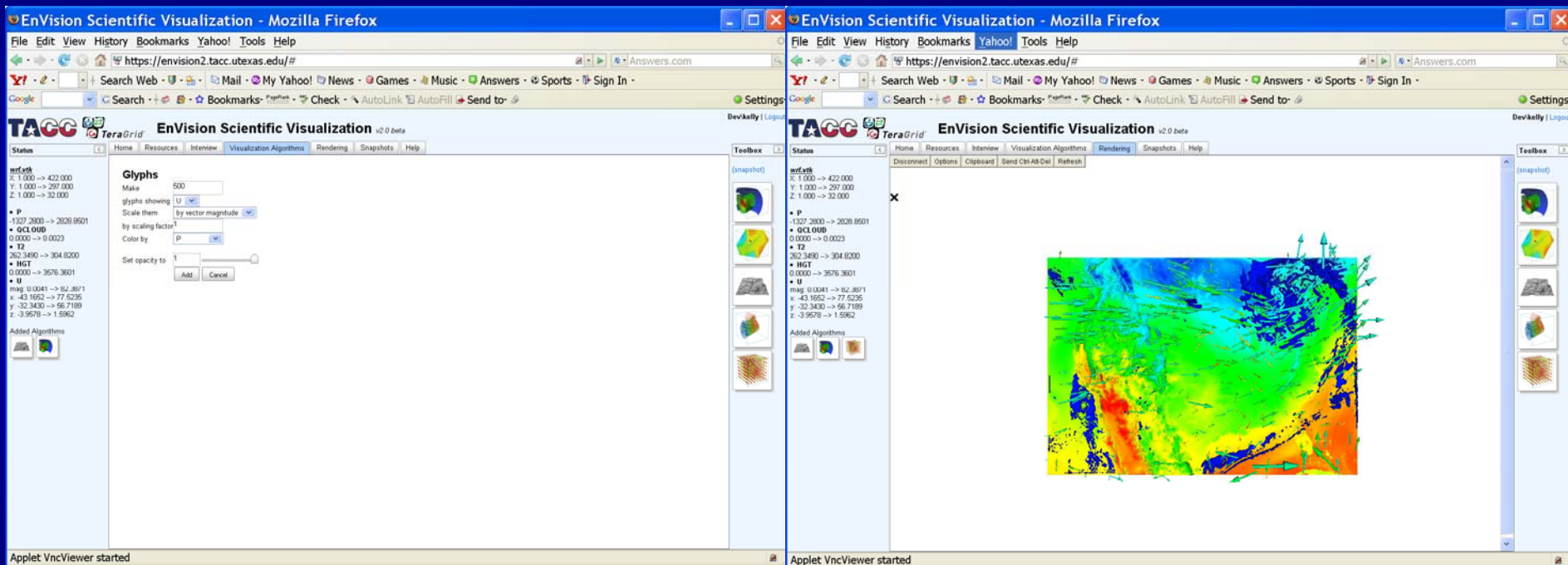
EnVision Demo

Step 7: Create an isosurface.



EnVision Demo

Step 8: Create glyphs.



Topics Covered

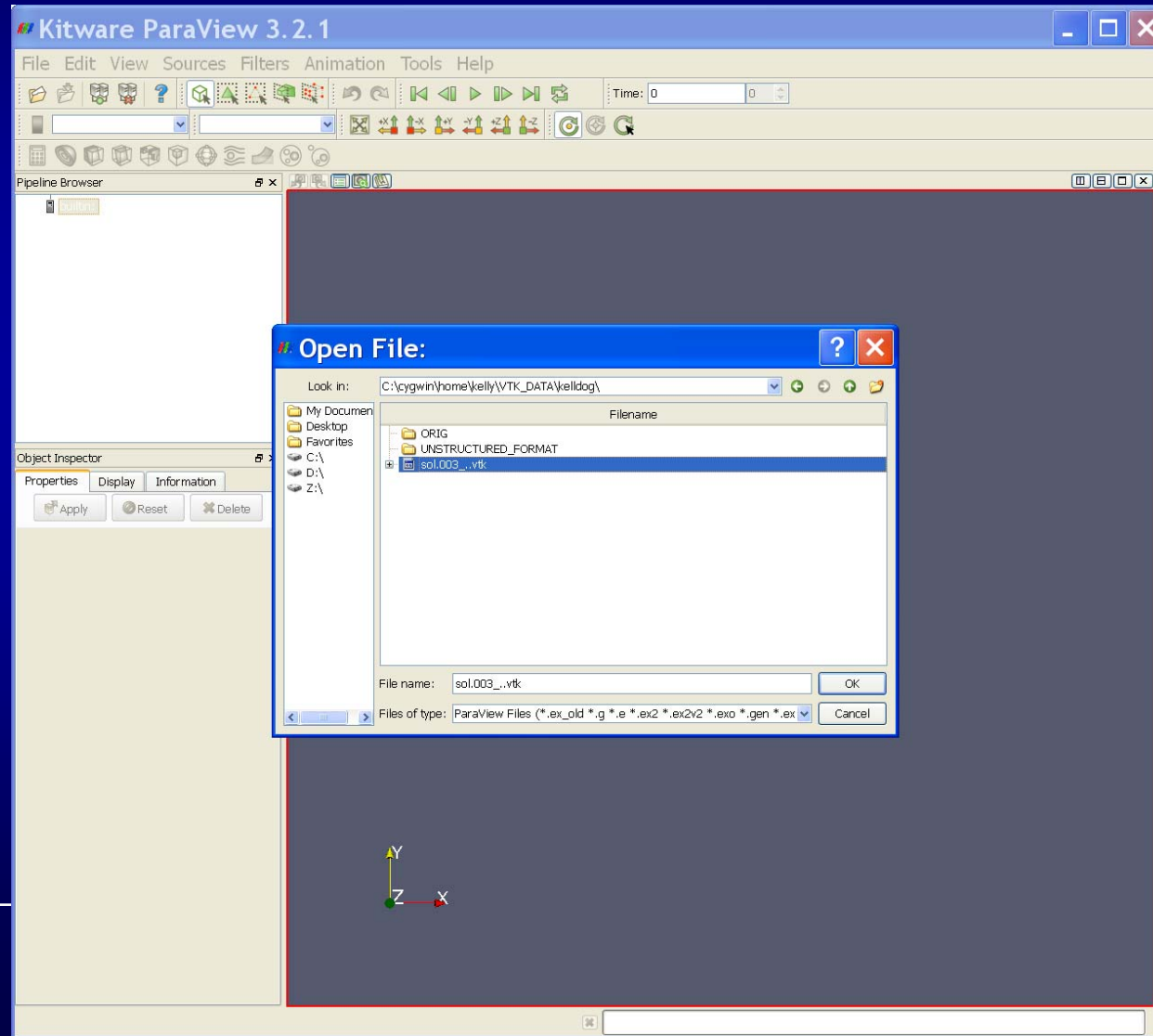
- Remote and Collaborative Visualization
- EnVision – simplified Interface for Visualization
- Visualizing and Animating a Time Series in Paraview
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- Parallel Visualization

Visualizing and Animating a Time Varying Dataset

- Download the data from your maverick account at `/work/utexas/staff/kelly/PORTUGAL/`
- The data is called `sol_data.tar.gz`
- gunzip the file: `gunzip sol_data.tar.gz`
- Untar the file: `tar -xvf sol_data.tar`
- This will produce a series of time steps

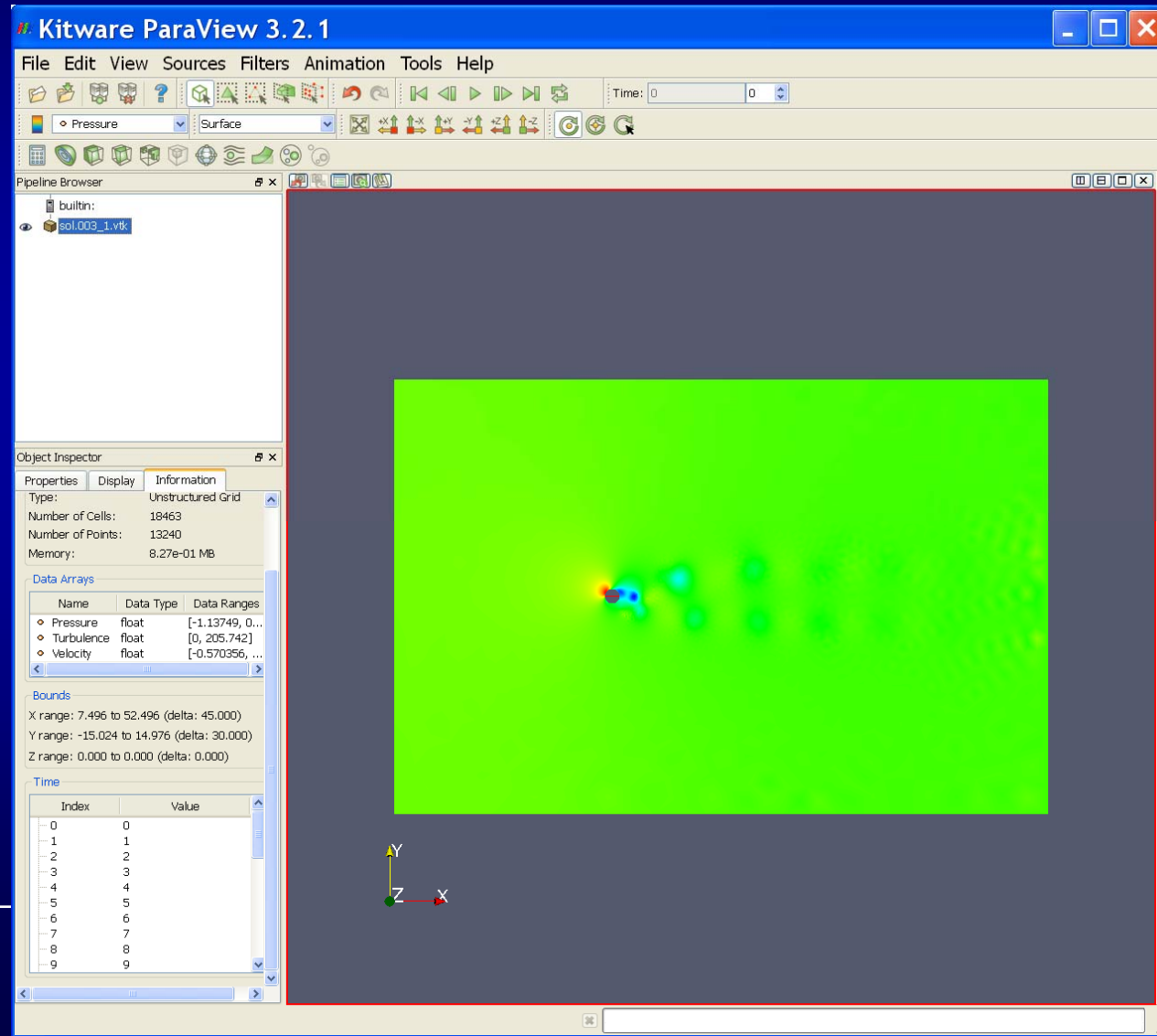
Visualizing and Animating a Time Varying Dataset

- Step 1: In paraview, locate the time series data, select it and load the data.



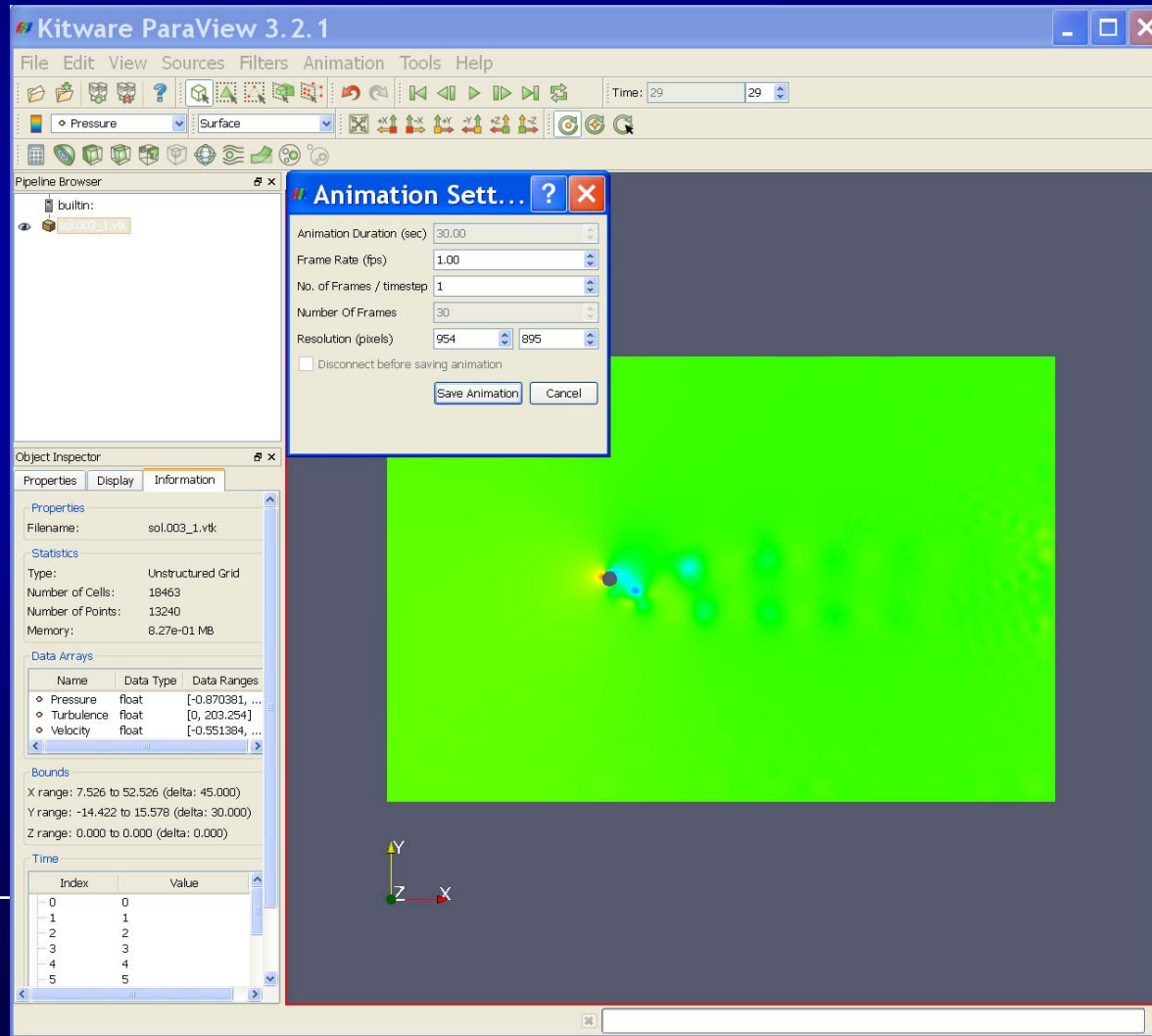
Visualizing and Animating a Time Varying Dataset

- Step2: Find the data's information and verify that all time steps were loaded.



Visualizing and Animating a Time Varying Dataset

- Step 3: In the File menu, select “Save Animation”. This will animate the time series.

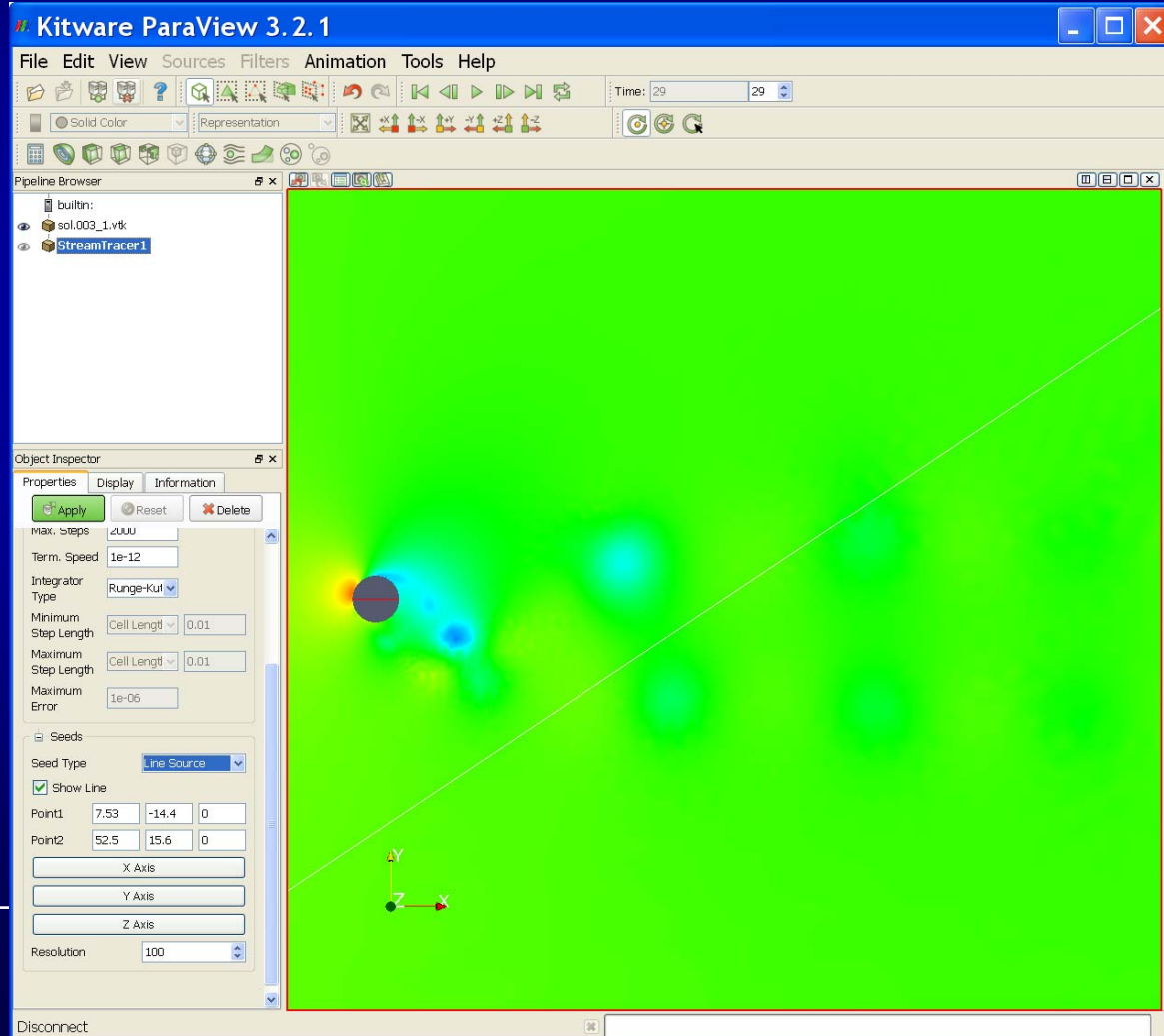


Visualizing and Animating a Time Varying Dataset

- The movie should look like:

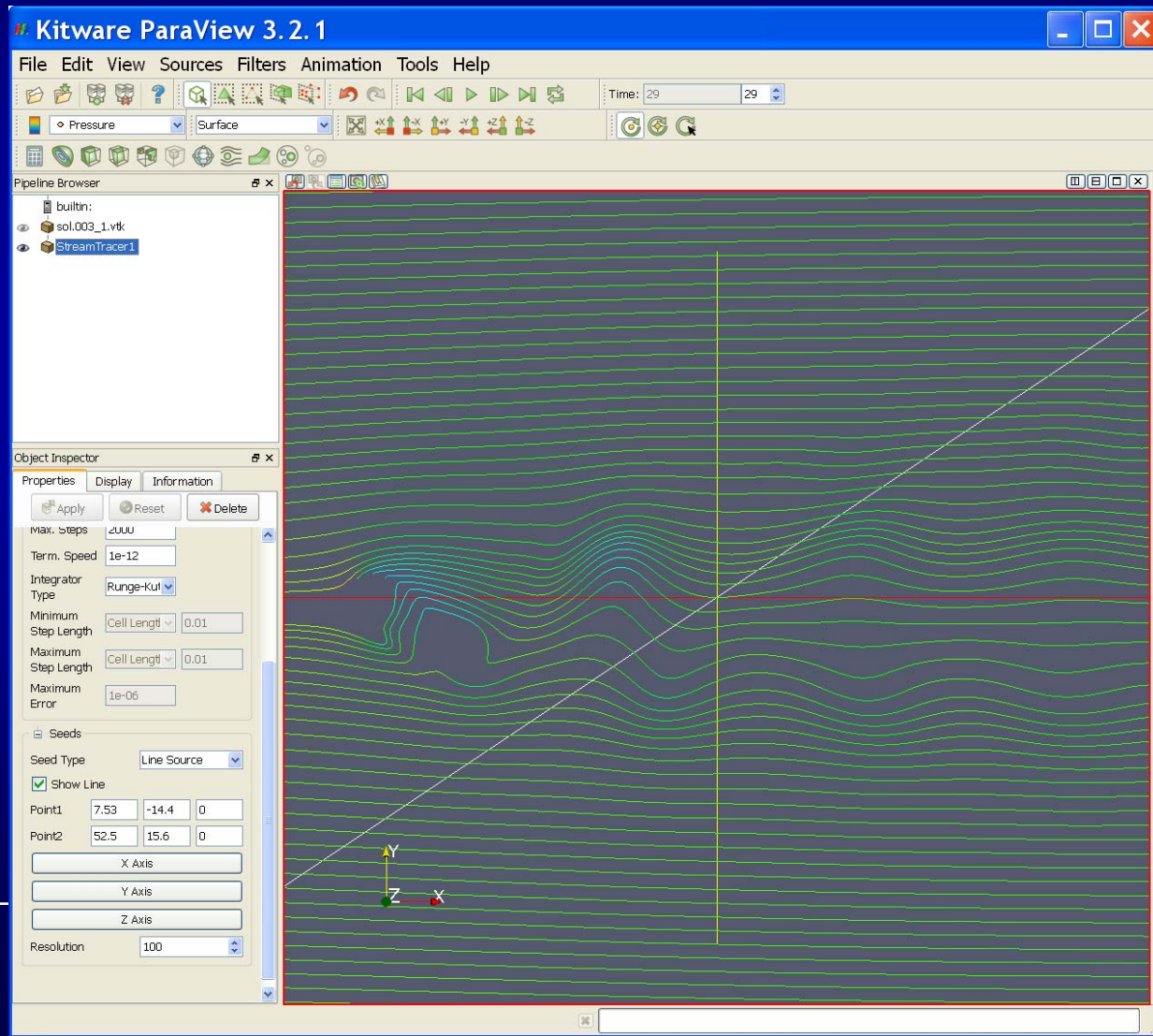
Visualizing and Animating a Time Varying Dataset

- Step 4: Add particle traces using a line to seed the points. Change the color to black and line width to 1.



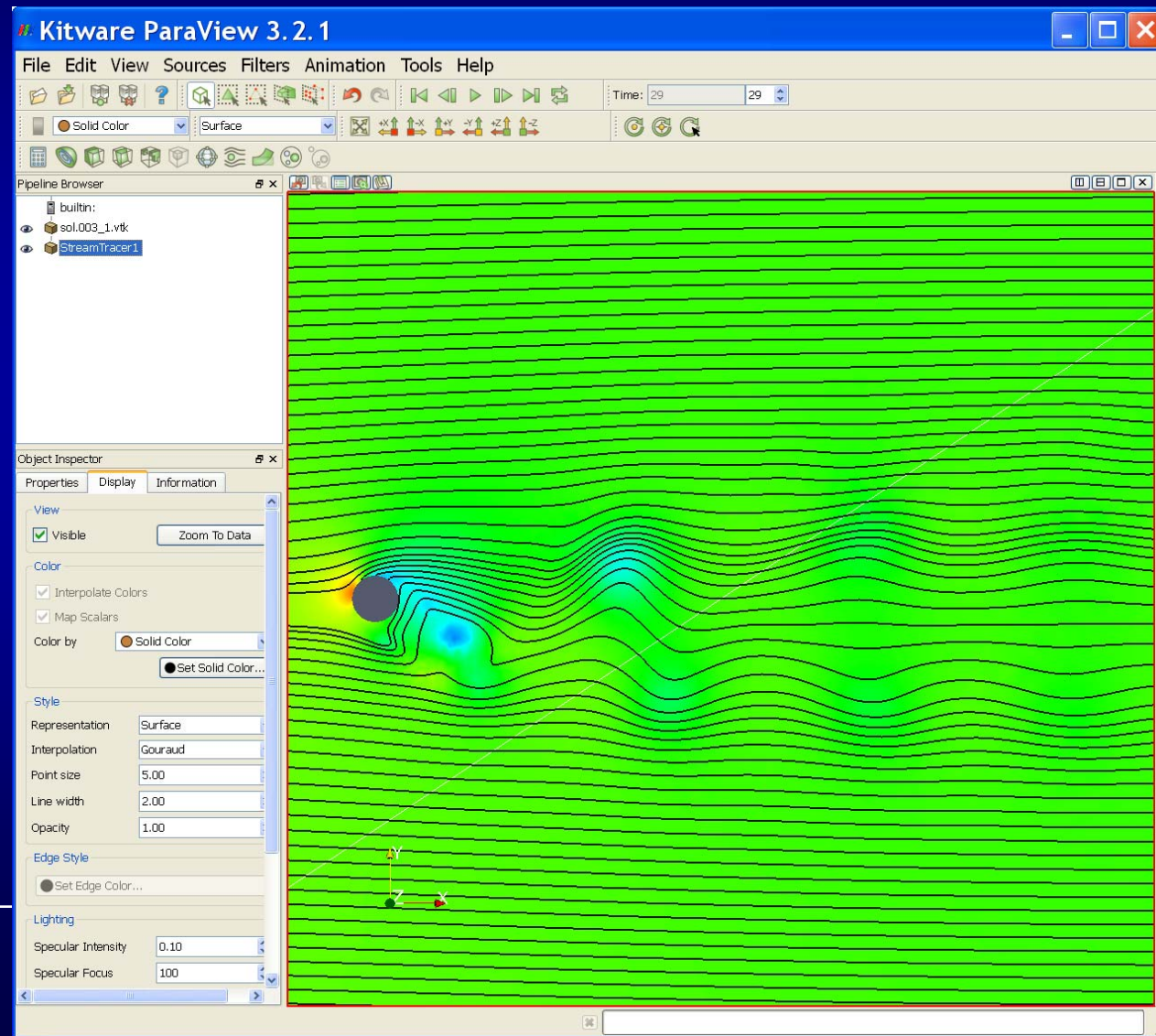
Visualizing and Animating a Time Varying Dataset

- Step 5: Go back to the contour and turn it back on.



Visualizing and Animating a Time Varying Dataset

- Step 6: Save an animation of this view.



Visualizing and Animating a Time Varying Dataset

- The movie should look like:

Topics Covered

- Remote and Collaborative Visualization
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- Visualizing and Animating a Time Series in Paraview
- **VisIt**
- Parallel Visualization

VisIt

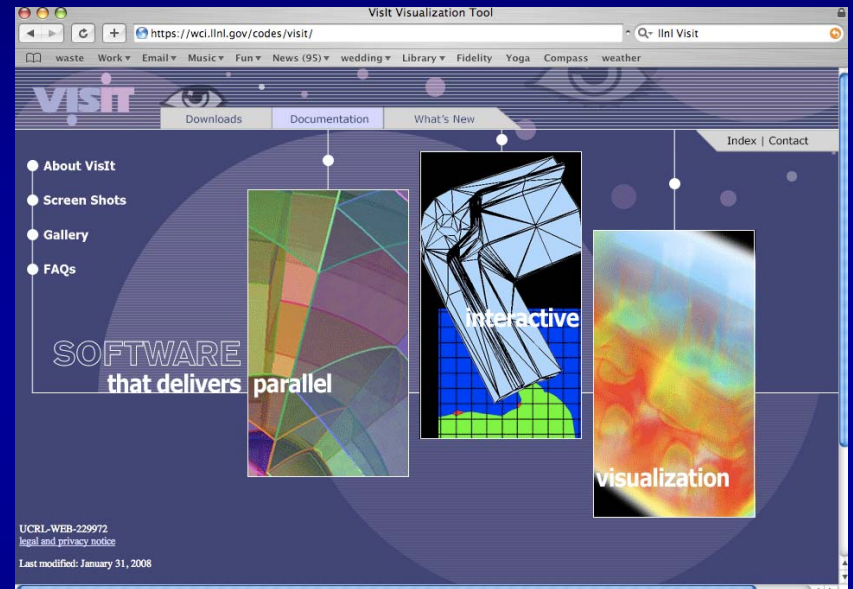
- Open source parallel visualization tool out of LLNL
- Key features:
 - Scalar, vector, and tensor field visualization
 - Structured and unstructured mesh types
 - Support for structured AMR meshes and CSG meshes\
 - Quantitative analysis (expressions, queries, picking, lineout)
 - GIS support
 - Image export (*BMP, JPEG, PNG, PPM, Raster Postscript, RGB, TIFF, stereo images*)
 - Annotation support for publication and presentation graphics
 - Built on VTK (open source graphics library)

Visit Supported File Formats

ANALYZE	FVCOM	PLOT3D
ANSYS	GGCM	Protein Databank
BOV (brick of values)	H5Nimrod	SAMRAI
Boxlib	H5Part	Silo
CGNS	Image	Spheral
Chombo	ITAPS	STL
CTRL	MFIX	TecPlot
Curve2D	MM5	VASP
Enight Gold	NASTRAN	Vis5D
Enzo	Nek3D	VTK
Exodus	NetCDF	Wavefront OBJ
FITS	OpenFOAM	Xmdv
FLASH	PATRAN	ZeusMP (HDF4)
FLUENT		
GIS (DEM, ArcGrid, ESRI Shapefile, vector file formats...)		

Running VisIt

- Download from web and install on local computer



VisIt Application

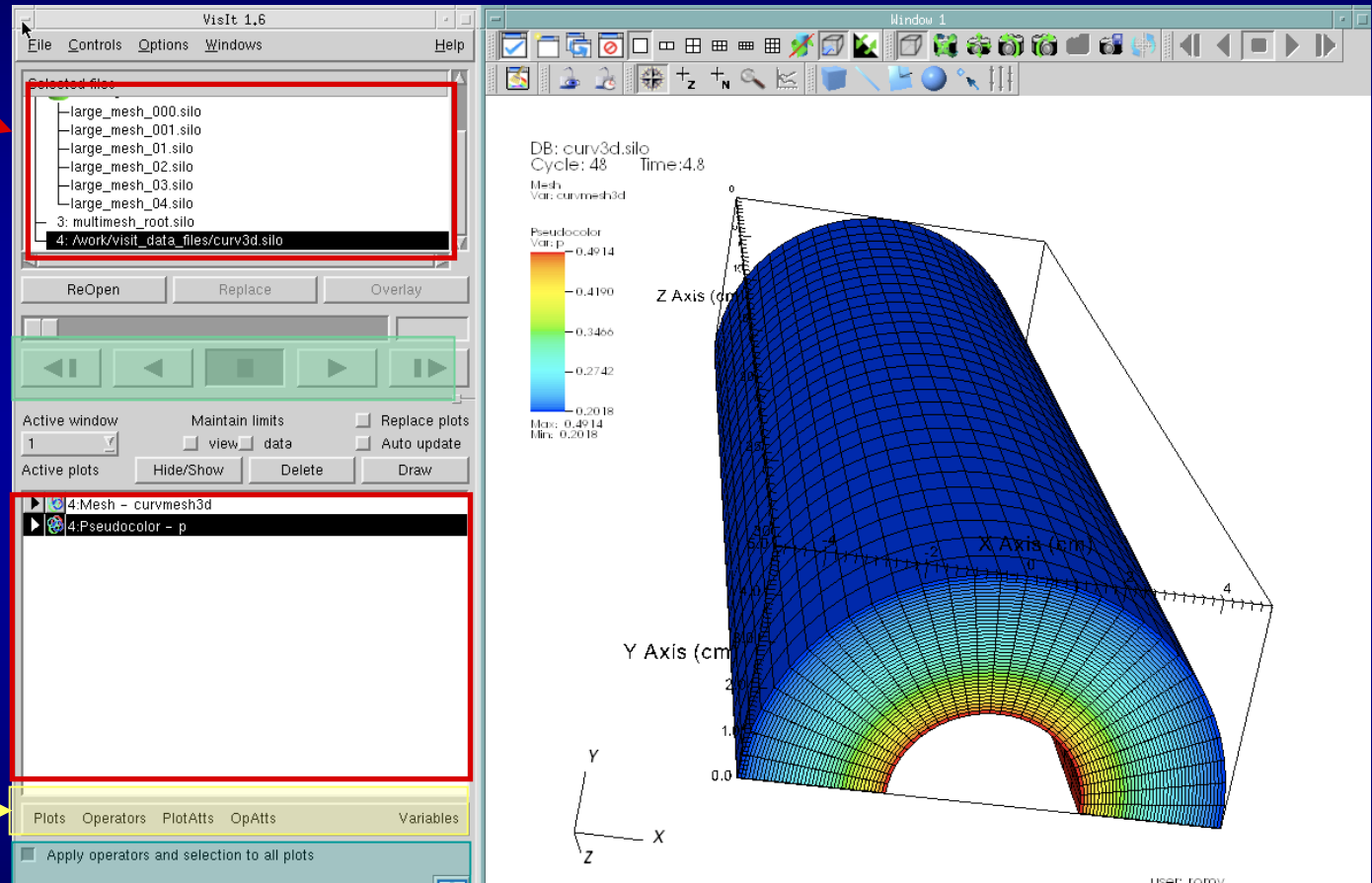
Database Viewer
(File List)

Animation
Controls

Plot List

Plot and Operator
Menus

Status Bar



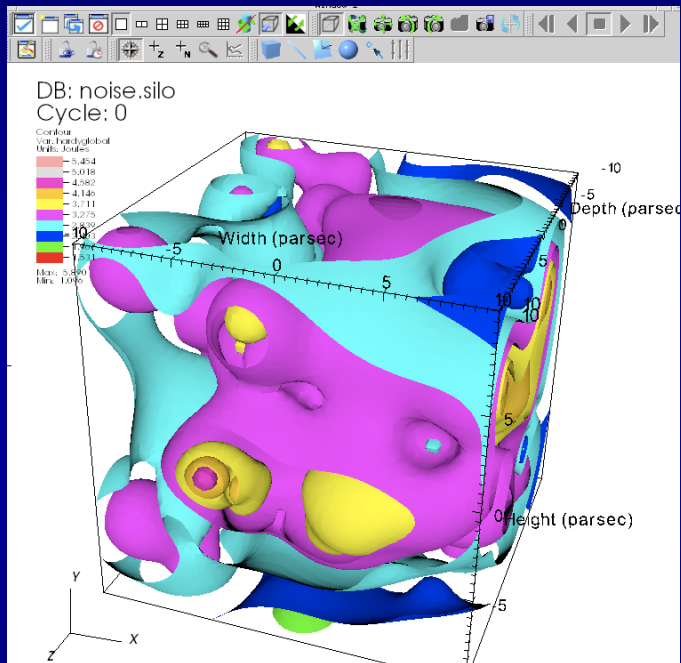
Viewer (Output Window)

Visit Terminology

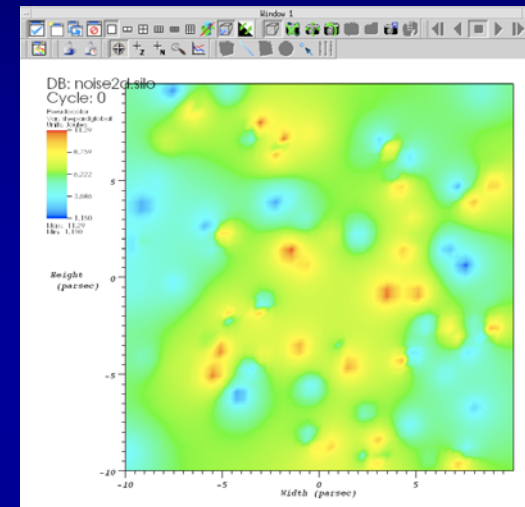
- Plot = Mapping Algorithm
 - Pseudocolor plot (scalar color map)
 - Surface plot (of 3D isosurface or 2D data)
 - Volume plot (3D volume rendered image)
- Operator = Data Manipulation Algorithm
 - Slice (extract data)
 - Resample (change data resolution)
 - Transform (move data in space or time)
- Database = file or set of files

Common Plots

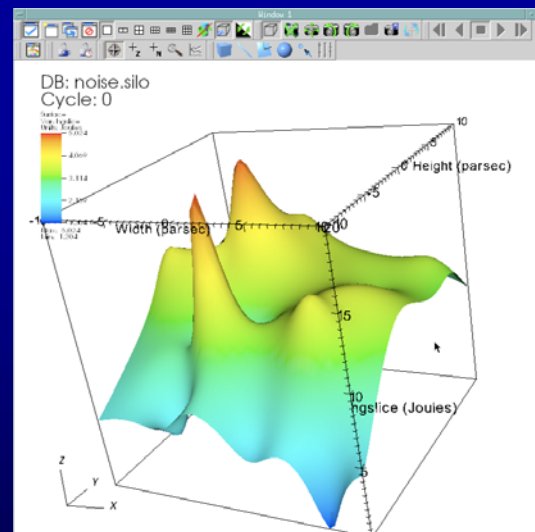
Contour



Pseudocolor

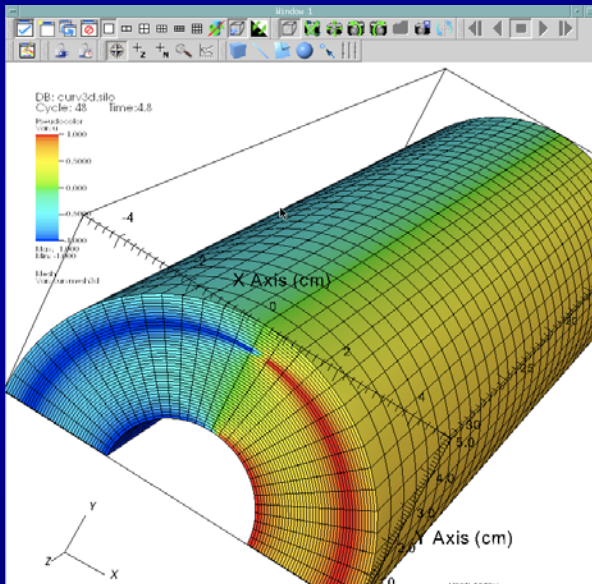


Surface

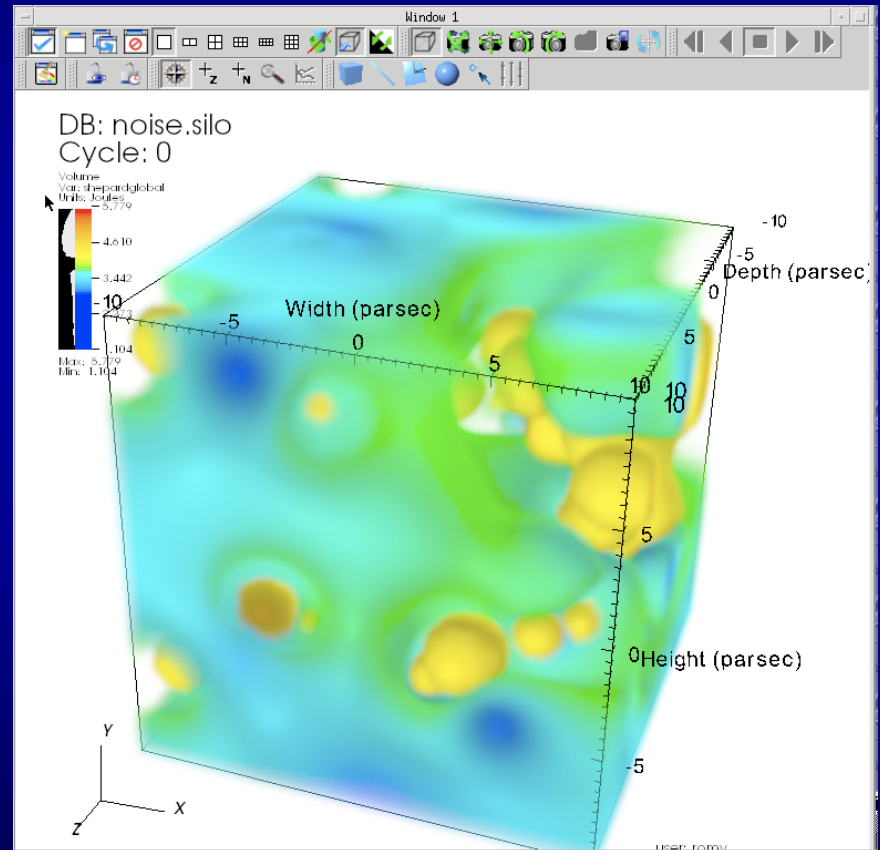


Common Plots

Mesh + Pseudocolor



Volume



VisIt Advanced Features

- Various lighting, rendering, and view (camera) options
- Geometry export (*Curve, Alias WaveFront Obj, STL, ULTRA, and VTK*)
- Animation and movie generation
- Scripting interface with Python
- API interface with C++ and Java
- Dynamically extensible through plugins
- Parallel and distributed architecture for visualizing very large data sets
- Database export (BOV, SILO, Tecplot, SimV1Writer, VTK, columnar ascii file (xmdf))
- Multiple database correlation / visualization

Download VisIt and Go Through Example

- **Step 1: Download VisIt from**
 - <https://wci.llnl.gov/codes/visit/executables.html>

VisIt Executables - Mozilla Firefox

File Edit View History Bookmarks Yahoo! Tools Help

<https://wci.llnl.gov/codes/visit/executables.html> Answers.com

Search Web Mail My Yahoo! News Games Music

Google VisIt Search Bookmarks PageRank Check AutoLink AutoFill Settings

- [Visit md5 checksums](#)
- [Visit sha1 checksums](#)
- [Visit file sizes](#)

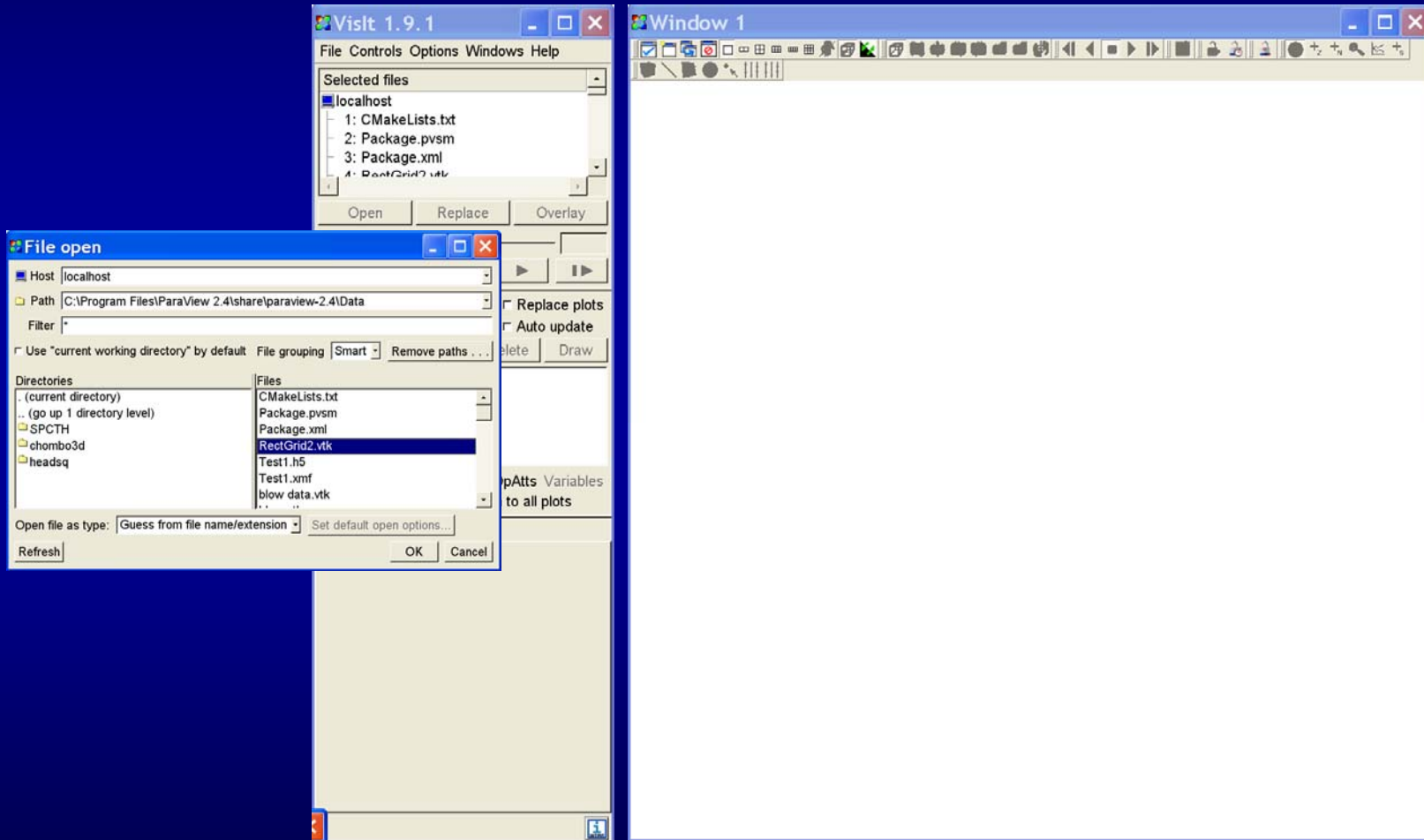
platform	executable
Linux - x86 32 bit Redhat Enterprise Linux 3, hoth.llnl.gov 2.4.21-27.0.2.c.ELsmp, gcc 3.2.3	download
Linux - x86 32 bit Redhat Enterprise Linux 4, ellipse.uchicago.edu 2.6.9-42.0.10.ELsmp, gcc 3.4.6	download
Linux - Opteron 64 bit Redhat Enterprise Linux 4, vertex.llnl.gov 2.6.9-70chaos, gcc 3.4.4	download
Linux - Opteron 64 bit Fedora Core 4, xchem.llnl.gov 2.6.17-1.2142_FC4smp, gcc 4.0.2	download
Linux - Itanium 64 bit Redhat Enterprise Linux 4, thunder.llnl.gov 2.6.9-70chaos, gcc 3.2.3	download
Linux - Altix 64 bit SUSE Linux Enterprise Server 9, davinci.nersc.gov 2.6.5-7.283-sn2, gcc 3.3.3	download
Windows SE/ME/2000/Xp MSVC7, Visual Studio 2003	download
Mac OS X - Intel Darwin 10.4.11, Darwin Kernel Version 8.11.1, gcc 4.0.1	download
Mac OS X - PowerPC Darwin 10.4, Darwin Kernel Version 8.10.0, gcc 4.0.1	download
Solaris SunOS 5.7, sunspot.llnl.gov Generic_106541-23, gcc 3.2	download
AIX - 32 bit AIX 5.3, up.llnl.gov 00C5D6DD4C00, xlc	download
AIX - 64 bit AIX 5.3, up.llnl.gov 00C5D6DD4C00, xlc	download
Irix IRIX 64 6.5, quad.llnl.gov 07010238, MIPSpro 7.41	download
Java client library (jar file, compiled classes, source code, examples)	download

VisIt 1.9.0

Done wci.llnl.gov

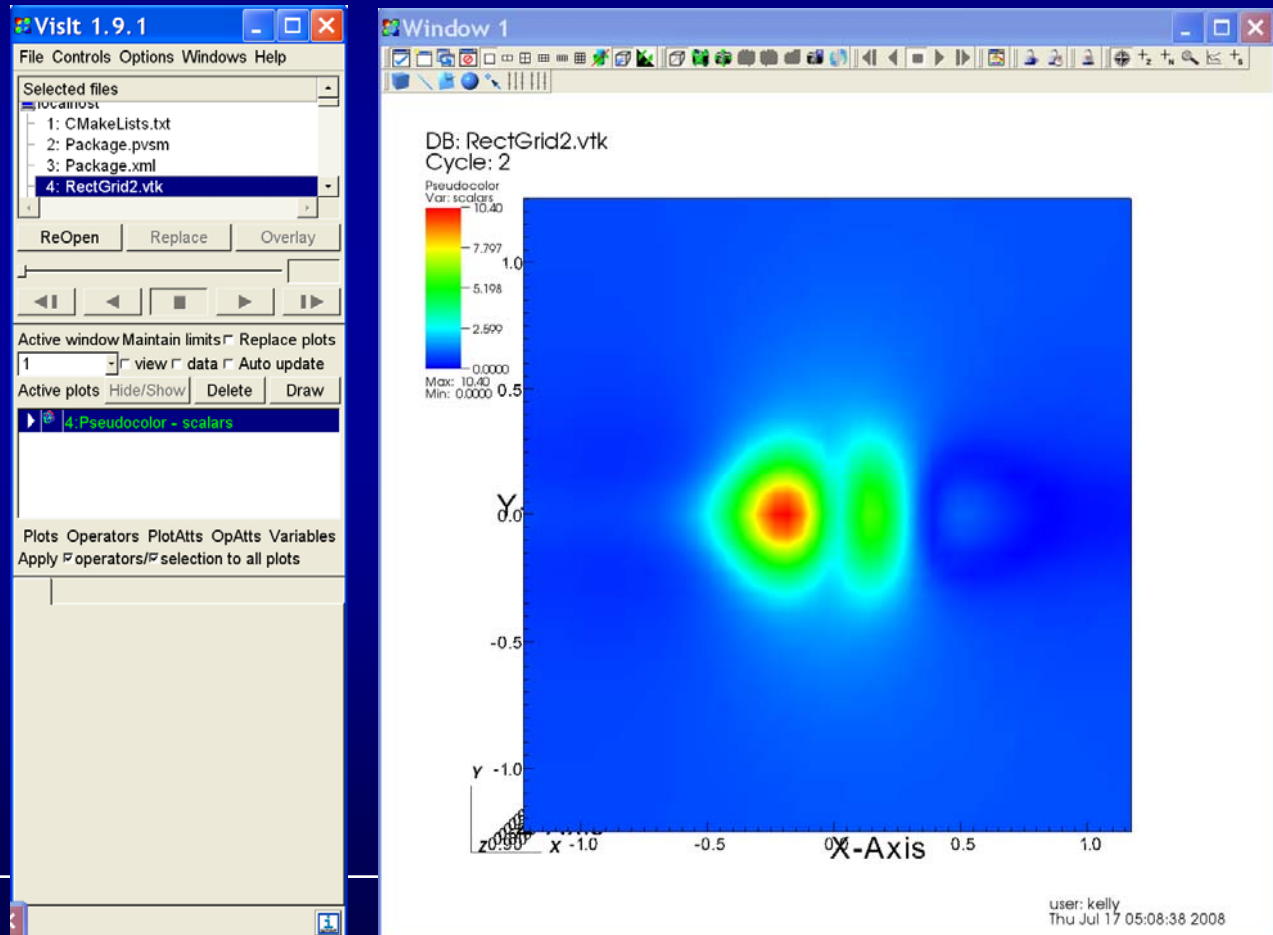
Download VisIt and Go Through Example

- Step 2: Bring up VisIt and Load the RectGrid2.vtk dataset



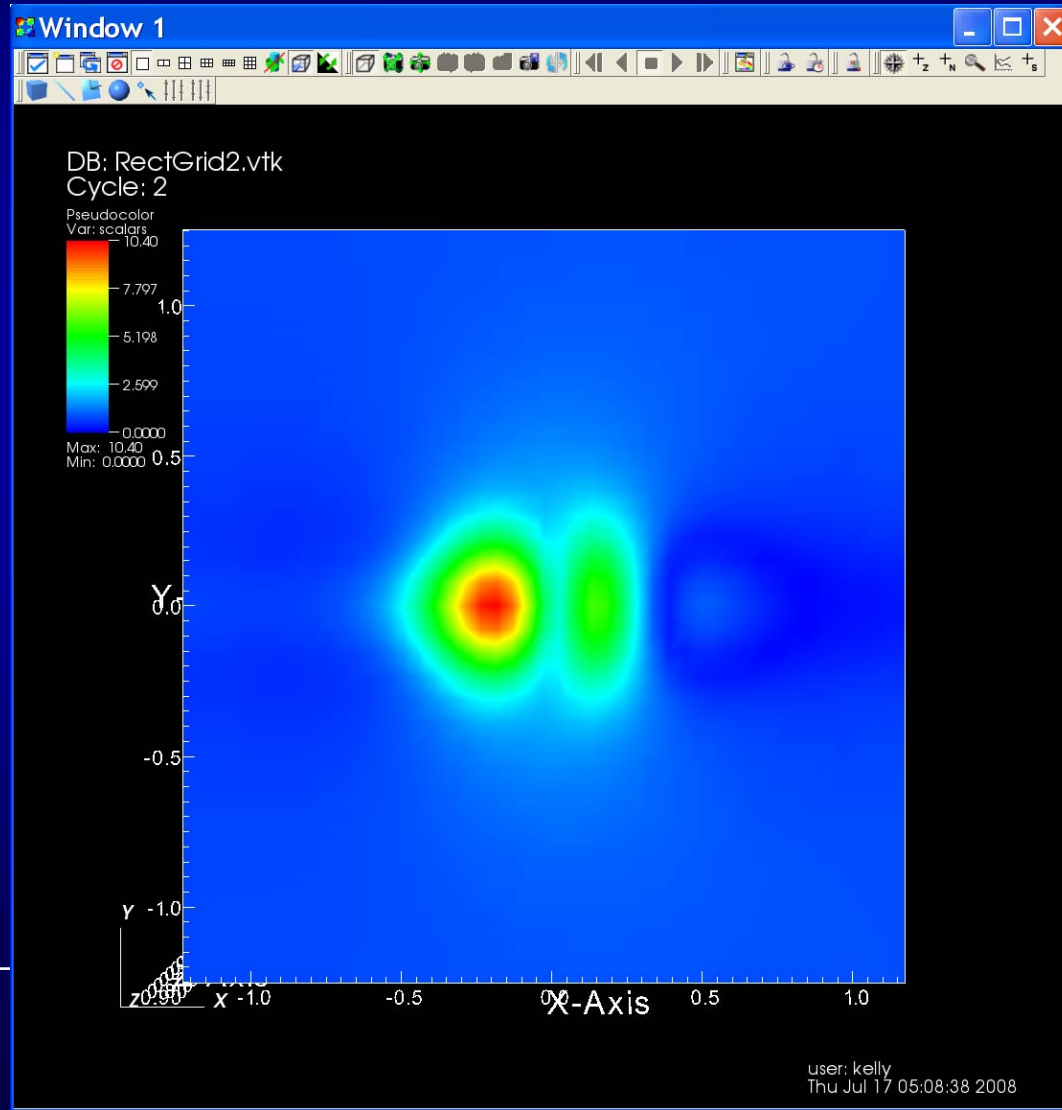
Download VisIt and Go Through Example

- Step 3: Create a surface plot (pseudocolor) of the volume boundary by clicking on plots and selecting pseudocolor.



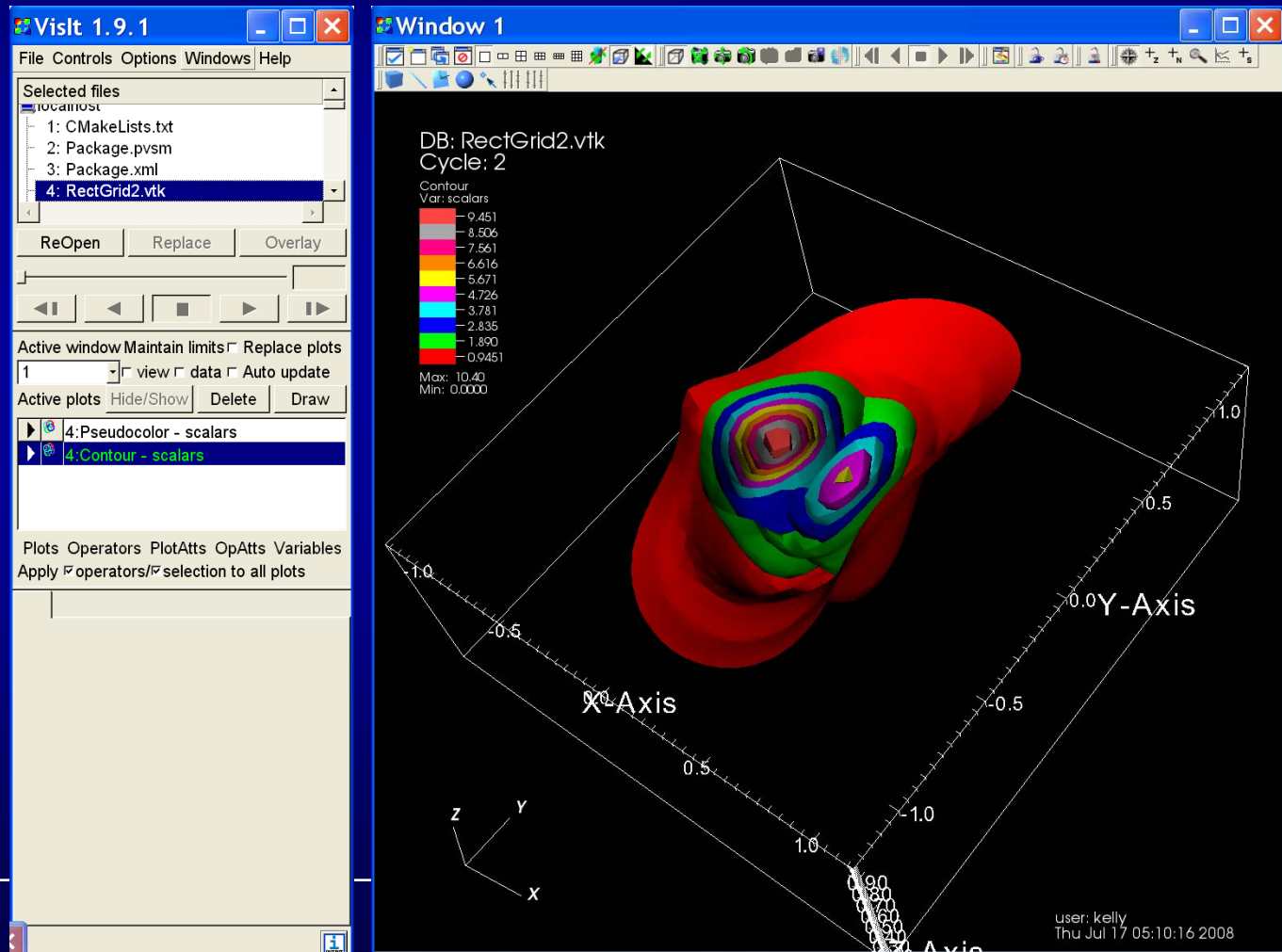
Download VisIt and Go Through Example

- Step 4: Swap the background color and foreground color



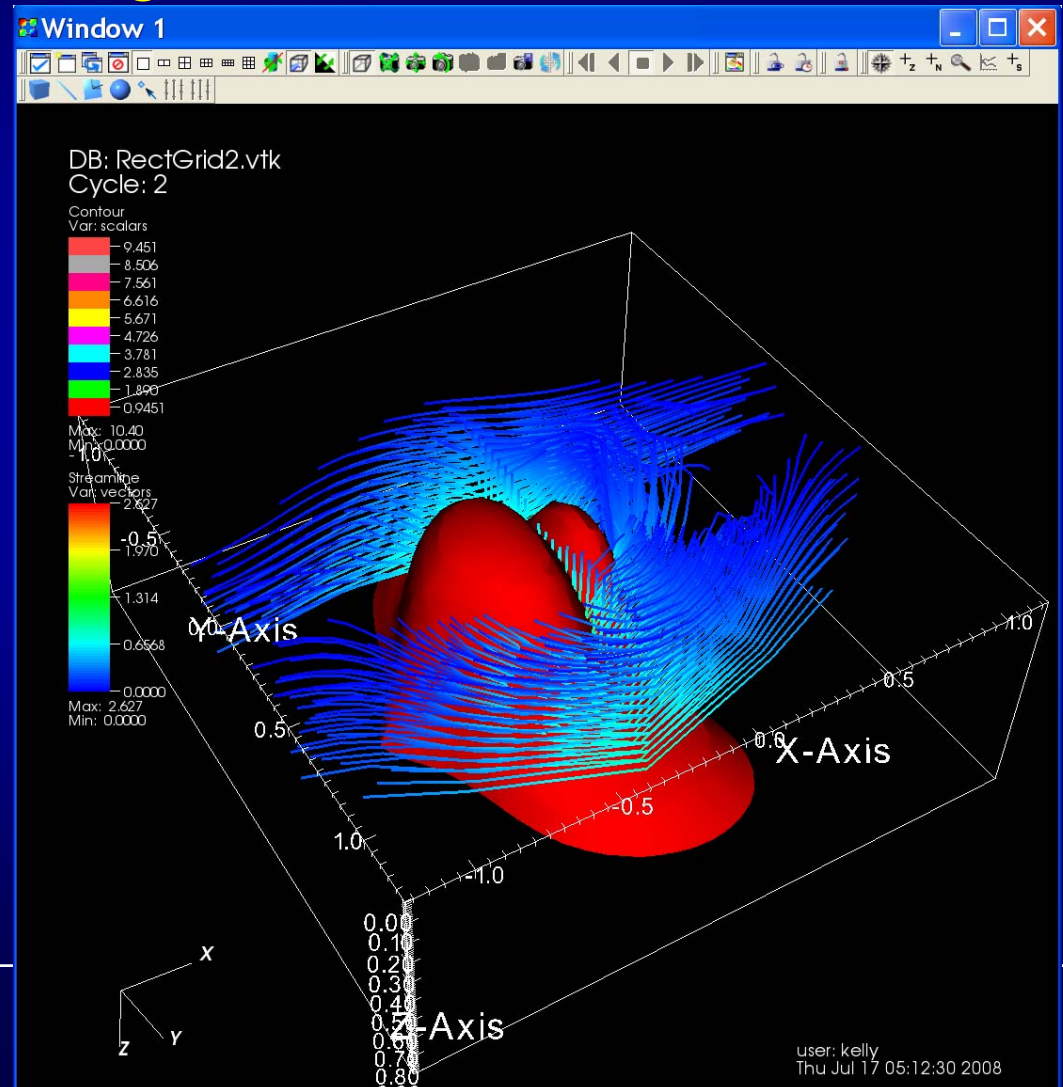
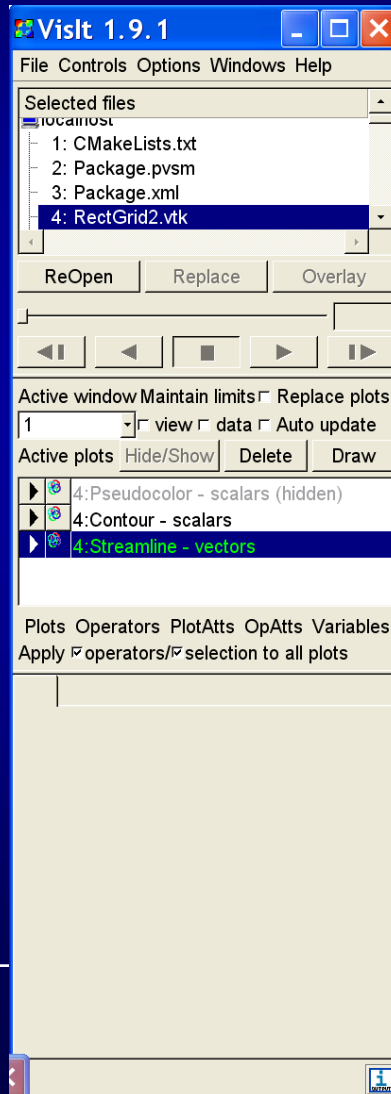
Download VisIt and Go Through Example

- Step 5: Create a set of isosurfaces by clicking on plots and selecting contours.



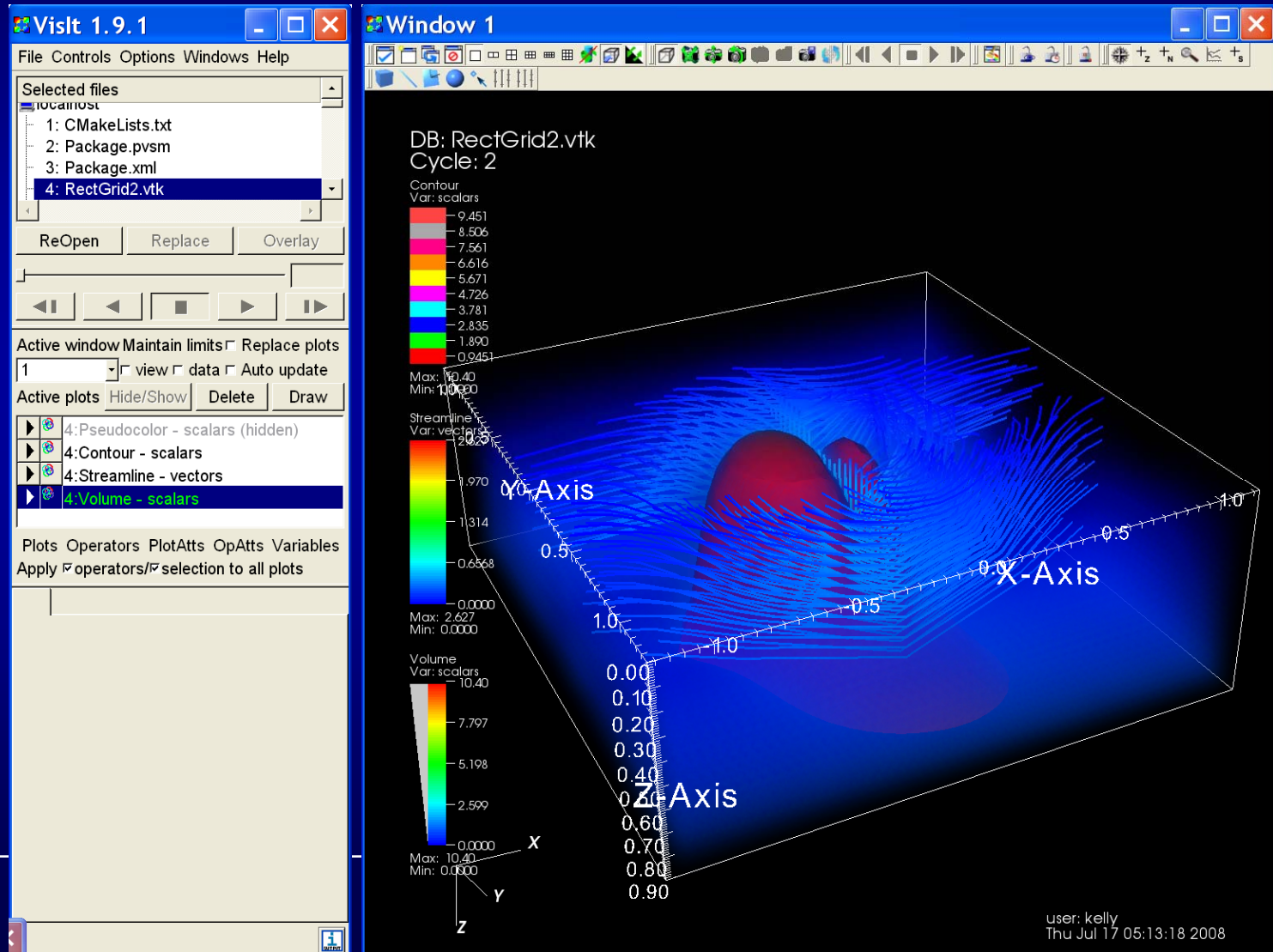
Download VisIt and Go Through Example

- Step 6: Create a set of streamlines by clicking on plots and selecting streamline



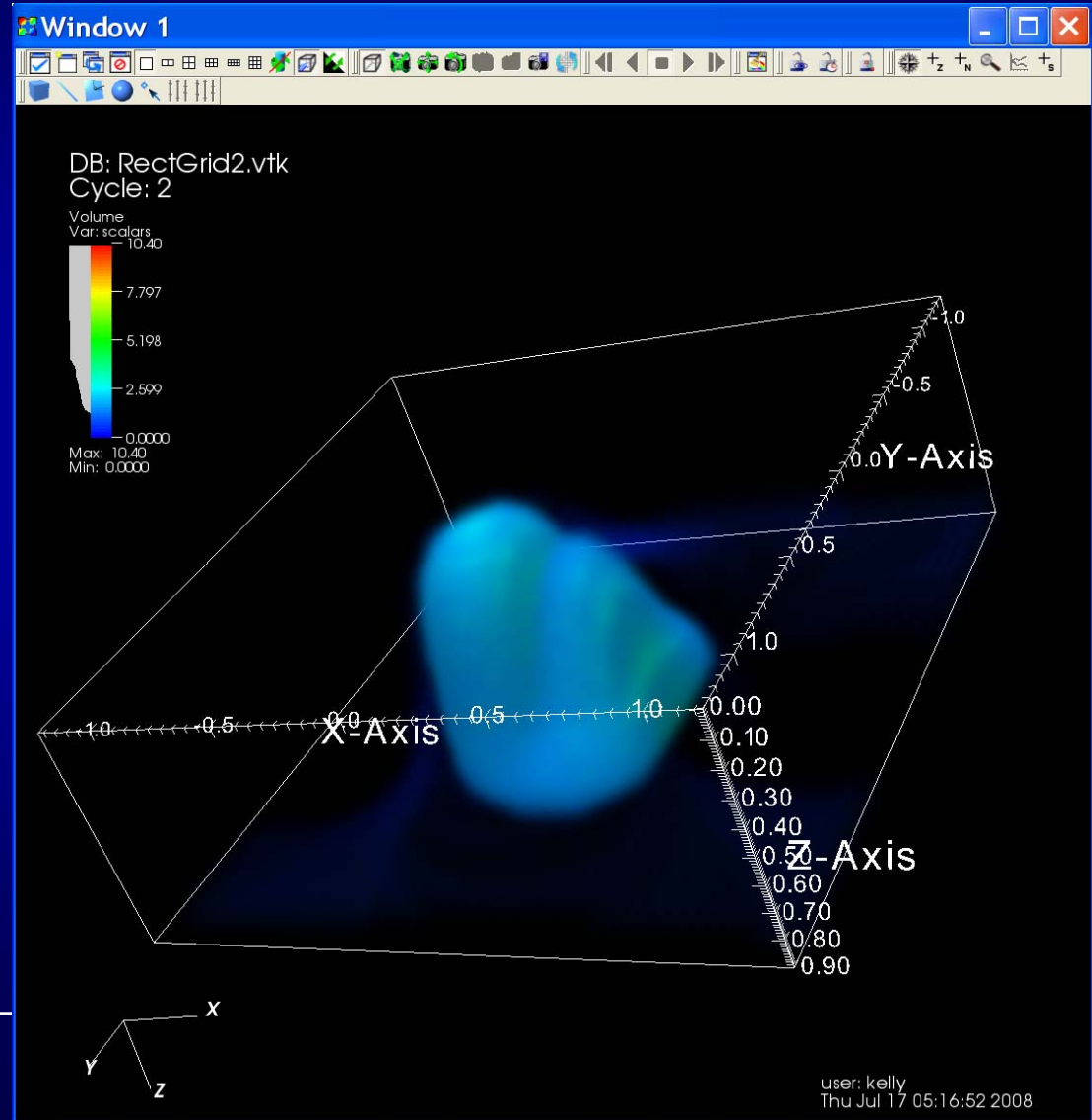
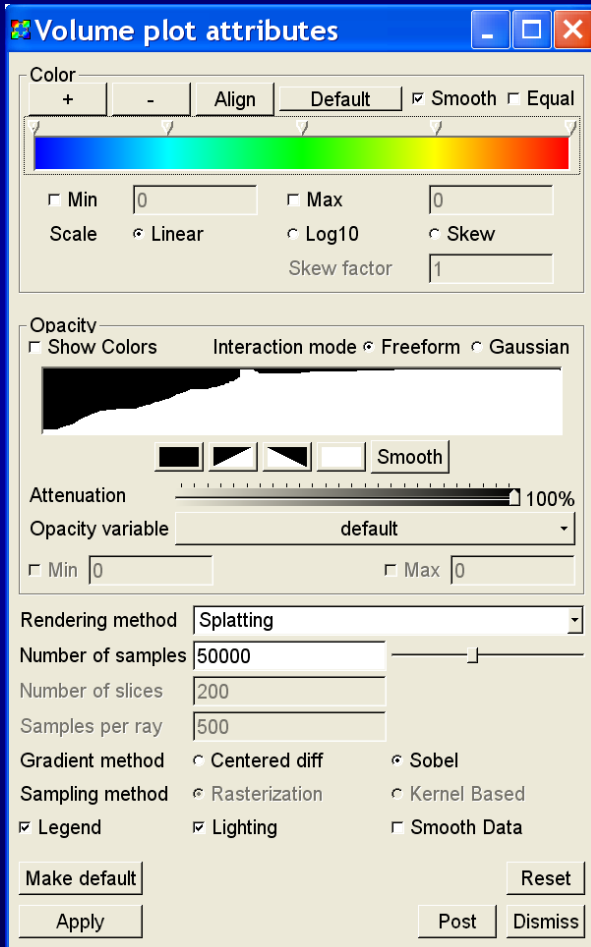
Download VisIt and Go Through Example

- Step 7: Create volume by selecting volume in plots



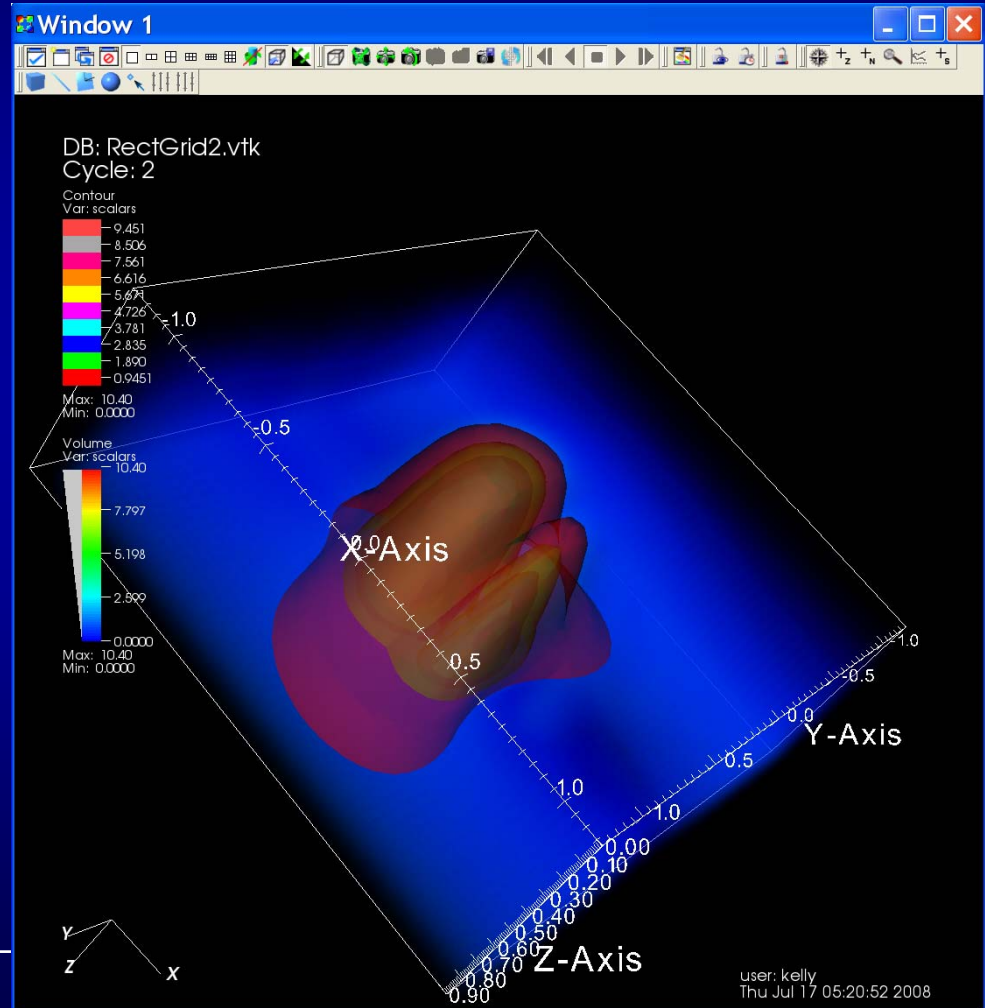
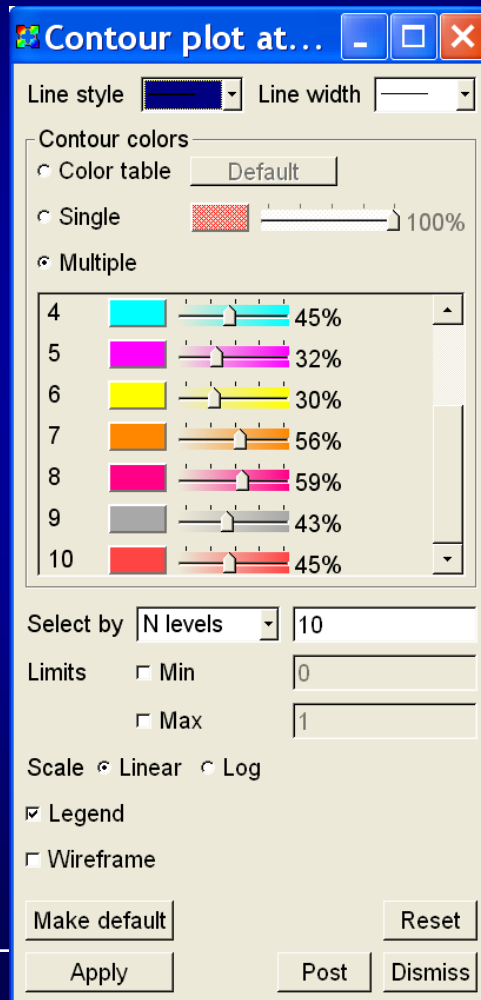
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- Step 8: Adjust the volume rendering color profile



Download VisIt and Go Through Example

- Step 9: Adjust the transparency and color of isosurfaces



Topics Covered

- Remote and Collaborative Visualization
- EnVision – simplified Interface for Visualization
- Visualizing and Animating a Time Series in Paraview
- VisIt
- **Parallel Visualization**

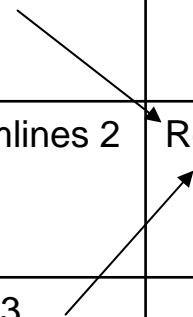
Parallel Visualization

- Three types of parallelism to think about:
 - Task parallelism – passing results to 1 process for rendering

Timesteps

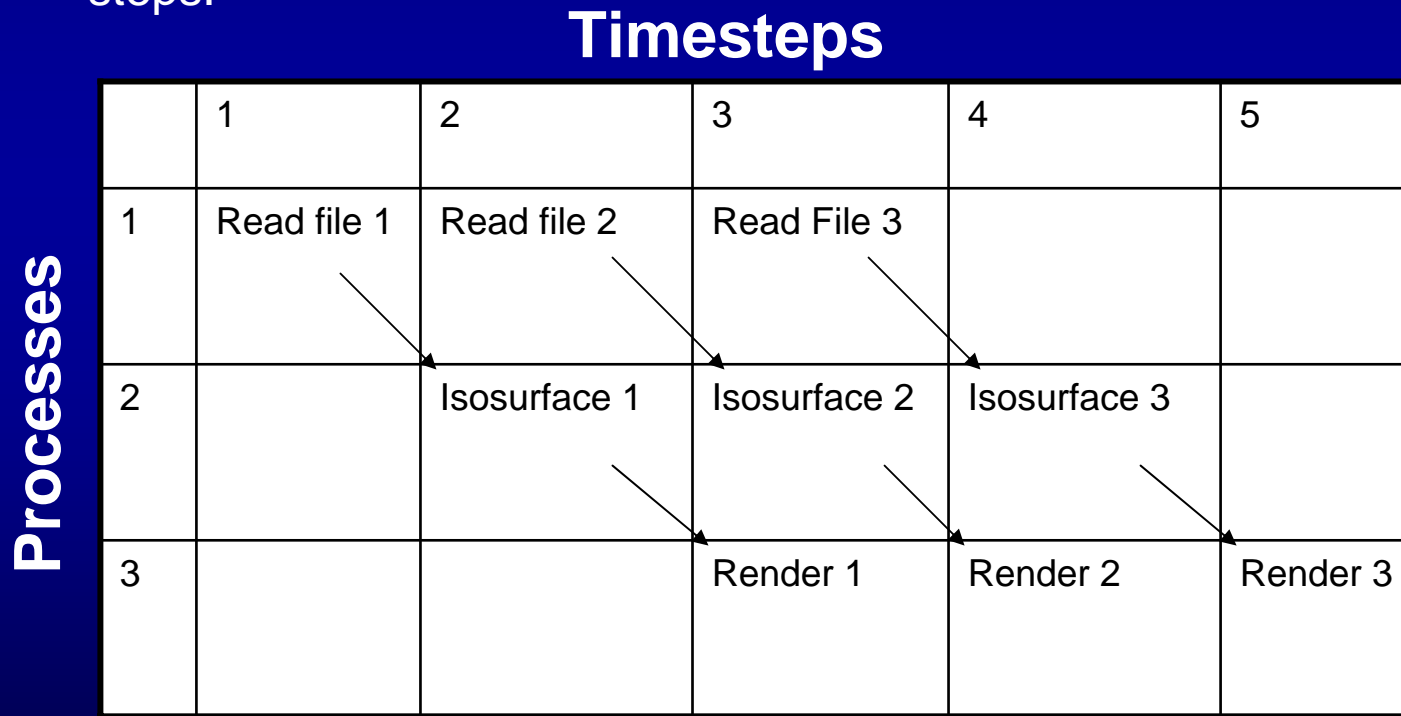
Processes

	1	2	3	4	5
1		Read file 1	Isosurface 1	Cut Plane 1	
2			Read file 2	Streamlines 2	Render
3	Read file 3	Triangulate 3	Decimate 3	Glyph 3	



Parallel Visualization

- Three types of parallelism to think about:
 - Pipeline parallelism – useful when processes have access to separate resources or when an operation requires many steps.



Parallel Visualization

- Three types of parallelism to think about:
 - Data parallelism – data set is partitioned between the processes and all processes execute same operations on the data. Scales well as long as the data and operations can be decomposed.

		Timesteps		
Processes		1	2	3
	1	Read partition 1	Isosurface partition 1	Render partition 1
	2	Read partition 2	Isosurface partition 2	Render partition 2
	3	Read partition 3	Isosurface partition 2	Render partition 3

Questions?

Parallel Paraview

- Paraview has three main logical components:
 - Client server responsible for user interface of the application
 - Data server reads and processes data sets to create final geometric models. Each process is told which partition of the data it should load
 - Render Server is responsible for rendering the final geometry. The render server can run in parallel if it is configured to do so.
- It is possible to run the render server with less processes than the data server, but never more.

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Parallel Paraview

- Paraview can be run in a variety of configurations
 - Client, Data Server and Render Server all running on the same process (the way we have been running this week)
 - Client as a single process program, Data Server and Render Server as MPI multi-process programs.
 - MPI is used to send messages between processes
 - Sockets are used to send messages and data between servers

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Parallel Paraview

- Distributed Stand-Alone Mode
 - `mpirun -np 4 ./paraview`
 - (Node 0: data server node 0, render server node 0, client)
 - (Node 1: data server node 1, render server node 1)
 - (Node 2: data server node 2, render server node 2)
 - (Node 3: data server node 3, render server node 3)

Parallel Paraview

- Client/Server Mode
 - `./paraview --client --host=server_host` (on your client)
 - `mpirun -np 4 ./pvserver` (on your host server)

Running Parallel Paraview through VNC Session

- Login to maverick.tacc.utexas.edu
- Start your vnc session:
 - `qsub /usr/local/qsub/RUN.vnc`
- Connect to your vnc session
 - Remember to look in vnc_server for the display number
- Inside your vnc session:
 - `ssh maverick /usr/local/qsub/paraview_mpi_64 $DISPLAY [num graphics devices]`
 - Default number of graphics cards requested is 3
- Wait for paraview to show up in your vnc session

Running Parallel Paraview in Client-Server Mode

- Login to maverick.tacc.utexas.edu
- For PVSERVER_PORT below: choose something > 1024
- For 32 bit execution:
 - /usr/local/qsub/pvserver_mpi <PVSERVER_PORT> [num graphics devices]
- For 64 bit execution:
 - /usr/local/qsub/pvserver_mpi_64 <PVSERVER_PORT> [num graphics devices]
- Wait a minute for the pvservers to get started
- Connect to mav1.tacc.utexas.edu by:
 - pvclient -sh=mav1.tacc.utexas.edu -sp=<PVSERVER_PORT.

Questions?