Scientific Visualization with VisIt

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PPPL
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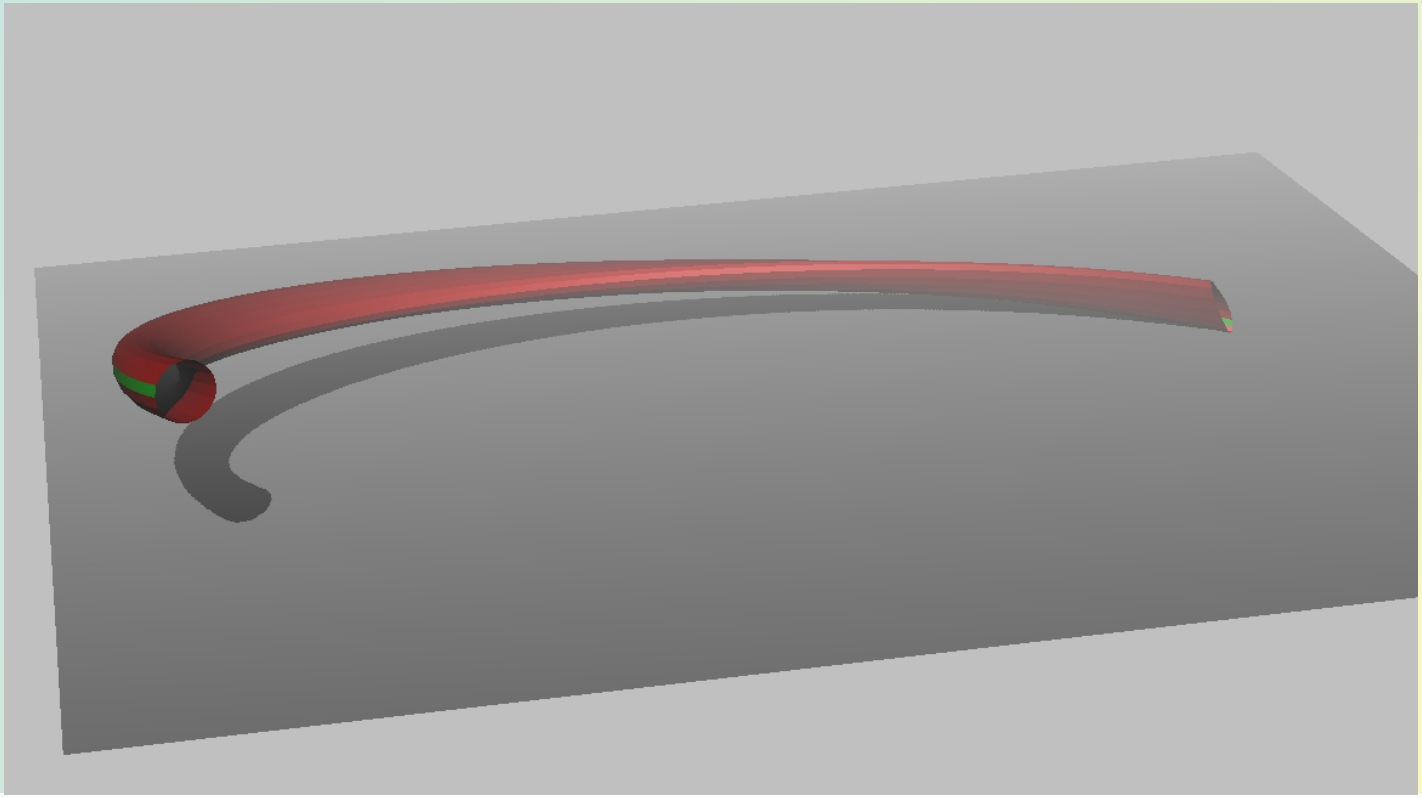


Teaching Assistants

Matthew Lotocki

Jared Miller

Michael Knyszek

Getting to Know Your Data

Geometric range

Numerical domain (min, max)

- Histogram
- Outliers
- Features
- Local / Global (steps)

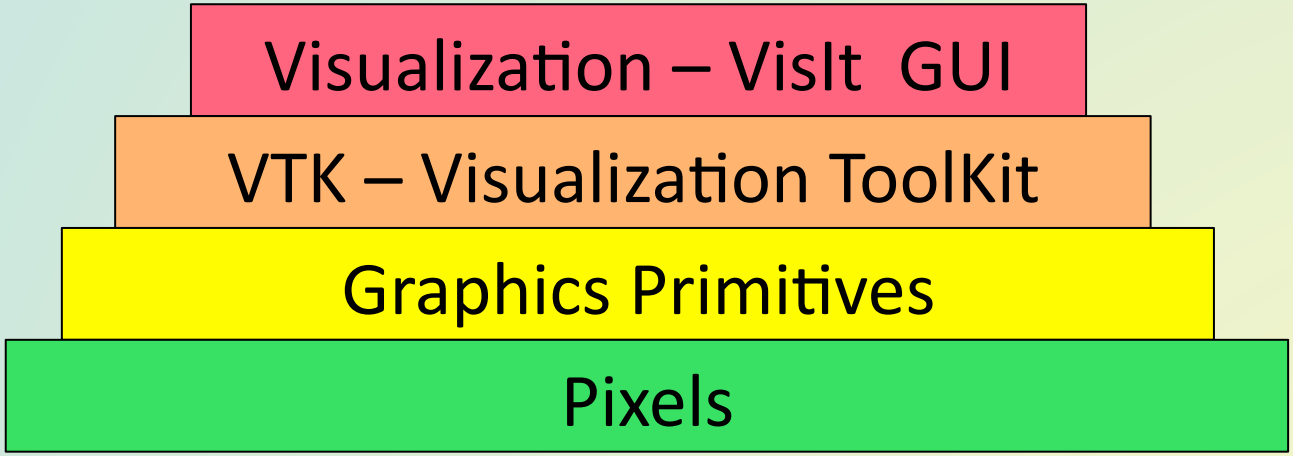
Presentation

Scientific Visualization

- Simulations generate data
- Acquire data from experiments
  - Biology
  - Chemistry
  - Physics
  - Engineering

- Explore
- Communicate
- Based on computer graphics
  - points
  - lines
  - polygons, surface mesh
    - 3D transformations
    - hidden surface removal
    - shading
    - lighting

Implementation



VisIt Plot Types

Points

Lines

Vectors

Contour lines & isosurfaces

Polygons, mesh

Volume

Molecule

Designing a Visualization

I want a visualization of my climate model.

Scientist

Map your data to a plot type.

Vis Guy

2-D/3-D Compute grid:

scalar or vector

per point, per cell

Selection + Operators

VisIt Can Read Data Files

- Silo
- Chombo
- GTC
- M3D
- H5Nimrod
- SAMRAI
- S3D
- Enzo
- ITAPS
- XDMF
- Exodus
- FLASH
- EnSight
- VTK **VTK is Internal Format**
- NetCDF
- CGNS
- NASTRAN
- TecPlot
- Protein Databank (PDB)
- Plot3D
- GIS (ESRI Shapefile, DEM, many more)
- Image formats

Database reader plug-ins can be developed for new formats

Variable types

- Scalar
- Vector
- Tensor
- Arrays
- Label
- Material
- Species
- X,Y pairs

https://wci.llnl.gov/codes/visit - downloads

just search for: visit visualization

Getting Data Into VisIt - document (& your project)

Silo

VTK - text or binary

VTK File Formats

Exercise 1

Visit Data Files

Open File ...

Desktop → vis2

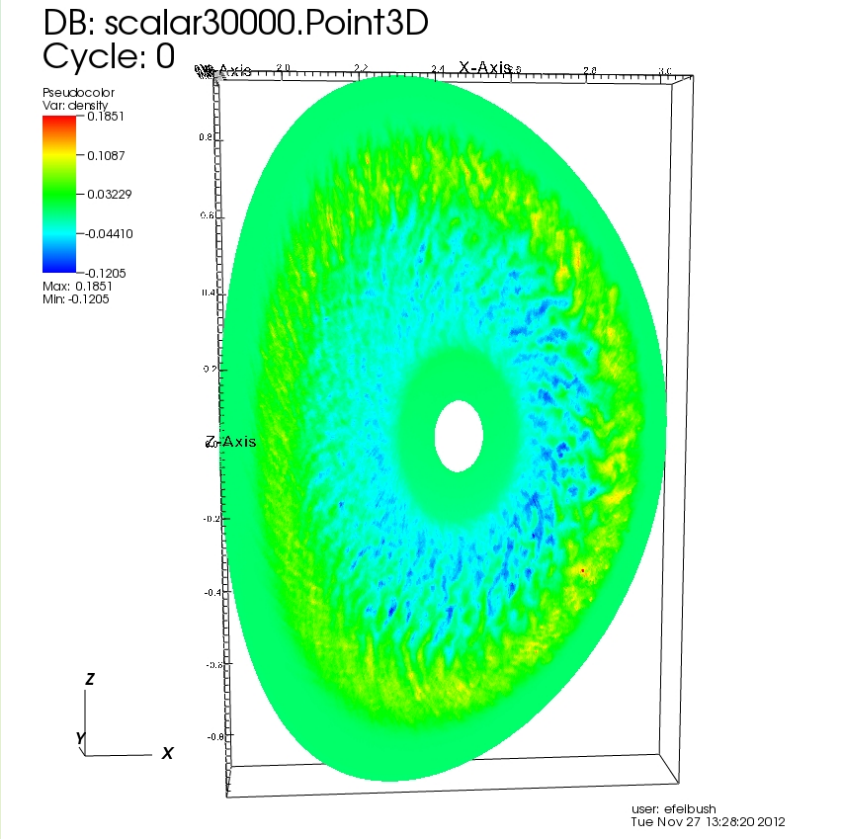
scalar30000.Point3D

Add Pseudocolor Plot

density

Attributes

Point size



Exercise 2

Visit Data Files

Open File

poloidalplane.vtk

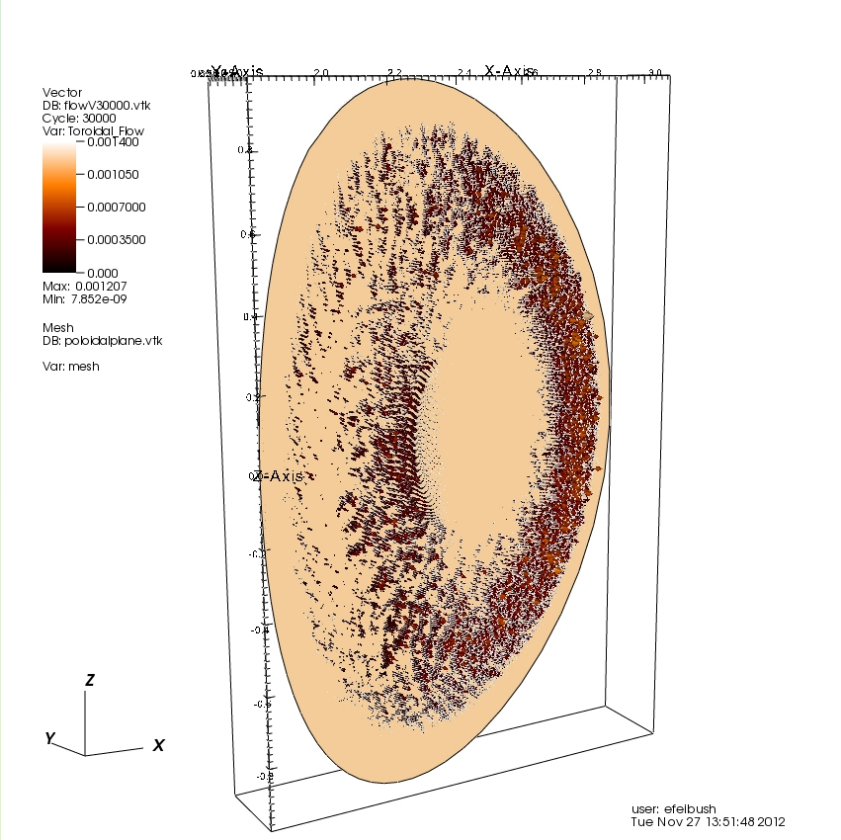
Add Mesh→mesh

Attributes

Open File

flowV30000.vtk

Add Vector→Toroidal_Flow



Exercise 3

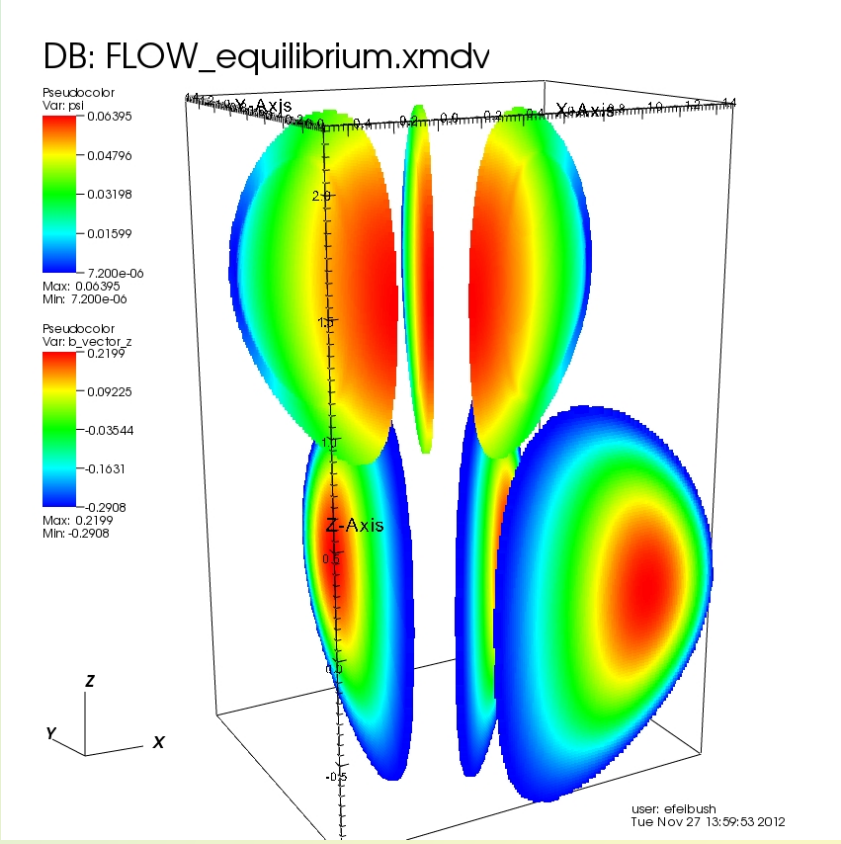
Open File

FLOW_equilibrium.xmdv

Add Pseudocolor→psi

Add Pseudocolor→b_vector_z

Operators→Transforms→Transform



Exercise 4

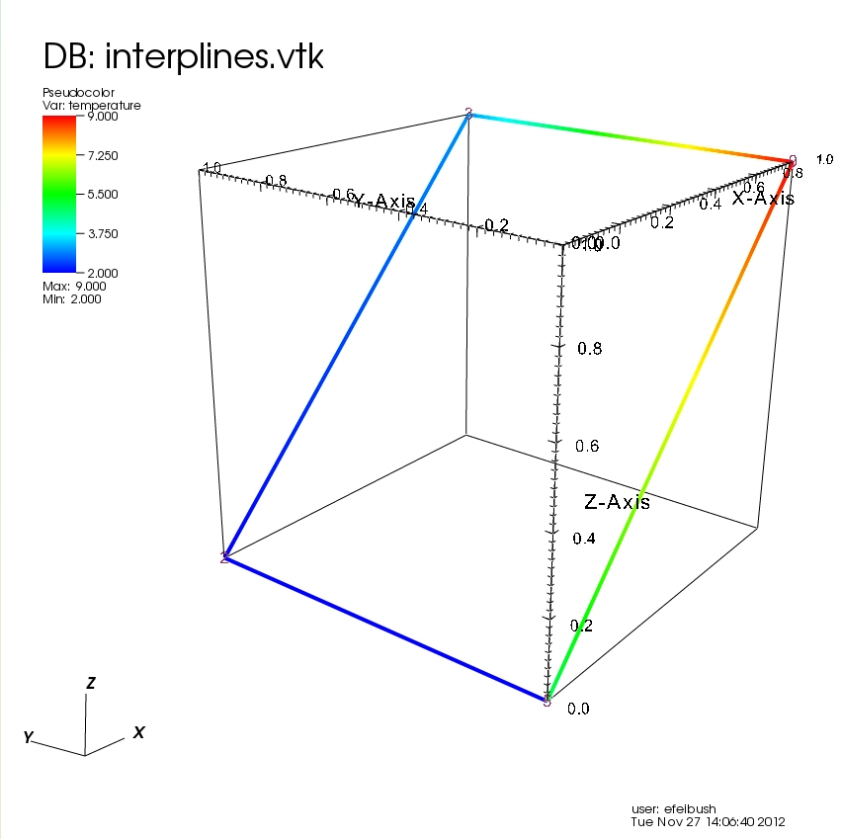
Open File interplines.vtk

Add Pseudocolor

temperature

Add Label

temperature



Exercise 5

Open File strpts3d.vtk

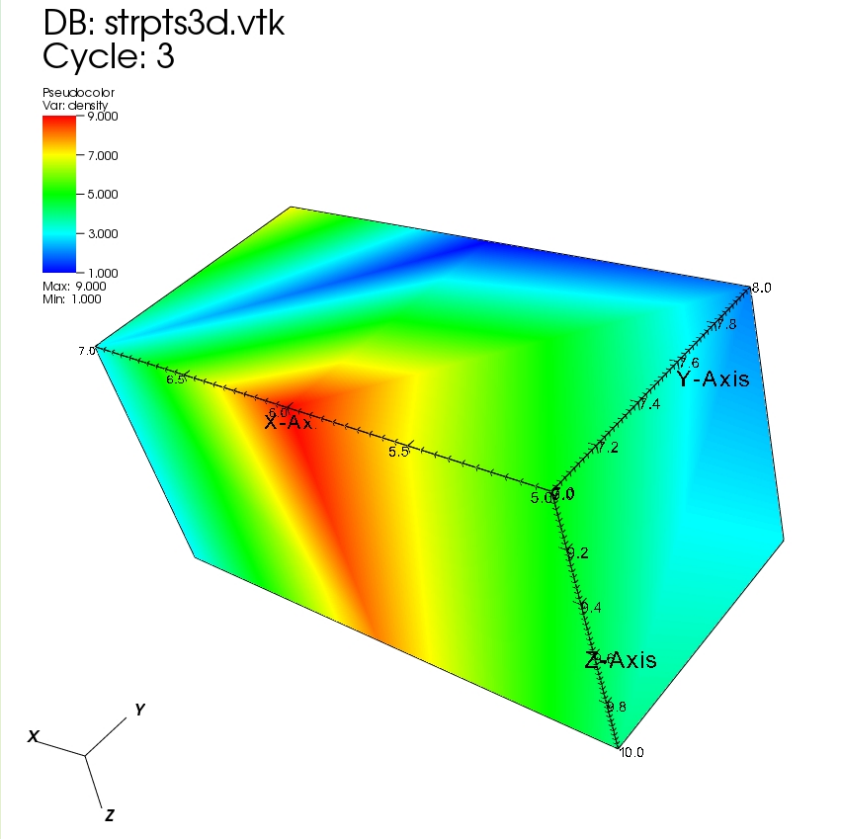
Add Pseudocolor→density

VTK:

STRUCTURED_POINTS

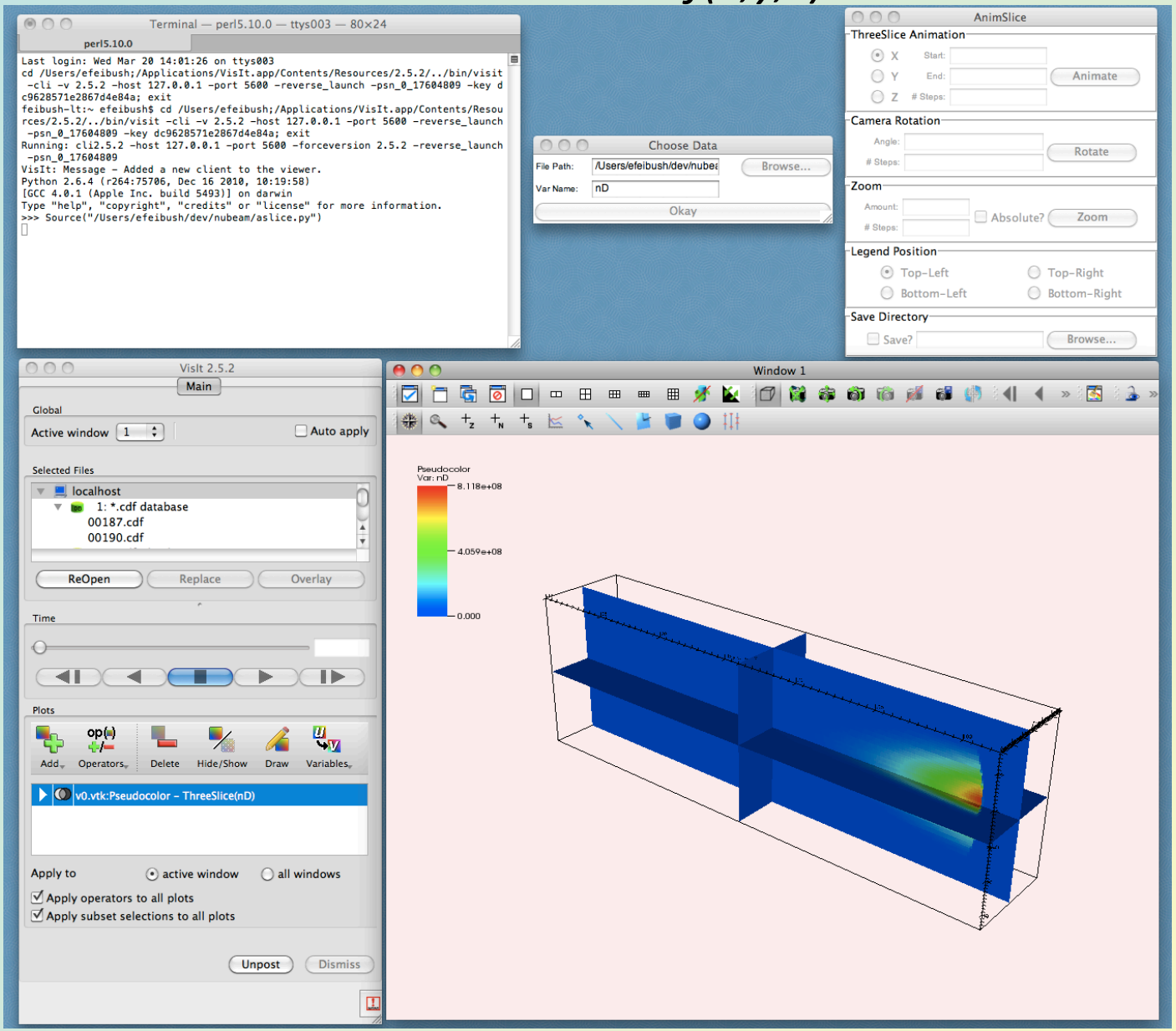
3x2x2 = 12 points

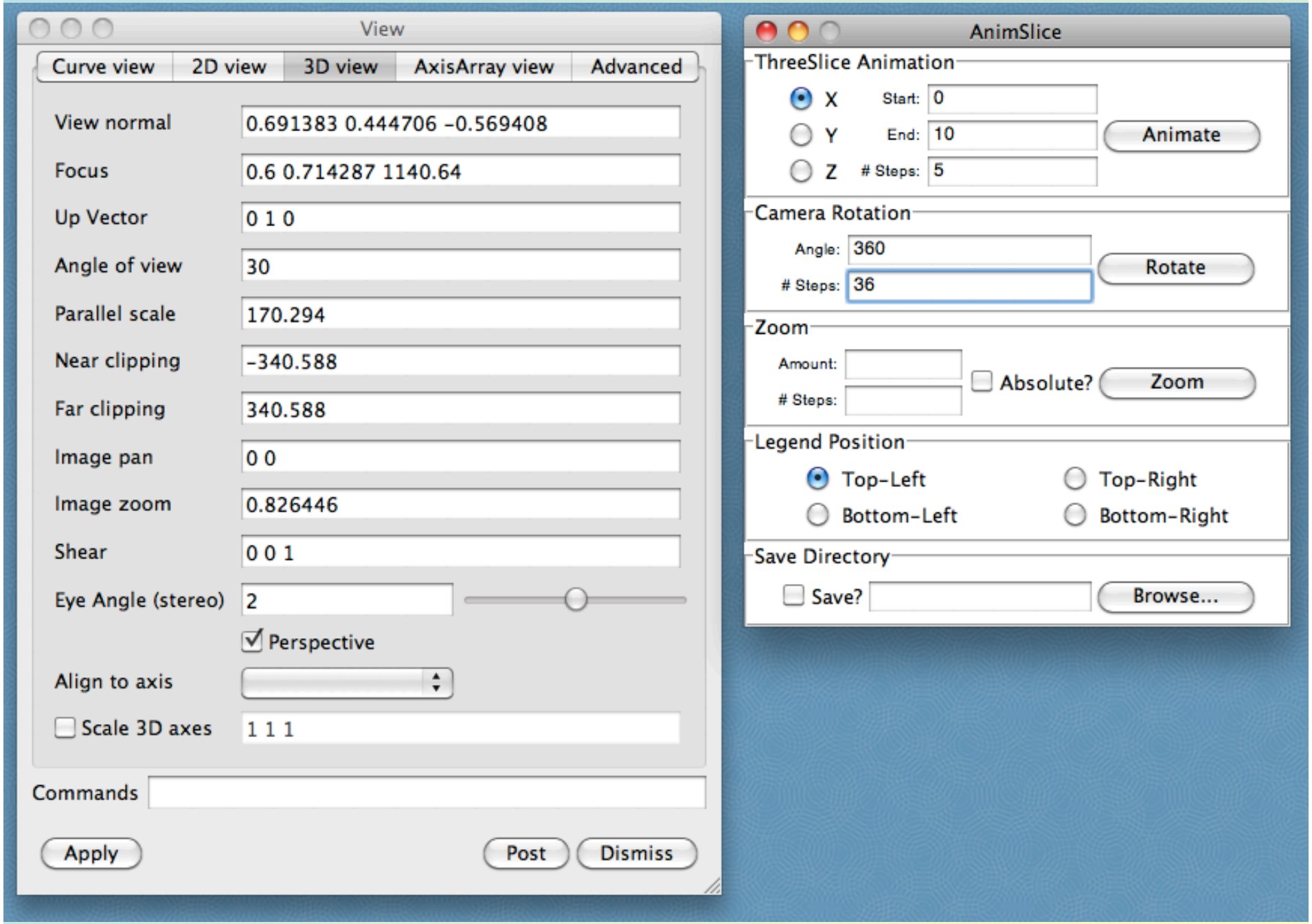
SCALARS density double



Slicing & Viewing Python Package

Exercise 6: *f(x,y,z)*

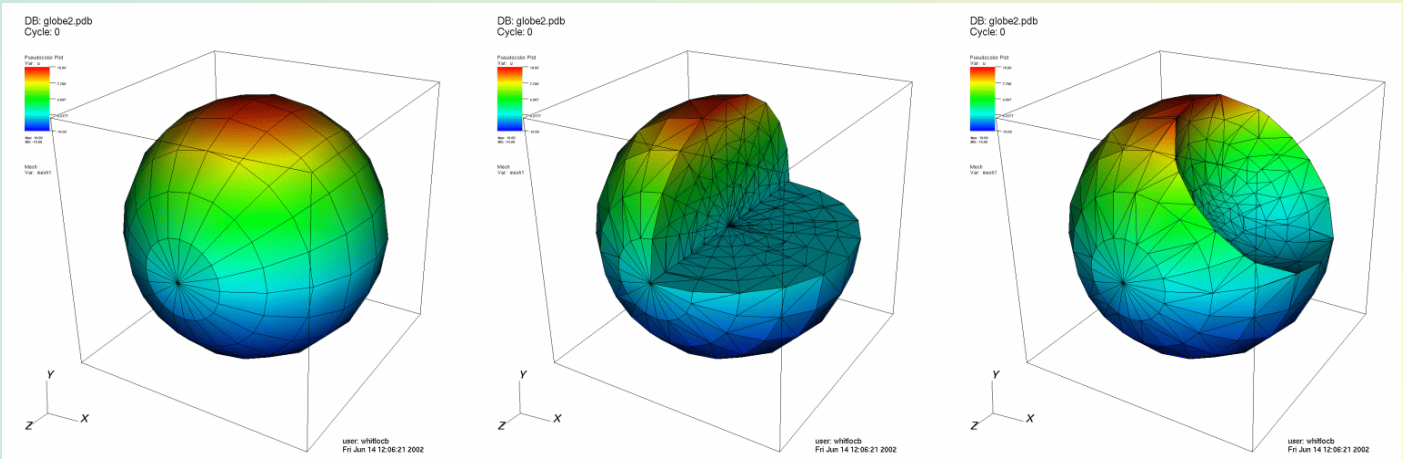



View
Curve view
2D view
3D view
AxisArray view
Advanced
View normal
0.691383 0.444706 -0.569408
Focus
0.6 0.714287 1140.64
Up Vector
0 1 0
Angle of view
30
Parallel scale
170.294
Near clipping
-340.588
Far clipping
340.588
Image pan
0 0
Image zoom
0.826446
Shear
0 0 1
Eye Angle (stereo)
2
Perspective
Align to axis
Scale 3D axes
1 1 1
Commands
Apply
Post
Dismiss
AnimSlice
ThreeSlice Animation
X
Y
Z
Start:
0
End:
10
Steps:
5
Animate
Camera Rotation
Angle:
360
Steps:
36
Rotate
Zoom
Amount:
Steps:
Absolute?
Zoom
Legend Position
Top-Left
Top-Right
Bottom-Left
Bottom-Right
Save Directory
Save?
Browse...

Clip operator

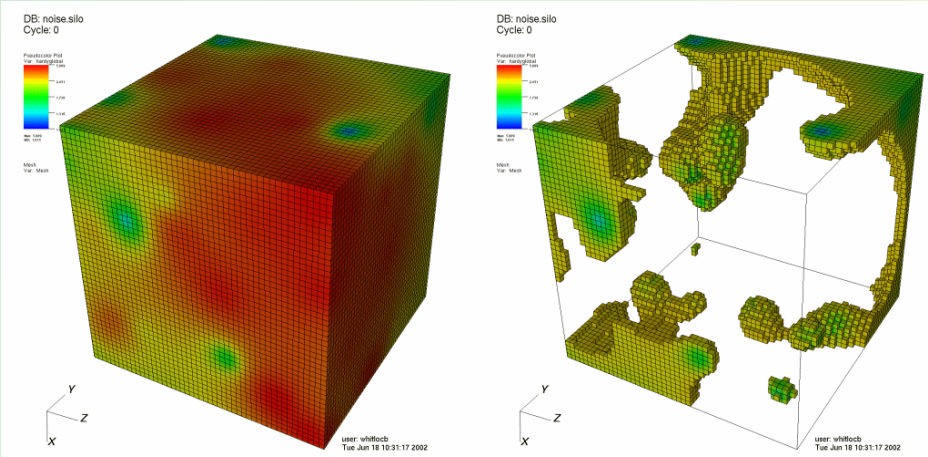
- The Clip operator clips 2D or 3D plots against planes or a sphere to remove sections of the plots
- Use this operator when you want to see a cross section of a 3D plot, while still leaving the plot in 3D

Original plots | Plots clipped with 2 planes | Plots clipped with a sphere

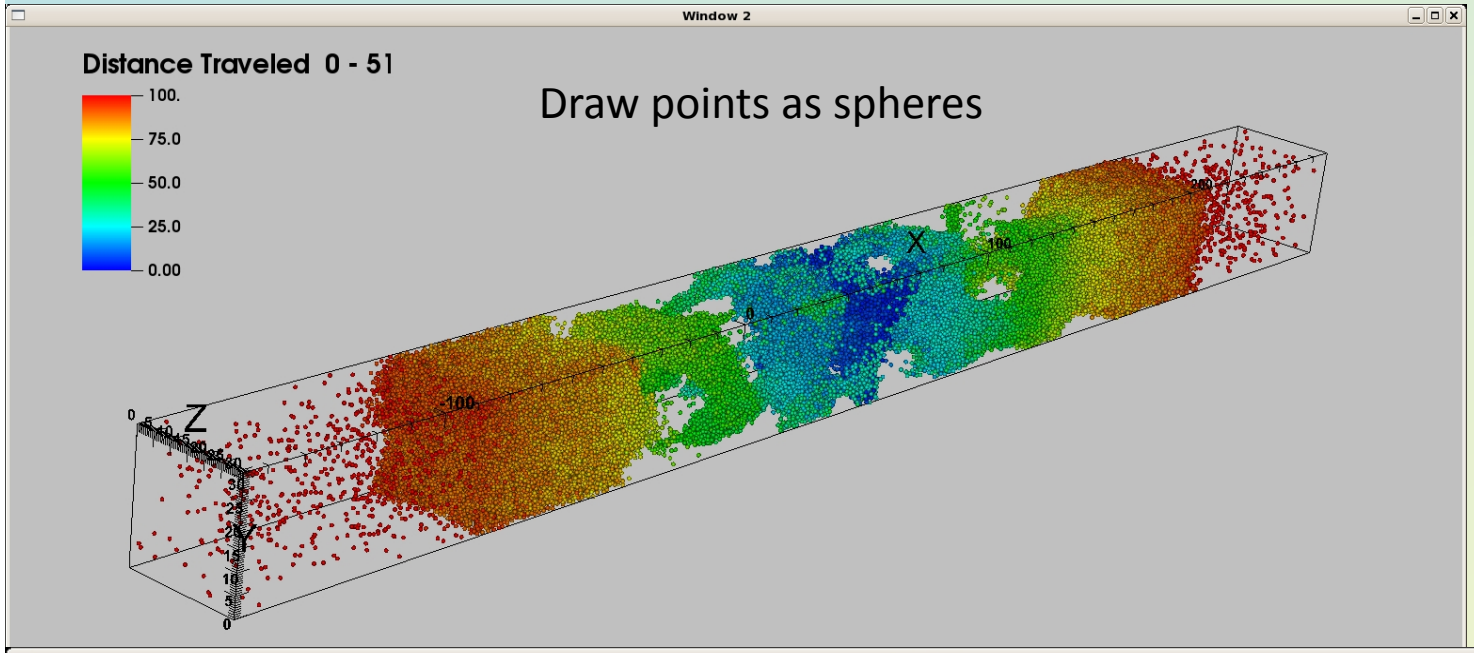


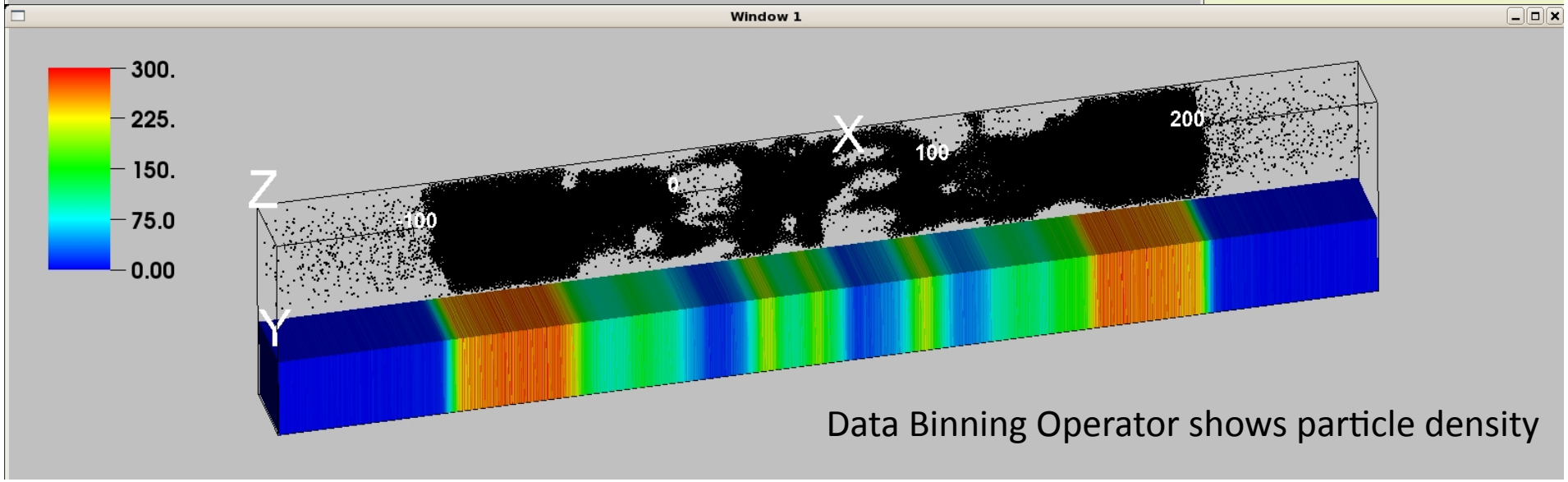
Threshold operator

- Removes cells whose value is not in the specified range
- Use this operator when you only want to look at cells that have values within an interesting range



Molecular Dynamics Example





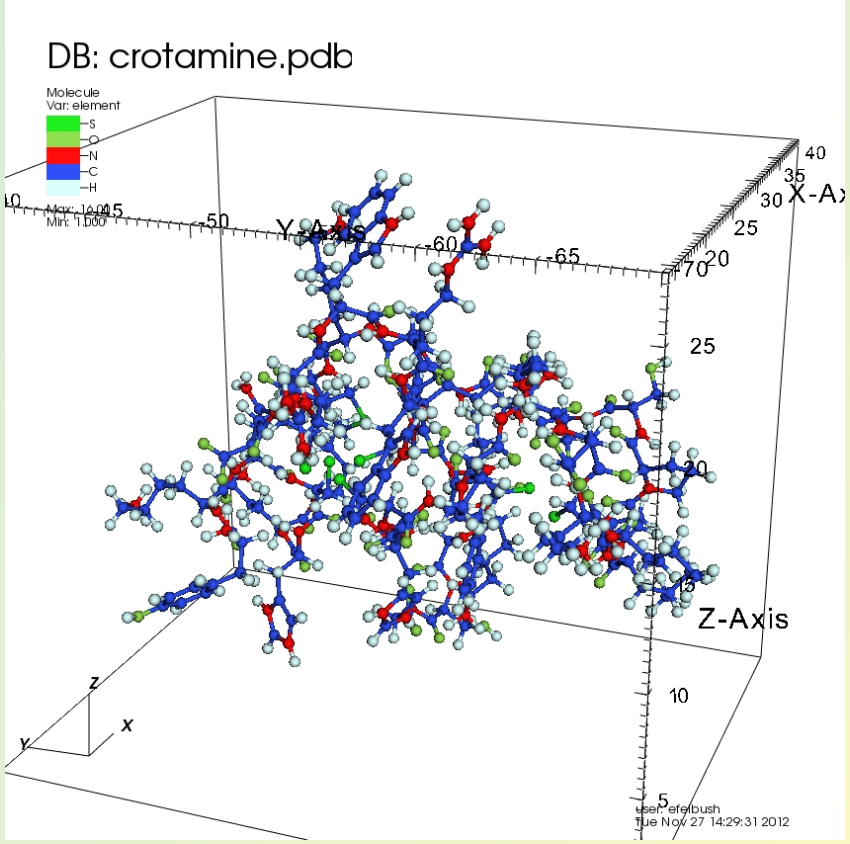
Exercise 7

Open File crotamine.pdb

(Protein Data Bank)

Add Molecule→element

attributes



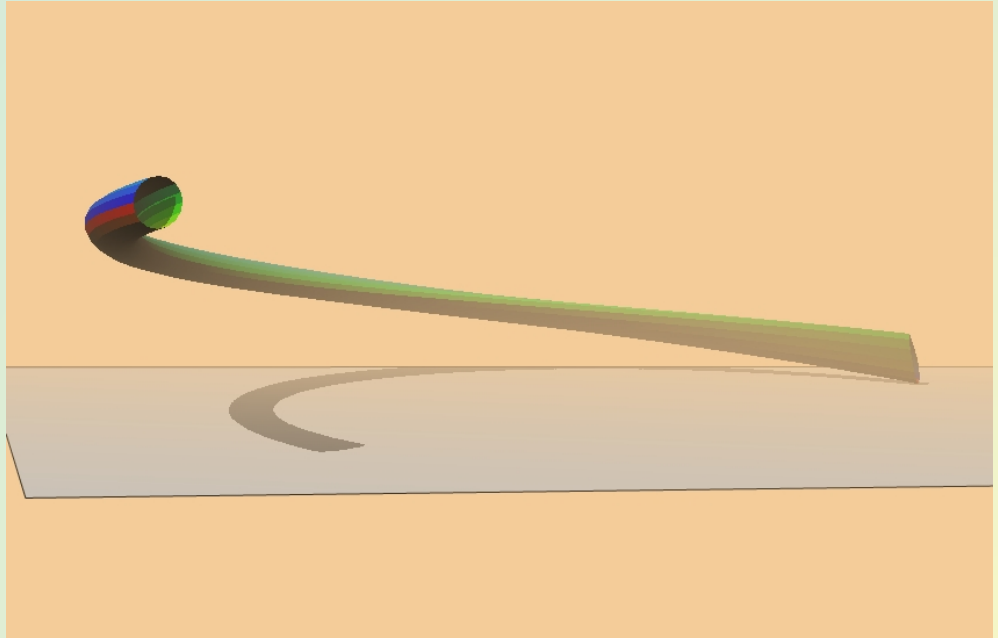
Exercise 8

Open File base.vtk

Open File fluxtube.vtk

Controls→Annotation

Options→Rendering ...



Animation

Time step
Variable index
Geometry change

View
Operators (slice, clip, etc.)

Simple vtk time steps
or
Complex python scripting

jpeg files → QuickTime .mov

Python interpreter -

```
import myscript
    [ edit, retry ]
reload(myscript)
```

Movie Maker Program

- Java – portable to Linux, Mac, Windows
  - Based on Sun's javax.media package.
- Reads all images in directory – JPEG, PNG
  - ImageMagick: mogrify -resize 100% *.jpeg
- Creates QuickTime movie file - .MOV

Eliot's pppl.gov website

w3.pppl.gov/~efeibush

Parallel Rendering Set Up

***on della* – runs engine_par as batch job**

.cshrc or .bashrc:

module load openmpi/intel-11.1/1.4.3/64

***on your desktop computer* -**

~/.visit/hosts/host_della.xml

config file for client-server operation

Summary of Today's Features

Plots + Attributes
- Mesh
- Pseudocolor
  - Points, Lines, Vectors, Polygons, Mesh – Color Tables
- Contour
- Molecule
- Volume

Data files
- Point3D, xmdv
- VTK

Transform operators
- Scale, Rotate, Translate

Selection operators
- Clip
- Box
- Threshold

Slicing operators
- Slice, ThreeSlice
- Isosurface

Viewing

Lighting, Shadow, Depth-Cue

Annotation

Animation
- Simple Time Slider movie
- Python scripting

Parallel Rendering

JPEGs to QuickTime movie

Resources

www.princeton.edu/~efeibush
Visualization with VisIt mini-course

https://wci.llnl.gov/codes/visit - downloads
web search: visit visualization

https://trac.princeton.edu/vislab
parallel rendering config file: host_della.xml

visitusers.org
search ...

Contact

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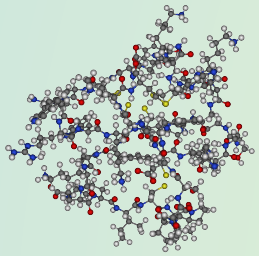
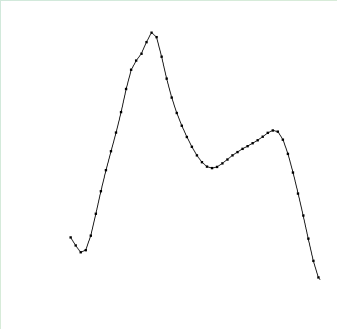
Supported mesh types

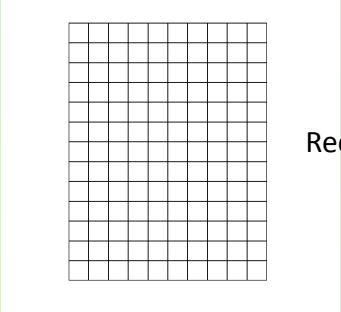
- 1D Curves
- 2D/3D meshes
  - Rectilinear
  - Curvilinear
  - Unstructured
  - Points
  - AMR
  - Molecular



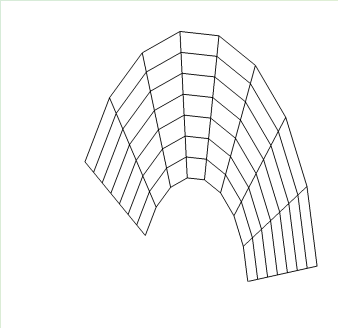
Molecular



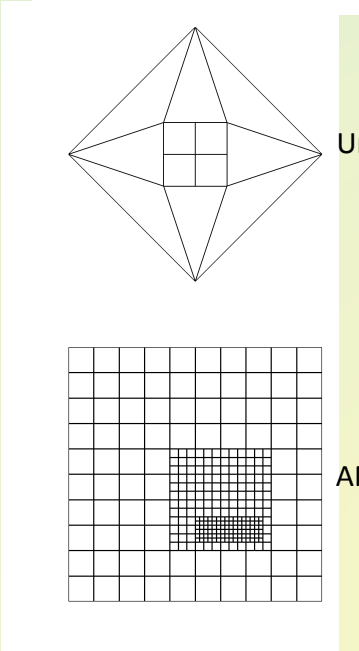
Curve



Rectilinear



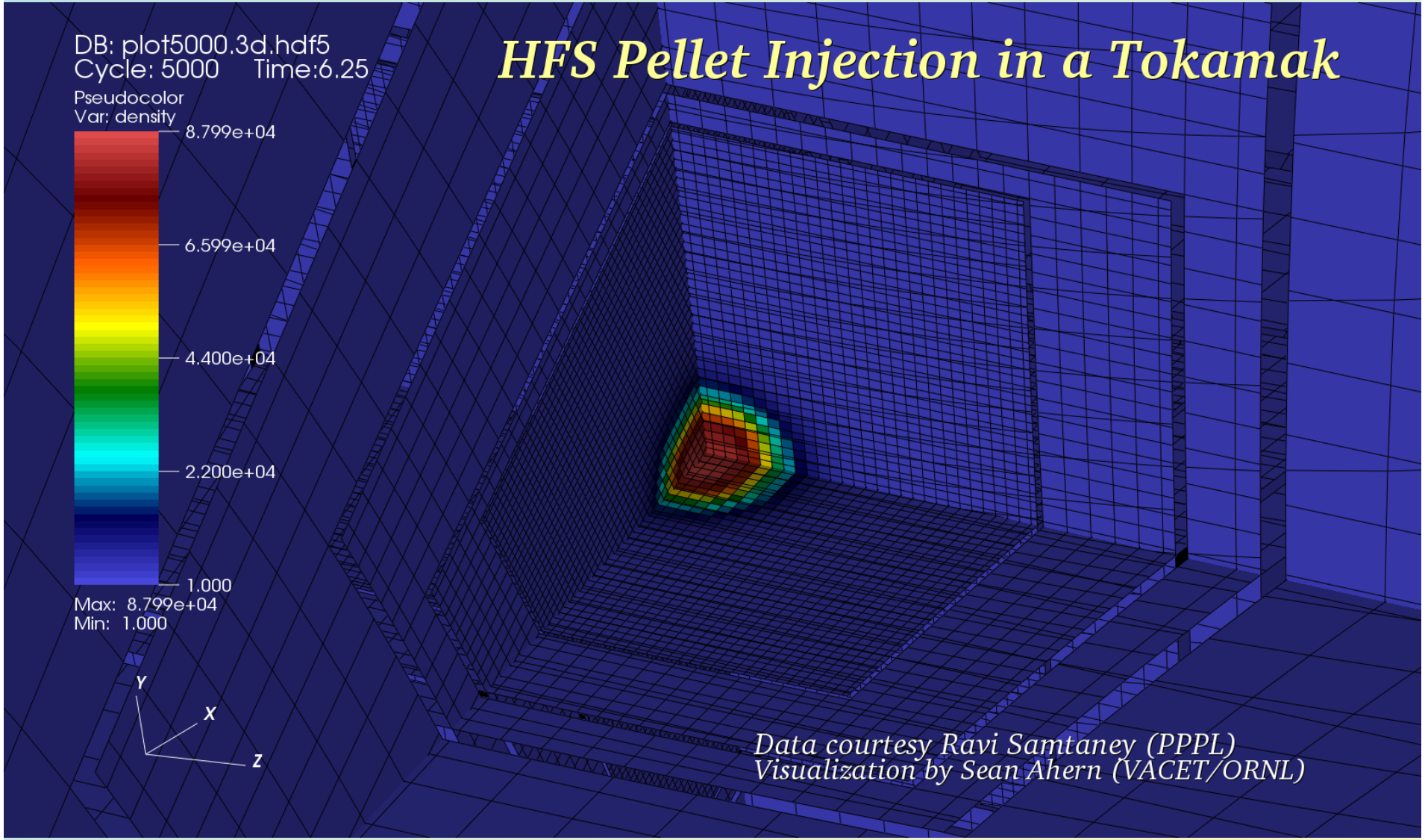
Curvilinear



Unstructured

Points

AMR



Three-Slice Operator on Adaptive Mesh

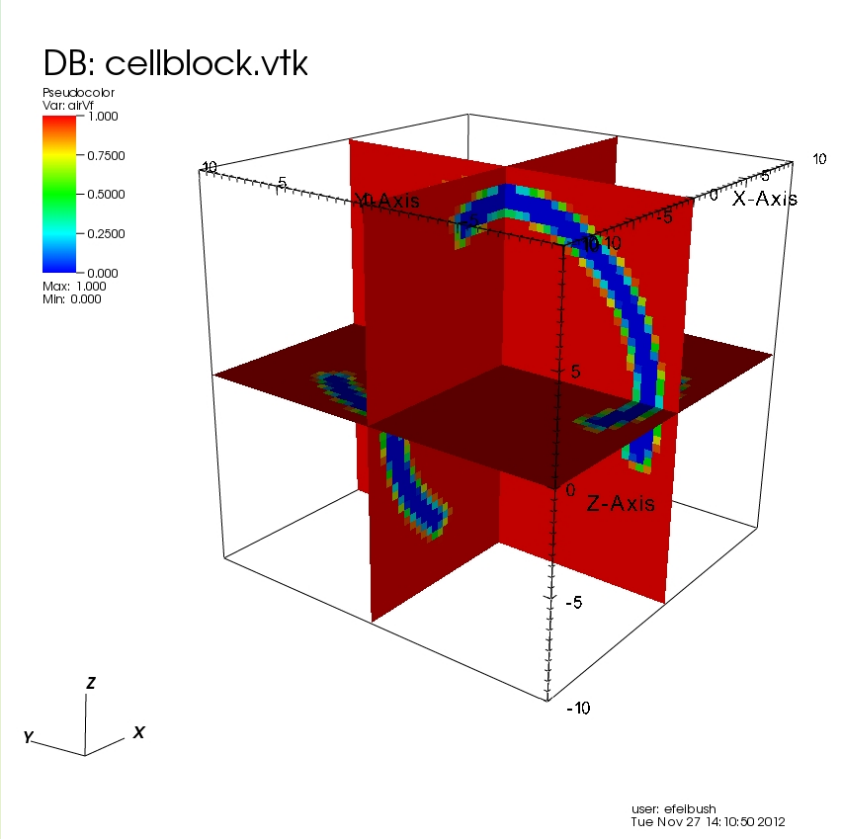
Exercise 6

Open File cellblock.vtk

Add Pseudocolor→airVf

Operators→Slicing→Slice

Tools→Plane

Operators→Slicing→ThreeSlice

Tools→Point