Three-Dimensional Graphics

as a Tool for Studying Dynamics

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Contributions from: Aaron Coutino, David Deepwell, Andrew Grace, Jared Penney

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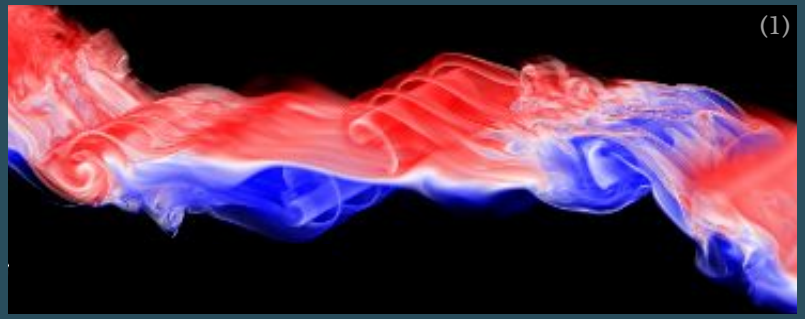
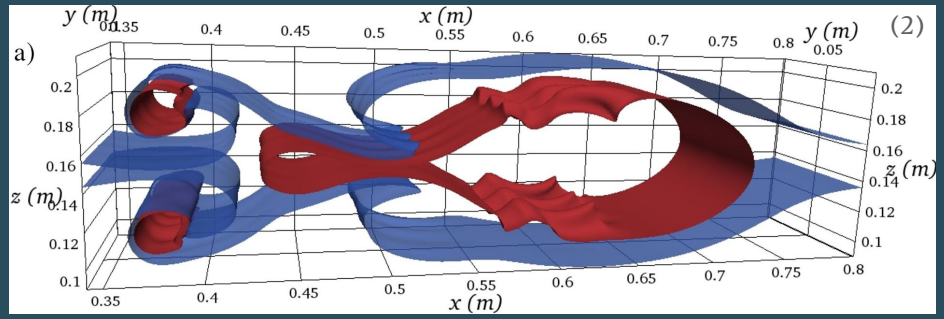
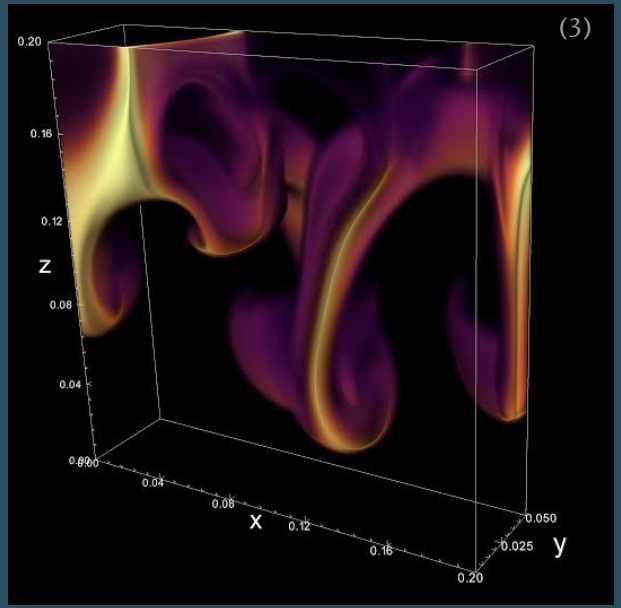
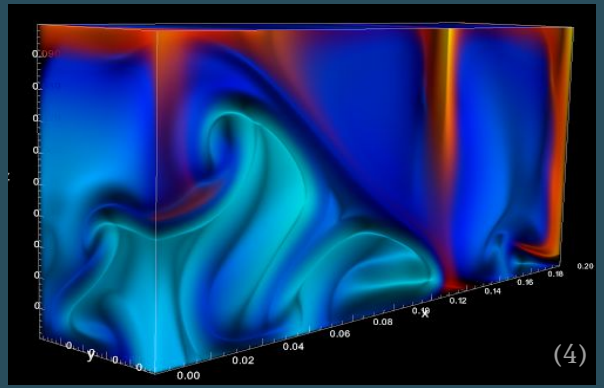
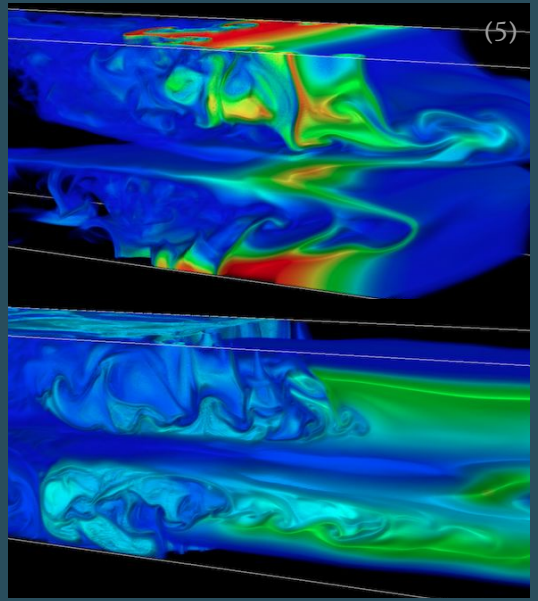






3D Graphics: Where to begin?





Images: Andrew Grace (1), David Deepwell (2), Laura Chandler (3-4), Aaron Coutino (5)

3D Graphics: Where to begin?

File Type: netCDF

- Represents scientific data using arrays
- Scalable
- Portable
- Appendable

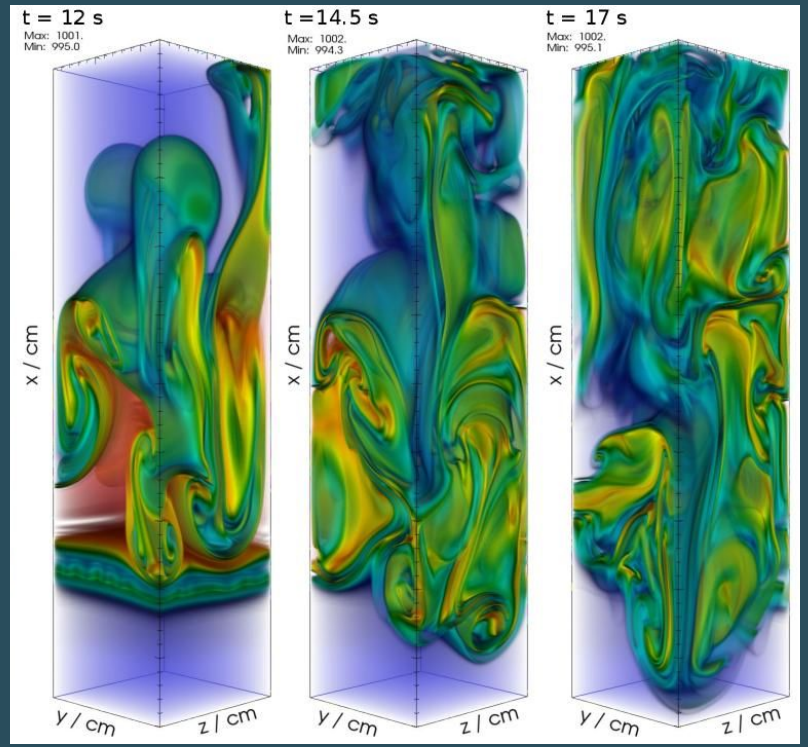
Visualization Tool: VisIt

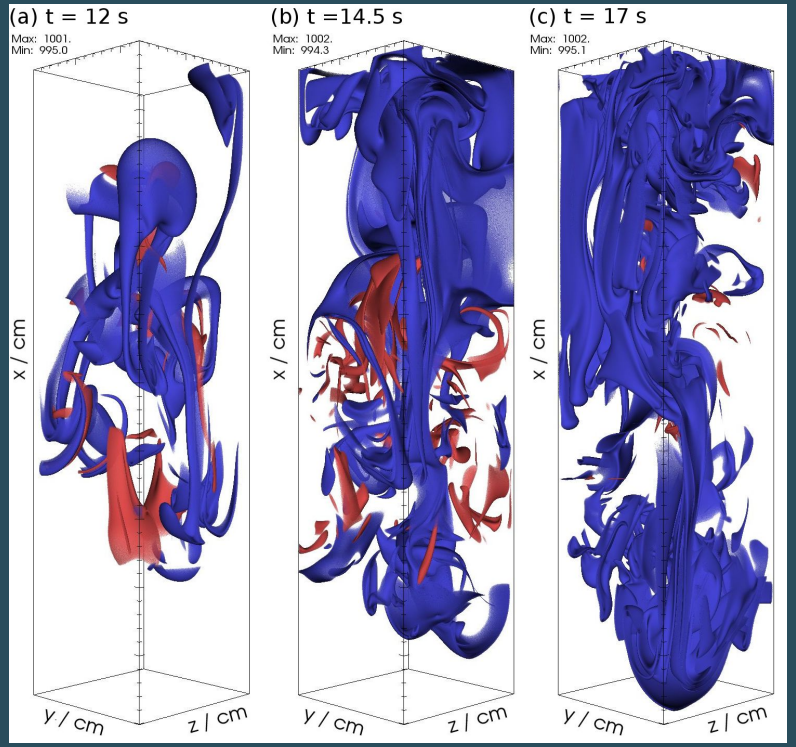
- Interactive
- Scalable
- Parallel
- Supports different meshes
- Plot vector, scalar, tensor fields
- Easy graphical interface

VisIt is compatible with...

- ANSYS
- Boxlib
- CGNS
- Chombo
- CTRL
- Ensight Gold
- Enzo
- Exodus
- FITS
- FLUENT
- FVCOM
- GGCM
- GIS
- H5Nimrod
- H5Part
- Image
- ITAPS
- MFIX
- MM5
- NASTRAN
- Nek5000
- NetCDF
- OpenFOAM
- PATRAN
- Silo
- Spheral
- VTK
- Wavefront OBJ
- Xmdv
- XDMF
- ZeusMP
- And more!

VisIt: Both visually pleasing and scientifically relevant

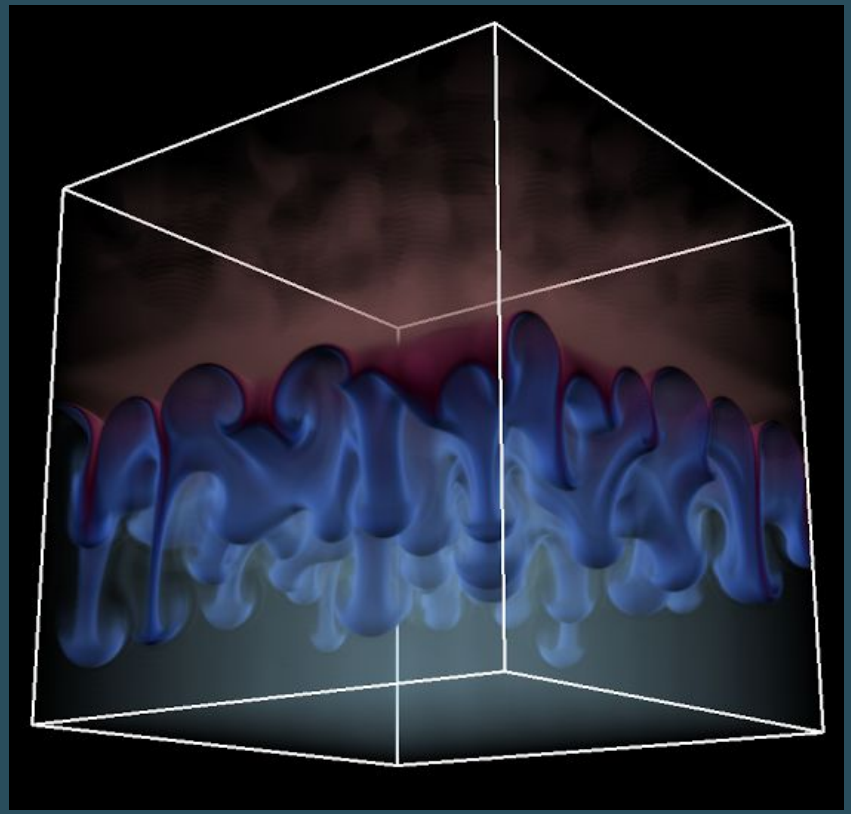




Images: Jared Penney

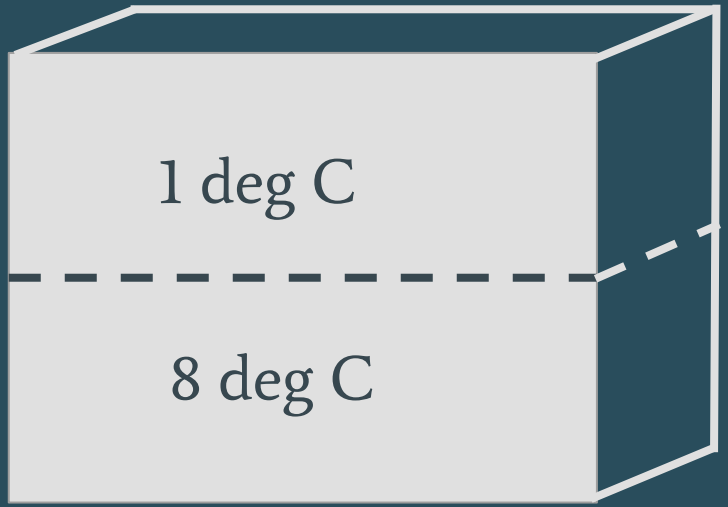
VisIt in 6 steps:

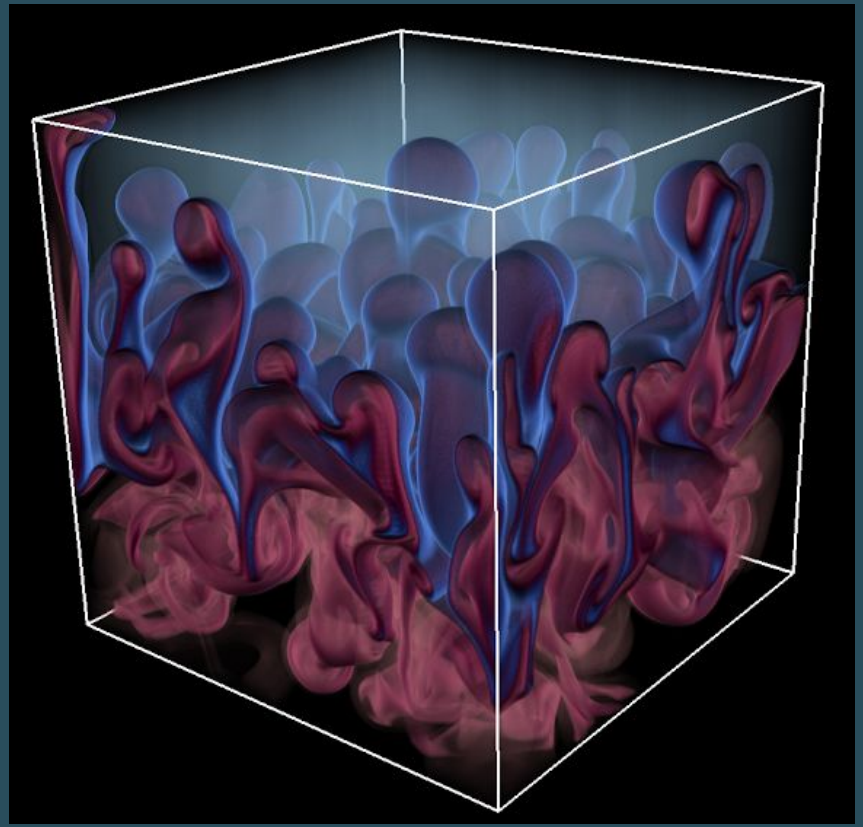
- Expressions
- Plot types
- Colormaps
- Opacity
- Creativity!
  (lighting, movies, etc.)
- Python scripting



Model Setup

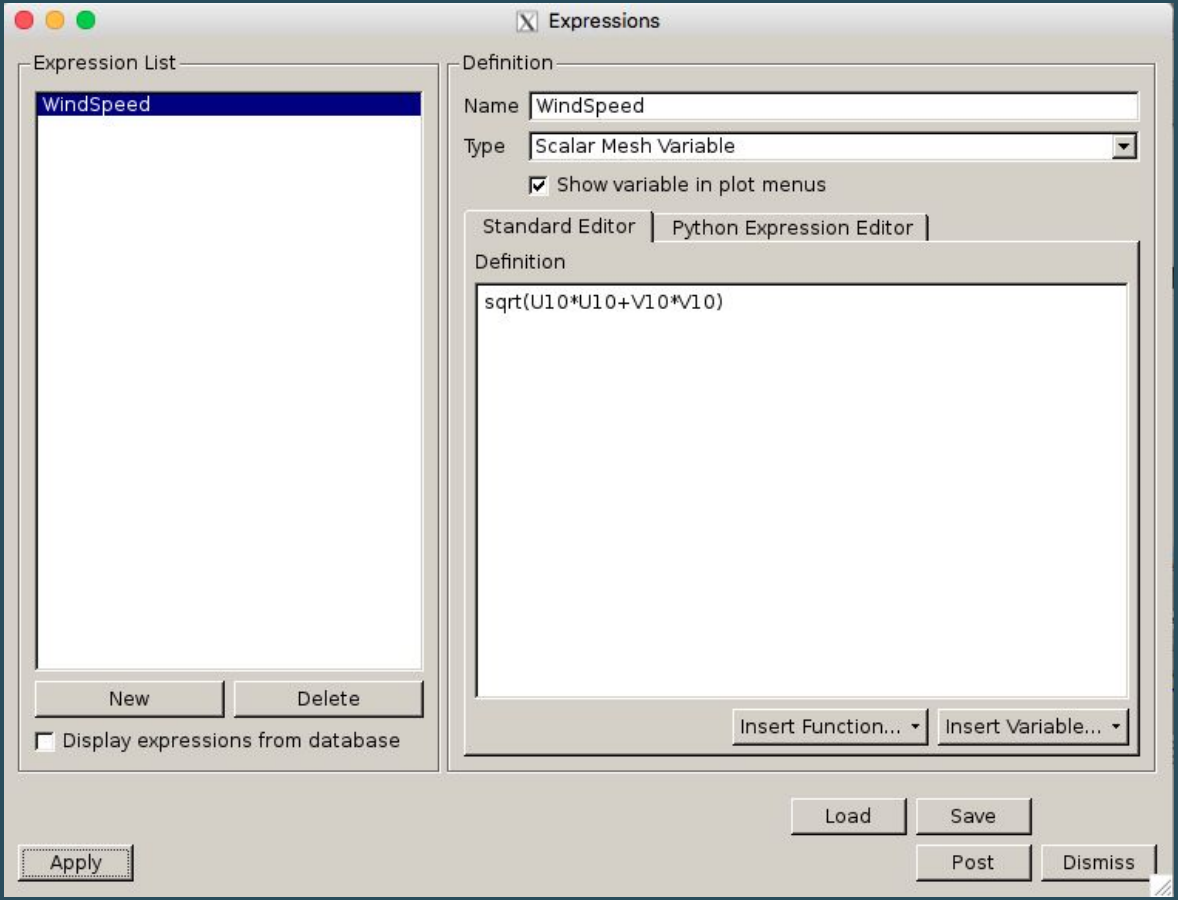
Rayleigh Taylor setup
near density maximum





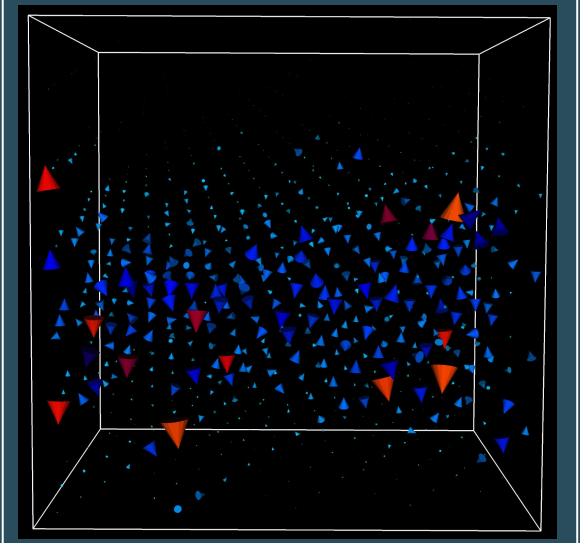
Expressions

Calculate new fields with given info

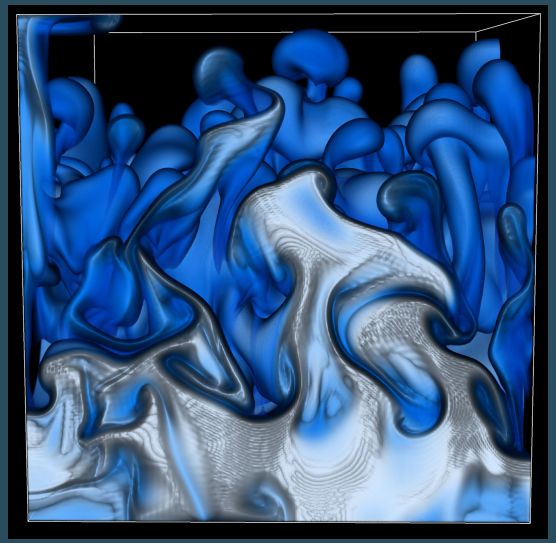


Types of plots:

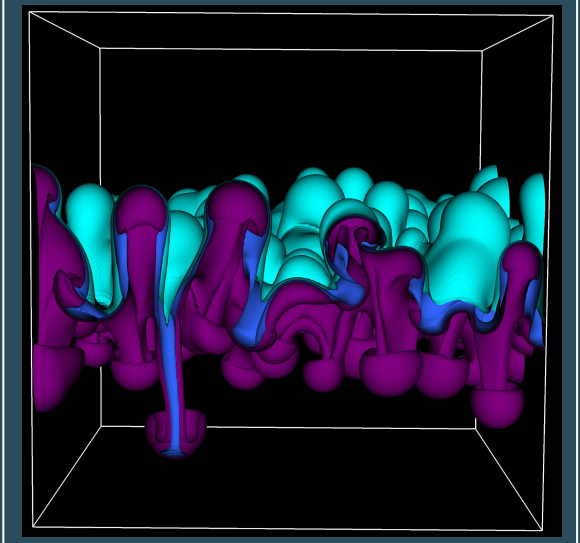
Vector



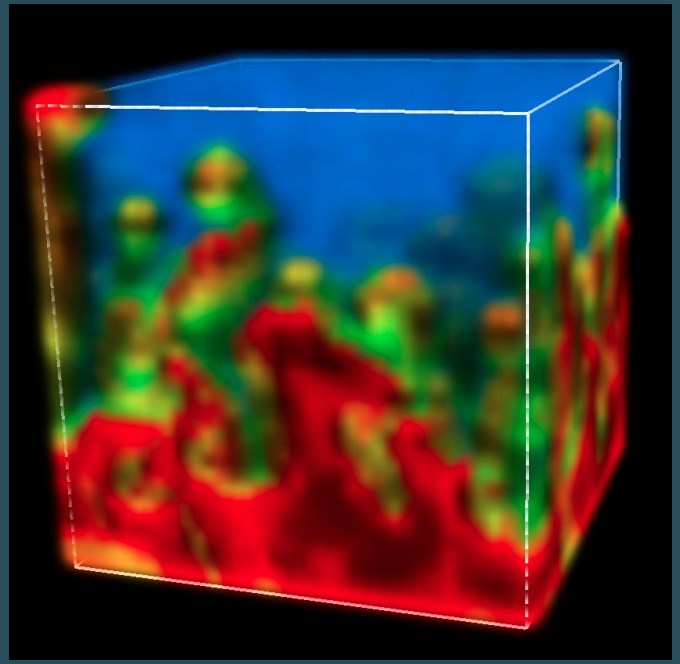
Volume



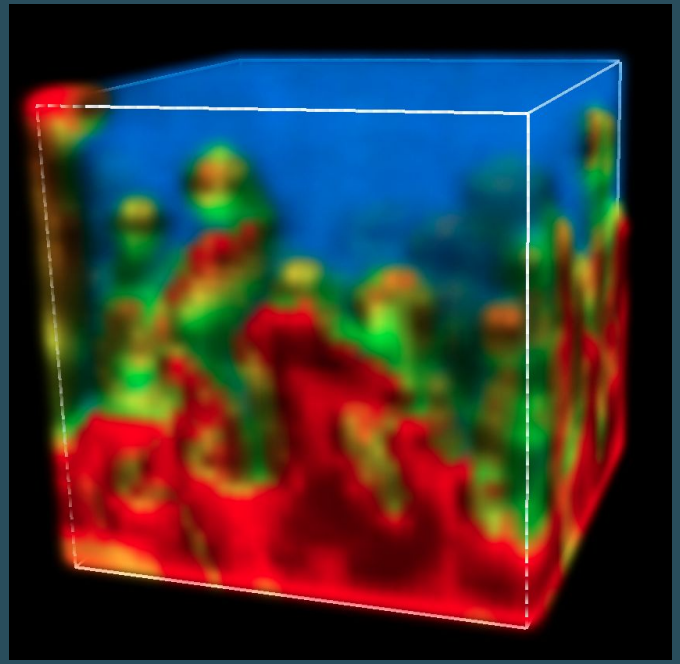
Contour



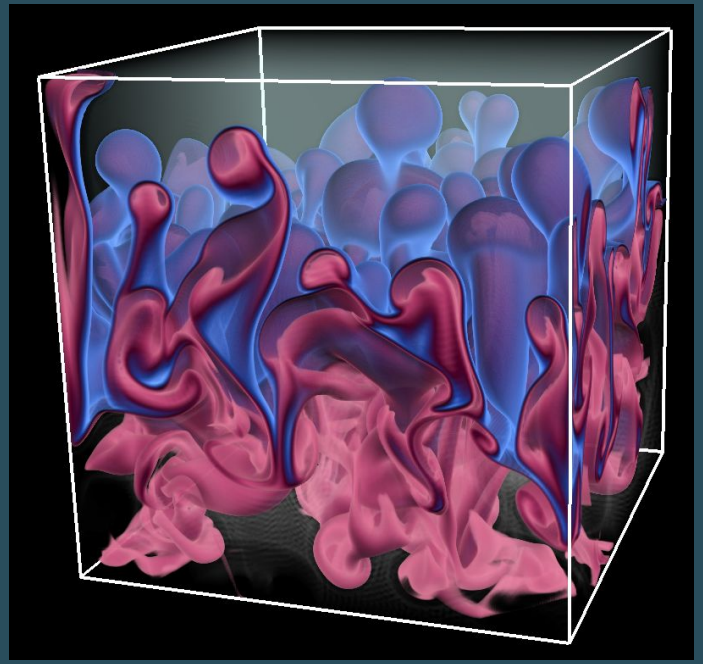
Volume Plots



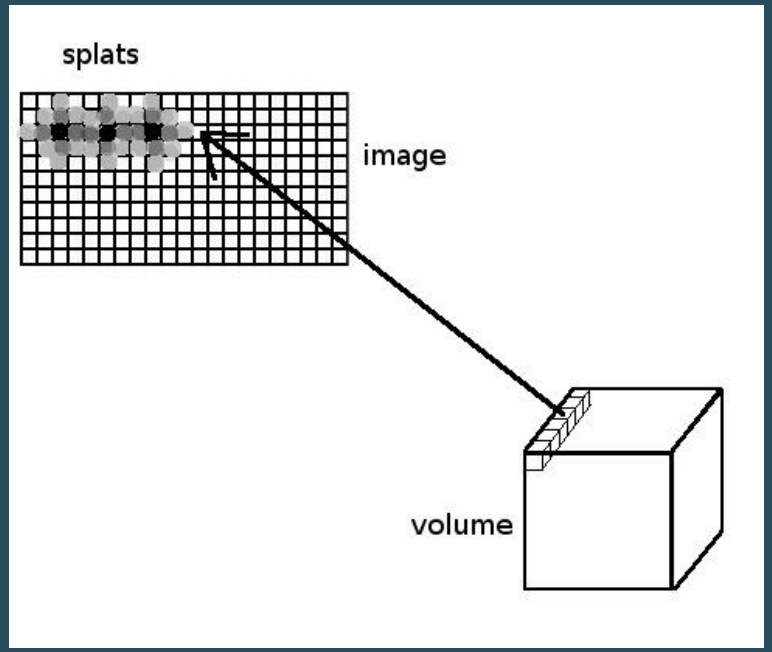
Volume Plots



???



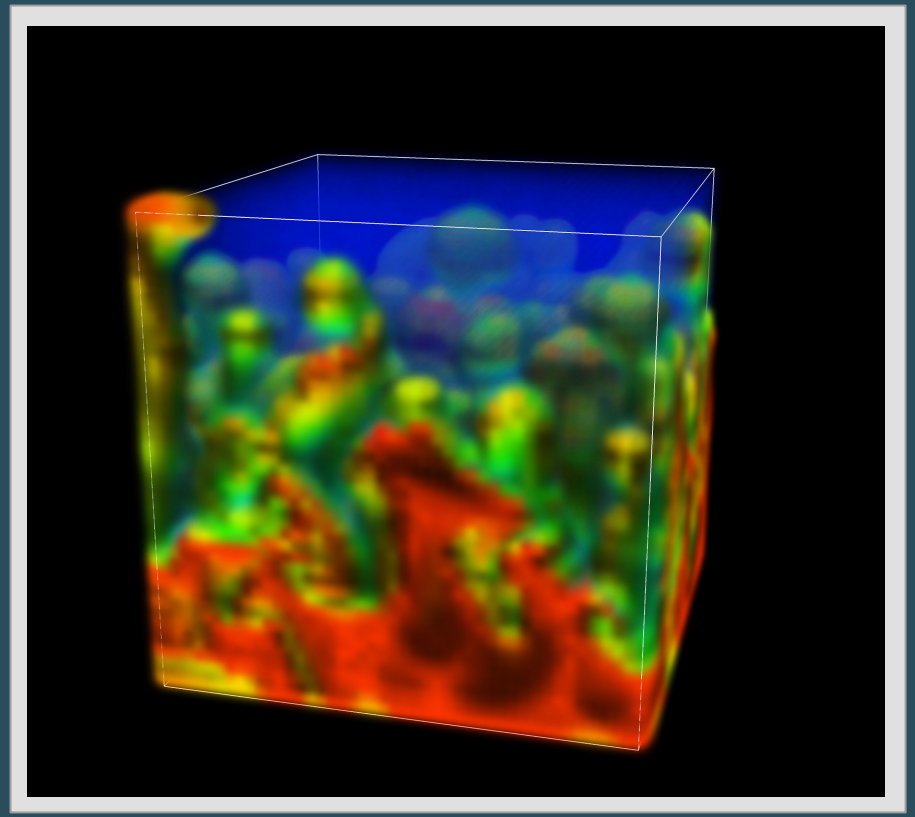
Volume Plots - Splatting



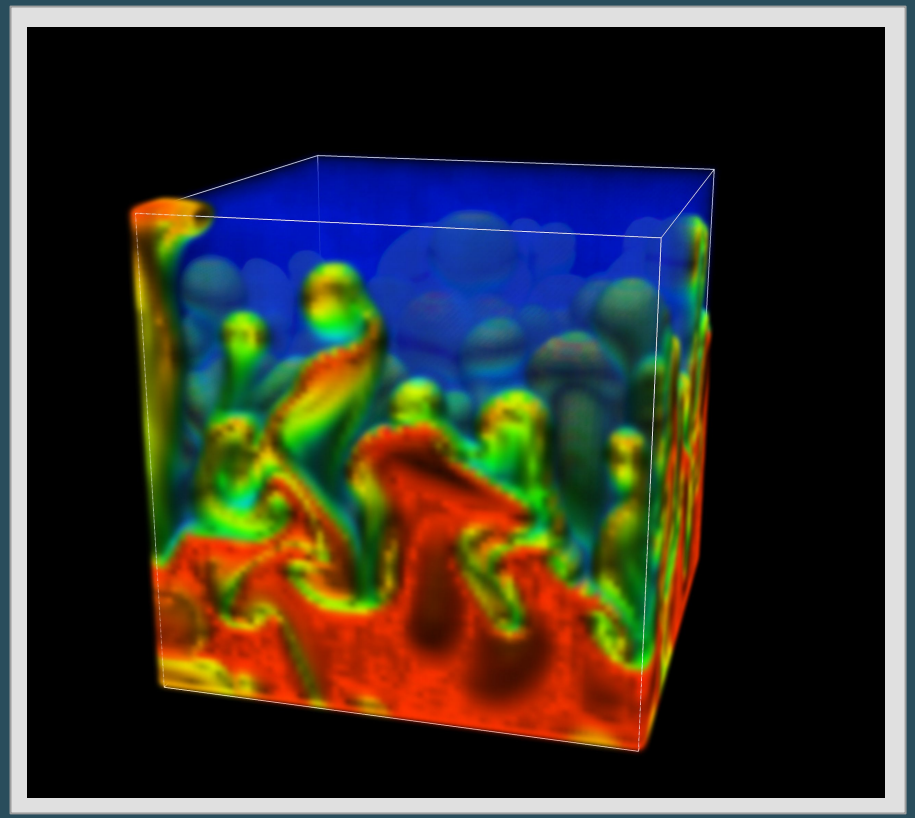
Splatting - draws every single voxel from the 3D mesh onto the 2D image, from back to front.

Splatting is faster since every voxel is a sample of many mesh points.

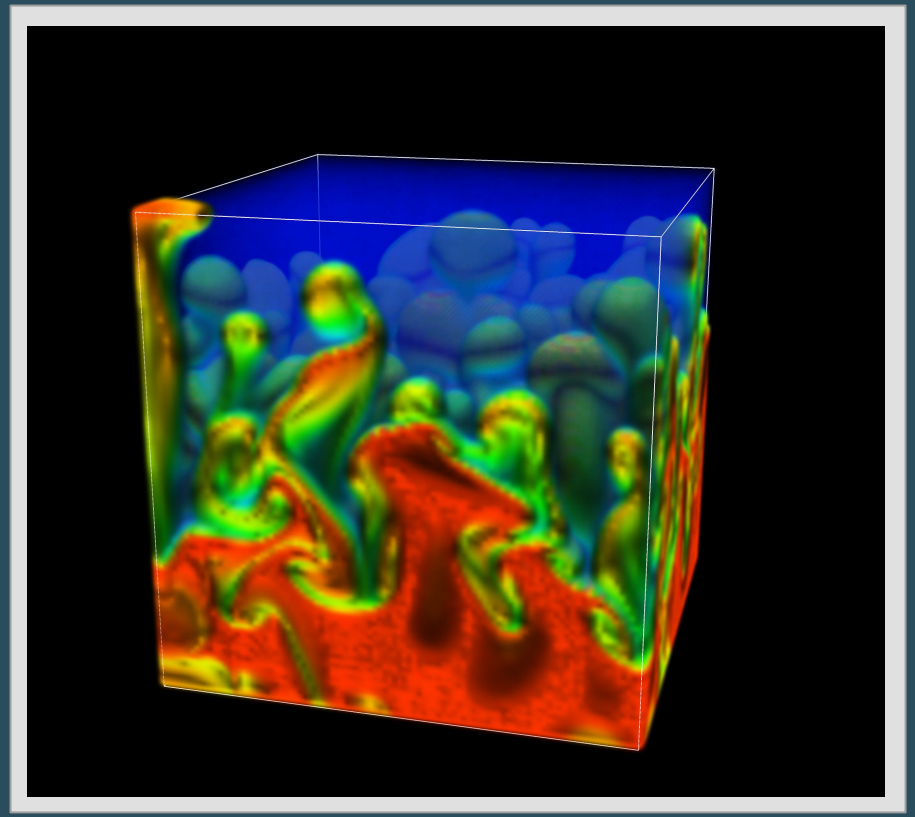
Image: Bloch (2006)



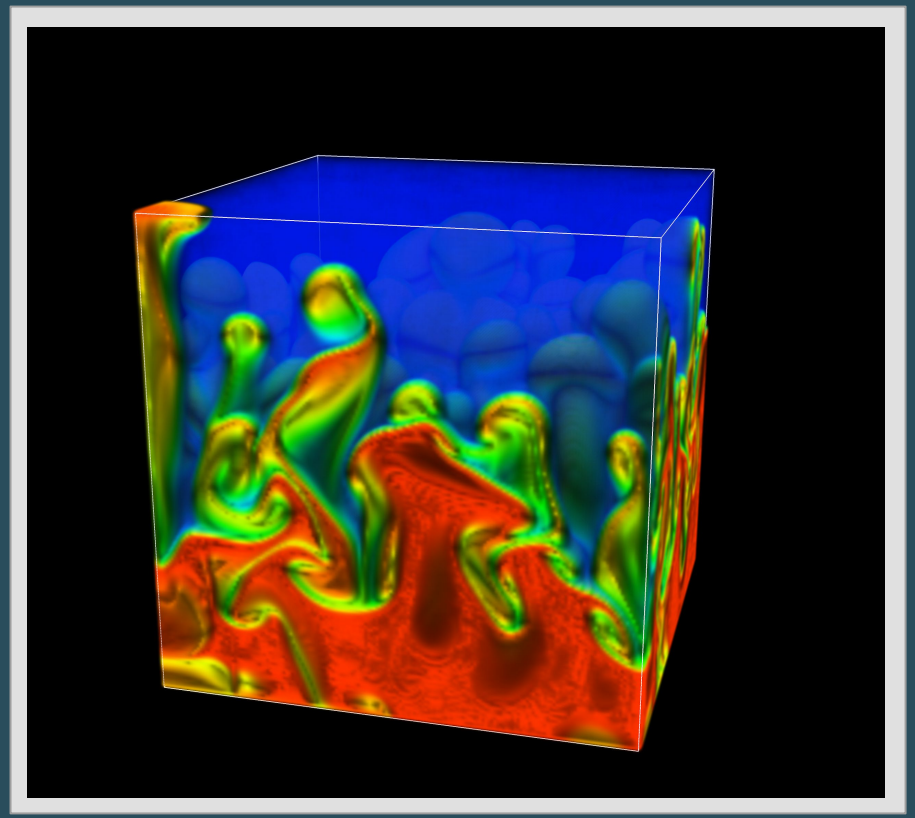
Splatting - 100 000 samples



Splatting - 500 000 samples

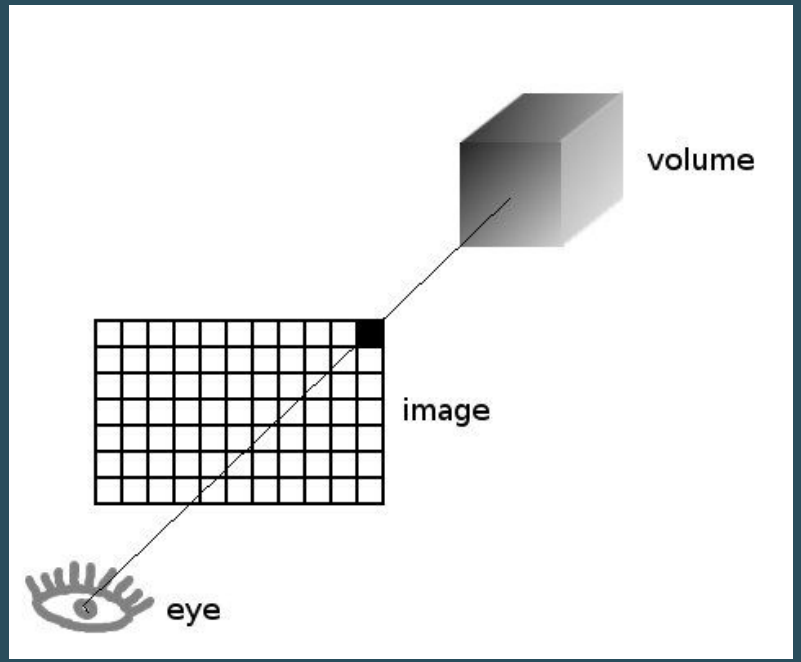


Splatting - 1 000 000 samples



Splatting - 5 000 000 samples

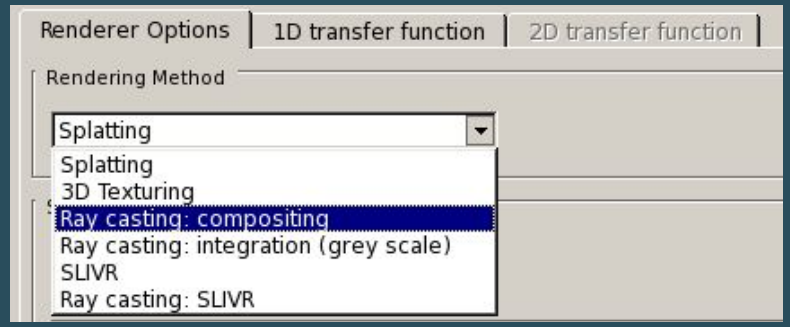
Volume Plots - Ray Casting

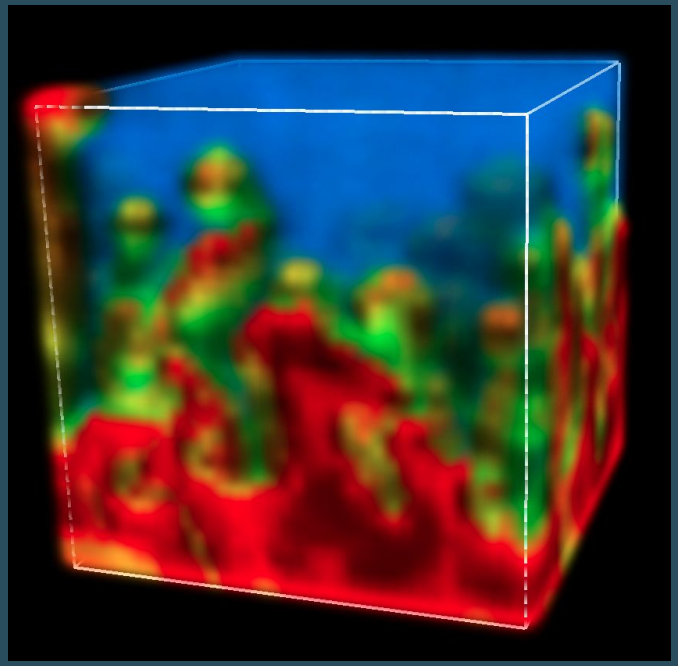


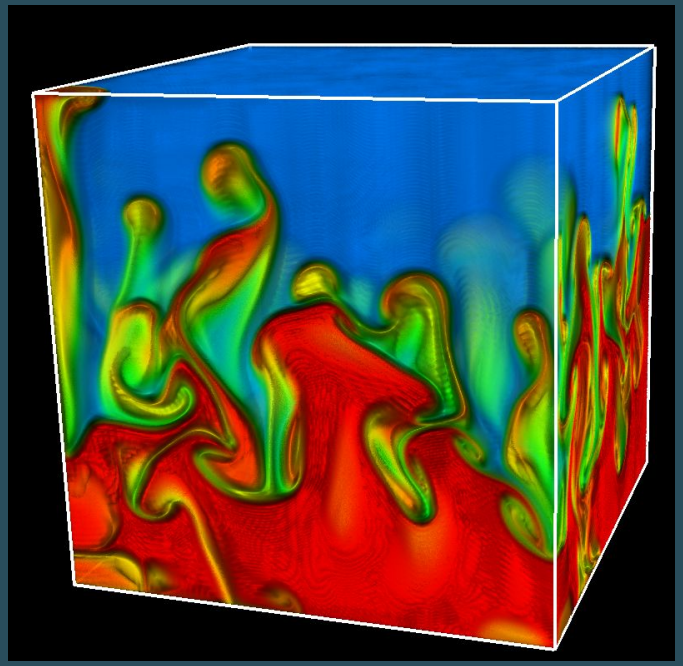
Ray Casting - converts a 3D mesh to 2D by drawing only the pixels needed, as seen by an ‘eye’ (or a ‘ray’).

Even though Ray Casting is parallel, it’s slower since it shows all the data instead of a sample.

Image: Bloch (2006)

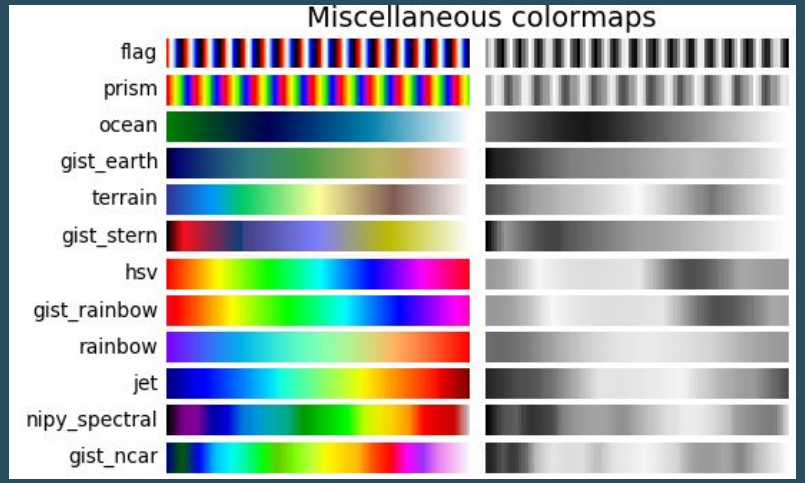

Renderer Options
1D transfer function
2D transfer function
Rendering Method
Splatting
Splatting
3D Texturing
Ray casting: compositing
Ray casting: integration (grey scale)
SLIVR
Ray casting: SLIVR

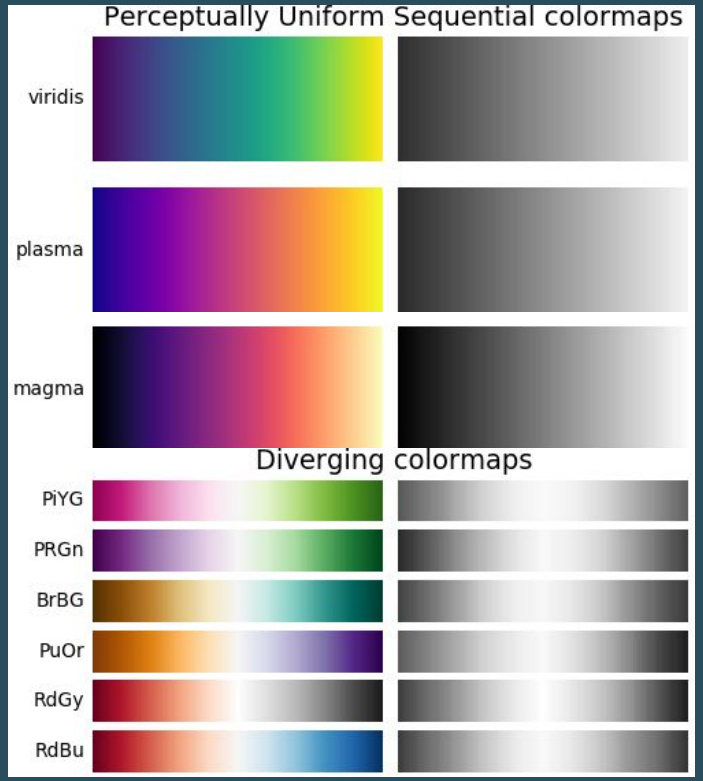


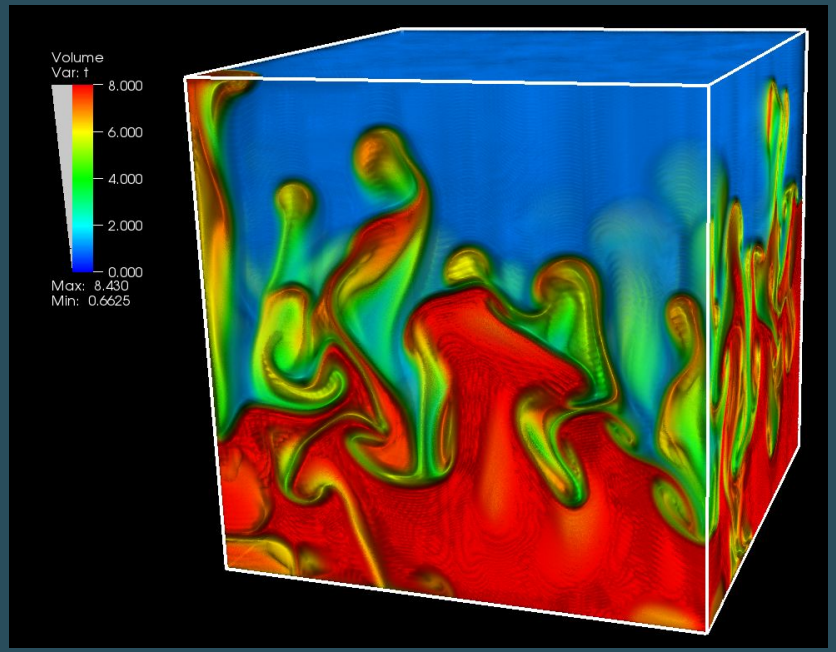


Colormaps - make your own!

Choose colormap based on your data
Consider how it looks in grayscale, avoid red/green together (VisCheck)



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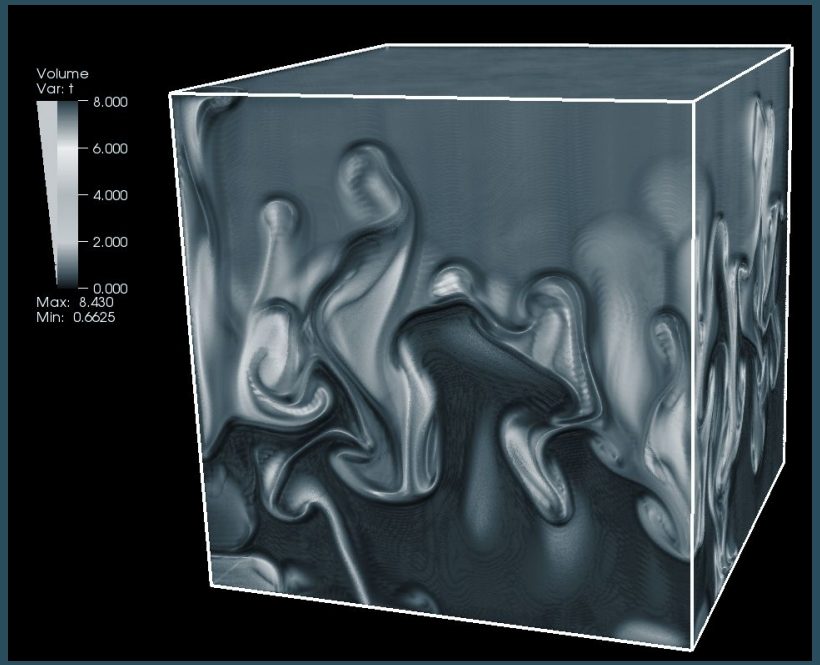
Max: 8.430
Min: 0.6625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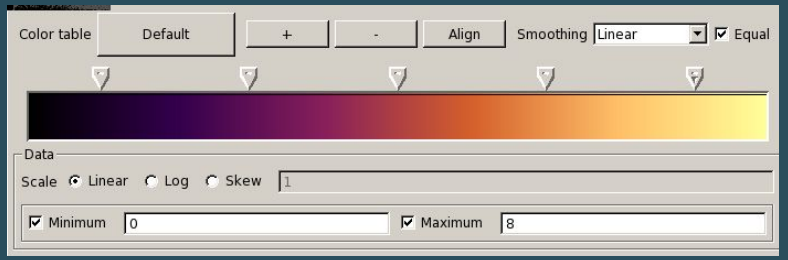
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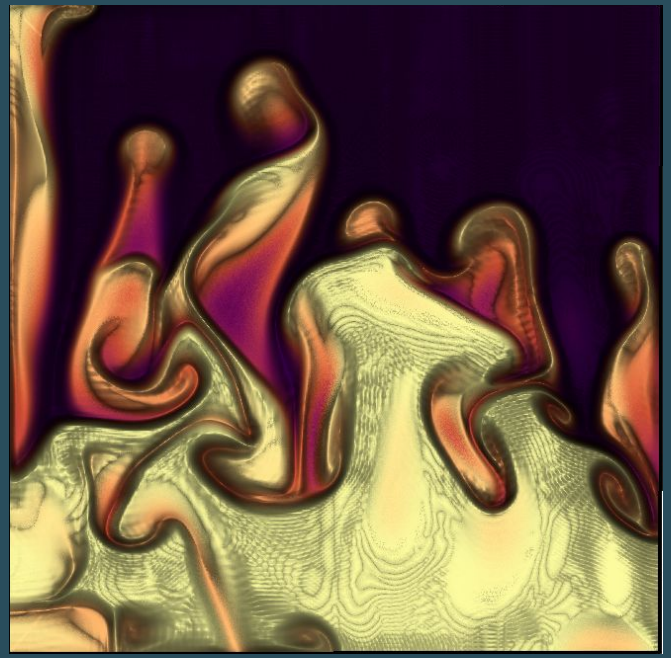

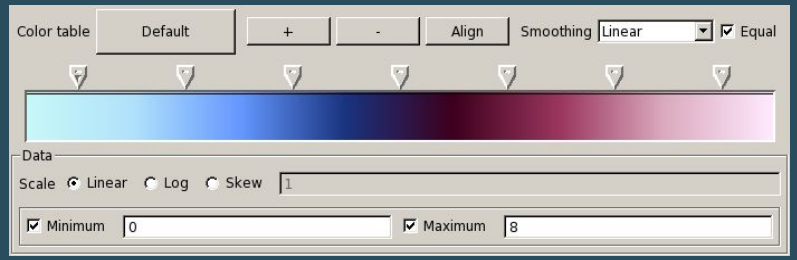
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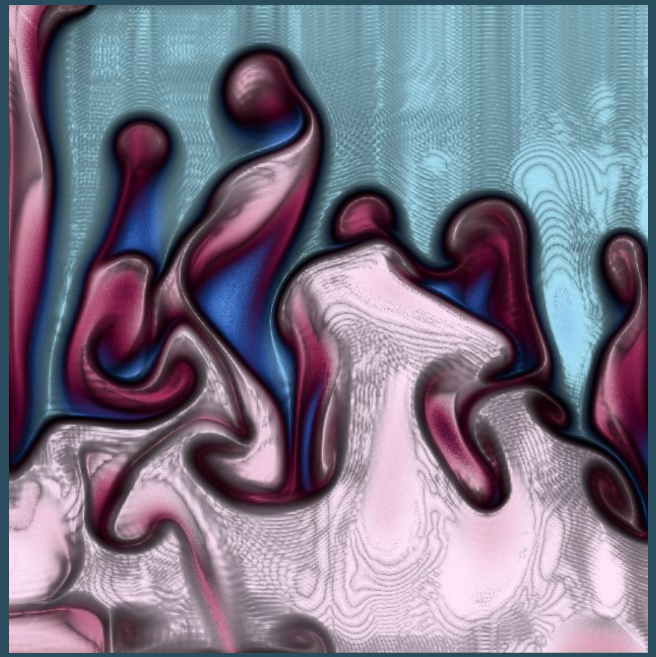


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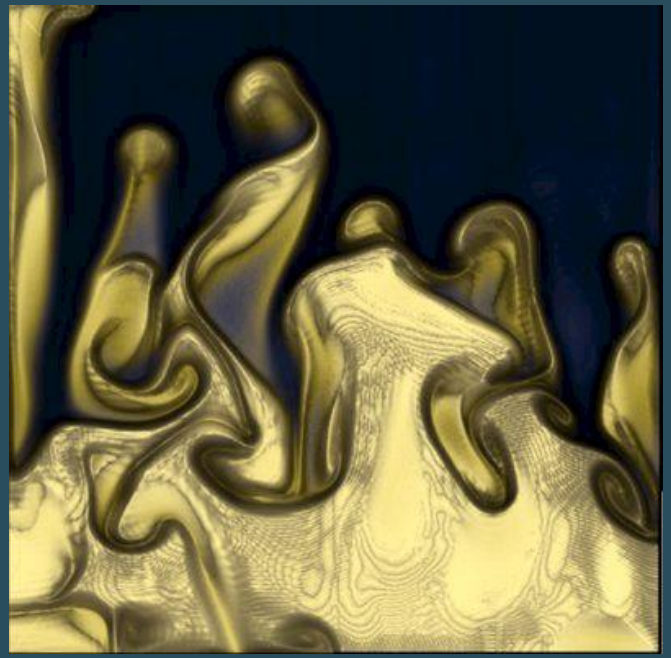


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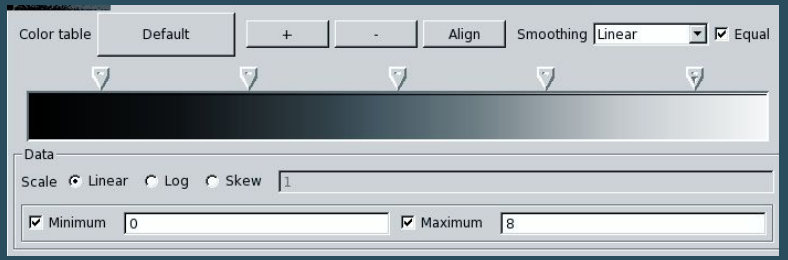
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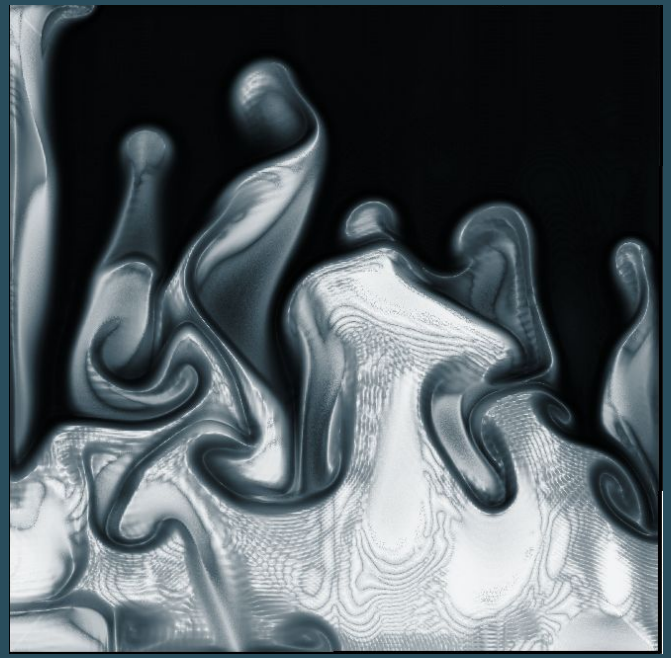

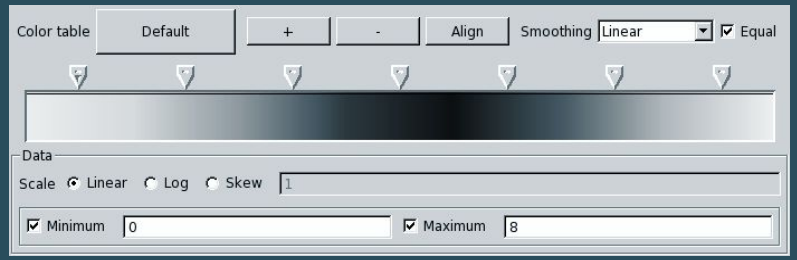
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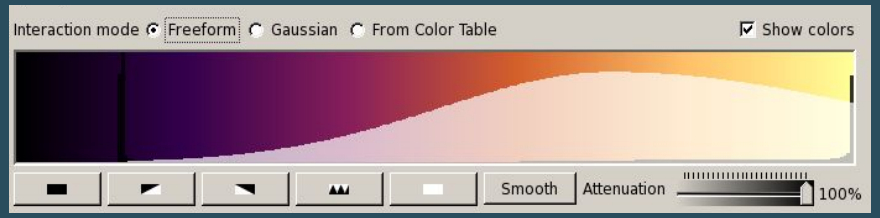
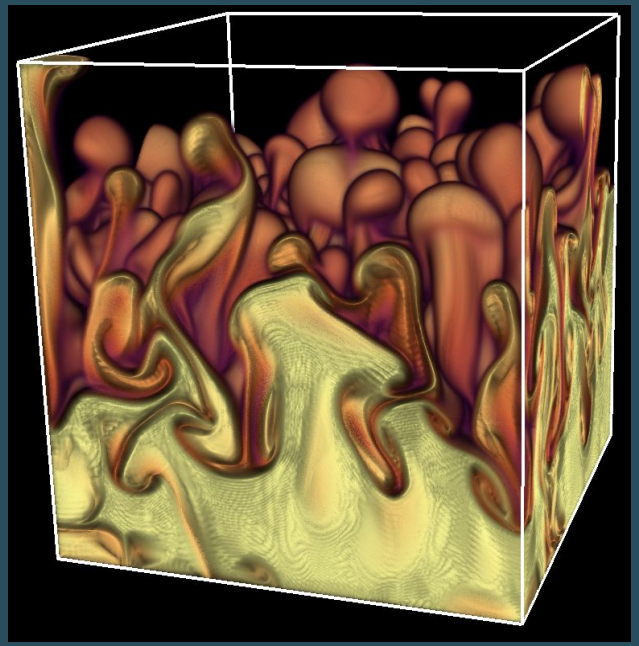
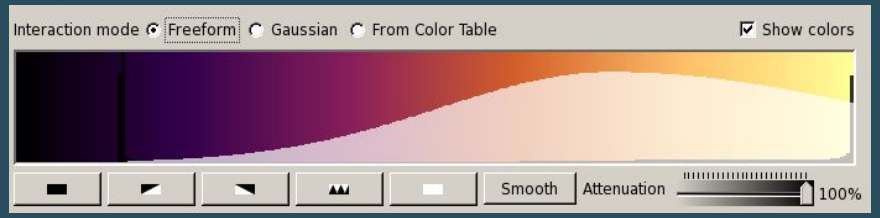
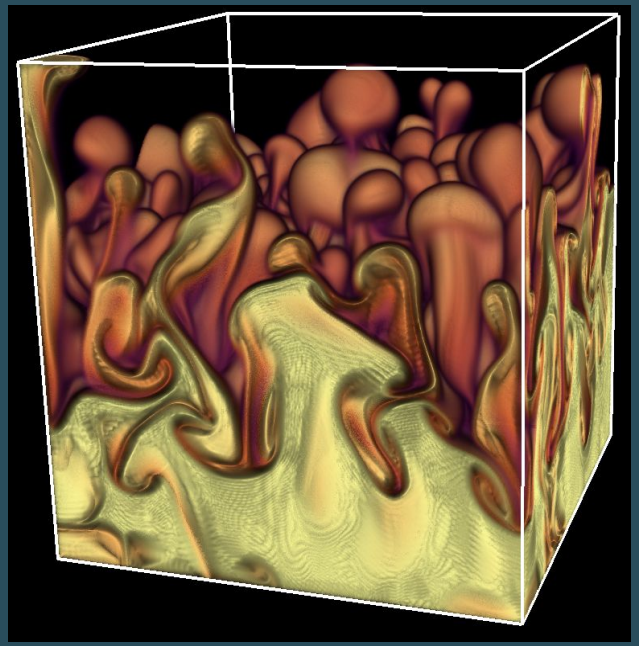
Opacity- use the ‘Volume Transfer Function’

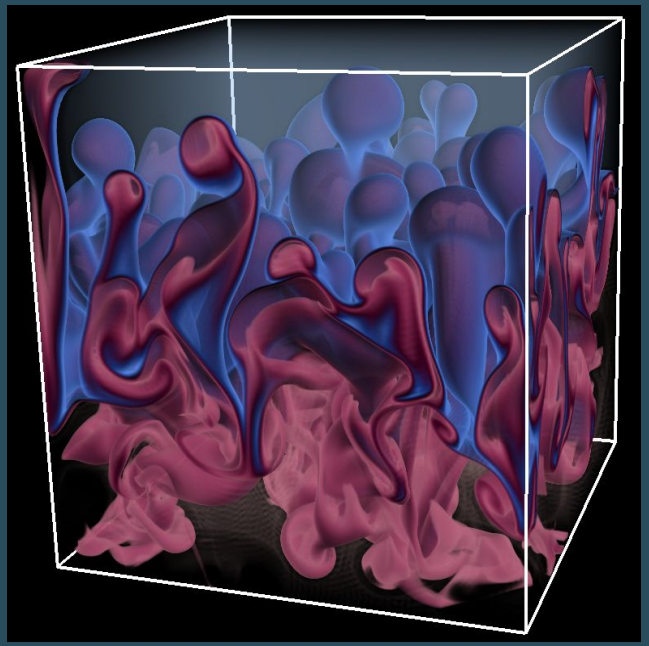




Opacity- use the ‘Volume Transfer Function’

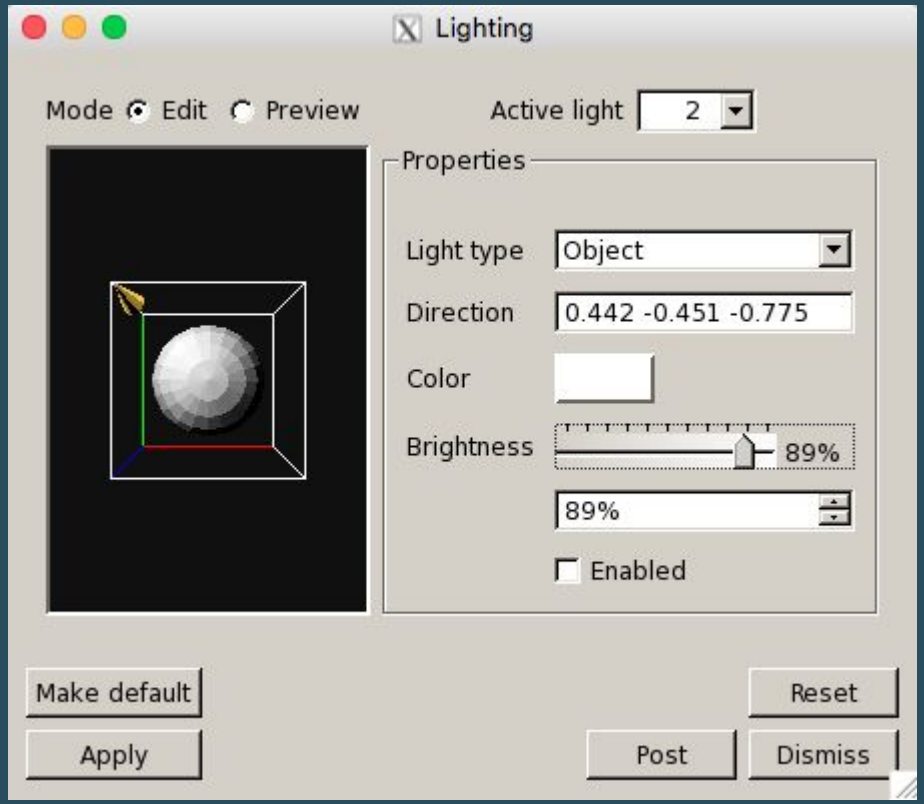






Other features

- Lighting
- Axes
- Labels
- Superimposing plots
- Movies
  - Time series
  - Spinning
  - Slices



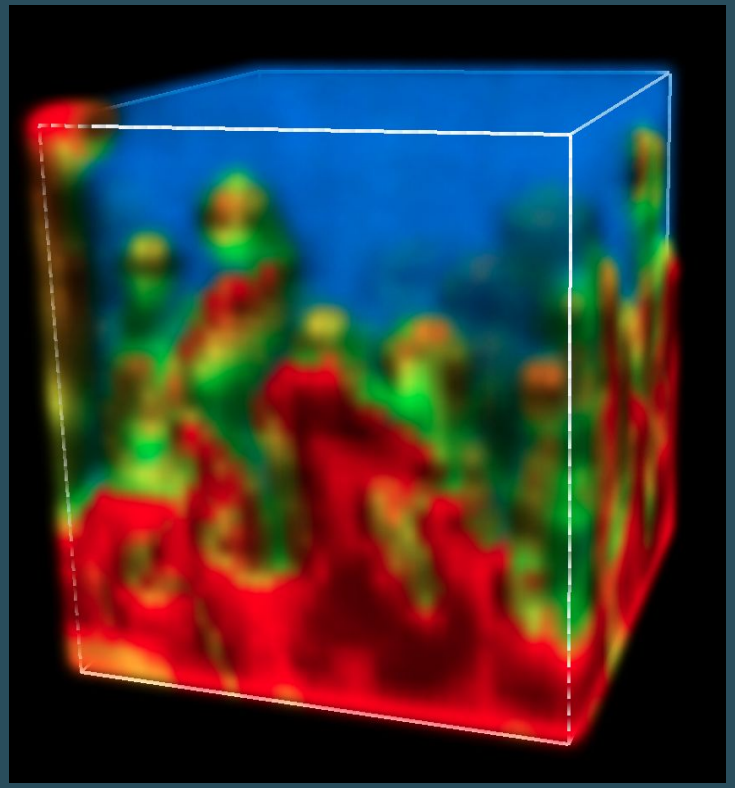
Python Scripting

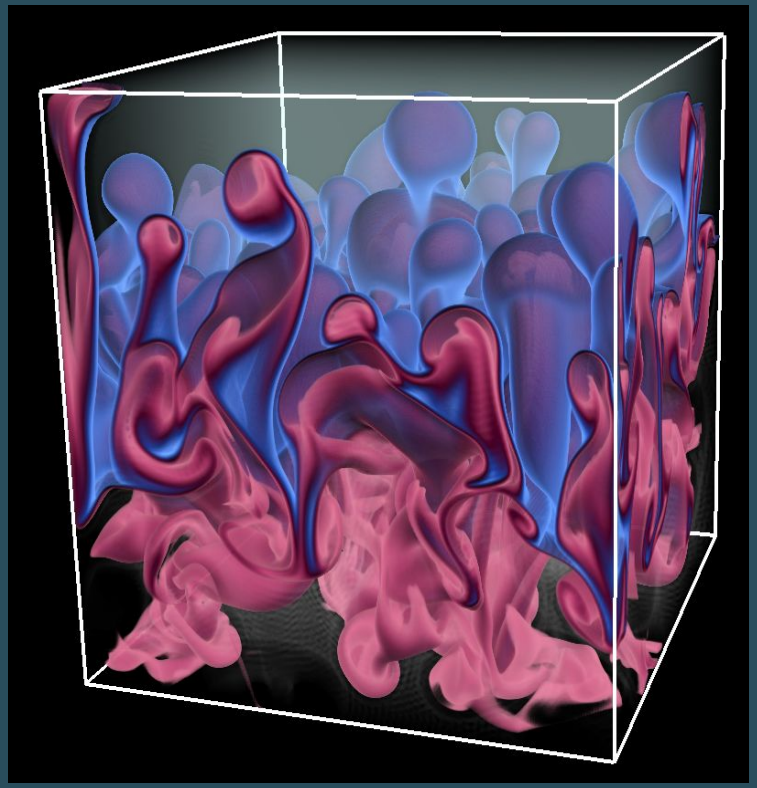
Easily record all edits (and other fine changes) in python, can be run at a later time to reproduce the plot style

```
f=open(''script.py'',''wt'')
WriteScript(f)
f.close()
```

```
Source(''script.py'').
```

```
# Create plots
# Create plot 1
OpenDatabase("localhost:/RAID2/mmstastn/bartry23deepright/*.nc database")
AddPlot("Volume", "t", 0, 0)
atts = VolumeAttributes()
#SetPlotOptions(atts)
silr = SILRestriction()
silr.TurnOffAll()
silr.TurnOnSet("domain1")
SetPlotSILRestriction(silr, 0)

SetActivePlots(0)

DrawPlots()

# Set the view
view = View3DAttributes()
view.viewNormal = (0.387158, -0.852159, 0.352042)
view.focus = (0.1, 0.025, 0.1)
view.viewUp = (-0.0892699, 0.34538, 0.934208)
view.viewAngle = 30
view.parallelScale = 0.143308
view.nearPlane = -0.286616
view.farPlane = 0.286616
view.imagePan = (0.0481336, 0.0831579)
view.imageZoom = 1
view.perspective = 1
view.eyeAngle = 2
view.centerOfRotationSet = 0
view.centerOfRotation = (0.1, 0.025, 0.1)
view.axis3DScaleFlag = 0
view.axis3DScales = (1, 1, 1)
view.shear = (0, 0, 1)
view.windowValid = 1
SetView3D(view)

# Set the annotation attributes
annot = AnnotationAttributes()
```





References

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