GRASS 3D Workshop – 3D data visualization with VTK

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Hydrogeology Group
Institute of Applied Geosciences

FOSS4G2006 Workshop

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   - What is VTK
   - How to use ParaView
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   - How to export with r.out.vtk
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The Visualization ToolKit (VTK)

- software system for 3D computer graphics, image processing and visualization

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- written in C++ and bindings for Phyton, Tcl/Tk and Java available
- open source and freely available from `http://www.vtk.org`

ParaView

- multi-platform visualization application based on VTK

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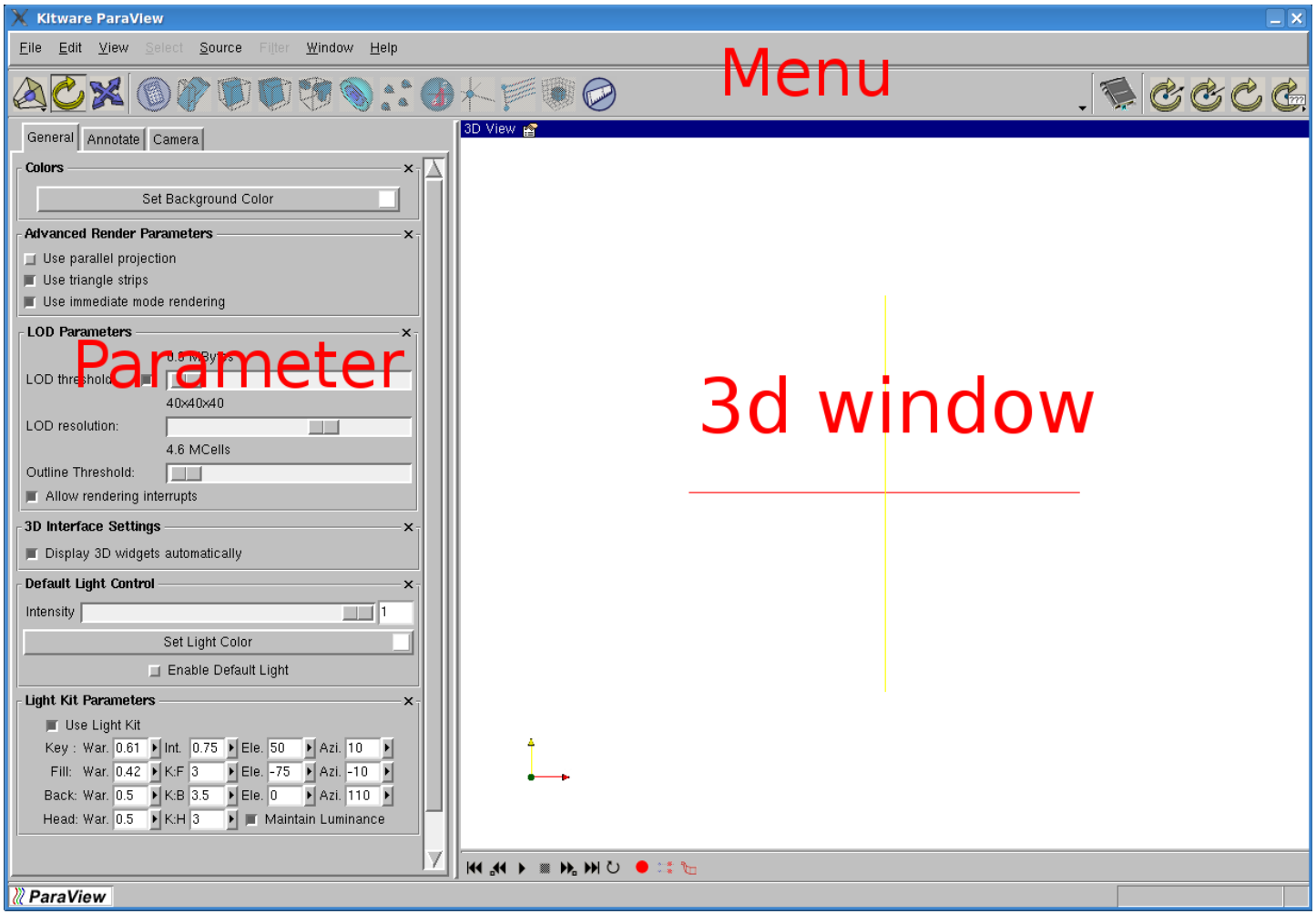
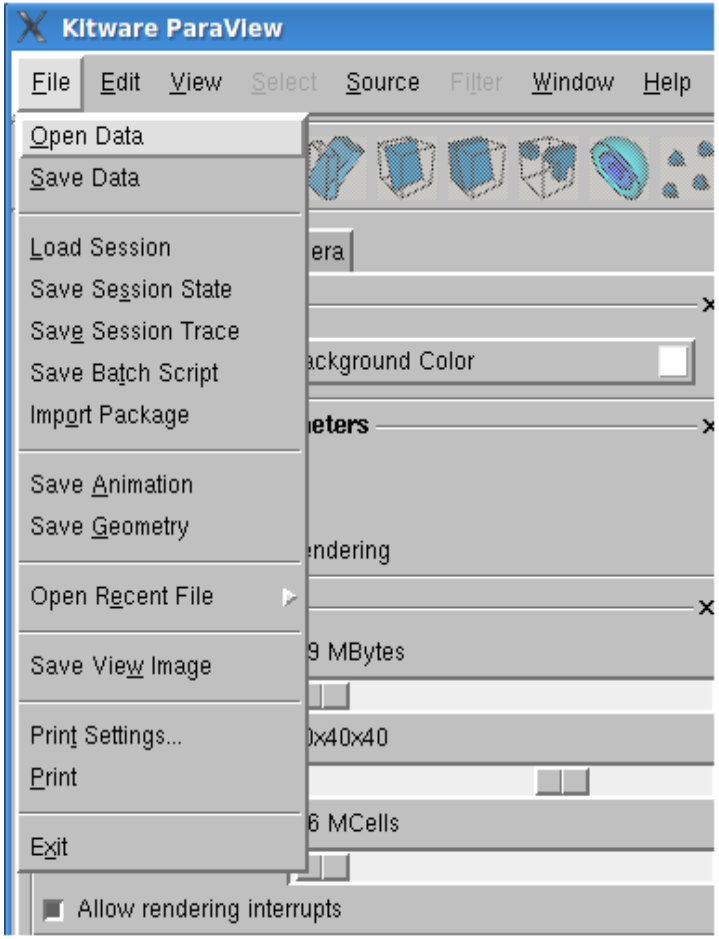
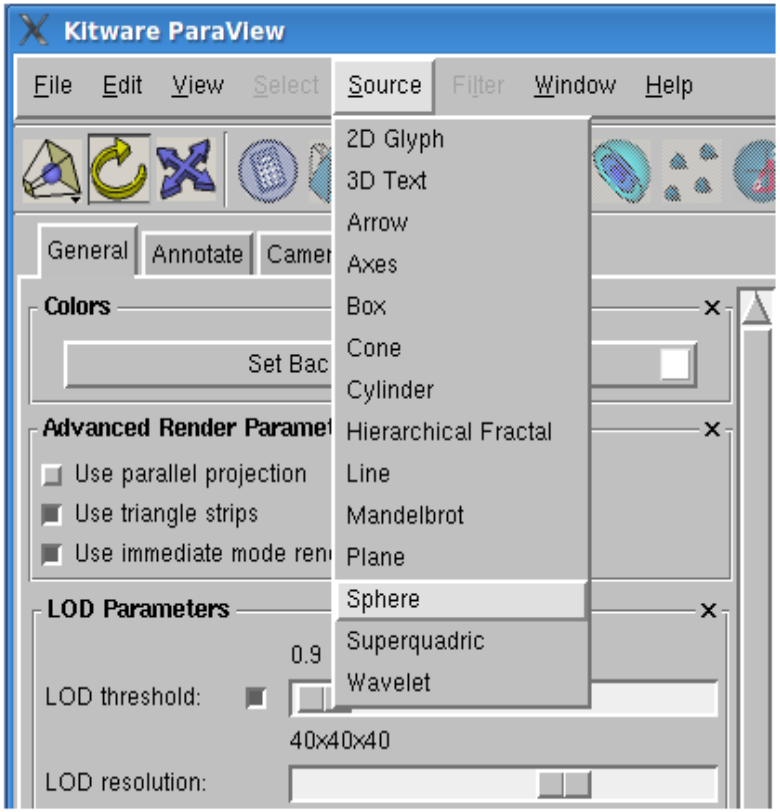
Please start ParaView by typing: `paraview`

ParaView

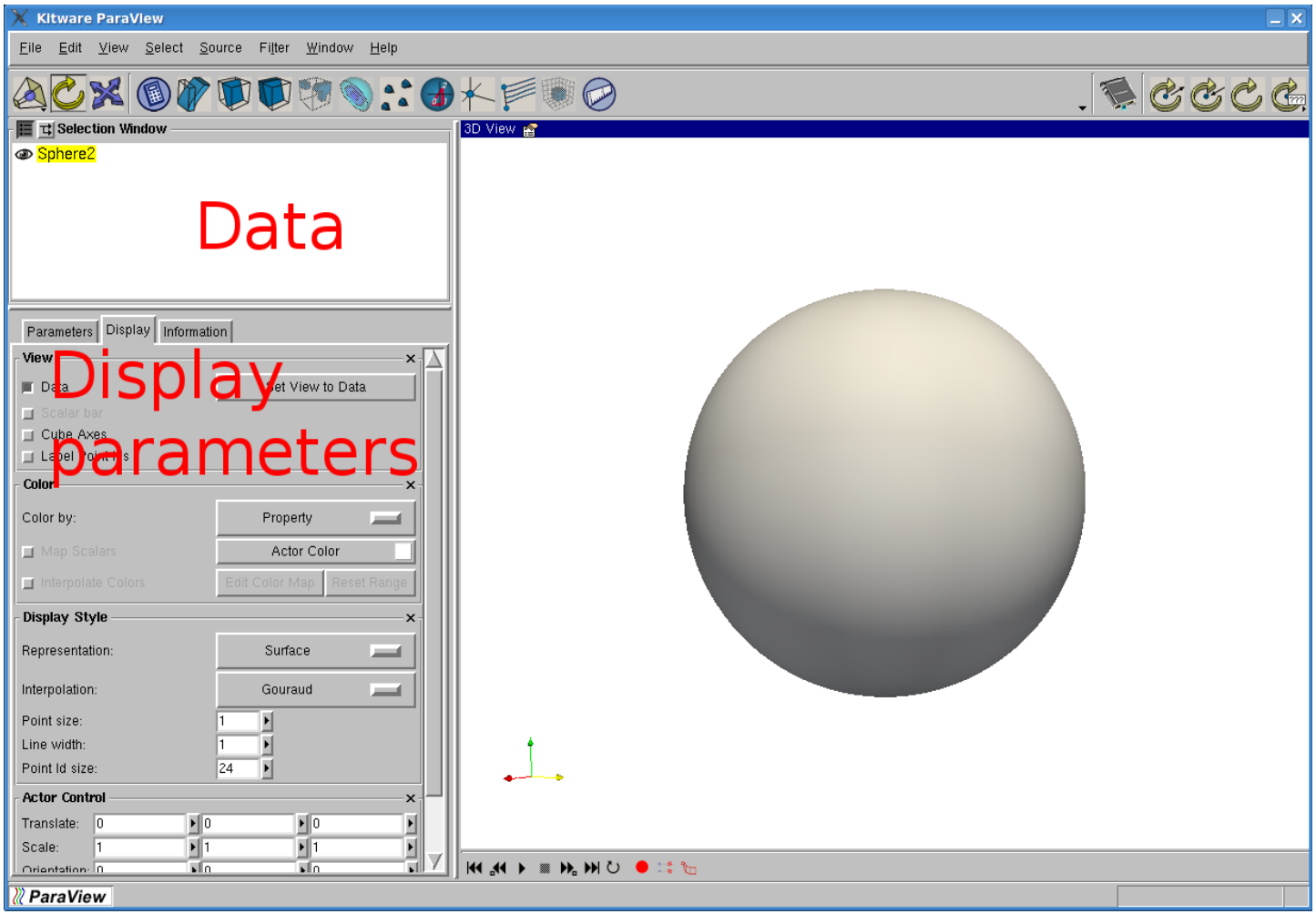

Kitware ParaView
File Edit View Select Source Filter Window Help
Menu
General Annotate Camera
Colors
Set Background Color
Advanced Render Parameters
Use parallel projection
Use triangle strips
Use immediate mode rendering
LOD Parameters
Parameter
LOD threshold:
40x40x40
LOD resolution:
4.6 MCells
Outline Threshold:
Allow rendering interrupts
3D Interface Settings
Display 3D widgets automatically
Default Light Control
Intensity
Set Light Color
Enable Default Light
Light Kit Parameters
Use Light Kit
Key : War. 0.61 Int. 0.75 Ele. 50 Azi. 10
Fill: War. 0.42 K:F 3 Ele. -75 Azi. -10
Back: War. 0.5 K:B 3.5 Ele. 0 Azi. 110
Head: War. 0.5 K:H 3 Maintain Luminance
3D View
3d window
ParaView

Data import and creation





Display


Kitware ParaView
File Edit View Select Source Filter Window Help
Selection Window
Sphere2
Data
3D View
Parameters Display Information
Display parameters
View
Data
Set View to Data
Scalar bar
Cube Axes
Color
Color by:
Property
Map Scalars
Actor Color
Interpolate Colors
Edit Color Map
Reset Range
Display Style
Representation:
Surface
Interpolation:
Gouraud
Point size:
Line width:
Point Id size:
Actor Control
Translate:
Scale:
ParaView

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4 Volume map export and visualization
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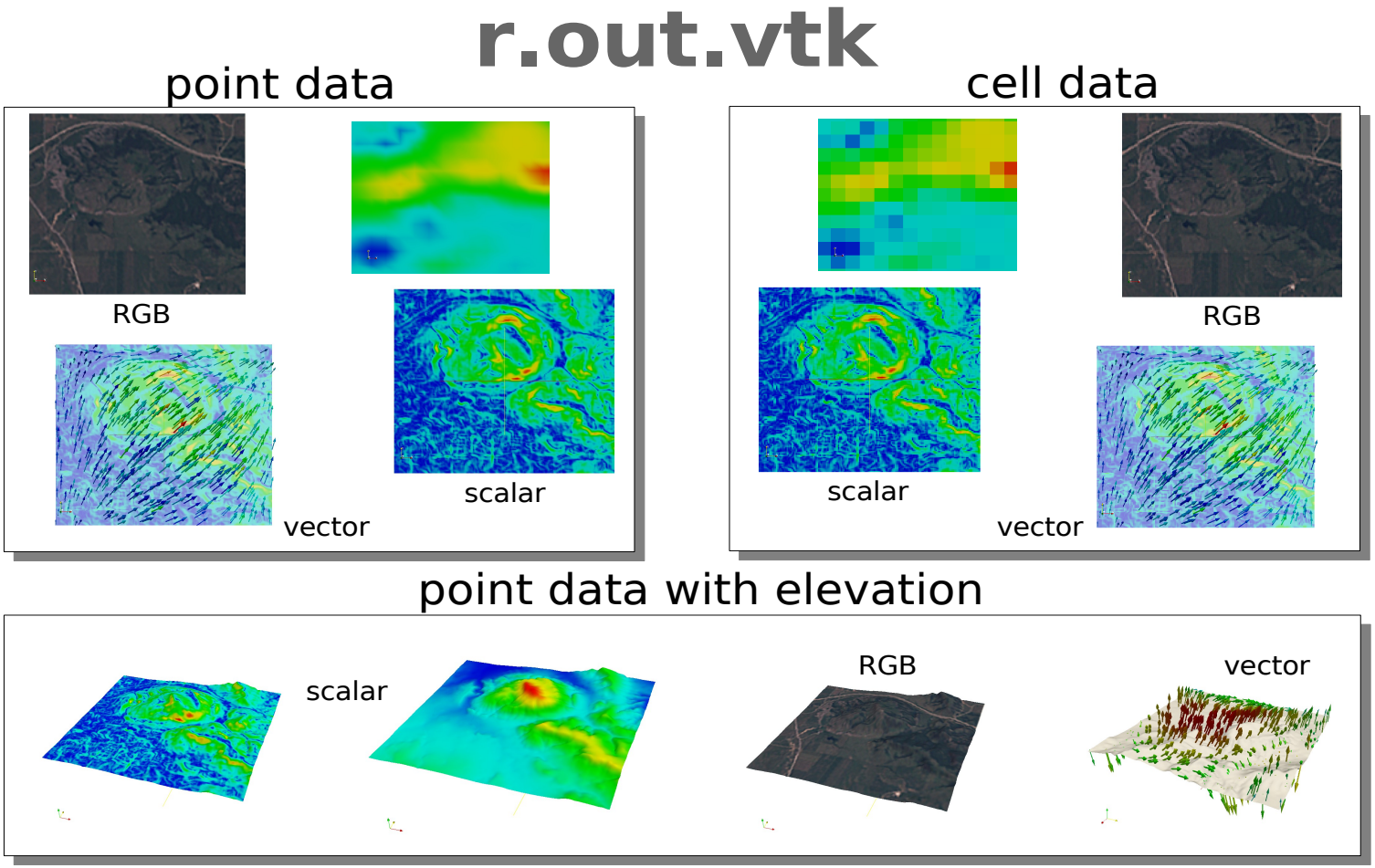
Features of r.out.vtk



How to use r.out.vtk

- Exporting cell data: `r.out.vtk in=slope out=celldata.vtk`

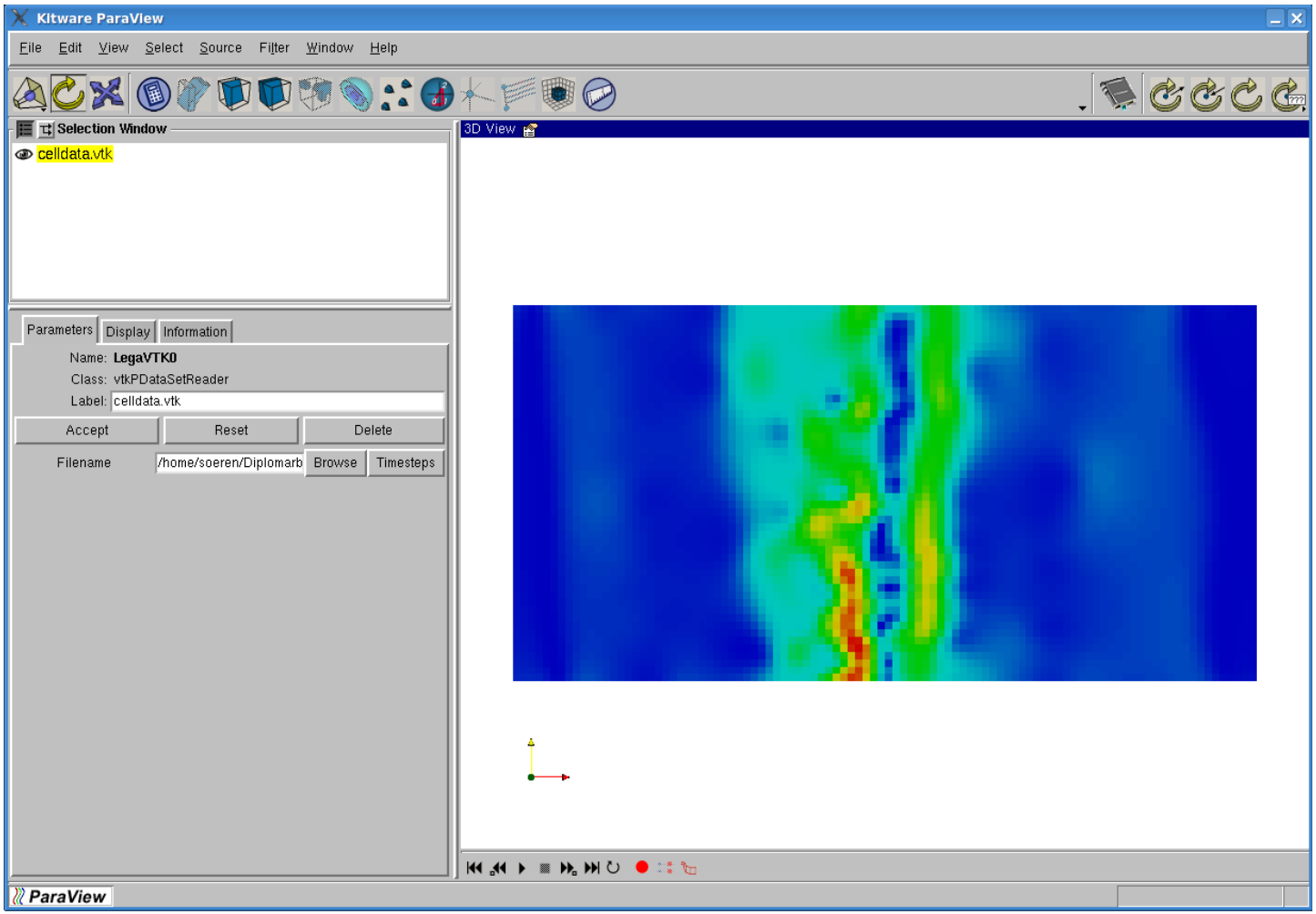
How to use r.out.vtk

- Exporting cell data: `r.out.vtk in=slope out=celldata.vtk`
- Exporting point data: `r.out.vtk -p in=slope out=pointdata.vtk`

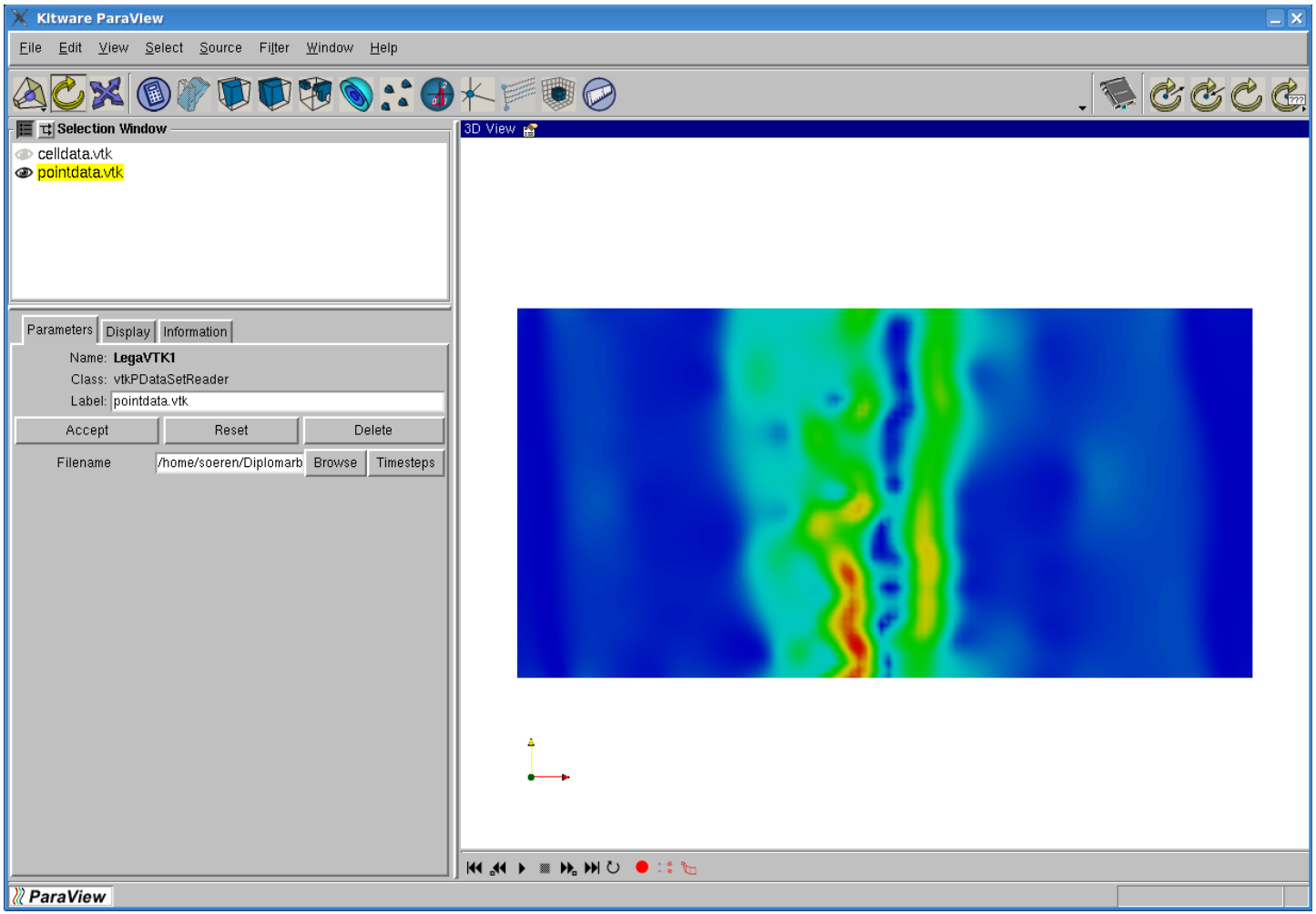
How to use r.out.vtk

- Exporting cell data: `r.out.vtk in=slope out=celldata.vtk`
- Exporting point data: `r.out.vtk -p in=slope out=pointdata.vtk`
- Exporting data with elevation: `r.out.vtk in=elevation elevation=elevation out=elev.vtk`

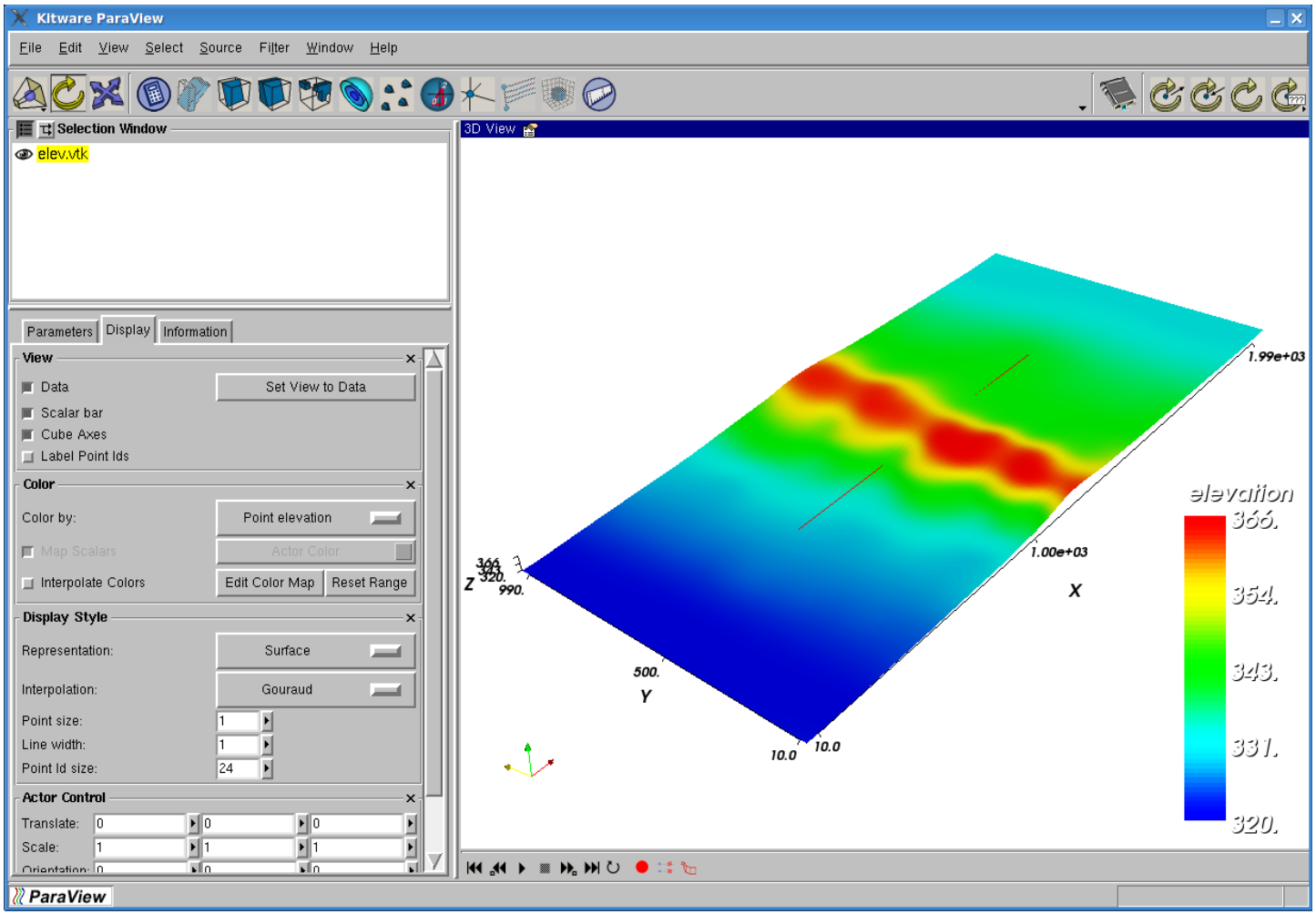
Cell data


Kitware ParaView
File Edit View Select Source Filter Window Help
Selection Window
celldata.vtk
3D View
Parameters Display Information
Name: LegaVTK0
Class: vtkPDataSetReader
Label: celldata.vtk
Accept Reset Delete
Filename /home/soeren/Diplomarb Browse Timesteps
ParaView

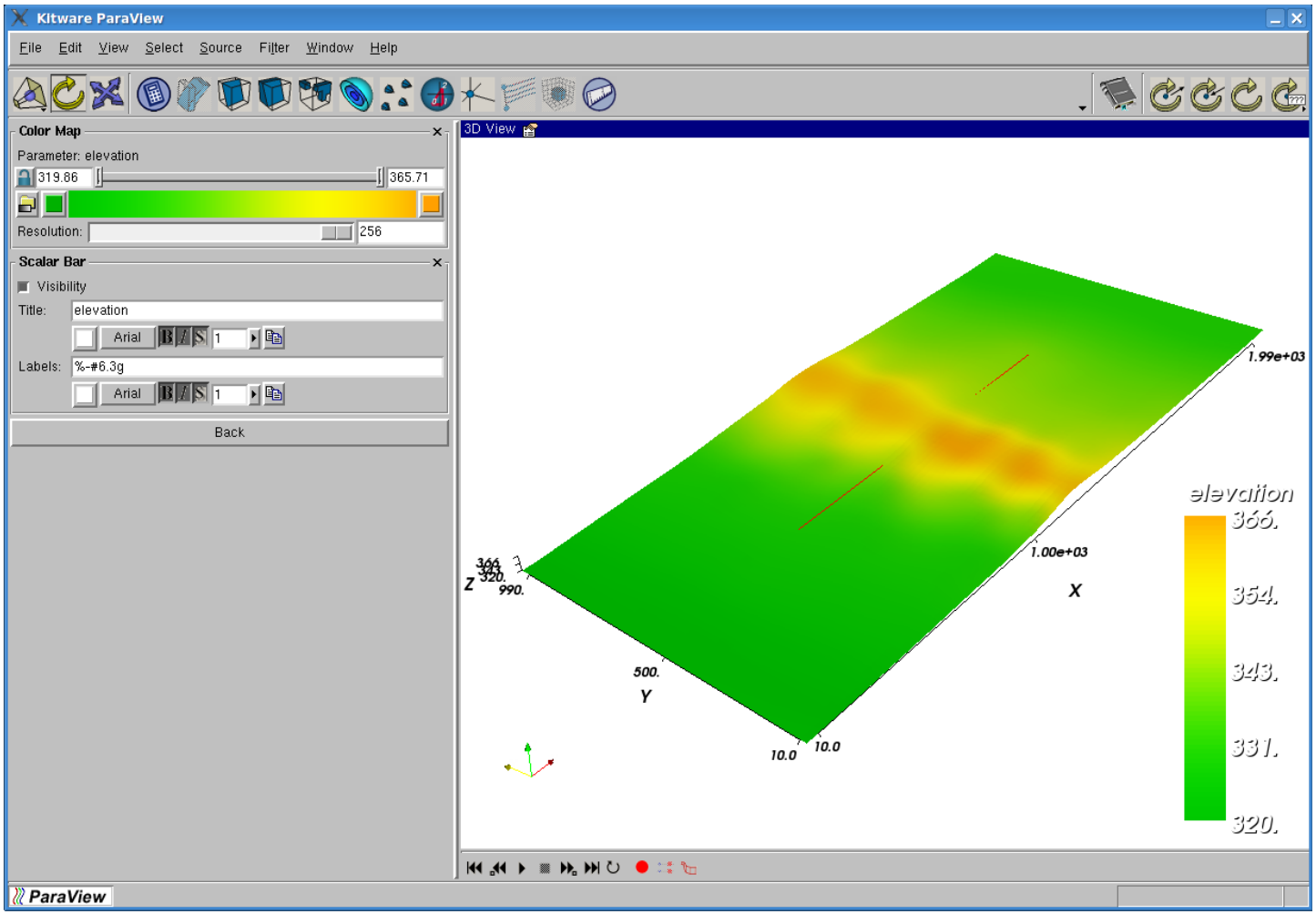
Point data


Kitware ParaView
File Edit View Select Source Filter Window Help
Selection Window
celldata.vtk
pointdata.vtk
Parameters Display Information
Name: LegaVTK1
Class: vtkPDataSetReader
Label: pointdata.vtk
Accept Reset Delete
Filename /home/soeren/Diplomarb Browse Timesteps
3D View
ParaView

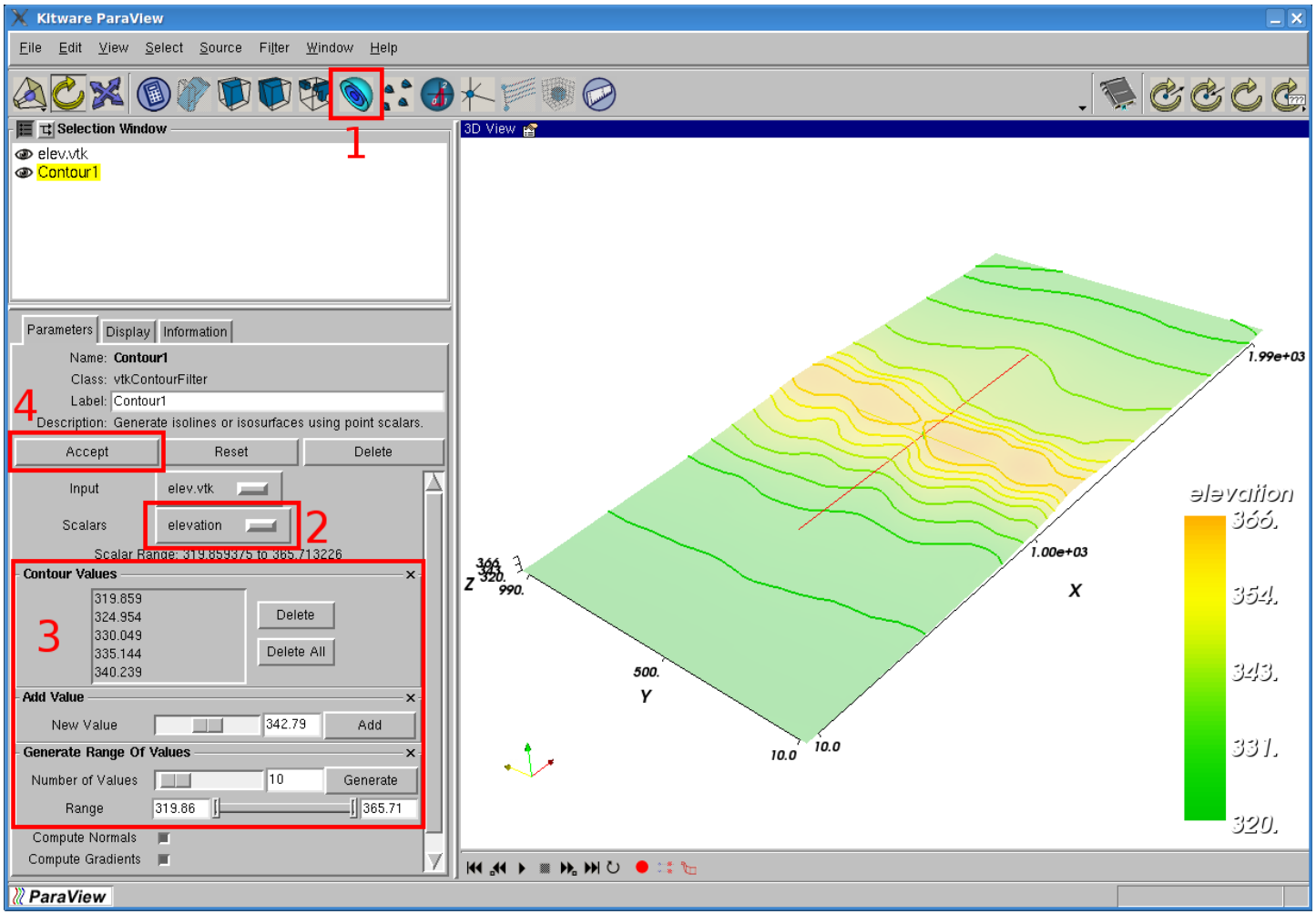
Elevation and data



Elevation color table



Contouring


Kitware ParaView
File Edit View Select Source Filter Window Help
1
Selection Window
elev.vtk
Contour1
Parameters Display Information
Name: Contour1
Class: vtkContourFilter
Label: Contour1
4
Description: Generate isolines or isosurfaces using point scalars.
Accept Reset Delete
Input elev.vtk
Scalars elevation
2
Scalar Range: 319.859375 to 365.713226
Contour Values
3
319.859
324.954
330.049
335.144
340.239
Delete
Delete All
Add Value
New Value 342.79 Add
Generate Range Of Values
Number of Values 10 Generate
Range 319.86 365.71
Compute Normals
Compute Gradients
3D View
1.99e+03
1.00e+03
elevation
366.
354.
343.
331.
320.
Z
990.
500.
Y
10.0
10.0
X
ParaView

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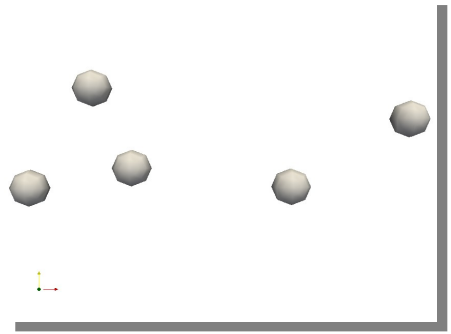
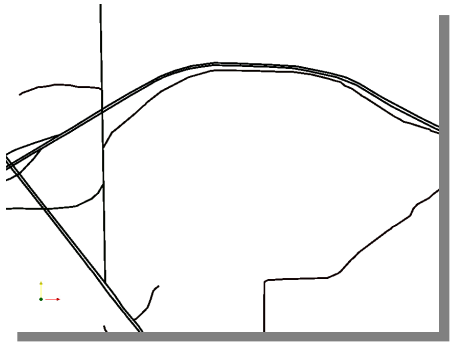
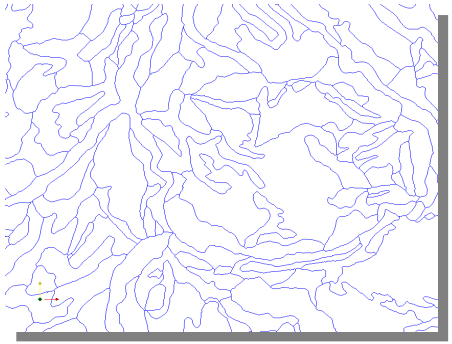
Features of v.out.vtk

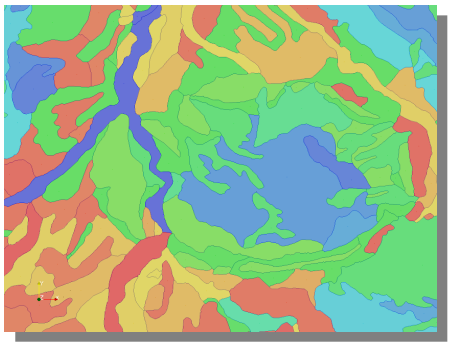

Points


Lines

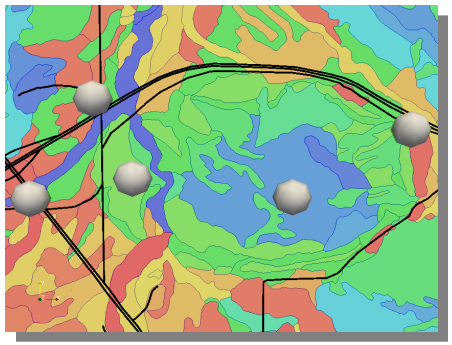

Boundaries

v.out.vtk

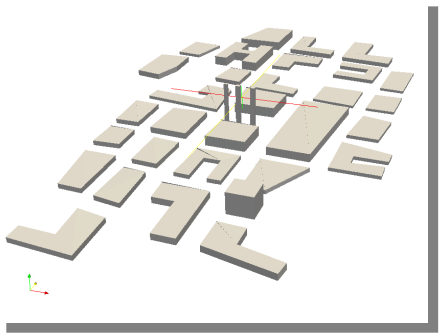
Areas



Mixed



Faces



Export data with v.out.vtk

- Exporting vector lines: `v.out.vtk input=roads3d output=roads3d.vtk type=line`

Export data with v.out.vtk

- Exporting vector lines: `v.out.vtk input=roads3d output=roads3d.vtk type=line`
- Exporting polygonal data

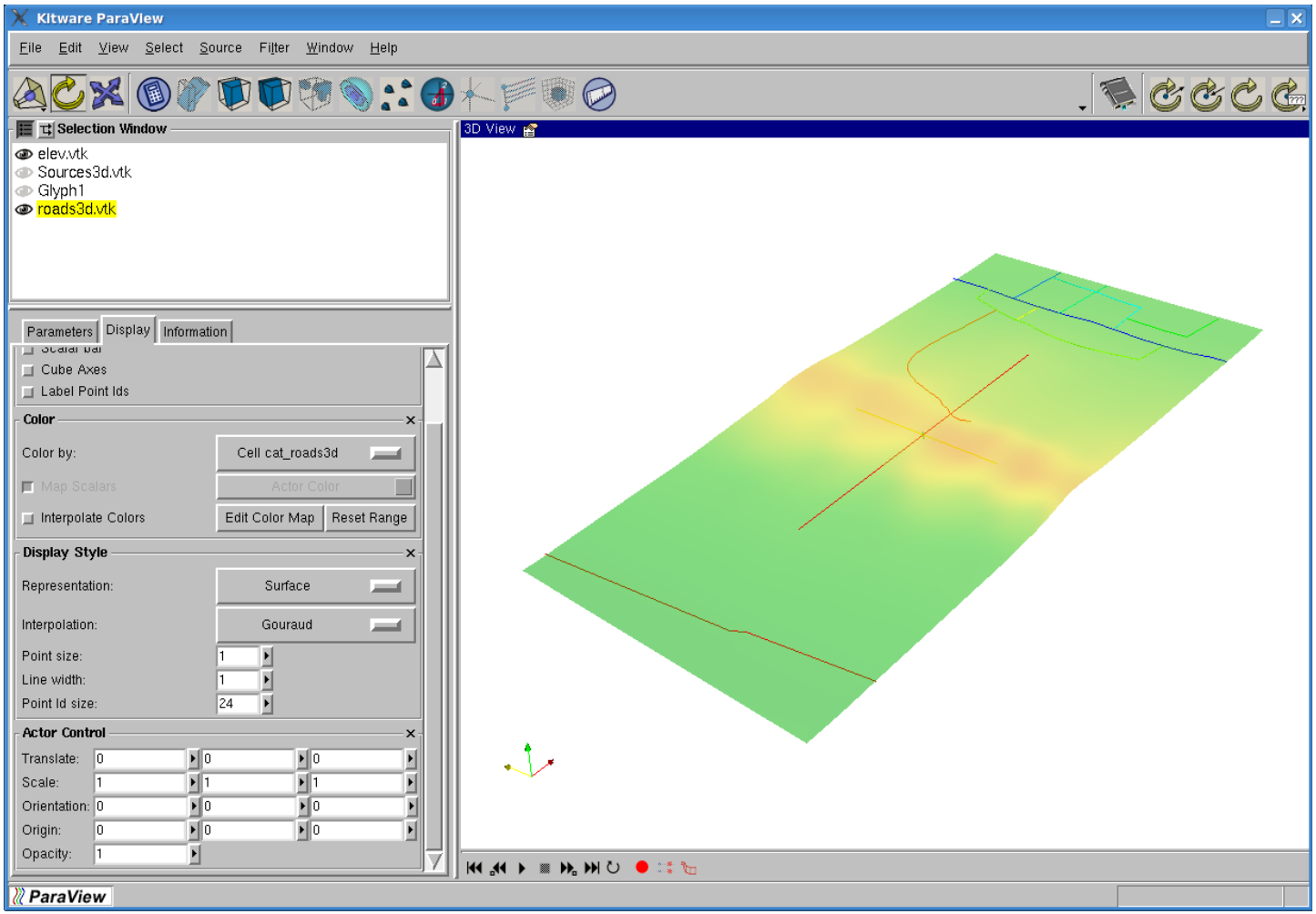
Export data with v.out.vtk

- Exporting vector lines: `v.out.vtk input=roads3d output=roads3d.vtk type=line`
- Exporting polygonal data
  - trees: `v.out.vtk input=trees3d output=trees3d.vtk type=line,face`

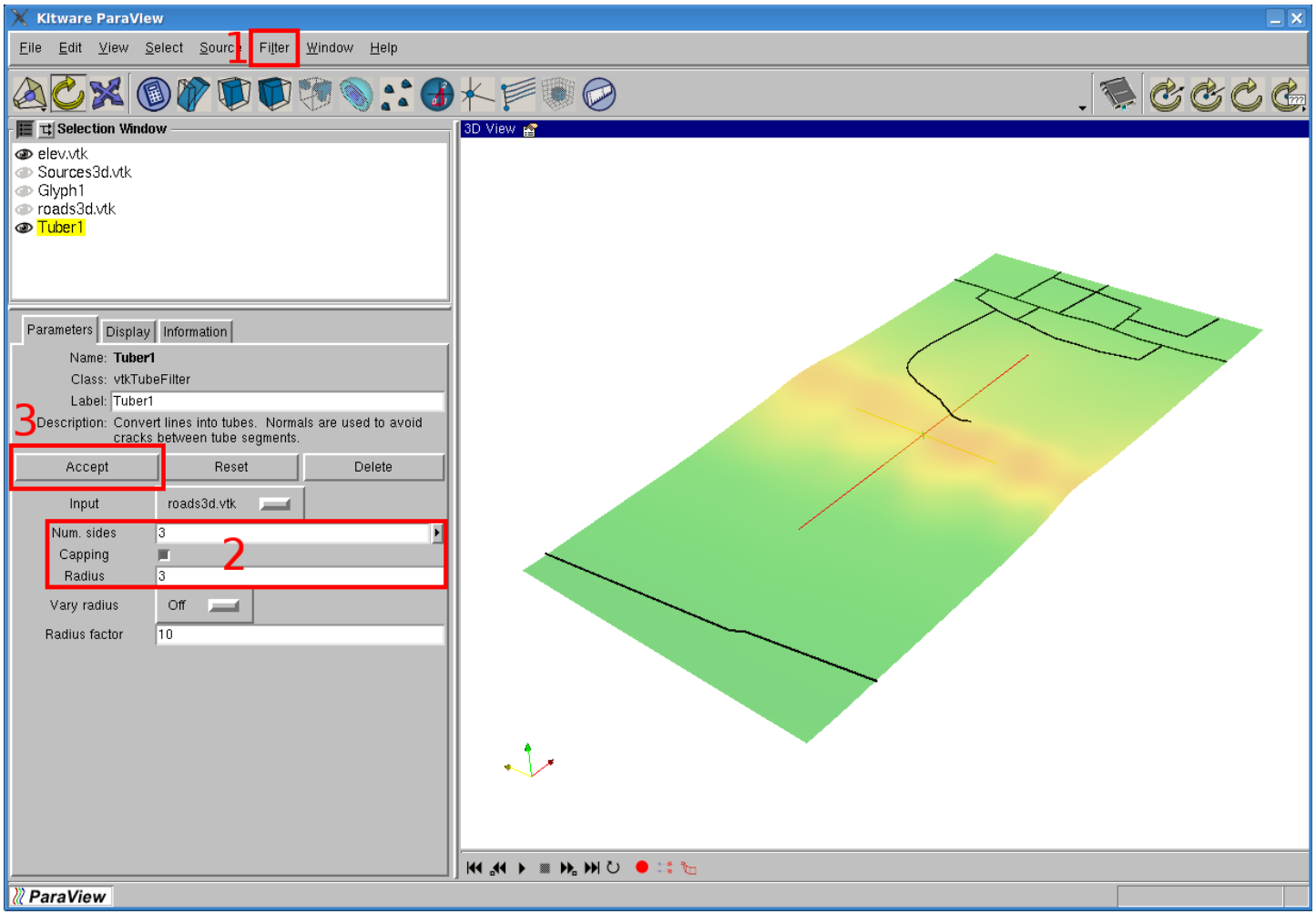
Export data with v.out.vtk

- Exporting vector lines: `v.out.vtk input=roads3d output=roads3d.vtk type=line`
- Exporting polygonal data
  - trees: `v.out.vtk input=trees3d output=trees3d.vtk type=line,face`
  - buildings: `v.out.vtk input=industry3d output=industry3d.vtk type=face`

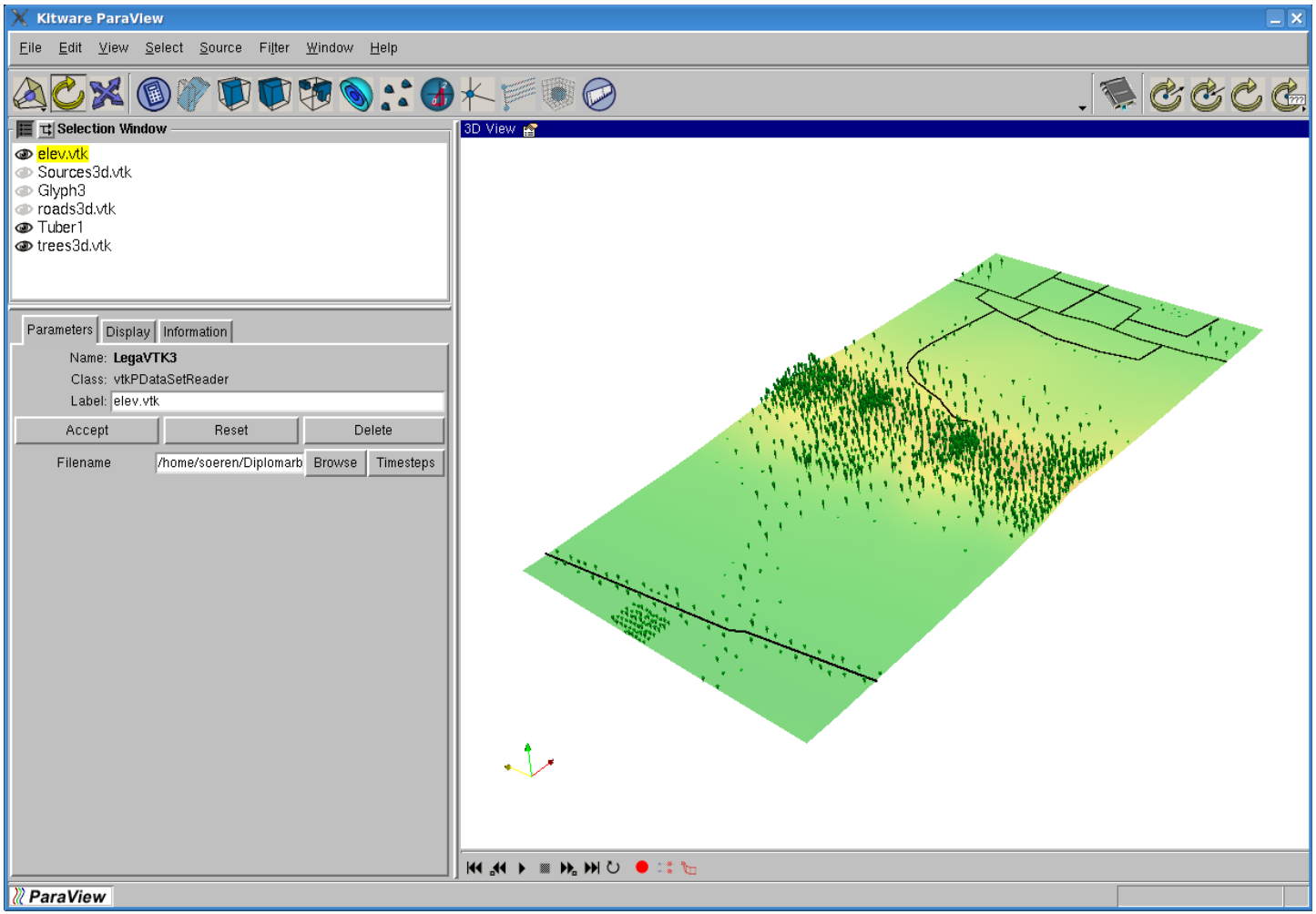
Vector lines



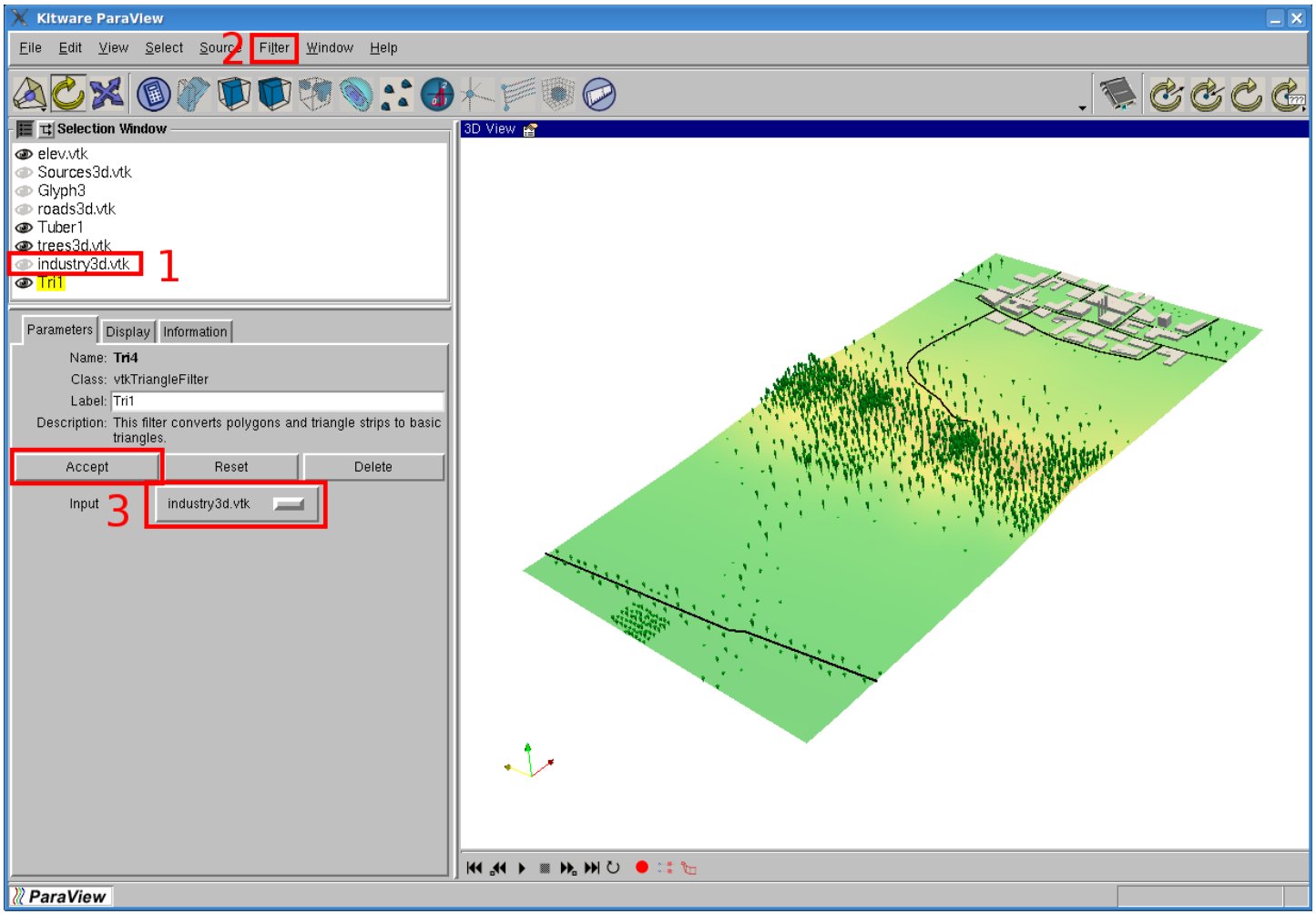
Using the *Tube* filter



Trees


Kitware ParaView
File Edit View Select Source Filter Window Help
Selection Window
elev.vtk
Sources3d.vtk
Glyph3
roads3d.vtk
Tuber1
trees3d.vtk
Parameters Display Information
Name: LegaVTK3
Class: vtkPDataSetReader
Label: elev.vtk
Accept Reset Delete
Filename /home/soeren/Diplomarb Browse Timesteps
3D View
ParaView

Buildings and *Triangulate* filter



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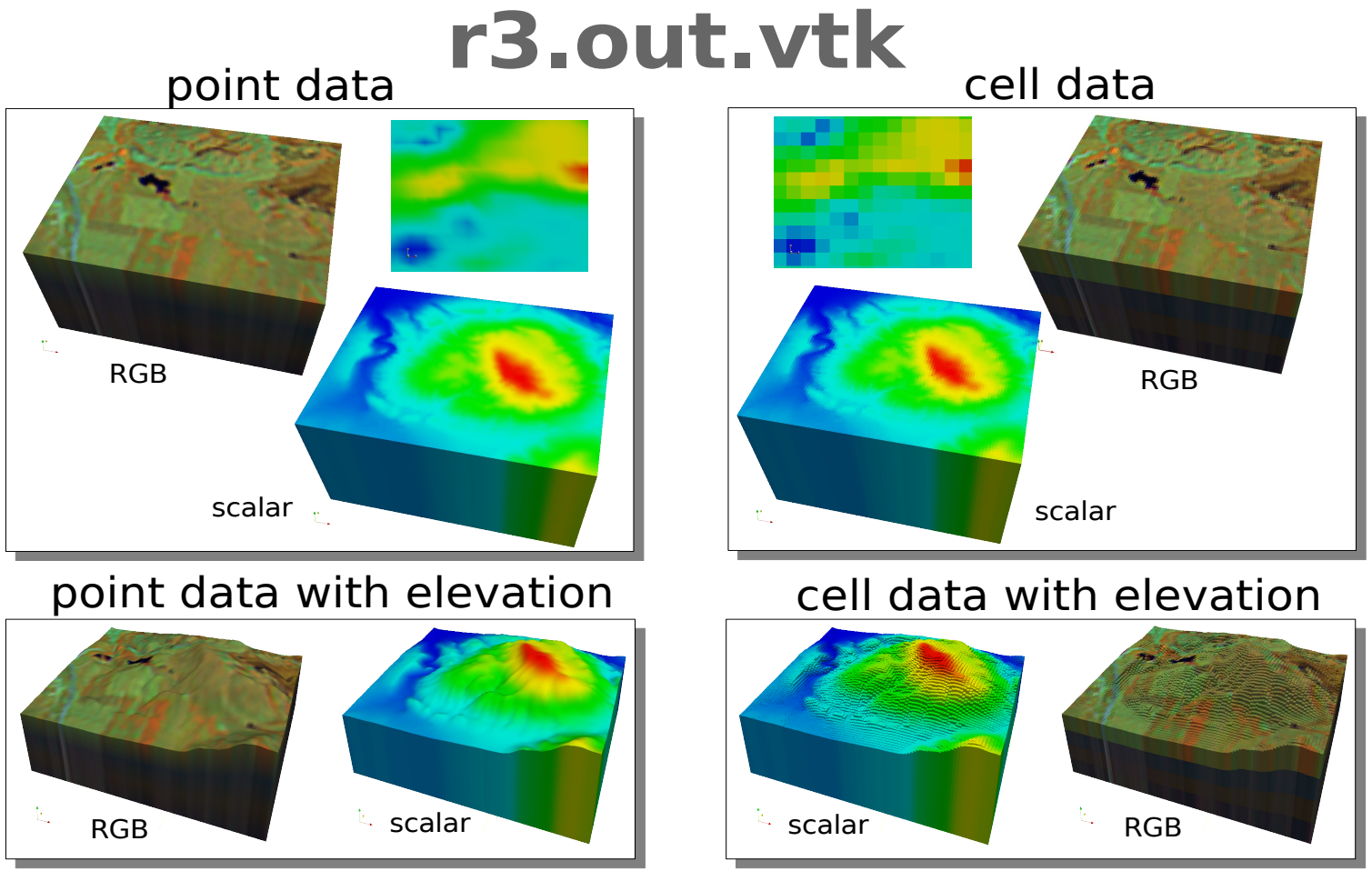
Features of r3.out.vtk



Export scalar data

- Exporting elevation data

Export scalar data

- Exporting elevation data
  - reduce the z-resolution `g.region tbres=150`

Export scalar data

- Exporting elevation data
  - reduce the z-resolution `g.region tbres=150`
  - `r3.out.vtk -sp top=elevation bottom=border_sand_clay out=clay3d.vtk`

Export scalar data

- Exporting elevation data
  - reduce the z-resolution `g.region tbres=150`
  - `r3.out.vtk -sp top=elevation bottom=border_sand_clay out=clay3d.vtk`
  - `r3.out.vtk -sp top=border_sand_clay bottom=border_bedrock_sand out=sand3d.vtk`

Export scalar data

- Exporting elevation data
  - reduce the z-resolution `g.region tbres=150`
  - `r3.out.vtk -sp top=elevation bottom=border_sand_clay out=clay3d.vtk`
  - `r3.out.vtk -sp top=border_sand_clay bottom=border_bedrock_sand out=sand3d.vtk`
  - `r3.out.vtk -sp top=border_bedrock_sand bottom=bottom out=bedrock3d.vtk`

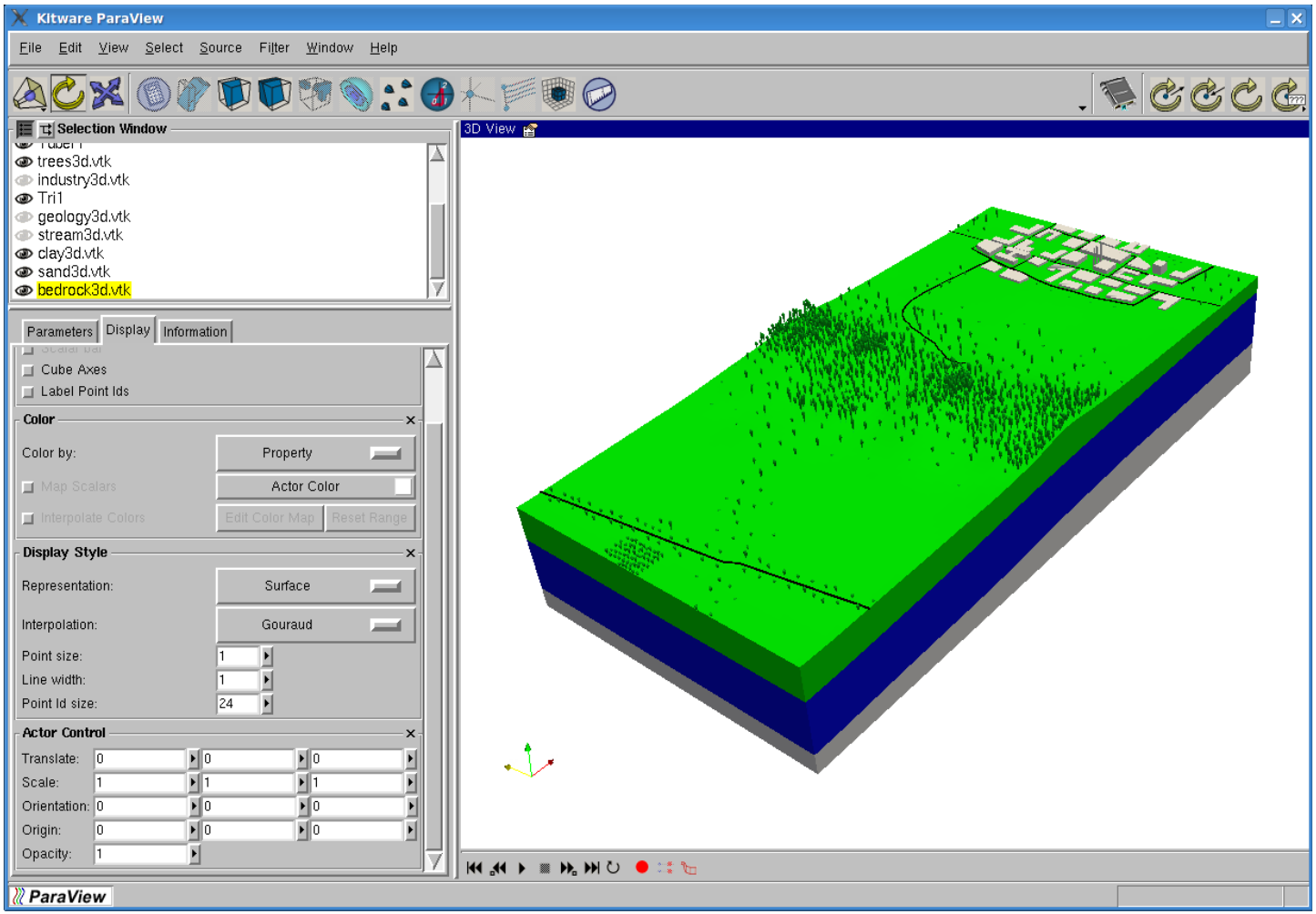
Export scalar data

- Exporting elevation data
  - reduce the z-resolution `g.region tbres=150`
  - `r3.out.vtk -sp top=elevation bottom=border_sand_clay out=clay3d.vtk`
  - `r3.out.vtk -sp top=border_sand_clay bottom=border_bedrock_sand out=sand3d.vtk`
  - `r3.out.vtk -sp top=border_bedrock_sand bottom=bottom out=bedrock3d.vtk`
- default region: `g.region -dp3`

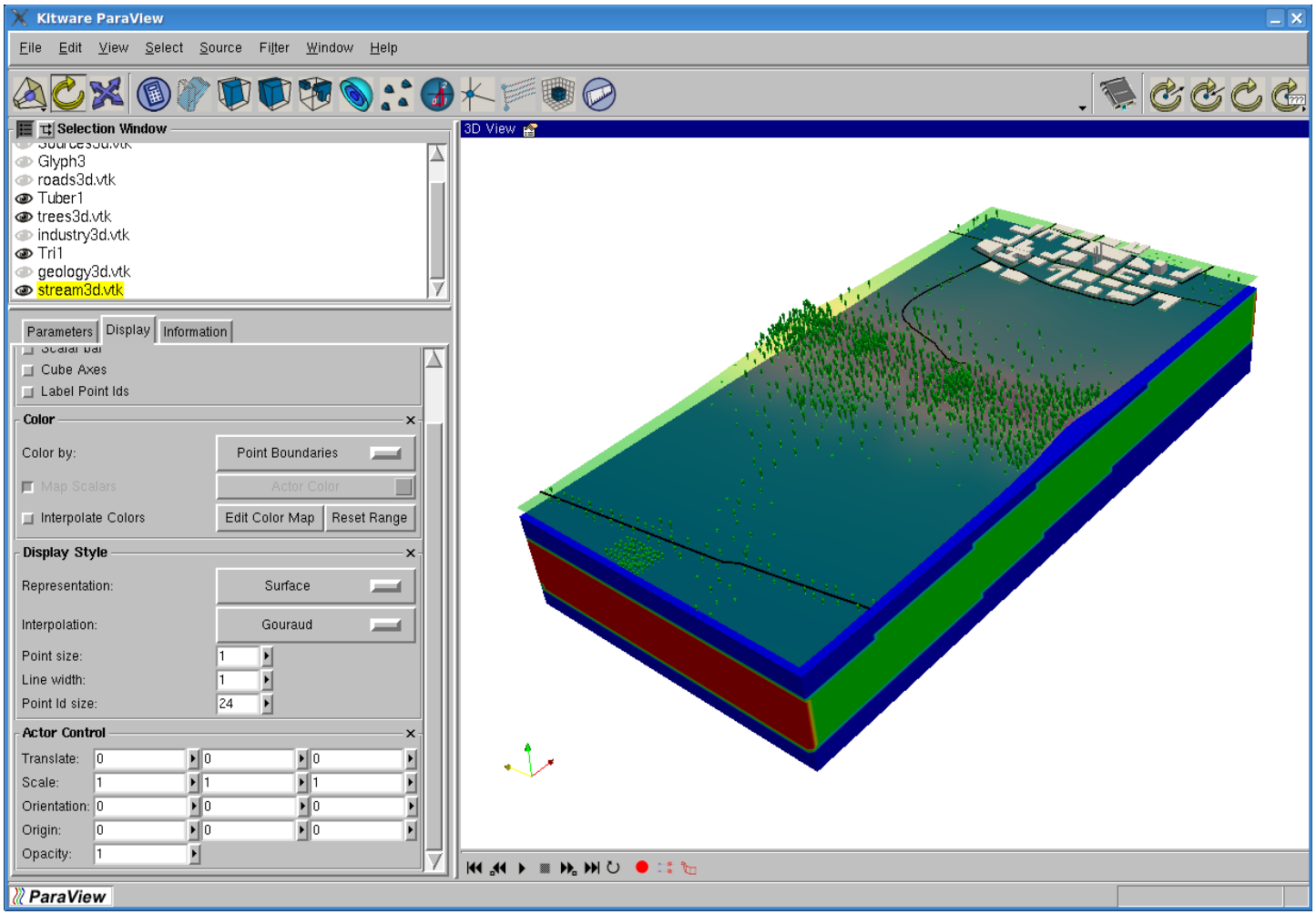
Export scalar data

- Exporting elevation data
  - reduce the z-resolution `g.region tbres=150`
  - `r3.out.vtk -sp top=elevation bottom=border_sand_clay out=clay3d.vtk`
  - `r3.out.vtk -sp top=border_sand_clay bottom=border_bedrock_sand out=sand3d.vtk`
  - `r3.out.vtk -sp top=border_bedrock_sand bottom=bottom out=bedrock3d.vtk`
- default region: `g.region -dp3`
- Exporting point data: `r3.out.vtk -p in=Boundaries,ResultStream out=gw3d.vtk`

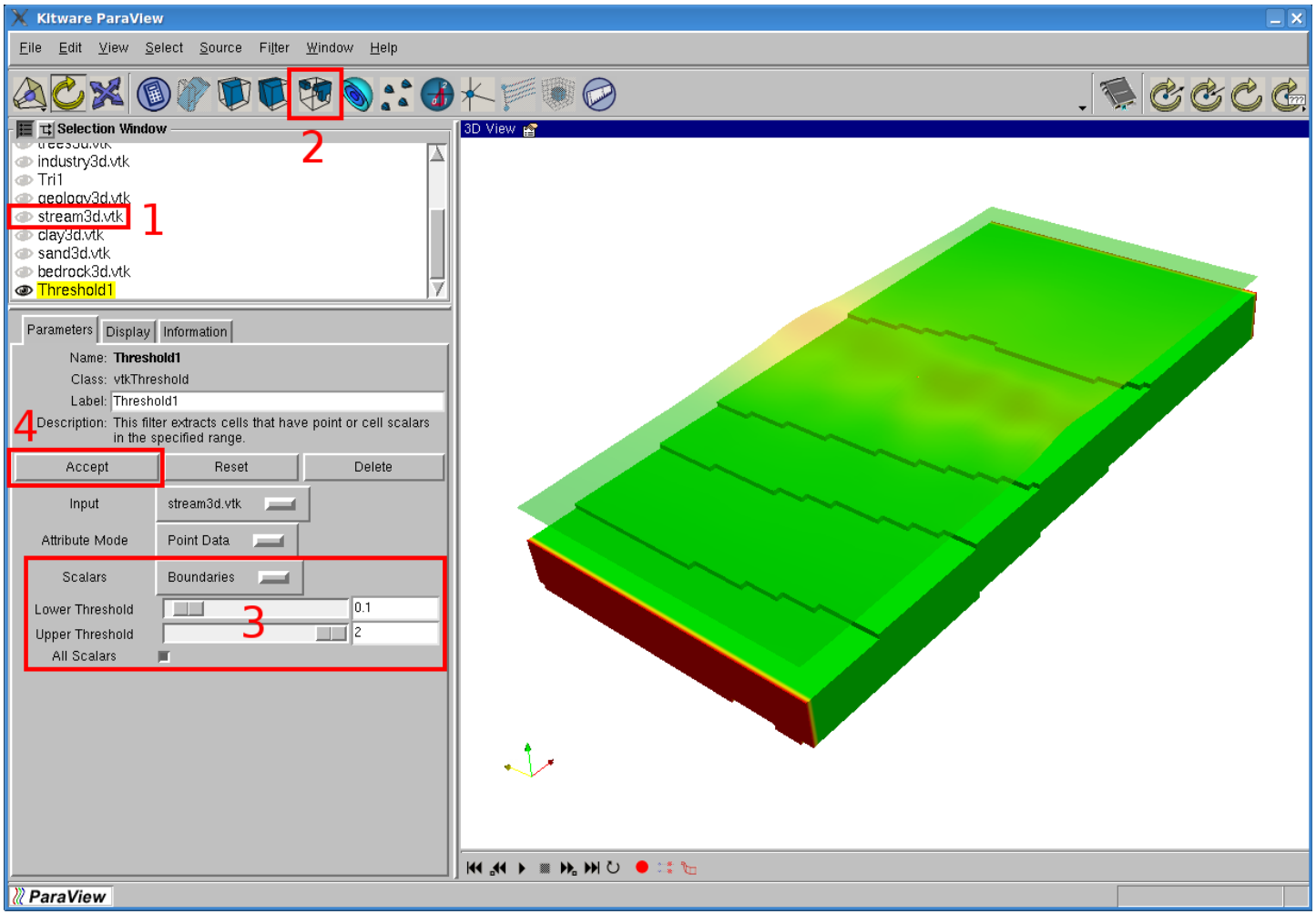
Elevation data



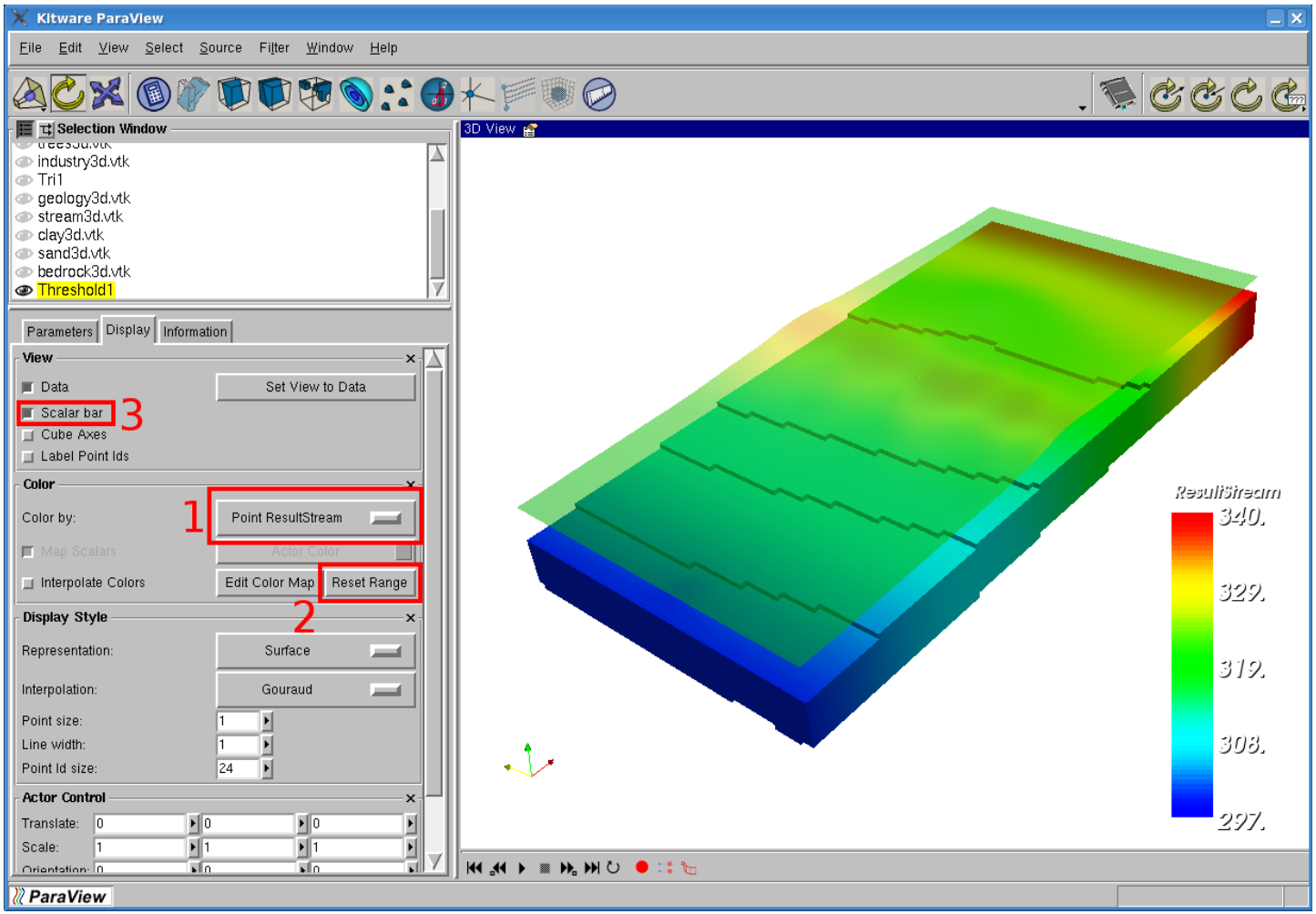
Point data


Kitware ParaView
File Edit View Select Source Filter Window Help
Selection Window
Glyph3
roads3d.vtk
Tuber1
trees3d.vtk
industry3d.vtk
Tri1
geology3d.vtk
stream3d.vtk
Parameters Display Information
Cube Axes
Label Point Ids
Color
Color by: Point Boundaries
Map Scalars
Actor Color
Interpolate Colors
Edit Color Map
Reset Range
Display Style
Representation: Surface
Interpolation: Gouraud
Point size: 1
Line width: 1
Point Id size: 24
Actor Control
Translate: 0 0 0
Scale: 1 1 1
Orientation: 0 0 0
Origin: 0 0 0
Opacity: 1
3D View
ParaView

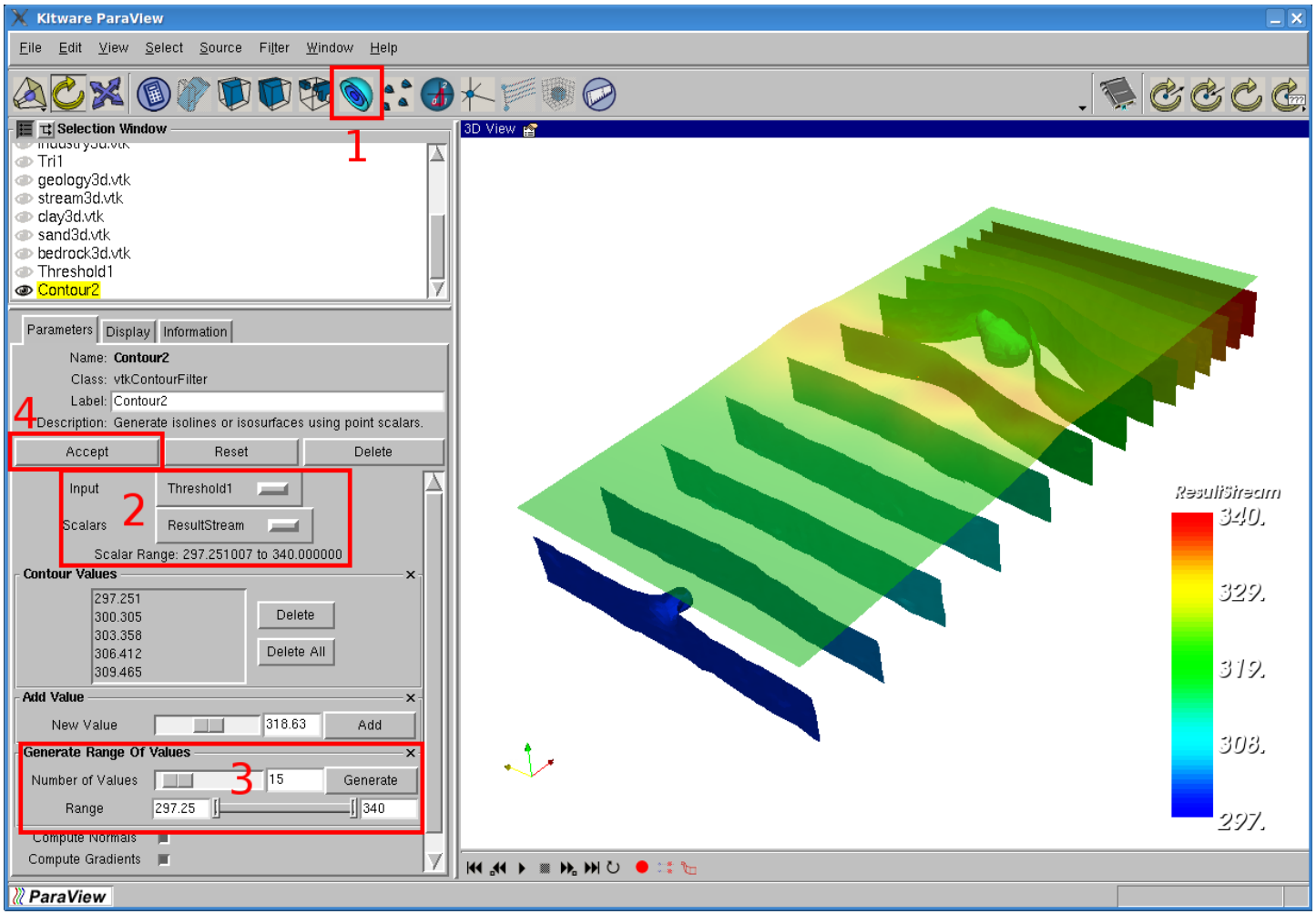
Data extraction



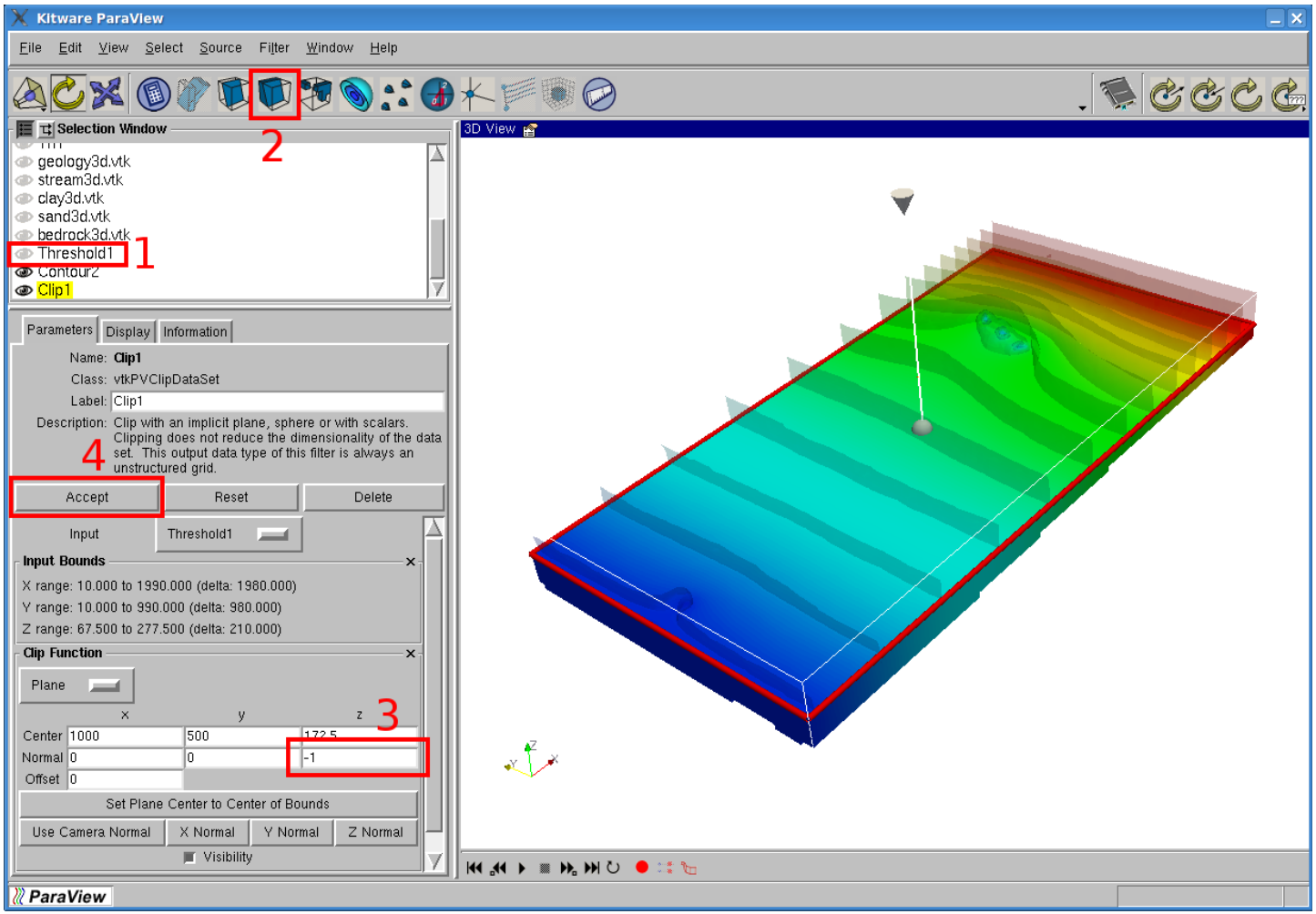
Data extraction



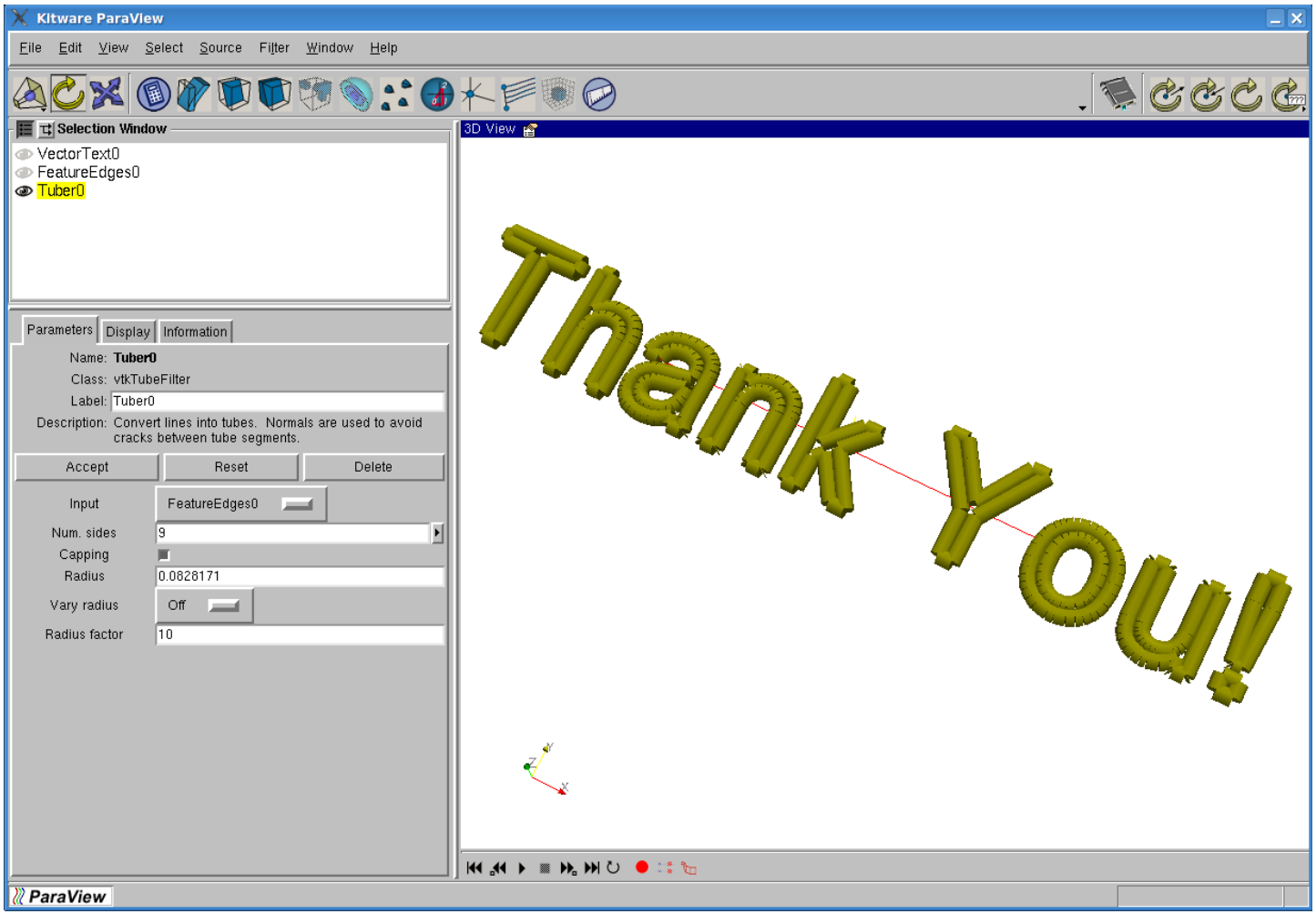
Isosurfaces



Clipping


Kitware ParaView
File Edit View Select Source Filter Window Help
Selection Window
geology3d.vtk
stream3d.vtk
clay3d.vtk
sand3d.vtk
bedrock3d.vtk
Threshold1
Contour2
Clip1
1
2
3
4
Parameters Display Information
Name: Clip1
Class: vtkPVClipDataSet
Label: Clip1
Description: Clip with an implicit plane, sphere or with scalars. Clipping does not reduce the dimensionality of the data set. This output data type of this filter is always an unstructured grid.
Accept Reset Delete
Input Threshold1
Input Bounds
X range: 10.000 to 1990.000 (delta: 1980.000)
Y range: 10.000 to 990.000 (delta: 980.000)
Z range: 67.500 to 277.500 (delta: 210.000)
Clip Function
Plane
x y z
Center 1000 500 172.5
Normal 0 0 -1
Offset 0
Set Plane Center to Center of Bounds
Use Camera Normal X Normal Y Normal Z Normal
Visibility
3D View
ParaView

The End


Kitware ParaView
File Edit View Select Source Filter Window Help
Selection Window
VectorText0
FeatureEdges0
Tuber0
Parameters Display Information
Name: Tuber0
Class: vtkTubeFilter
Label: Tuber0
Description: Convert lines into tubes. Normals are used to avoid cracks between tube segments.
Accept Reset Delete
Input FeatureEdges0
Num. sides 9
Capping
Radius 0.0828171
Vary radius Off
Radius factor 10
3D View
Thank You!
ParaView

The End

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