National Alliance for Medical Image Computing
Neuroimage Analysis Center

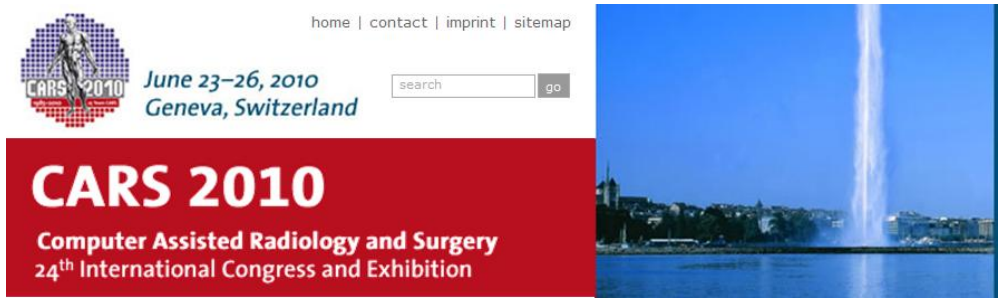
Leonardo da Vinci (1452-1519), Virgin and Child
Alte Pinakothek, München

Data Loading & 3D Visualization

Sonia Pujol, Ph.D.

Surgical Planning Laboratory

Harvard Medical School



Slicer3

- An end-user application for image analysis
- An open-source environment for software development
- A software platform that is both easy to use for clinical researchers and easy to extend for programmers

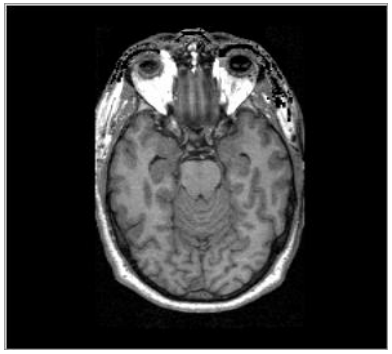
Picture courtesy Wendy Plesniak, Ph.D.

Slicer3

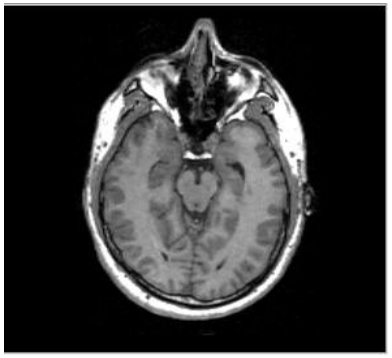
- Slicer3 is a multi-platform software that is developed and maintained on:
  - Windows XP
  - Linux x86_64
  - Linux x86
  - Mac OSX – Darwin x86-Intel

Download the training dataset

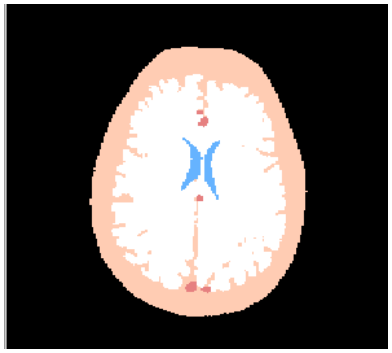
- This course is built upon three datasets of a single healthy subject brain:



MR DICOM
GRASS



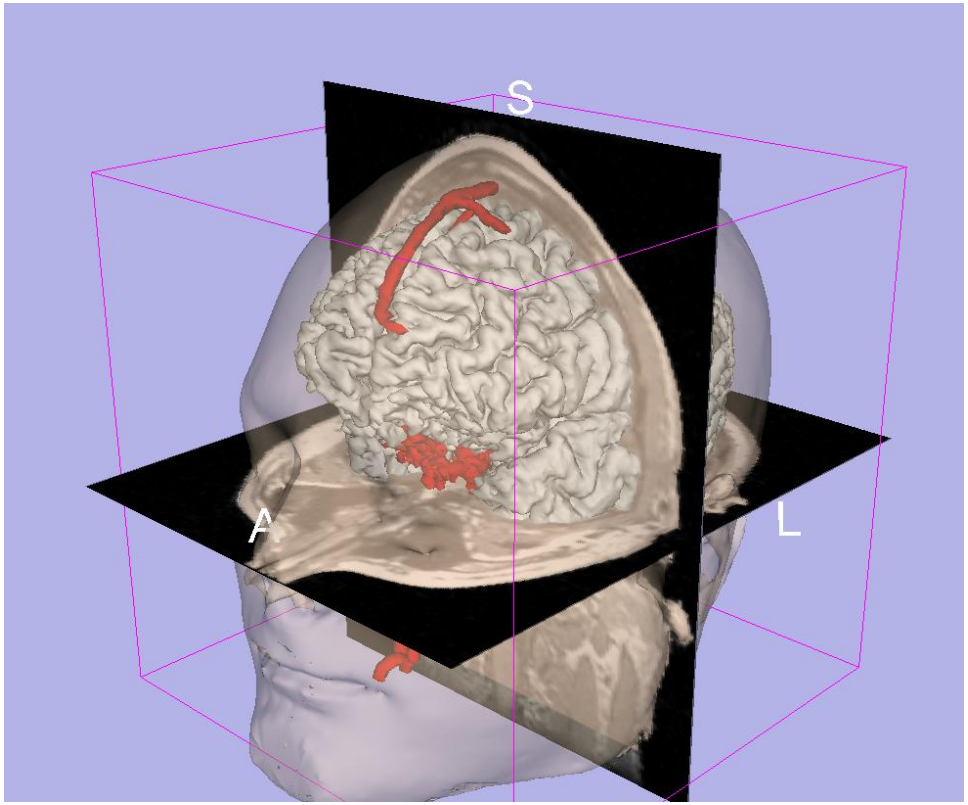
MR Nrrd
SPGR



Pre-computed
Label Map

Learning objective

Following this tutorial, you'll be able to load and visualize volumes within Slicer3, and to interact in 3D with structural images and models.



Start Slicer3

Linux/Mac users

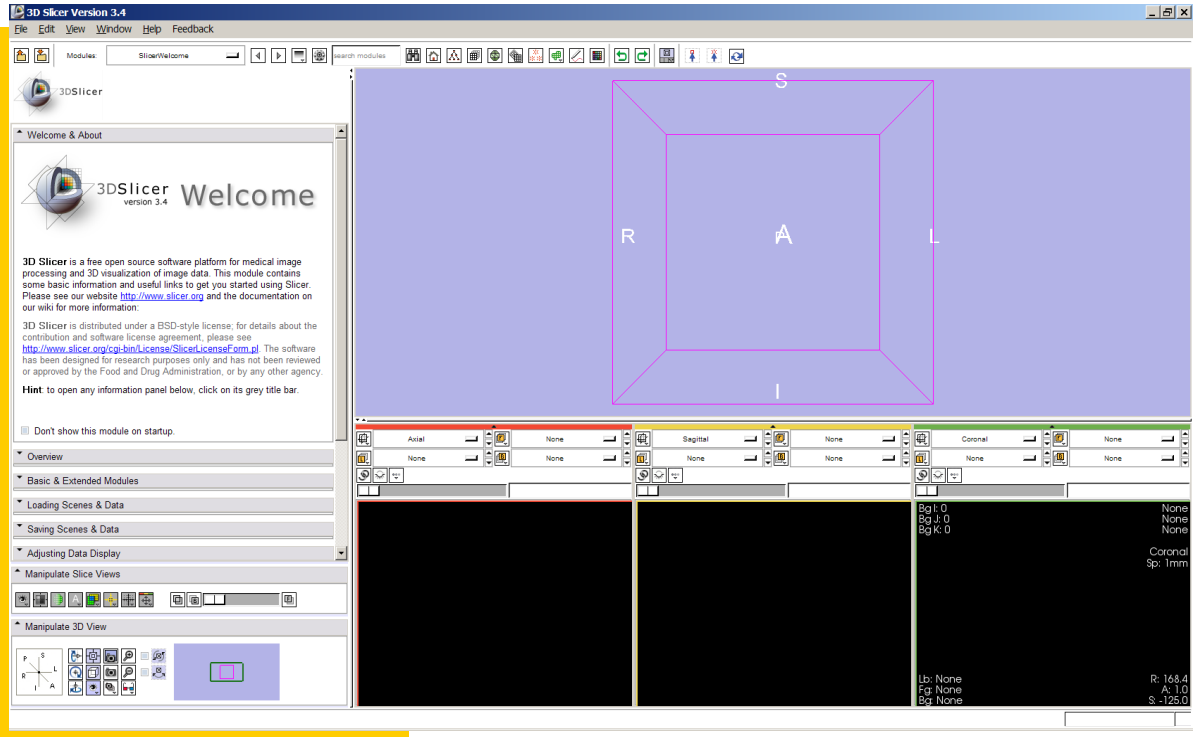
Launch the Slicer3 executable located in the Slicer3.4 directory

Windows users

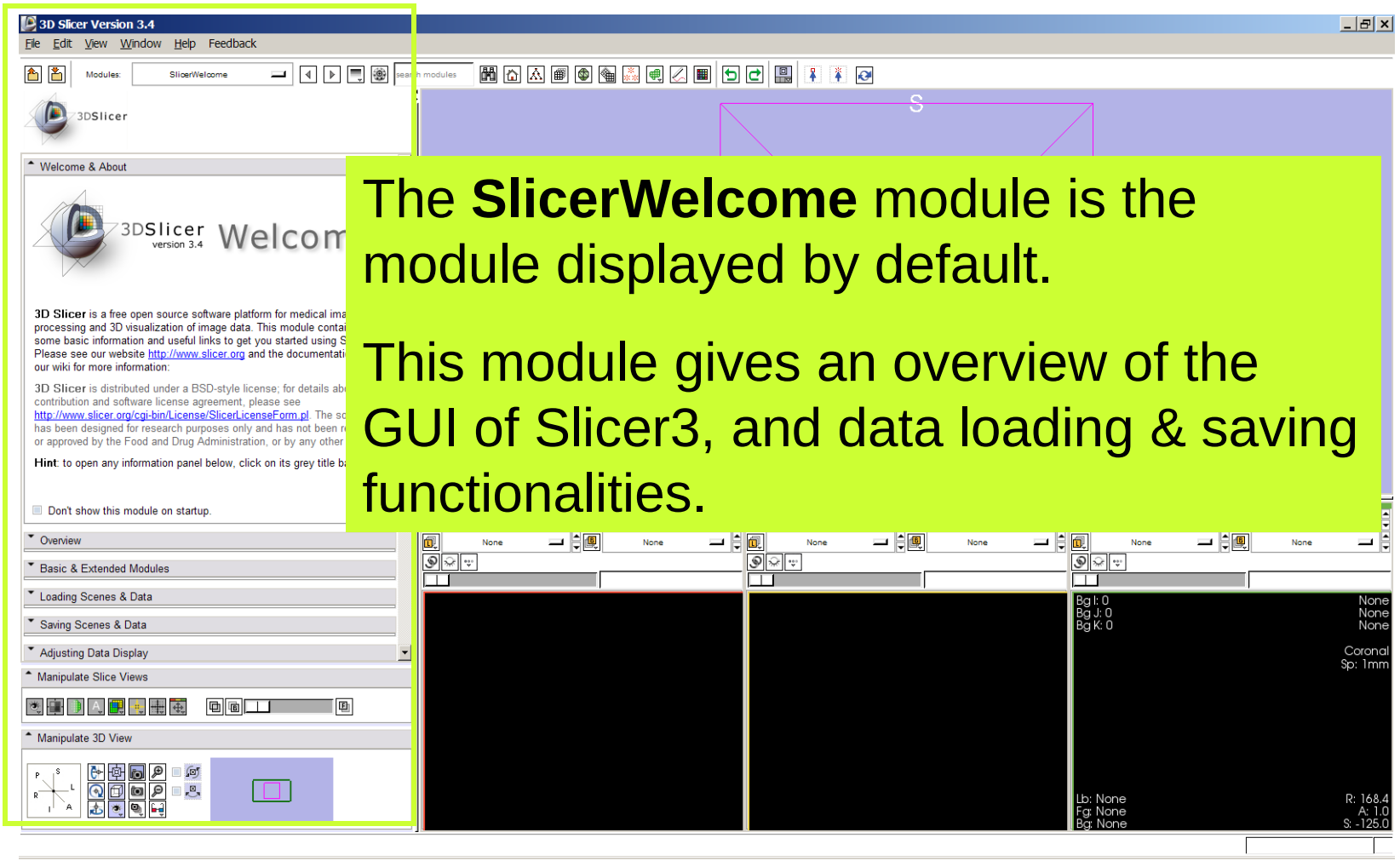
Select

Start → All Programs

→ Slicer3 3.4 2009-05-21→Slicer3



Slicer Welcome



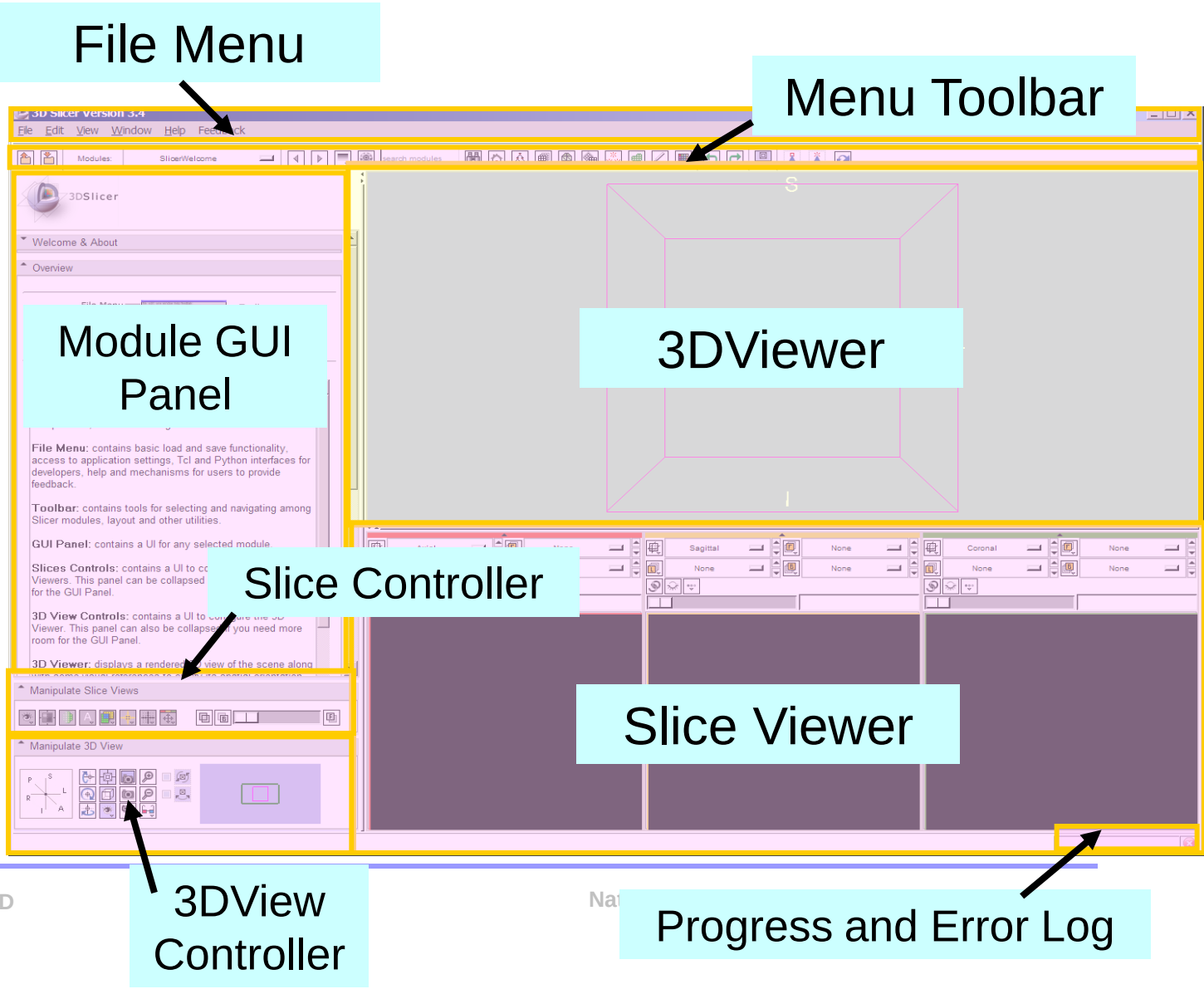
The **SlicerWelcome** module is the module displayed by default.

This module gives an overview of the GUI of Slicer3, and data loading & saving functionalities.

Slicer3 GUI

The Graphical User Interface (GUI) of Slicer3.4 integrates 8 main components:

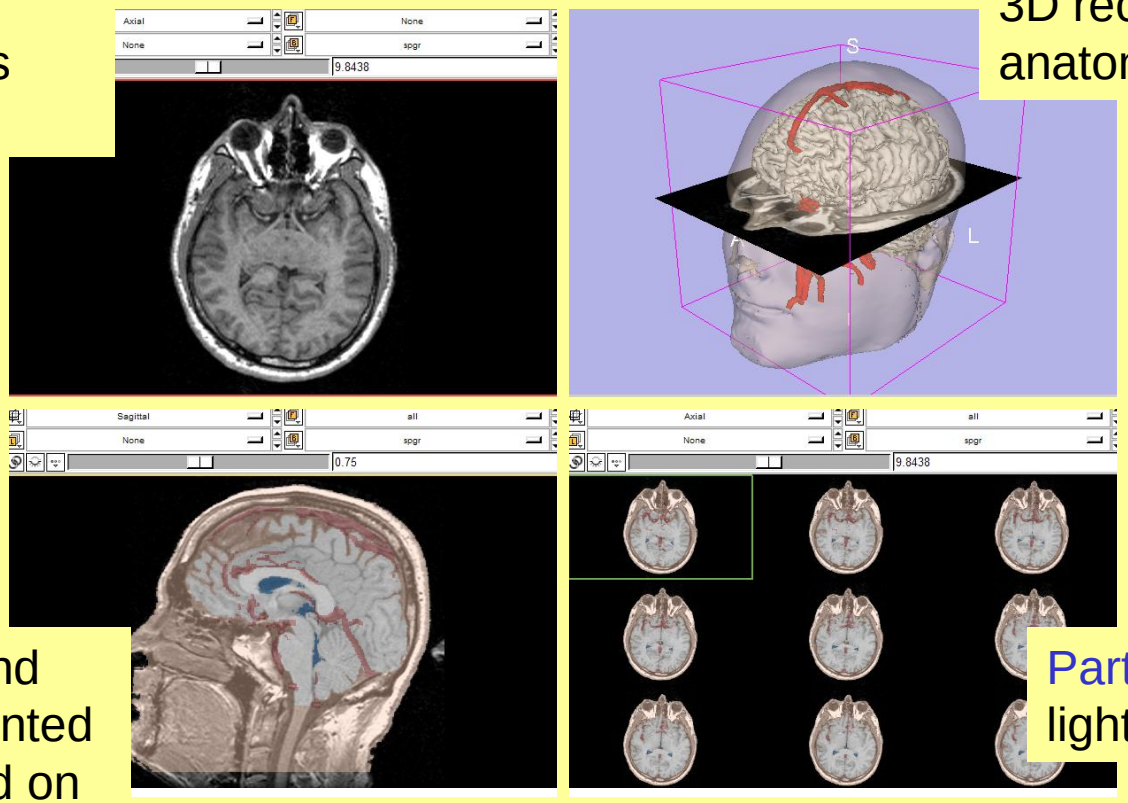
- the File Menu
- the Menu Toolbar
- the Module GUI Panel
- the 3D Viewer
- the Slice Viewer
- the Slice Controller
- the 3D View Controller



Overview

Part 1. Loading and visualizing multiple volumes simultaneously

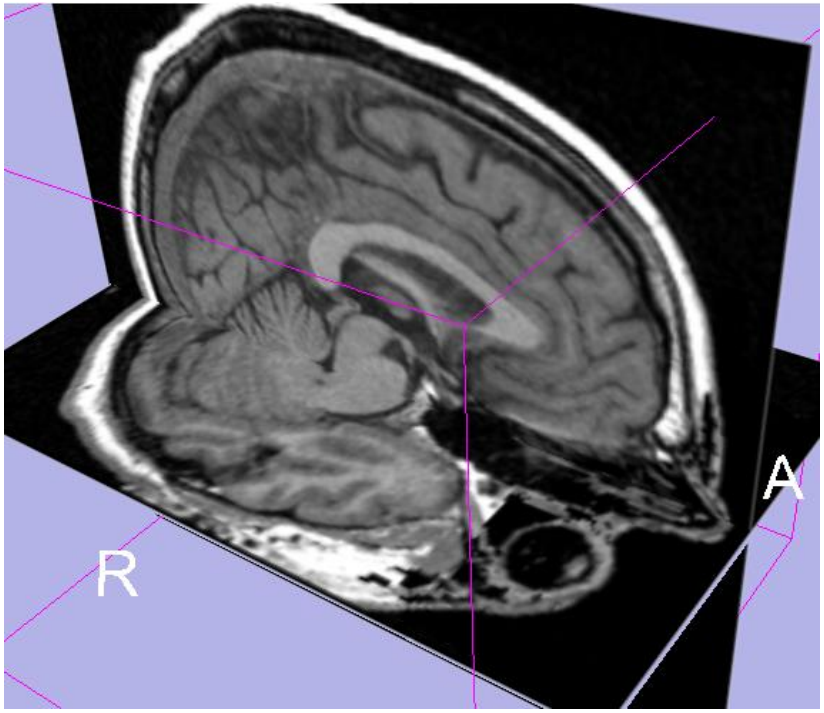
Part 3. Visualizing 3D reconstructions of anatomical surfaces



Part 2. Loading and visualizing segmented structures overlaid on grayscale images

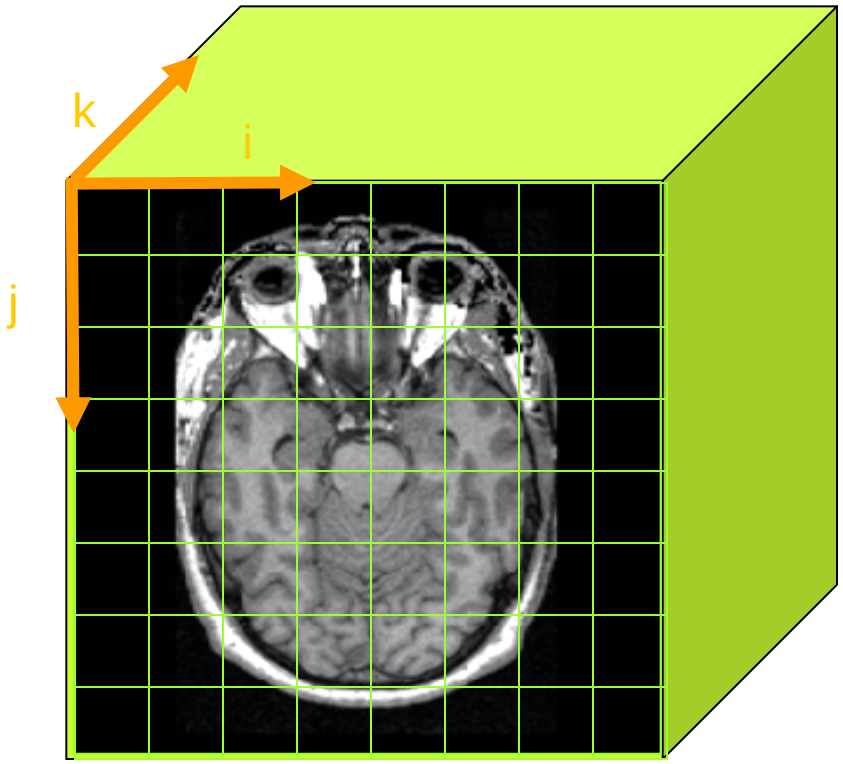
Part 4. The lightbox viewer

Part 5. Saving data



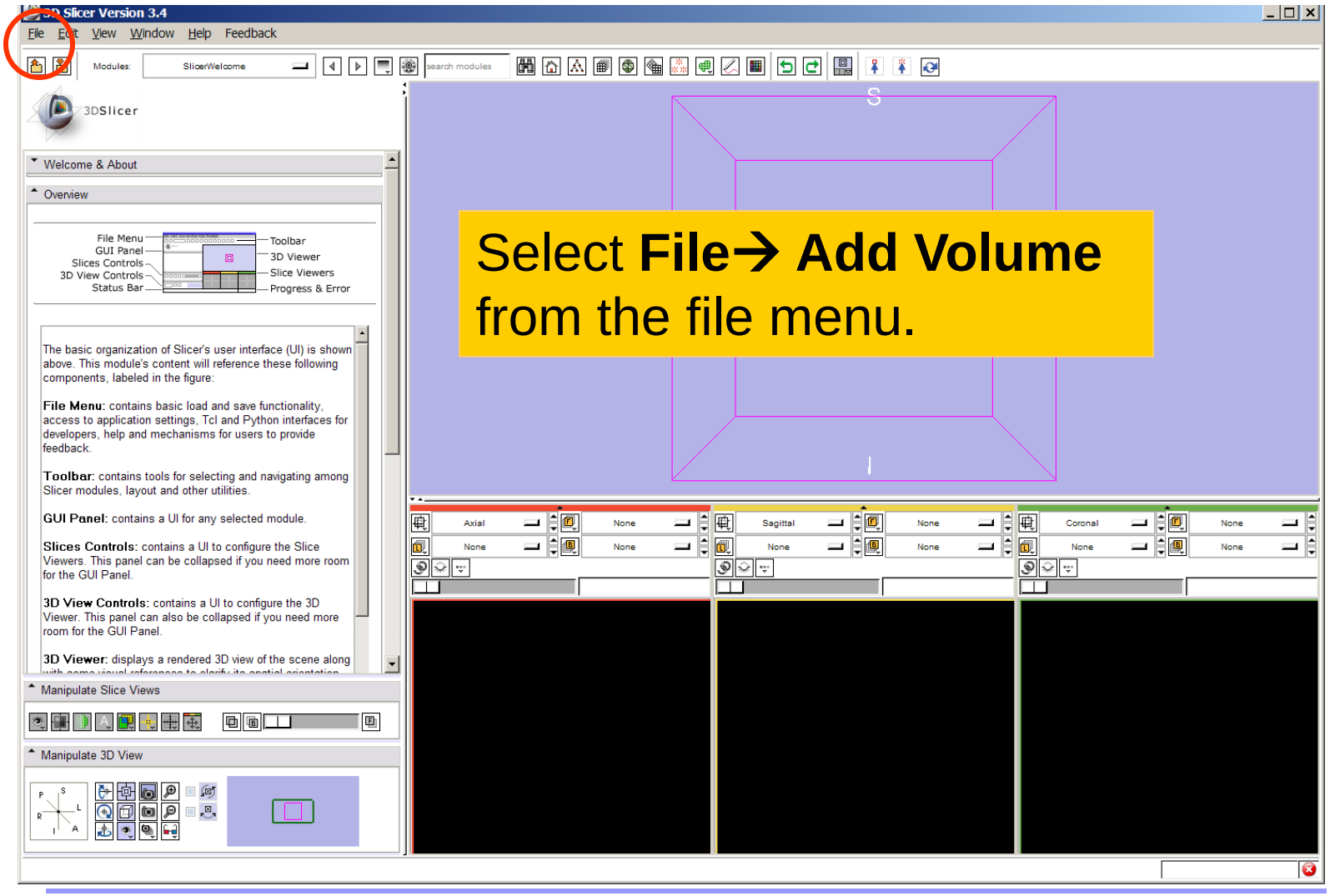
Part 1: Loading and visualizing multiple volumes simultaneously

Data Representation

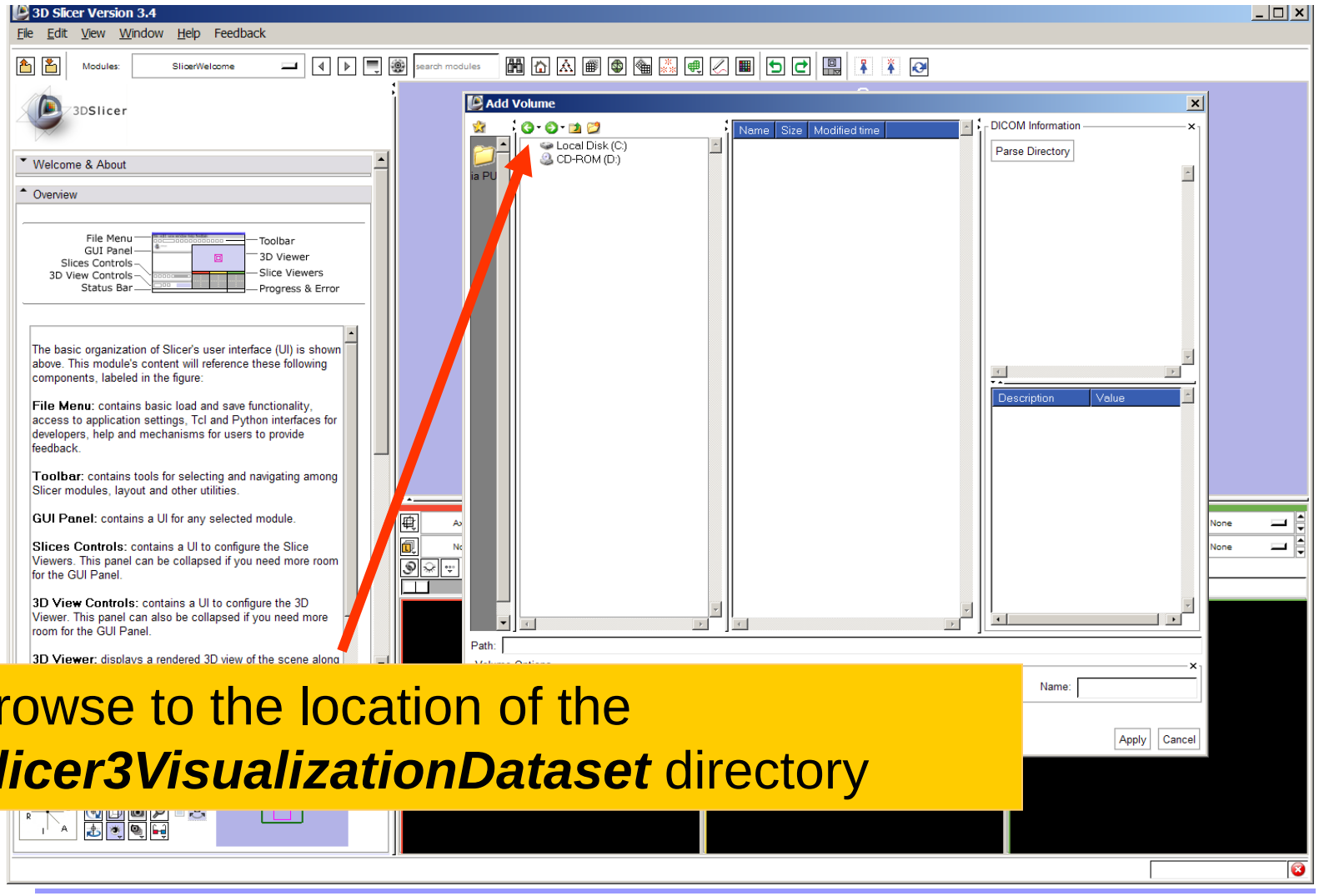


- The result of a volumetric acquisition is a 3D volume of data related to the patient.
- The 3D raster dataset is sampled on a discrete grid with elements called voxels which contain the signal intensity.

Loading Volumes

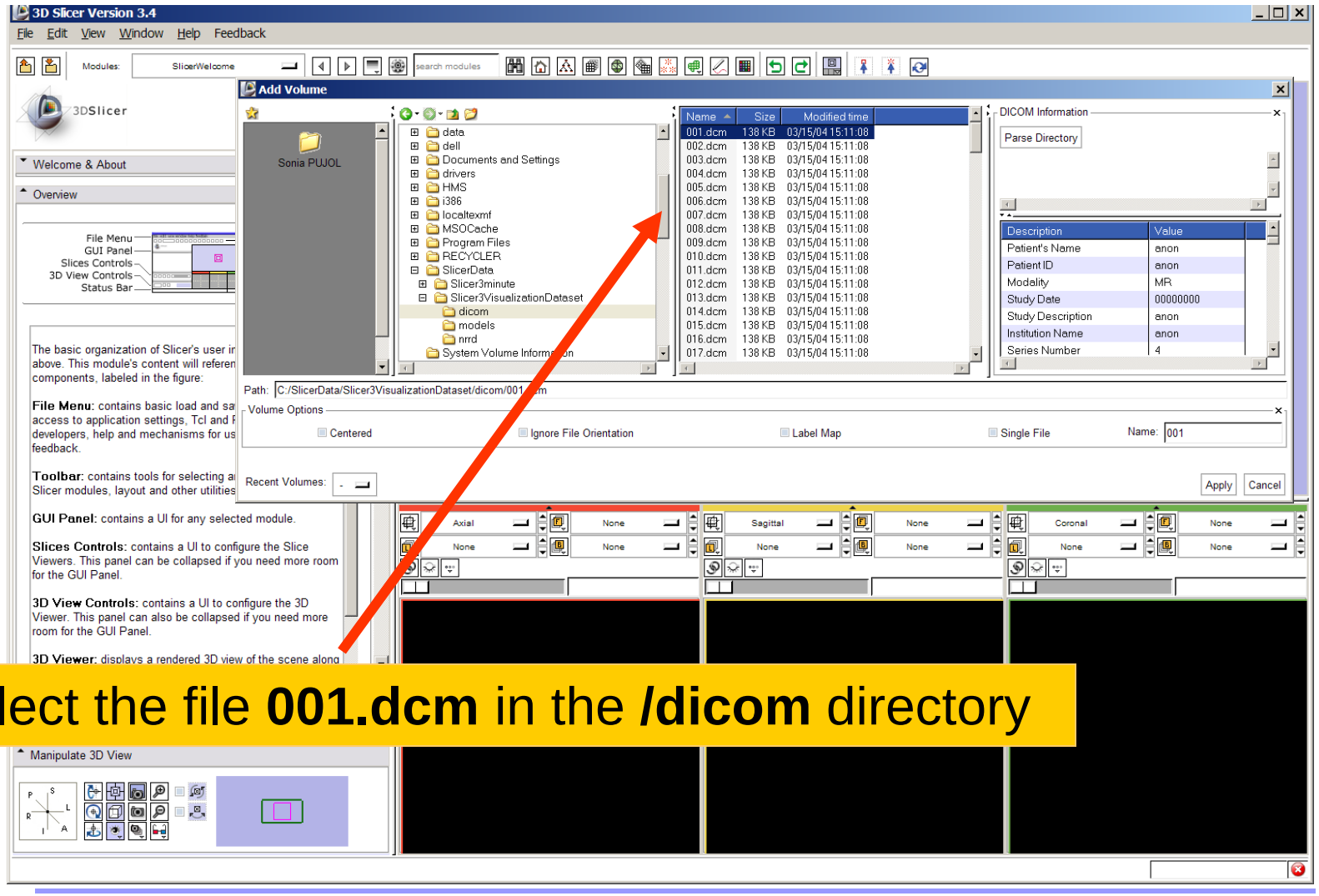


Loading Volumes

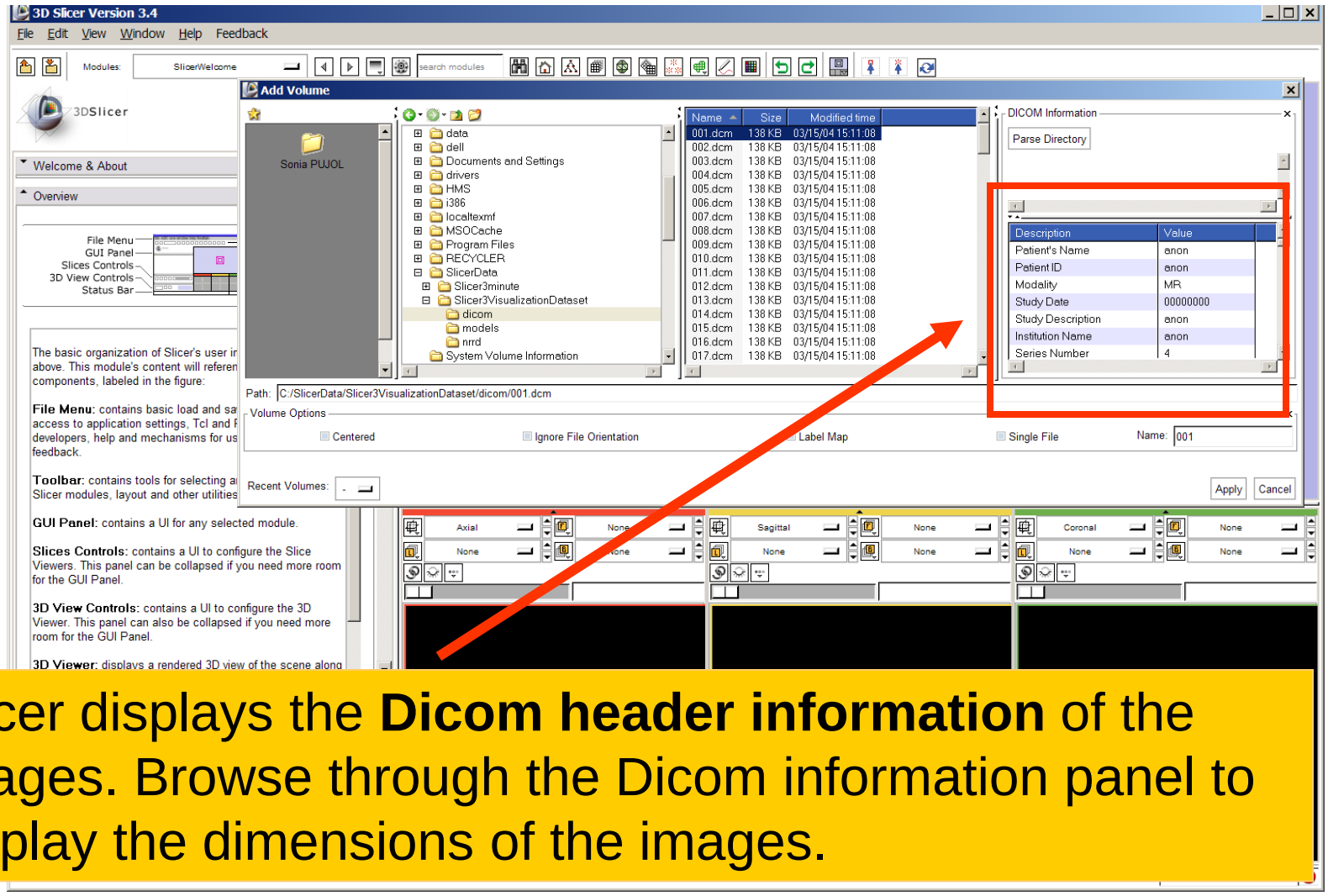


Browse to the location of the ***Slicer3VisualizationDataset*** directory

Loading Volumes



Loading Volumes



Slicer displays the **Dicom header information** of the images. Browse through the Dicom information panel to display the dimensions of the images.

Loading Volumes

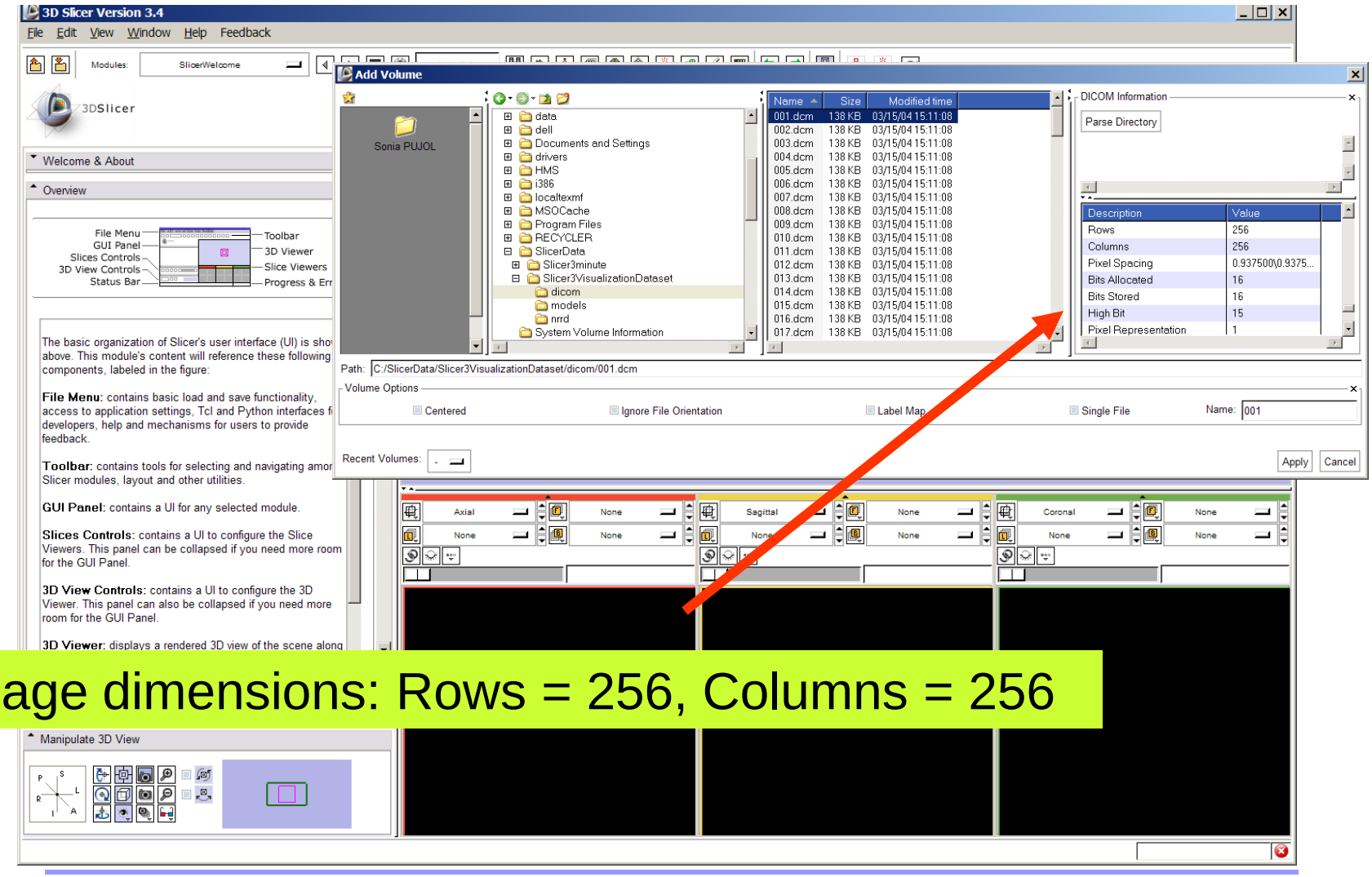
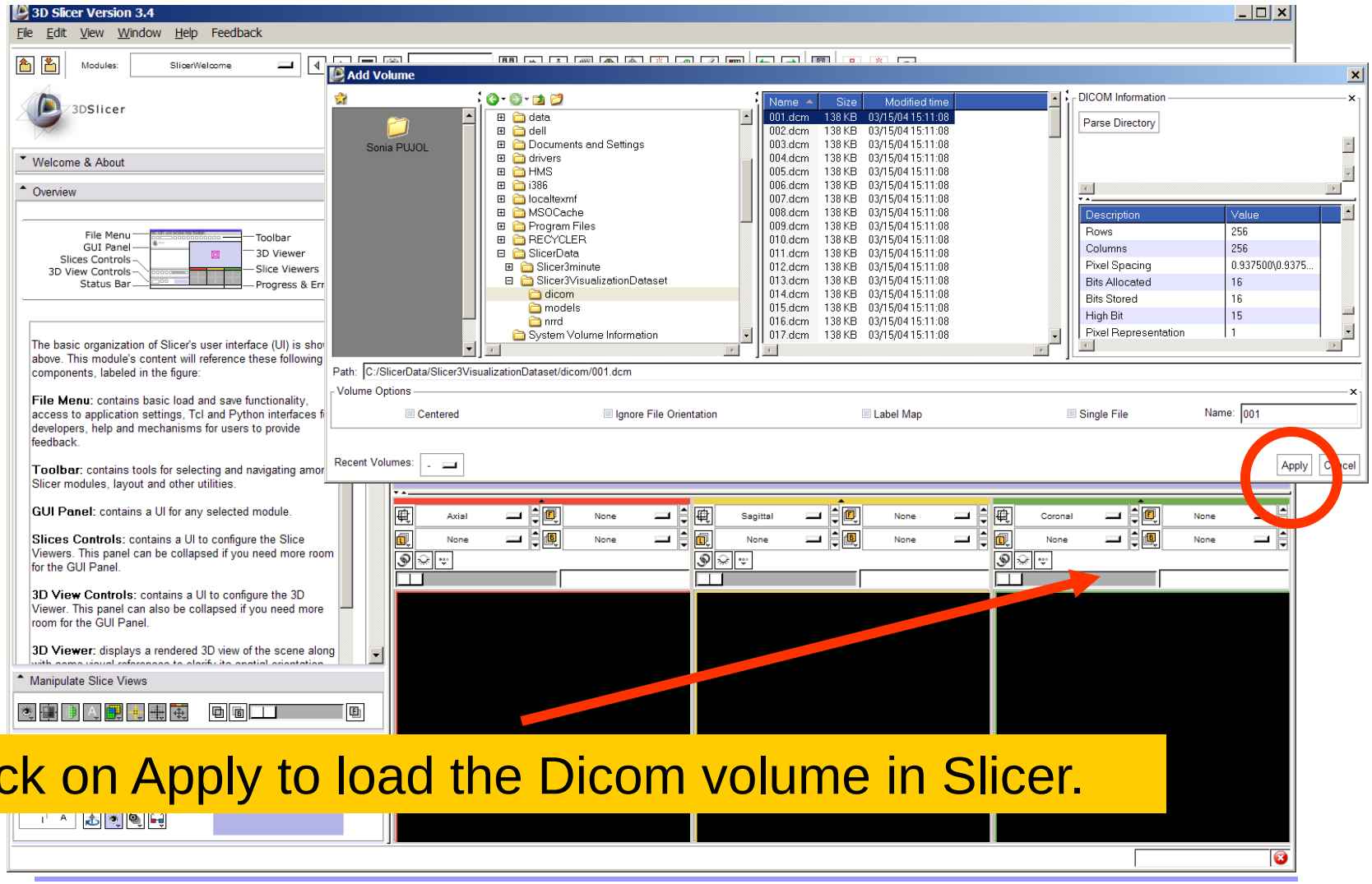


Image dimensions: Rows = 256, Columns = 256

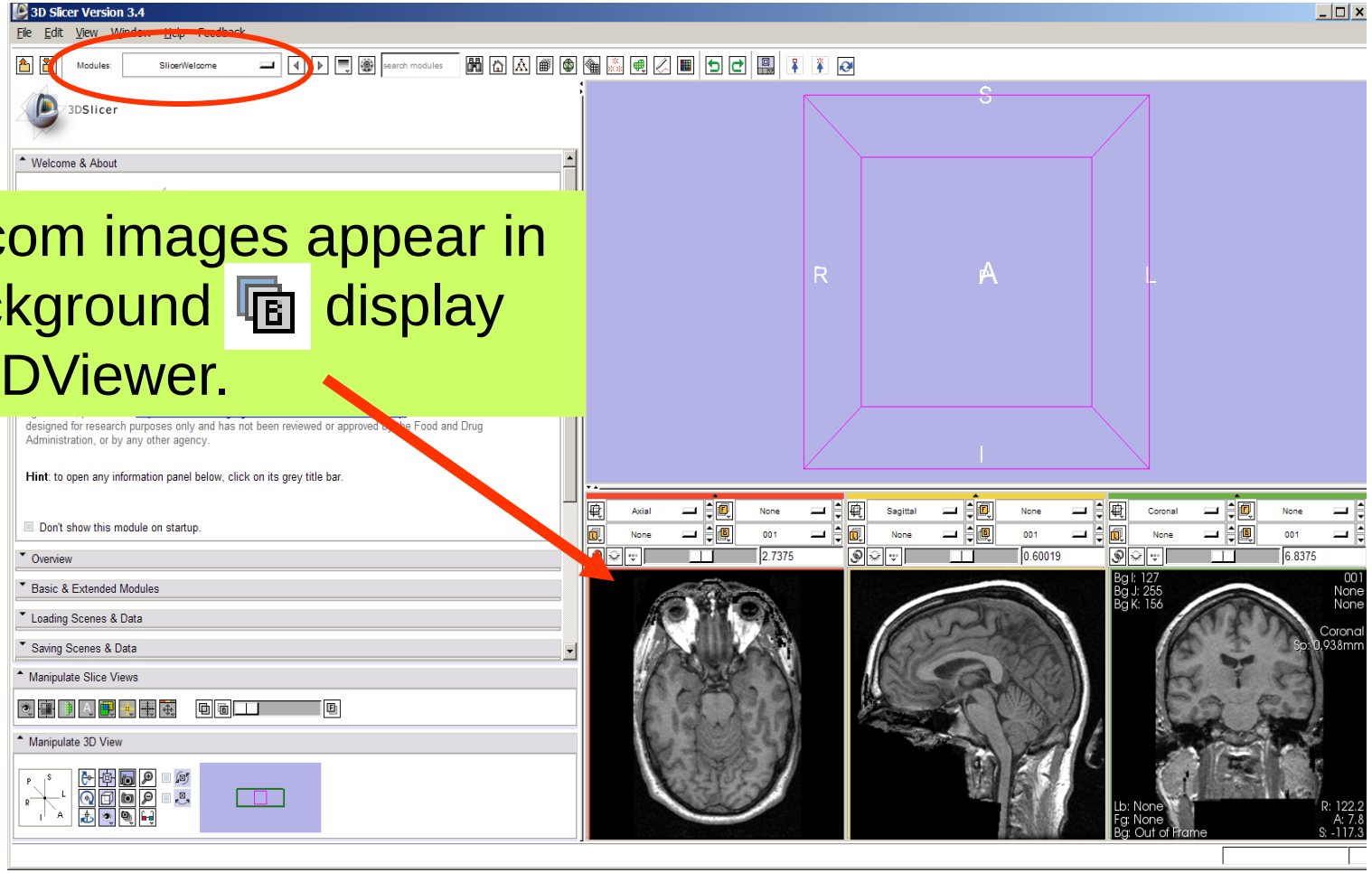
Loading Volumes



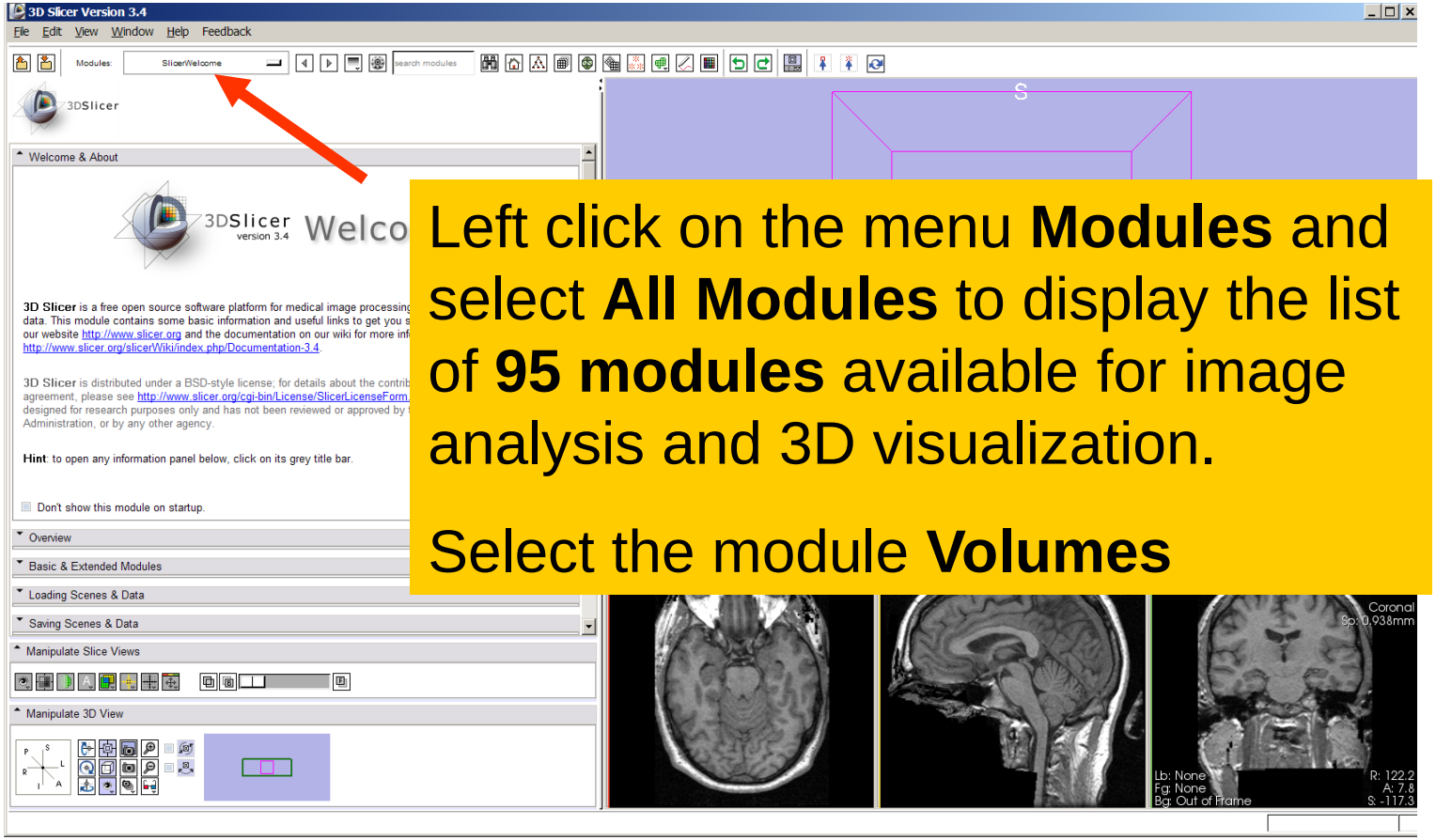
Click on Apply to load the Dicom volume in Slicer.

Loading Volumes

The Dicom images appear in the Background display of the 2DViewer.



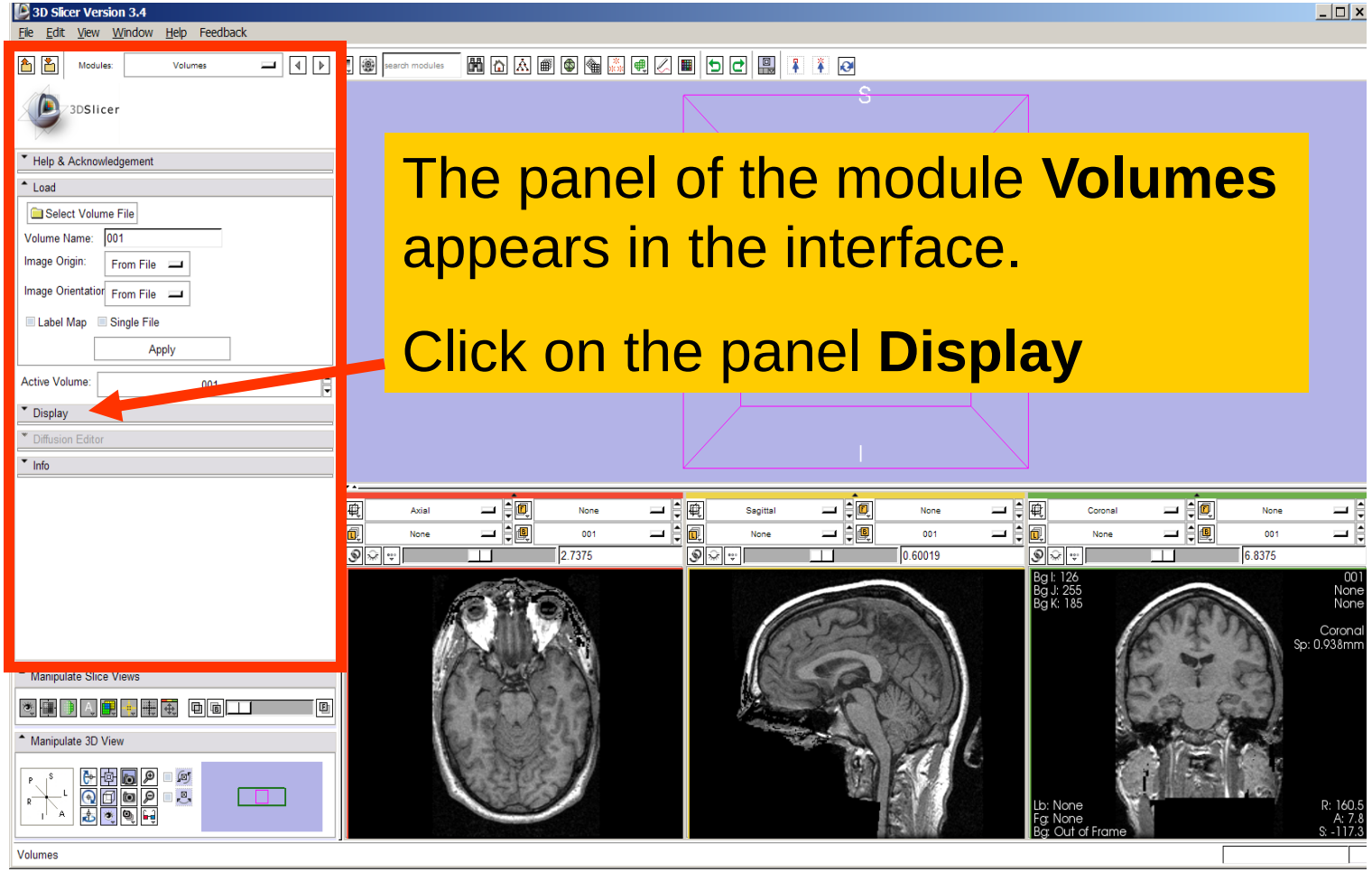
Loading Volumes



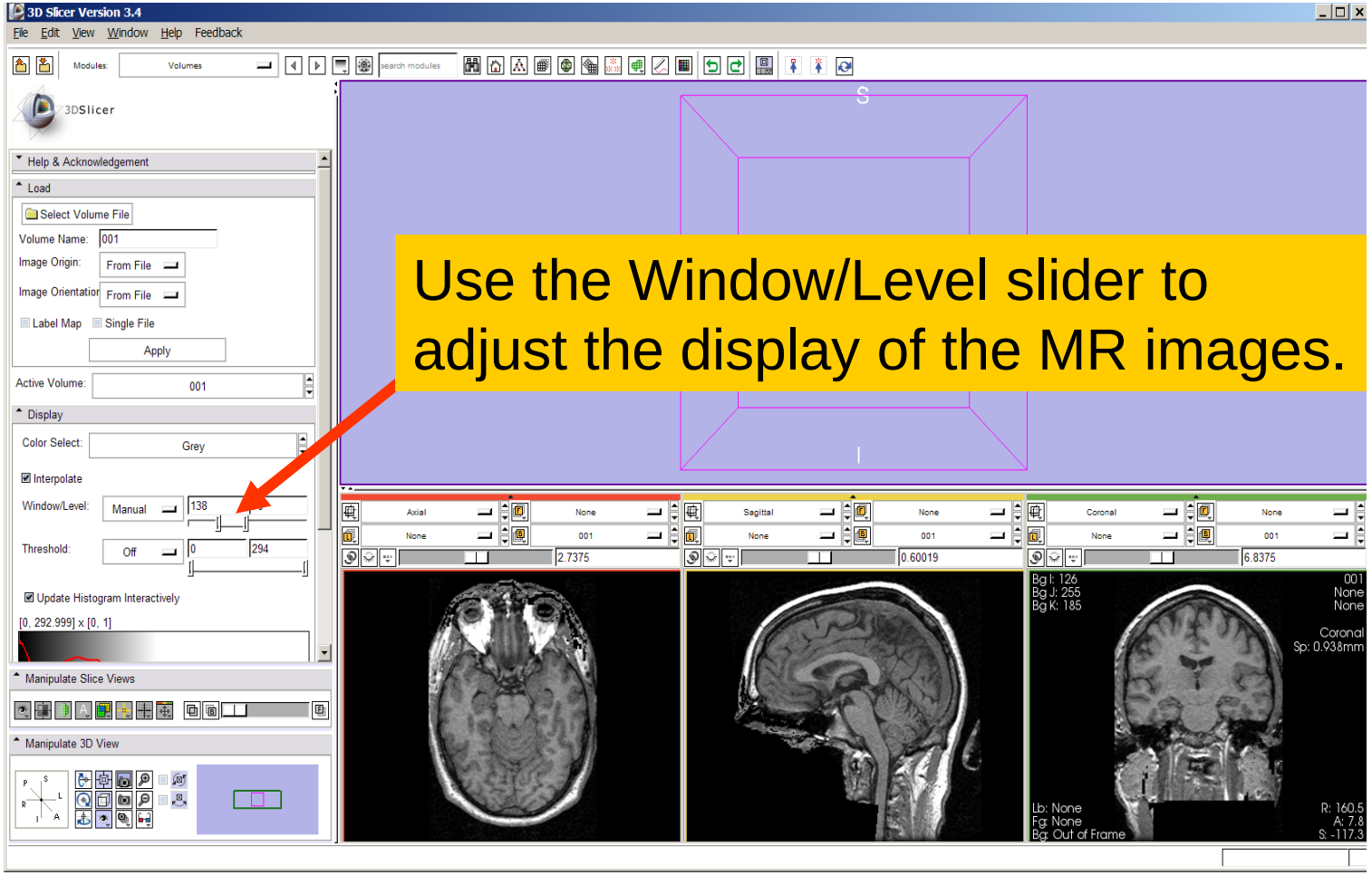
Left click on the menu **Modules** and select **All Modules** to display the list of **95 modules** available for image analysis and 3D visualization.

Select the module **Volumes**

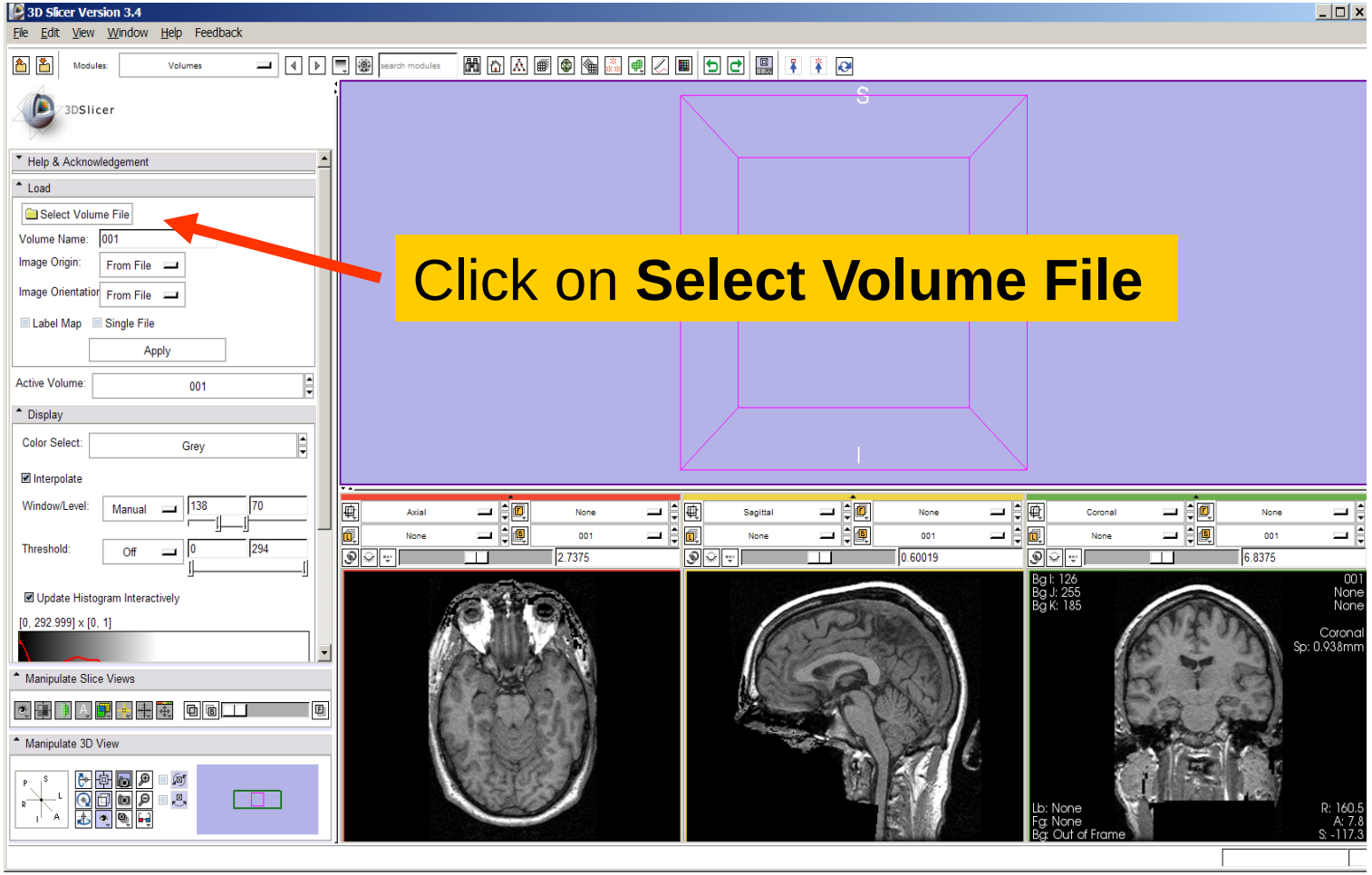
Loading Volumes



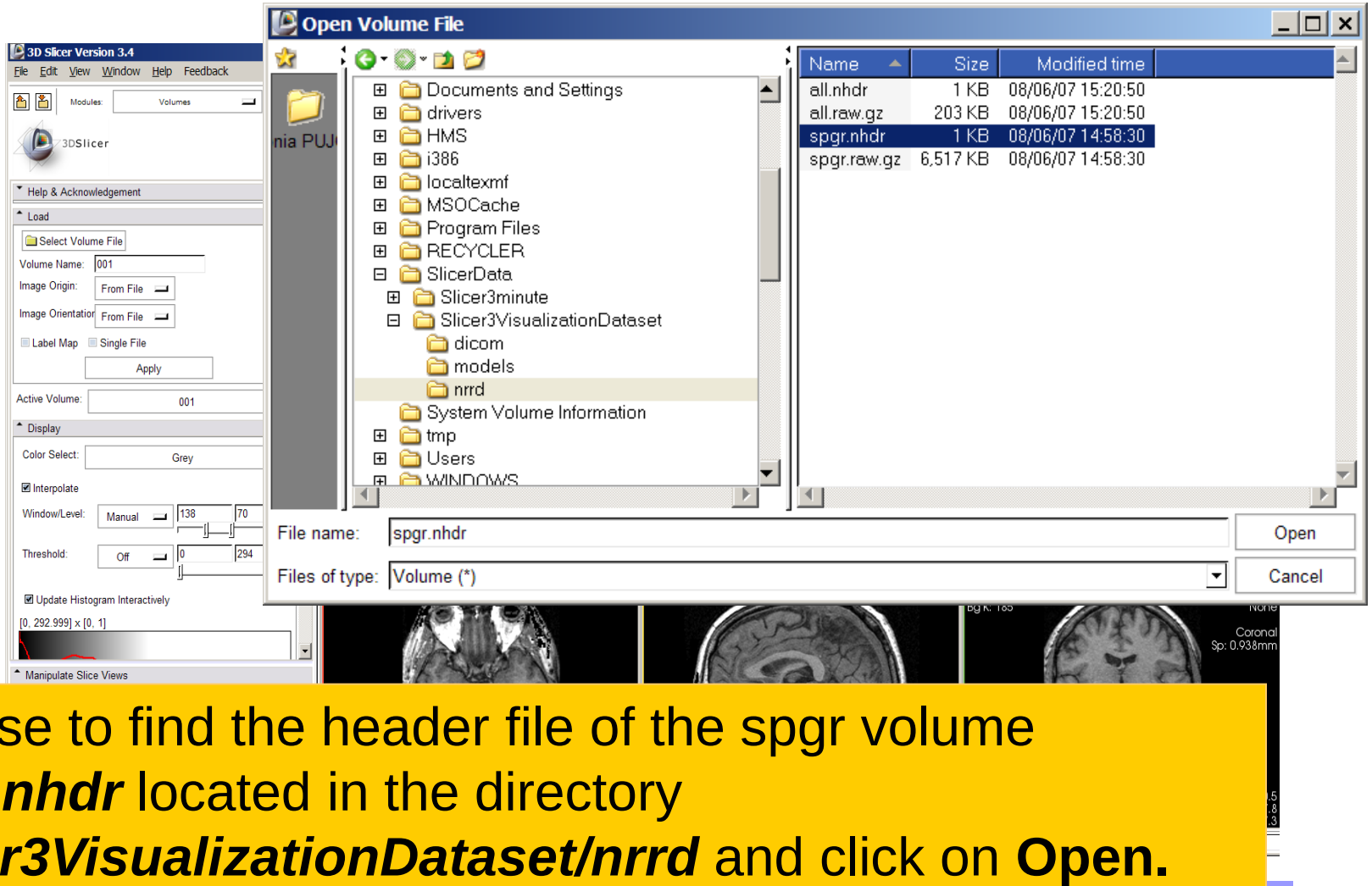
Loading Volumes



Loading Volumes

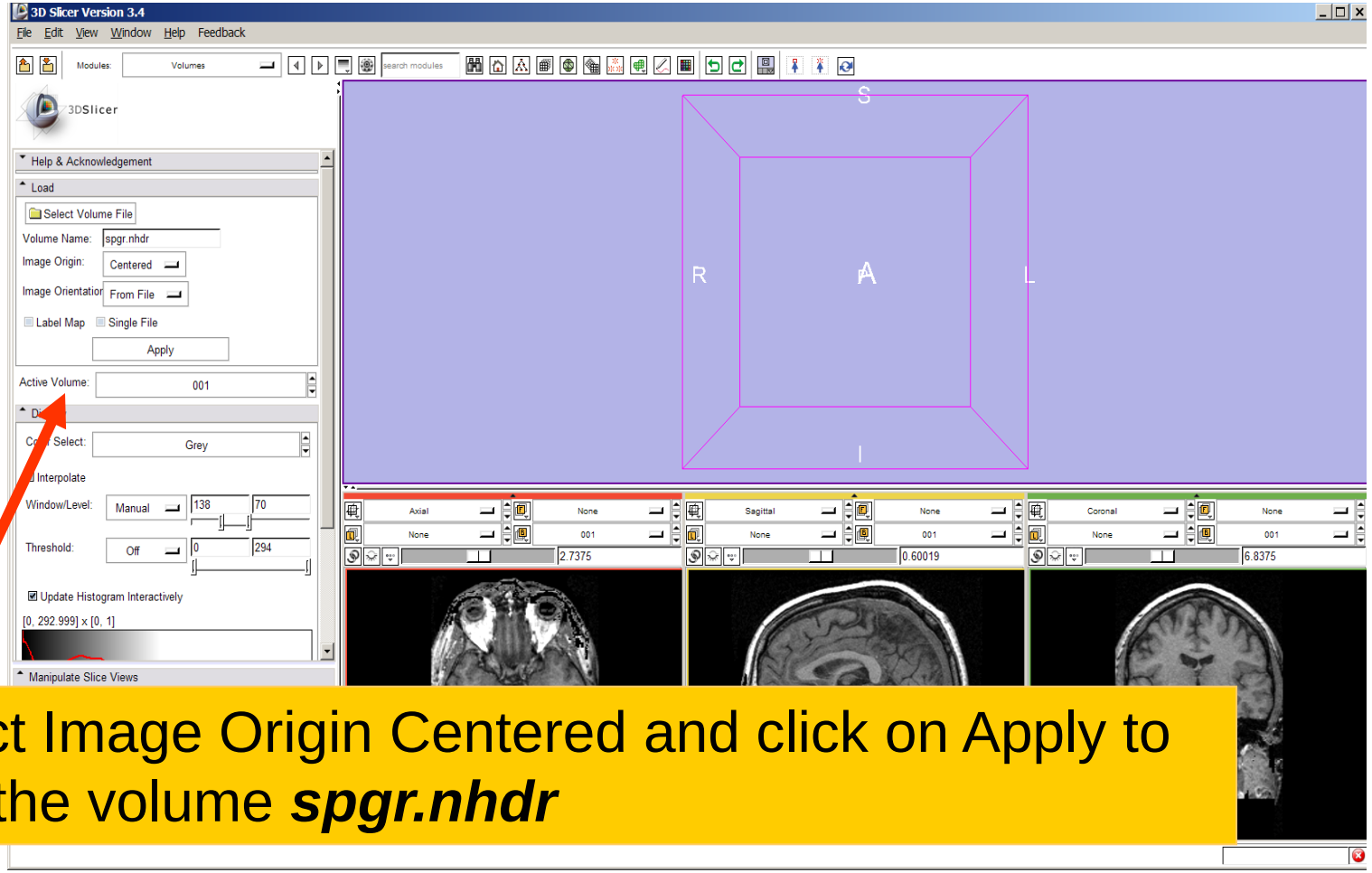


Loading Volumes



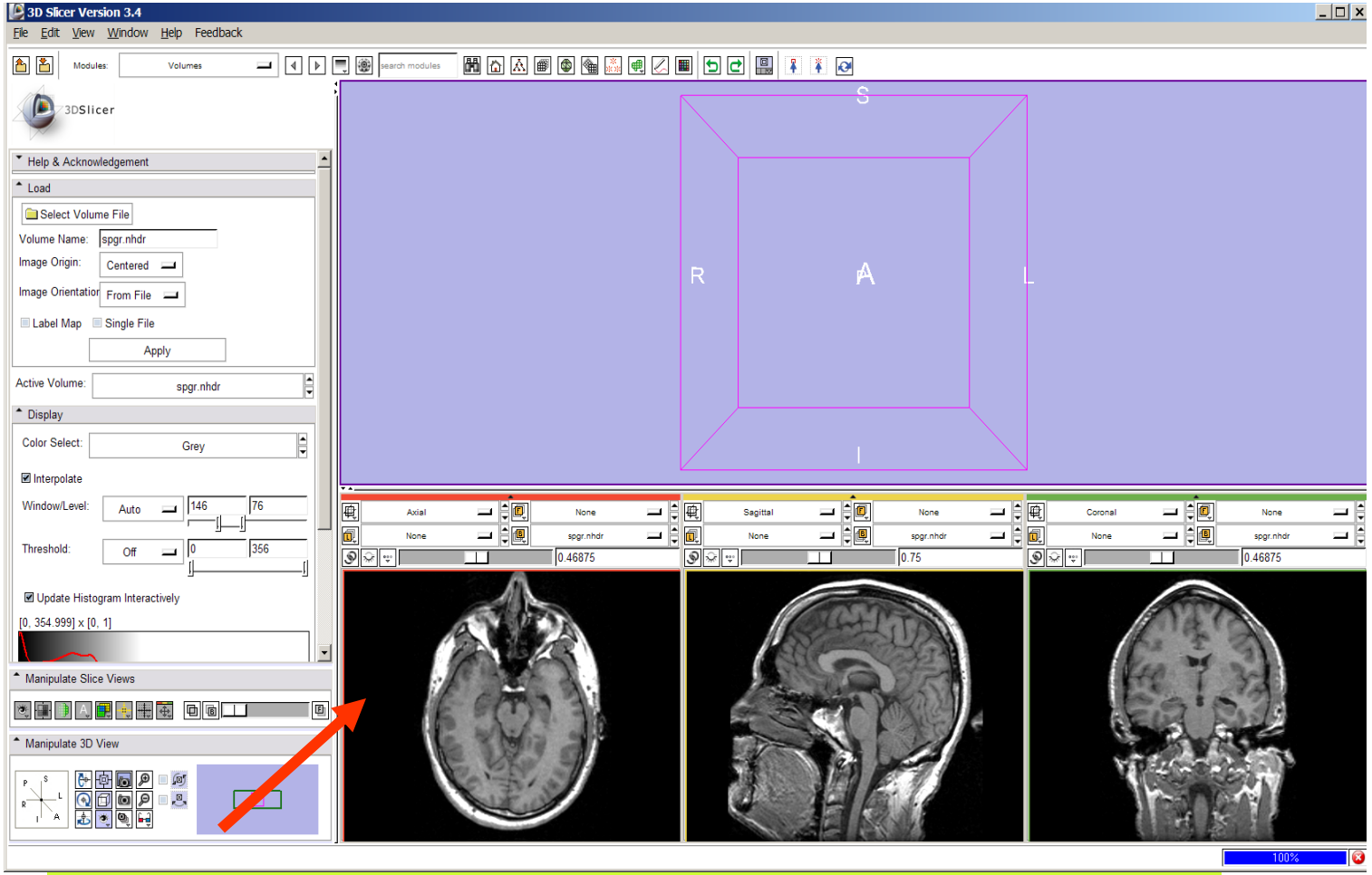
Browse to find the header file of the spgr volume ***spgr.nhdr*** located in the directory ***Slicer3VisualizationDataset/nrrd*** and click on **Open.**

Loading Volumes



Select Image Origin Centered and click on Apply to load the volume ***spgr.nhdr***

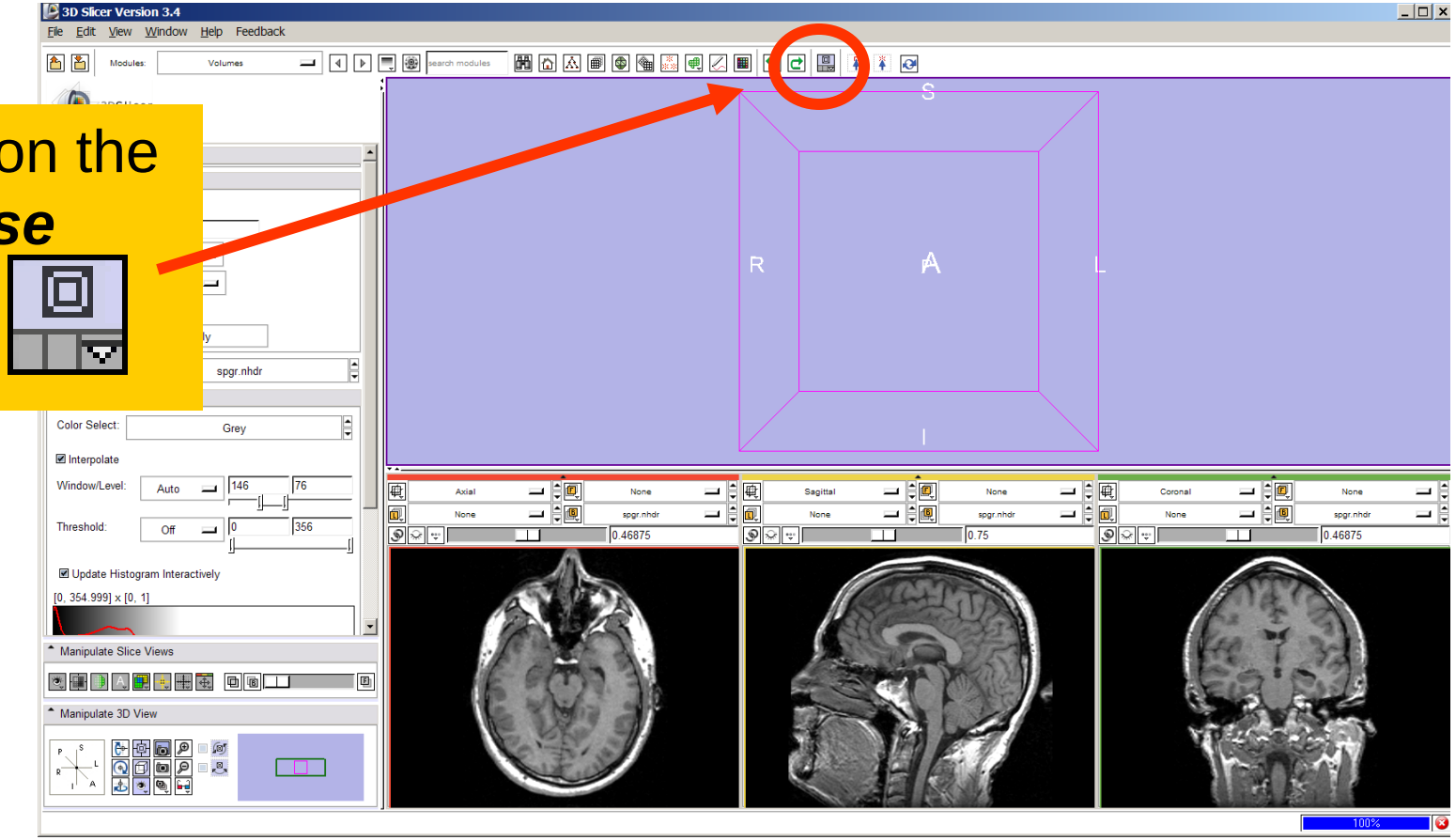
Loading Volumes



The spgr volume appears in the Background display of the 2D Viewer.

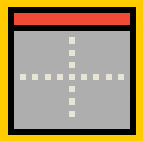
Exploring the data

Click on the ***choose view*** icon

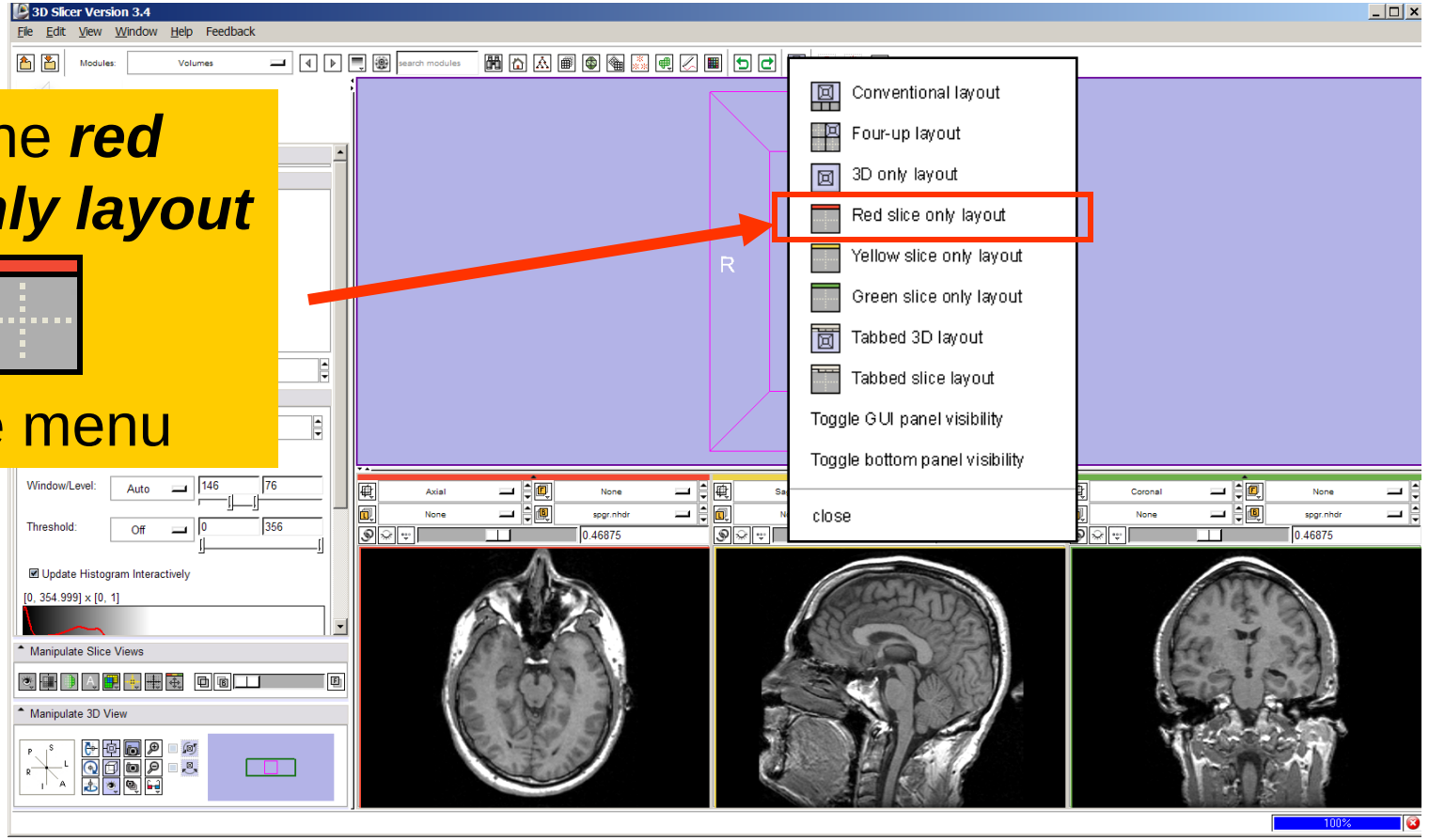


Exploring the data

Select the ***red slice only layout***

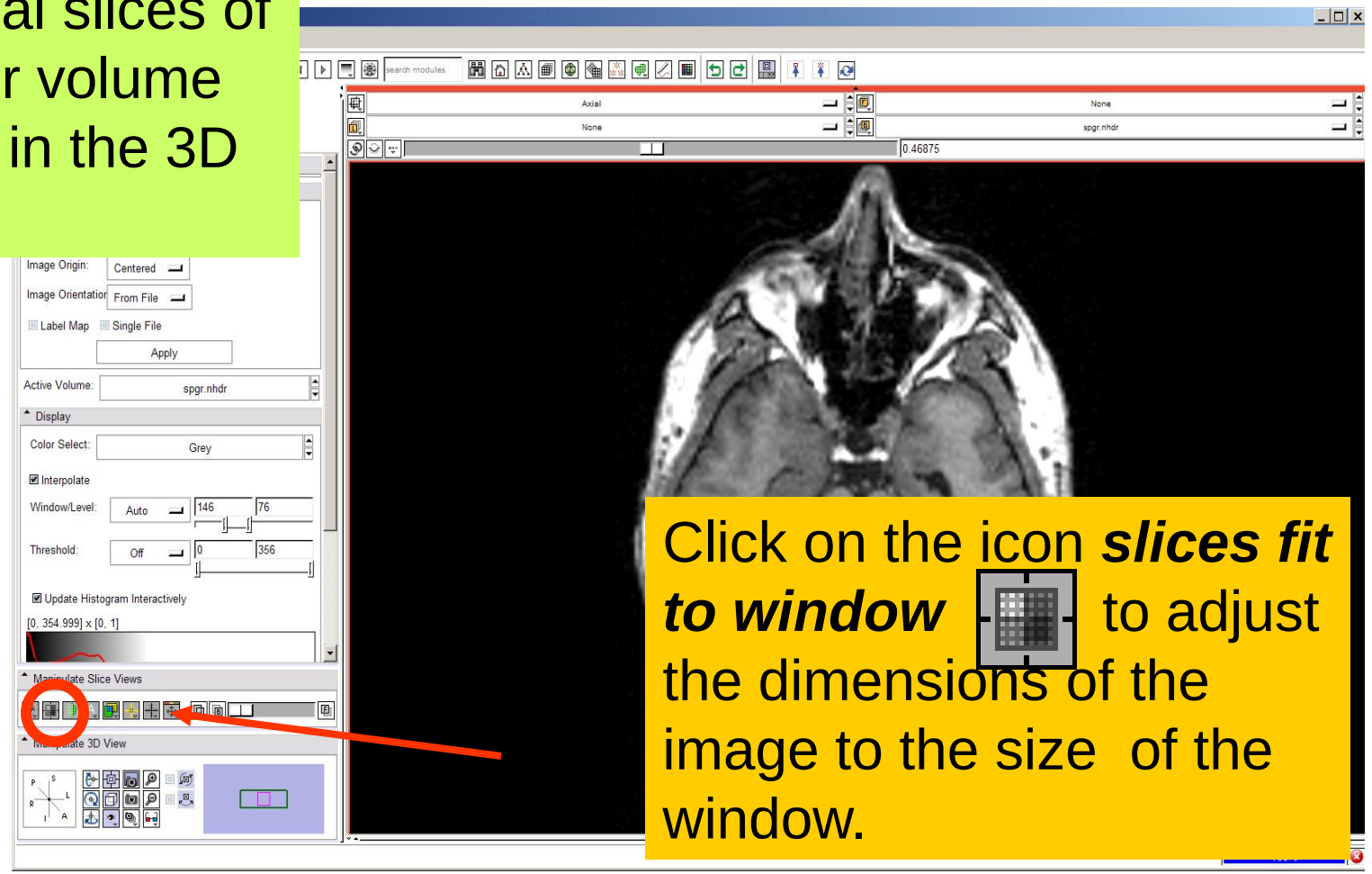


from the menu



Exploring the data

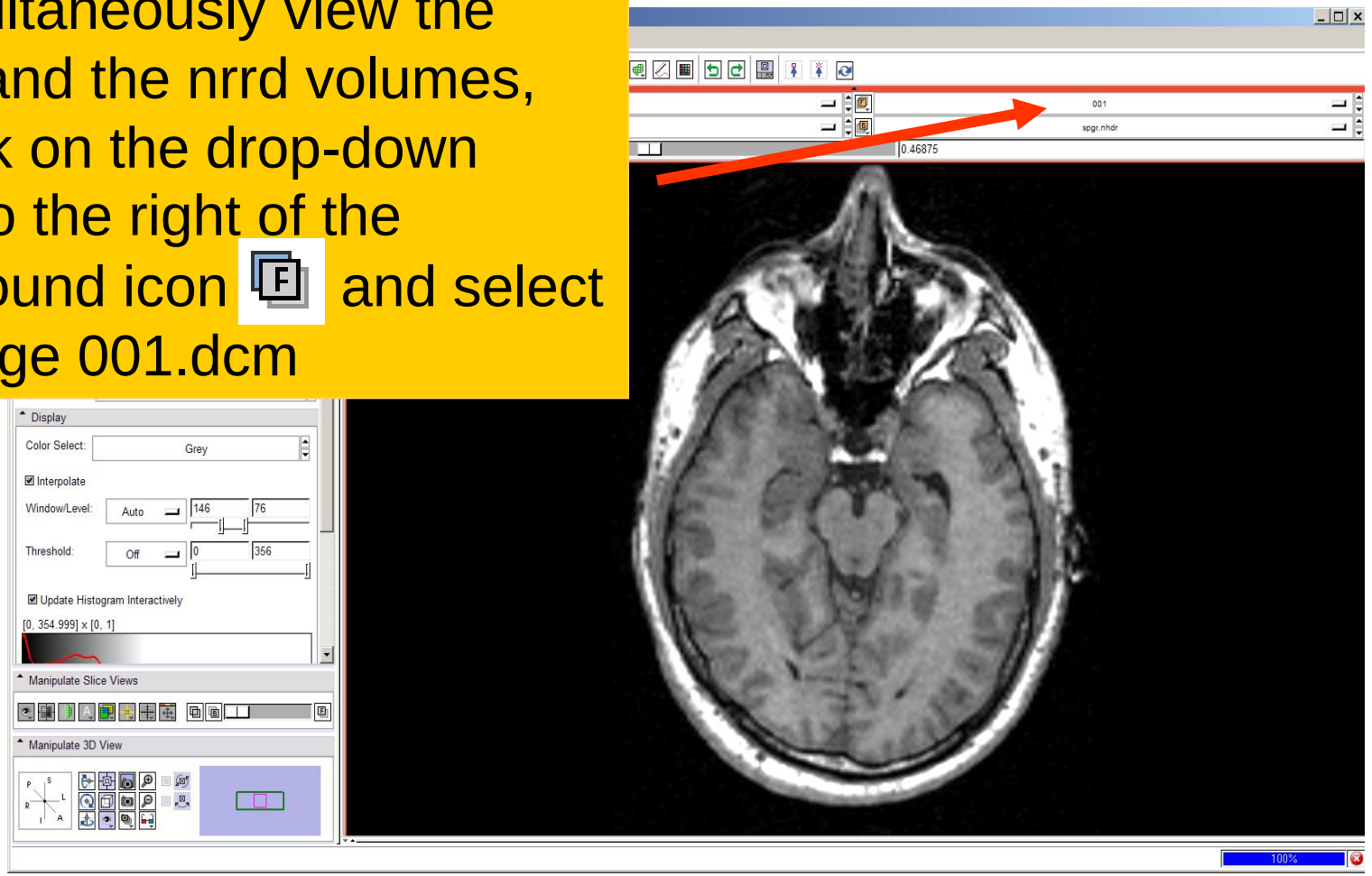
The axial slices of the spgr volume appear in the 3D viewer.



Click on the icon ***slices fit to window*** to adjust the dimensions of the image to the size of the window.

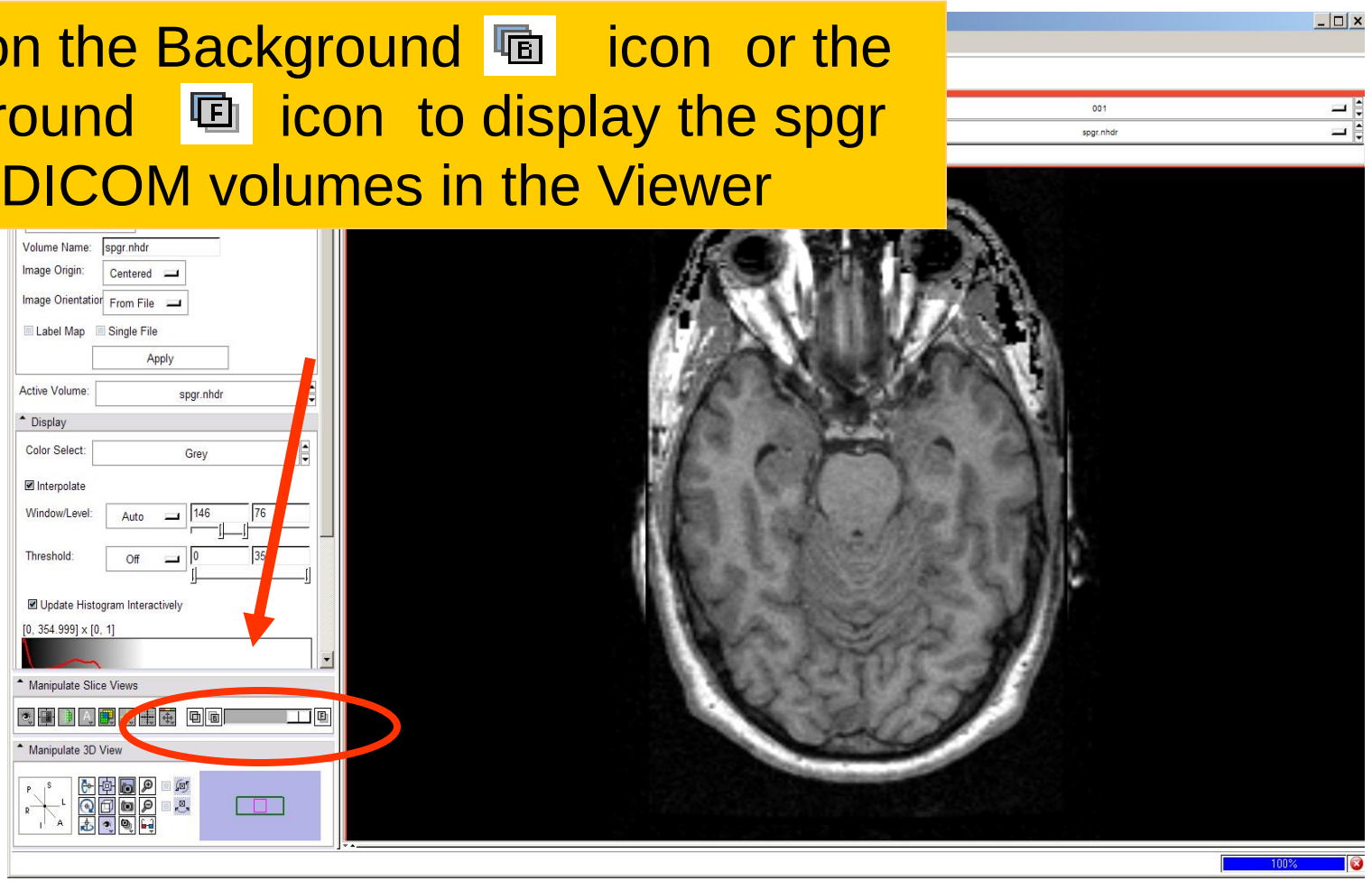
Exploring the data

To simultaneously view the dicom and the nrrd volumes, left click on the drop-down menu to the right of the Foreground icon and select the image 001.dcm



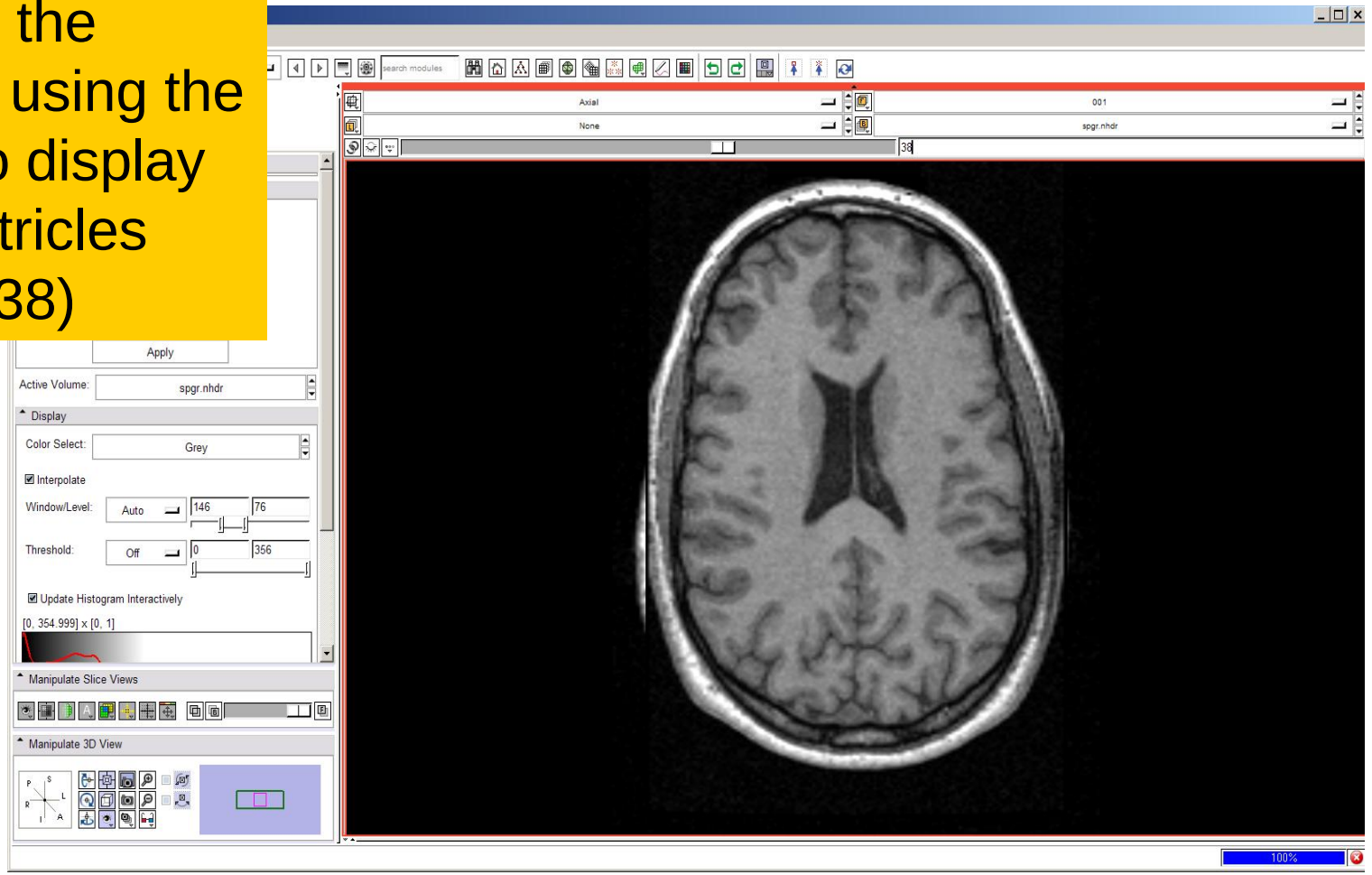
Exploring the data

Click on the Background icon or the Foreground icon to display the spgr or the DICOM volumes in the Viewer



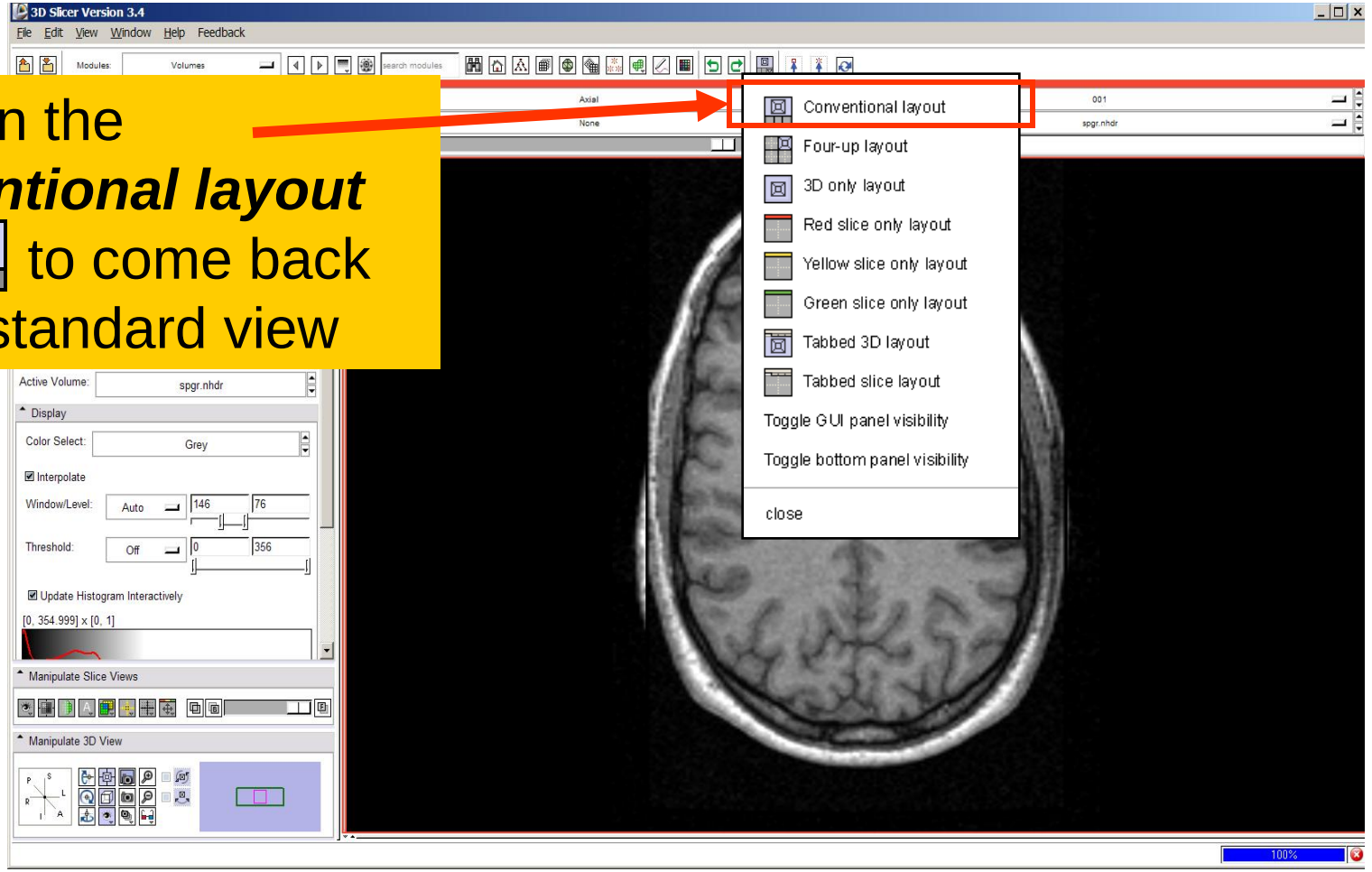
Exploring the data

Browse the images using the slider to display the ventricles (~slice 38)



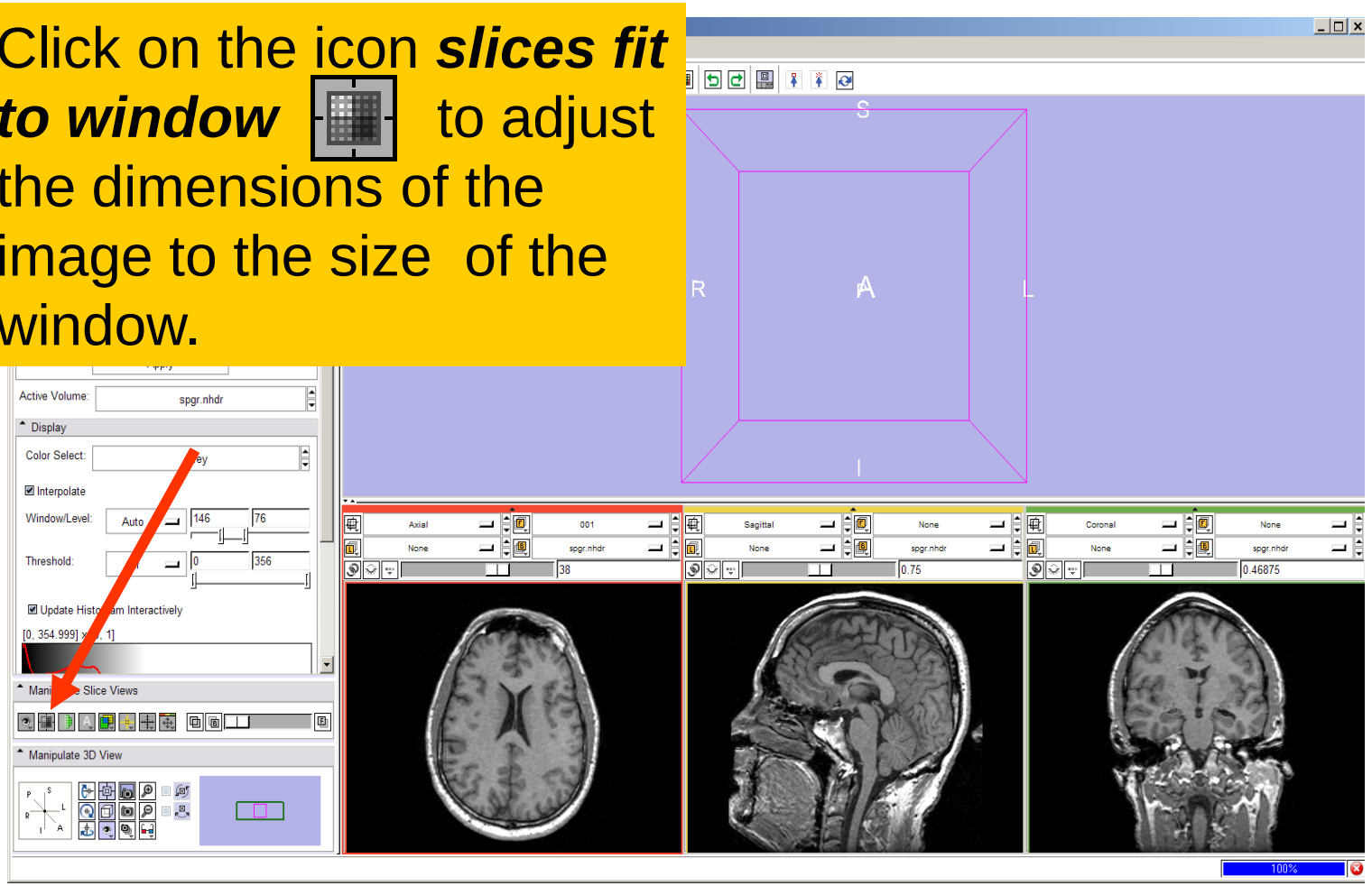
Exploring the data

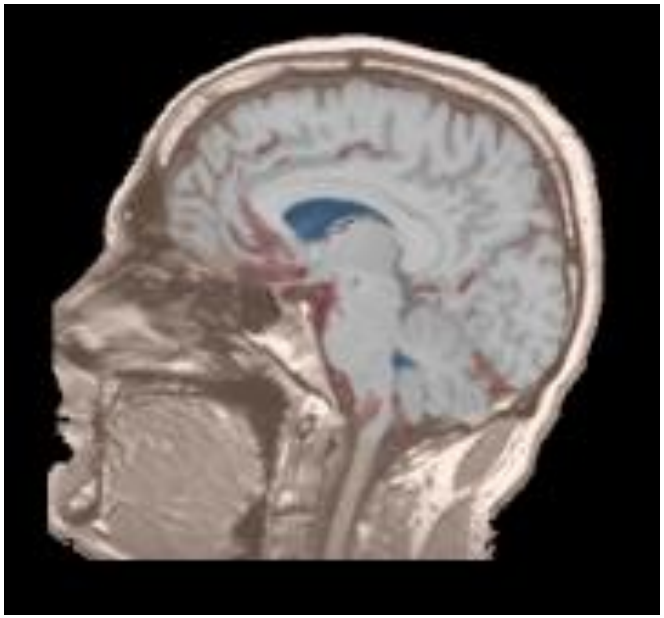
Click on the ***conventional layout*** *icon*  to come back to the standard view



Loading Volumes

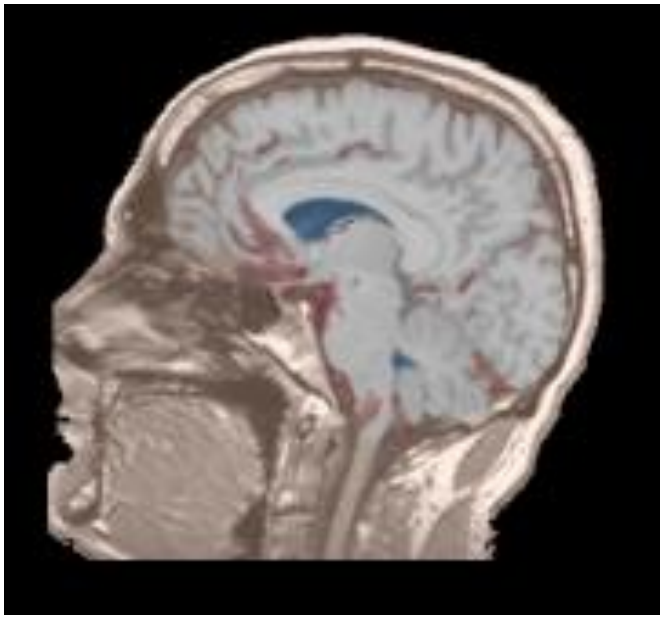
Click on the icon ***slices fit to window*** to adjust the dimensions of the image to the size of the window.





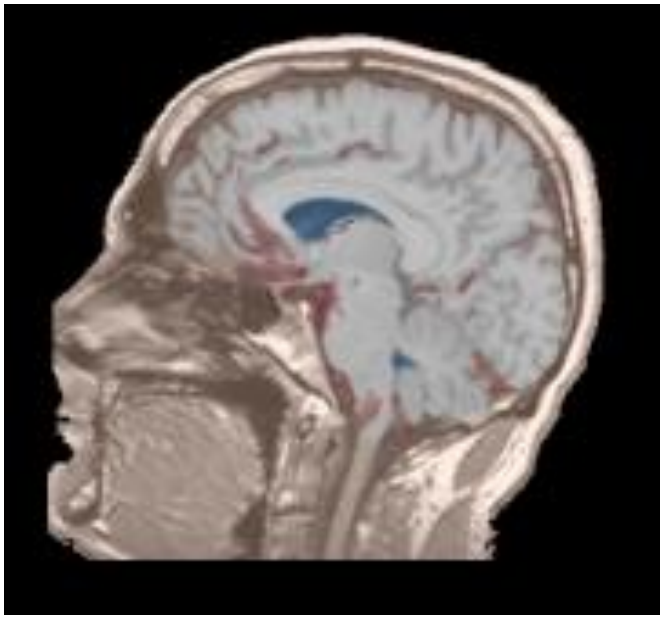
Part 2: Loading and visualizing segmented structures overlaid on grayscale images

Label map



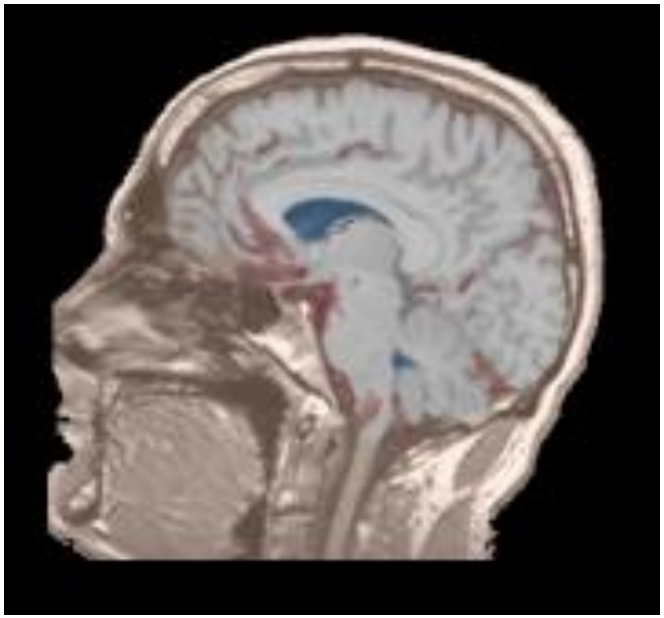
- Image segmentation is the extraction of structural information of particular interest from surrounding image.

Label map



- Image segmentation is the extraction of structural information of particular interest from surrounding image.
- Each pixel is assigned a specific label value which corresponds to the anatomical structure that it belongs to.

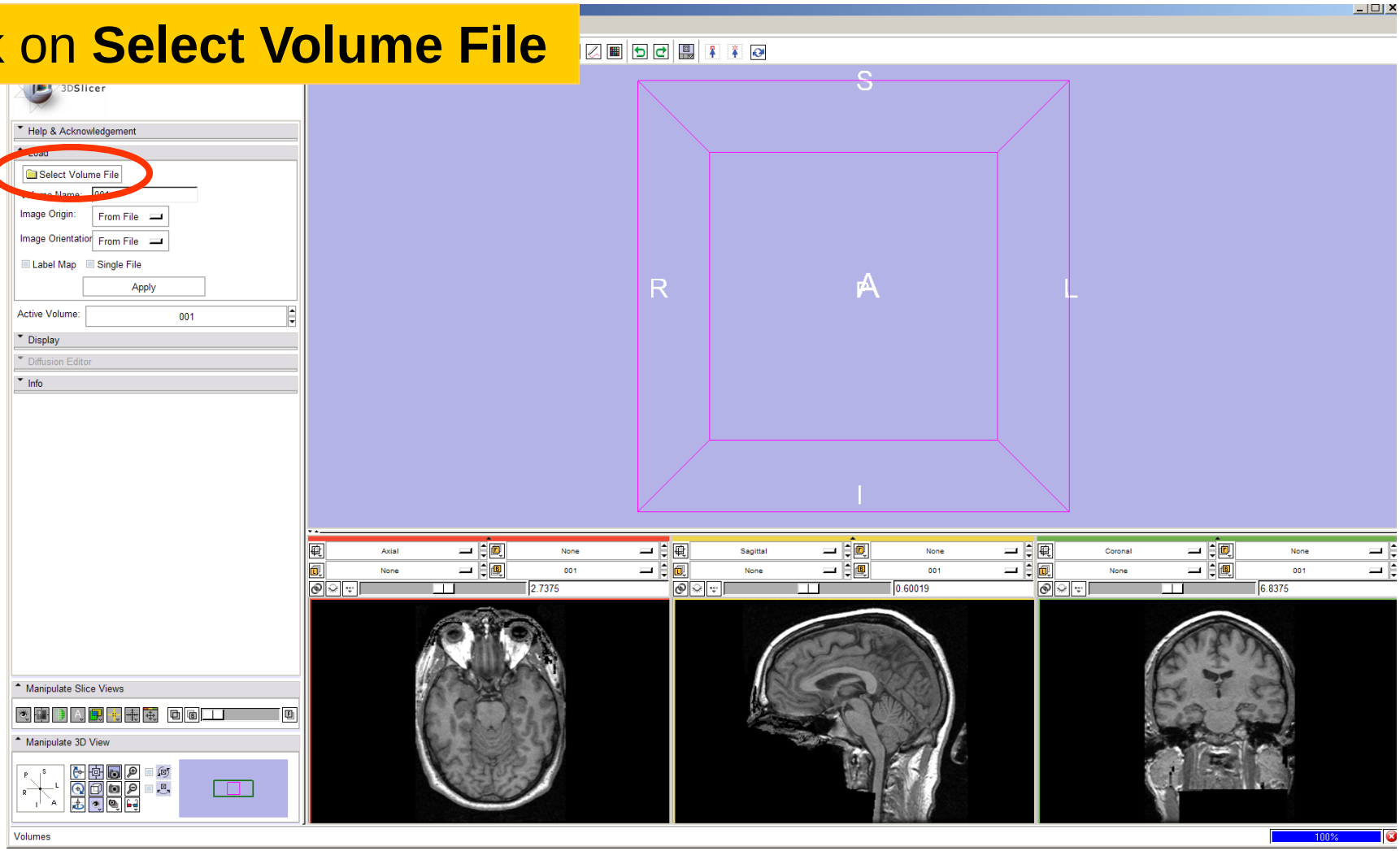
Label map



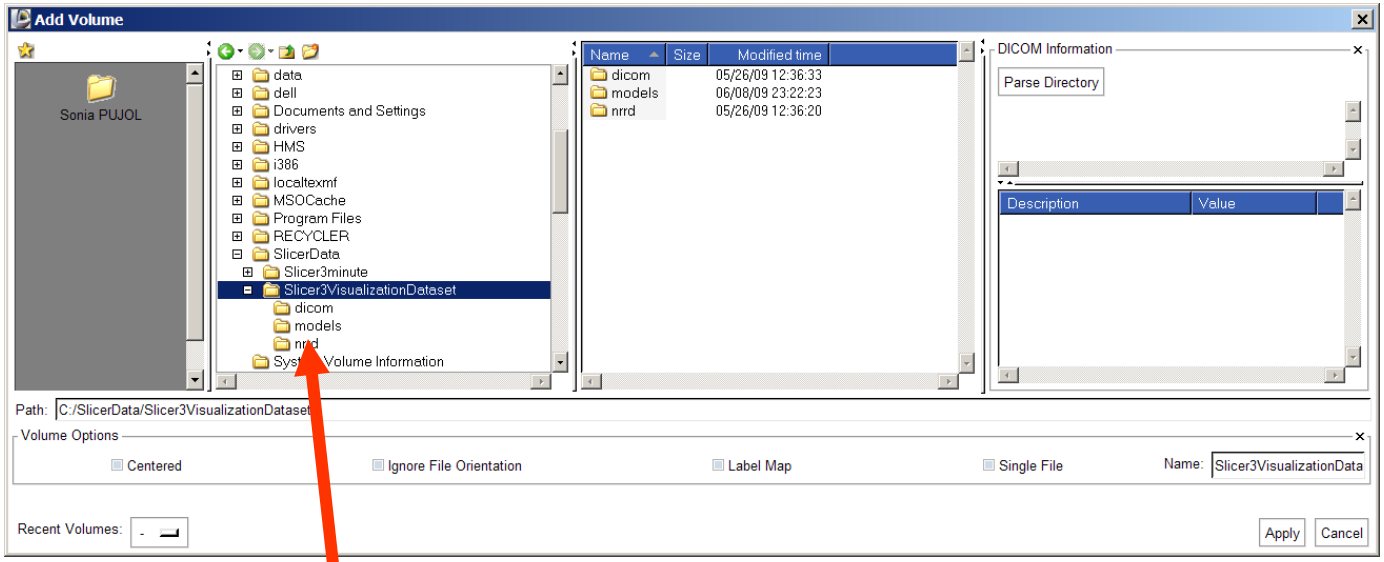
- Image segmentation is the extraction of structural information of particular interest from surrounding image.
- Each pixel is assigned a specific label value which corresponds to the anatomical structure that it belongs to.
- The three-dimensional result of the segmentation is a binary array called a label map.

Loading a label map

Click on **Select Volume File**

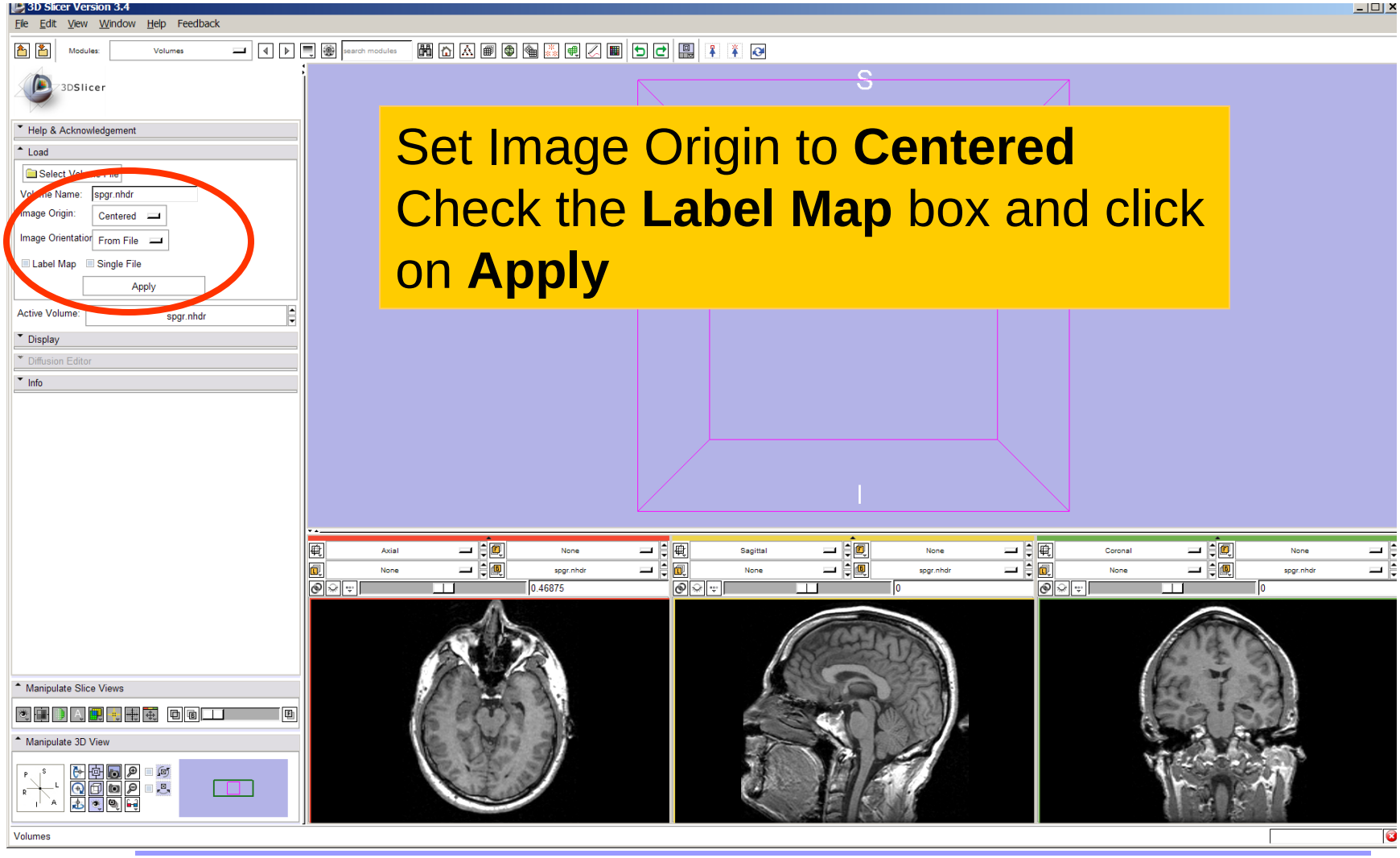


Loading a label map



Browse to find the header file ***all.nhdr*** of the label map dataset located in the directory ***Slicer3VisualizationDataset/nrrd*** and click on **Open**

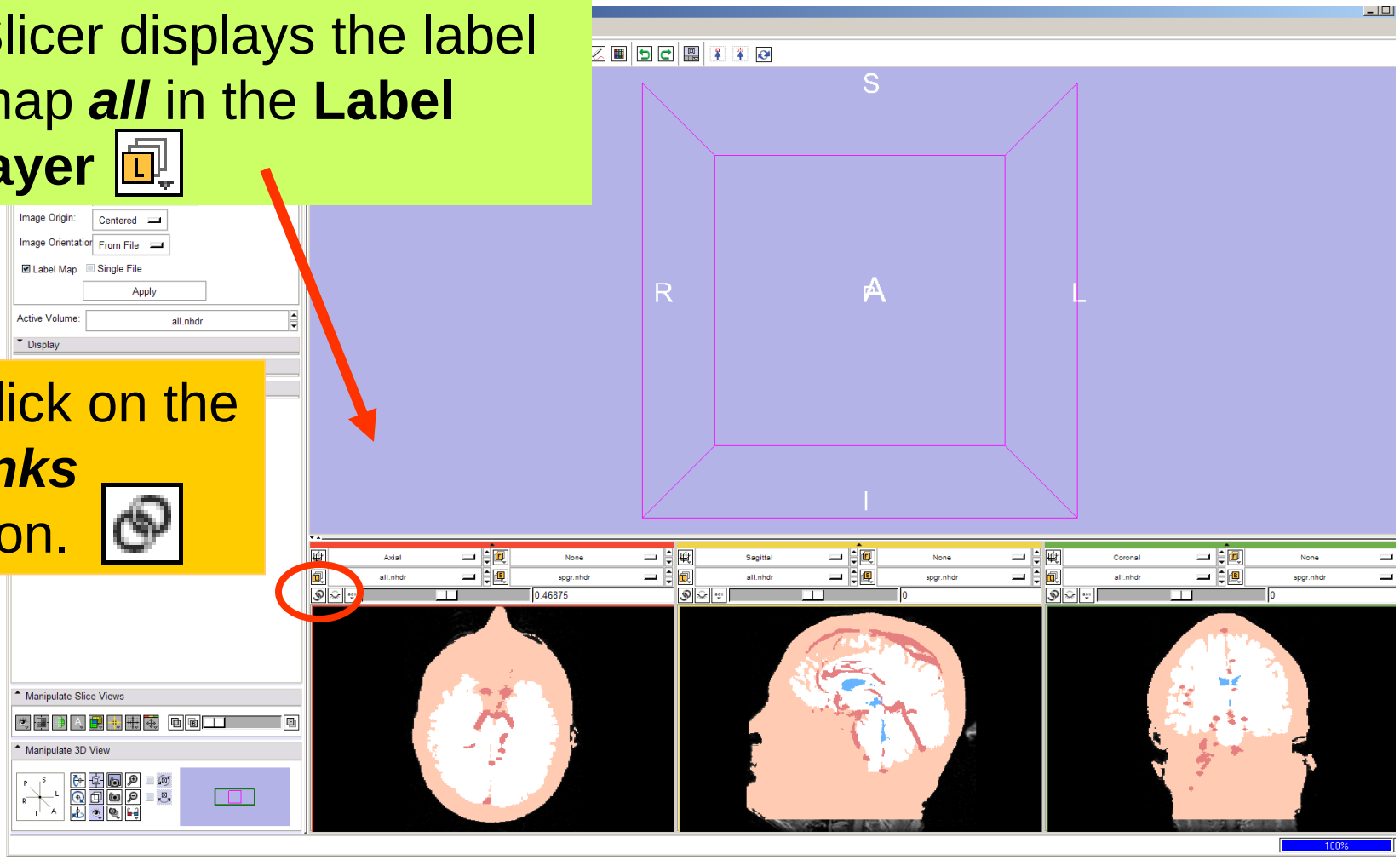
Visualizing a label map



Visualizing a label map

Slicer displays the label map ***all*** in the **Label layer**

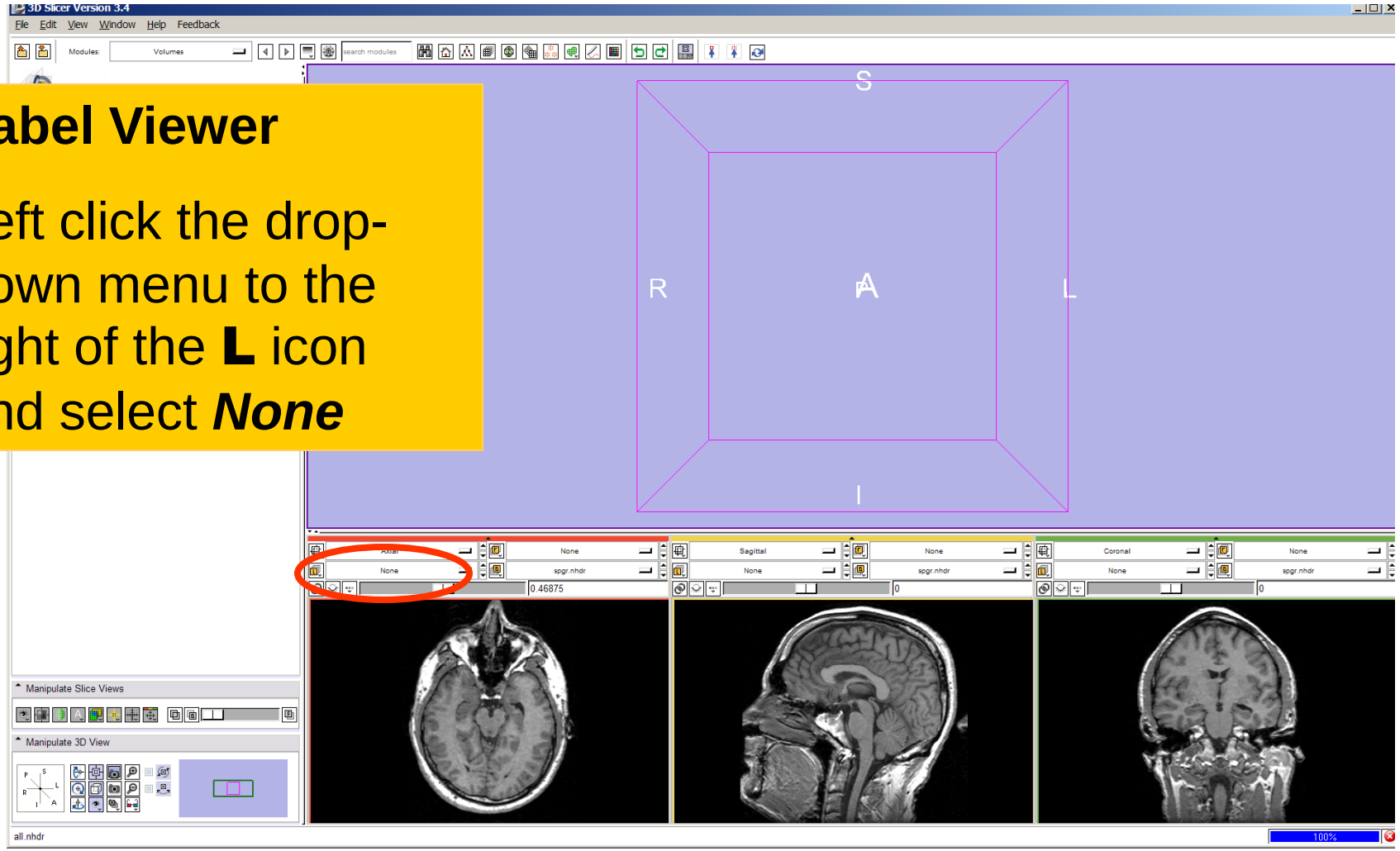
Click on the ***links*** icon.



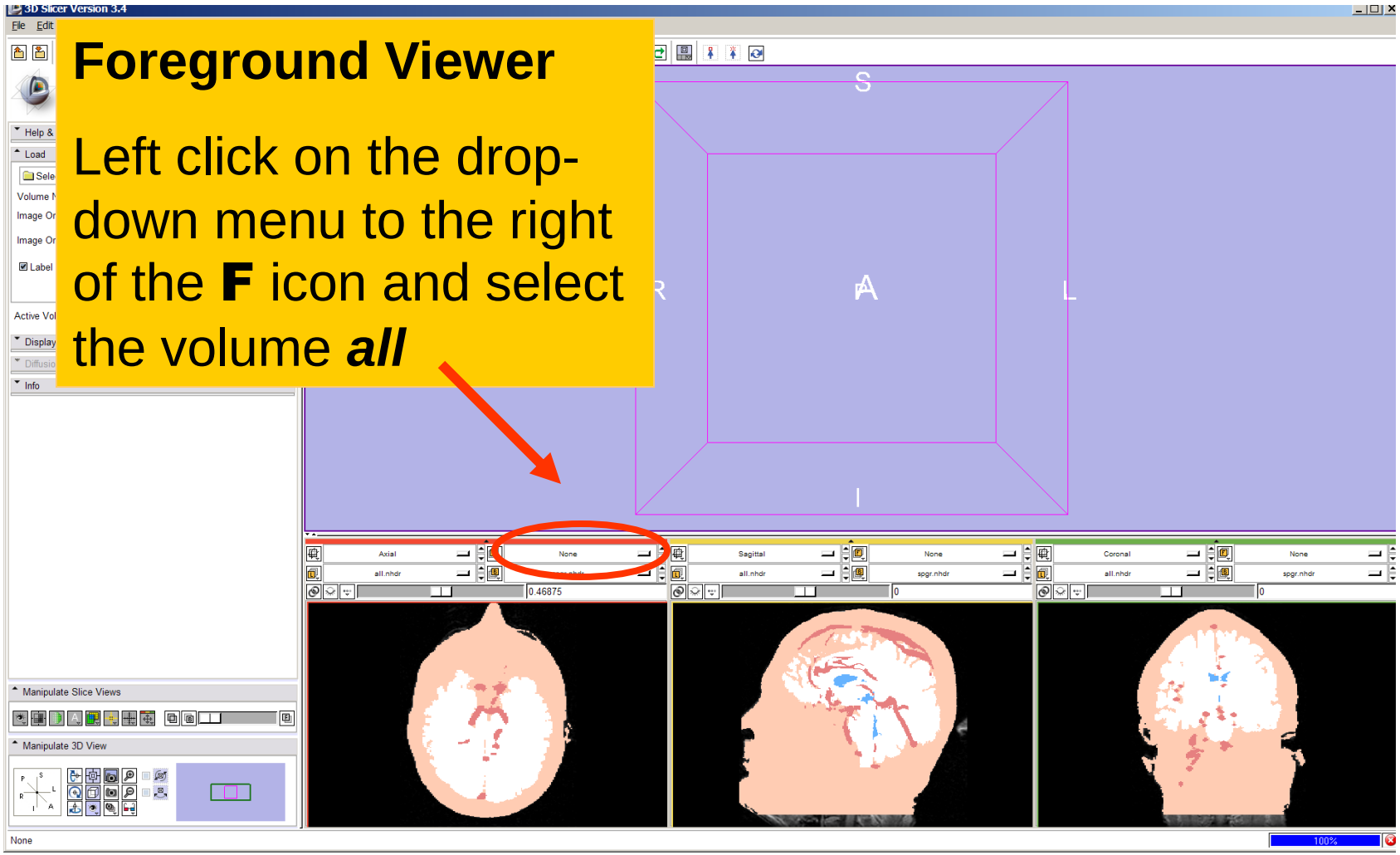
Visualizing Multiple Volumes

Label Viewer

Left click the drop-down menu to the right of the **L** icon and select ***None***



Visualizing Multiple Volumes

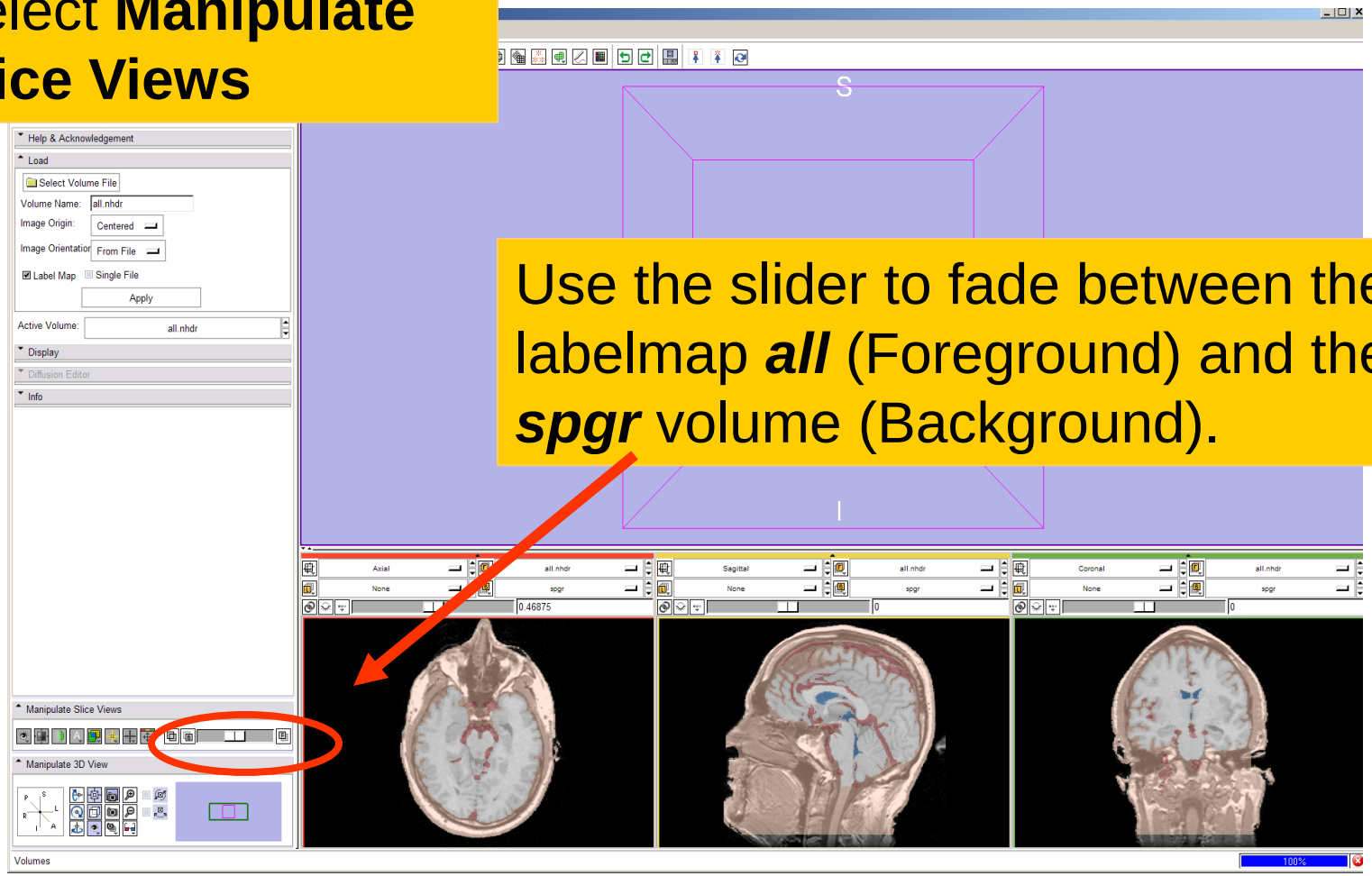


Foreground Viewer

Left click on the drop-down menu to the right of the **F** icon and select the volume ***all***

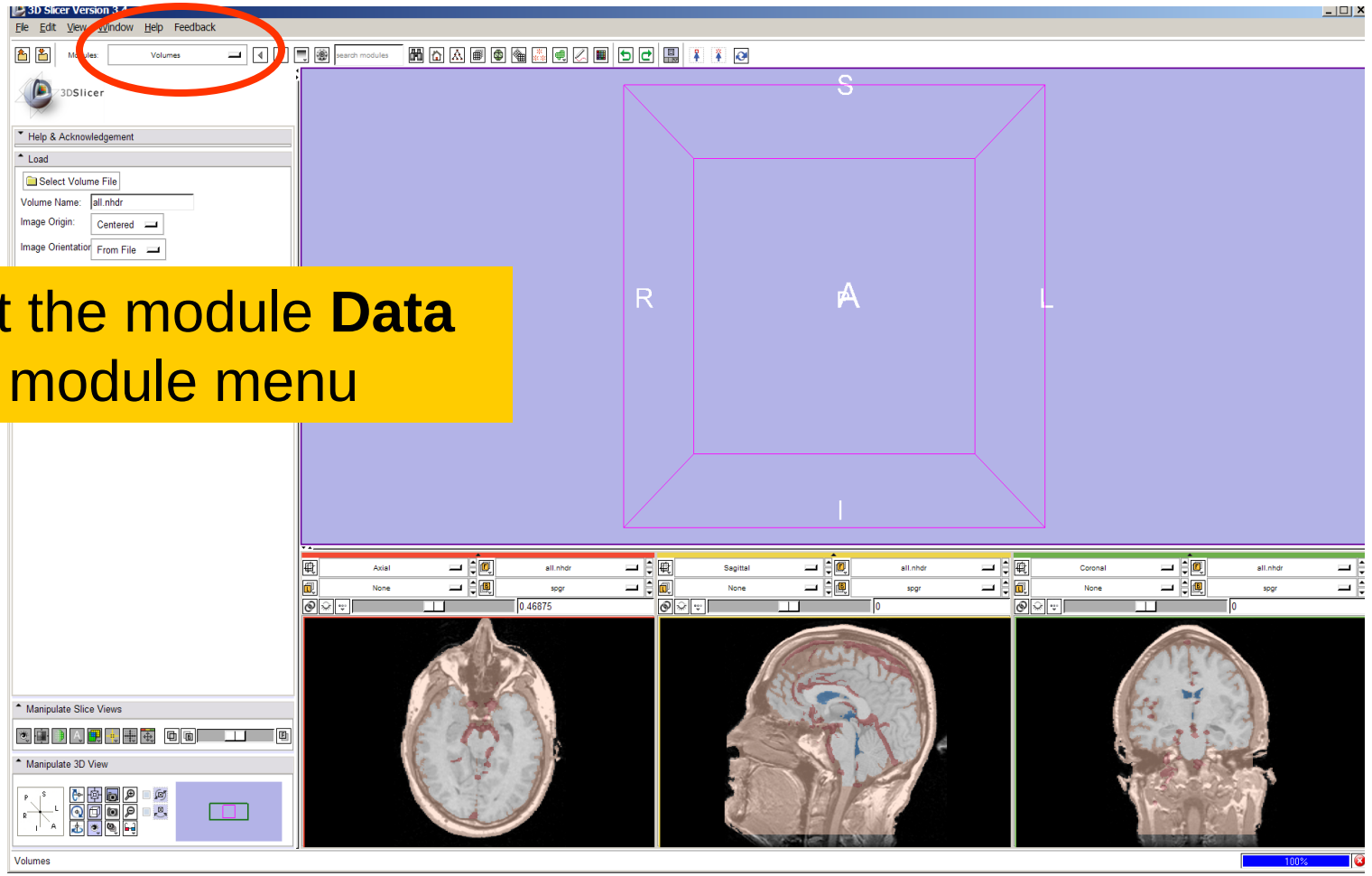
Visualizing Multiple Volumes

Select **Manipulate Slice Views**



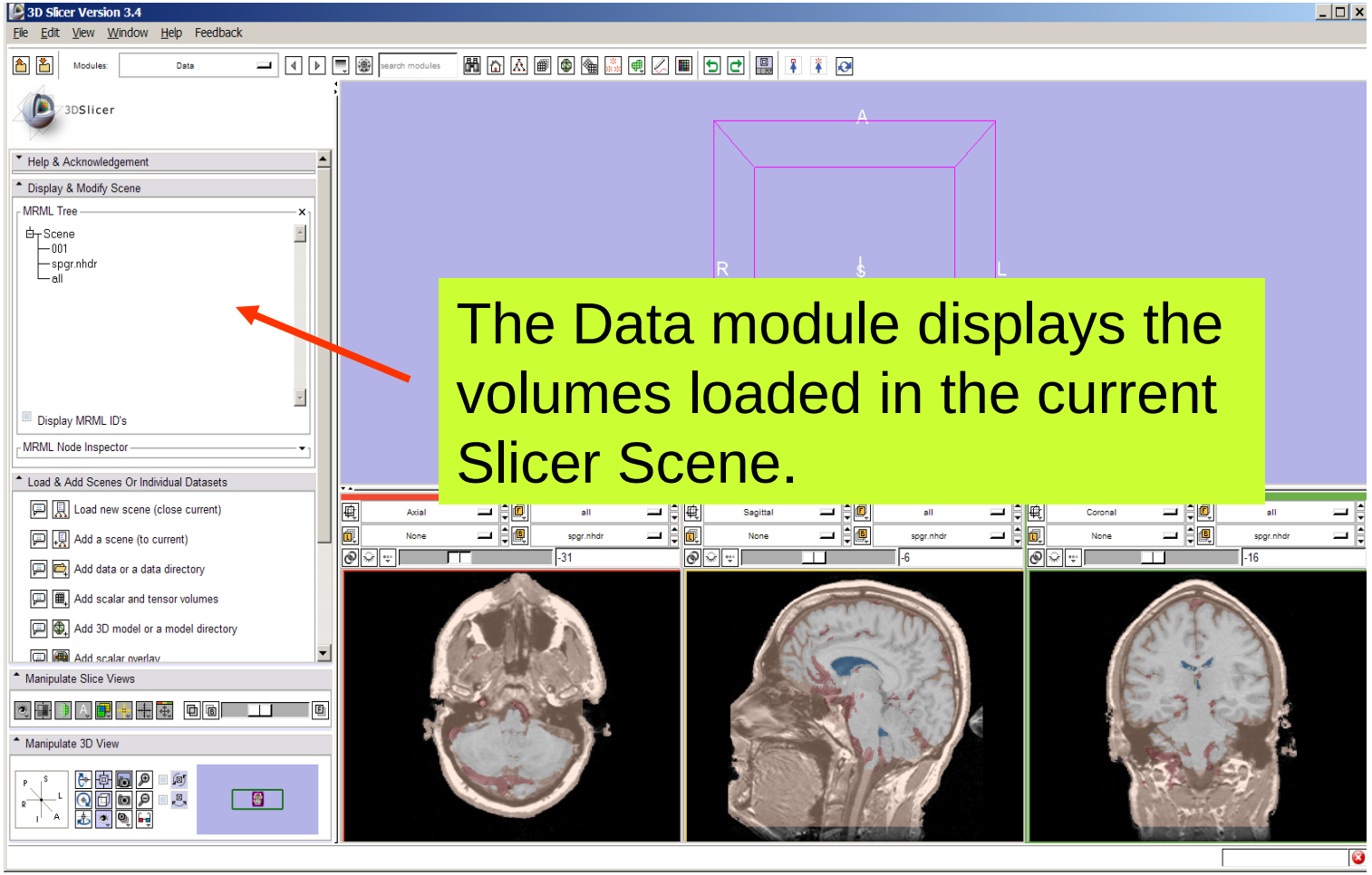
Use the slider to fade between the labelmap ***all*** (Foreground) and the ***spgr*** volume (Background).

3D Visualization

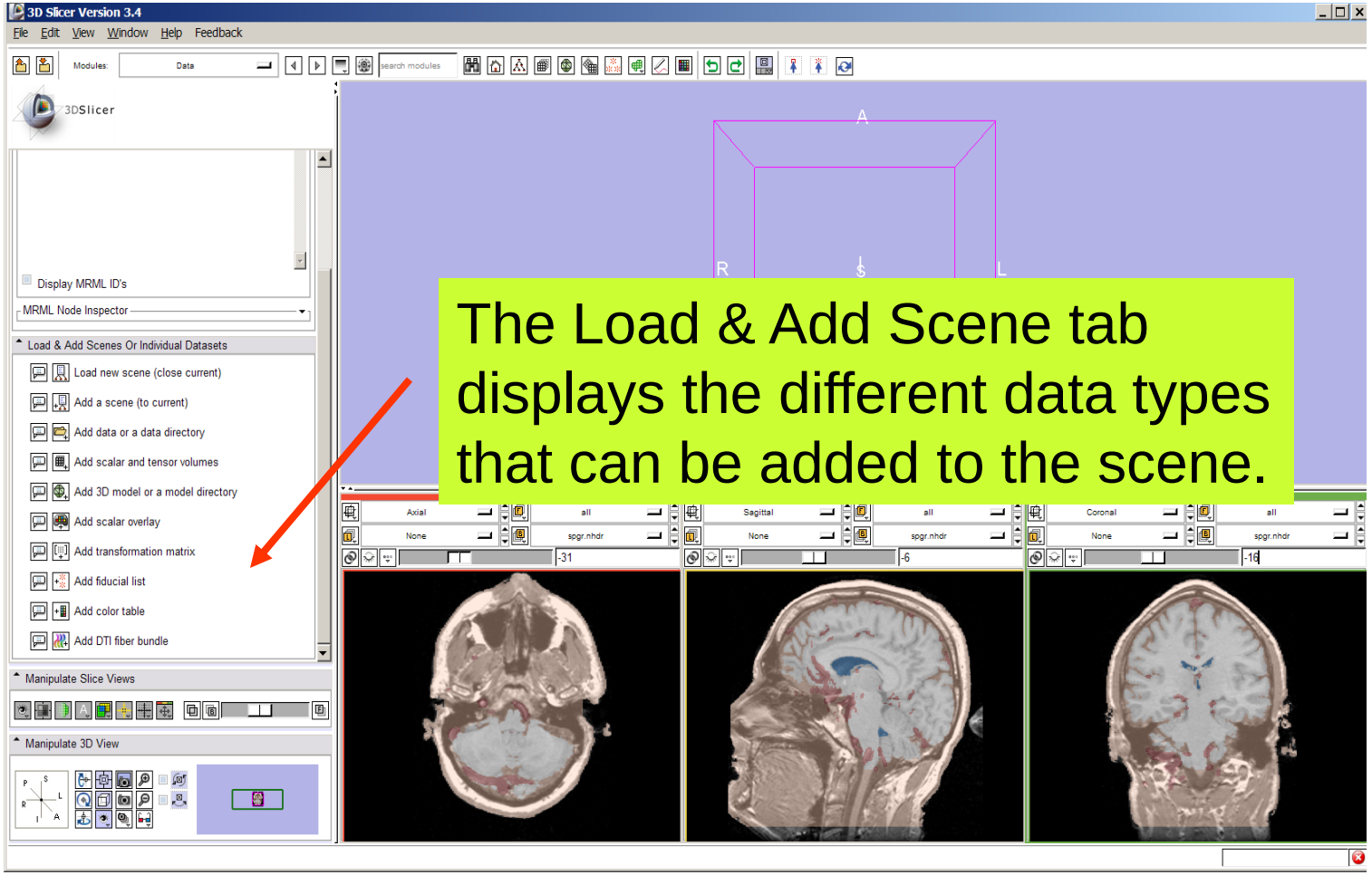


Select the module **Data** in the module menu

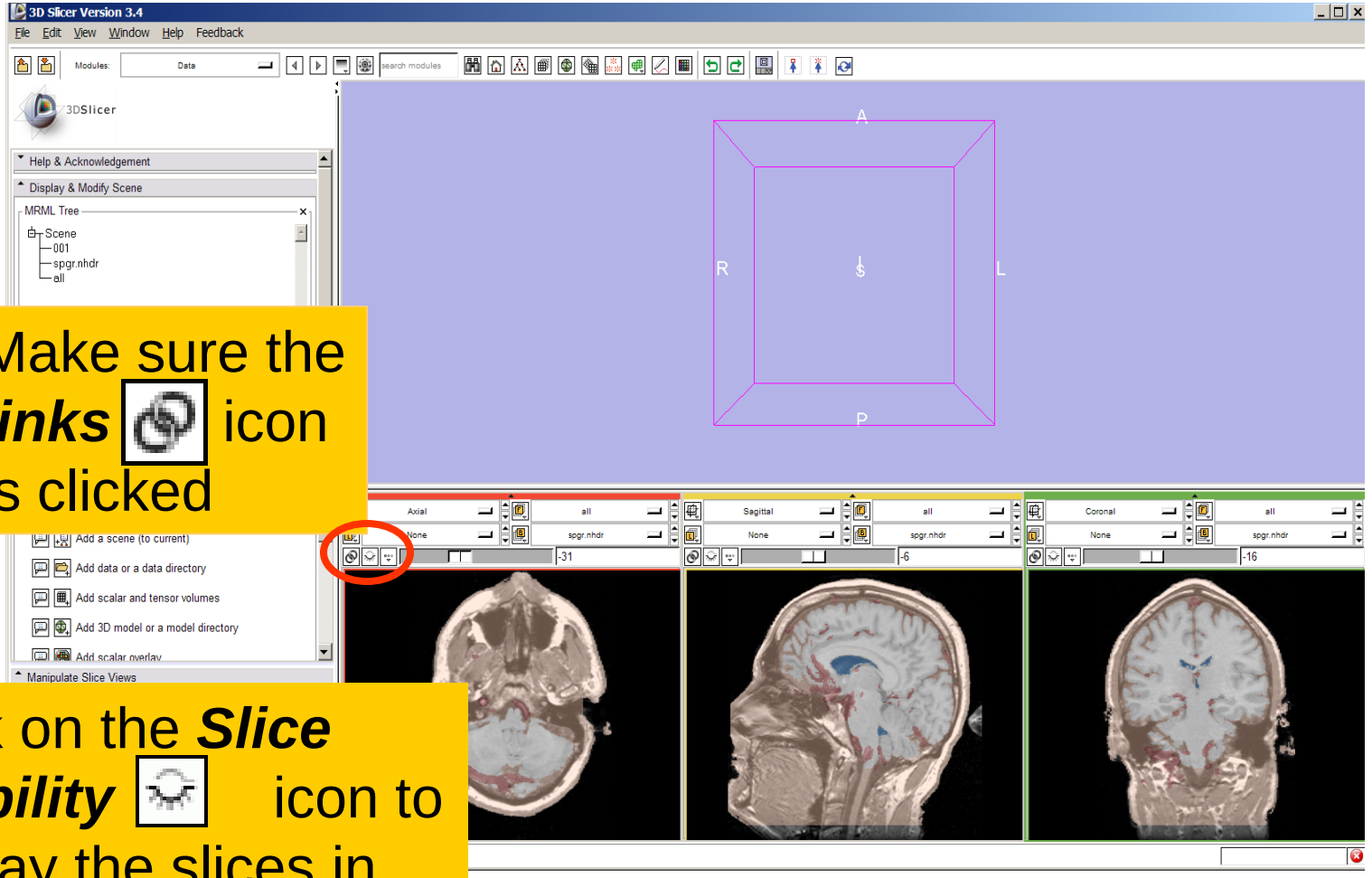
3D Visualization



3D Visualization



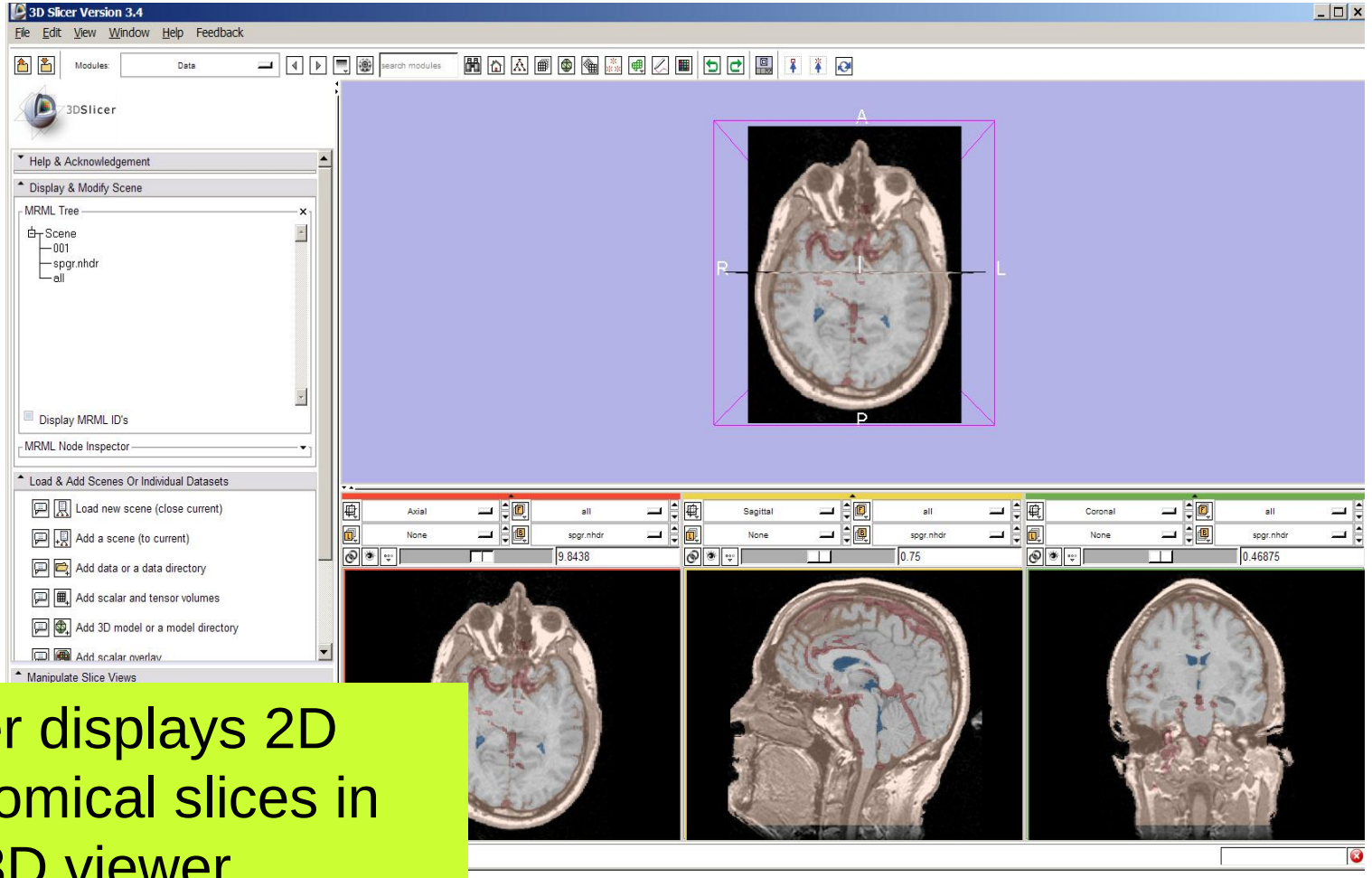
3D Visualization



Make sure the ***links*** icon is clicked

Click on the ***Slice Visibility*** icon to display the slices in the 3D Viewer

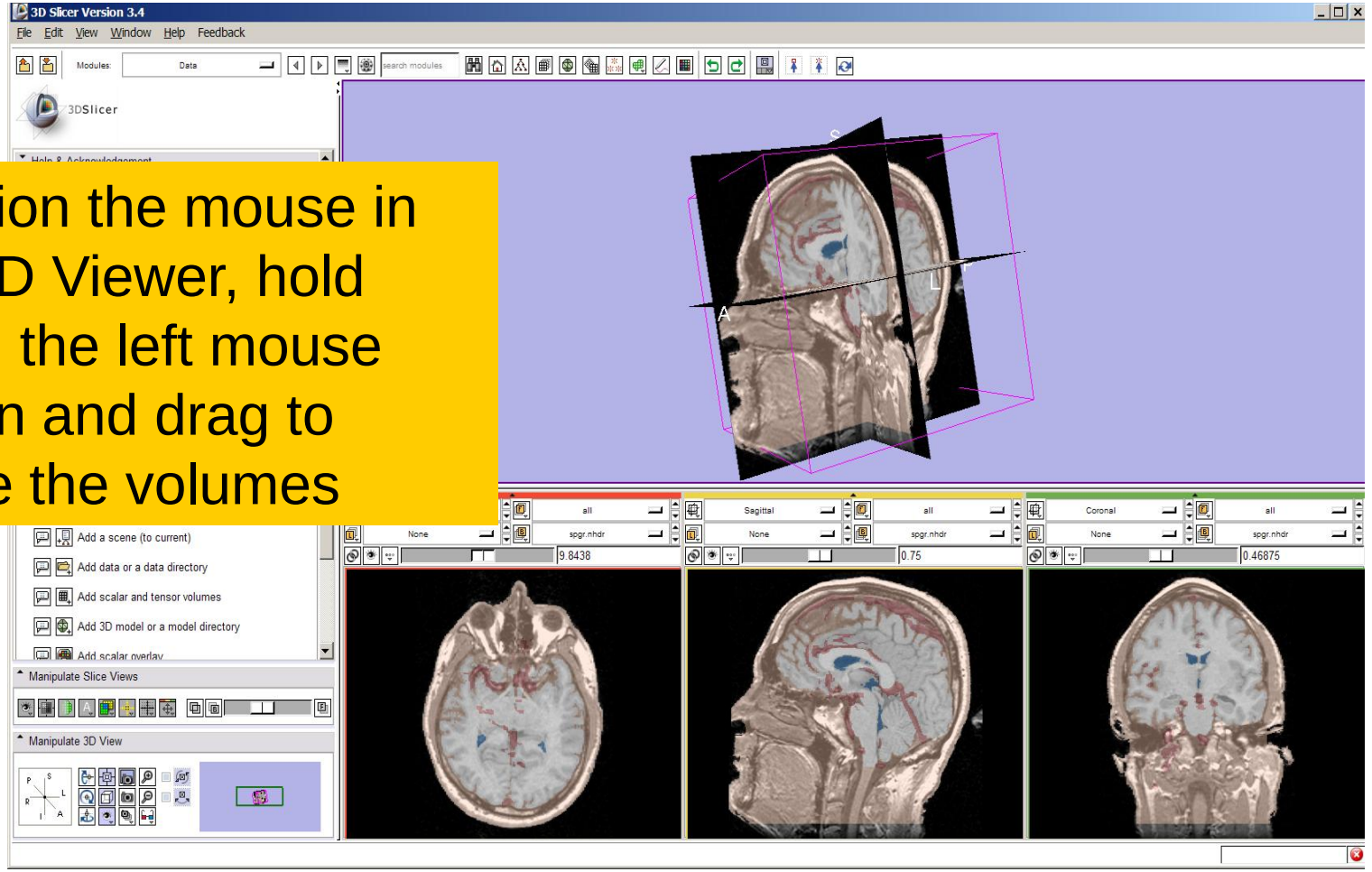
3D Visualization

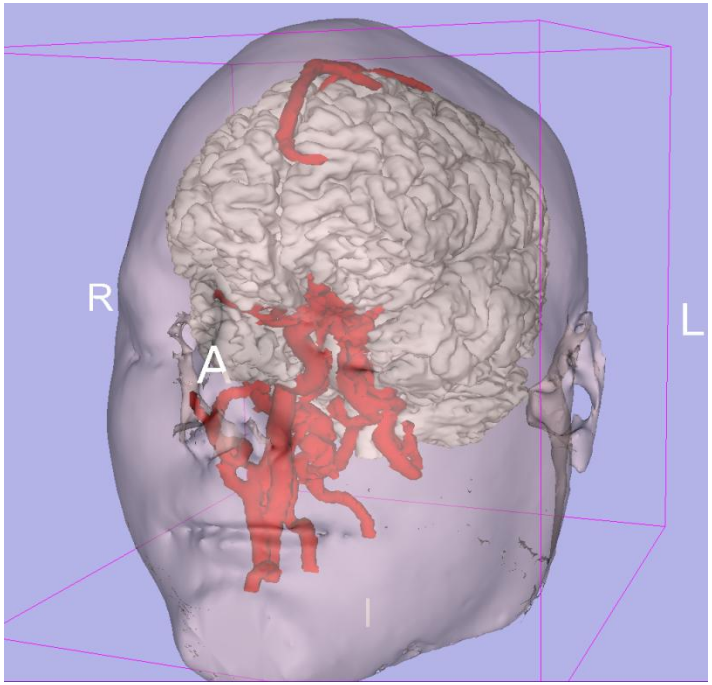


Slicer displays 2D anatomical slices in the 3D viewer

3D Visualization

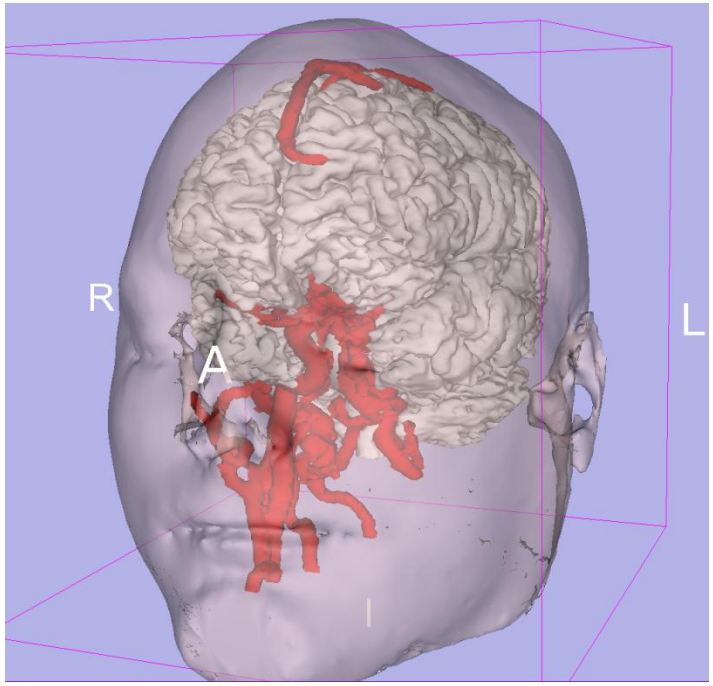
Position the mouse in the 3D Viewer, hold down the left mouse button and drag to rotate the volumes





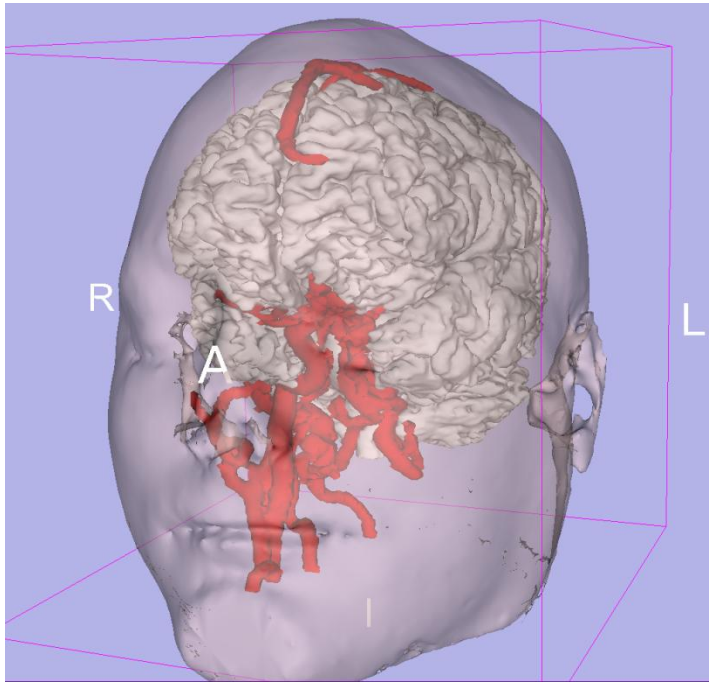
Part 3: Loading and visualizing 3D models of the anatomy

3D models



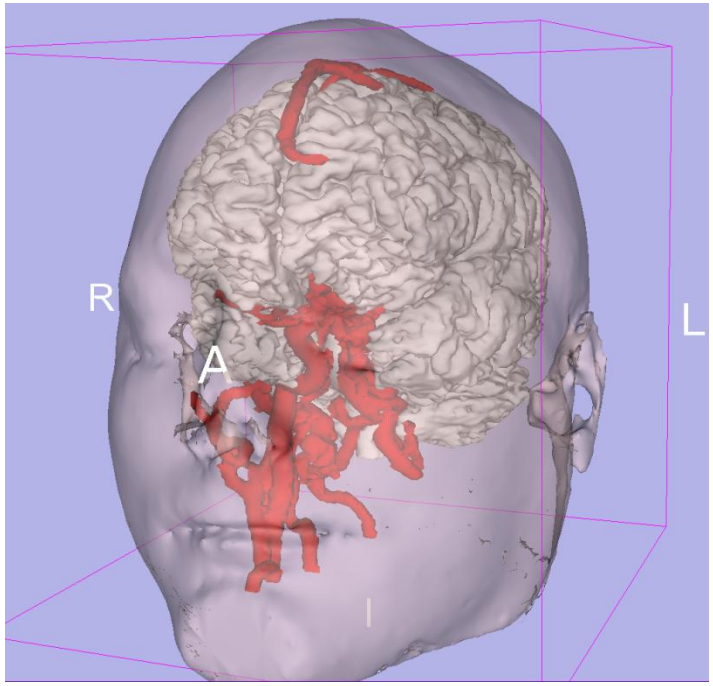
- A 3D model is a surface reconstruction of an anatomical structure.

3D models



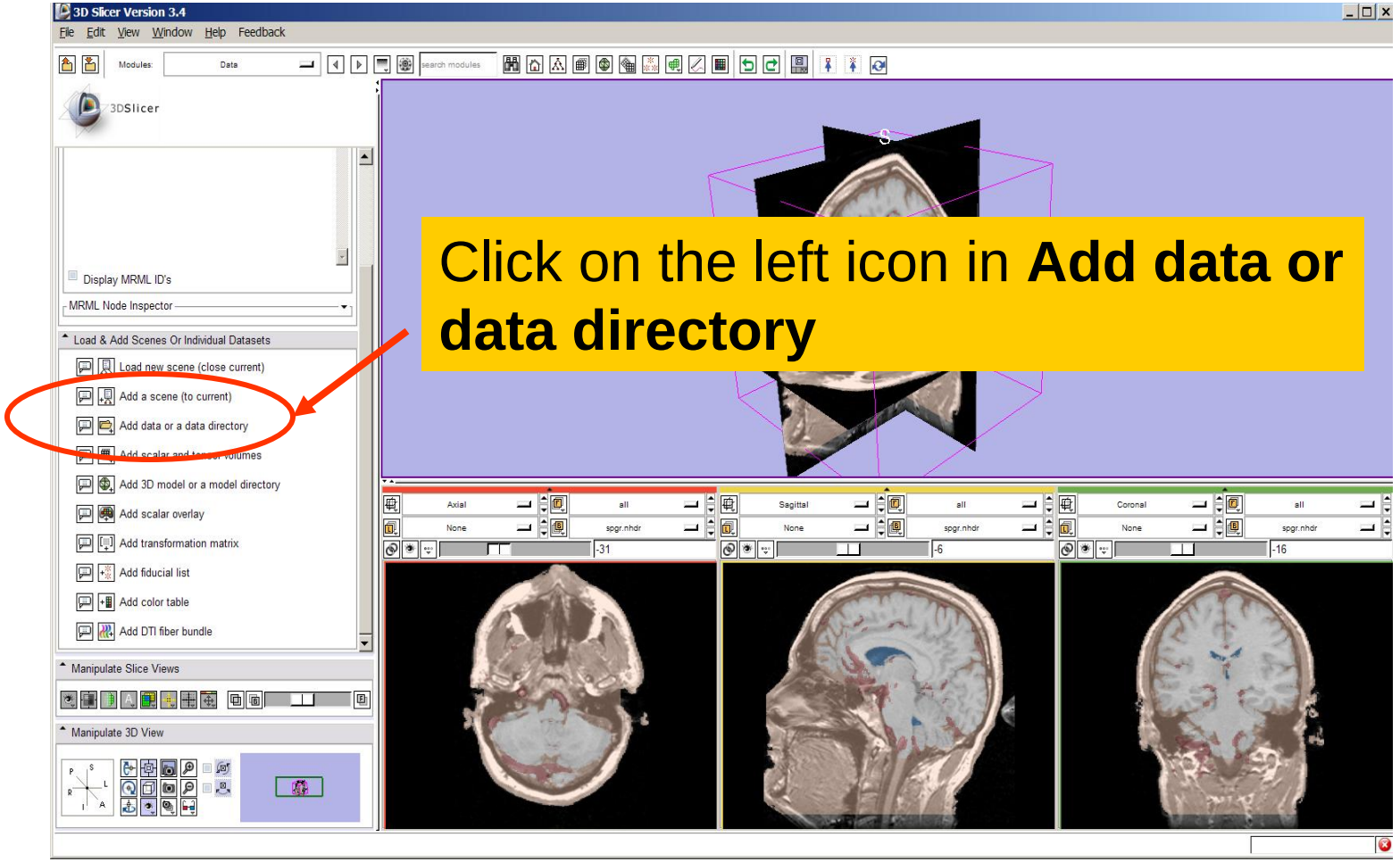
- A 3D model is a surface reconstruction of an anatomical structure.
- The model is a triangular mesh that approximates a surface from a 3D label map.

3D models

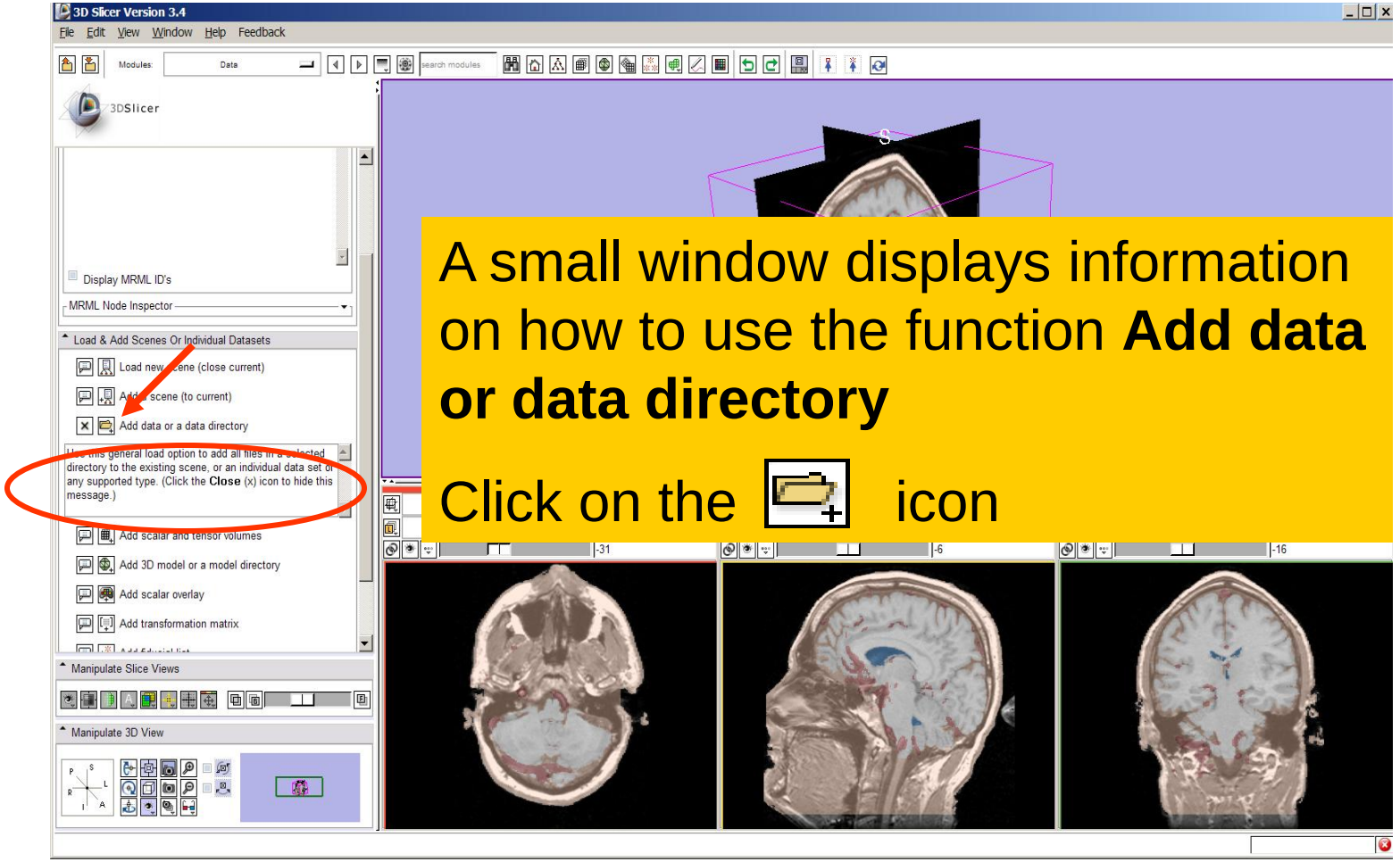


- A 3D model is a surface reconstruction of an anatomical structure.
- The model is a triangular mesh that approximates a surface from a 3D label map.
- The scalar values for surface models are integers which correspond to the label that had been assigned in the segmentation process.

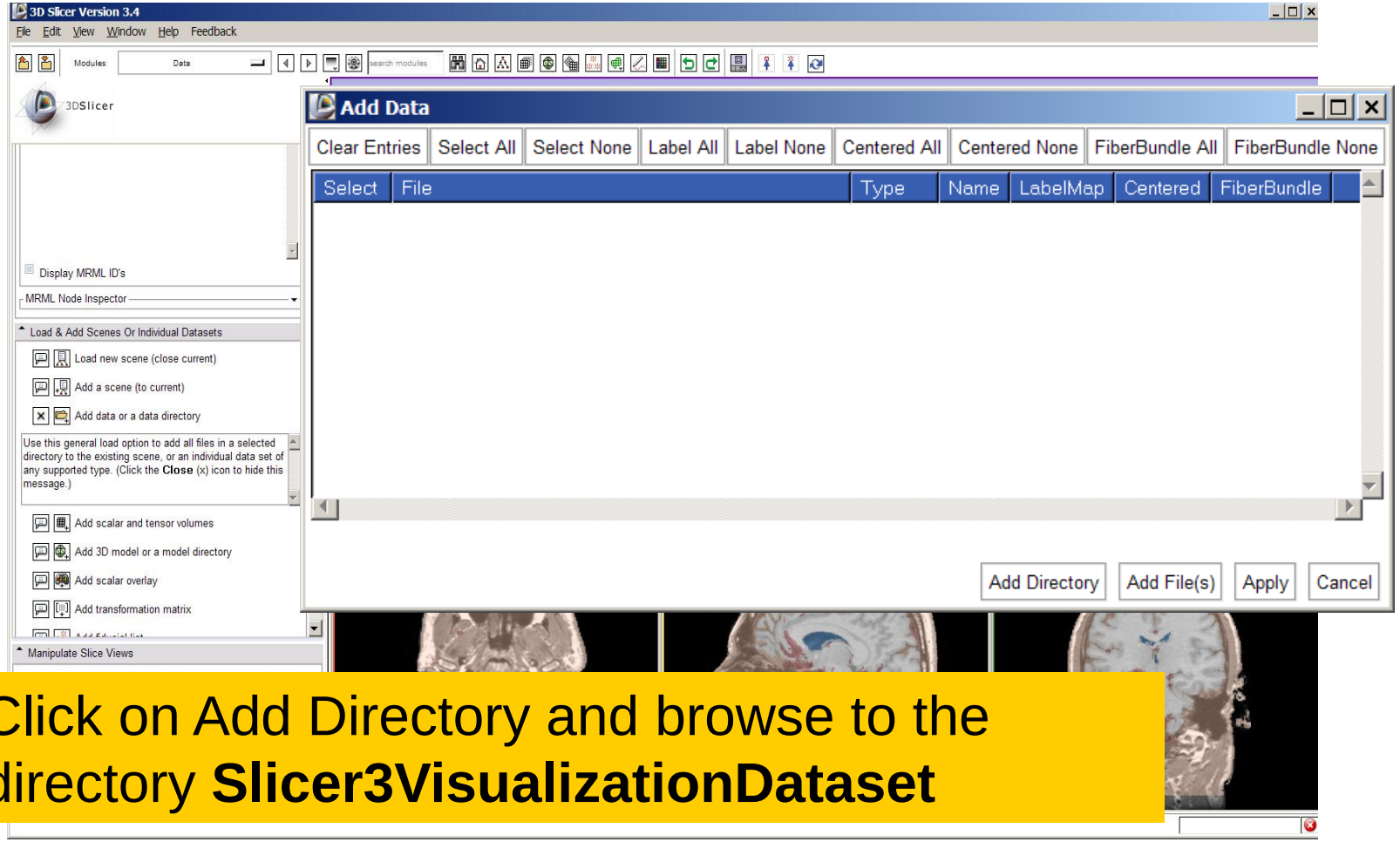
3D Visualization



3D Visualization

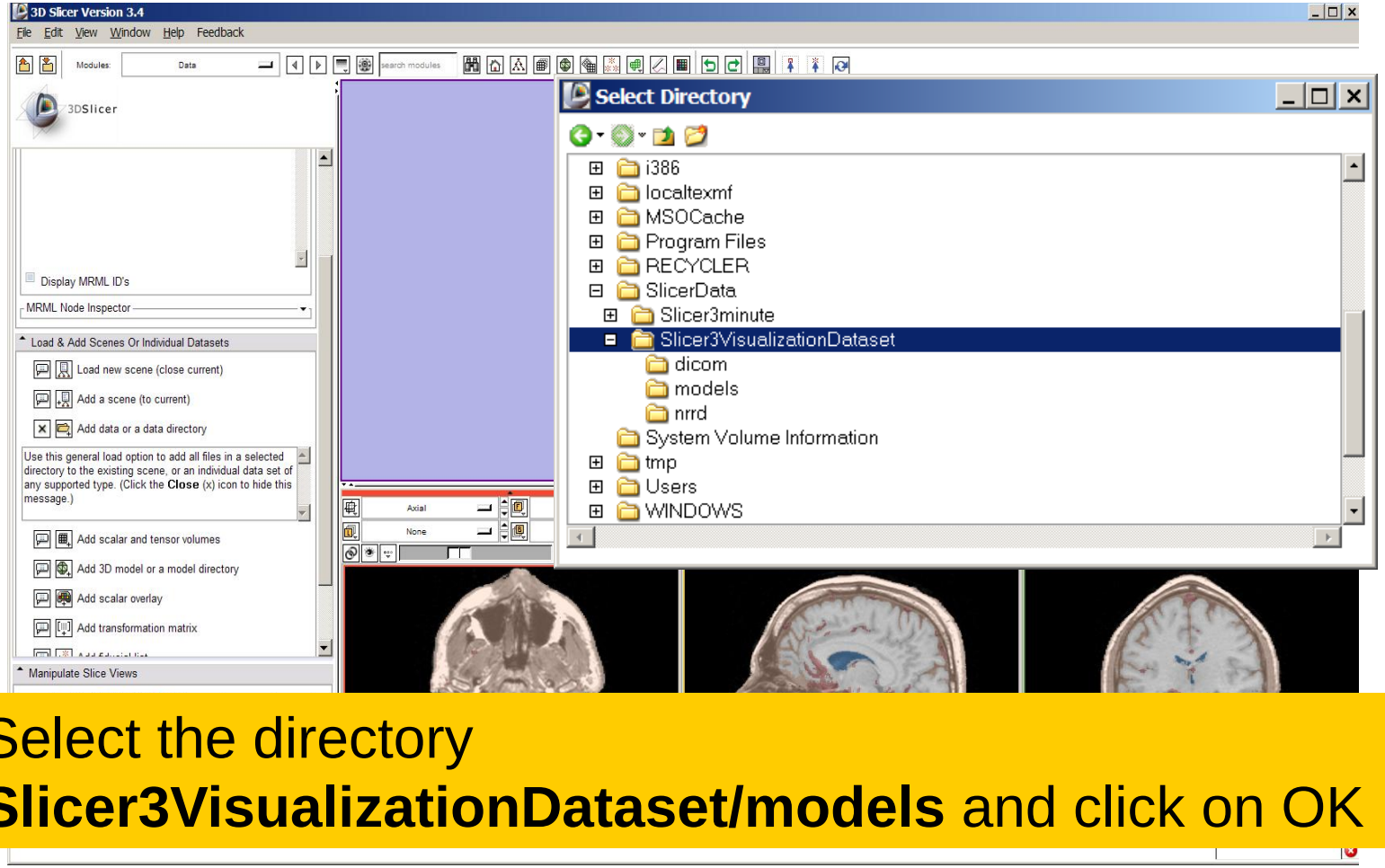


3D Visualization



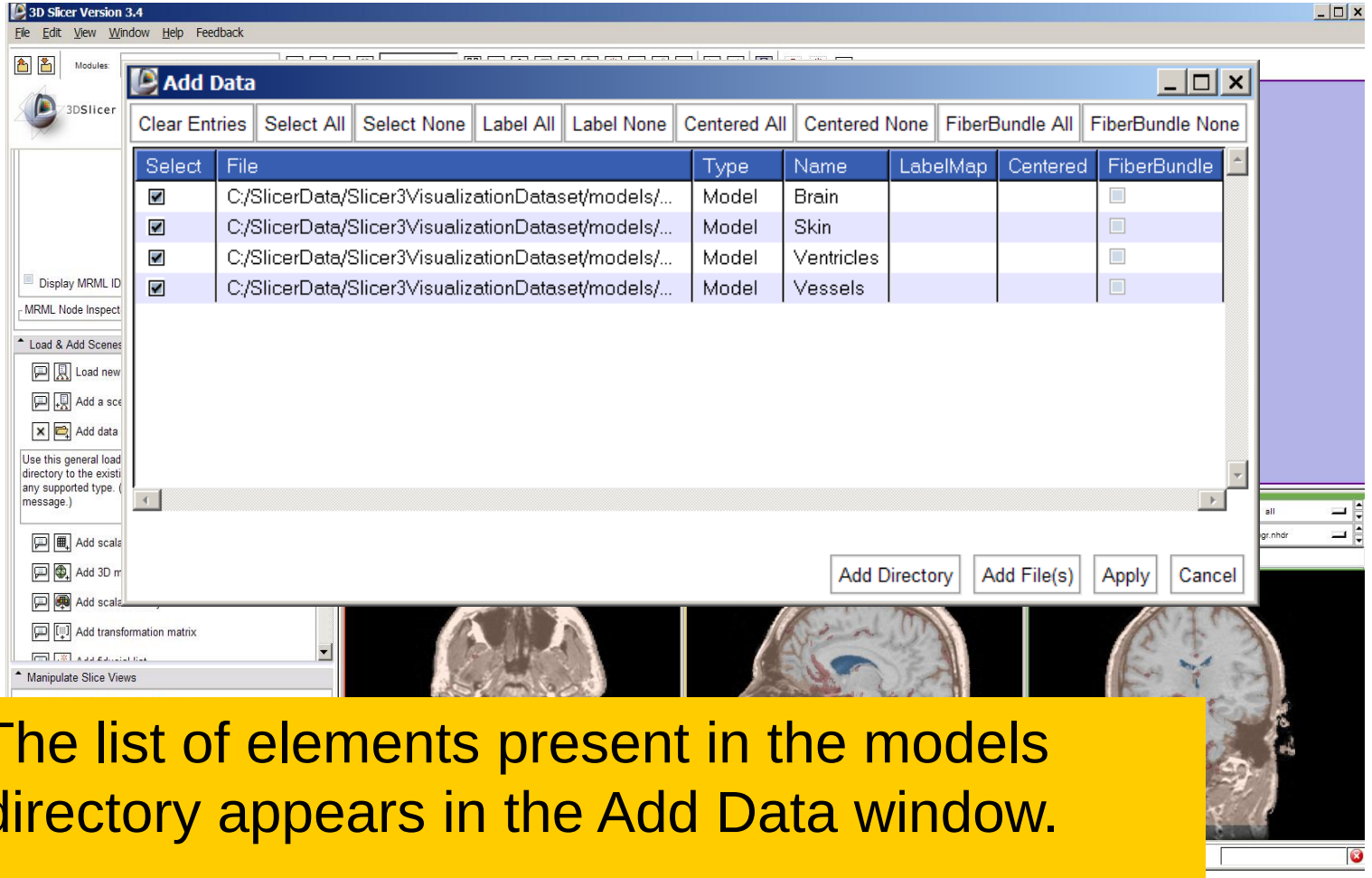
Click on Add Directory and browse to the directory **Slicer3VisualizationDataset**

Loading 3D models



Select the directory
Slicer3VisualizationDataset/models and click on OK

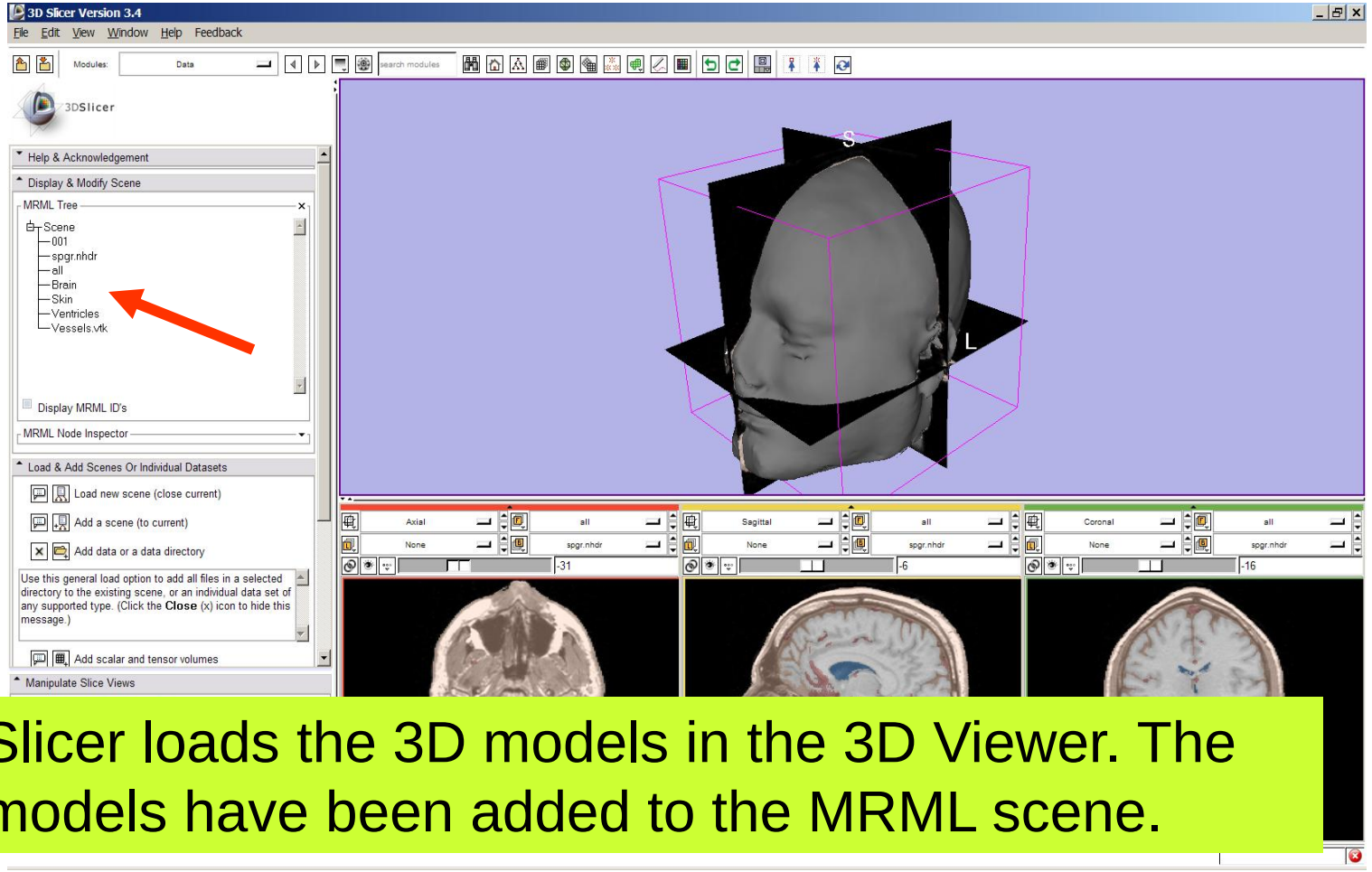
Loading 3D models



The list of elements present in the models directory appears in the Add Data window.

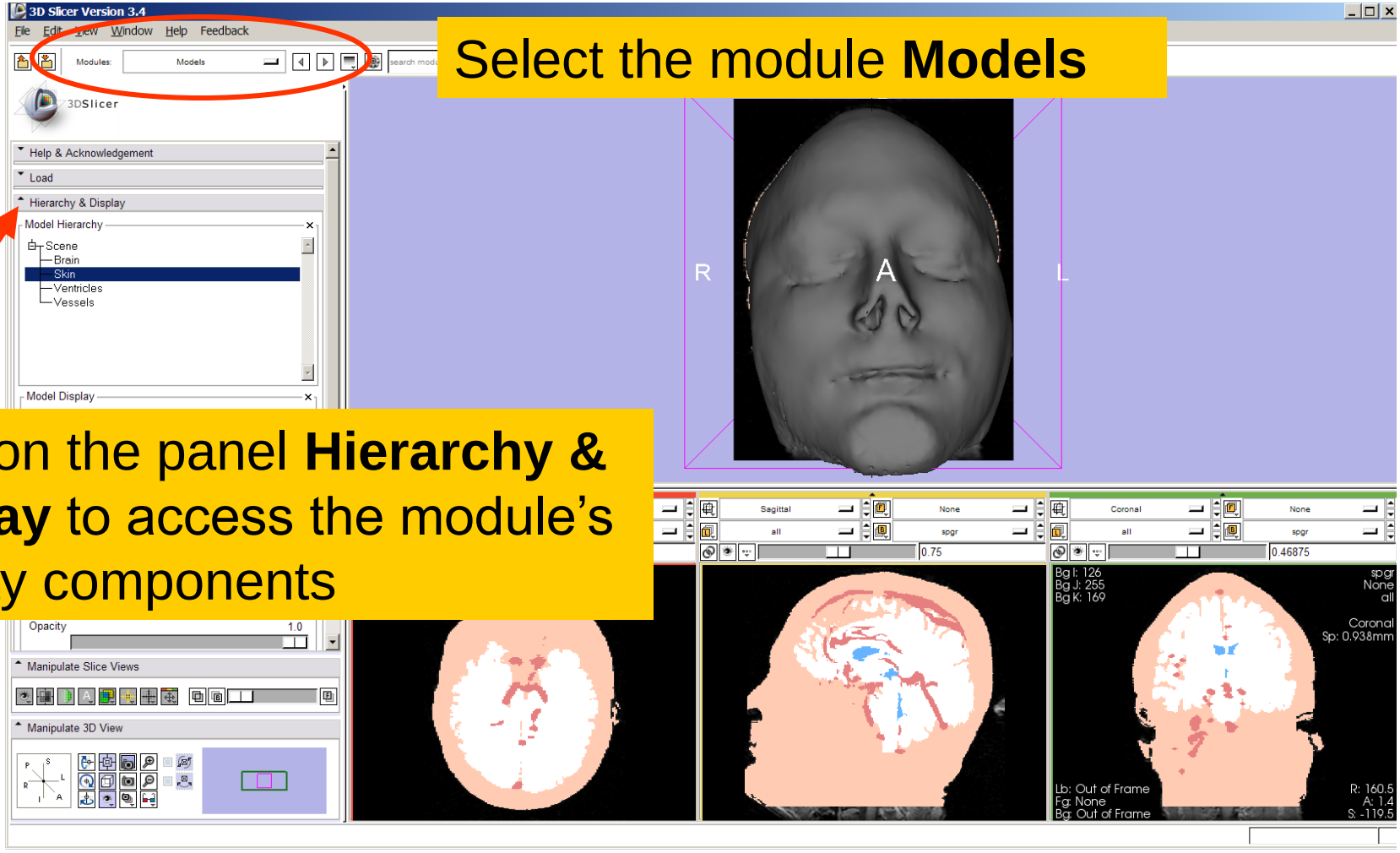
Click on **Apply** to load all the **3D models**.

Loading 3D models



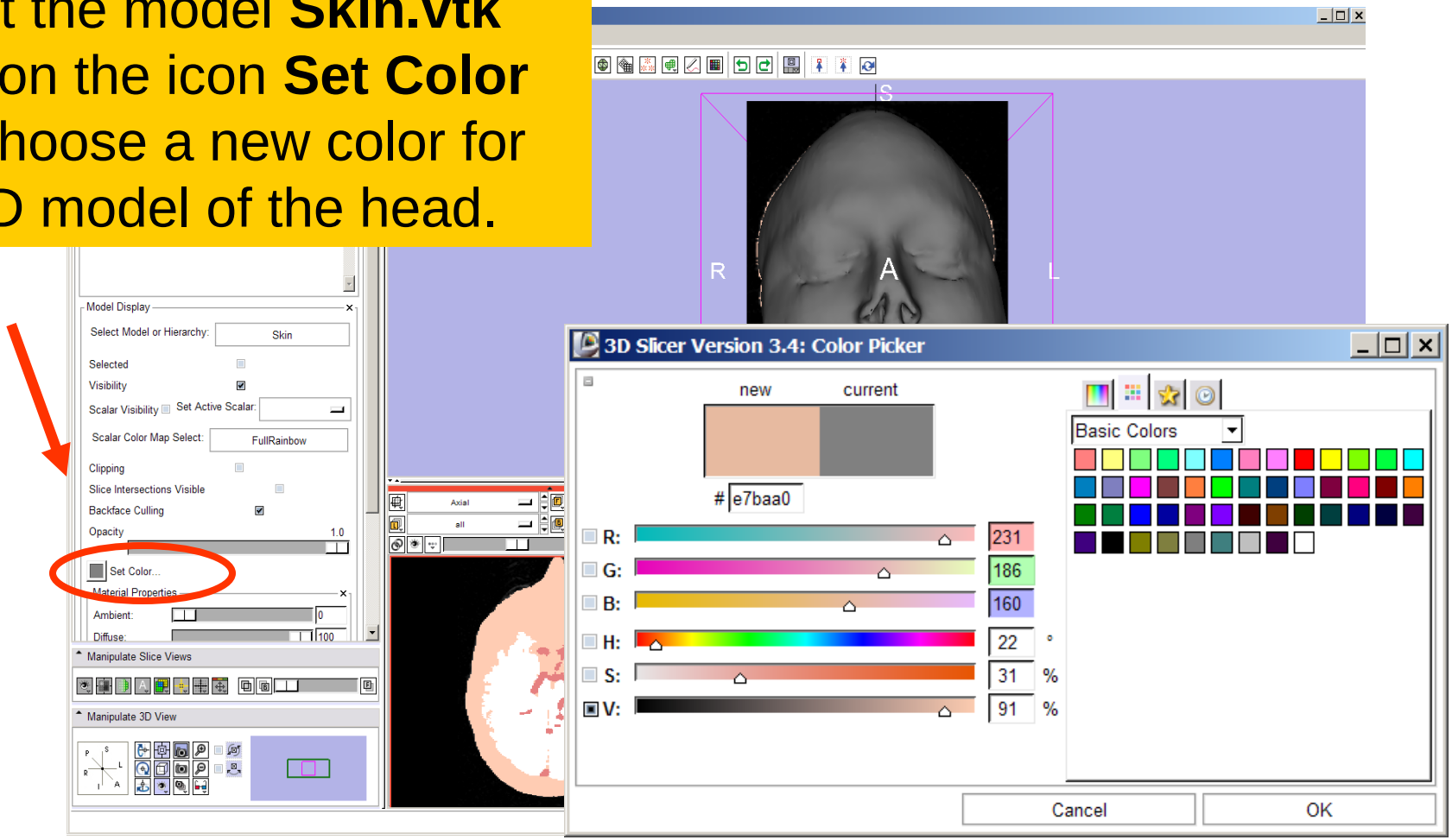
Slicer loads the 3D models in the 3D Viewer. The models have been added to the MRML scene.

Loading a 3D model

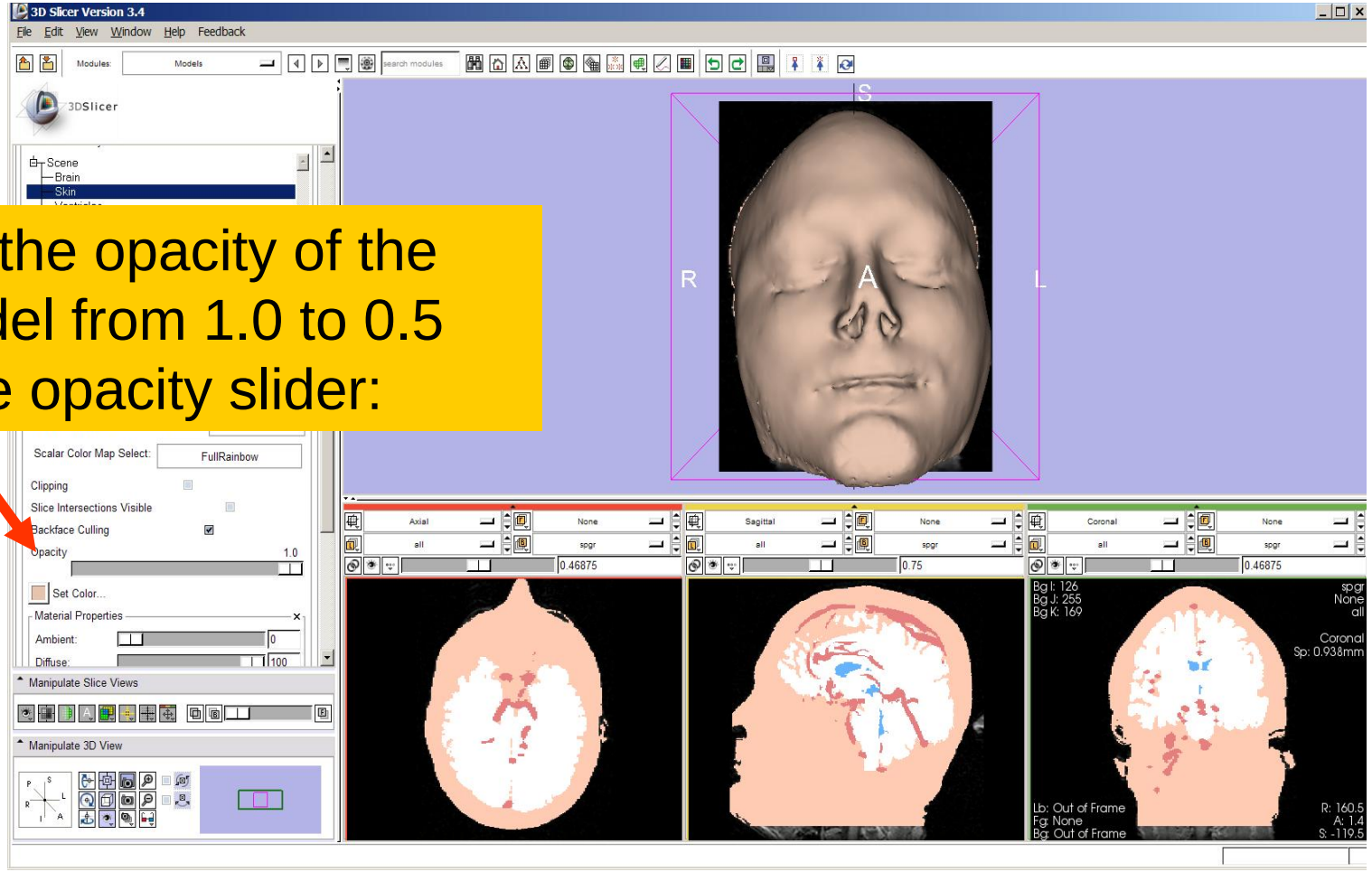


Visualizing a 3D model

Select the model **Skin.vtk**
Click on the icon **Set Color** and choose a new color for the 3D model of the head.



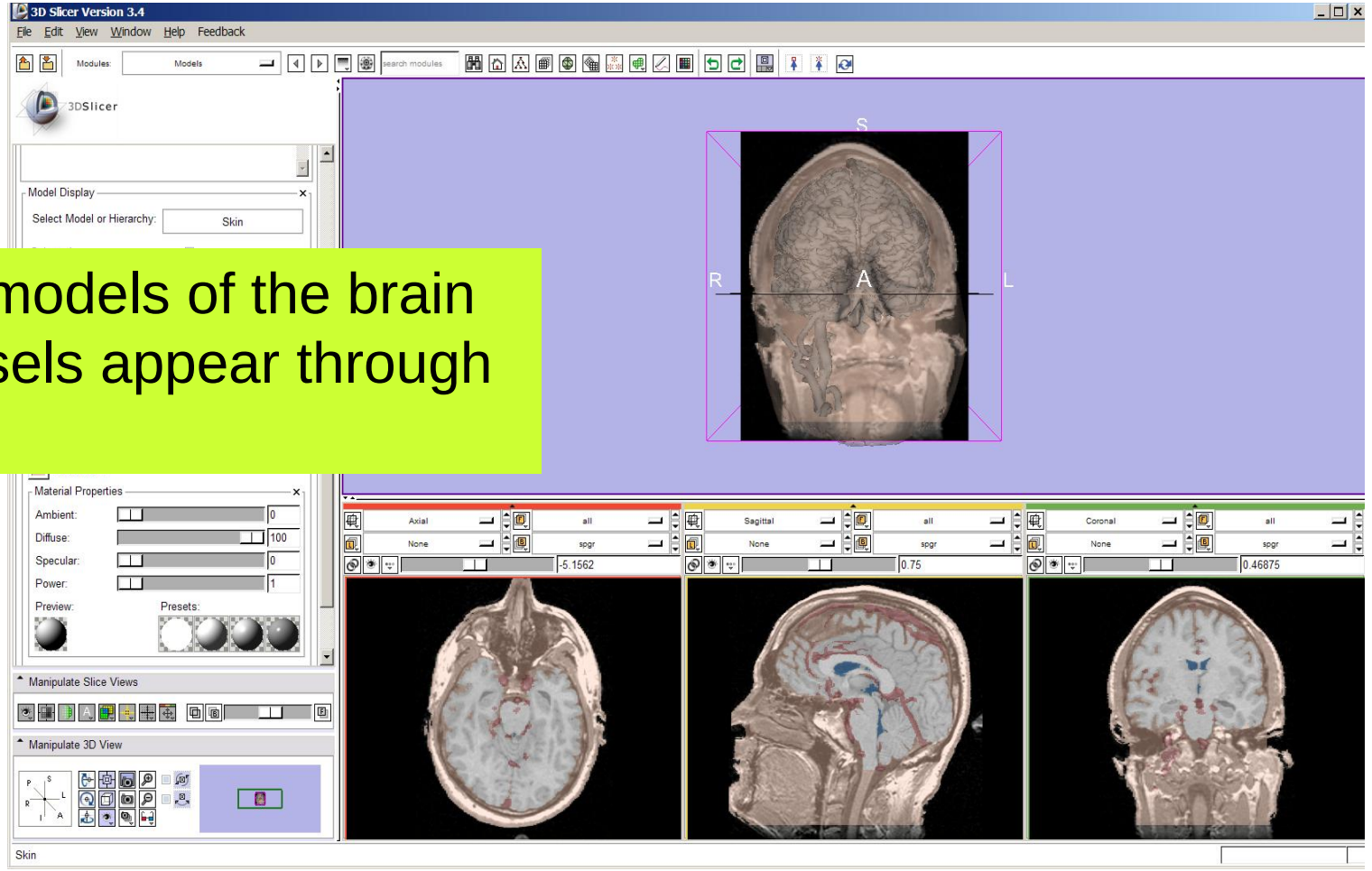
Visualizing a 3D model



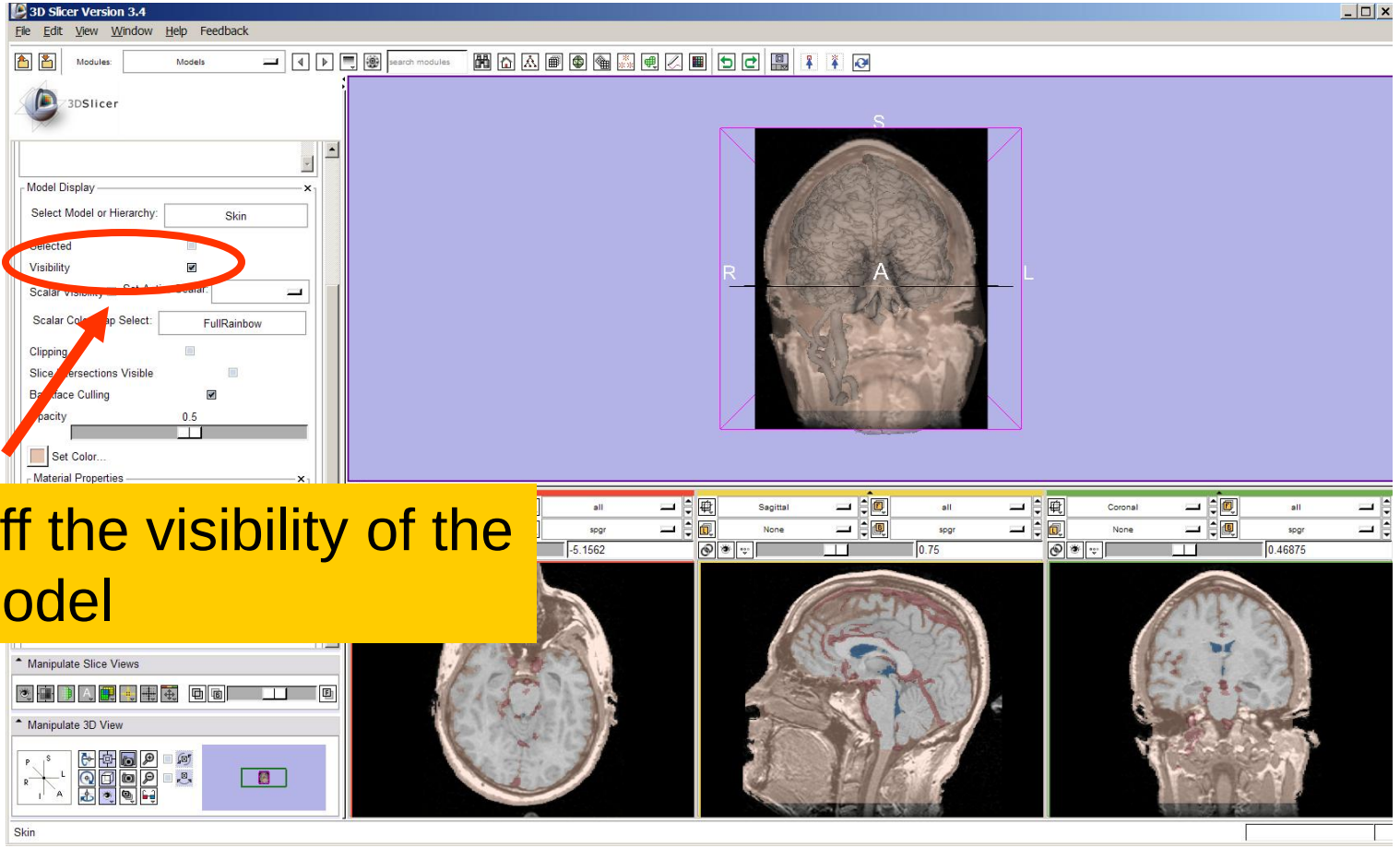
Change the opacity of the skin model from 1.0 to 0.5 using the opacity slider:

Visualizing a 3D model

The 3D models of the brain and vessels appear through the skin

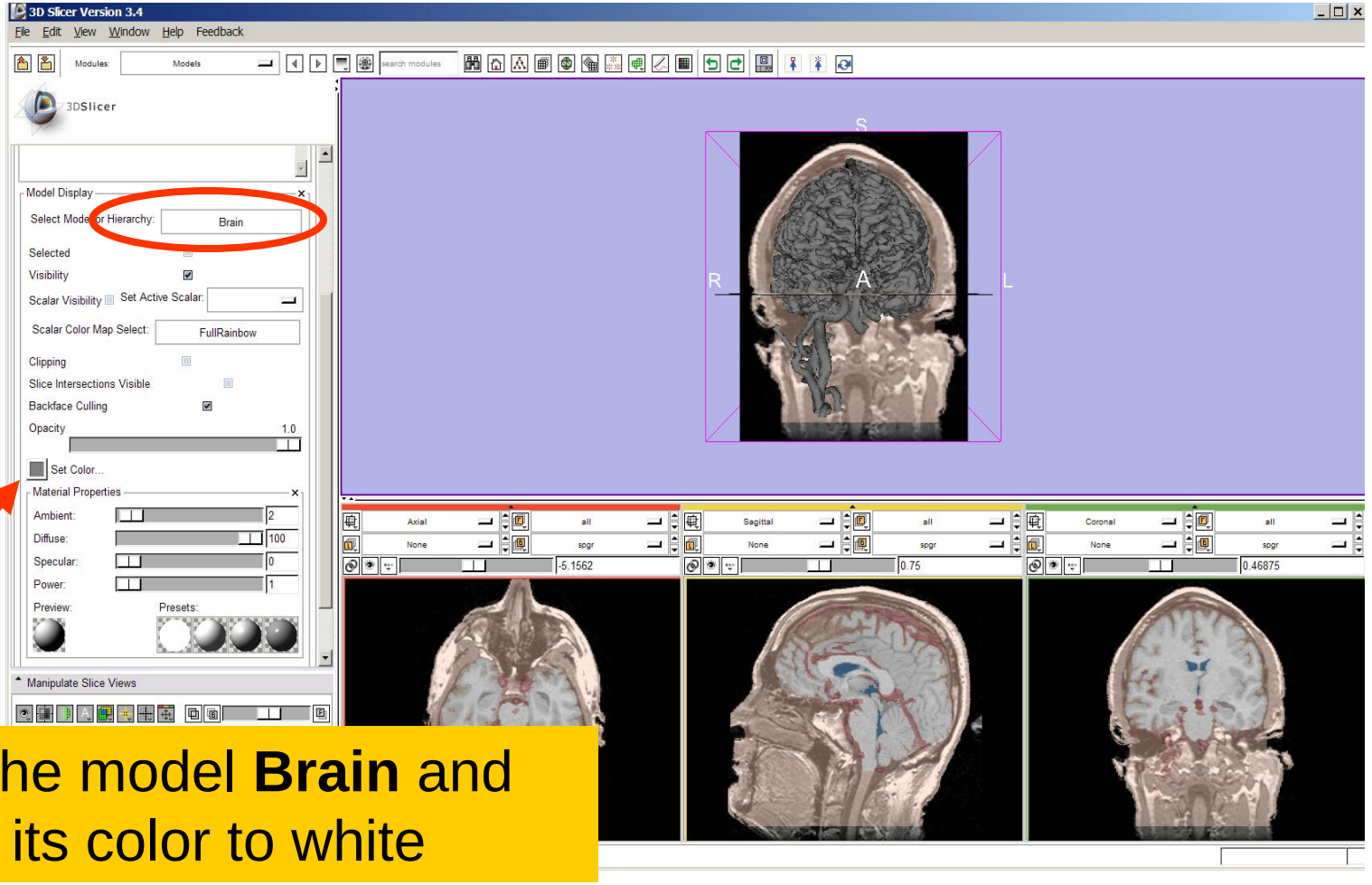


Visualizing a 3D model



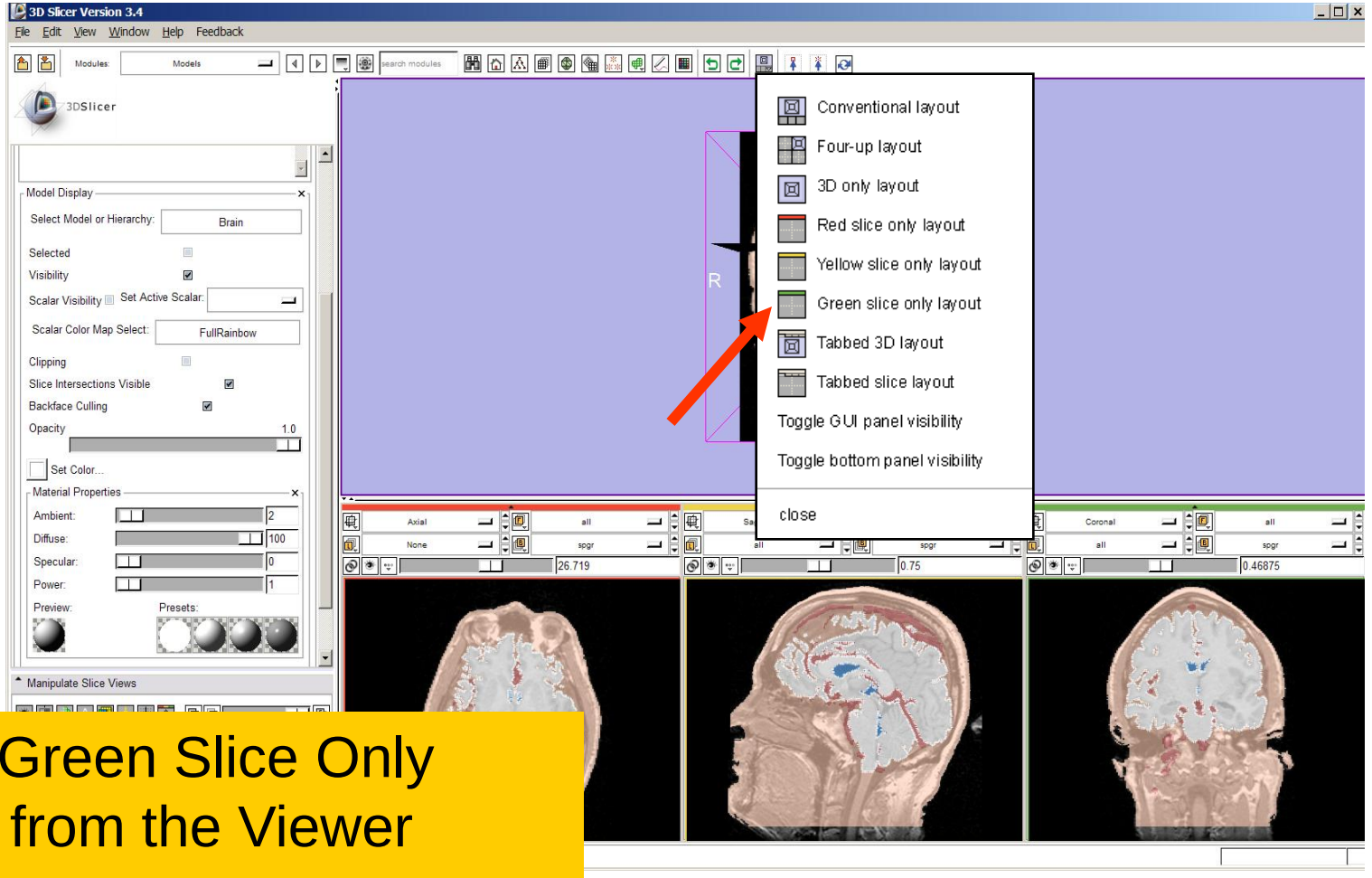
Turn off the visibility of the skin model

Visualizing a 3D model



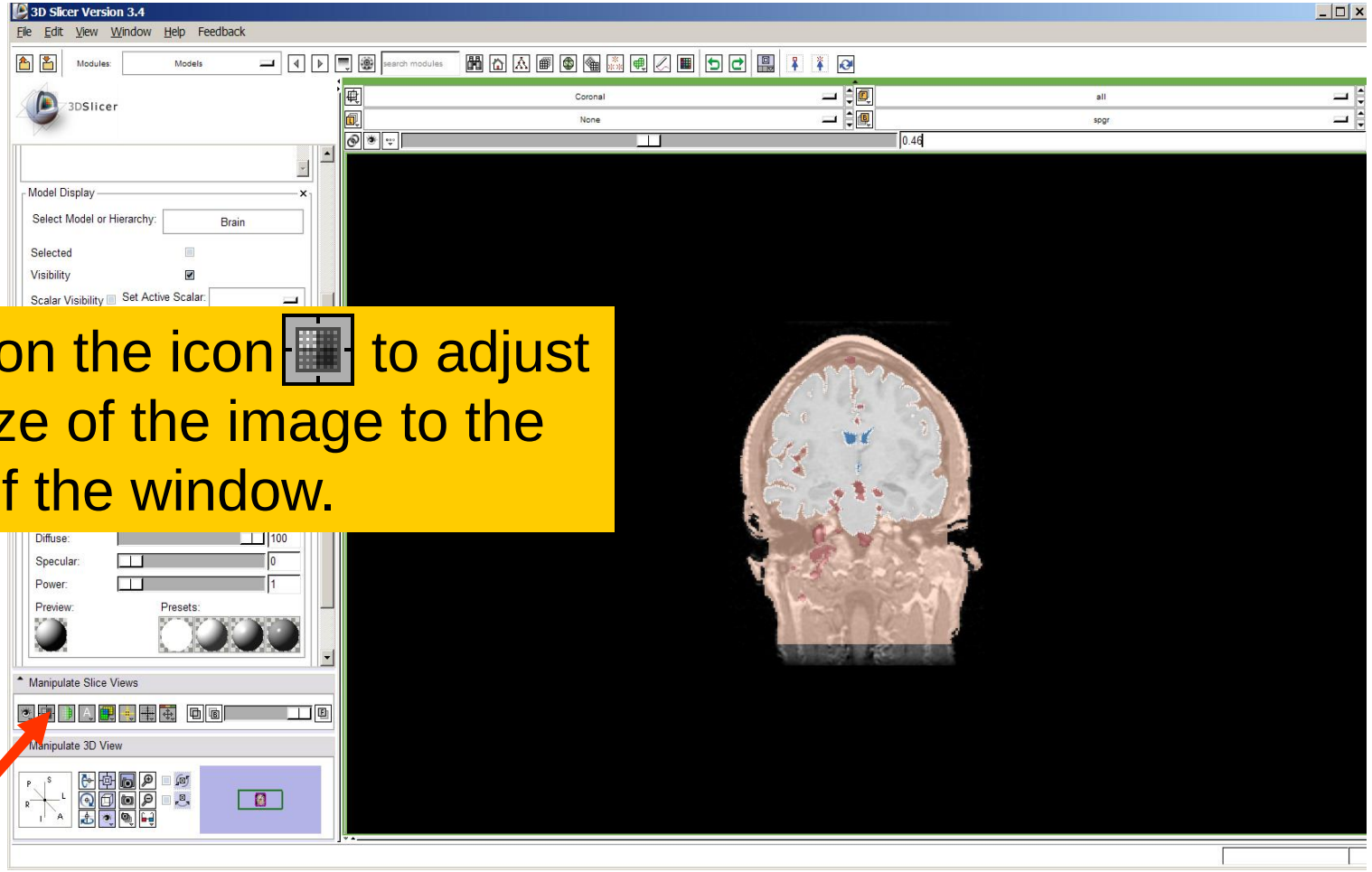
Select the model **Brain** and change its color to white

Visualizing a 3D model



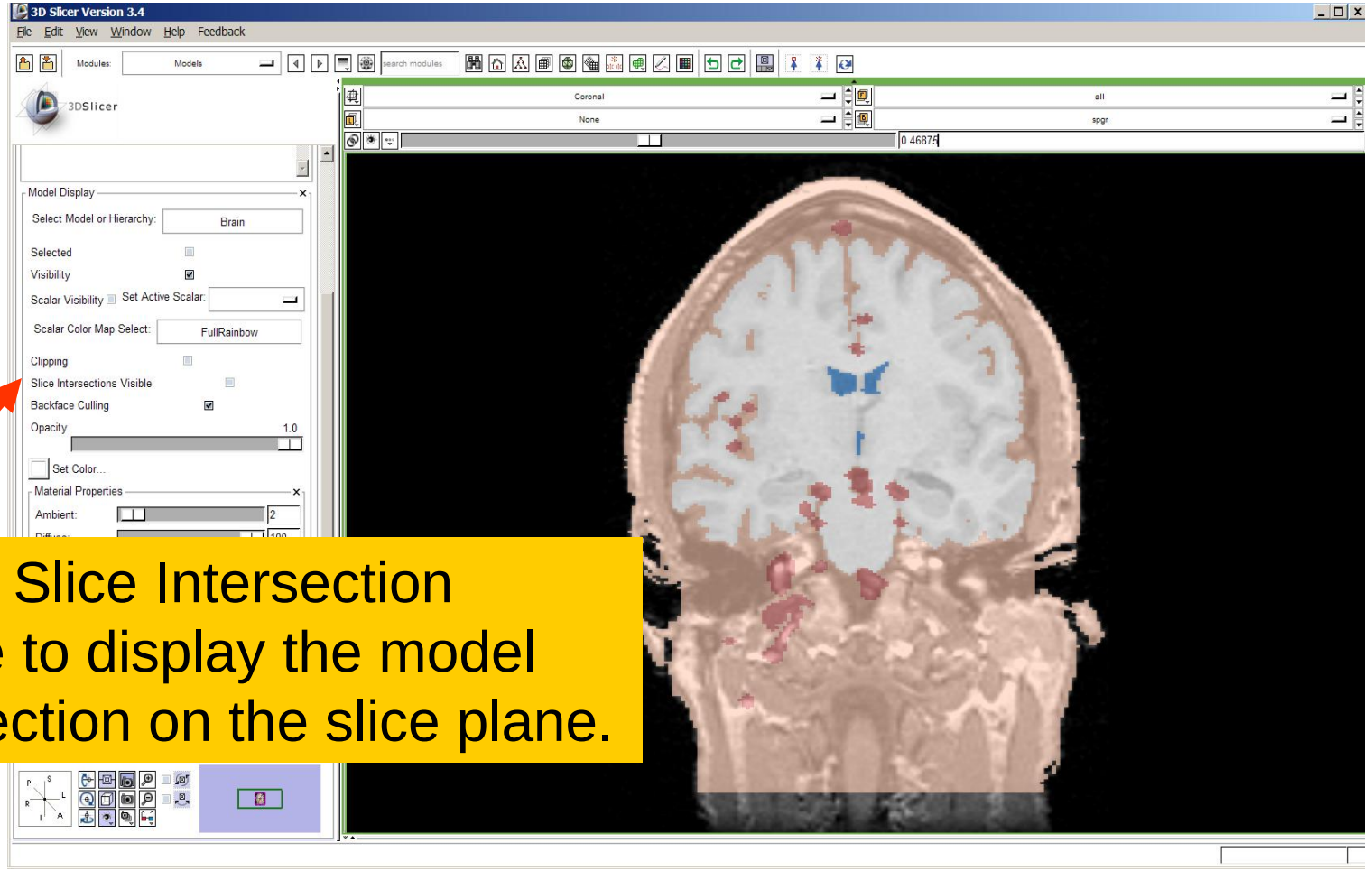
Select Green Slice Only Layout from the Viewer menu

Visualizing a 3D model



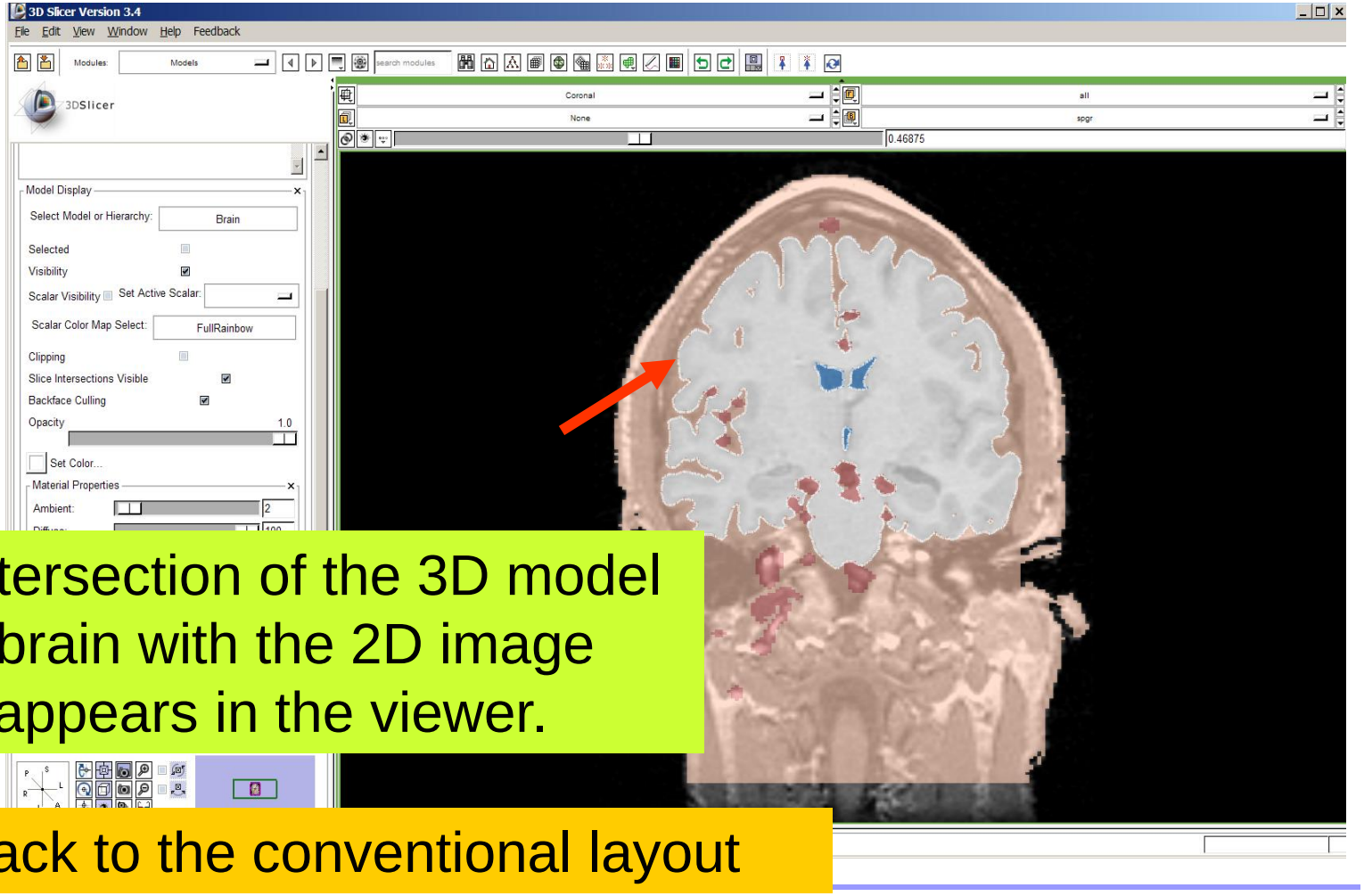
Click on the icon to adjust the size of the image to the size of the window.

Visualizing a 3D model



Select Slice Intersection Visible to display the model intersection on the slice plane.

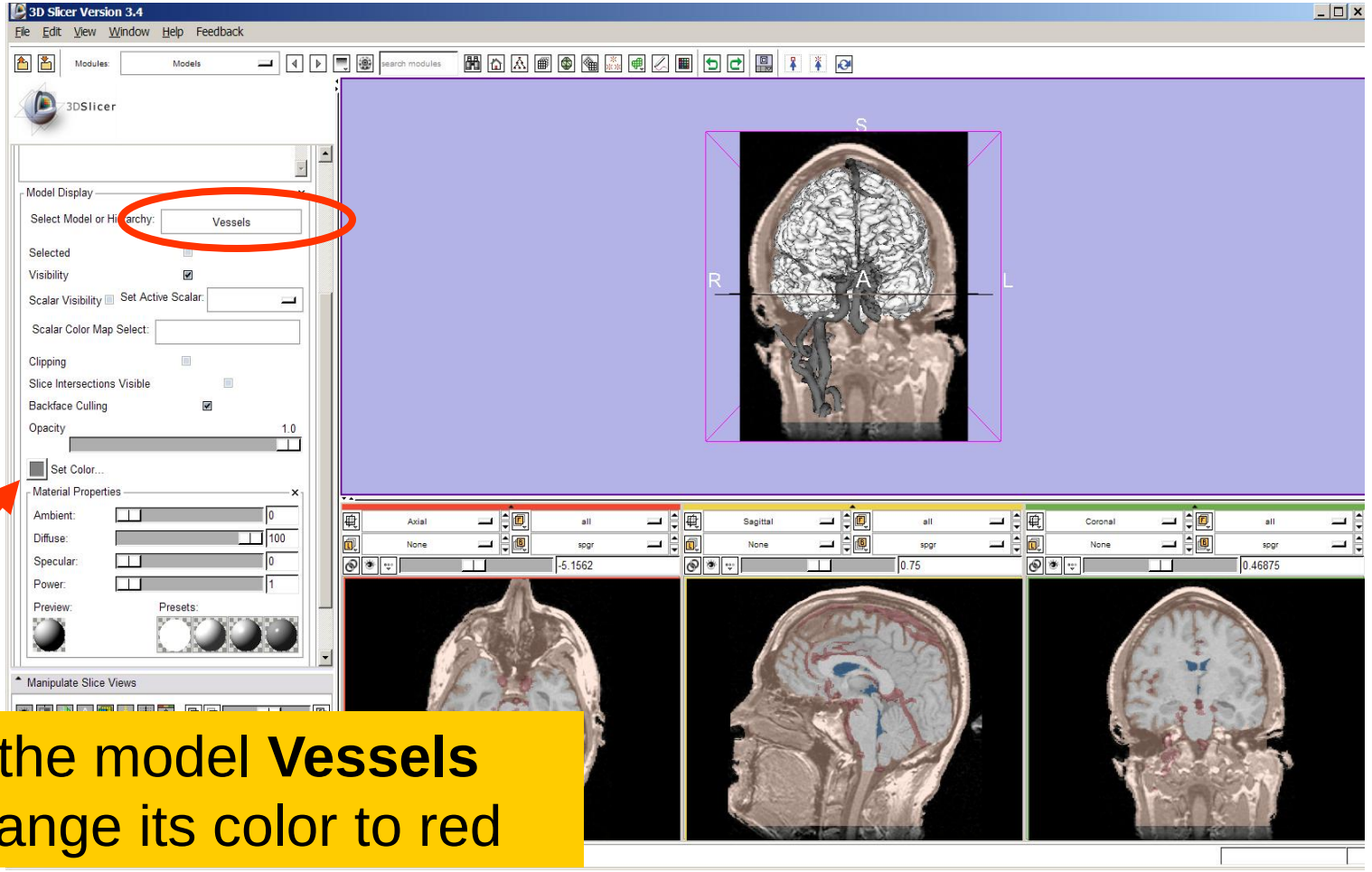
Visualizing a 3D model



The intersection of the 3D model of the brain with the 2D image plane appears in the viewer.

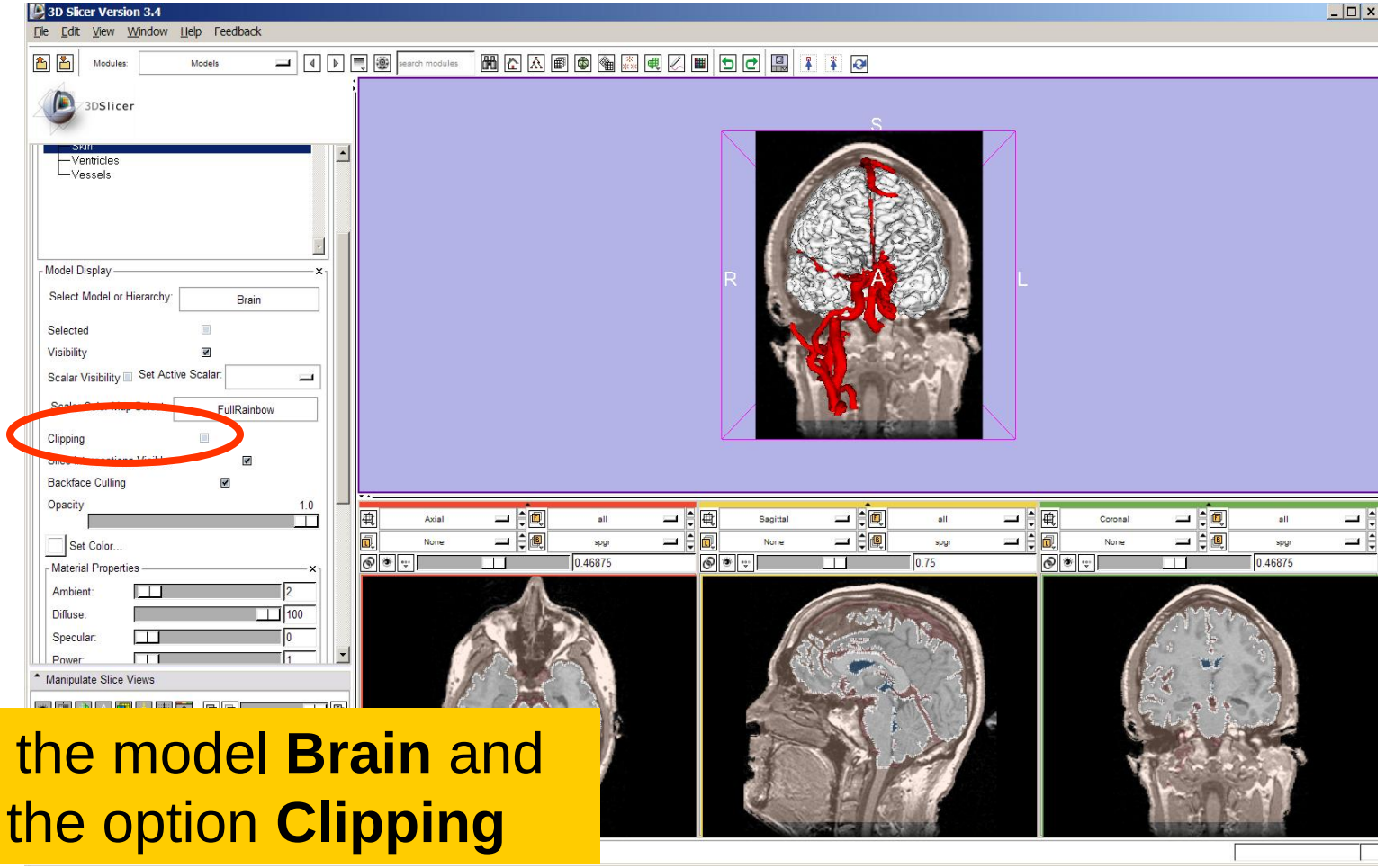
Go back to the conventional layout

Visualizing a 3D model



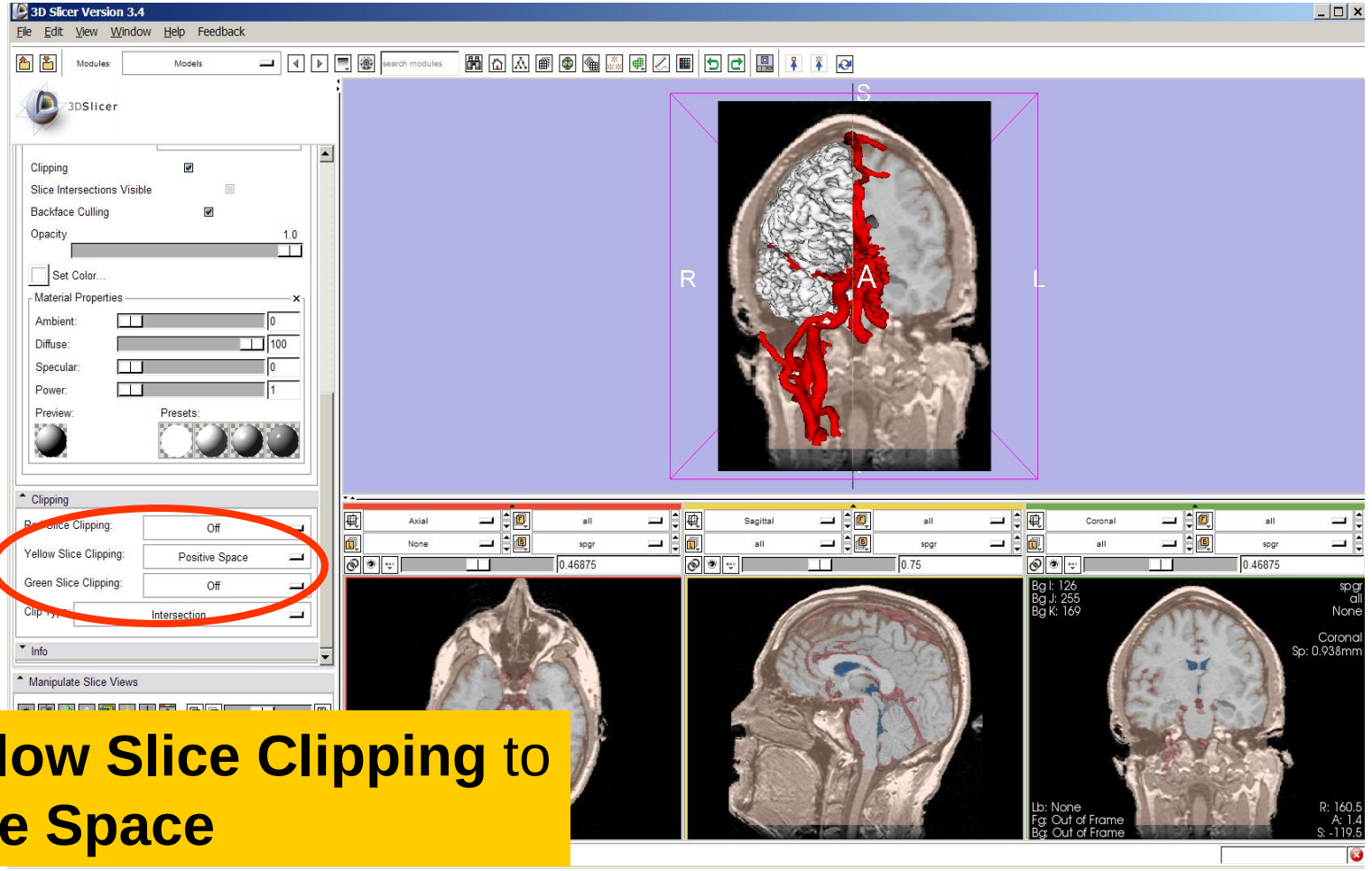
Select the model **Vessels** and change its color to red

Visualizing a 3D model



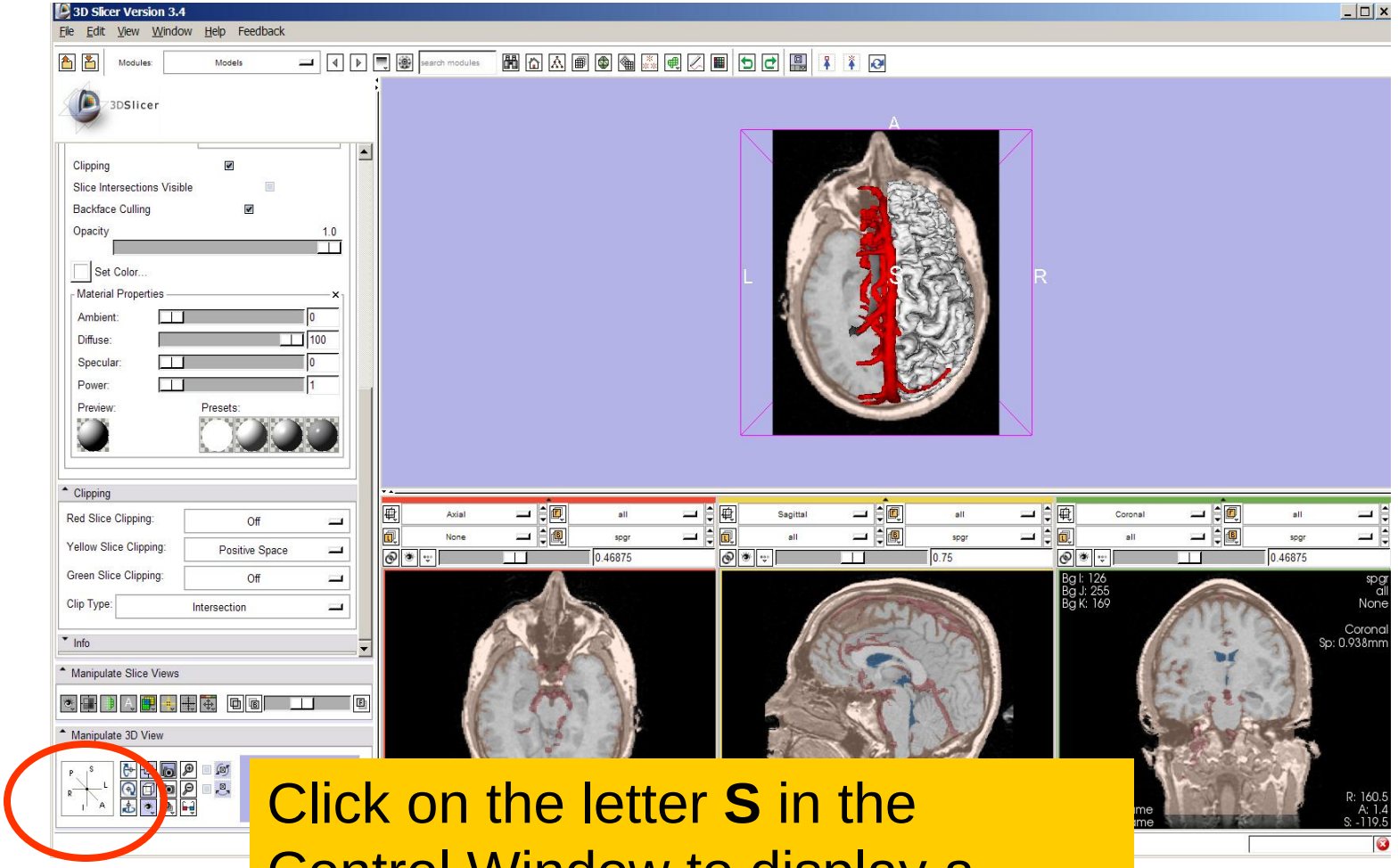
Select the model **Brain** and select the option **Clipping**

Visualizing a 3D model



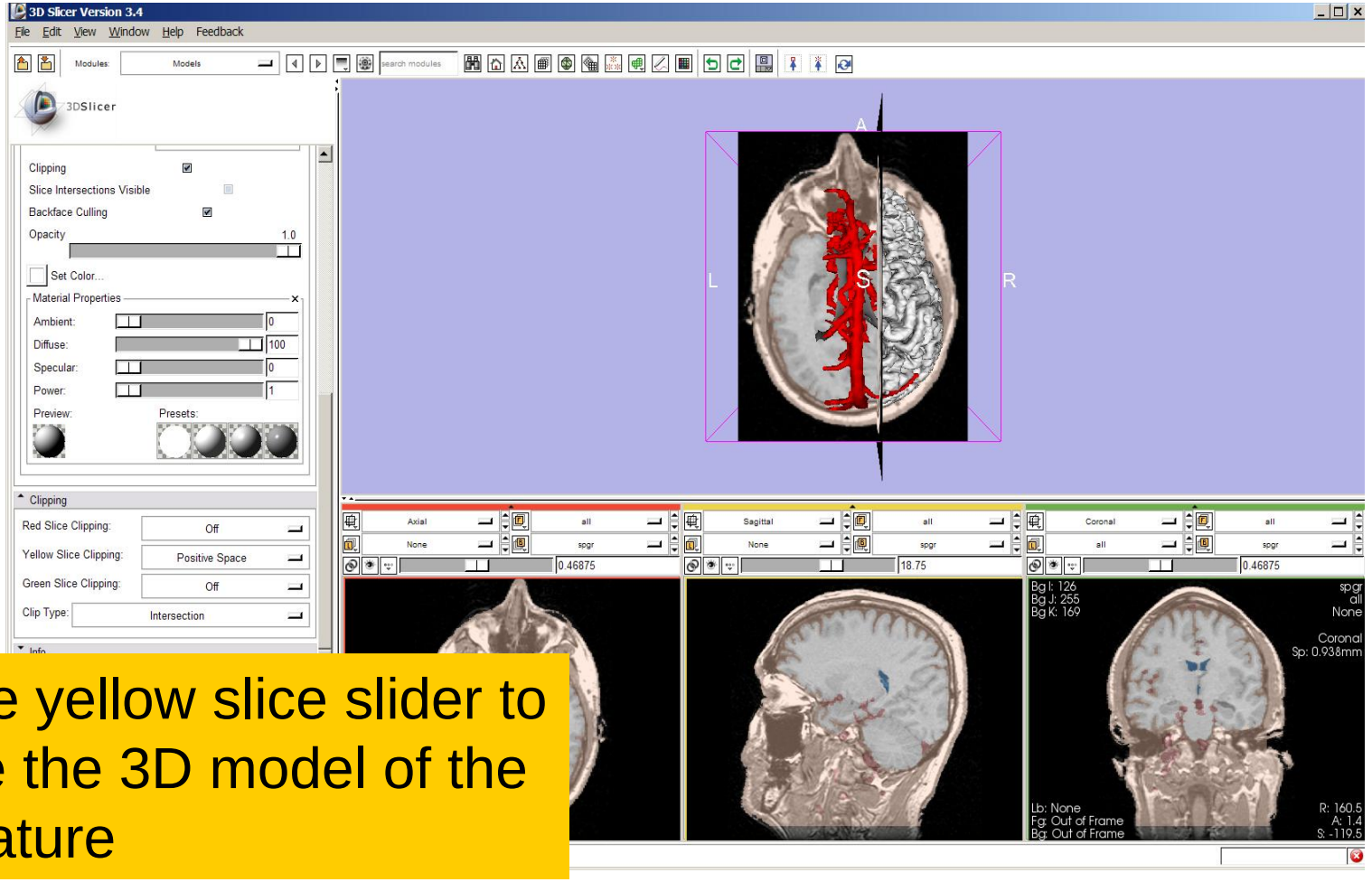
Set **Yellow Slice Clipping** to **Positive Space**

Visualizing a 3D model



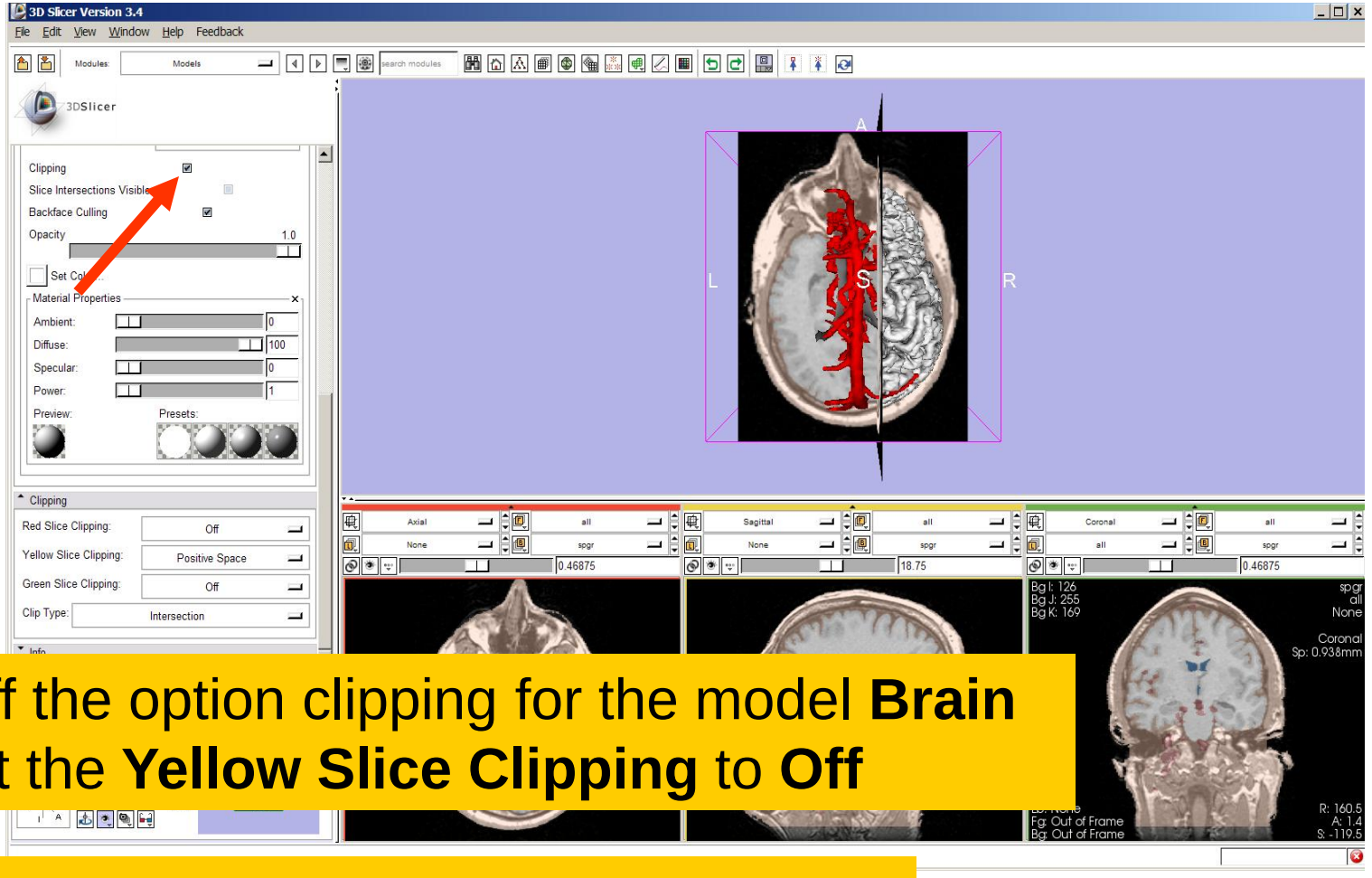
Click on the letter **S** in the Control Window to display a superior view of the 3D models

Visualizing a 3D model



Use the yellow slice slider to expose the 3D model of the vasculature

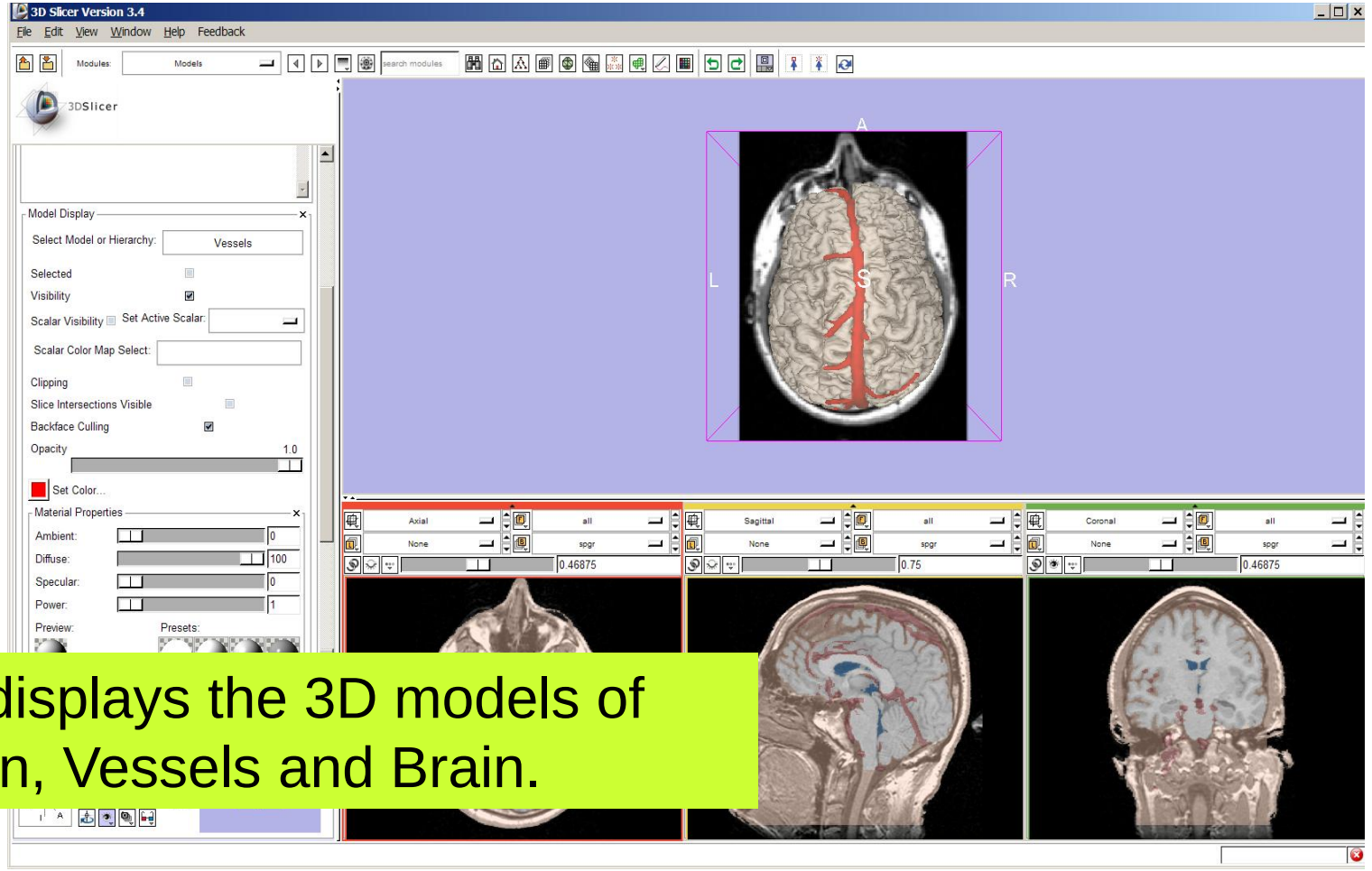
Visualizing a 3D model



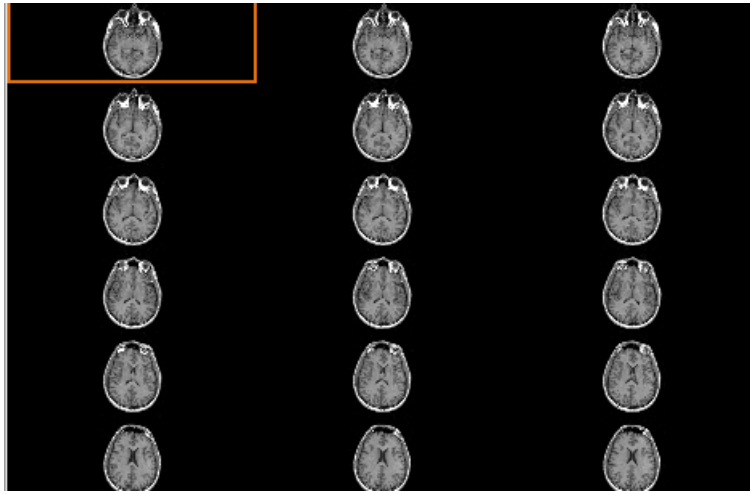
Turn off the option clipping for the model **Brain** and set the **Yellow Slice Clipping** to **Off**

Turn on the visibility of the model **Skin**

Visualizing a 3D model

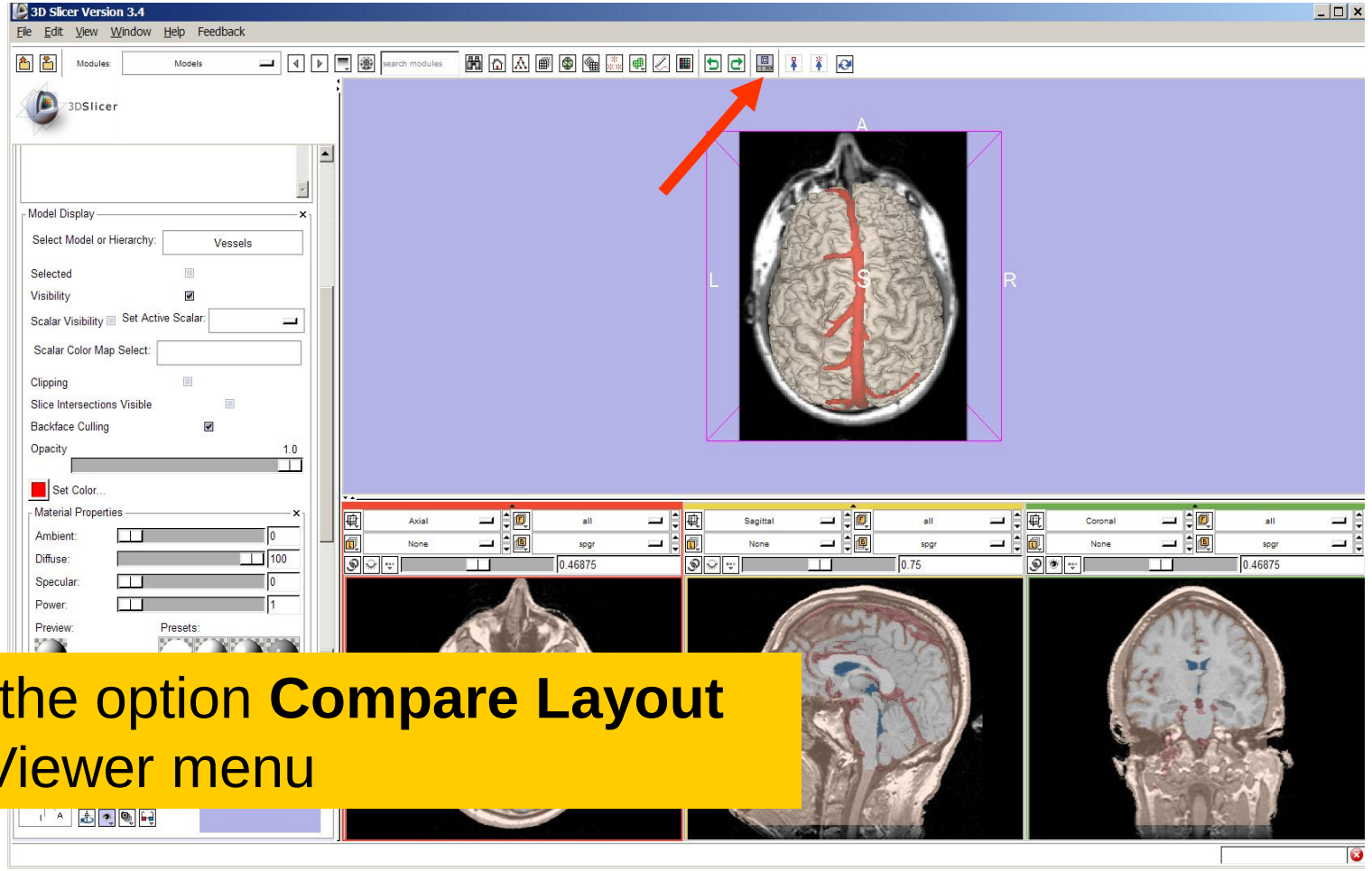


Slicer displays the 3D models of the Skin, Vessels and Brain.



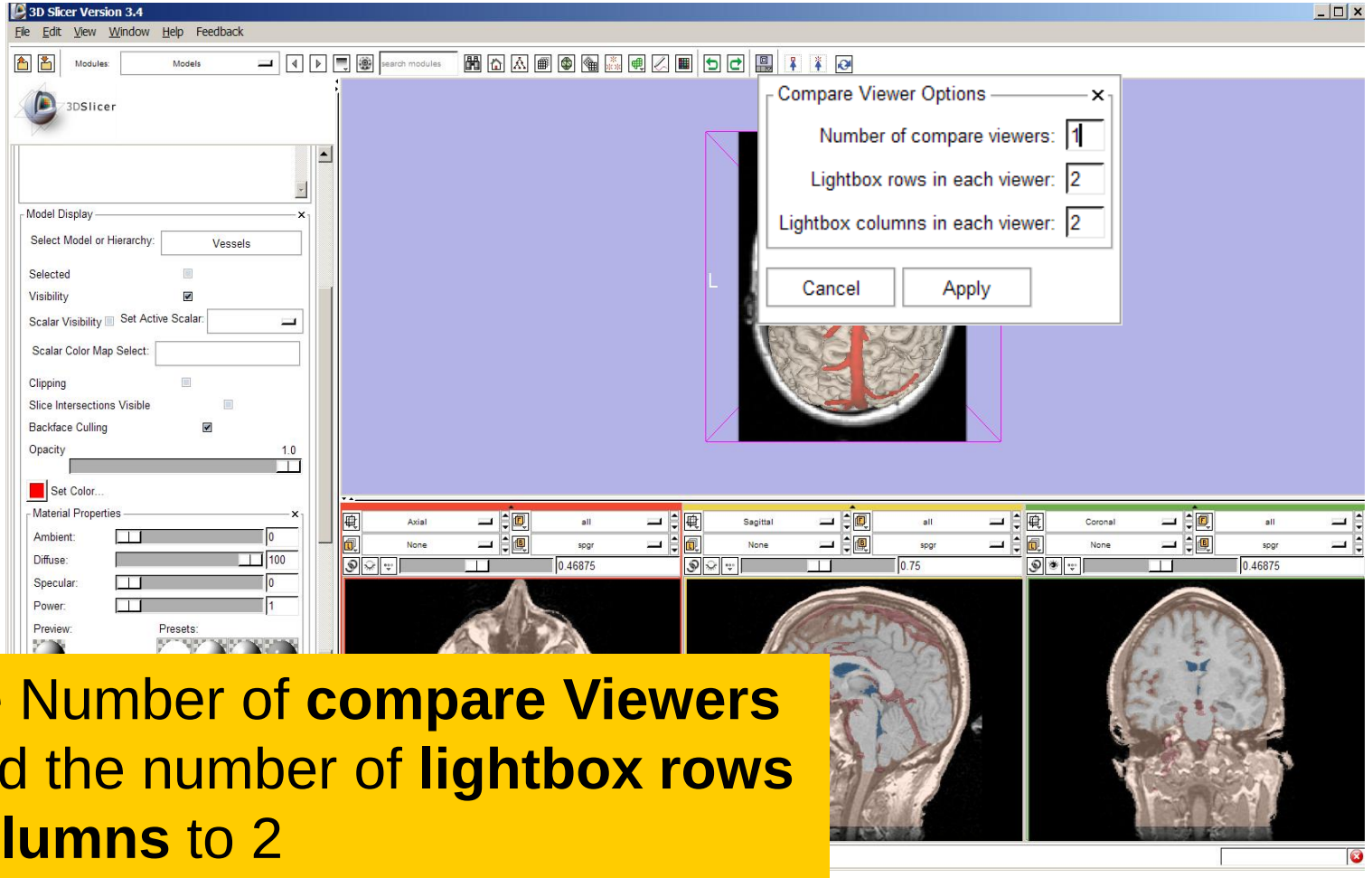
Part 4: Lightbox viewer

Visualizing a 3D model



Select the option **Compare Layout** in the Viewer menu

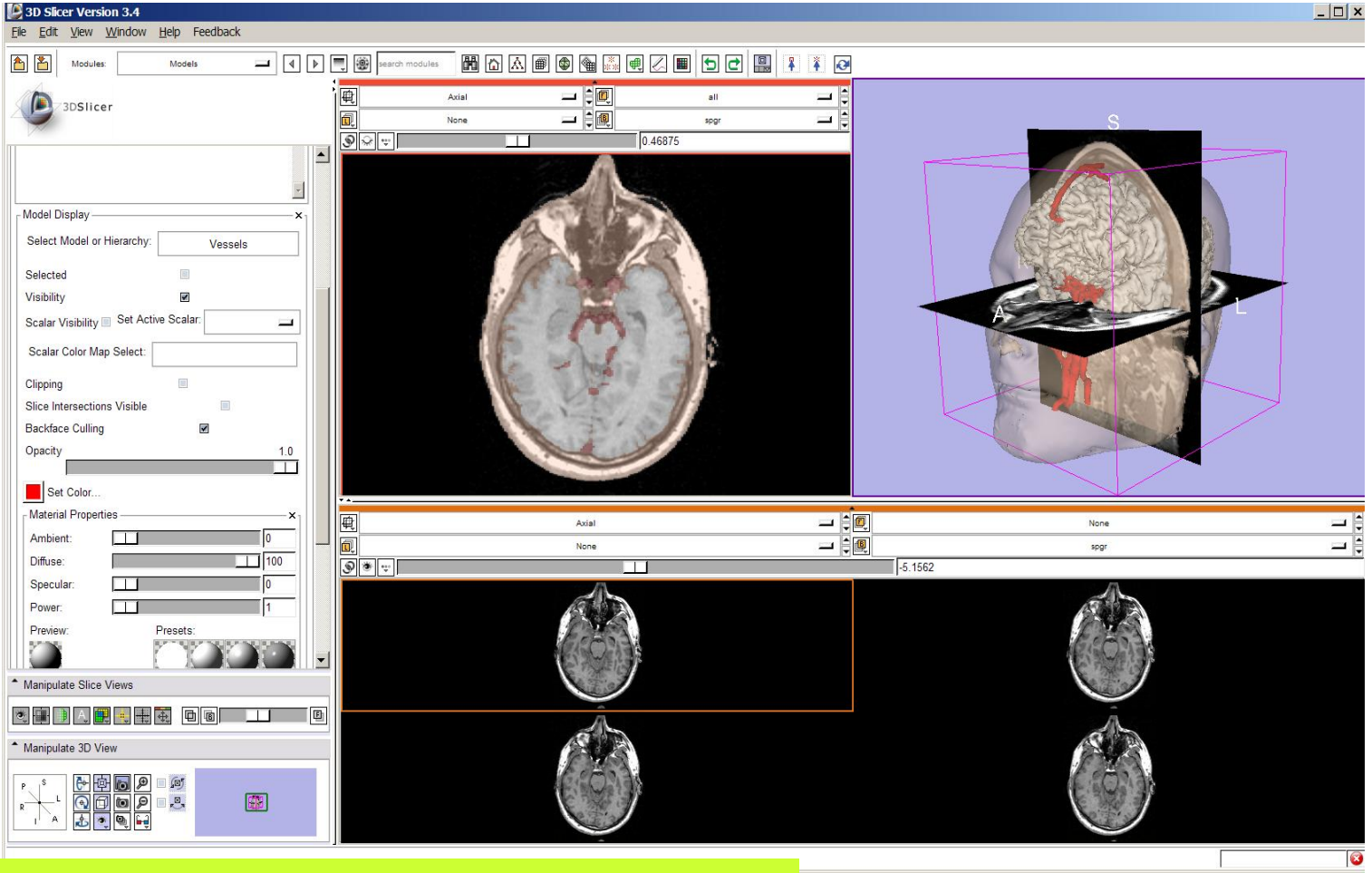
Visualizing a 3D model



Set the Number of **compare Viewers** to 1 and the number of **lightbox rows** and **columns** to 2

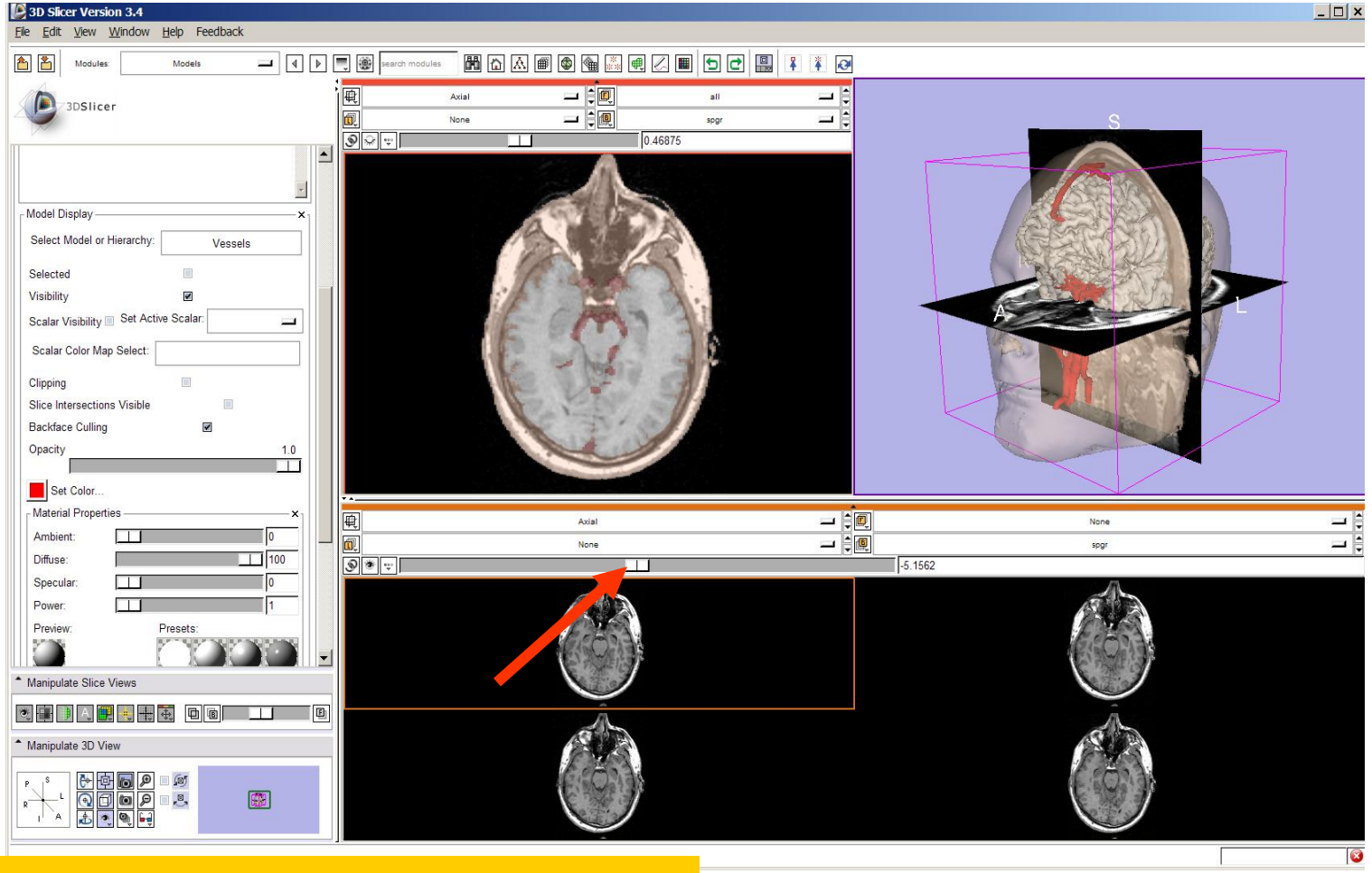
Click on **Apply**

Lightbox viewer



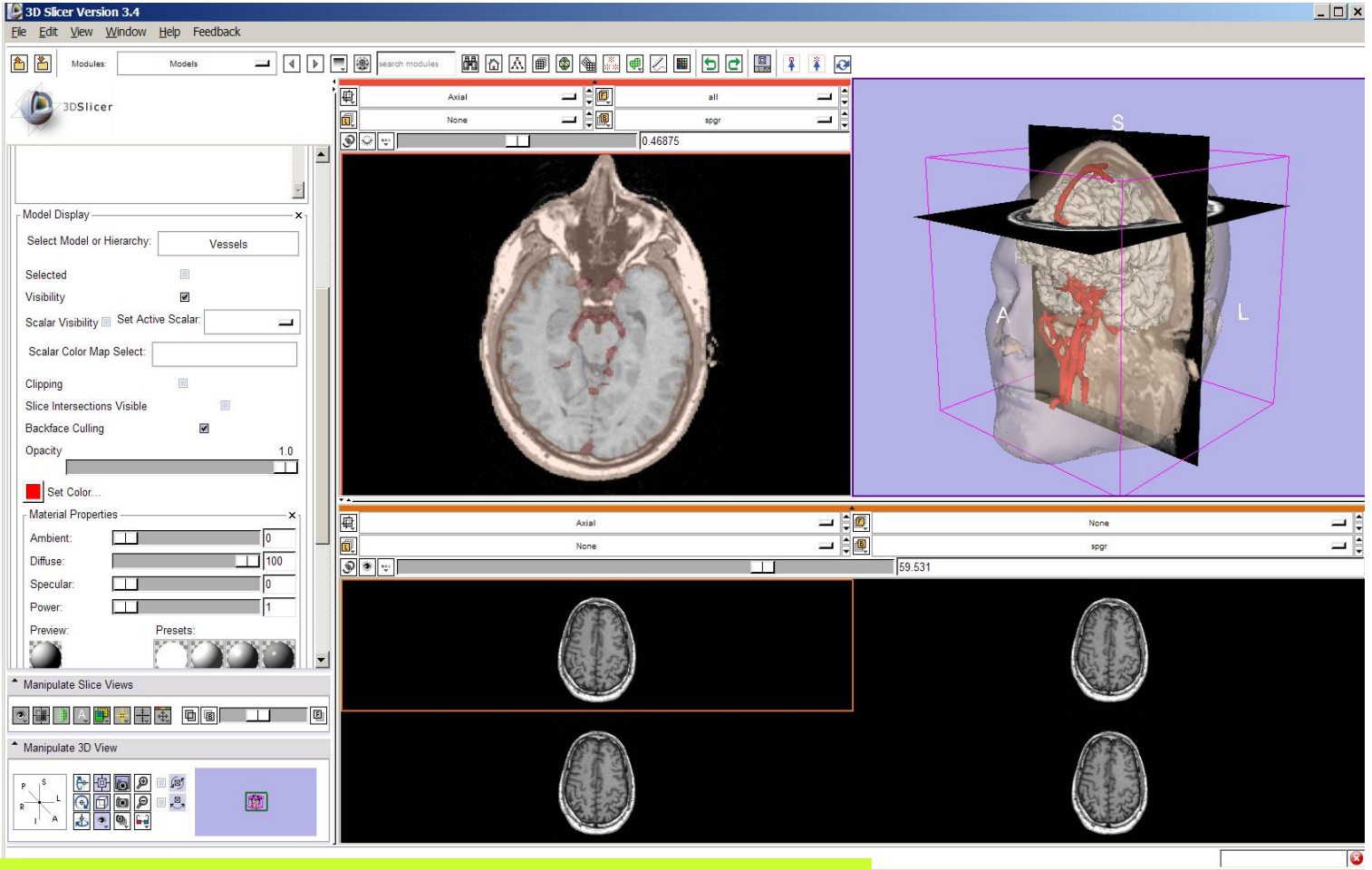
Slicer displays a lightbox view of the Background dataset.

Lightbox viewer



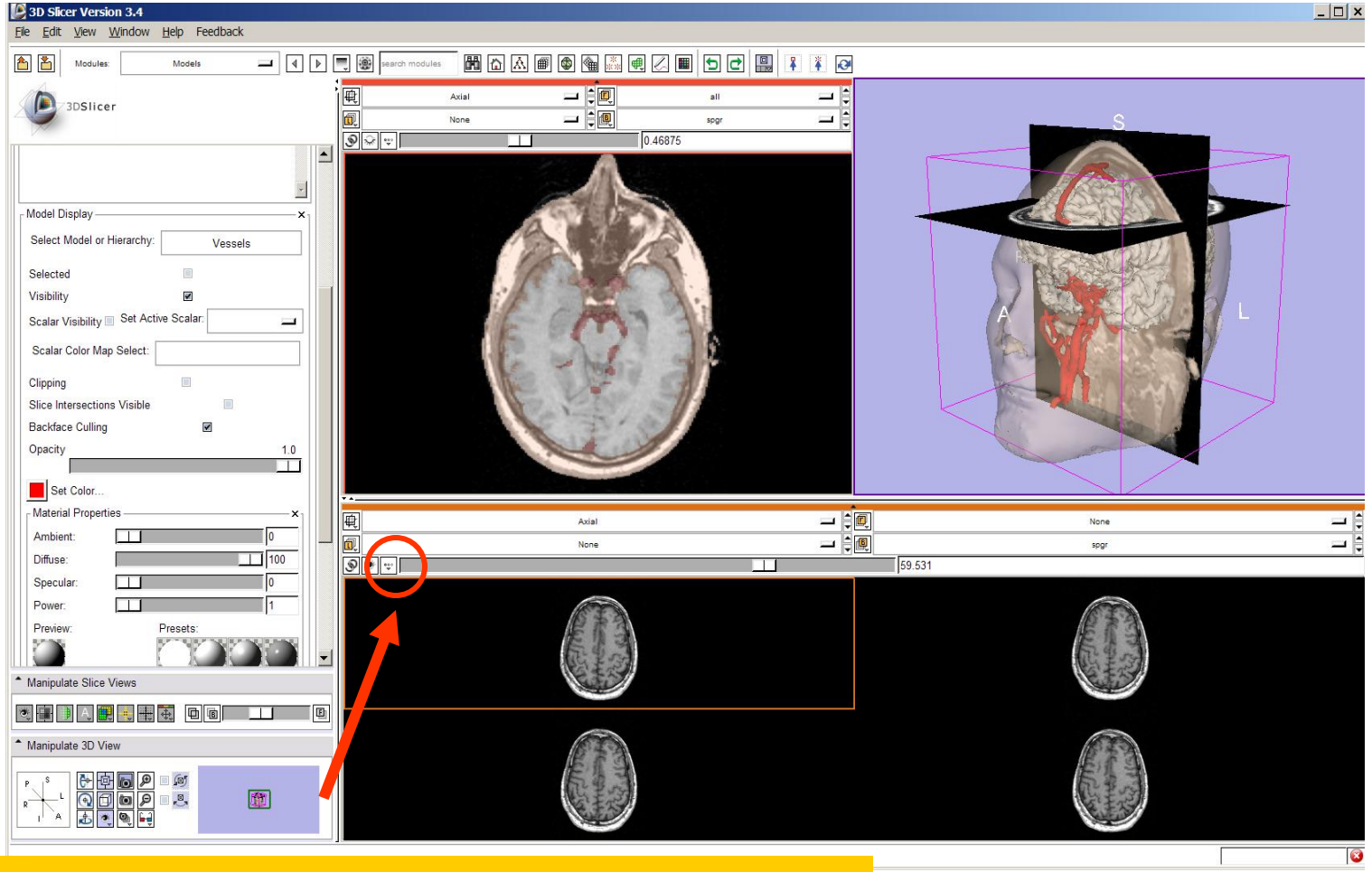
Browse through the spgr volume using the lightbox slider

Lightbox viewer



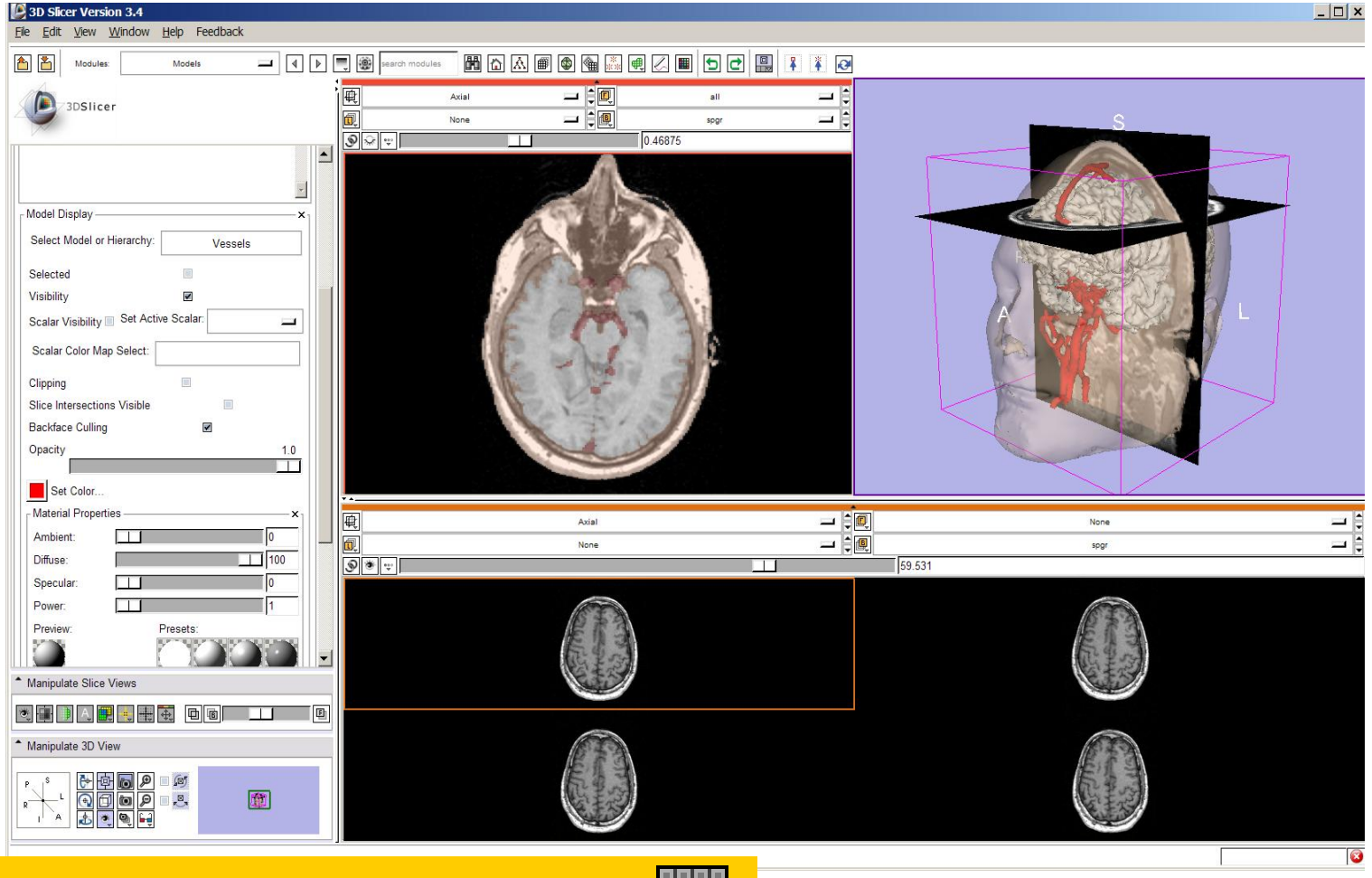
Slicer displays 4 adjacent axial slices of the spgr volume simultaneously

Lightbox viewer



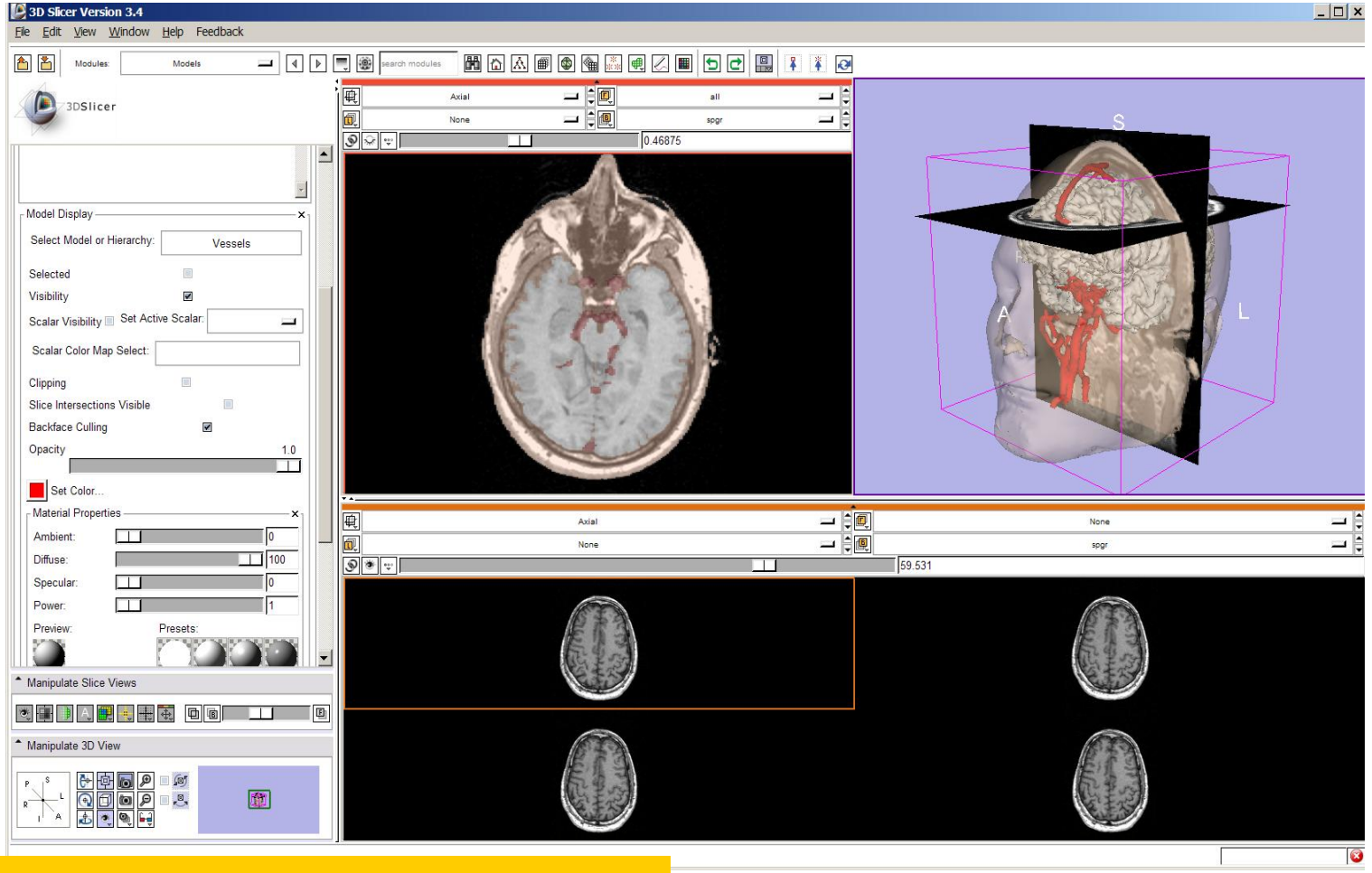
Left click on the Slice Viewer menu of the Compare Layout viewer

Lightbox viewer



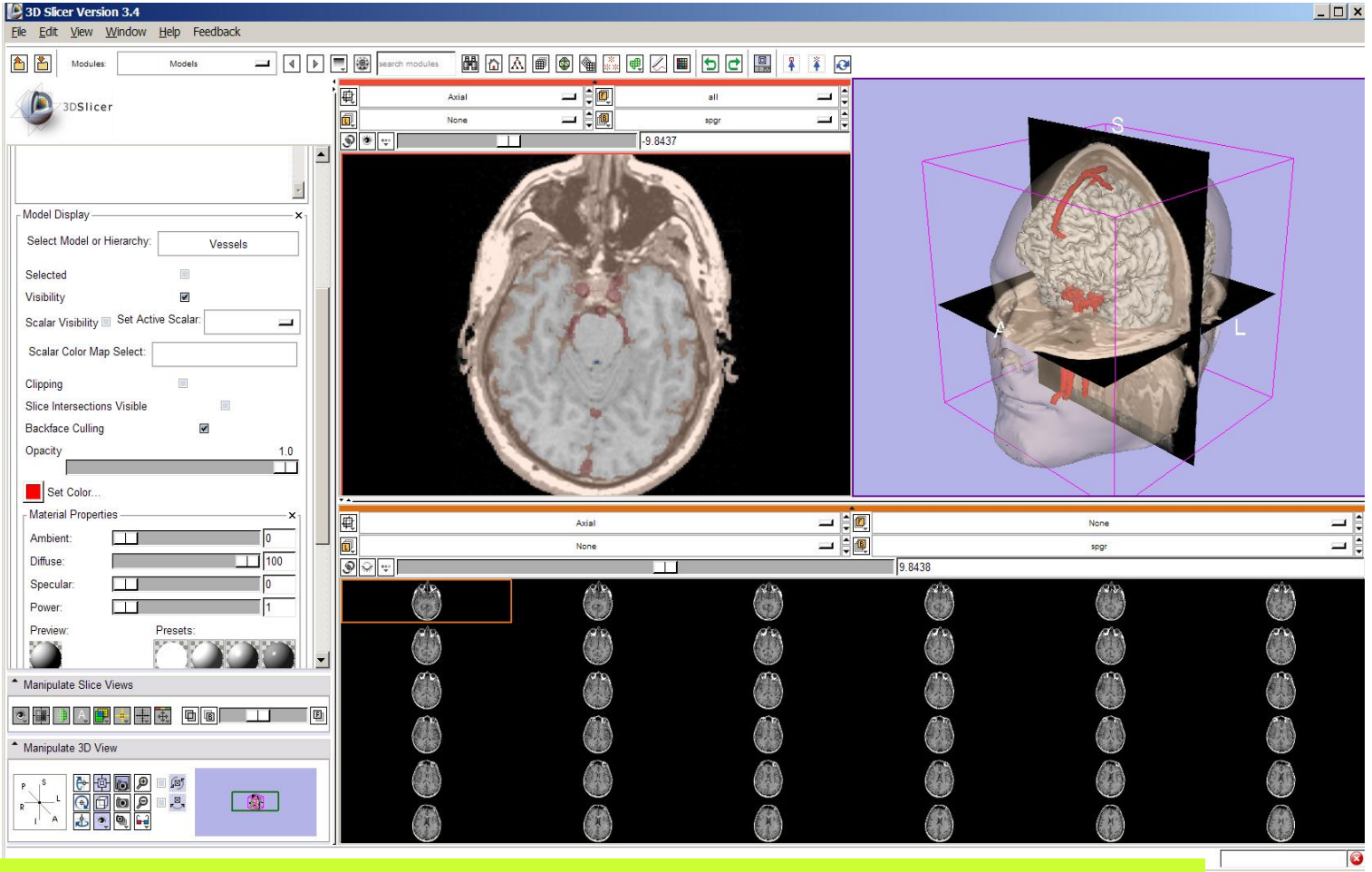
Select the **lightbox view** option 

Lightbox viewer



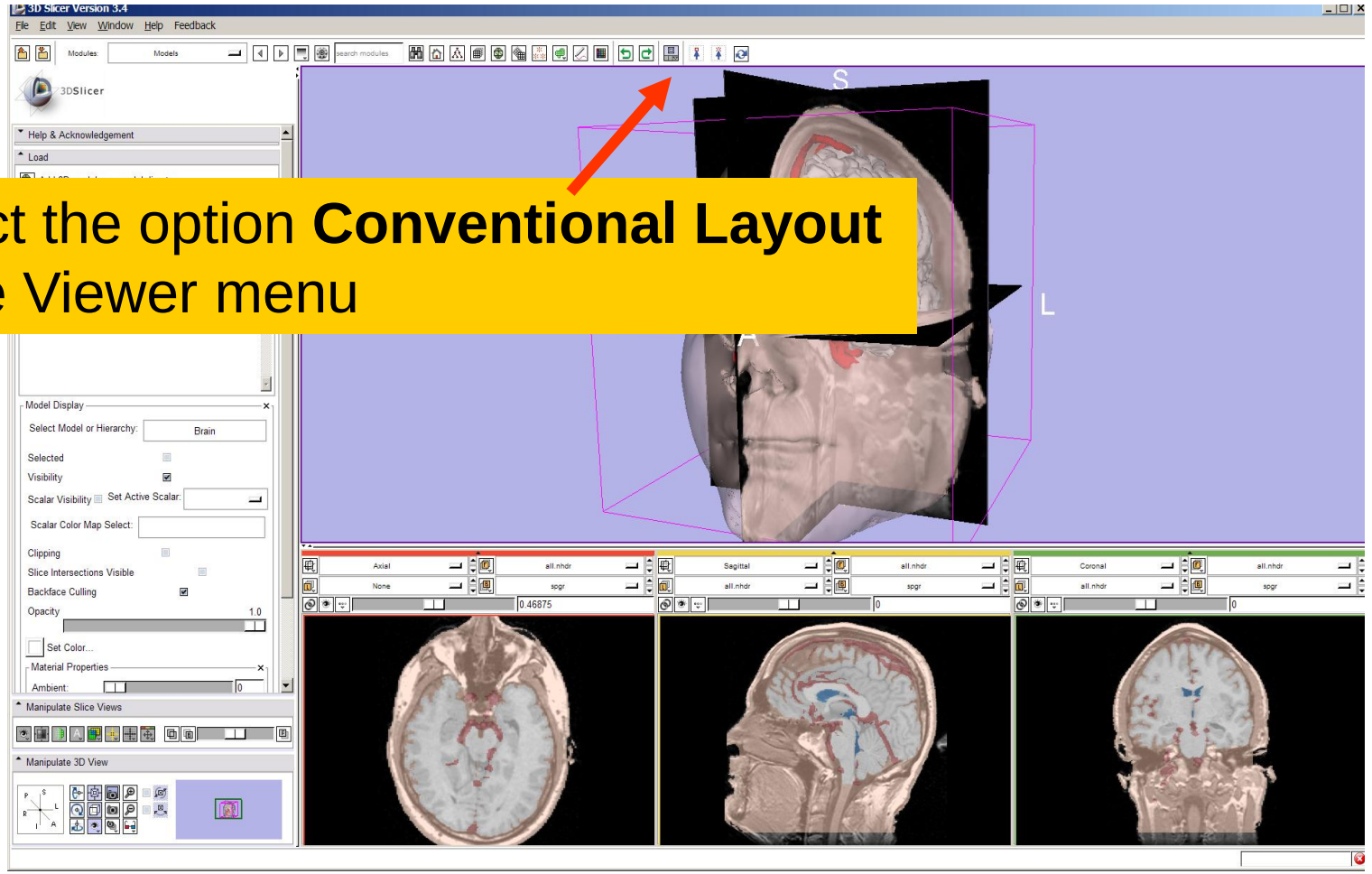
Set the configuration of the light box view to **6x6**

Lightbox viewer

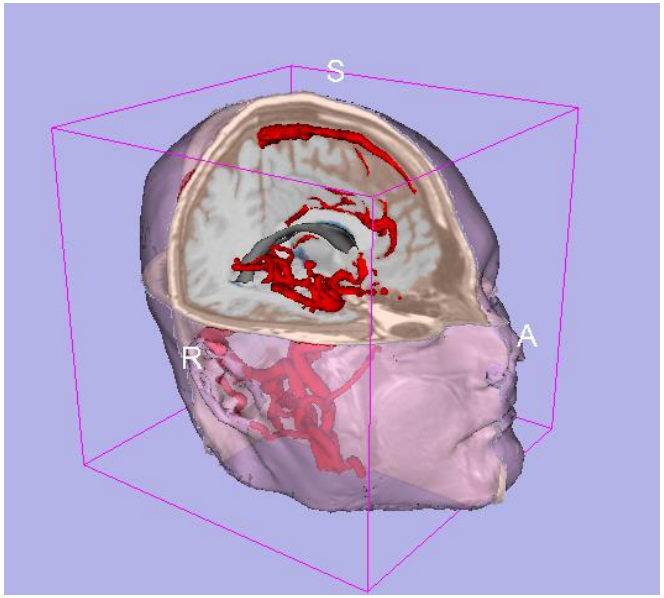


Slicer displays a matrix of 36 adjacent axial slices of the spgr volume.

Lightbox viewer

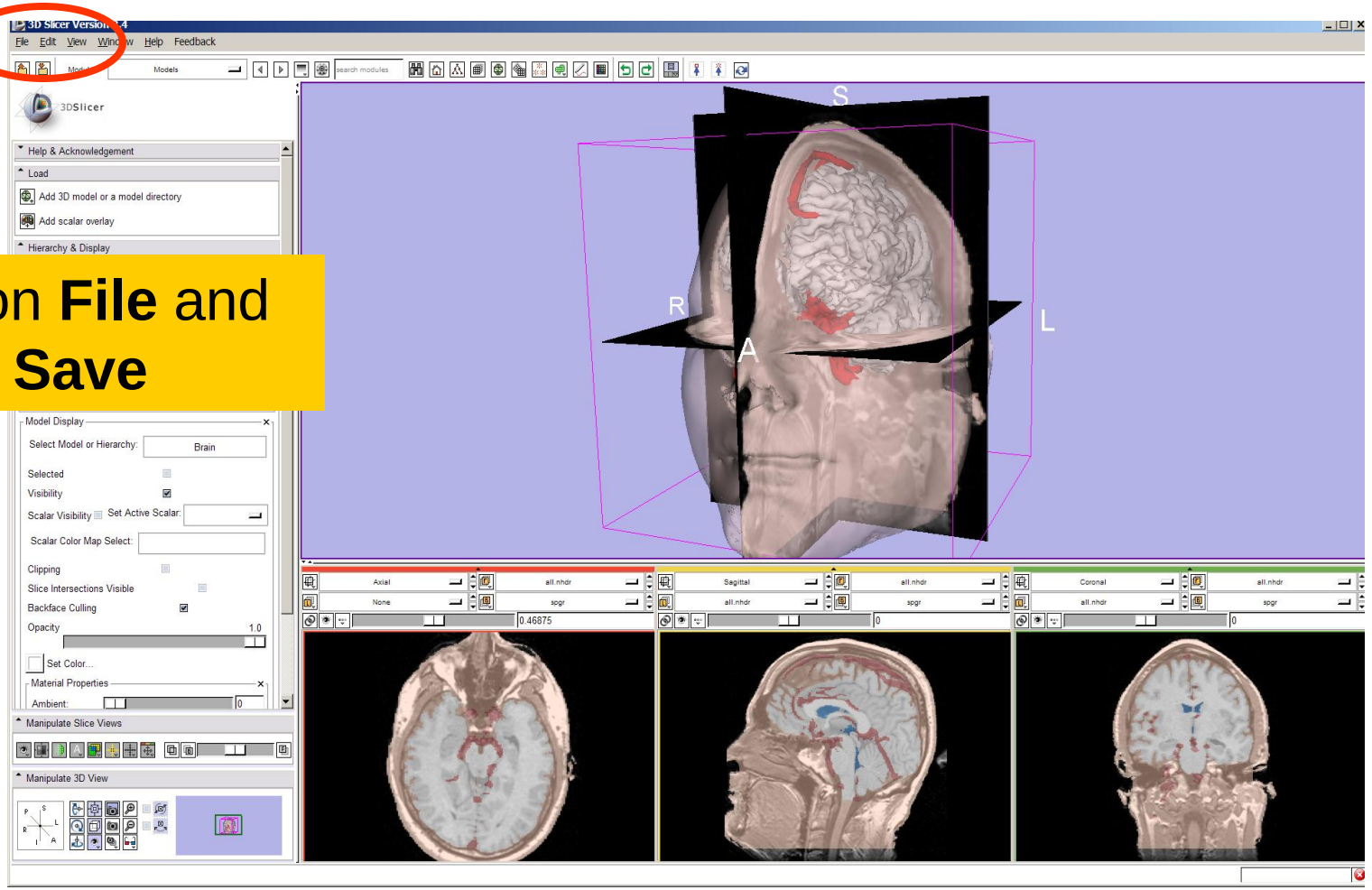


Select the option **Conventional Layout** in the Viewer menu



Part 5: Loading and saving a Scene

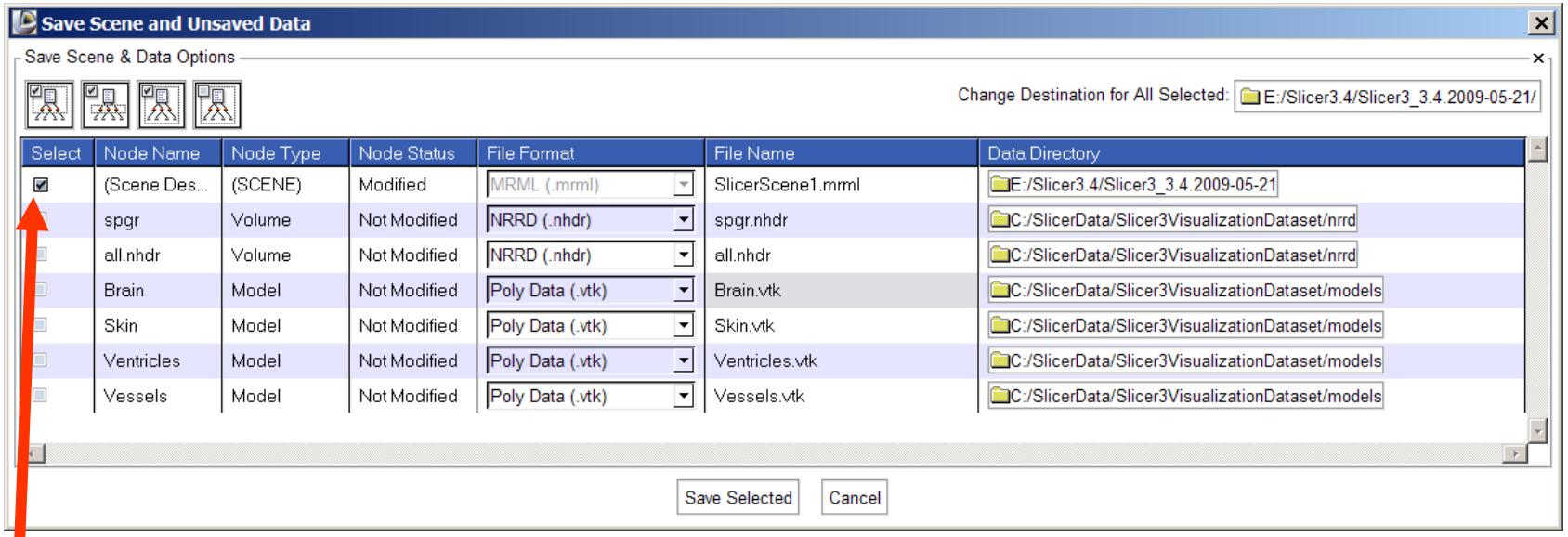
Saving Data



Click on **File** and Select **Save**

Saving Data

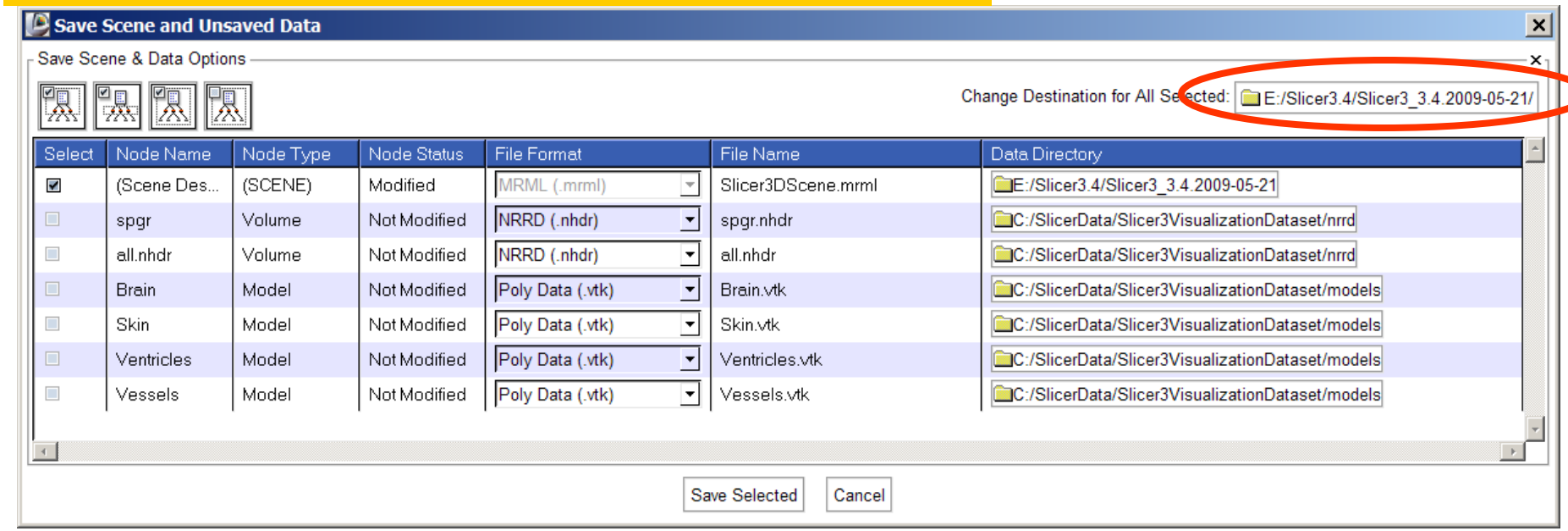
The list of elements currently loaded into Slicer3 appears.



Make sure only the first check box is selected

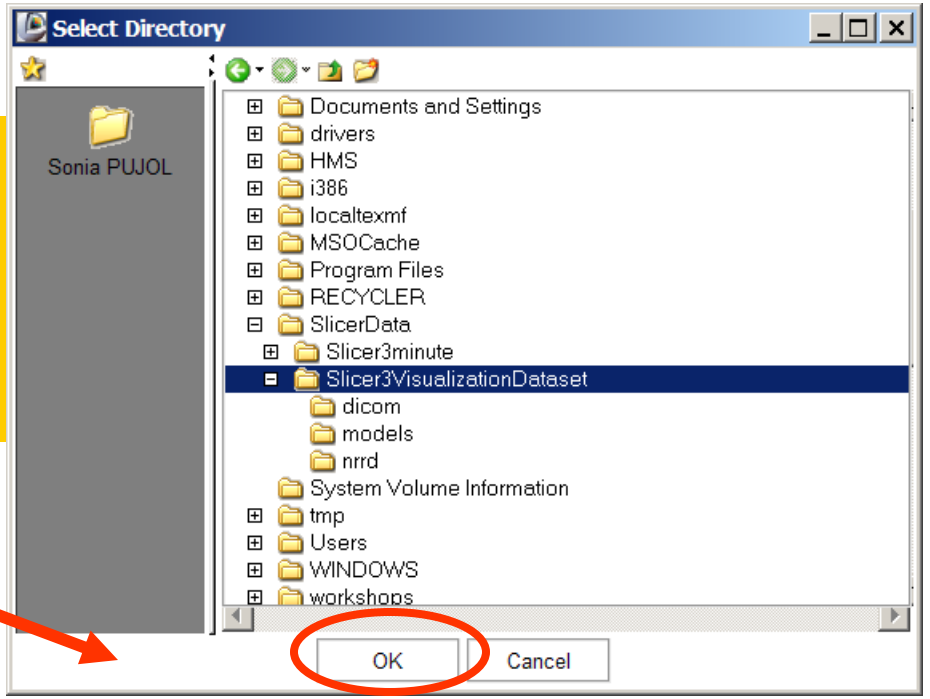
Saving Data

Click on **Change Destination for All Selected** and browse to the location where the scene will be saved



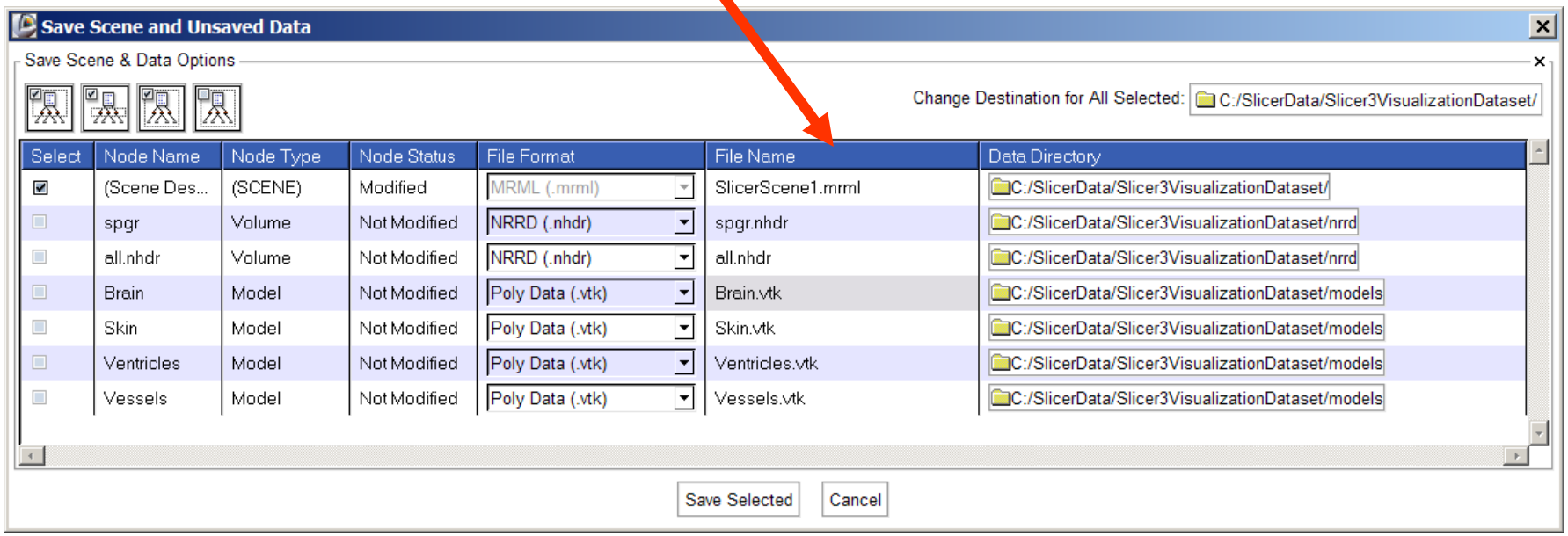
Saving Data

Browse to the directory where you would like to save your scene and click OK



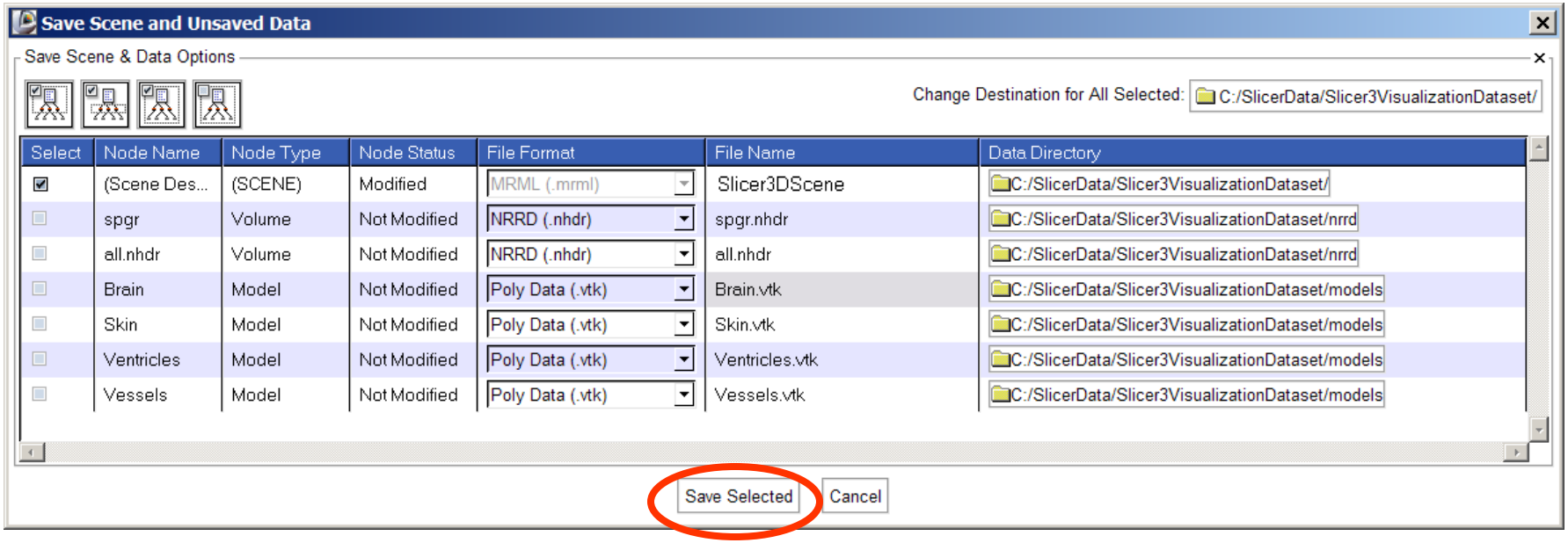
Saving Data

Double click on the file name **SlicerScene1** and change it to **Slicer3DScene**



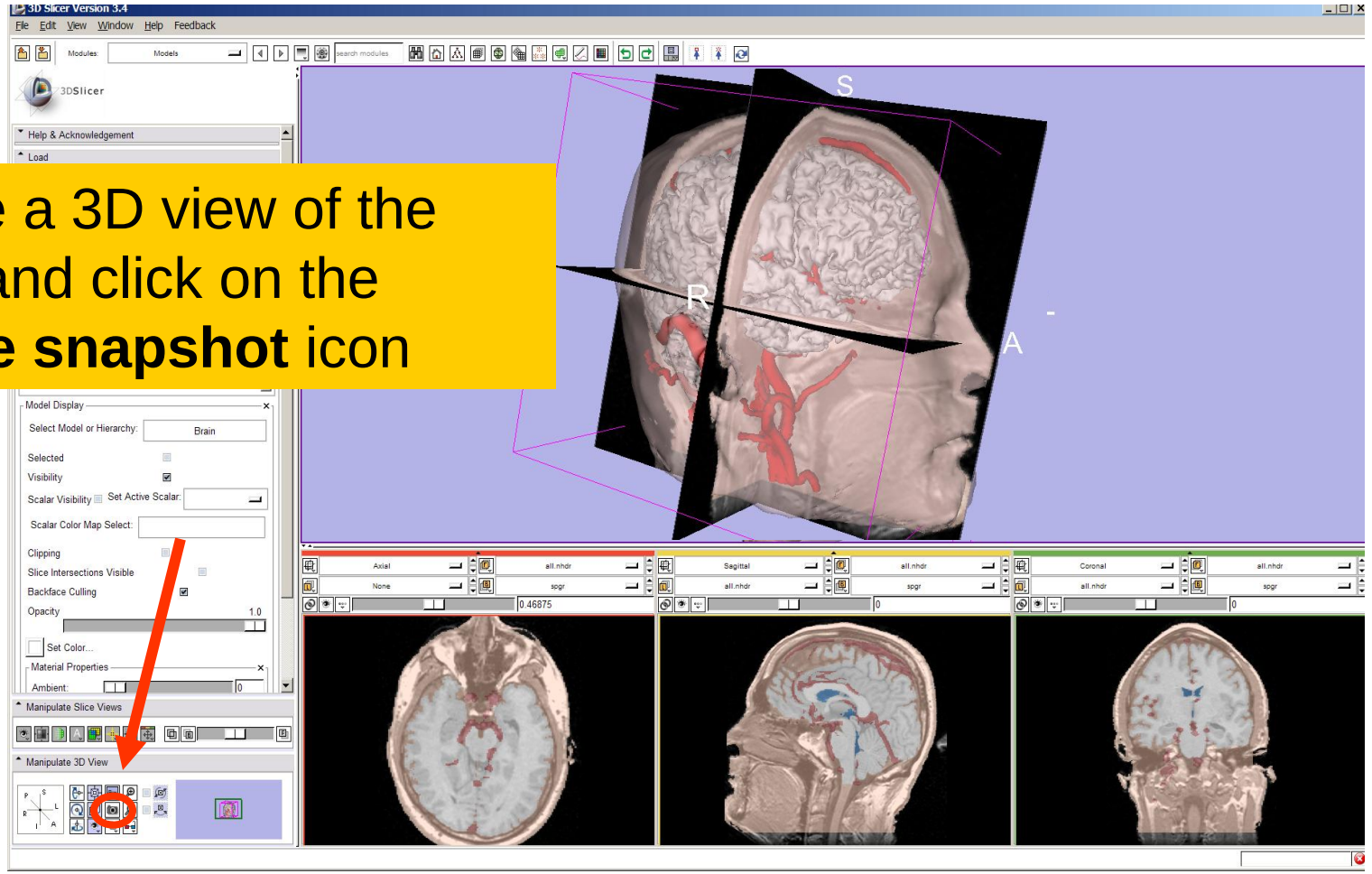
Saving Data

Click on **Save Selected**

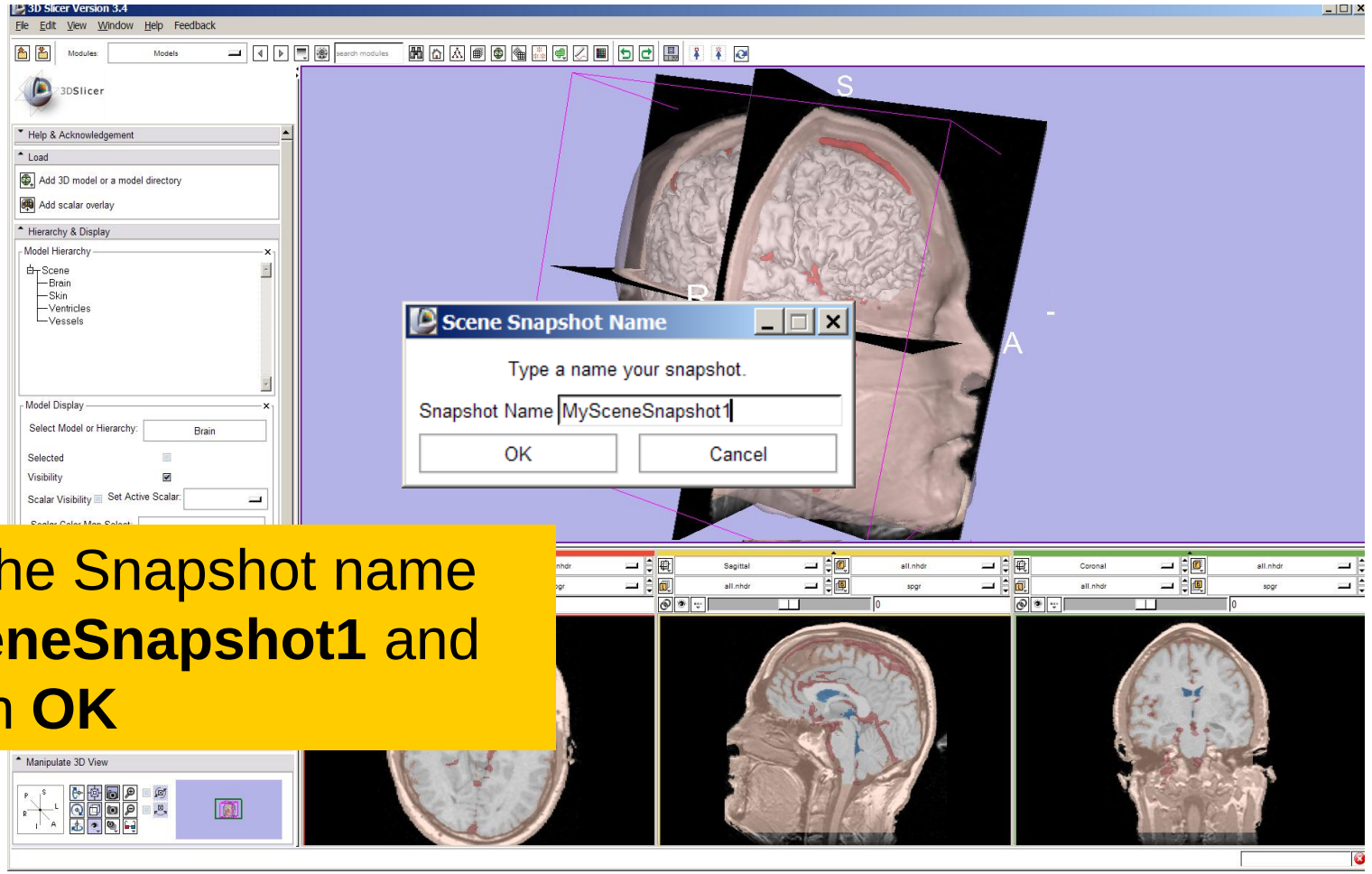


Creating Scene Snapshots

Choose a 3D view of the scene and click on the **capture snapshot** icon

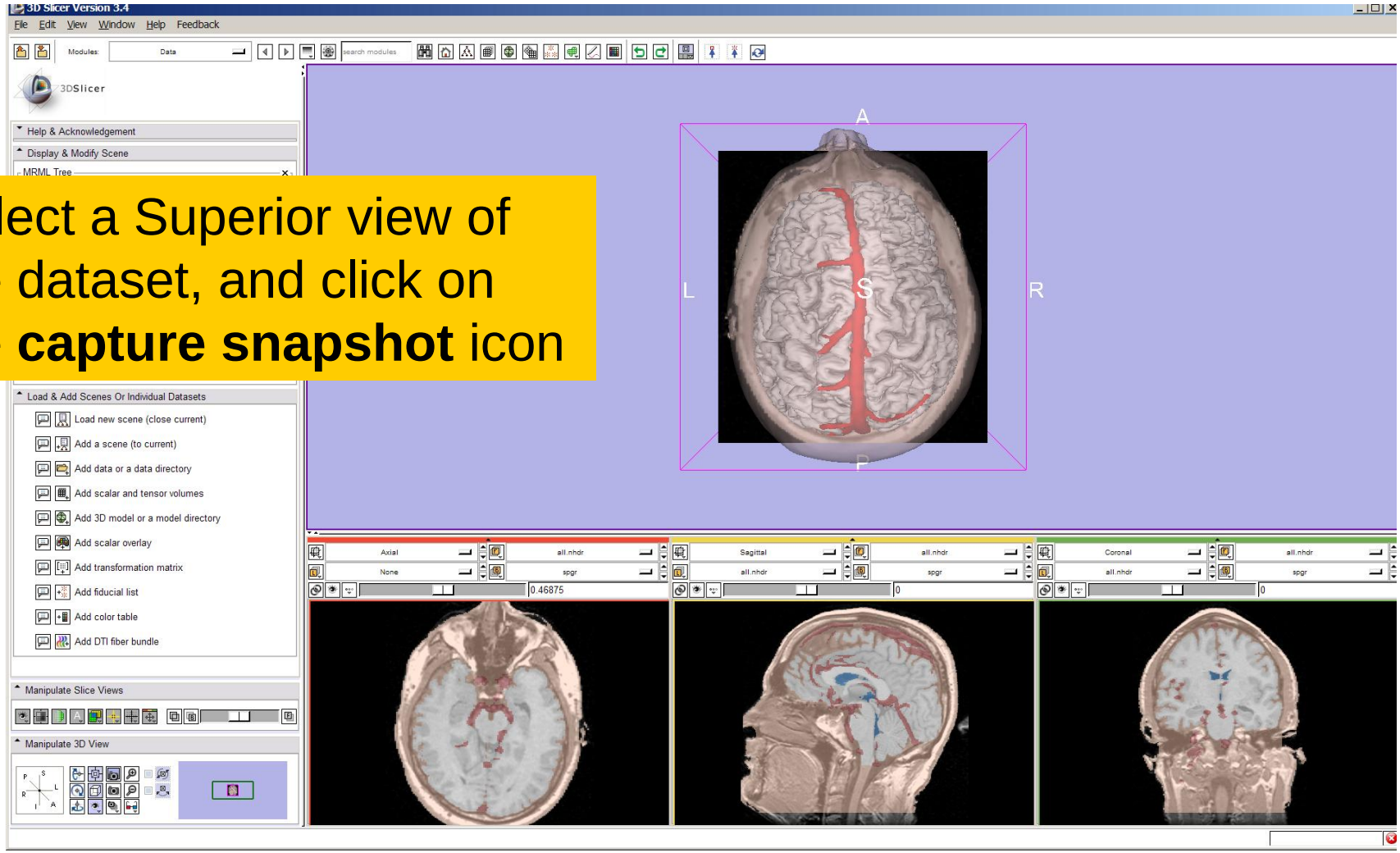


Creating Scene Snapshots



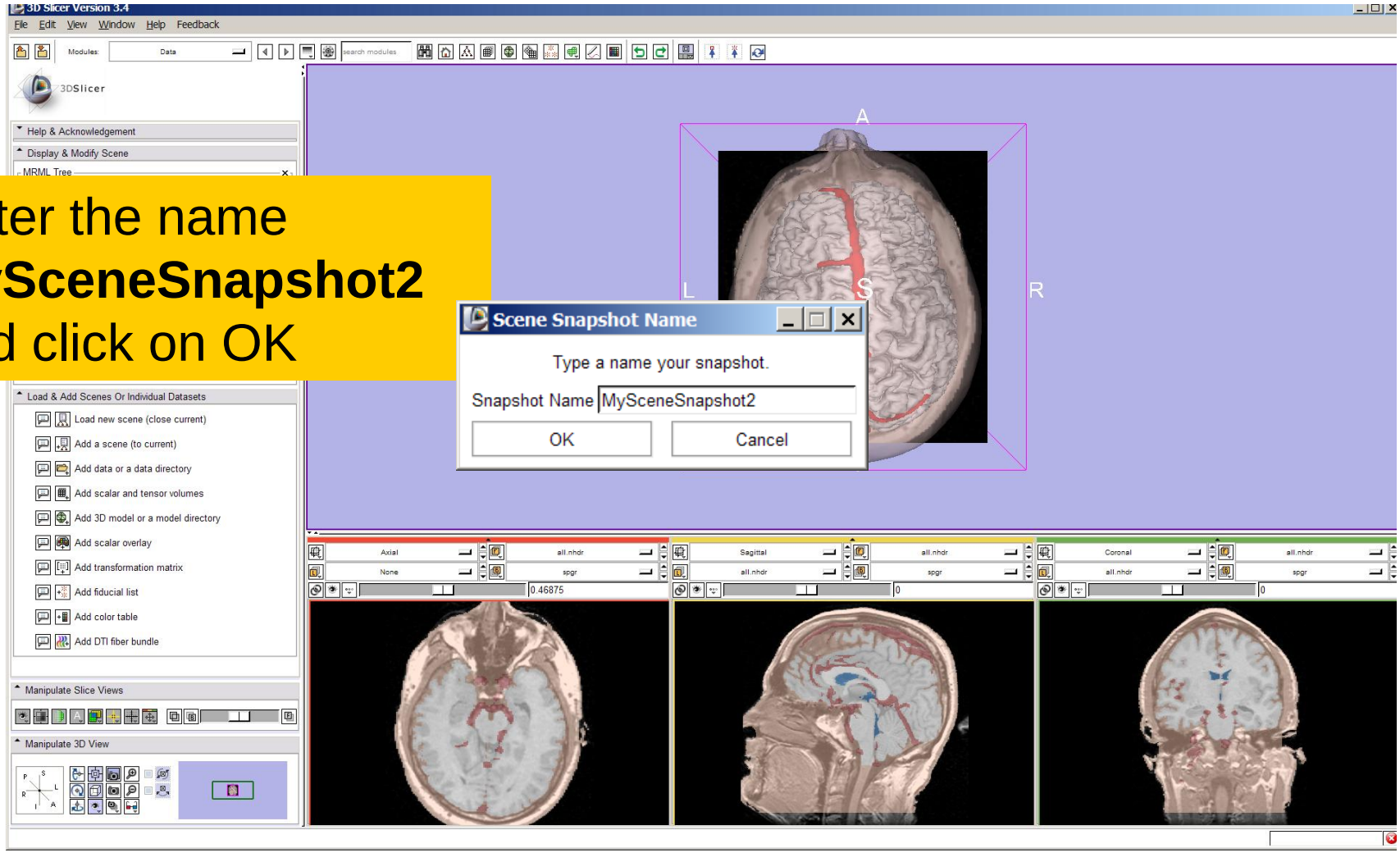
Enter the Snapshot name **MySceneSnapshot1** and click on **OK**

Creating Scene Snapshots



Select a Superior view of the dataset, and click on the **capture snapshot** icon

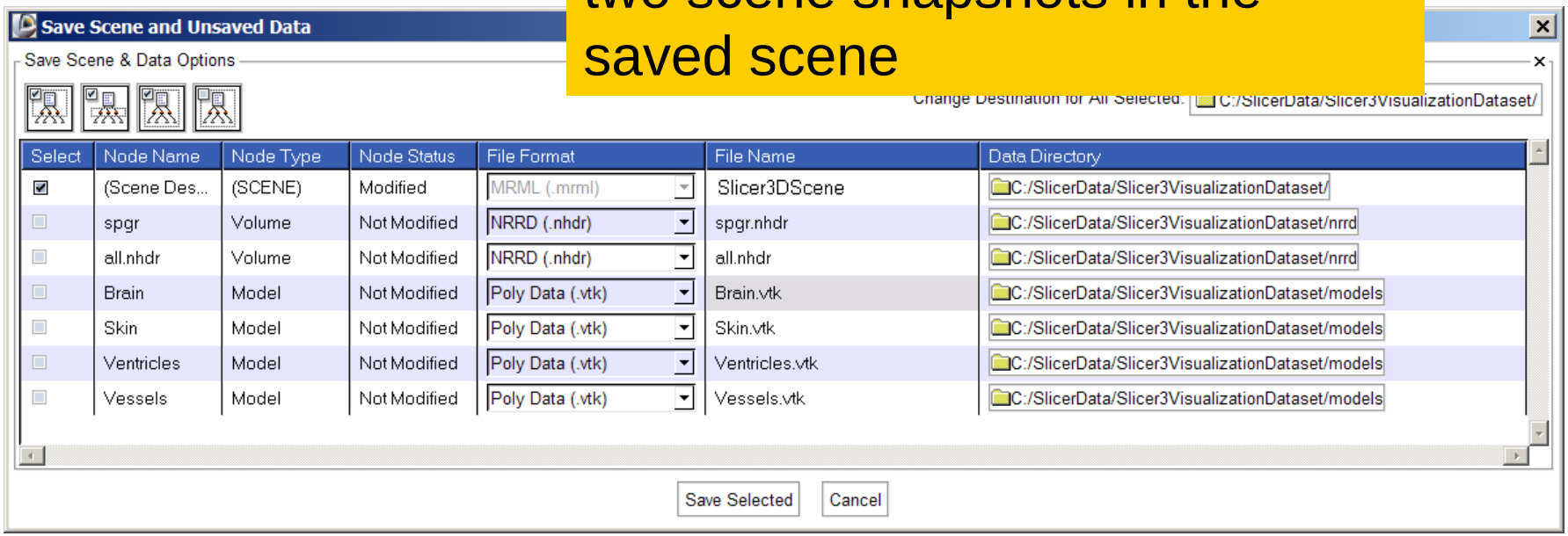
Creating Scene Snapshots



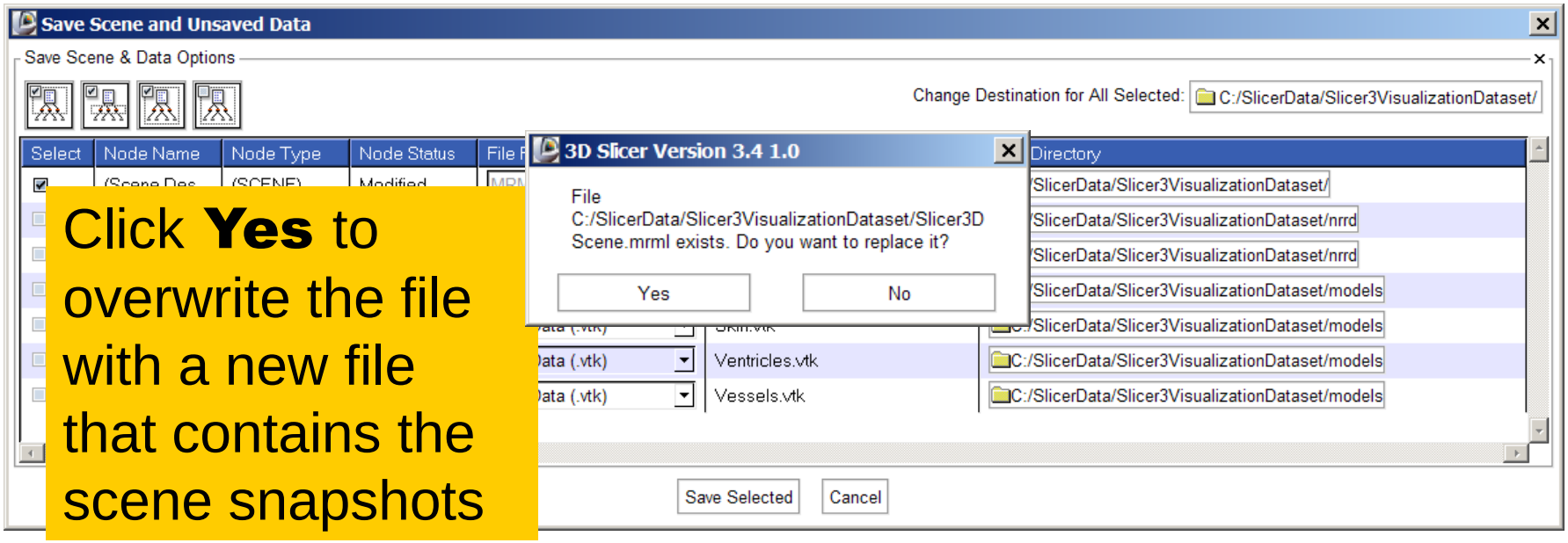
Enter the name **MySceneSnapshot2** and click on OK

Creating Scene Snapshots

Select **File→ Save** and click on **Save Selected** to include the two scene snapshots in the saved scene

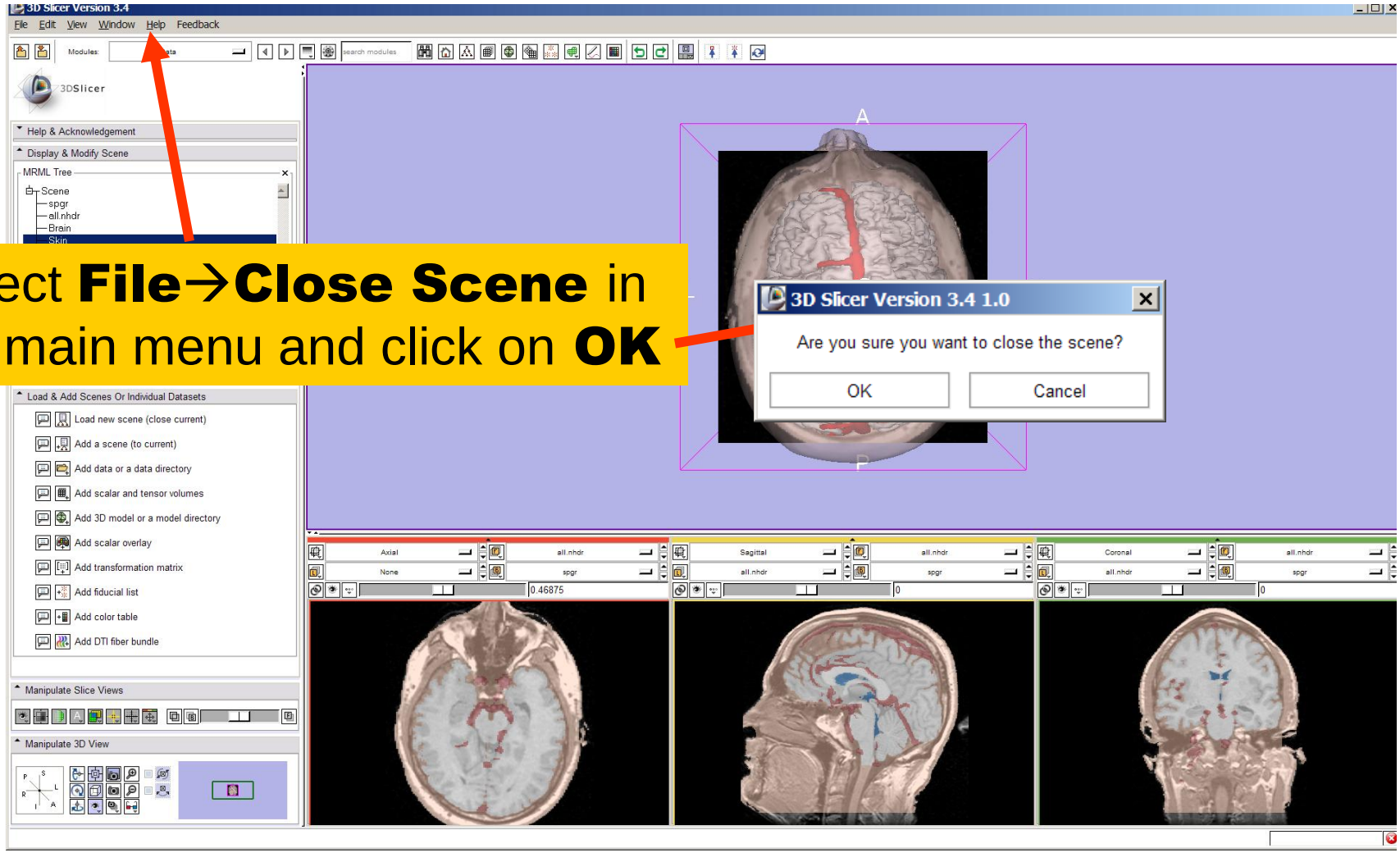


Creating Scene Snapshots



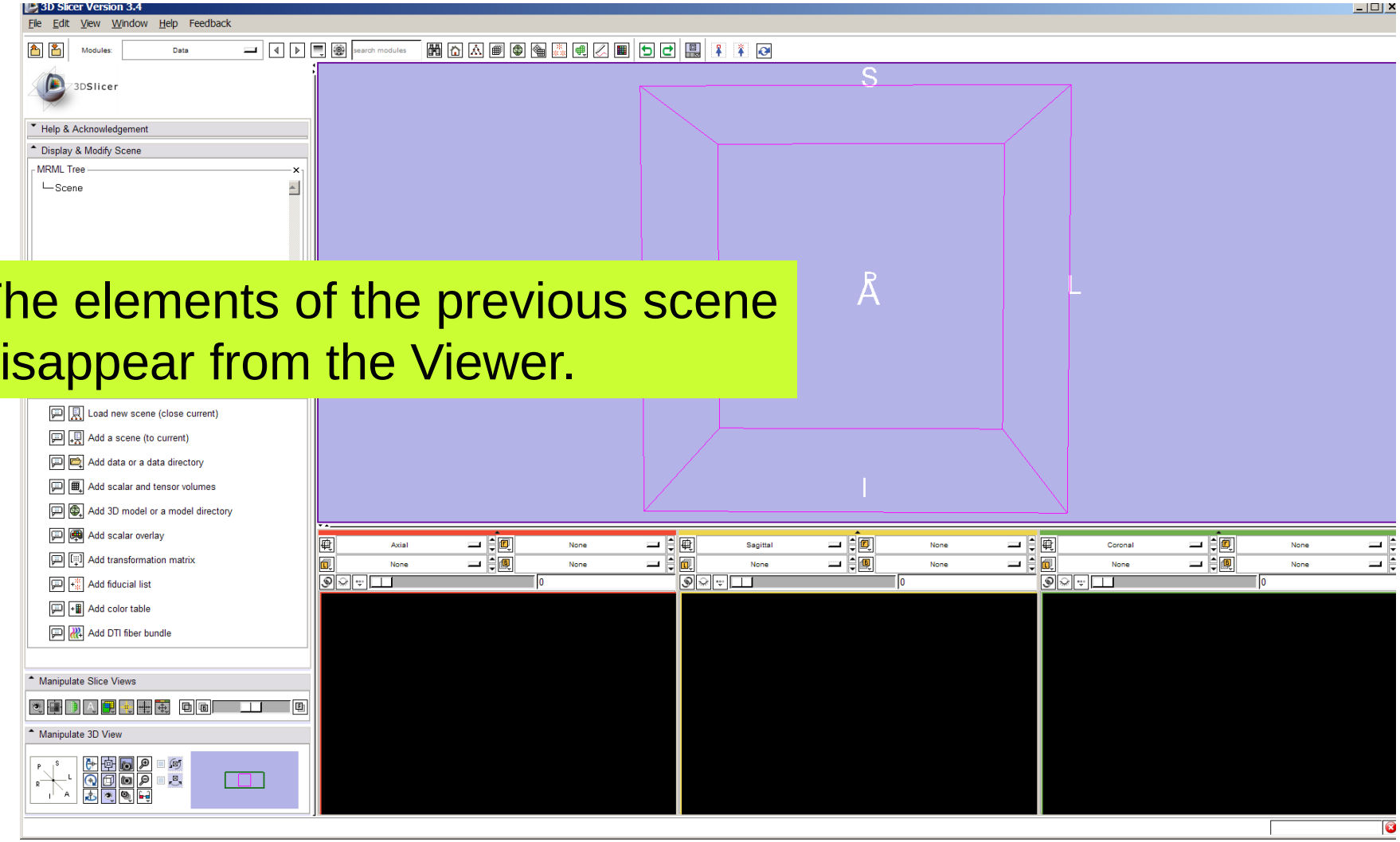
Click **Yes** to overwrite the file with a new file that contains the scene snapshots

Saving Data



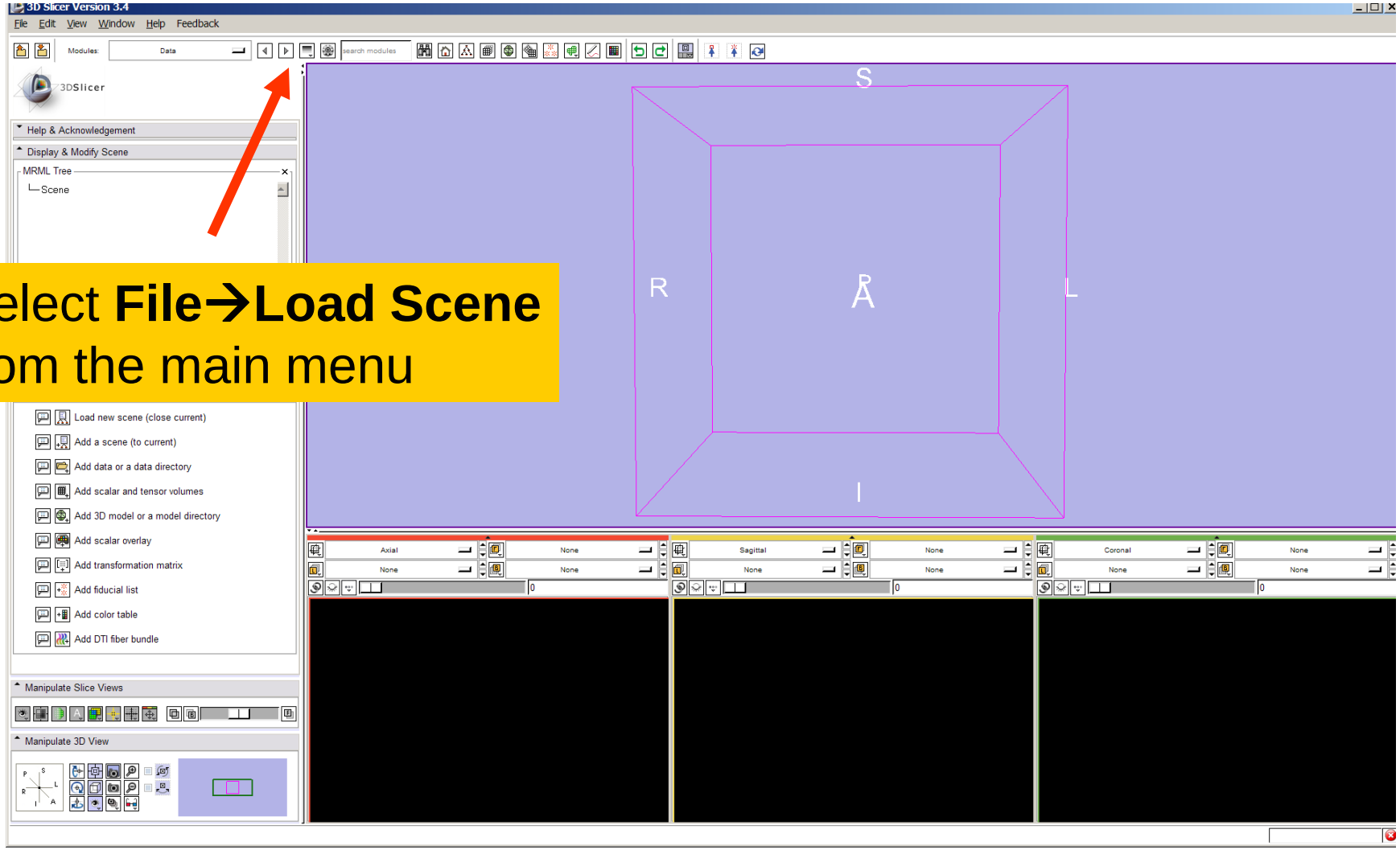
Select **File→Close Scene** in the main menu and click on **OK**

Saving Data



The elements of the previous scene disappear from the Viewer.

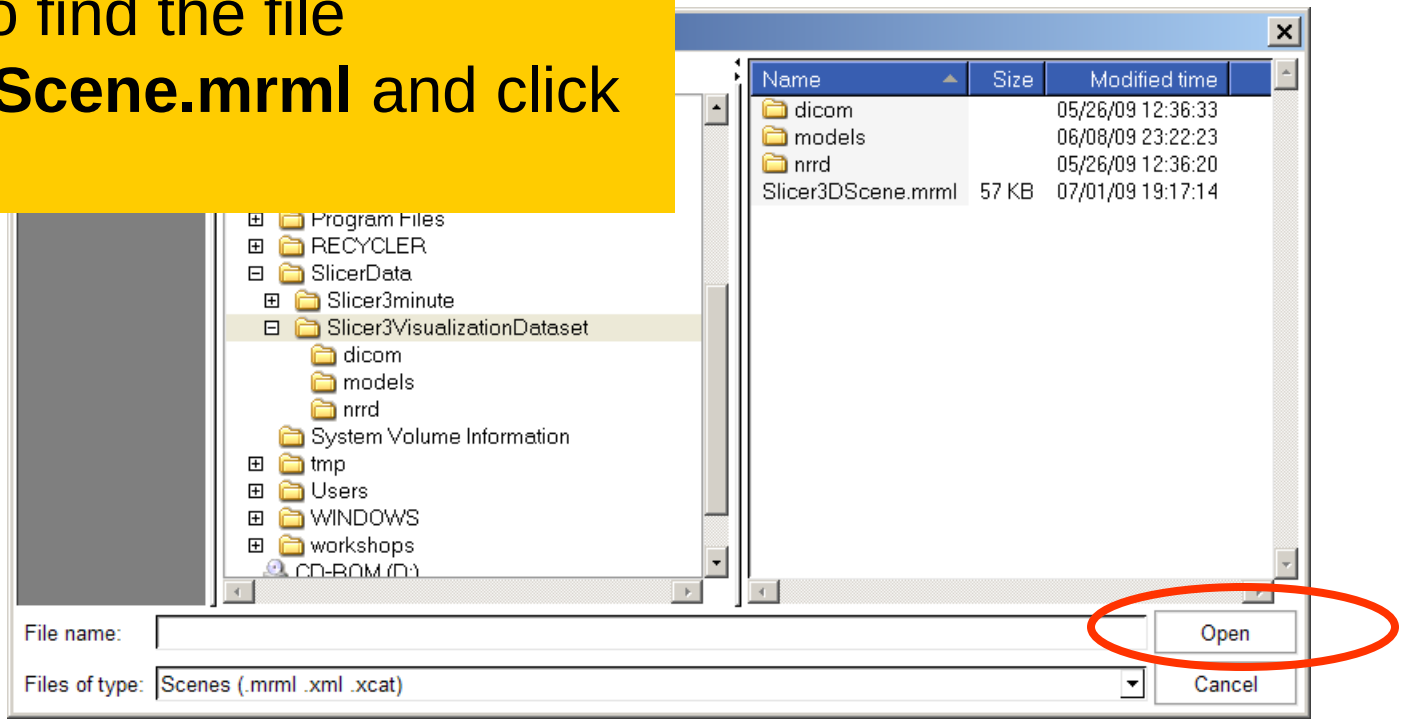
Saving Data



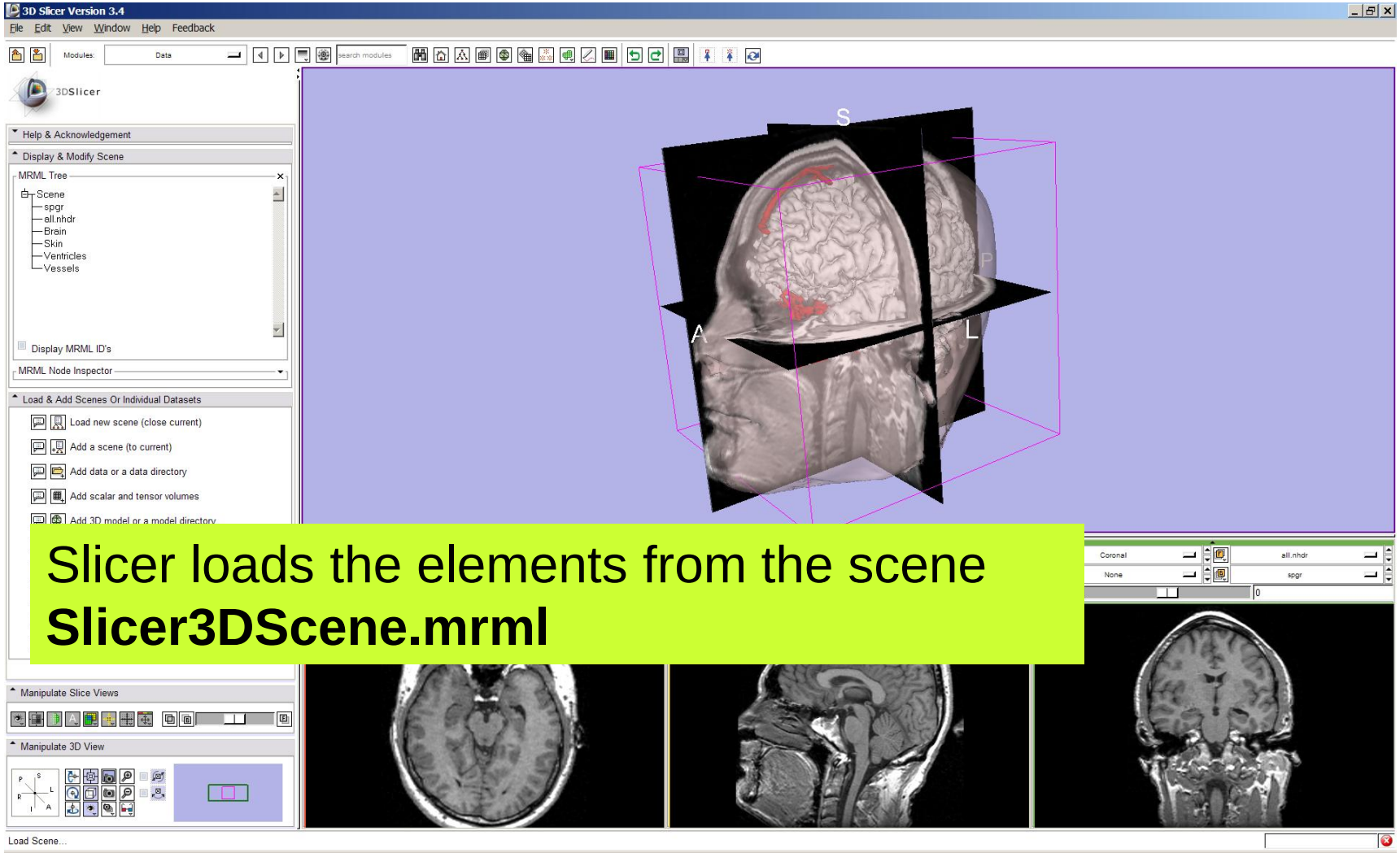
Select **File→Load Scene** from the main menu

Saving Data

Browse to find the file **Slicer3DScene.mrml** and click on **Open**

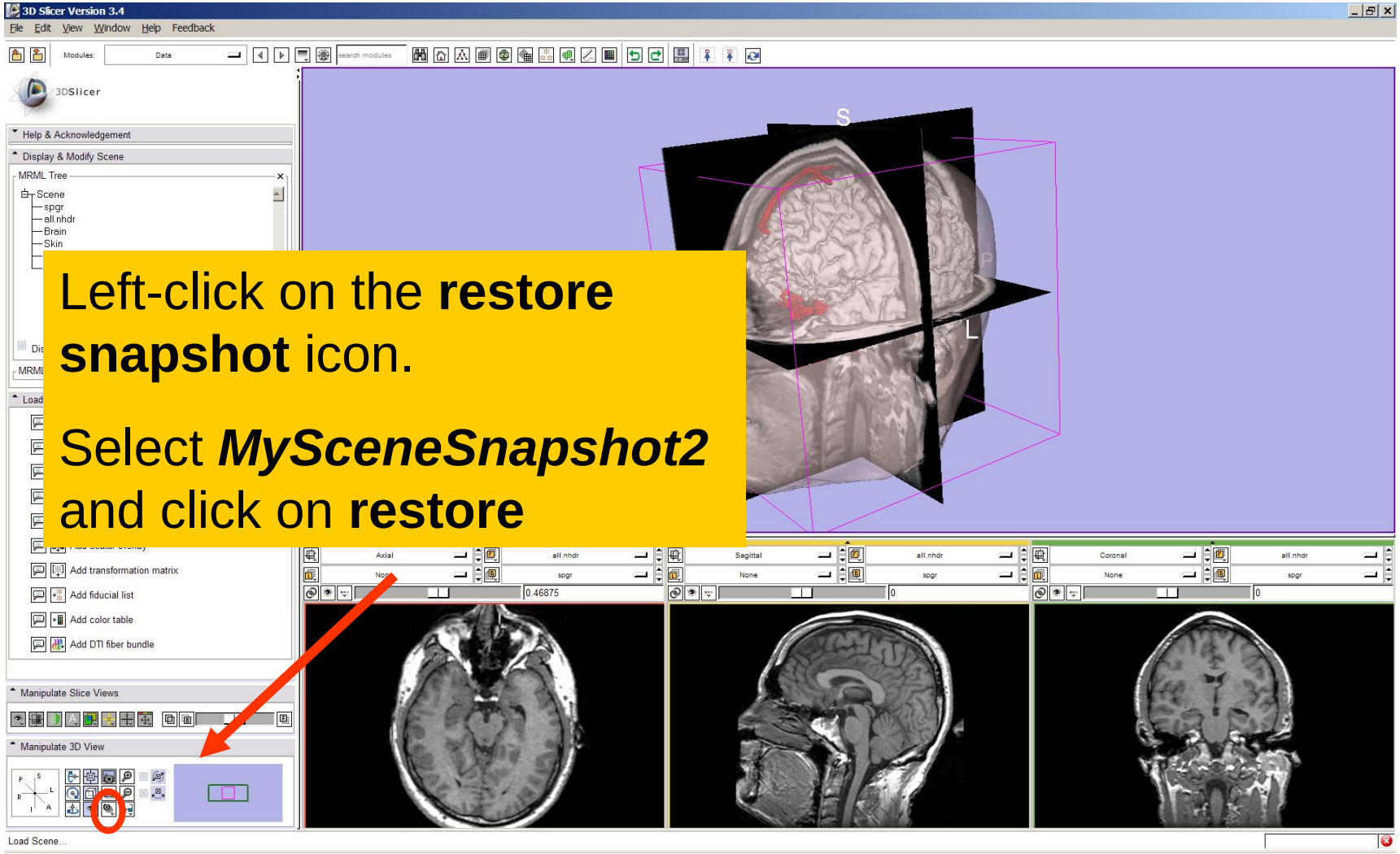


Loading a Scene



Slicer loads the elements from the scene **Slicer3DScene.mrml**

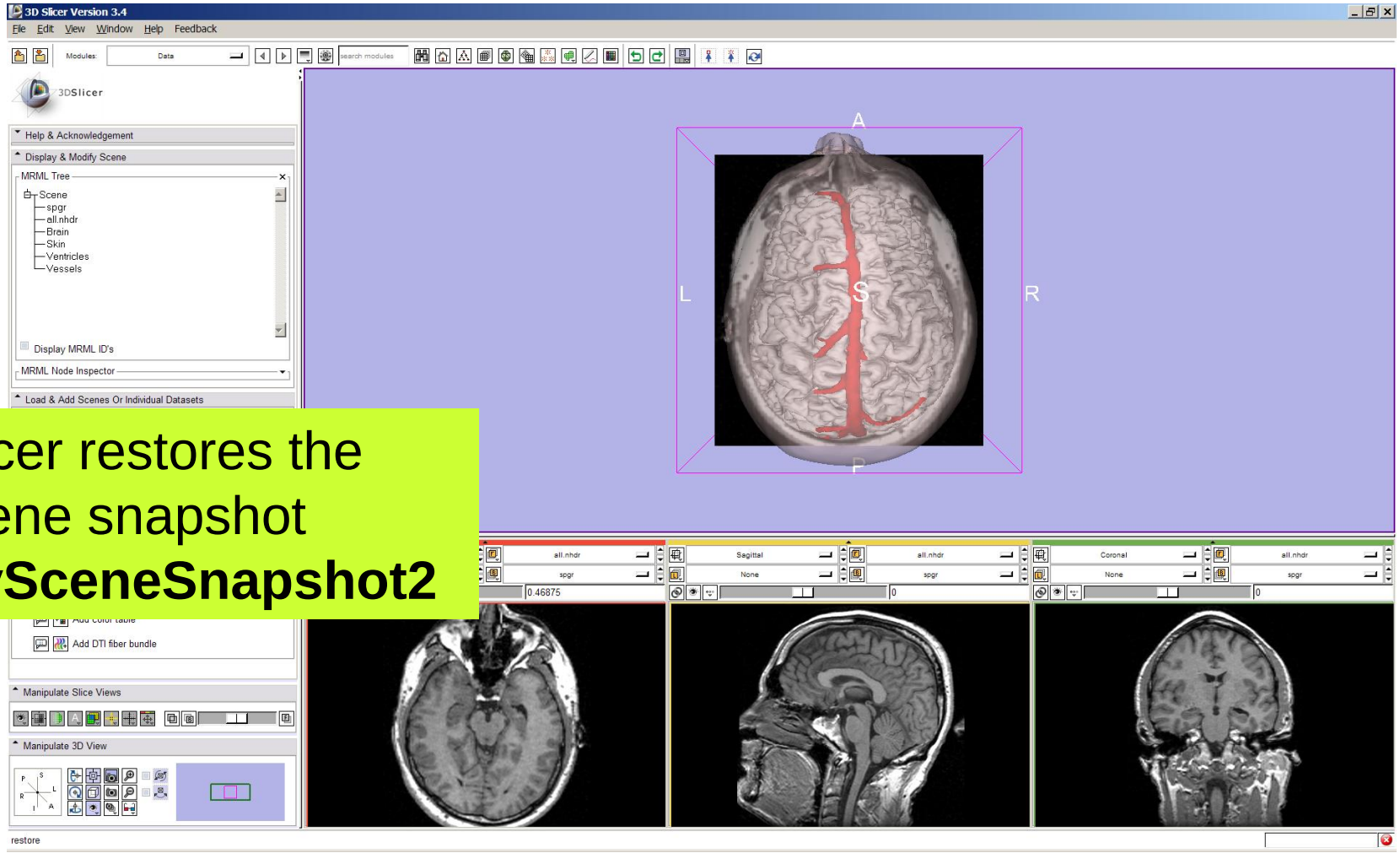
Loading a Scene



Left-click on the **restore snapshot** icon.

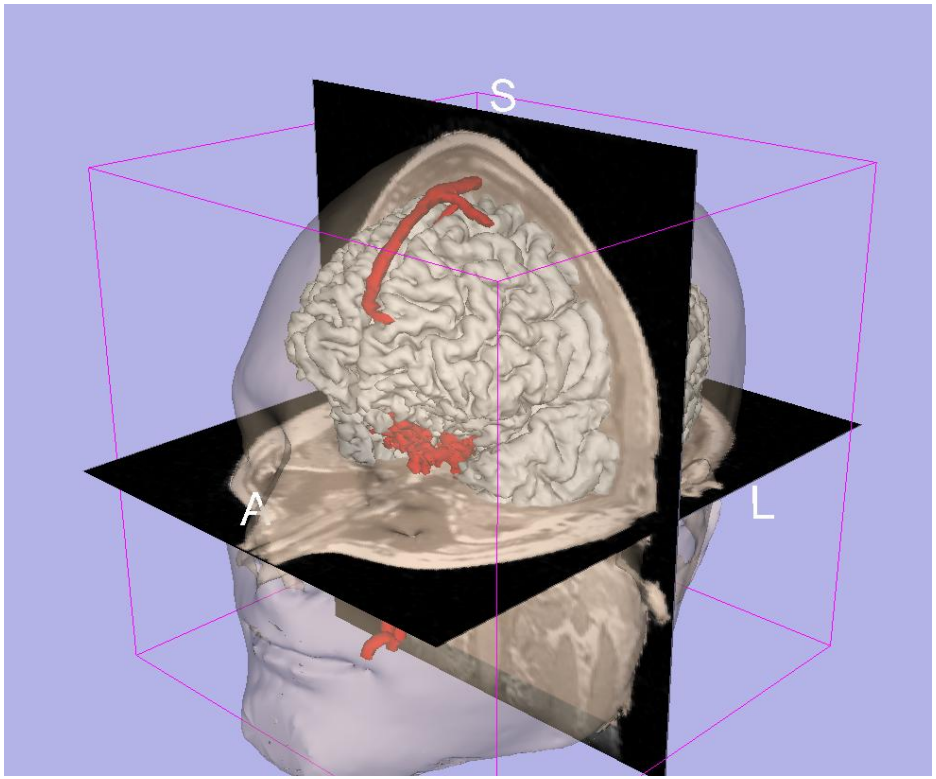
Select ***MySceneSnapshot2*** and click on **restore**

Loading a Scene



Slicer restores the scene snapshot **MySceneSnapshot2**

Conclusion



- 3D visualization of anatomical surface reconstructions
- 3D interaction with volumes and models
- Open-source platform

Acknowledgments

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