

# 3D Visualization of FreeSurfer Data

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# *Acknowledgements*

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NIH U24RRO21382

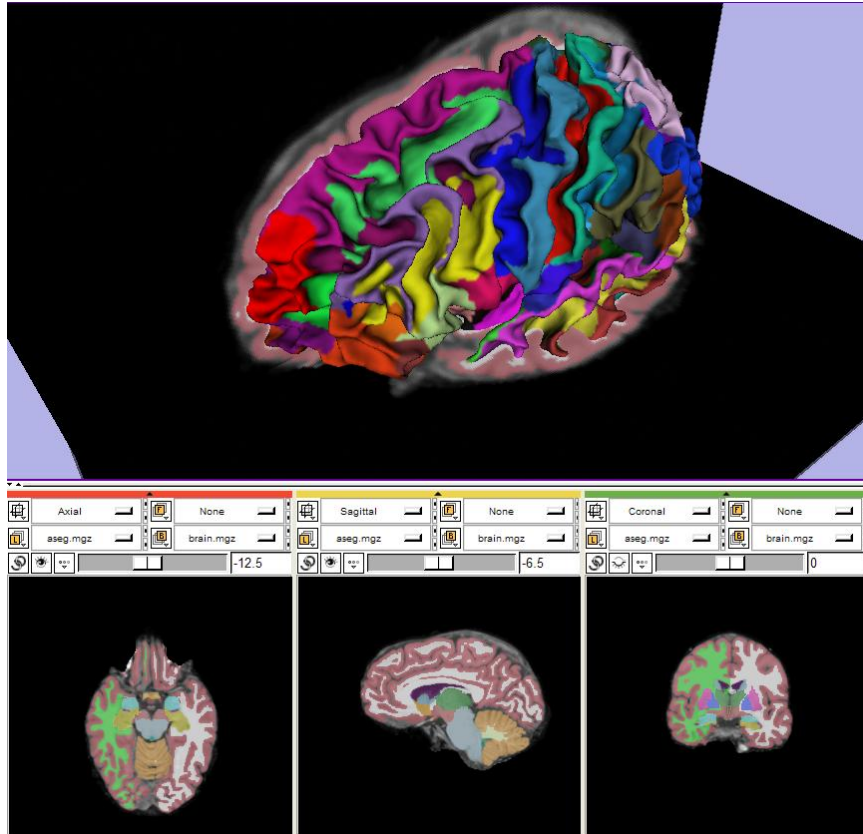


**Surgical Planning Laboratory (BWH)**  
Thanks to Nicole Aucoin



**Center for Functional Neuroimaging Technology**  
NIH P41RR14075

# Learning Objective



Guide you step-by-step through the process of loading and viewing **FreeSurfer** segmentations, surface reconstructions, and parcellation results within **Slicer3**.



# *Prerequisites*

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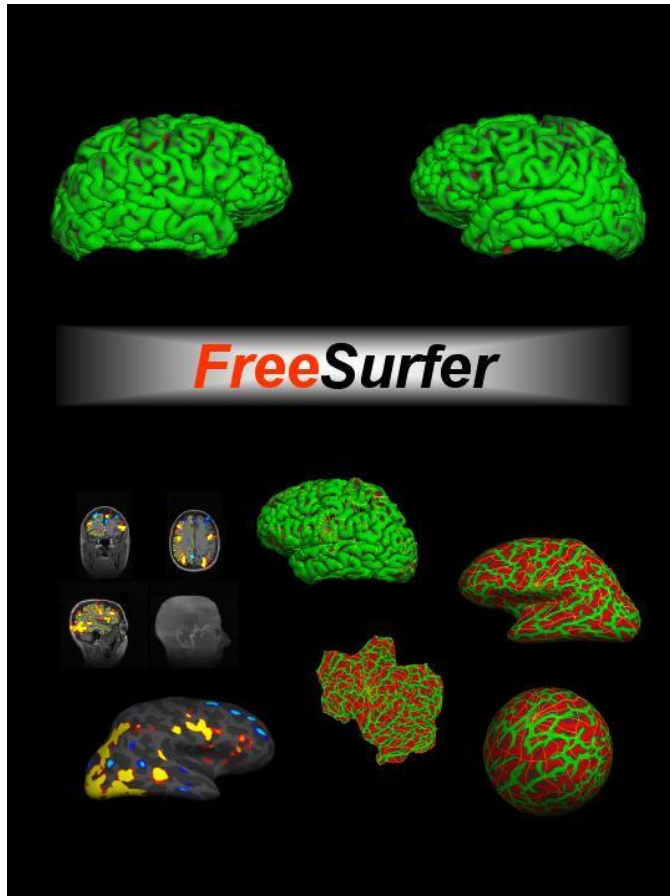
This tutorial assumes that you have completed the course **Slicer3Visualization Tutorial**.

Tutorials for **Slicer3.6** are available on the Slicer101 page:

[http://www.slicer.org/slicerWiki/index.php/Slicer3.6:Training#Software\\_tutorials](http://www.slicer.org/slicerWiki/index.php/Slicer3.6:Training#Software_tutorials)

# Prerequisites

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This tutorial assumes a working knowledge of how to use **FreeSurfer** to generate segmentation and surface files.

Tutorials for **FreeSurfer** are available at the following location:

<http://surfer.nmr.mgh.harvard.edu/fswiki/Tutorials/>



# Materials

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This tutorial requires the installation of the **Slicer3.6-2010-06-10 release** software and the tutorial dataset. These materials are available at the following locations:

- **Slicer3.6 release version** download page:

<http://www.slicer.org/pages/Special:SlicerDownloads>

**Disclaimer:** *It is the responsibility of the user of Slicer to comply with both the terms of the license and with the applicable laws, regulations, and rules.*



# Materials

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This tutorial makes use of the same T1 weighted image dataset (bert) that is used for the FreeSurfer tutorial available at the following location:

<http://surfer.nmr.mgh.harvard.edu/fswiki/FsTutorial>

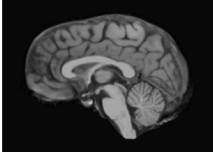
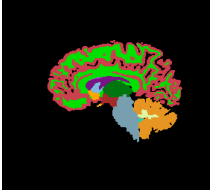
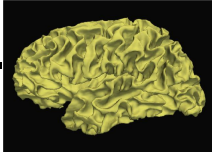
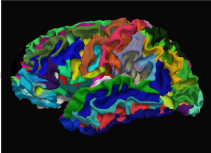
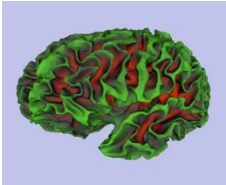
If you already have the FreeSurfer subject 'bert' on your computer, then just download the file 'slicerGenericScene.mrml'

<http://www.na-mic.org/Wiki/index.php/Image:SlicerGenericScene.mrml>

If you don't have the FreeSurfer tutorial dataset known as 'bert' on your computer, then download the archive below:

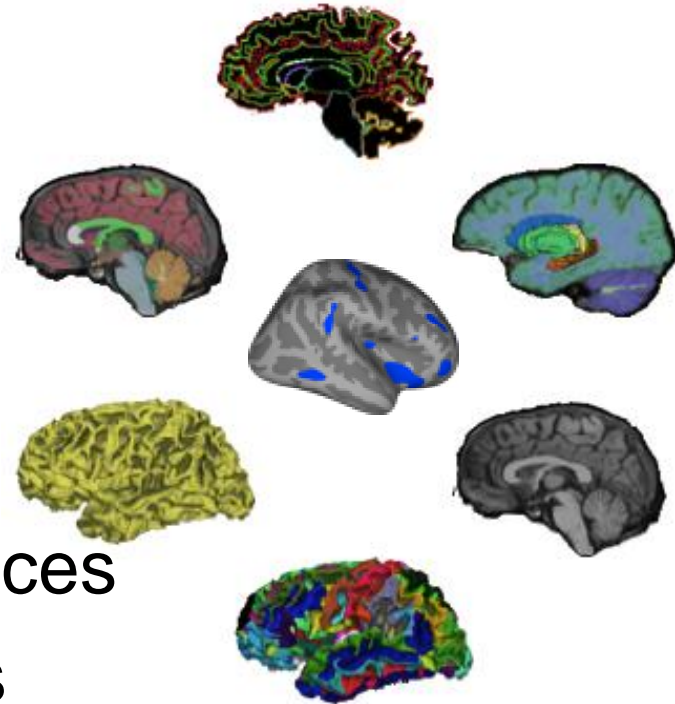
<http://www.na-mic.org/Wiki/index.php/Image:FreeSurferData.tar.gz>

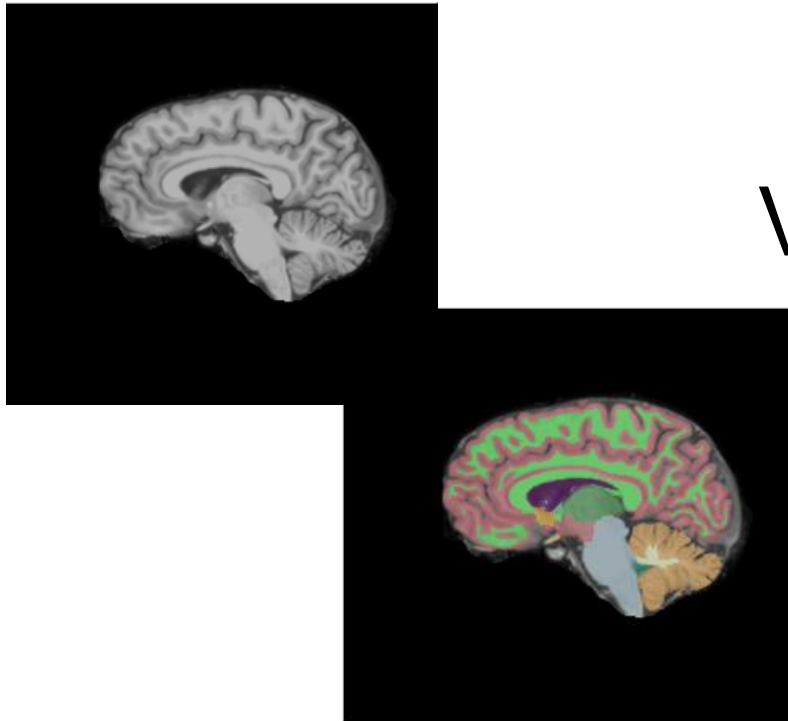
From **FreeSurfer**, **Slicer3** can load:

- Brain volumes . . . . . 
- ASEG volumes . . . . . 
- Surfaces . . . . . 
- Parcellation Maps . . . . . 
- All of the above, via a scene file. . . . . 



- Part 1: Loading and Visualizing FreeSurfer Volumes
- Part 2: Building 3D Models
- Part 3: Loading FreeSurfer Surfaces and Visualizing Parcellation Maps
- Part 4: Automatic Data Loading via a Generic Scene File

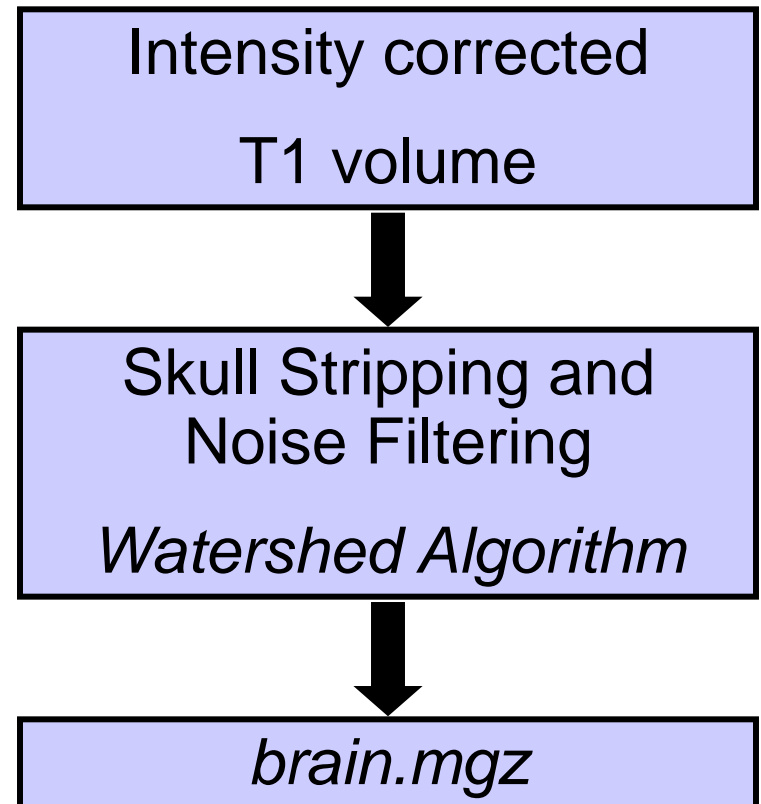
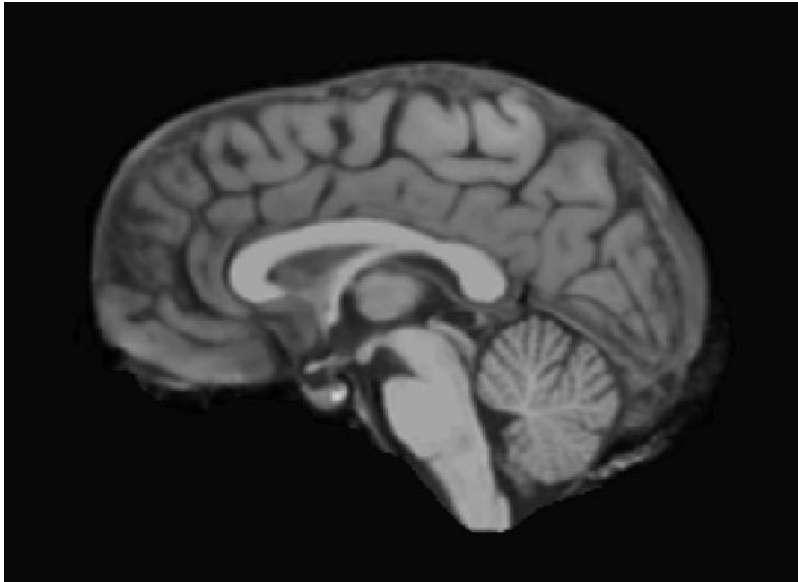




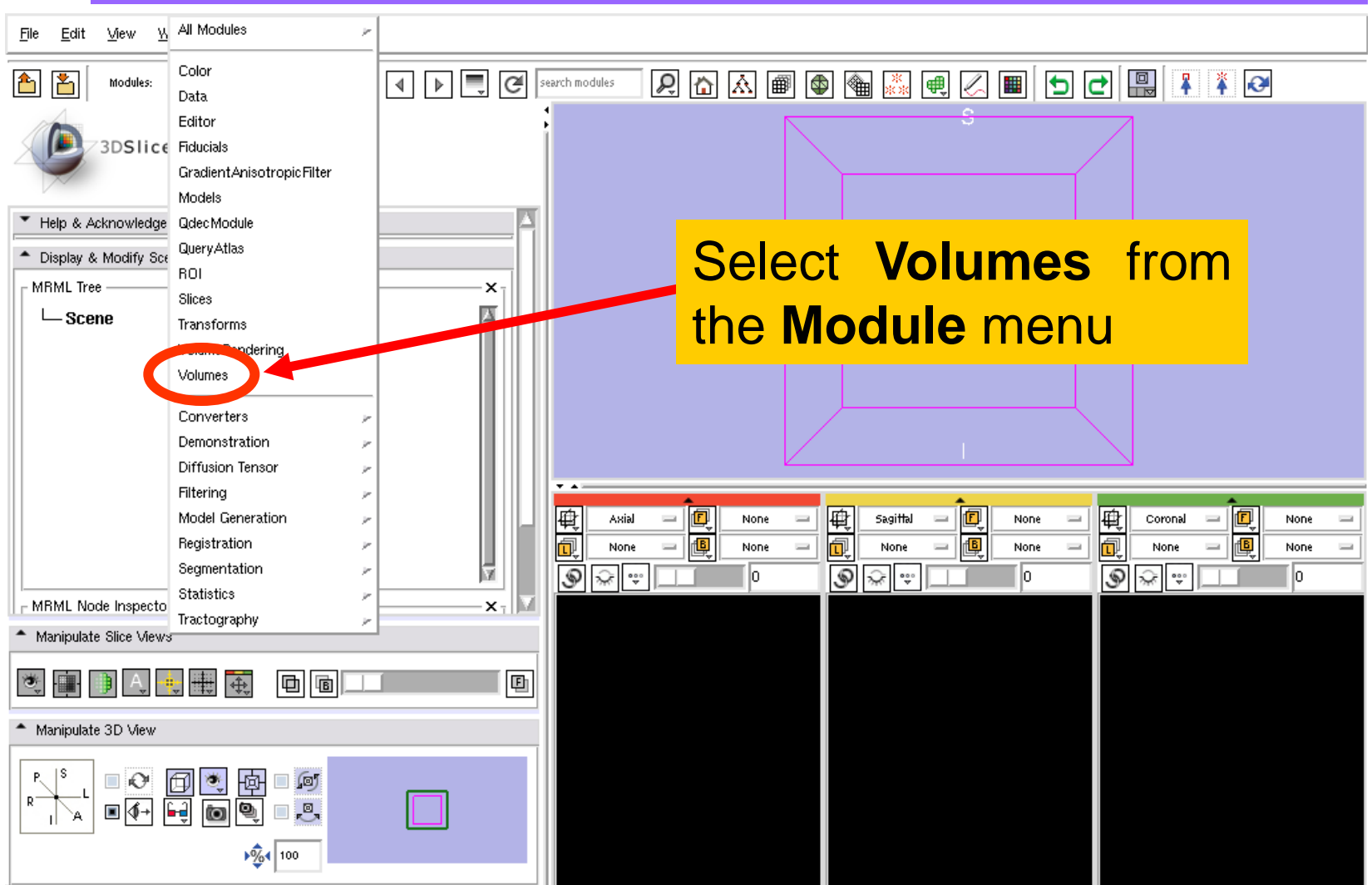
# Part 1: Loading and Visualizing FreeSurfer Volumes

# Loading a Brain File

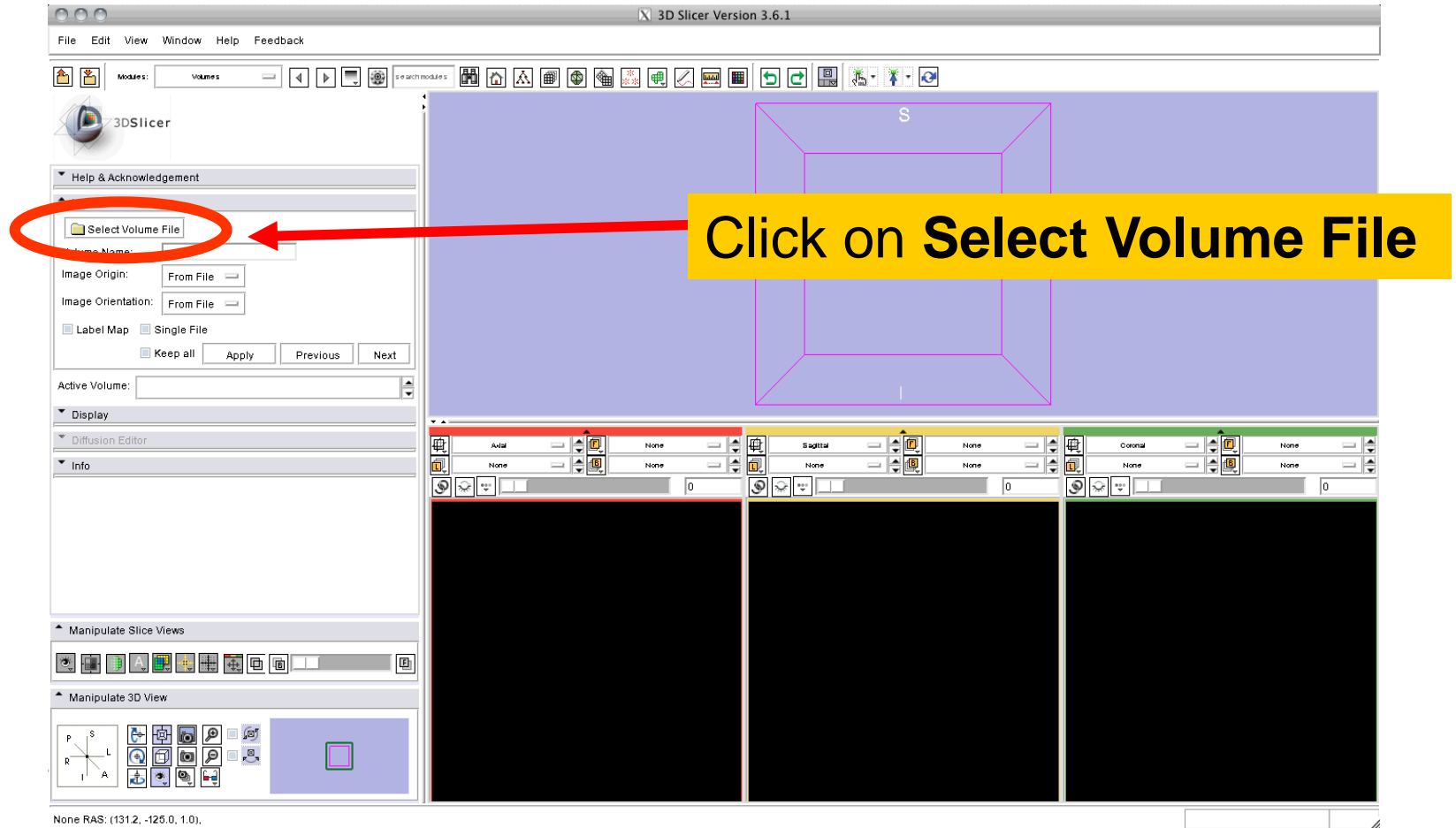
## FreeSurfer pipeline



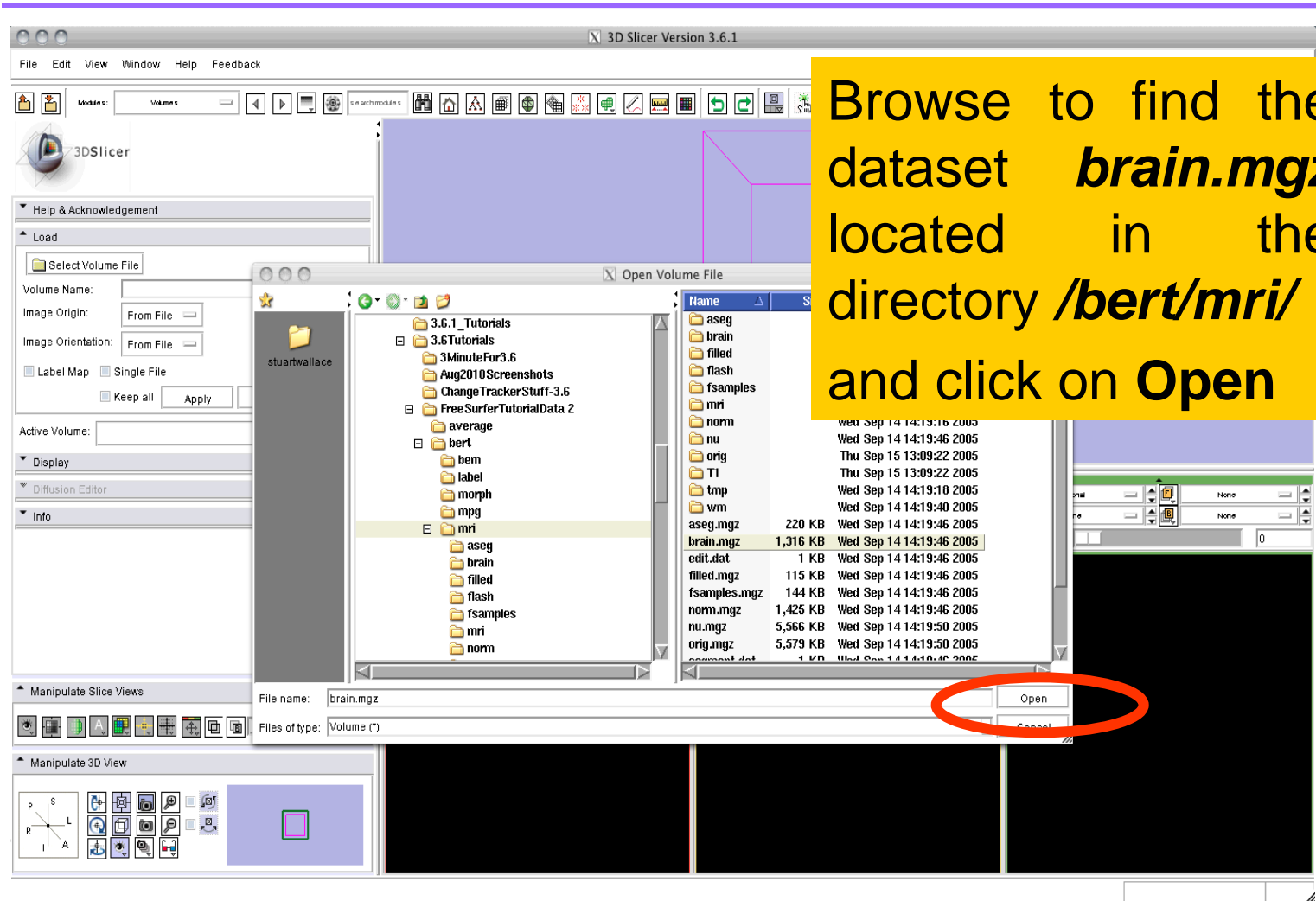
# Loading a Brain File



# Loading a Brain File



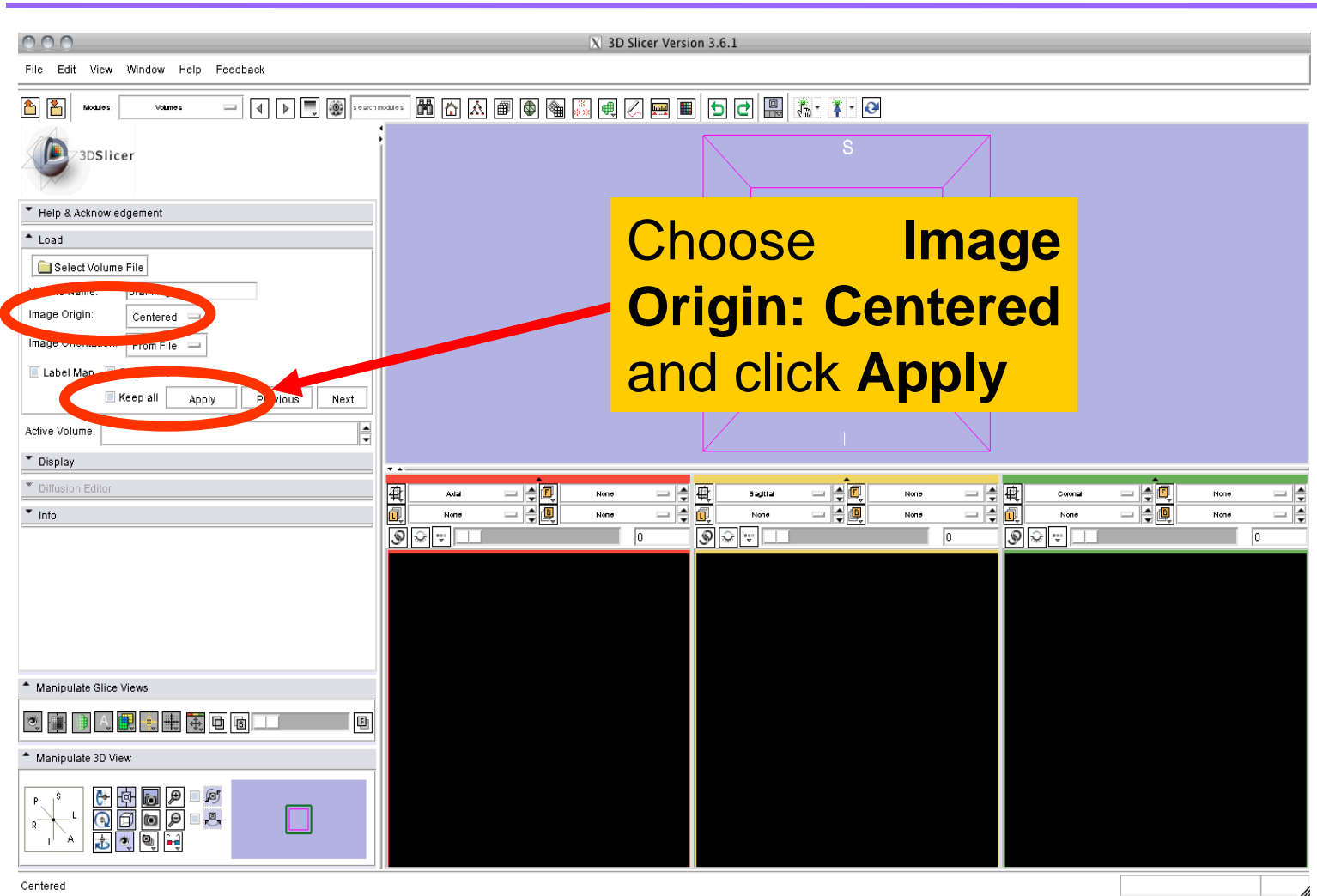
# Loading a Brain File



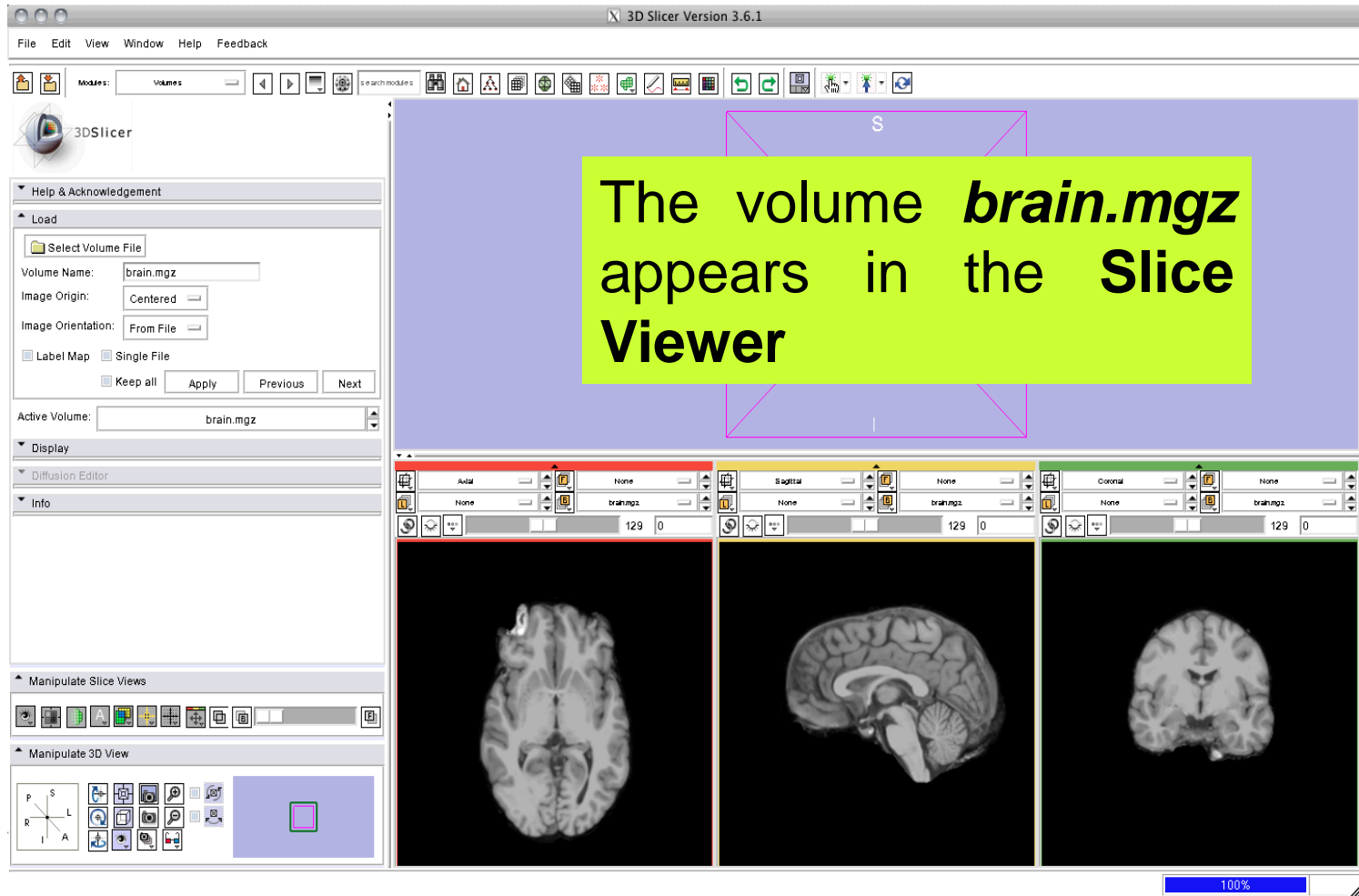
Browse to find the dataset **brain.mgz** located in the directory **/bert/mri/** and click on **Open**

Name	Size	Modified
aseg	220 KB	Wed Sep 14 14:19:46 2005
brain	1,316 KB	Wed Sep 14 14:19:46 2005
filled	115 KB	Wed Sep 14 14:19:46 2005
flash	144 KB	Wed Sep 14 14:19:46 2005
fsamples	1,425 KB	Wed Sep 14 14:19:46 2005
norm	5,566 KB	Wed Sep 14 14:19:50 2005
nu	5,579 KB	Wed Sep 14 14:19:50 2005
orig	1 KB	Wed Sep 14 14:19:46 2005
T1		Wed Sep 14 14:19:46 2005
tmp		Wed Sep 14 14:19:46 2005
wm		Wed Sep 14 14:19:46 2005
aseg.mgz	220 KB	Wed Sep 14 14:19:46 2005
brain.mgz	1,316 KB	Wed Sep 14 14:19:46 2005
edit.dat	1 KB	Wed Sep 14 14:19:46 2005
filled.mgz	115 KB	Wed Sep 14 14:19:46 2005
fsamples.mgz	144 KB	Wed Sep 14 14:19:46 2005
norm.mgz	1,425 KB	Wed Sep 14 14:19:46 2005
nu.mgz	5,566 KB	Wed Sep 14 14:19:50 2005
orig.mgz	5,579 KB	Wed Sep 14 14:19:50 2005
segment.dat	1 KB	Wed Sep 14 14:19:46 2005

# Loading a Brain File

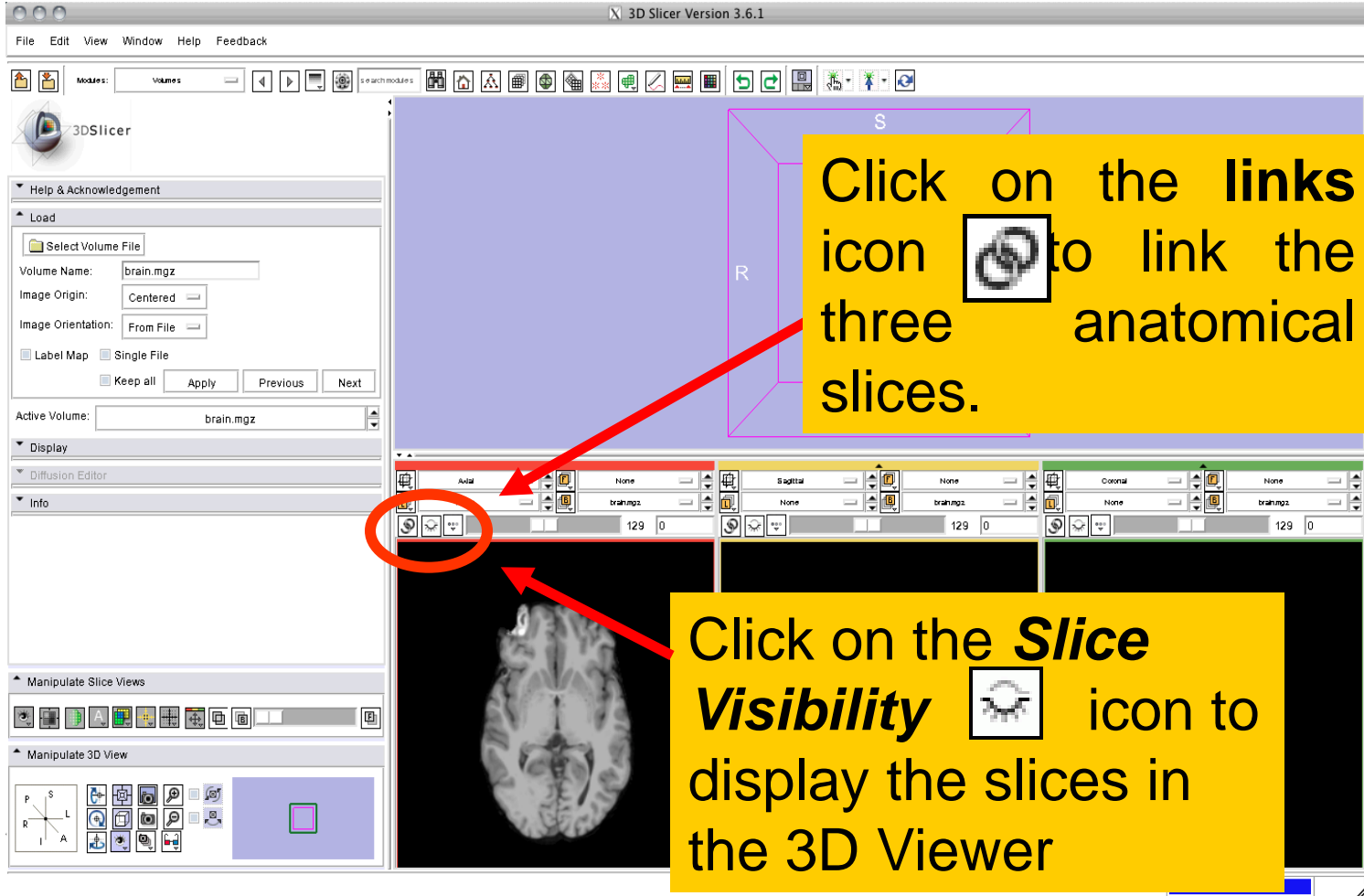



# Loading a Brain File






# Loading a Brain File

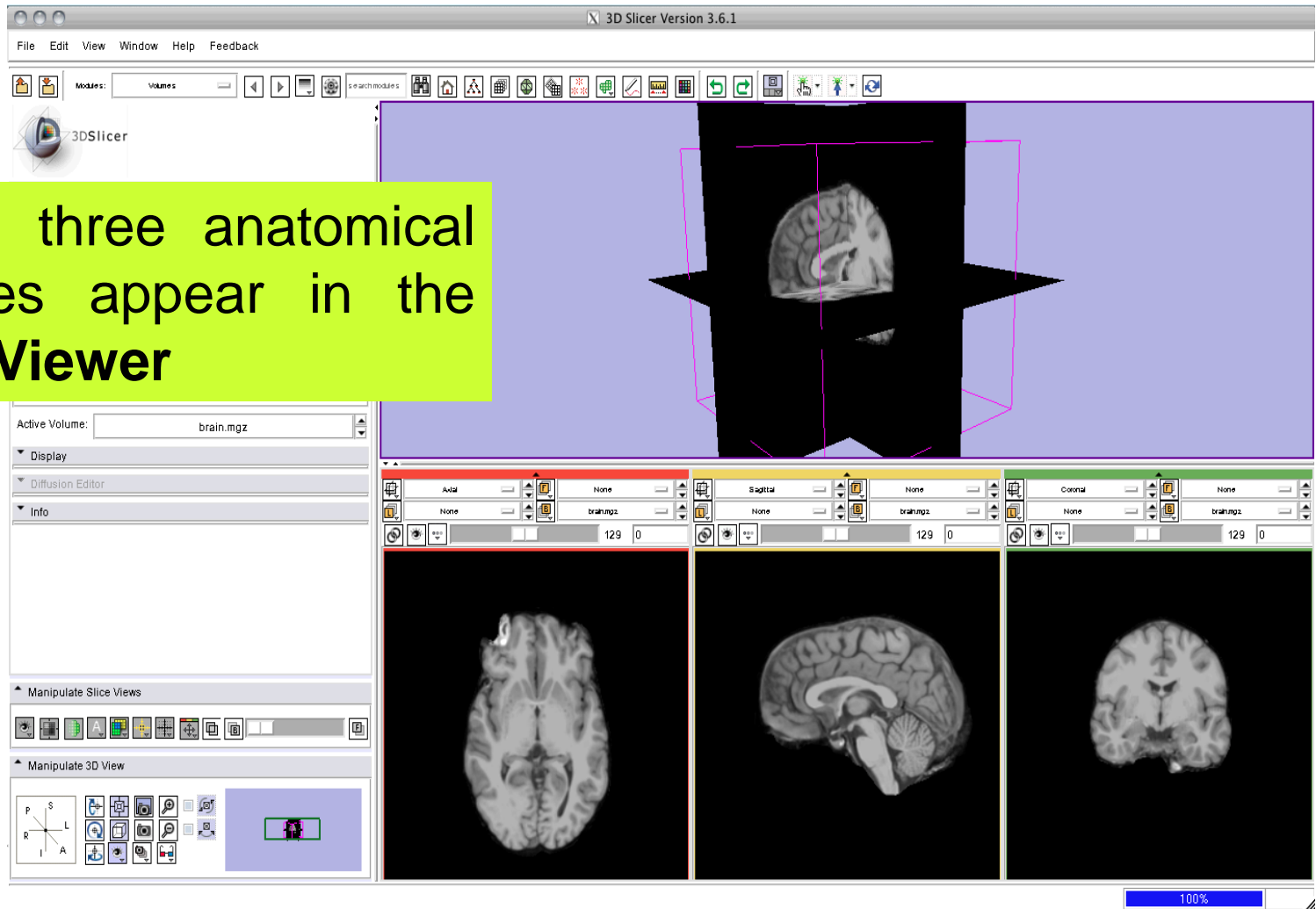


Click on the **links** icon  to link the three anatomical slices.

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

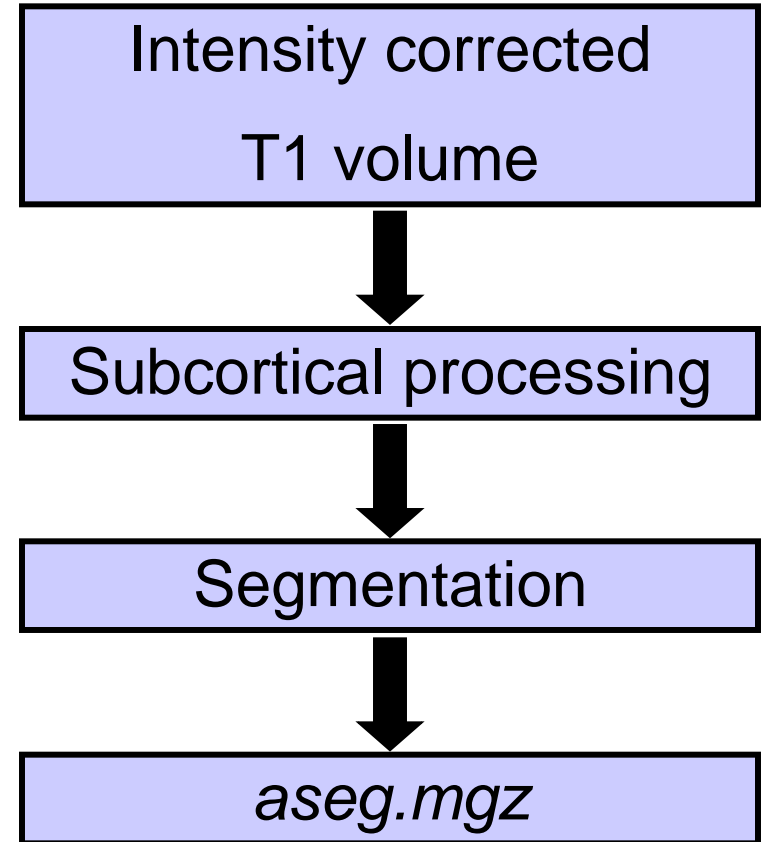
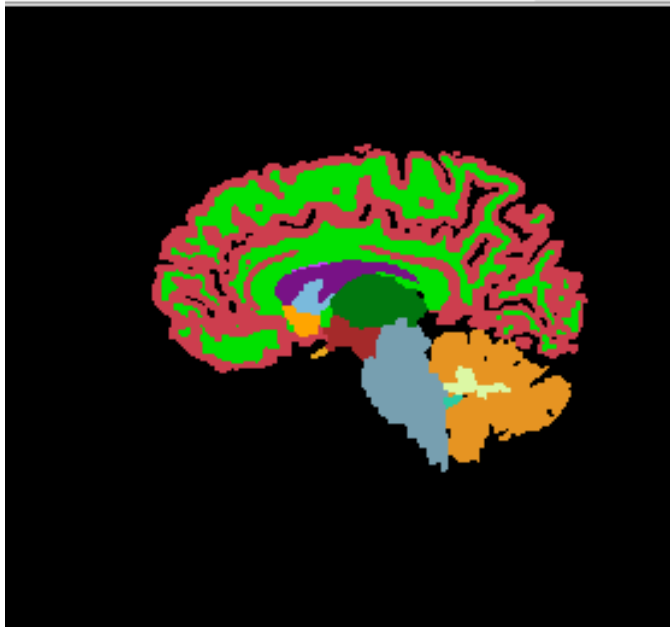
# Loading a Brain File

The three anatomical slices appear in the 3D Viewer



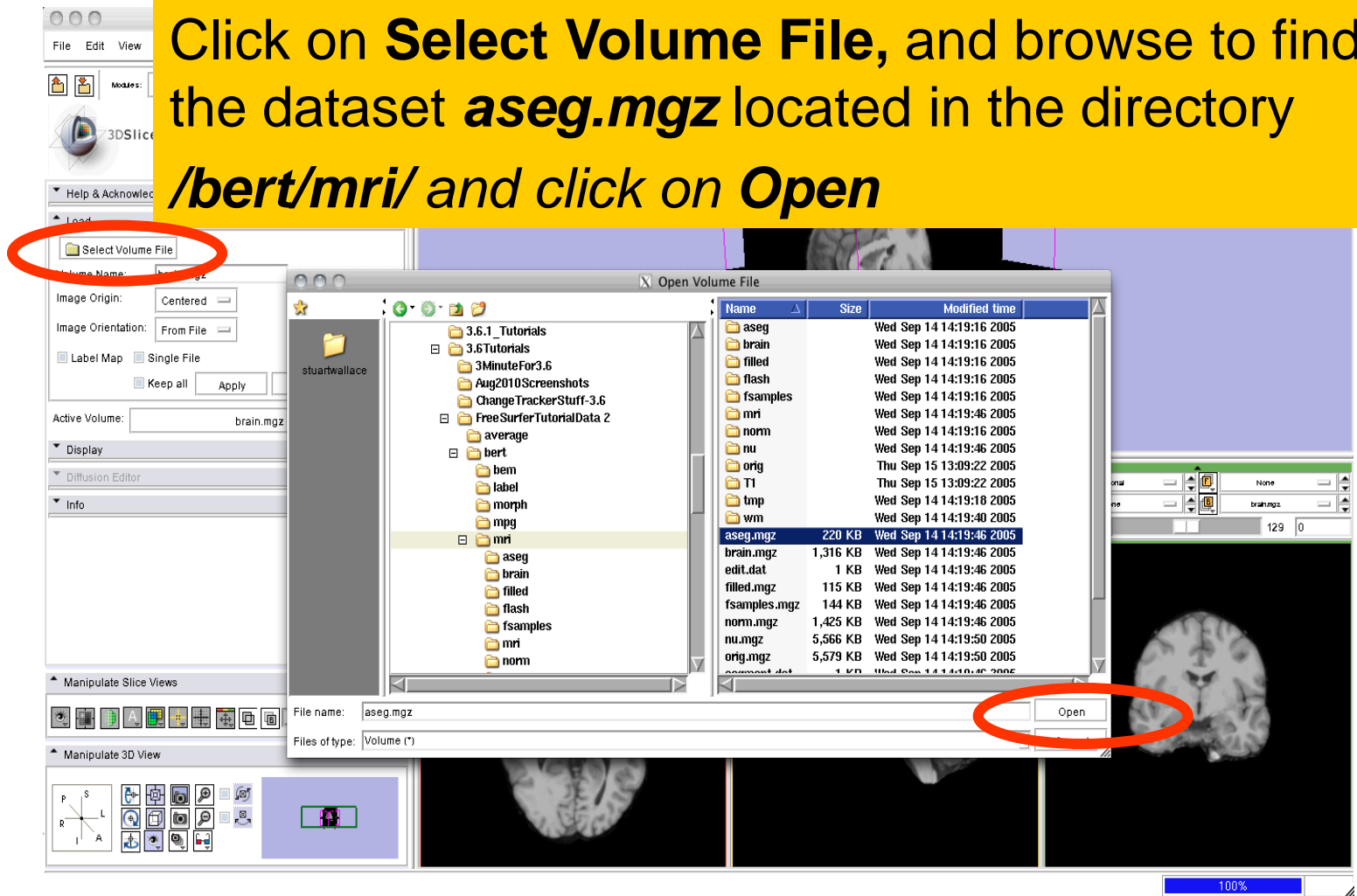
# *Loading an ASEG File*

## FreeSurfer pipeline

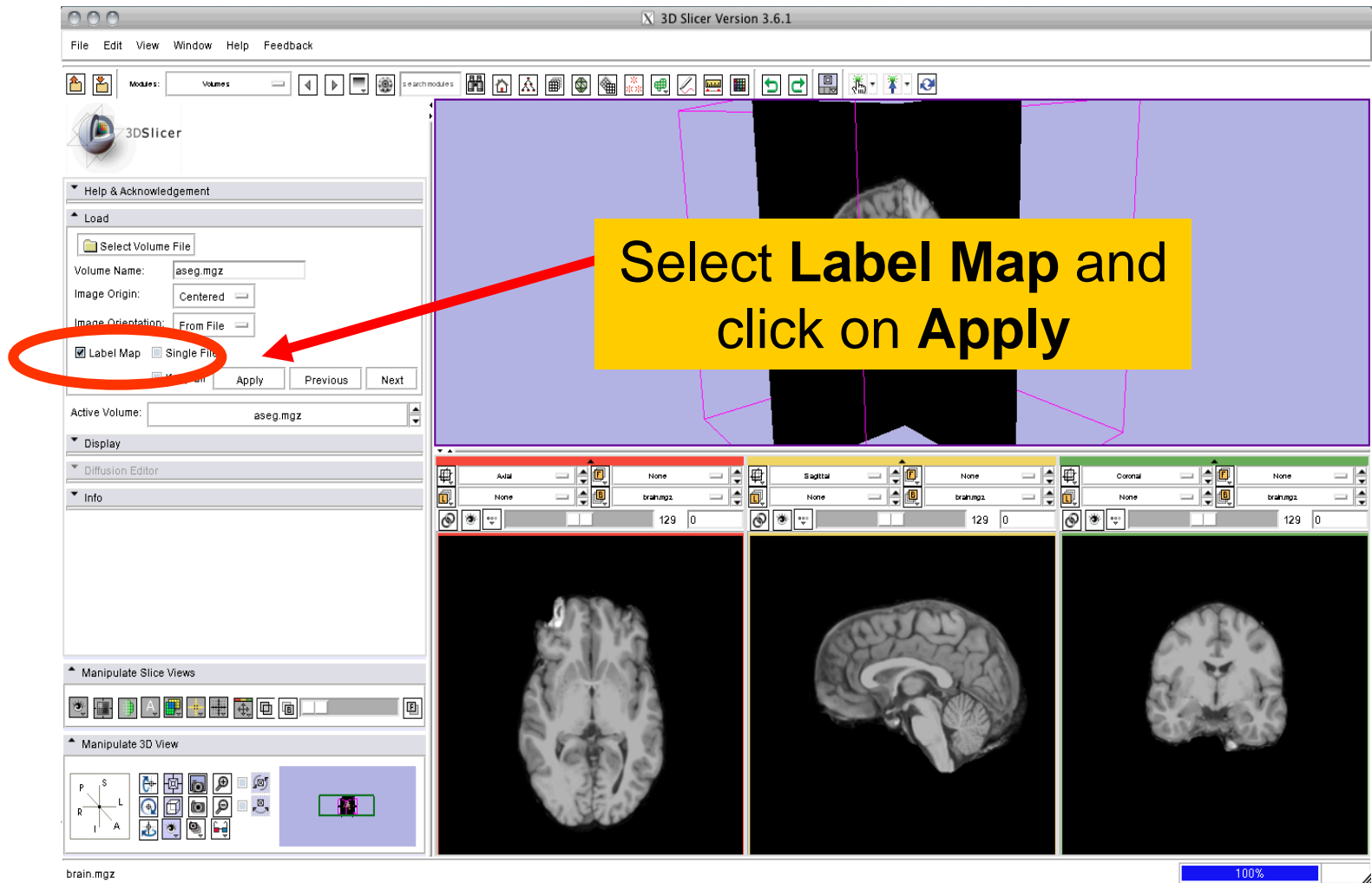


# Loading an ASEG File

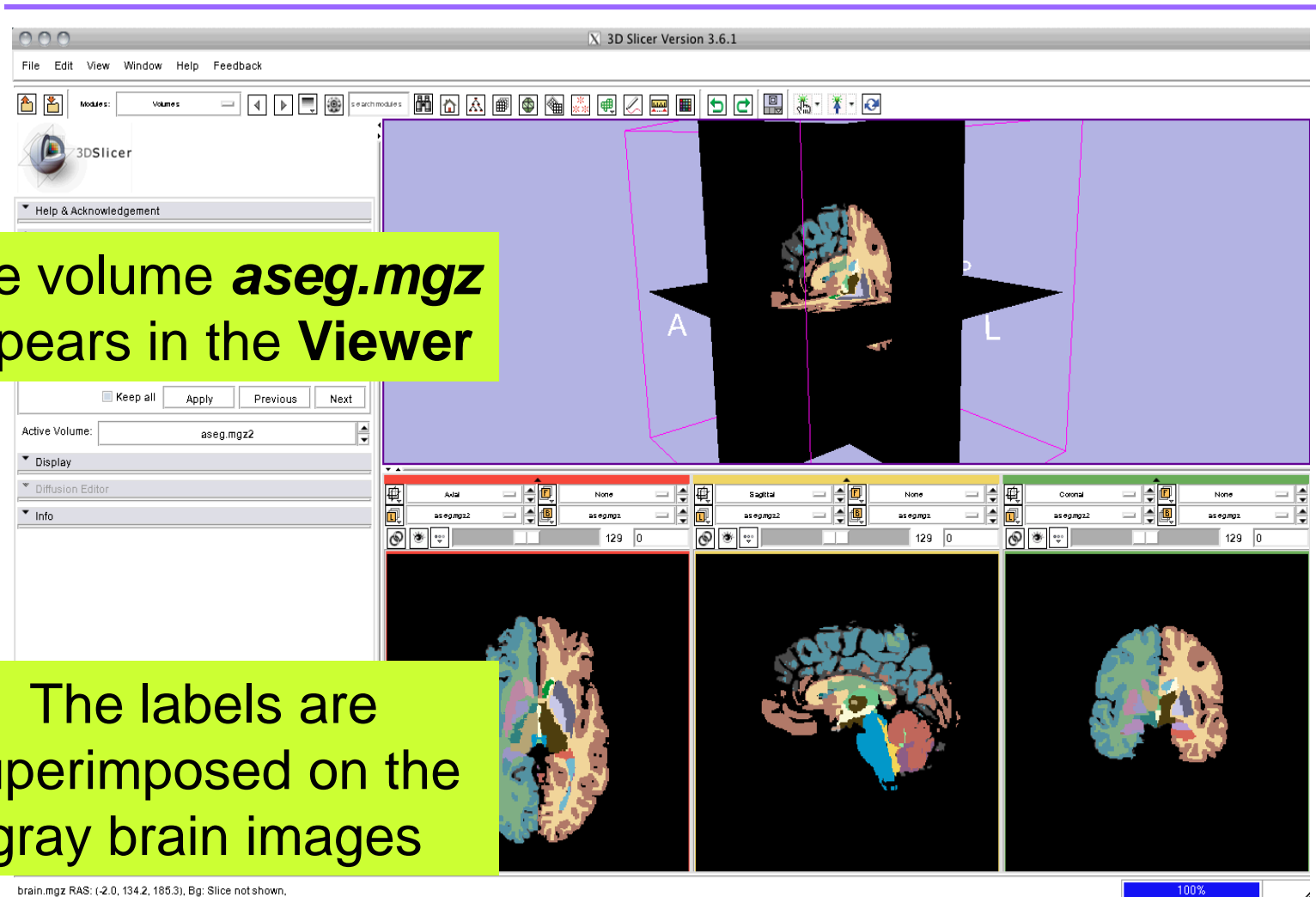
Click on **Select Volume File**, and browse to find the dataset *aseg.mgz* located in the directory */bert/mri/* and click on **Open**



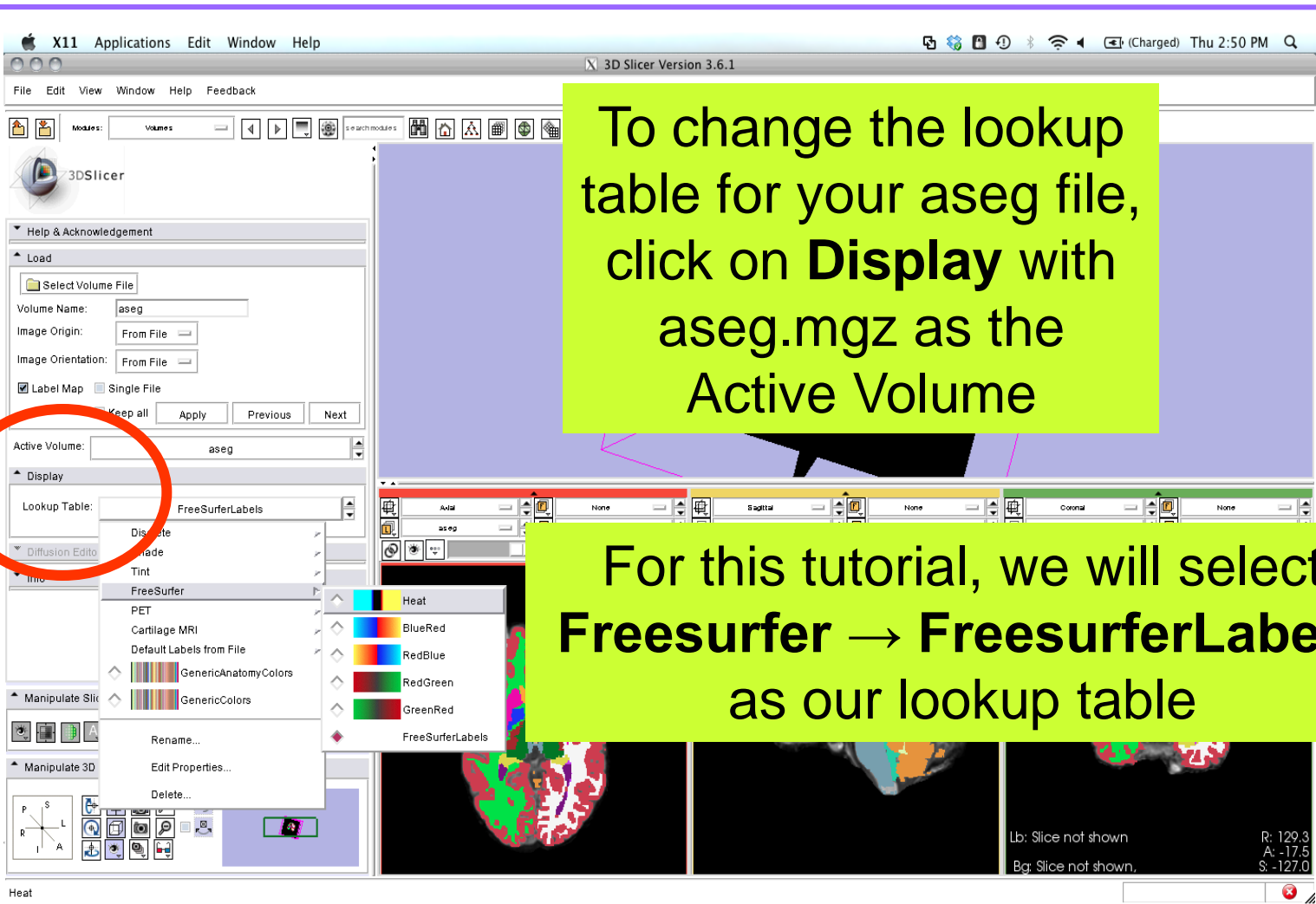
# Loading an ASEG File



# Loading an ASEG File



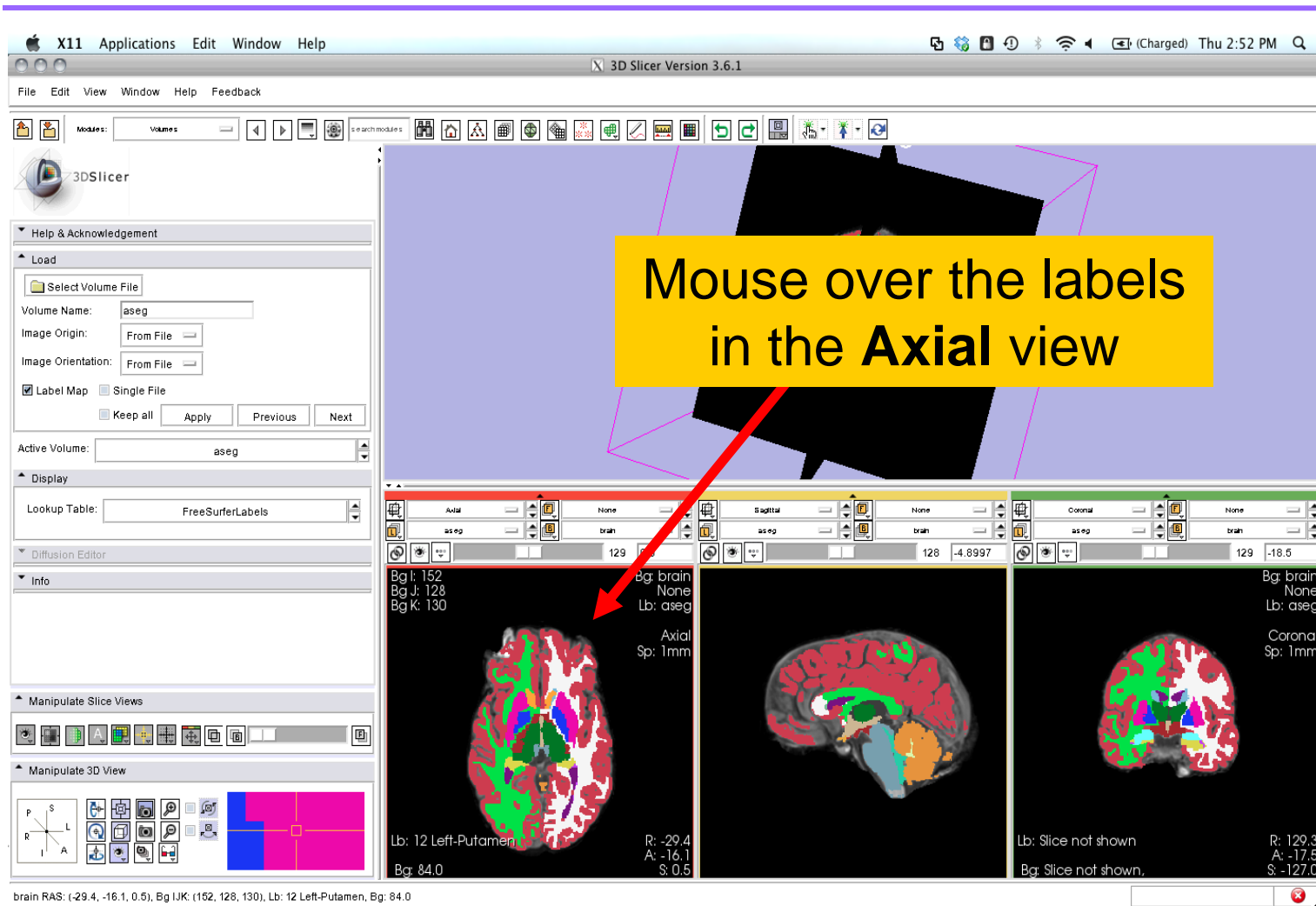
# Loading an ASEG File



To change the lookup table for your aseg file, click on **Display** with aseg.mgz as the Active Volume

For this tutorial, we will select **Freesurfer** → **FreesurferLabels** as our lookup table

# Loading an ASEG File



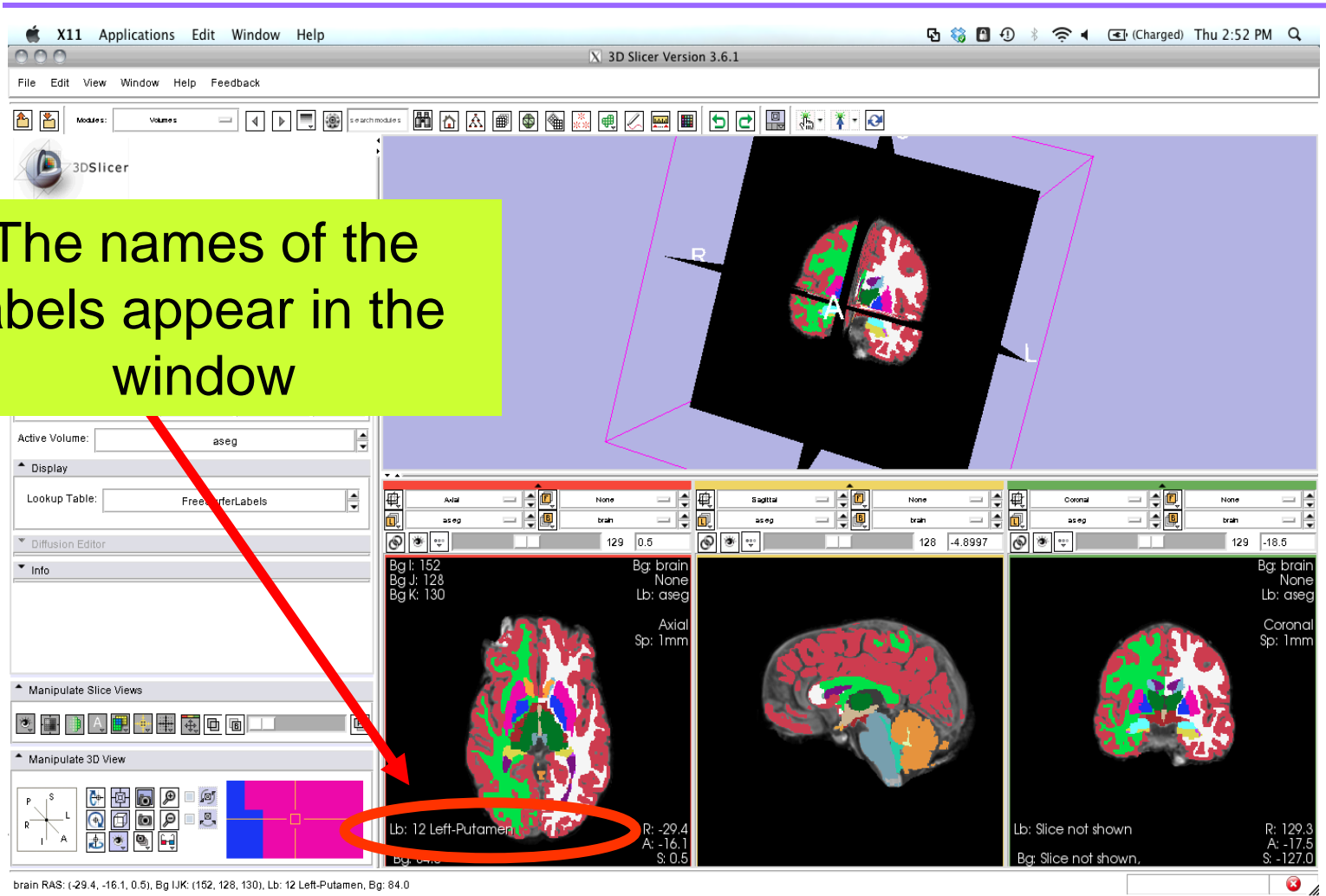
The screenshot shows the 3DSlicer application window. The 'Load' panel on the left is active, with the 'Label Map' checkbox checked. A yellow callout box with the text 'Mouse over the labels in the Axial view' and a red arrow points to the 'Label Map' checkbox. The main view area displays three brain slices: Axial, Sagittal, and Coronal. The Axial slice shows a brain with various colored regions. The Sagittal slice shows a brain with colored regions. The Coronal slice shows a brain with colored regions. The status bar at the bottom displays the following information: brain RAS: (-29.4, -16.1, 0.5), Bg IJK: (152, 128, 130), Lb: 12 Left-Putamen, Bg: 84.0.



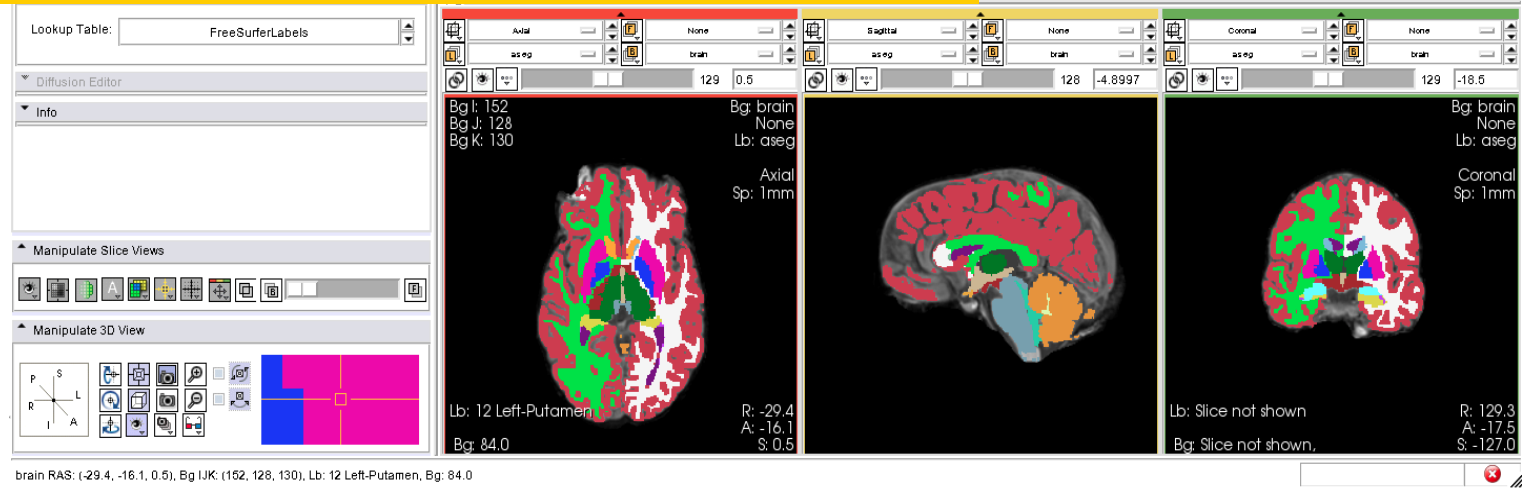
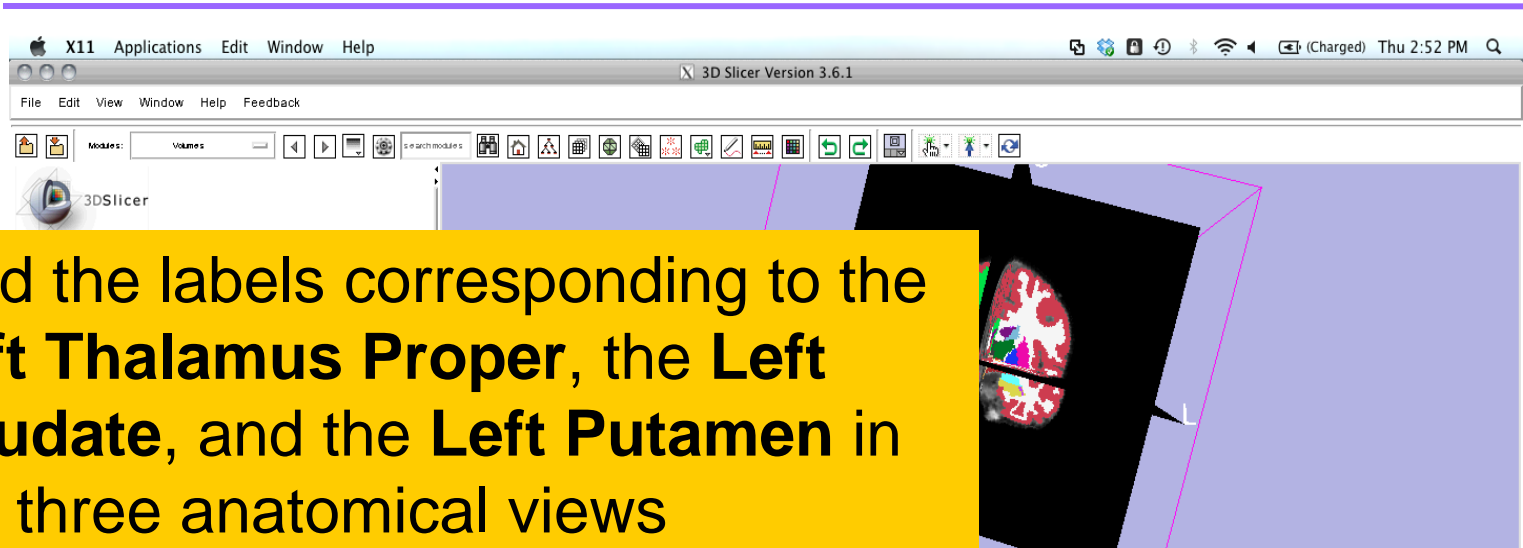


# Overlay Brain & Segmentation

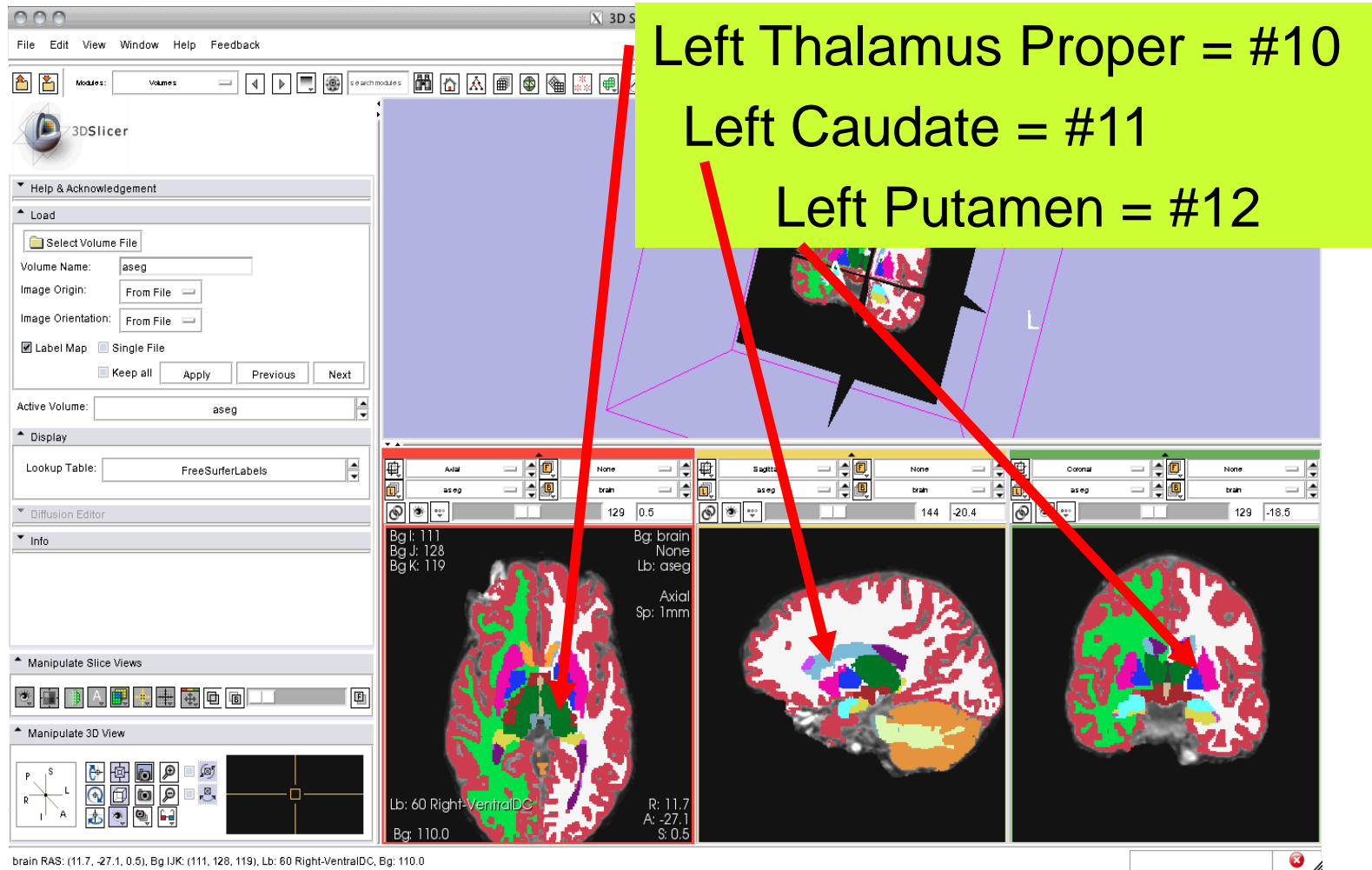
The names of the labels appear in the window



# Overlay Brain & Segmentation

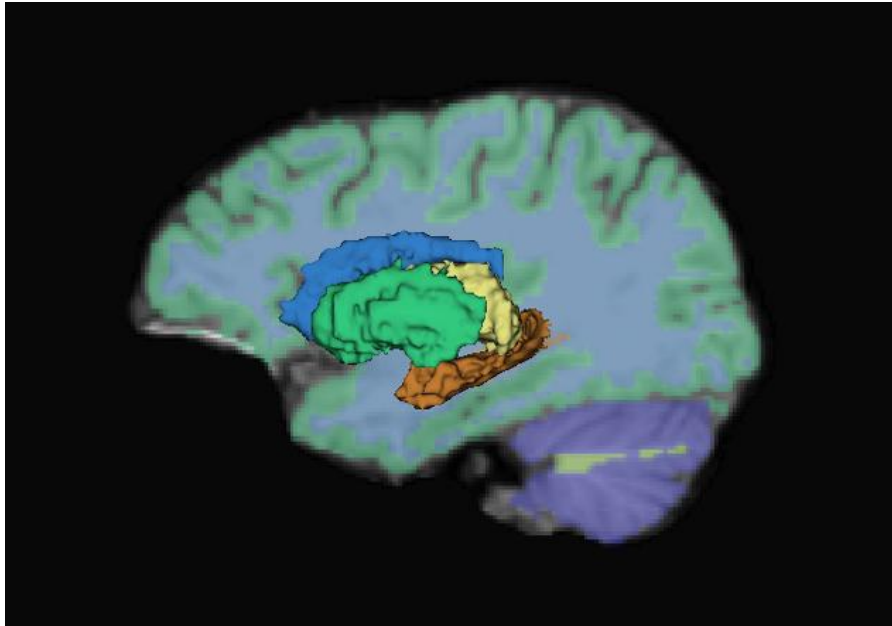


# Overlay Brain & Segmentation



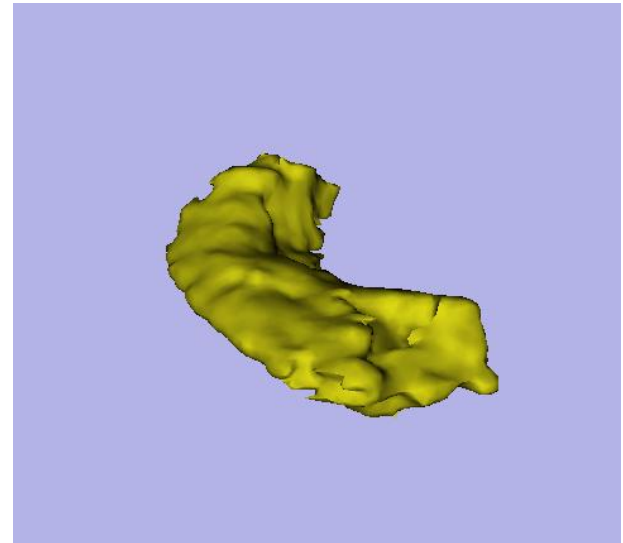
Left Thalamus Proper = #10  
 Left Caudate = #11  
 Left Putamen = #12

brain RAS: (11.7, -27.1, 0.5), Bg IJK: (111, 128, 119), Lb: 60 Right-VentralDC, Bg: 110.0

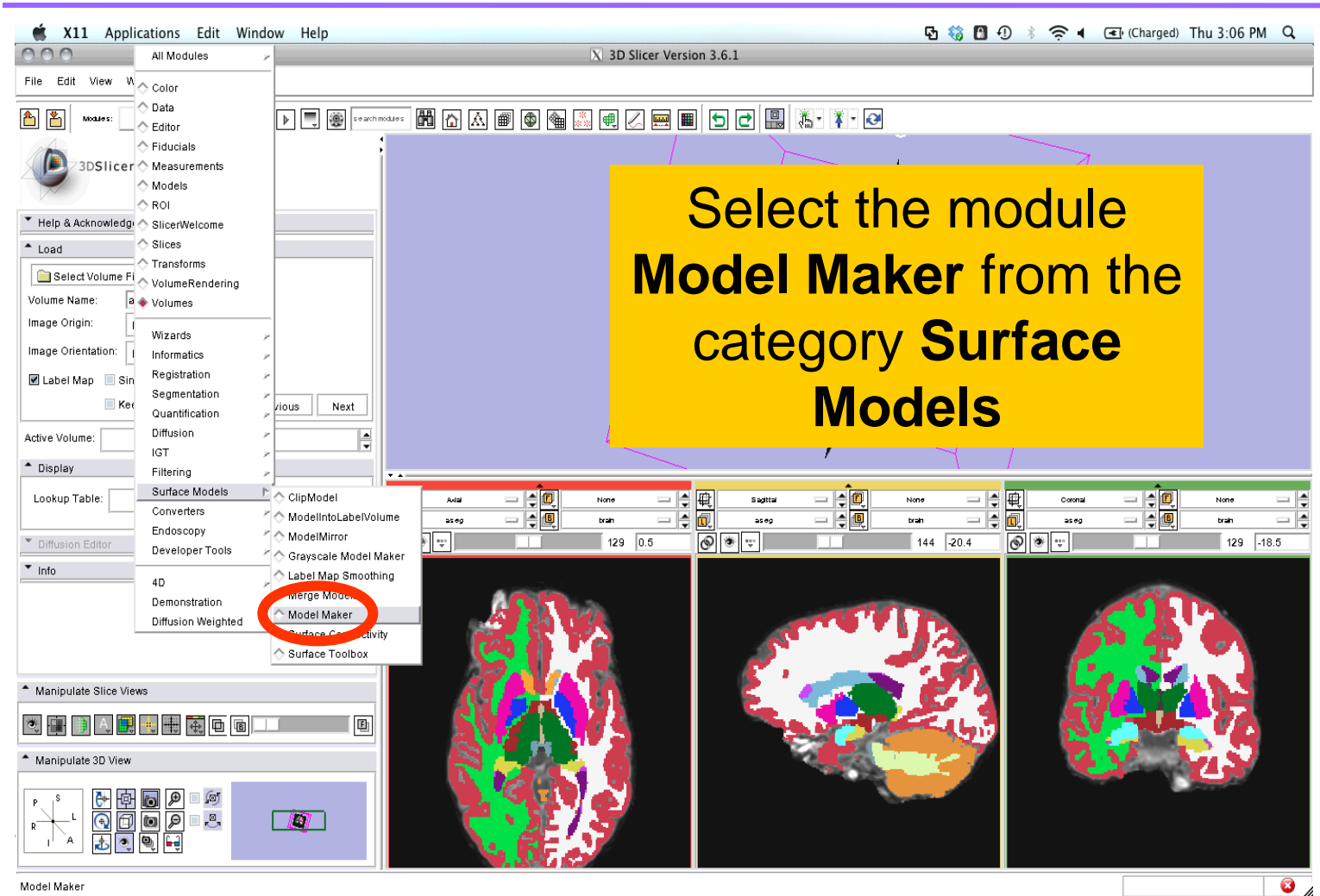


## Part 2: Building 3D Models

- Building a Single Model
- Building Multiple Models

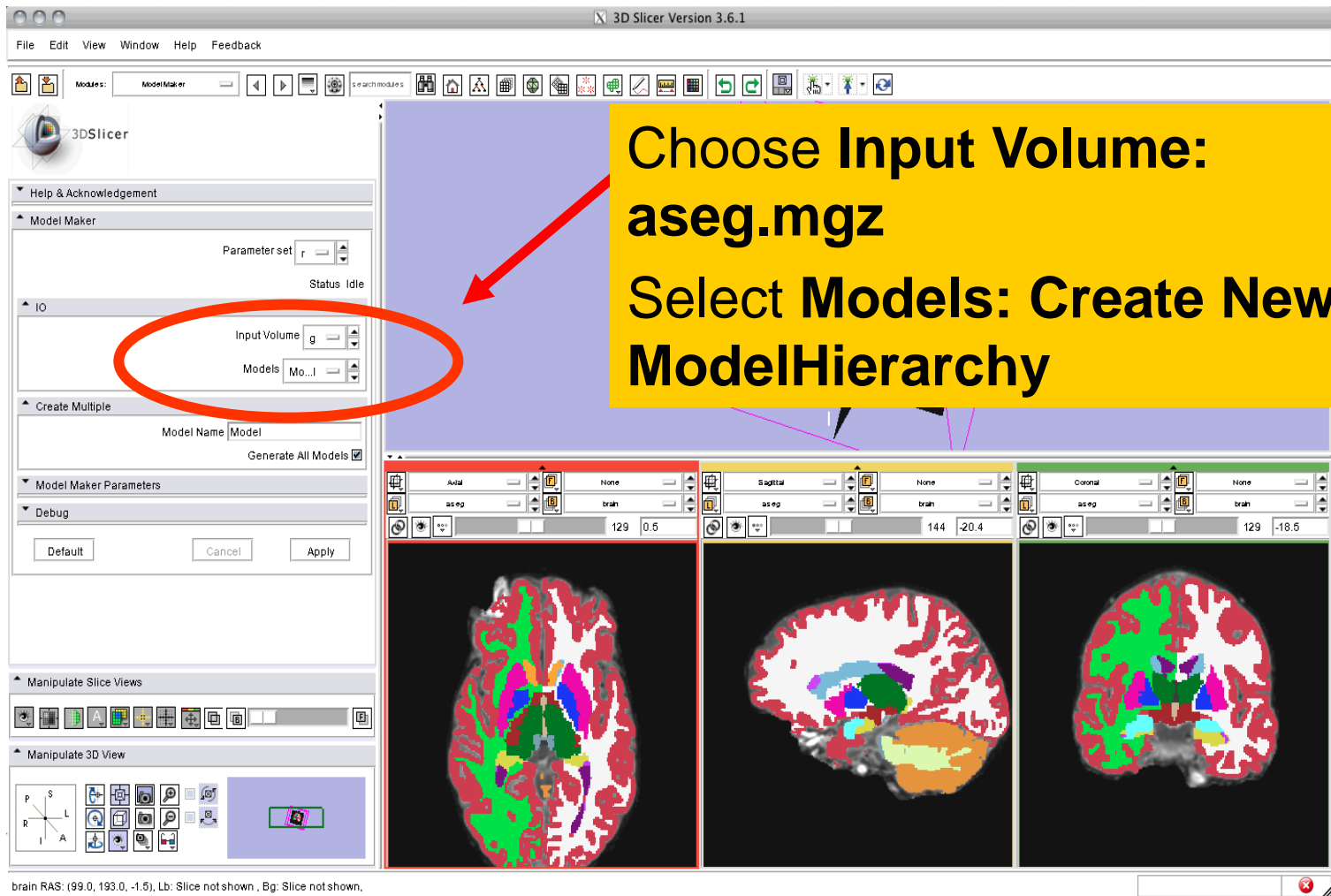


# Building a Single Model



The screenshot shows the 3D Slicer 3.6.1 interface. A yellow text box in the center reads: "Select the module **Model Maker** from the category **Surface Models**". The 'All Modules' list on the left has 'Surface Models' expanded, and 'Model Maker' is circled in red. The main view displays three orthogonal slices (Axial, Sagittal, Coronal) of a brain volume with a multi-colored segmentation. The 'Model Maker' module is active at the bottom of the interface.

# Building a Single Model



3D Slicer Version 3.6.1

File Edit View Window Help Feedback

Model Maker

Parameter set: r

Status: Idle

IO

Input Volume: g

Models: Mo...l

Create Multiple

Model Name: Model

Generate All Models:

Model Maker Parameters

Debug

Default Cancel Apply

Manipulate Slice Views

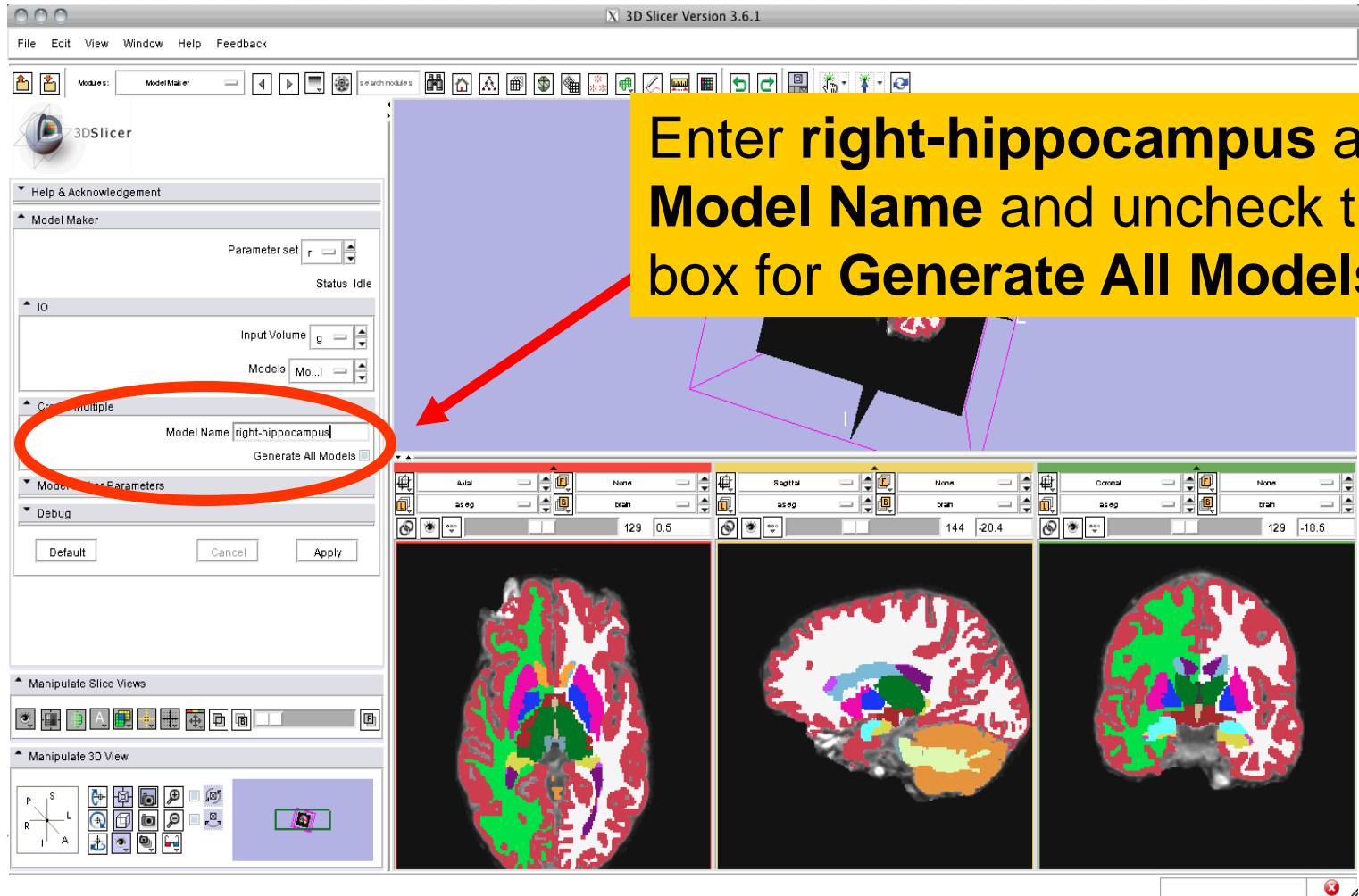
Manipulate 3D View

brain RAS: (99.0, 193.0, -1.5), Lb: Slice not shown, Bg: Slice not shown.

**Choose Input Volume: aseg.mgz**

**Select Models: Create New ModelHierarchy**

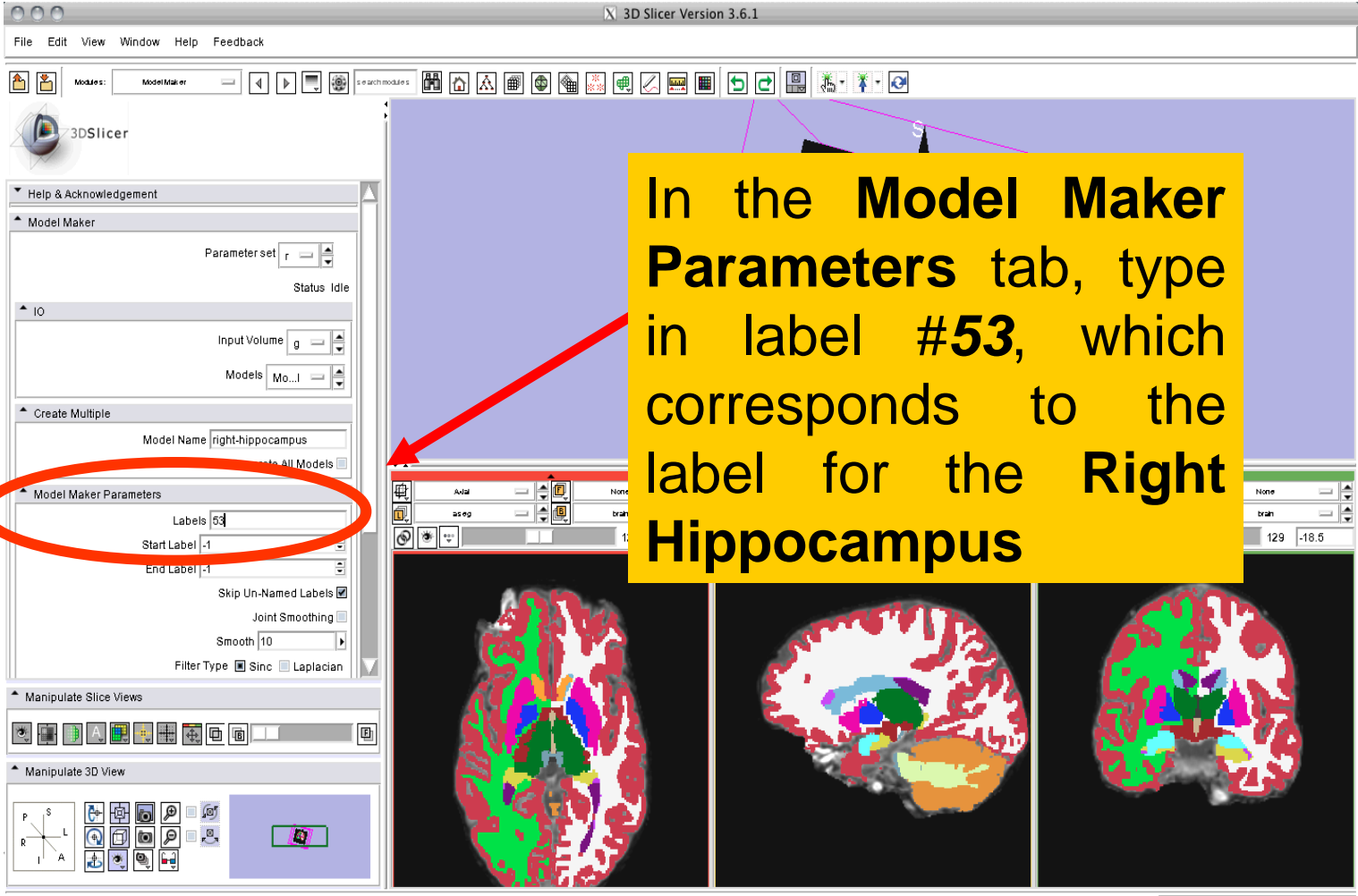
# Building a Single Model



Enter **right-hippocampus** as **Model Name** and uncheck the box for **Generate All Models**



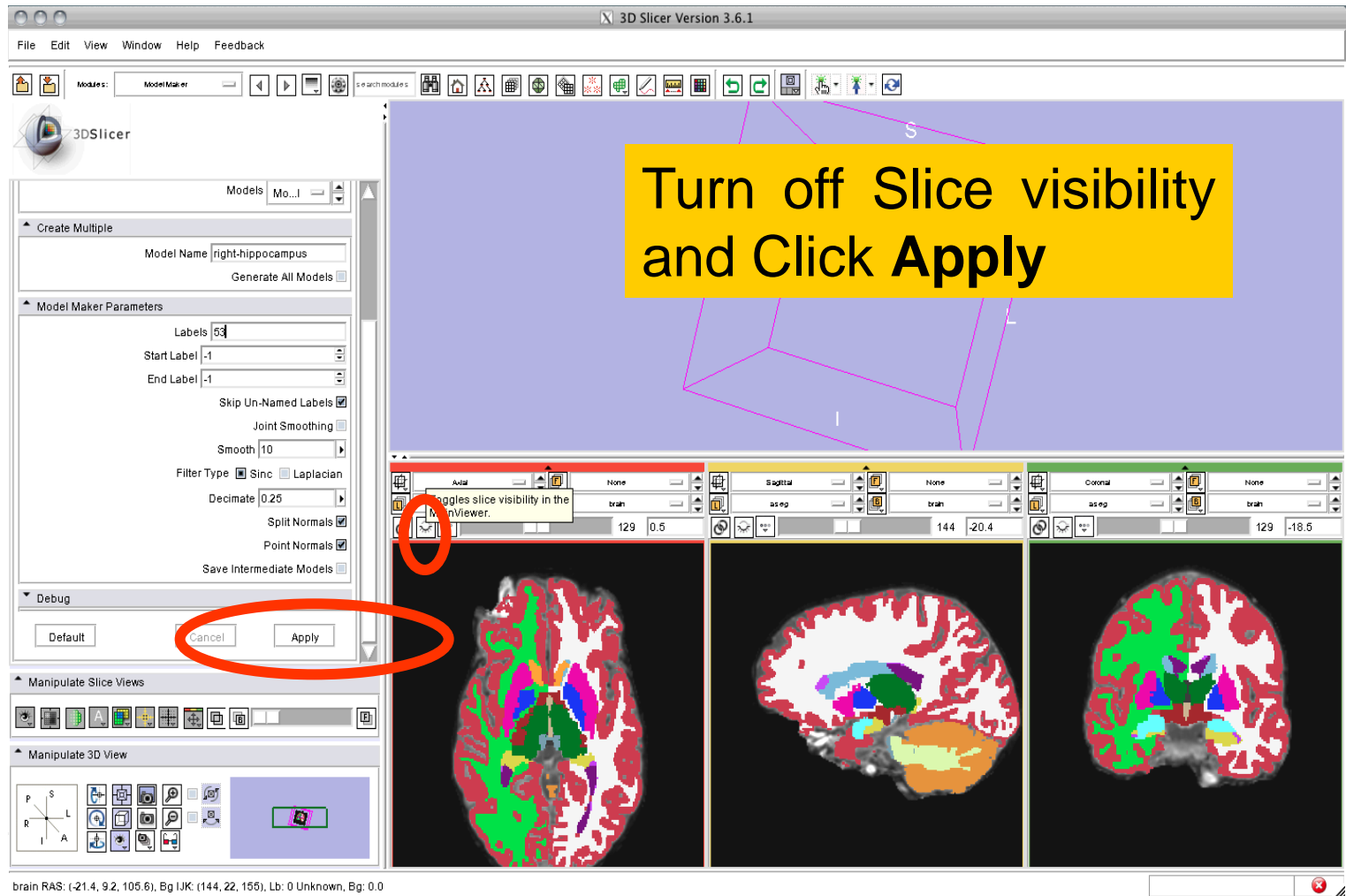
# Building a Single Model



The screenshot shows the 3D Slicer 3.6.1 interface. The 'Model Maker Parameters' tab is active, and the 'Labels' field is circled in red, containing the value '53'. A red arrow points from this field to a yellow text box. The main 3D view displays three brain slices with segmented regions in various colors.

In the **Model Maker Parameters** tab, type in label **#53**, which corresponds to the label for the **Right Hippocampus**

# Building a Single Model



3D Slicer Version 3.6.1

File Edit View Window Help Feedback

Module: ModelMaker

Models Mo... |

Create Multiple

Model Name: right-hippocampus

Generate All Models

Model Maker Parameters

Labels: 53

Start Label: -1

End Label: -1

Skip Un-Named Labels

Joint Smoothing

Smooth: 10

Filter Type: Sinc  Laplacian

Decimate: 0.25

Split Normals

Point Normals

Save Intermediate Models

Debug

Default Cancel Apply

Manipulate Slice Views

Manipulate 3D View

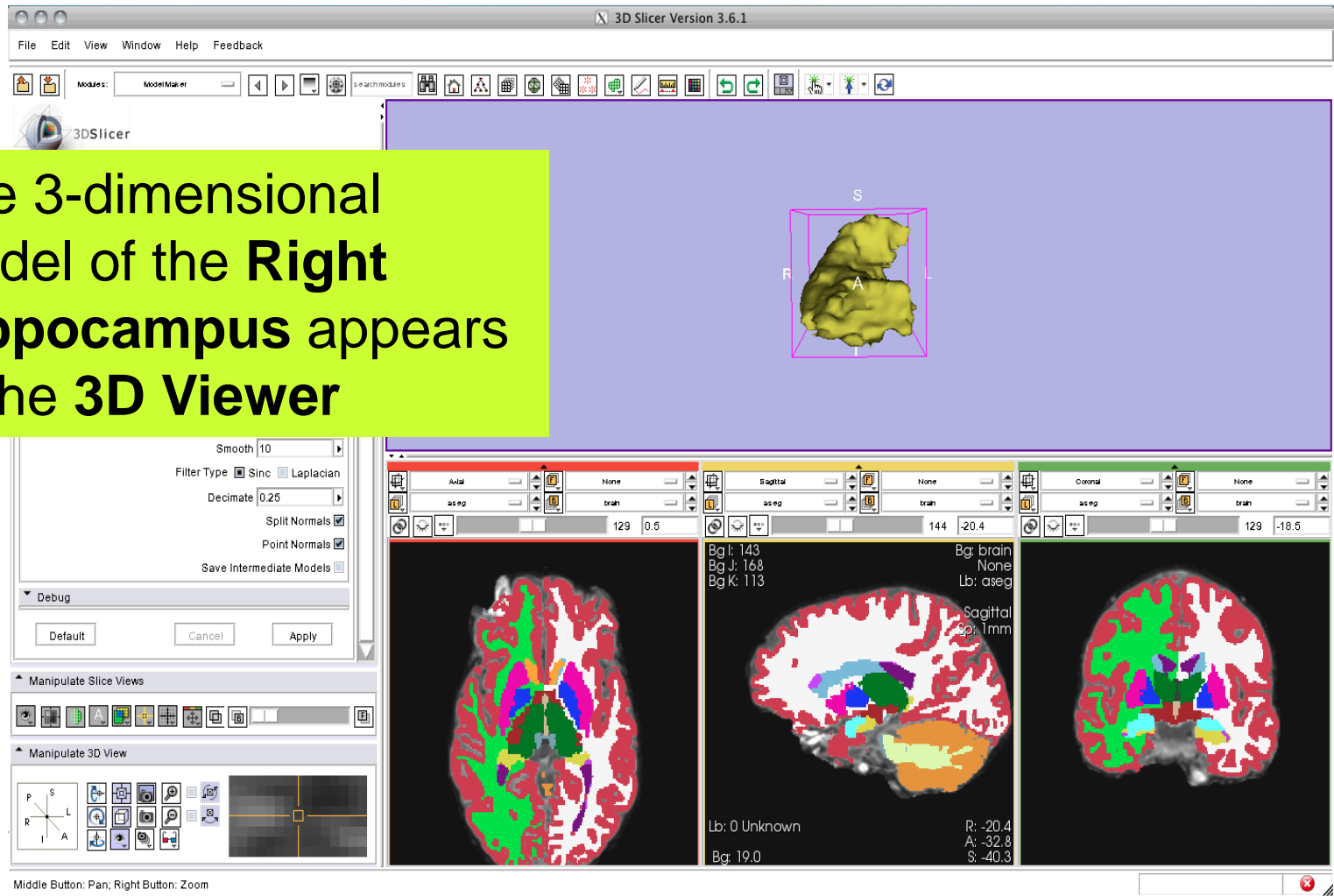
Toggle slice visibility in the MainViewer.

brain RAS: (-21.4, 9.2, 105.6), Bg IJK: (144, 22, 155), Lb: 0 Unknown, Bg: 0.0

Turn off Slice visibility and Click **Apply**

# Building a Single Model

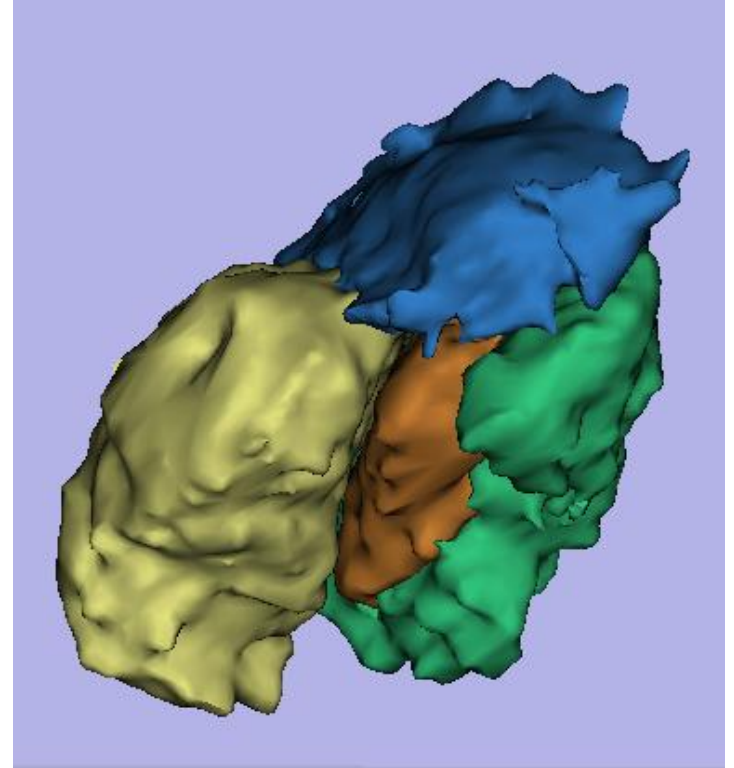
The 3-dimensional model of the **Right Hippocampus** appears in the **3D Viewer**



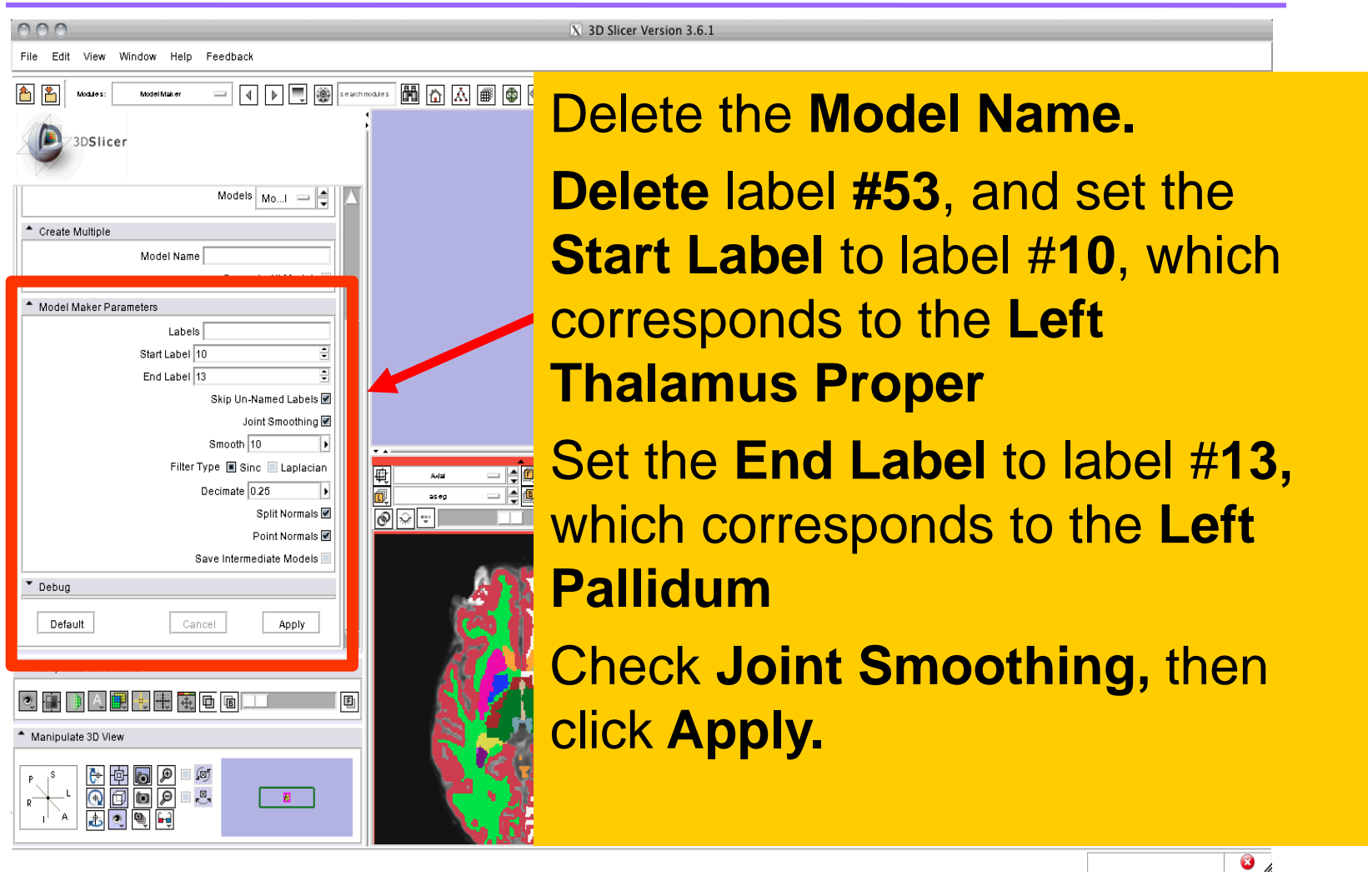
# *Building 3D Models*

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- Building a Single Model
- Building Multiple Models



# *Building Multiple Models*



**Delete the Model Name.**

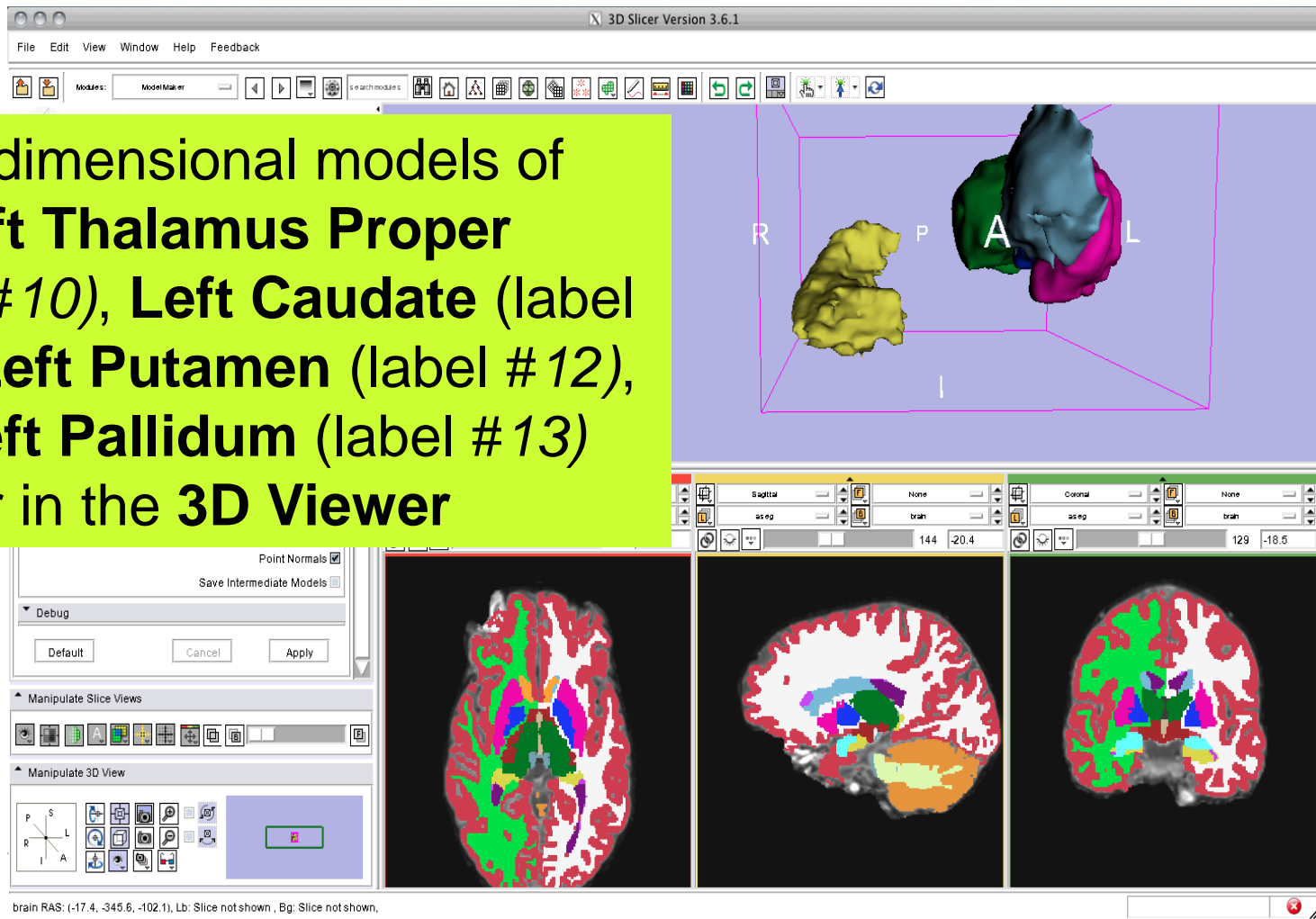
**Delete label #53, and set the Start Label to label #10, which corresponds to the Left Thalamus Proper**

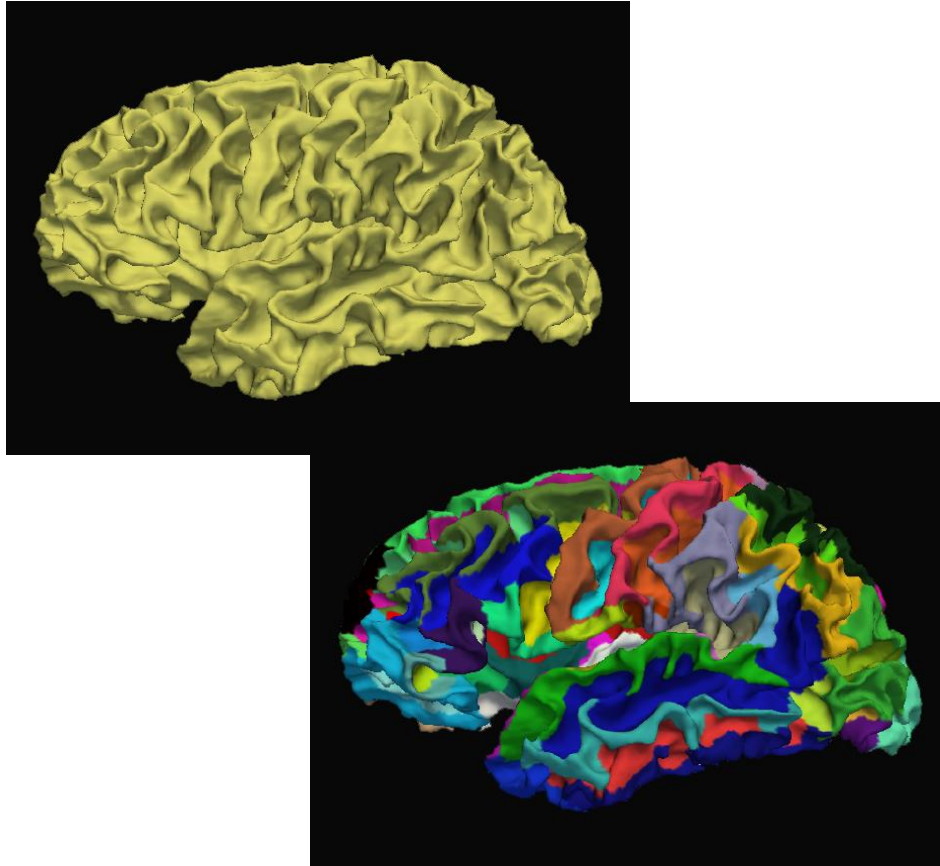
**Set the End Label to label #13, which corresponds to the Left Pallidum**

**Check Joint Smoothing, then click Apply.**

# Building Multiple Models

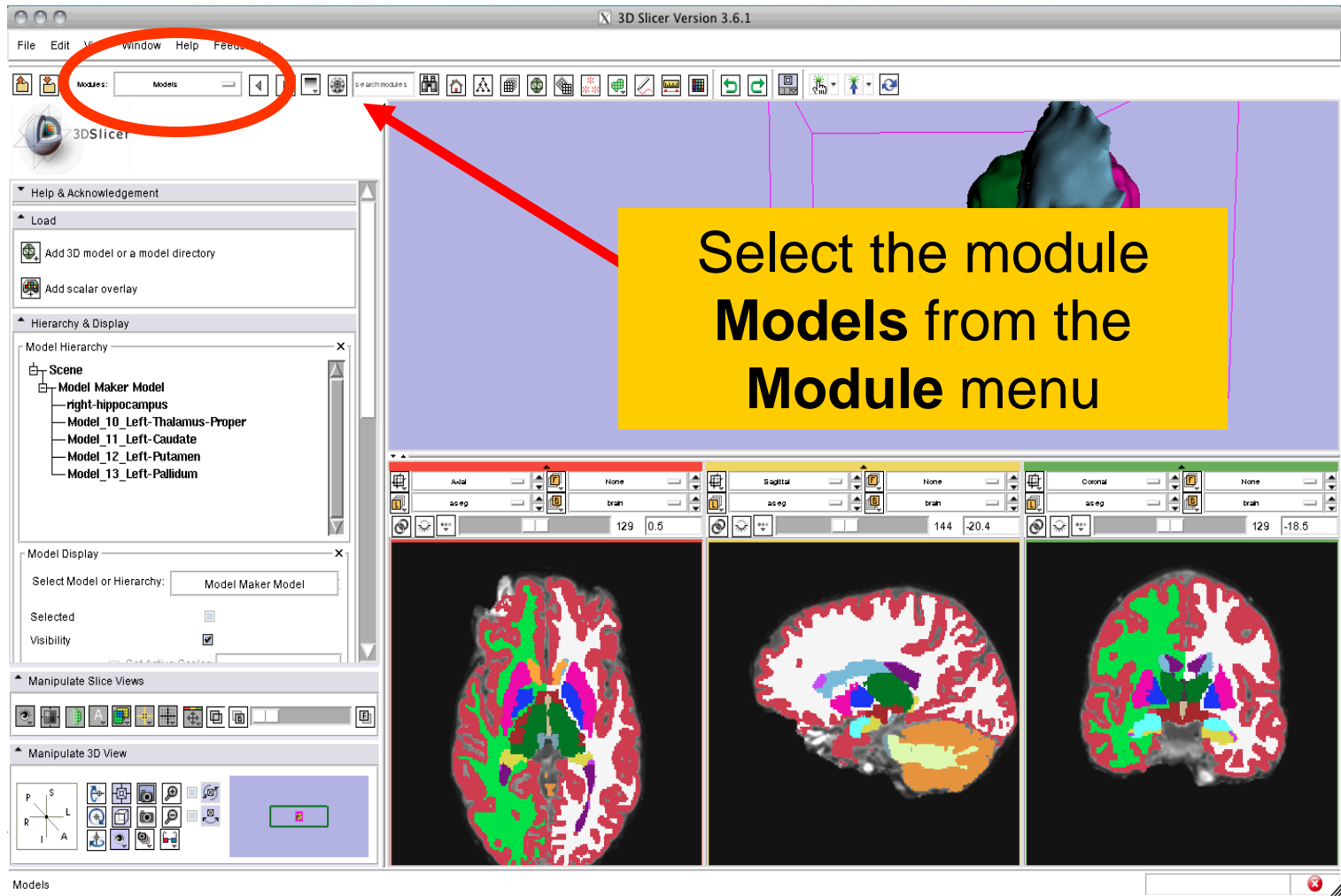
The 3-dimensional models of the **Left Thalamus Proper** (label #10), **Left Caudate** (label #11), **Left Putamen** (label #12), and **Left Pallidum** (label #13) appear in the **3D Viewer**



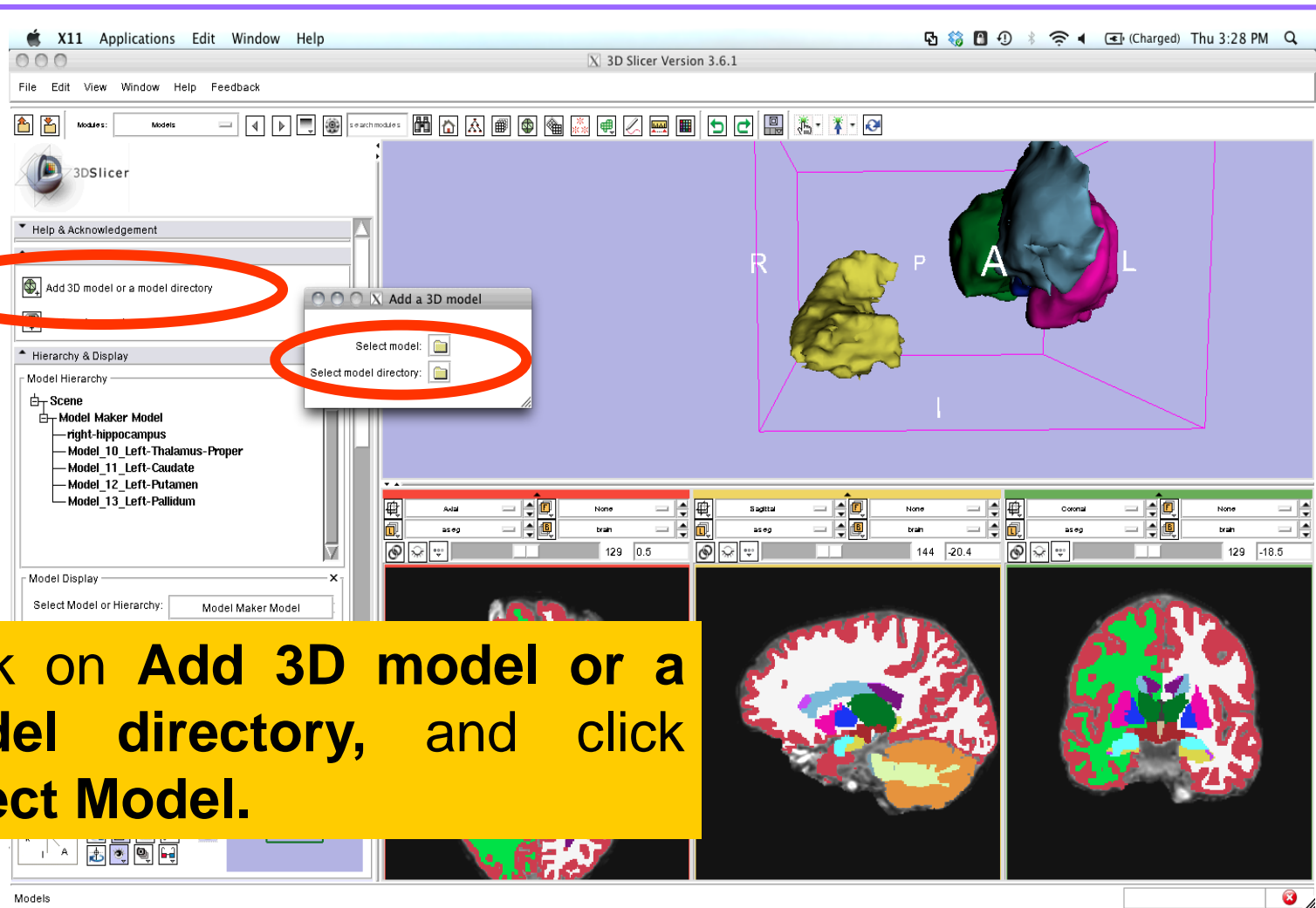


## Part 3: Loading FreeSurfer Surfaces and Visualizing Parcellation Maps

# Building Multiple Models



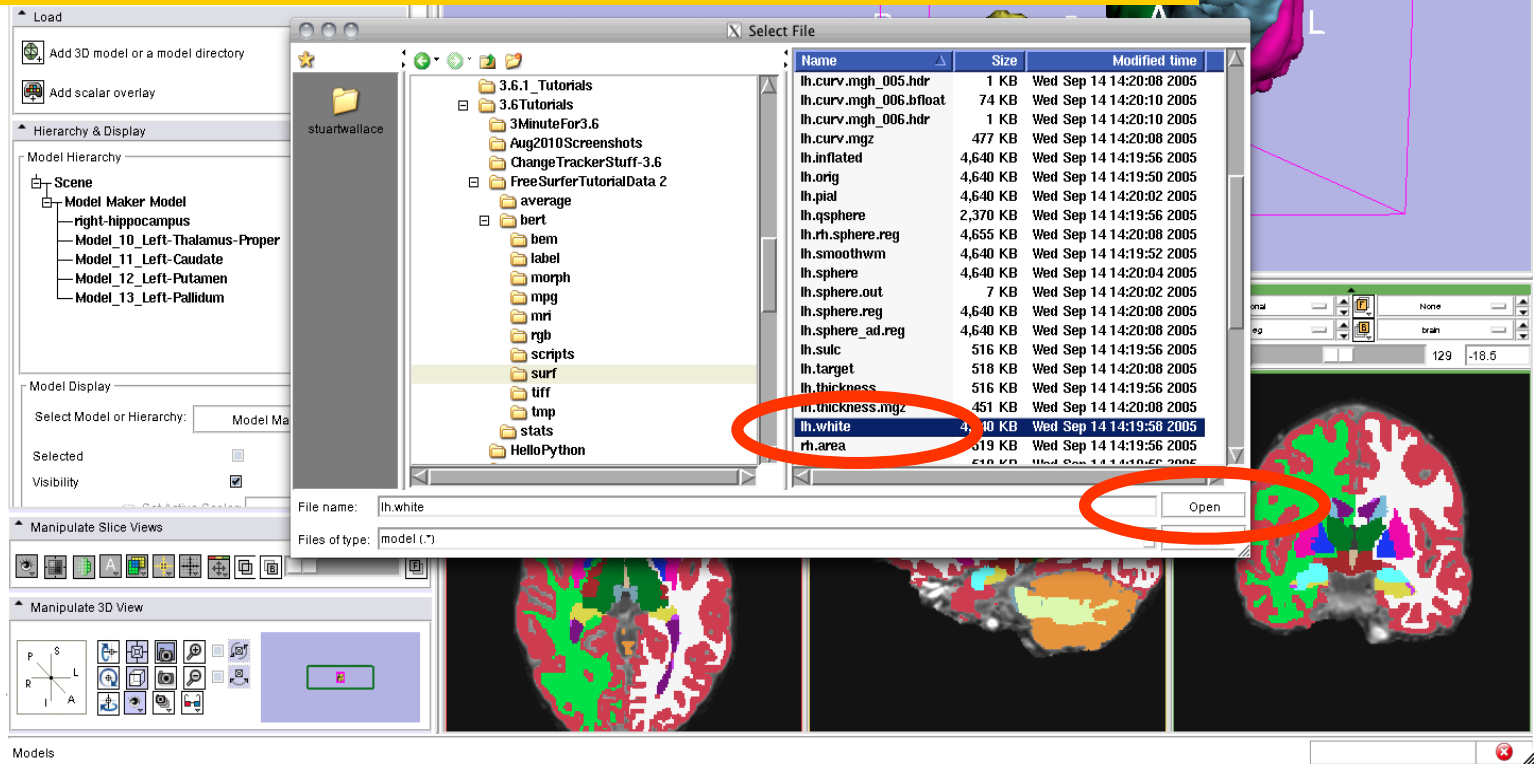




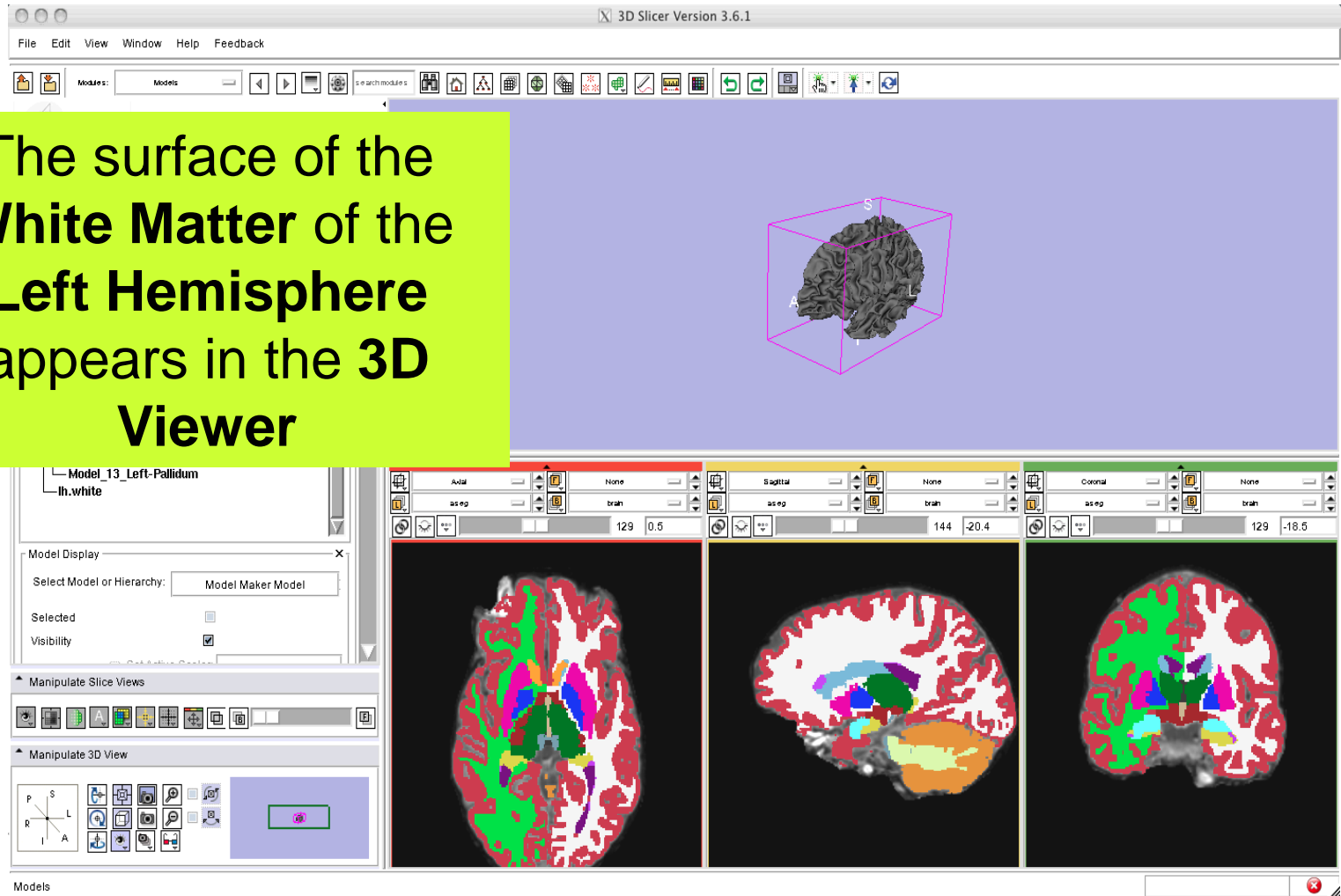
The screenshot shows the 3D Slicer 3.6.1 interface. The main window displays a 3D model of a brain with colored surfaces (yellow, green, blue, pink) and a purple wireframe bounding box. The interface includes a menu bar (File, Edit, View, Window, Help, Feedback), a toolbar, and several panels. The 'Hierarchy & Display' panel on the left shows a tree view of the scene, including 'Model Maker Model' and its sub-models: 'right-hippocampus', 'Model\_10\_Left-Thalamus-Proper', 'Model\_11\_Left-Caudate', 'Model\_12\_Left-Putamen', and 'Model\_13\_Left-Pallidum'. The 'Model Display' panel at the bottom shows three orthogonal views: Axial, Sagittal, and Coronal. A yellow text box is overlaid on the bottom left of the screenshot, containing the instruction: 'Click on Add 3D model or a model directory, and click Select Model.' Two red circles highlight the 'Add 3D model or a model directory' button in the 'Hierarchy & Display' panel and the 'Select model:' button in the 'Add a 3D model' dialog box.

Click on **Add 3D model** or a model directory, and click **Select Model**.

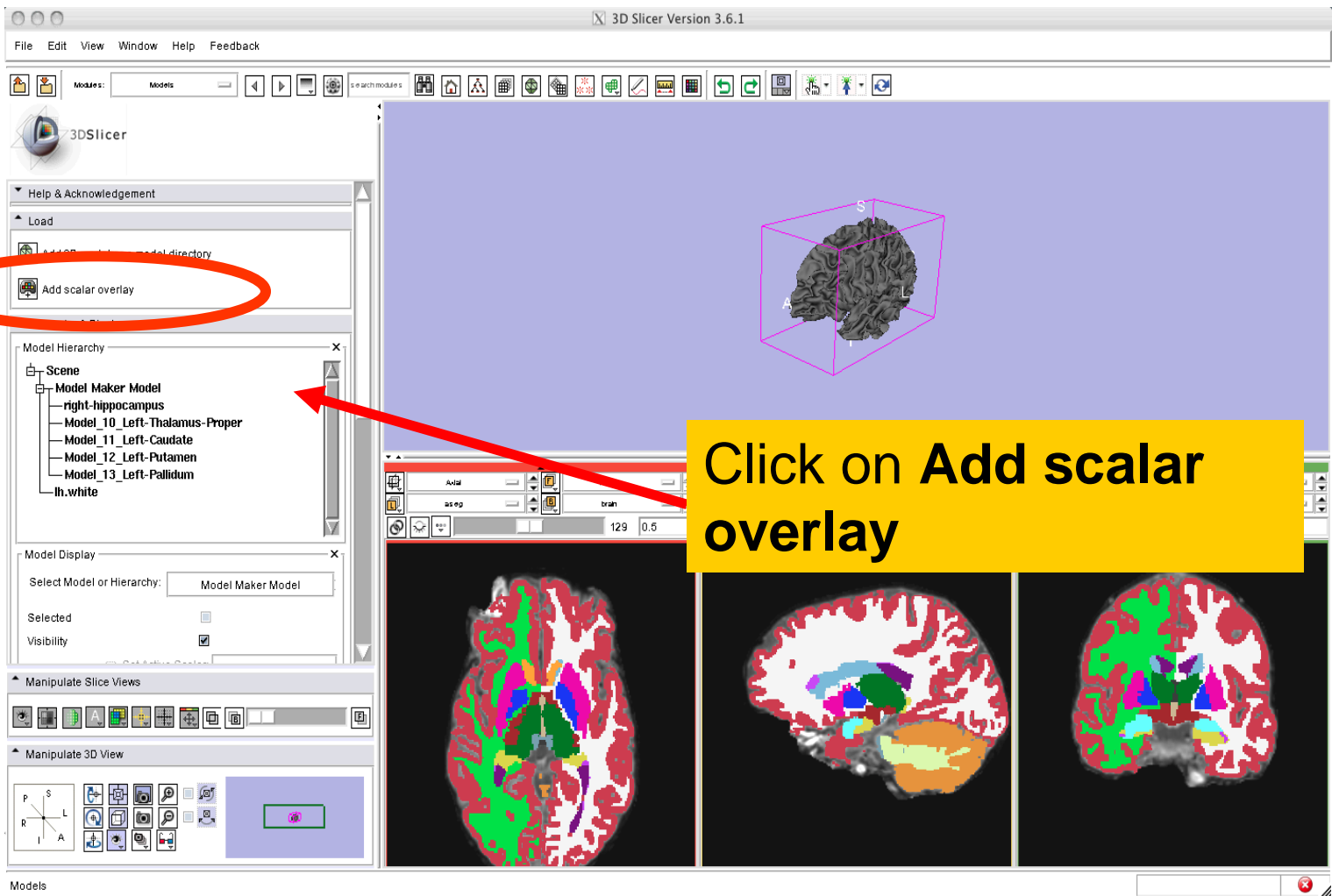
Browse to find the surface *lh.white* located in the directory */bert/surf/*  
 Click on ***Open***



The surface of the  
**White Matter** of the  
**Left Hemisphere**  
appears in the **3D**  
**Viewer**



# Visualizing Parcellation Maps



3D Slicer Version 3.6.1

File Edit View Window Help Feedback

Models: Models

3DSlicer

Help & Acknowledgement

Load

Add scalar overlay

Model Hierarchy

- Scene
  - Model Maker Model
    - right-hippocampus
    - Model\_10\_Left-Thalamus-Proper
    - Model\_11\_Left-Caudate
    - Model\_12\_Left-Putamen
    - Model\_13\_Left-Pallidum
    - lh.white

Model Display

Select Model or Hierarchy: Model Maker Model

Selected

Visibility

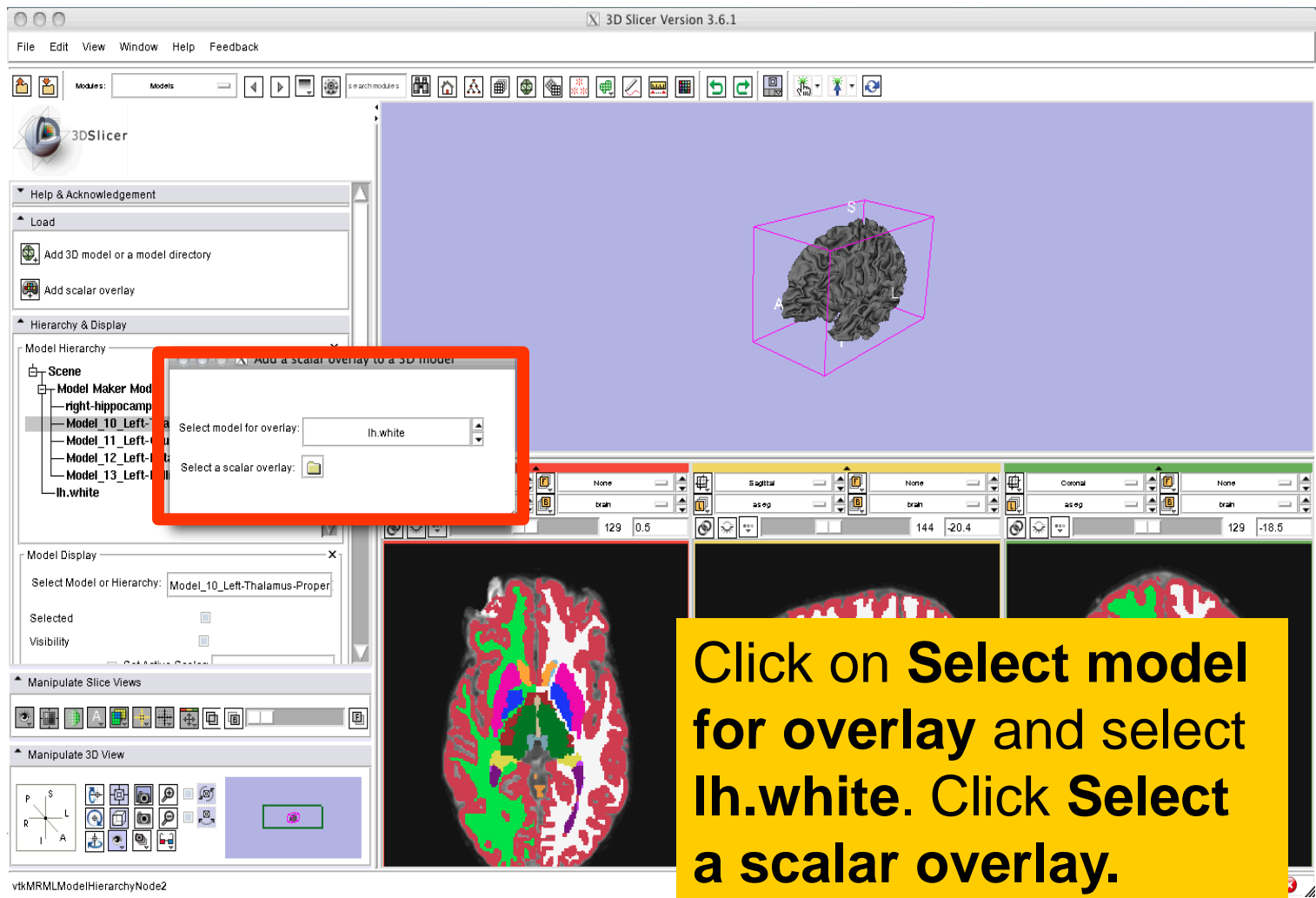
Manipulate Slice Views

Manipulate 3D View

Click on **Add scalar overlay**

Models

# Visualizing Parcellation Maps



3D Slicer Version 3.6.1

File Edit View Window Help Feedback

Models: Models

3DSlicer

Help & Acknowledgement

Load

- Add 3D model or a model directory
- Add scalar overlay

Hierarchy & Display

Model Hierarchy

- Scene
  - Model Maker Model
  - right-hippocamp
  - Model\_10\_Left-
    - lh.white
  - Model\_11\_Left-
    - lh.white
  - Model\_12\_Left-
    - lh.white
  - Model\_13\_Left-
    - lh.white
  - lh.white

Select model for overlay: lh.white

Select a scalar overlay:

Model Display

Select Model or Hierarchy: Model\_10\_Left-Thalamus-Proper

Selected

Visibility

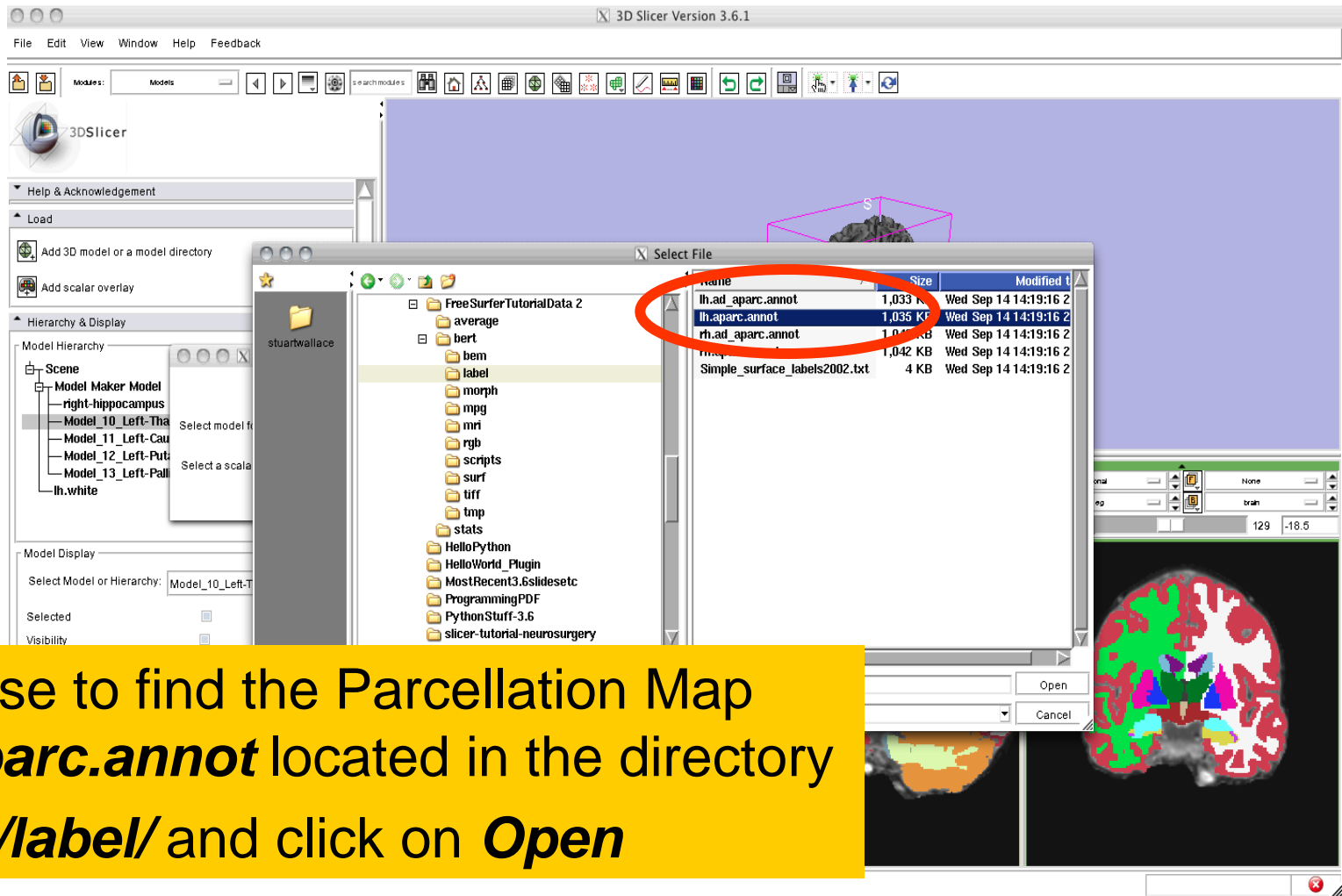
Manipulate Slice Views

Manipulate 3D View

vtkMRMLModelHierarchyNode2

Click on **Select model for overlay** and select **lh.white**. Click **Select a scalar overlay**.

# Visualizing Parcellation Maps



The screenshot shows the 3D Slicer software interface. A 'Select File' dialog box is open, displaying a file browser view. The file 'lh.aparc.annot' is selected and circled in red. The file list in the dialog box is as follows:

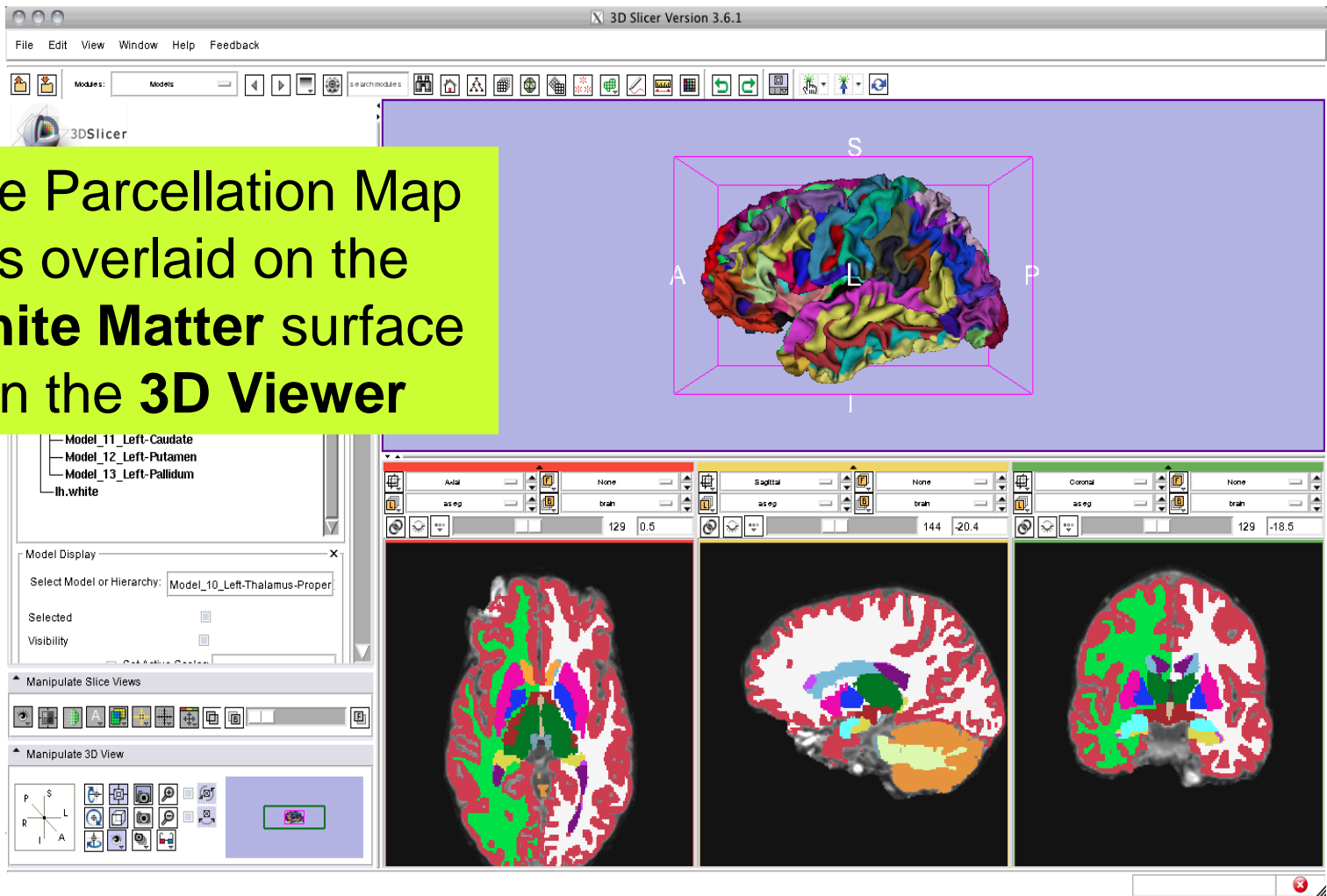
Name	Size	Modified
lh.ad_aparc.annot	1,033 B	Wed Sep 14 14:19:16 2
lh.aparc.annot	1,035 KB	Wed Sep 14 14:19:16 2
rh.ad_aparc.annot	1,042 KB	Wed Sep 14 14:19:16 2
Simple_surface_labels2002.txt	4 KB	Wed Sep 14 14:19:16 2

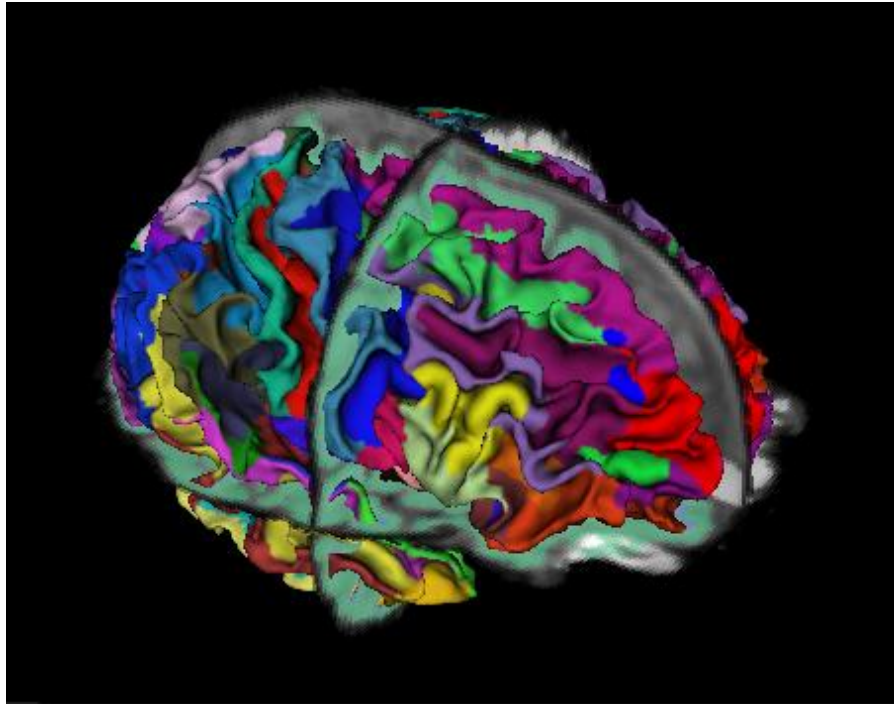
The background shows the 3D Slicer interface with a 3D brain model and a parcellation map. The parcellation map is a 3D brain model with different regions colored in various colors (red, green, blue, yellow, etc.).

**Browse to find the Parcellation Map *lh.aparc.annot* located in the directory */bert/label/* and click on *Open***

# Visualizing Parcellation Maps

The Parcellation Map is overlaid on the **White Matter** surface in the **3D Viewer**

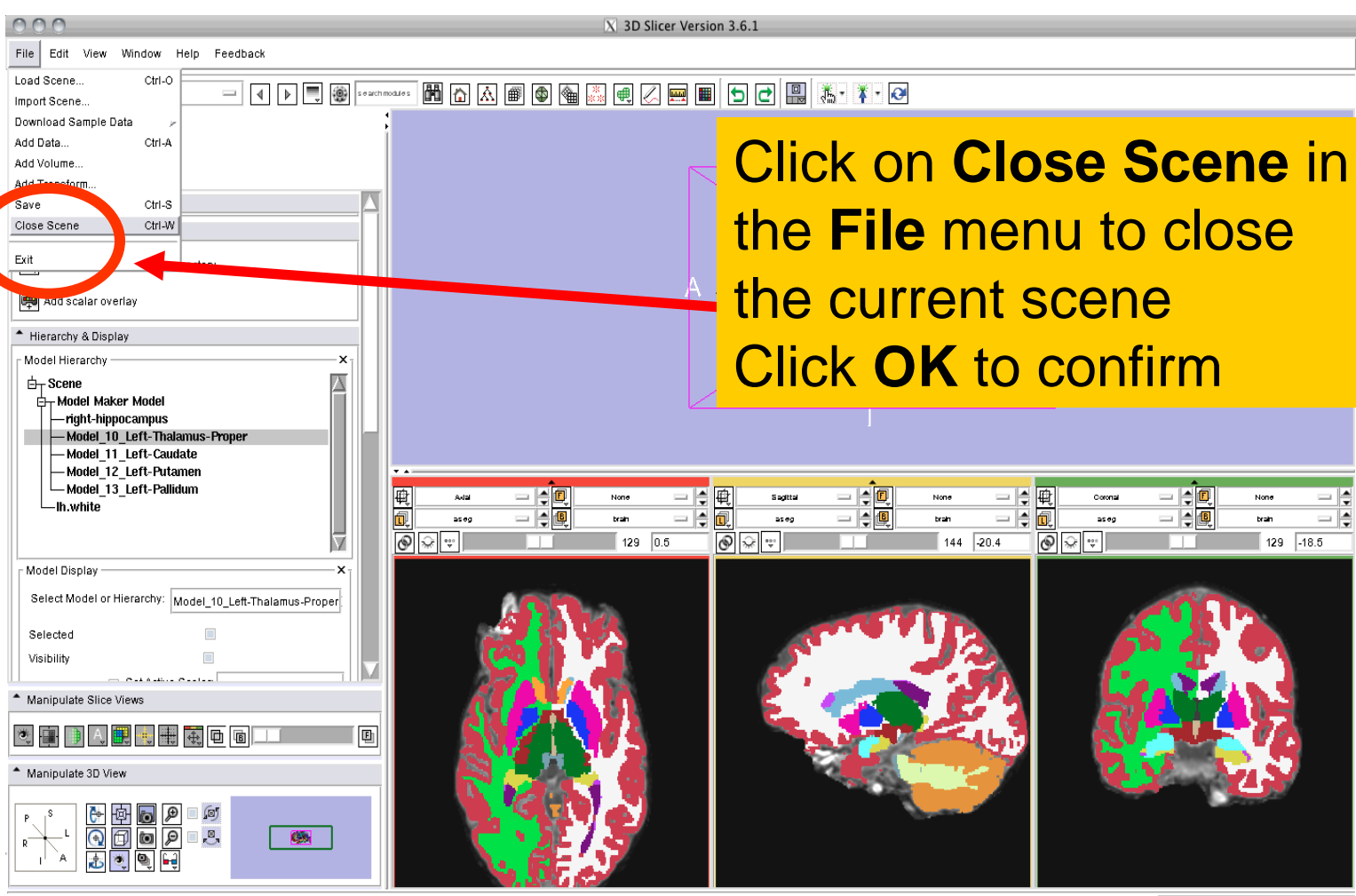




## Part 4: Automatic Data Loading via a Generic Scene File



# Loading a Generic Scene File



The screenshot shows the 3D Slicer Version 3.6.1 interface. The 'File' menu is open, and the 'Close Scene' option is circled in red. A red arrow points from the 'Close Scene' option to a yellow callout box. The callout box contains the text: 'Click on **Close Scene** in the **File** menu to close the current scene. Click **OK** to confirm'. The interface also shows a 'Model Hierarchy' panel on the left with a tree view containing 'Scene', 'Model Maker Model', 'right-hippocampus', 'Model\_10\_Left-Thalamus-Proper', 'Model\_11\_Left-Caudate', 'Model\_12\_Left-Putamen', 'Model\_13\_Left-Pallidum', and 'lh.white'. The 'Model Display' panel shows 'Model\_10\_Left-Thalamus-Proper' selected. The 'Manipulate Slice Views' and 'Manipulate 3D View' panels are also visible. The main 3D view shows three orthogonal slices of a brain with colored overlays.



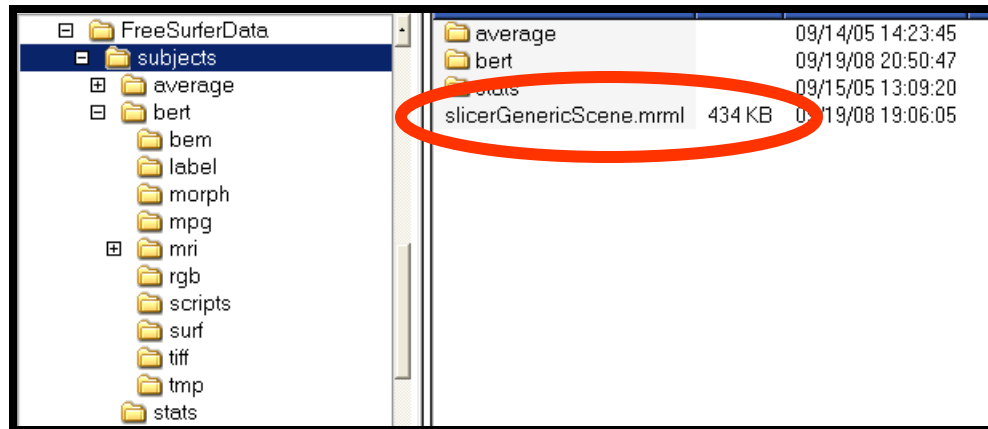
# *Loading a Generic Scene File*

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- The **generic scene** file works by looking in the subject directory created by **FreeSurfer**, and loading all available volumes and models based on known subdirectory names and filenames.
- The file **slicerGenericScene.mrml** will work properly if the subdirectory names and filenames have not been changed by the user.

# *Loading a Generic Scene File*

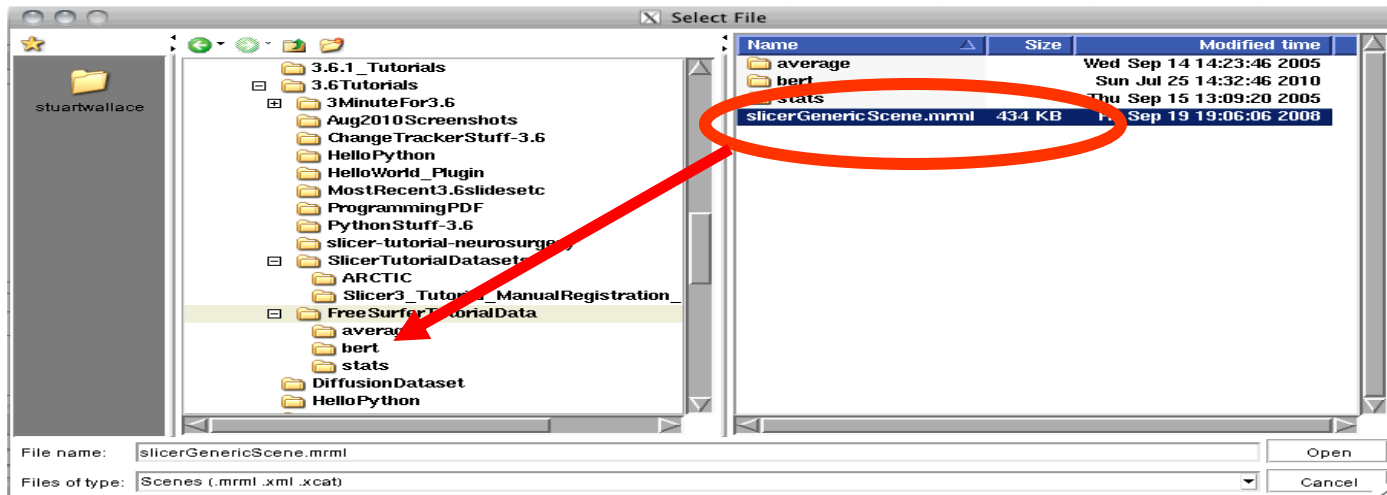
Copy the file **slicerGenericScene.mrml** into the directory **/subjects/** of our tutorial dataset.



**/subjects/**

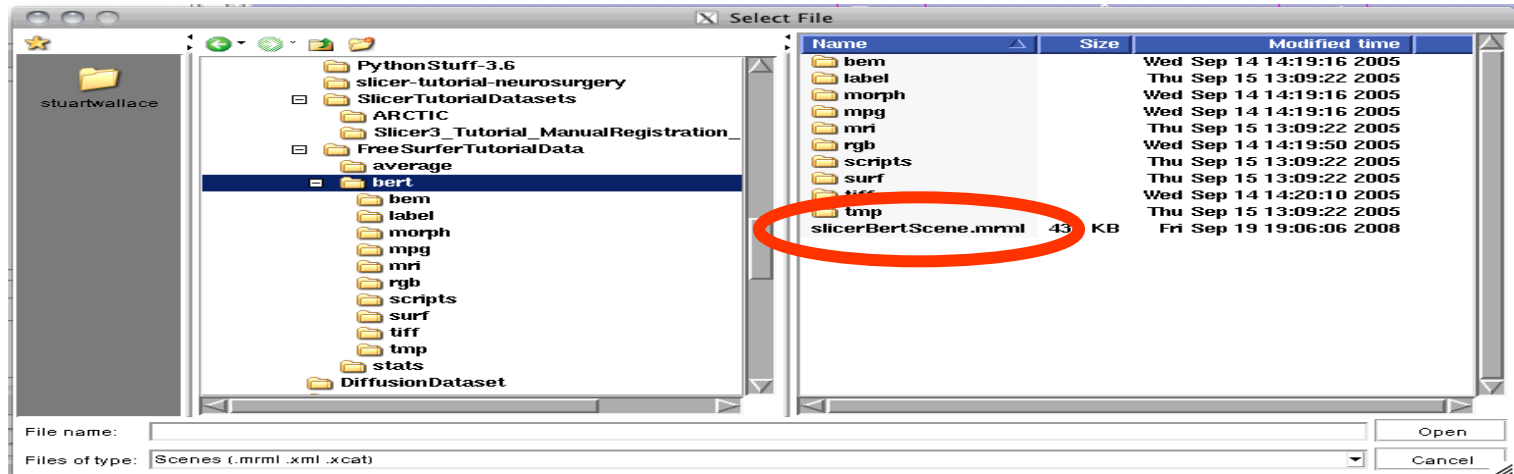
# Loading a Generic Scene File

Copy the file  **slicerGenericScene.mrml**  located in the tutorial directory, into the directory  **/bert/**  of our sample subject.

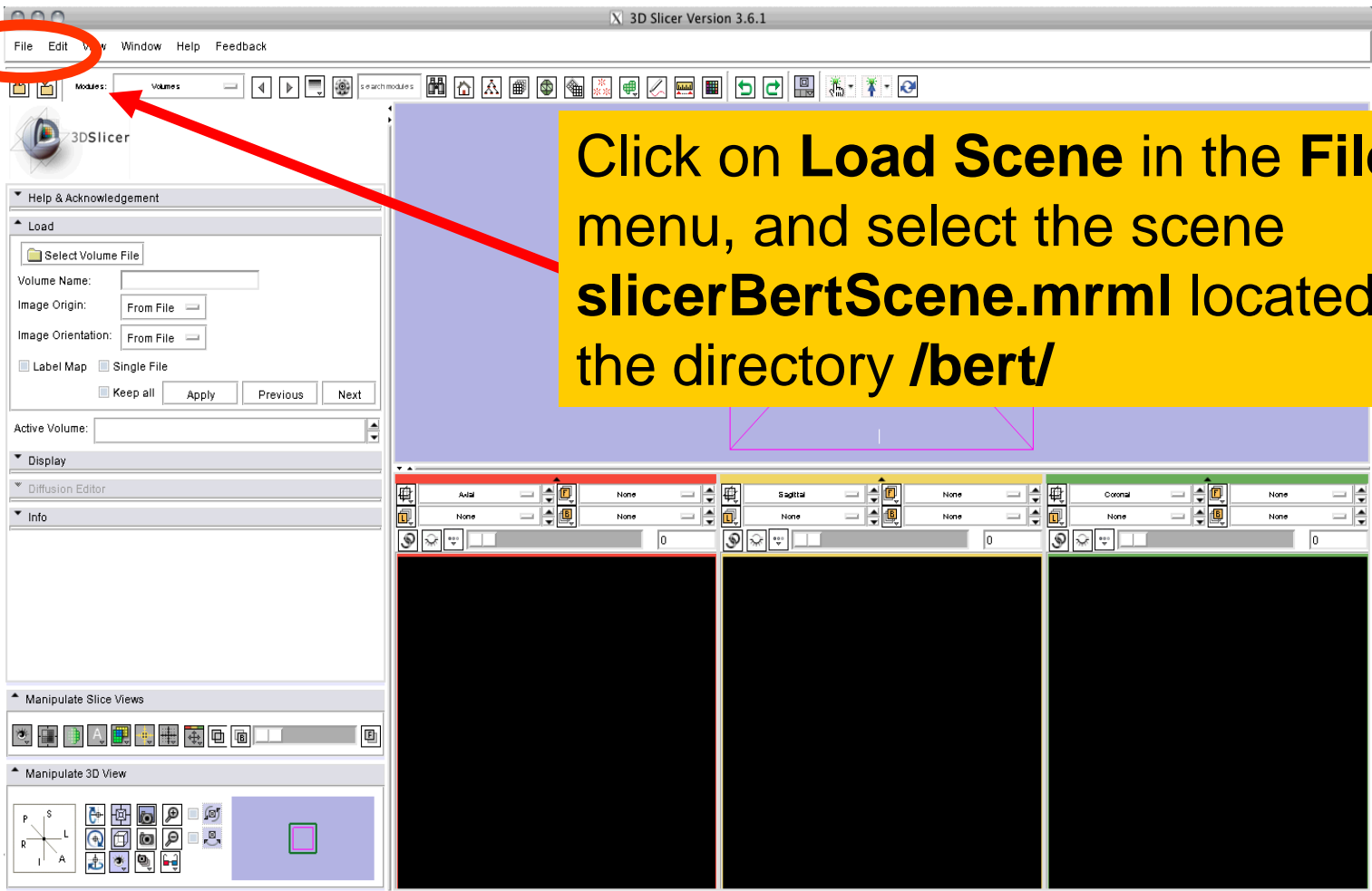


# Loading a Generic Scene File

Rename the file 'slicerGenericScene.mrml' located in the directory /bert/ 'slicerBertScene.mrml'



# Loading a Generic Scene File

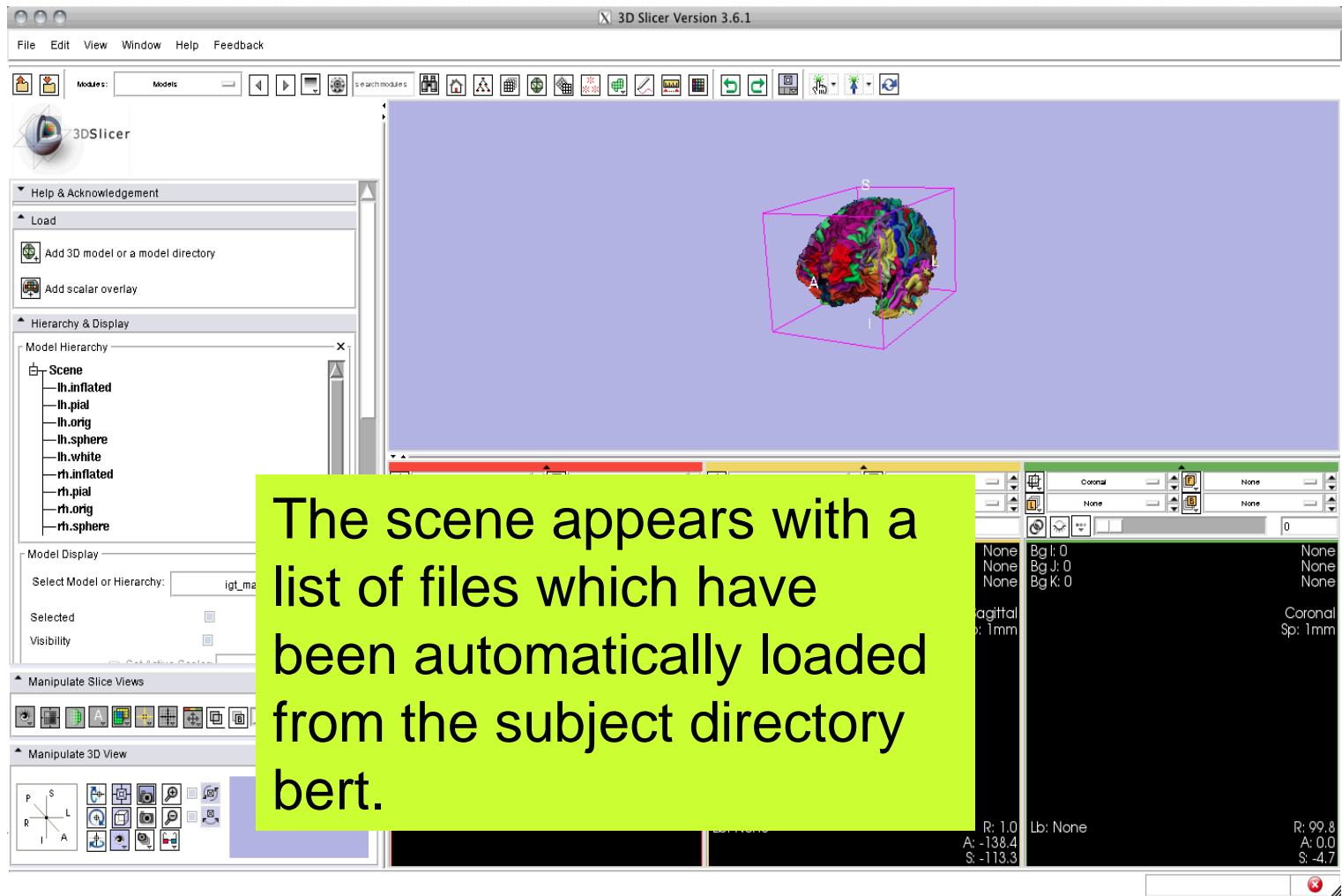


The screenshot shows the 3D Slicer 3.6.1 interface. The **File** menu is circled in red, and a red arrow points to the **Load** option. The **Load** dialog box is open, showing the **Select Volume File** section with fields for **Volume Name**, **Image Origin** (set to **From File**), and **Image Orientation** (set to **From File**). There are also checkboxes for **Label Map** and **Single File**, and buttons for **Keep all**, **Apply**, **Previous**, and **Next**. The **Active Volume** field is empty. The **Display** section is expanded, showing **Diffusion Editor** and **Info** sub-sections. The **Manipulate Slice Views** and **Manipulate 3D View** sections are also visible. The main 3D view area is currently black, with three viewports (Axial, Sagittal, Coronal) visible at the bottom. The status bar at the bottom left shows **None RAS: (131.2, -125.0, 1.0)**.

Click on **Load Scene** in the **File** menu, and select the scene  **slicerBertScene.mrml** located in the directory **/bert/**

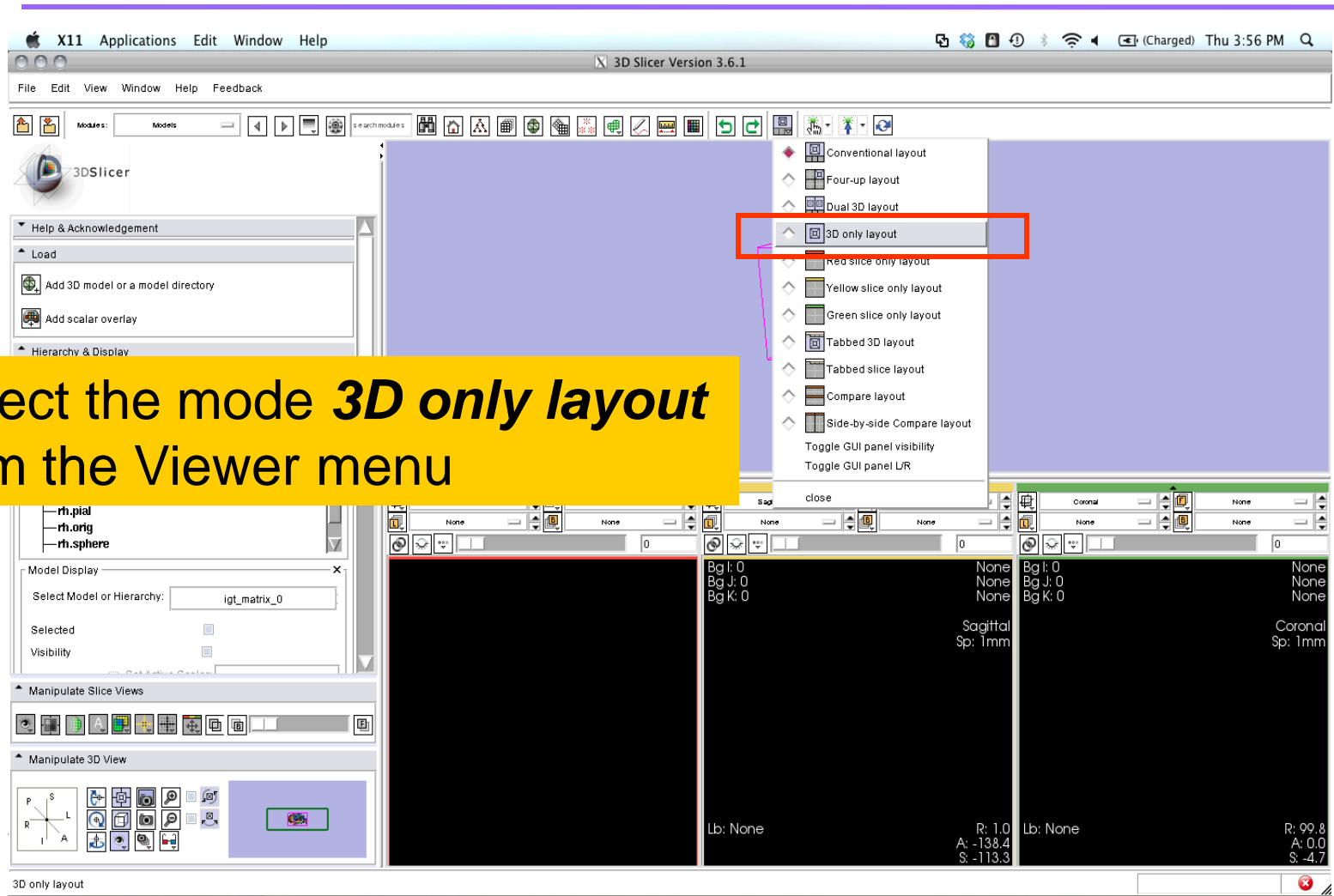


# Loading a Generic Scene File



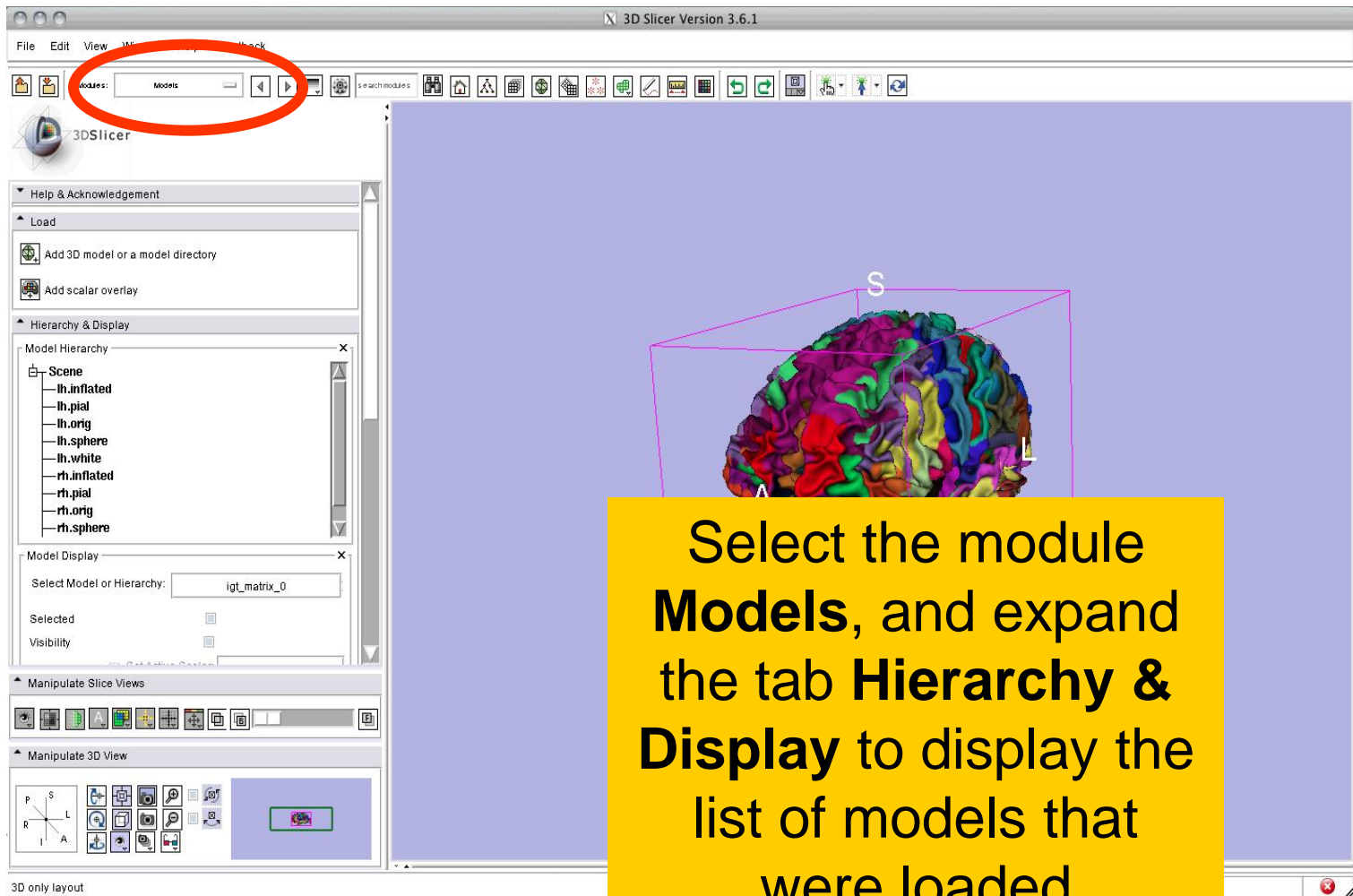


# Loading a Generic Scene File

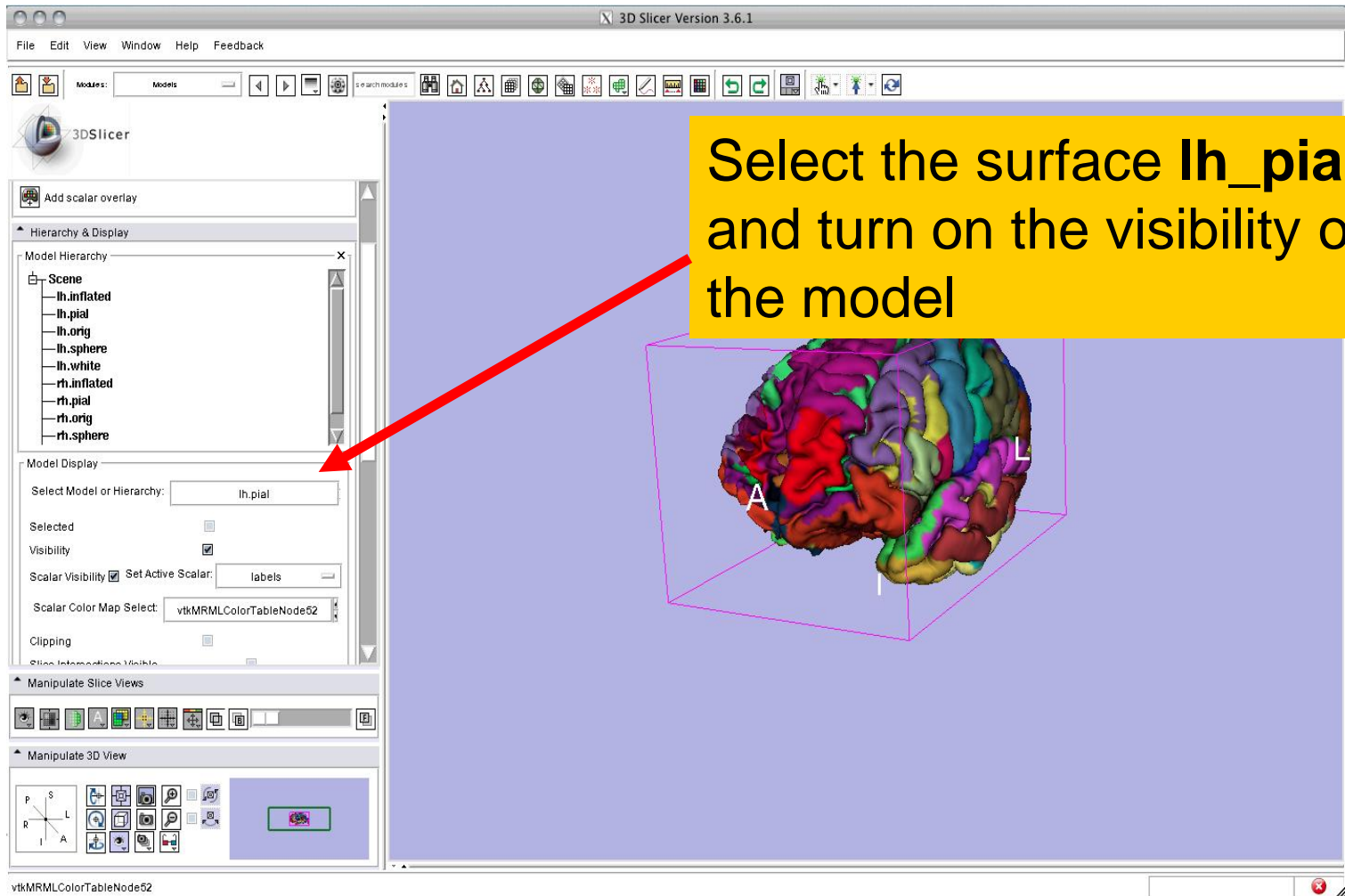




# Loading a Generic Scene File

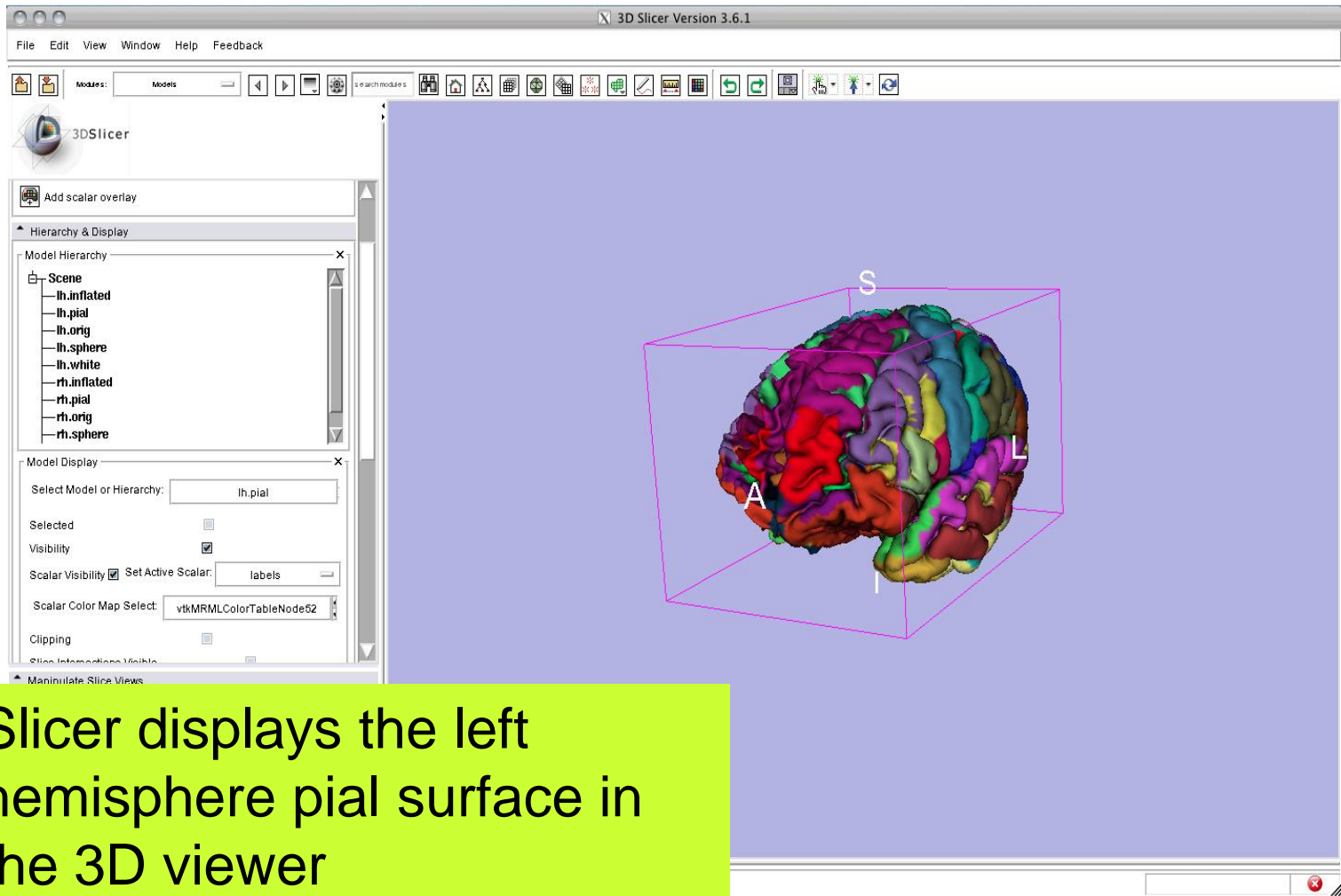


# Loading a Generic Scene File



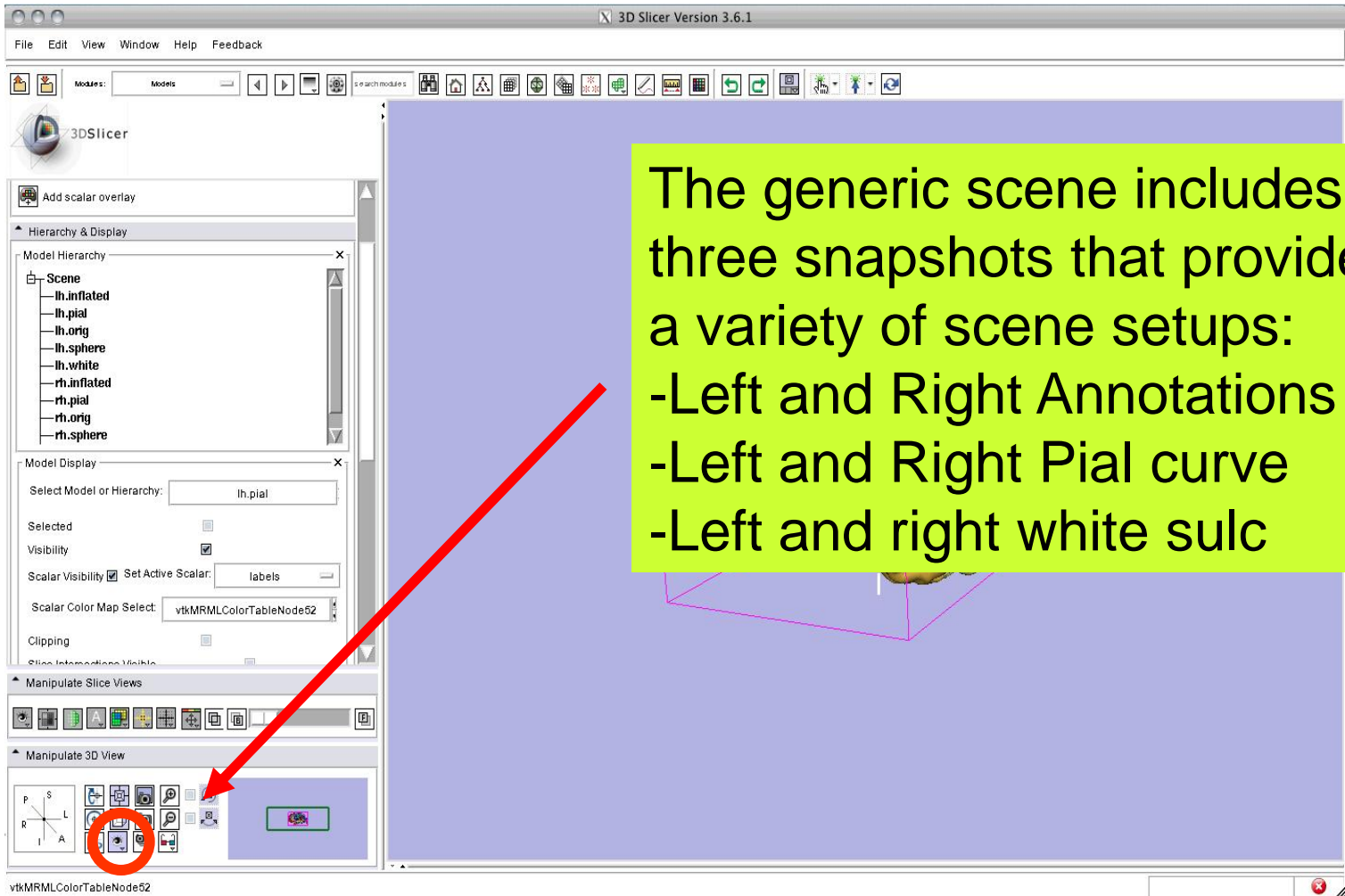


# Loading a Generic Scene File



Slicer displays the left hemisphere pial surface in the 3D viewer

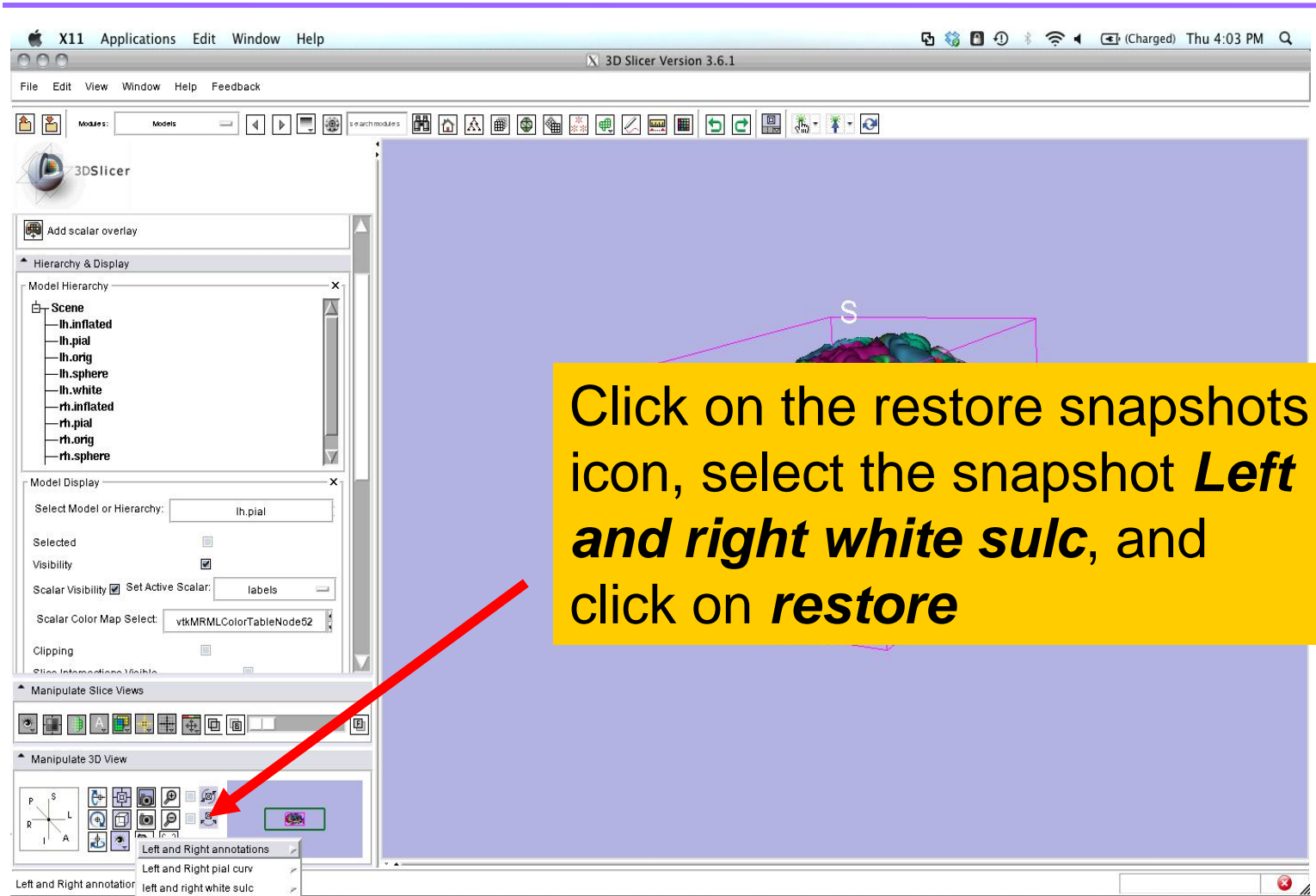
# Loading a Generic Scene File



The generic scene includes three snapshots that provide a variety of scene setups:

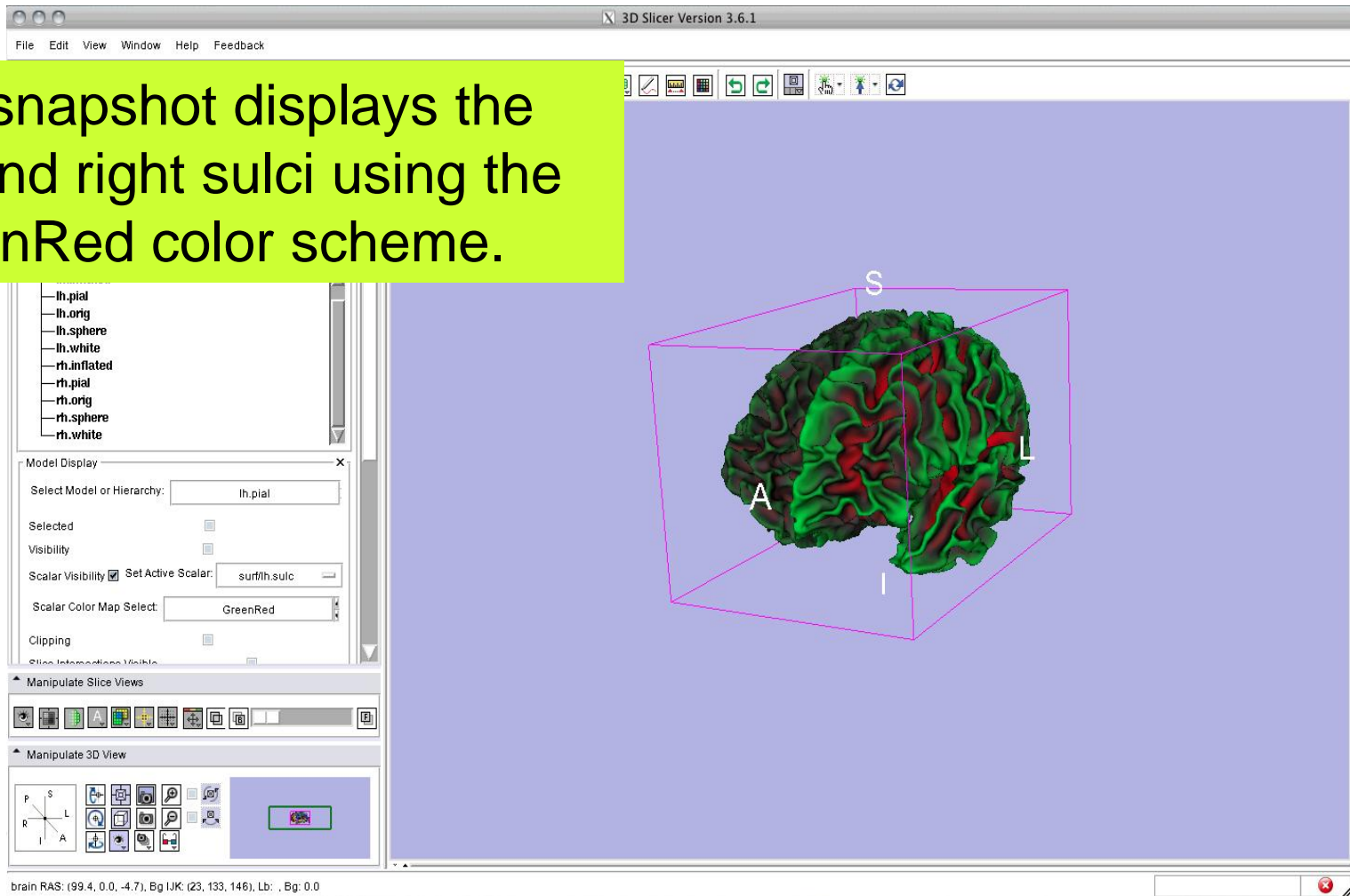
- Left and Right Annotations
- Left and Right Pial curve
- Left and right white sulc

# Loading a Generic Scene File

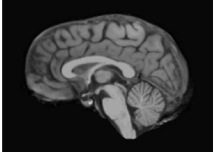
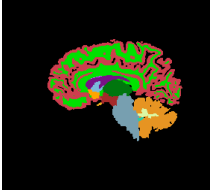
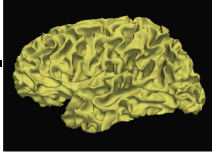
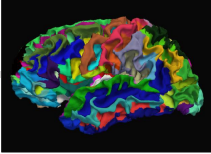
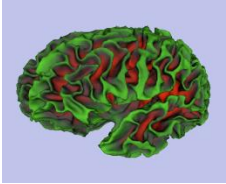


# Loading a Generic Scene File

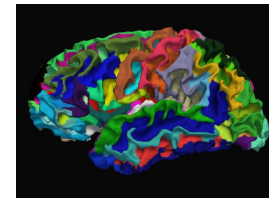
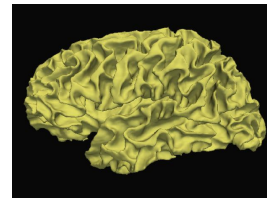
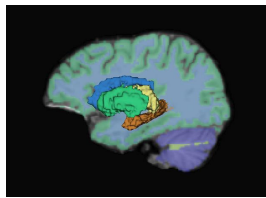
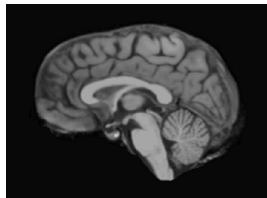
The snapshot displays the left and right sulci using the GreenRed color scheme.



From **FreeSurfer**, **Slicer3** can load:

- Brain volumes . . . . . 
- ASEG volumes . . . . . 
- Surfaces . . . . . 
- Parcellation Maps . . . . . 
- All of the above, via a scene file. . . . . 

- 3D visualization of brain segmented surfaces and parcellation maps
- Intuitive graphical user interface to interact with FreeSurfer data
- Multi platforms open-source environment



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