



NA-MIC

National Alliance for Medical Image Computing

<http://na-mic.org>

Interactive Editor tutorial

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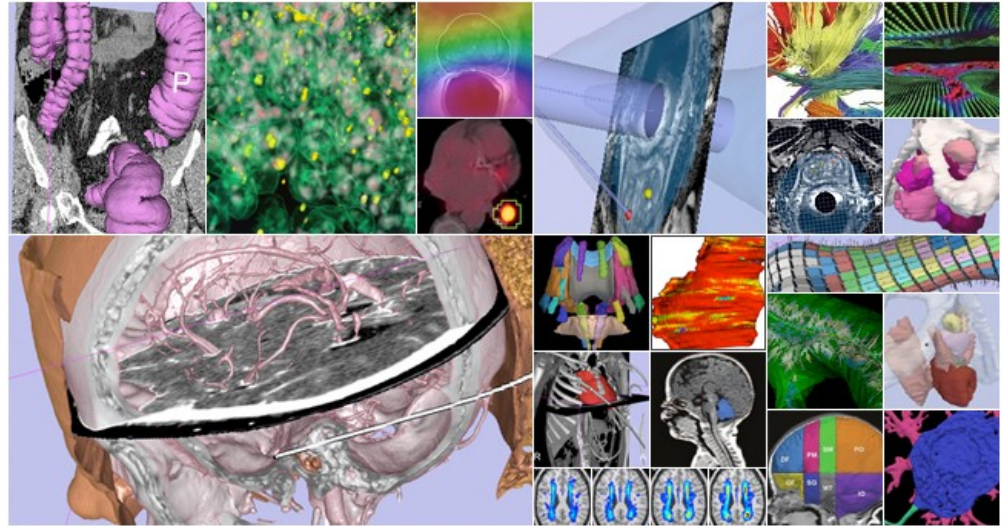
Harvard Medical School



Slicer3.6

- An **end-user application** for image analysis

- An **open-source environment** for software development

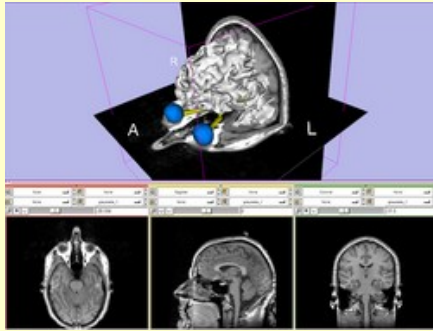


- A software platform that is both **easy to use for clinical researchers** and **easy to extend for programmers**



Pre-requisite

- This course supposes that you have taken the following tutorial:



'Slicer3 Data Loading and Visualization'
Sonia Pujol, PhD

http://www.slicer.org/slicerWiki/index.php/Slicer3.6:Training#Software_tutorials



Material

This course requires the following material

- Slicer3.6 release version available at

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

- EditorTutorialData.zip available at

<http://www.slicer.org/slicerWiki/index.php/File:EditorTutorialDataset.zip>

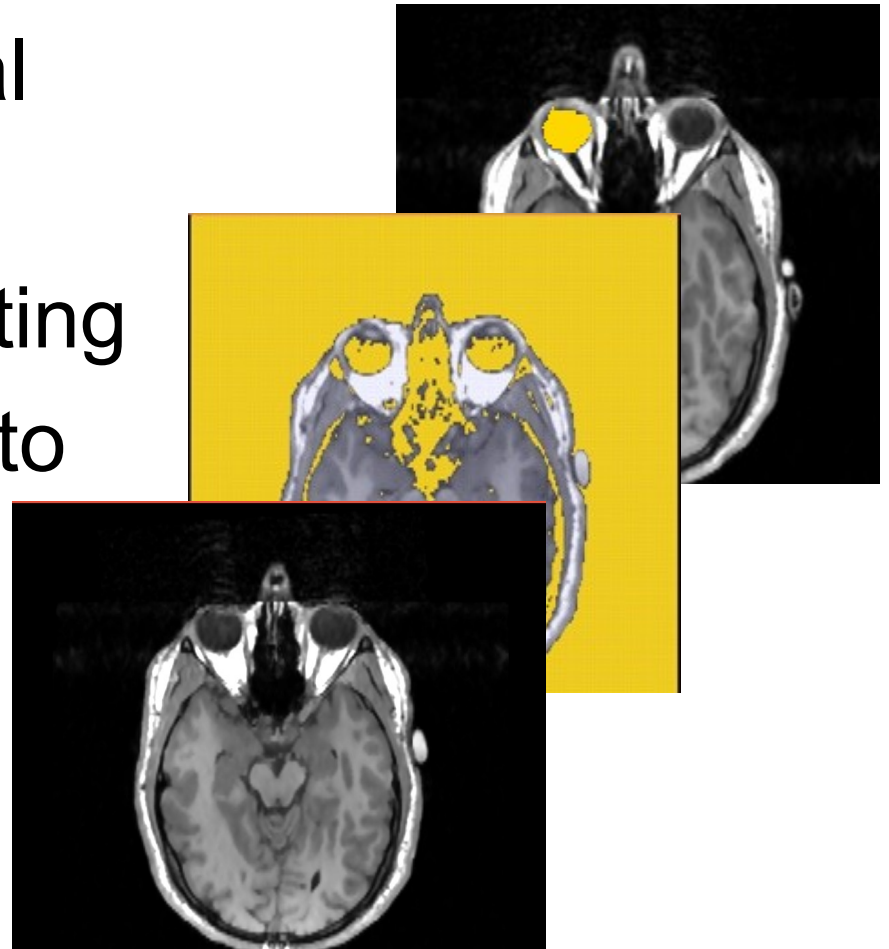
Disclaimer

It is the responsibility of the user of 3DSlicer to comply with both the terms of the license and with the applicable laws, regulations and rules.



Learning Objective

The goal of this tutorial to train you to use the suite of interactive editing tools built in Slicer3.6 to create and edit label maps.





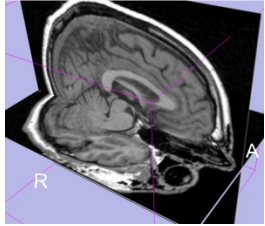
Label map



A **label map** has a number at each pixel representing the anatomy present at that point.



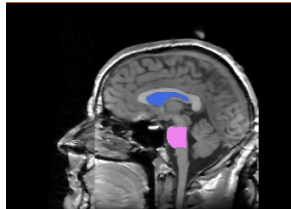
Overview



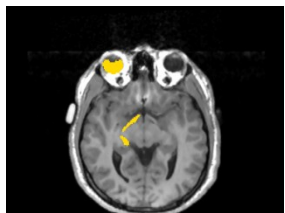
Part 1: Creating a single label map

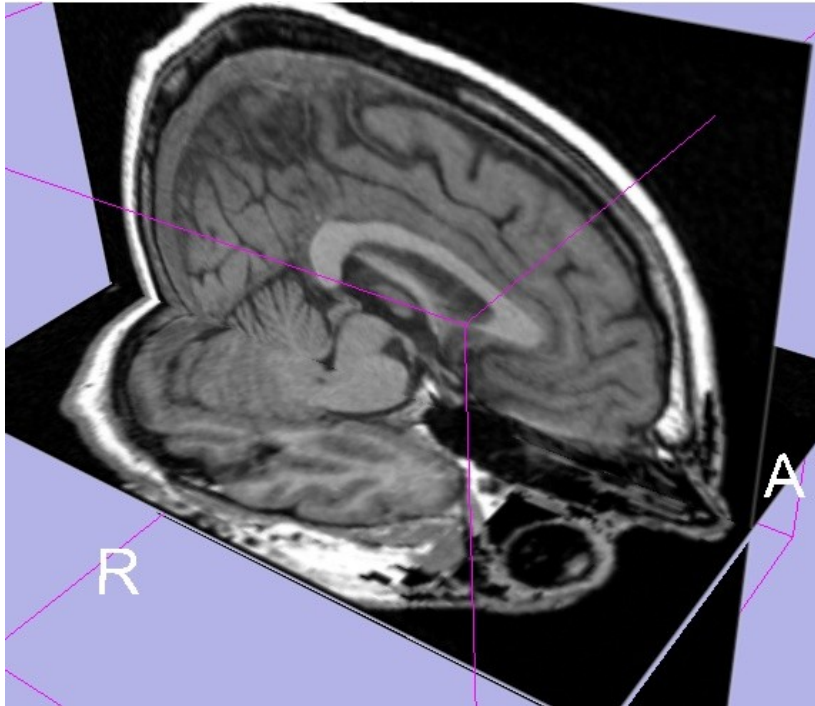


Part 2: Editing a single label map



Part 3: Creating and editing a label map with multiple labels

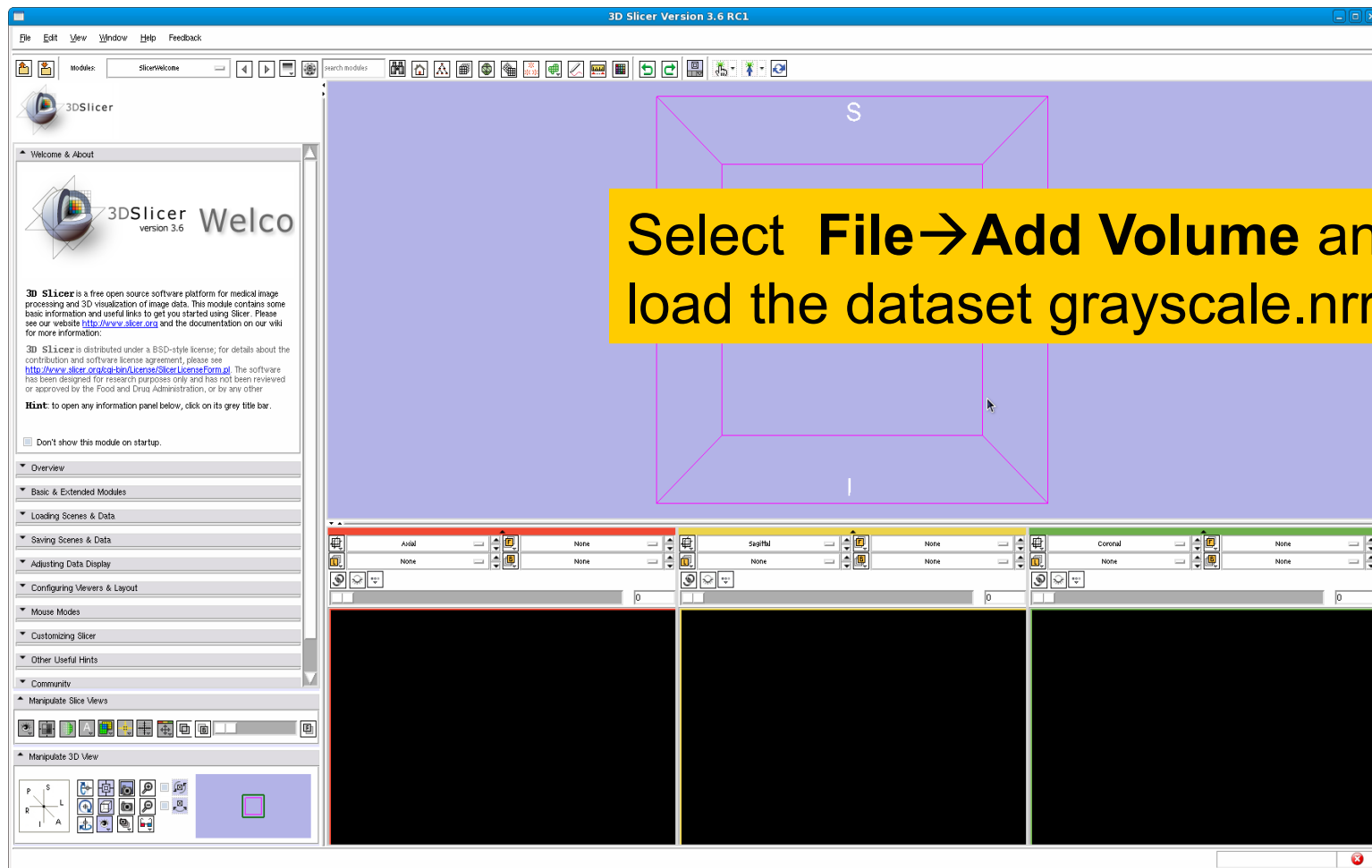




Part 1: Creating a single label map

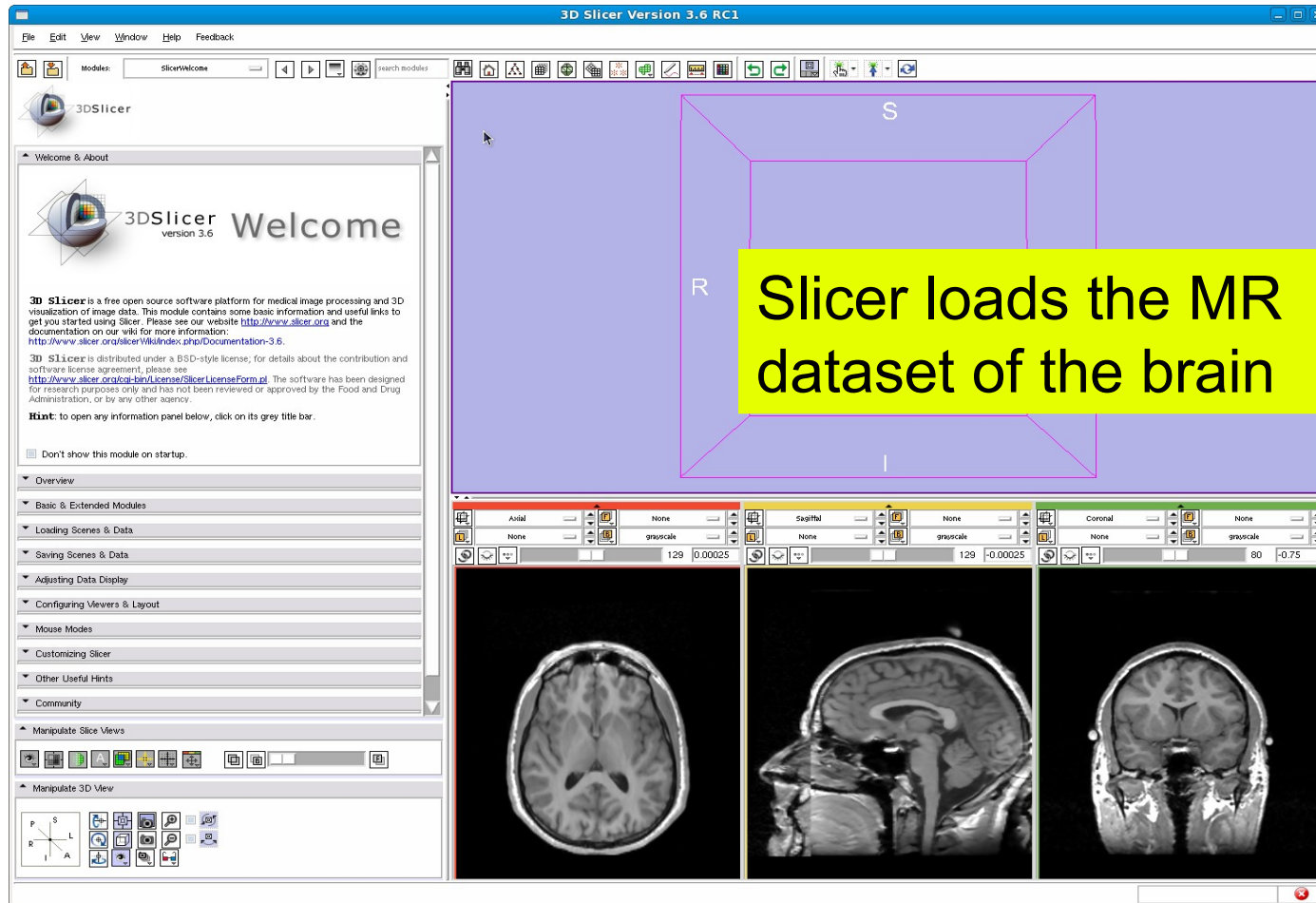


Data Loading



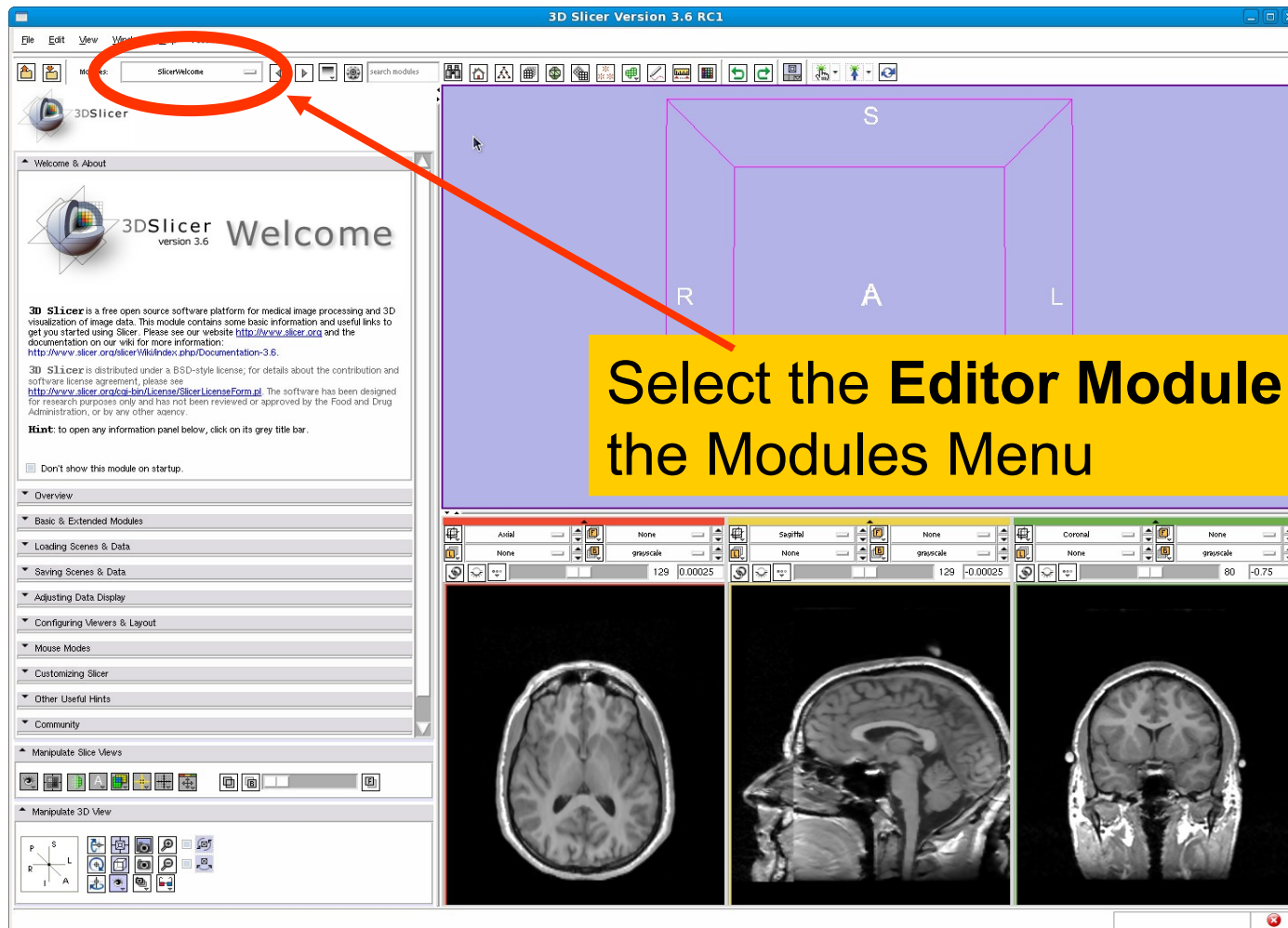


Data Loading



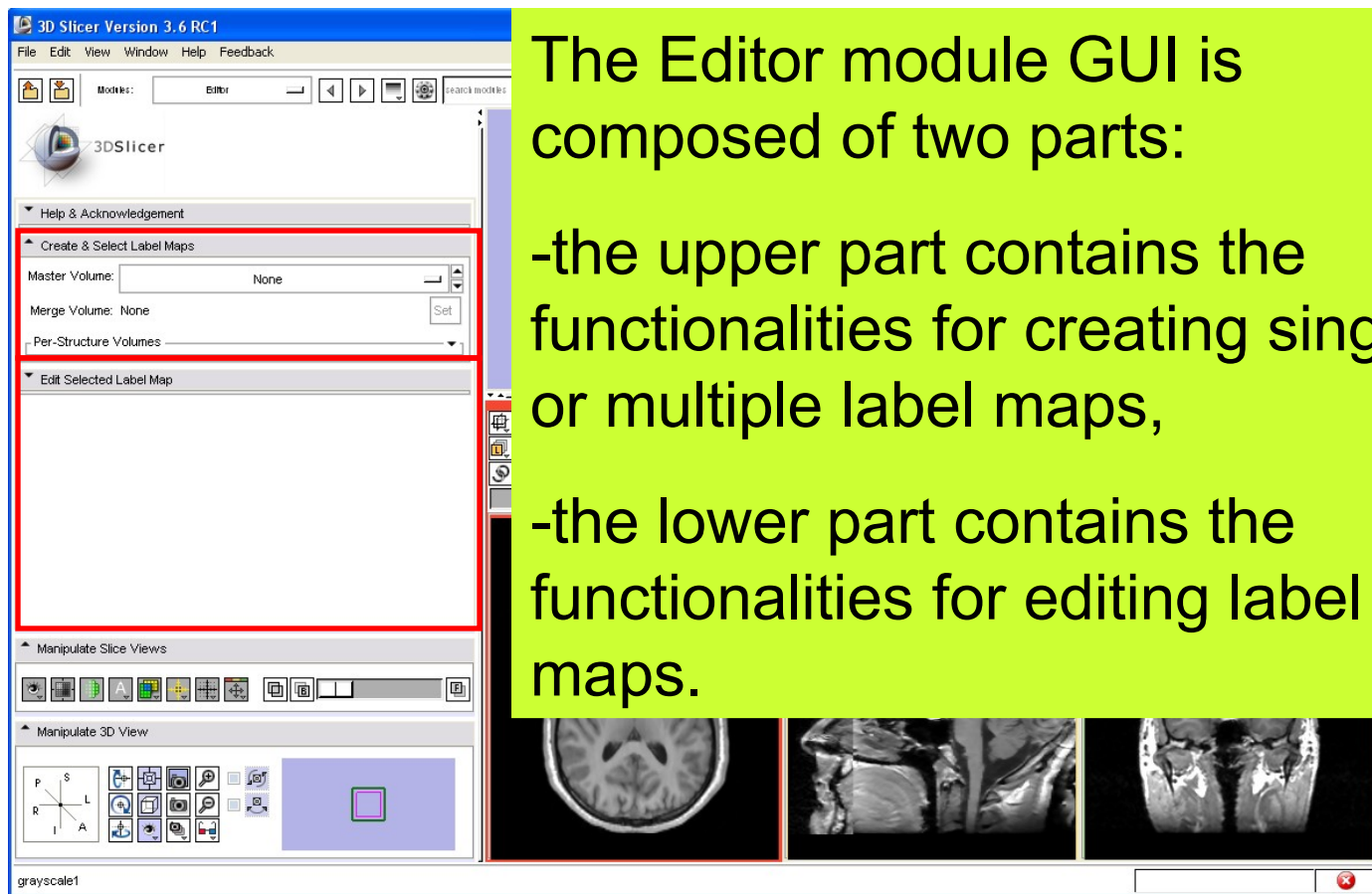


Data Loading





Editor Module

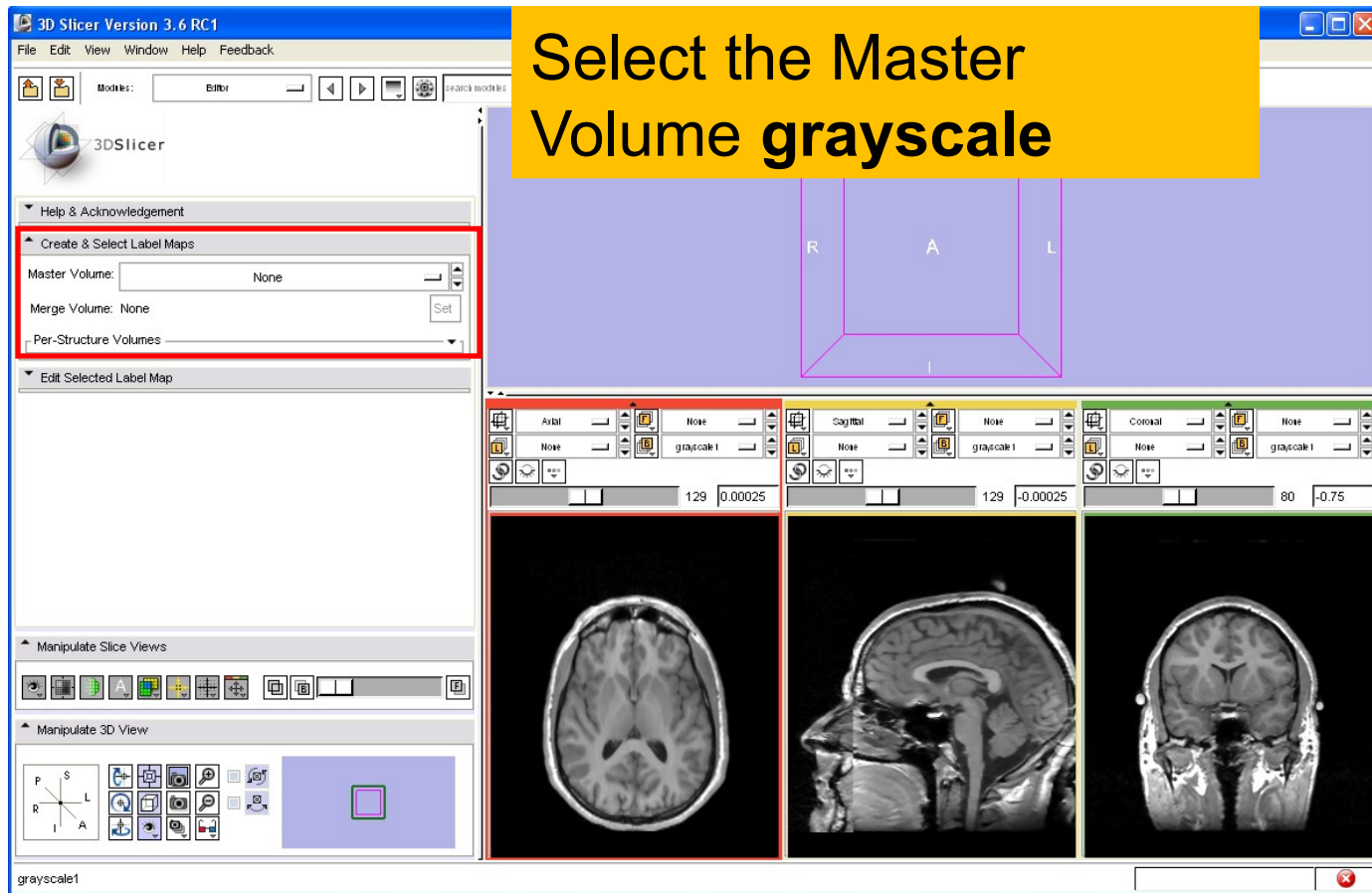


The Editor module GUI is composed of two parts:

- the upper part contains the functionalities for creating single or multiple label maps,
- the lower part contains the functionalities for editing label maps.

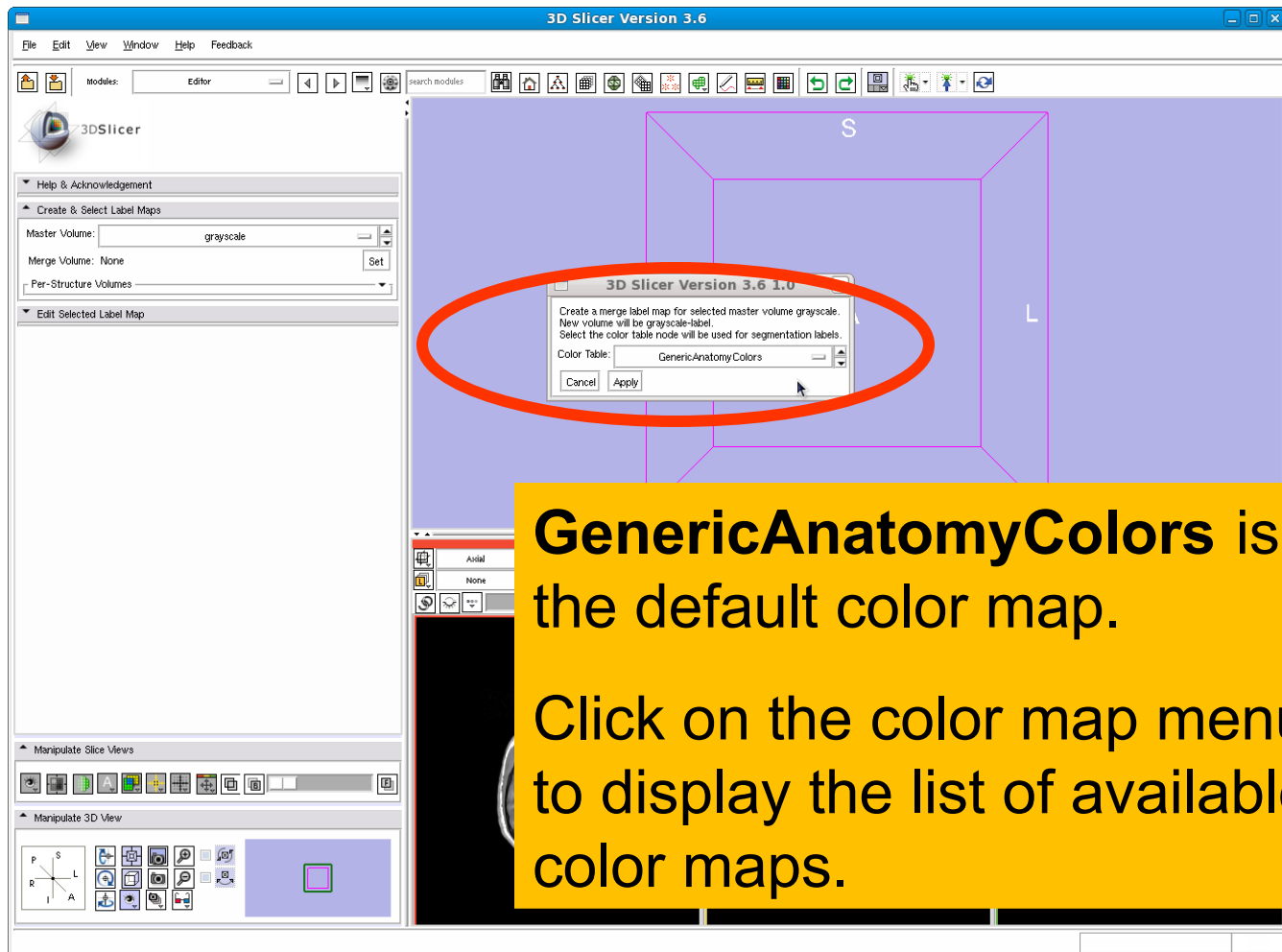


Label Map Creation





Label Map Creation

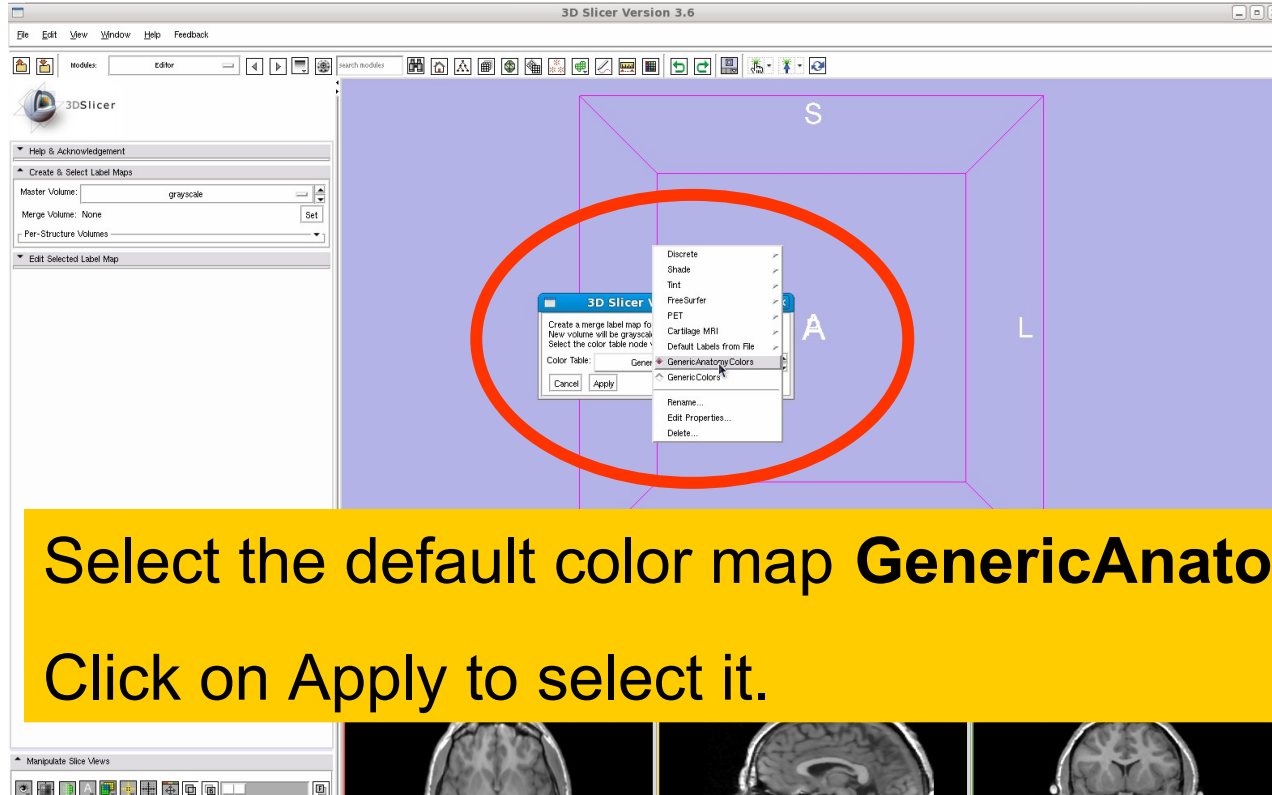


GenericAnatomyColors is the default color map.

Click on the color map menu to display the list of available color maps.



Label Map Creation



Select the default color map **GenericAnatomyColors**

Click on Apply to select it.

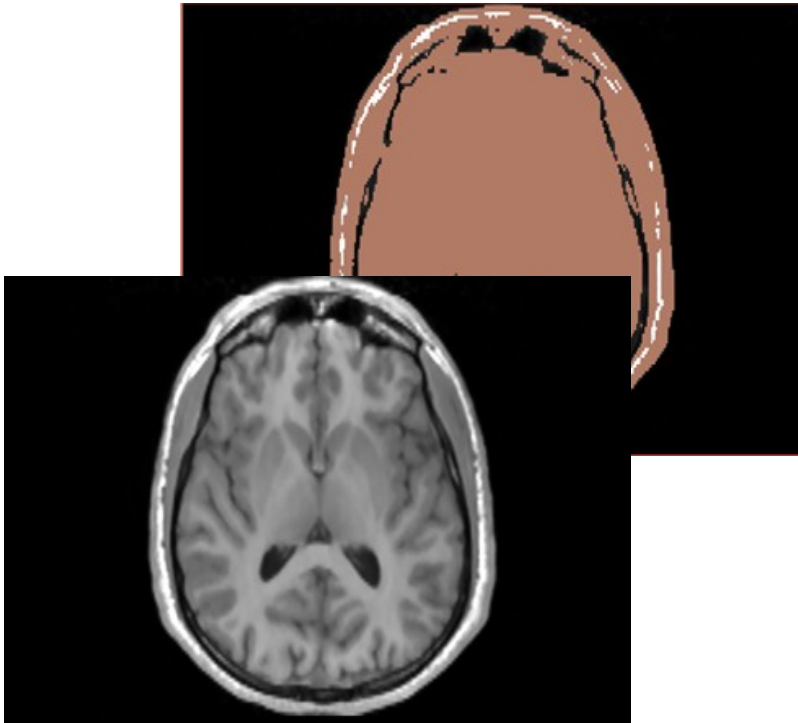
Note: You may use the Colors module if you need a custom or application specific color map



Label Map Creation

Slicer creates the empty label map **grayscale-label** and displays the frame which contains the different tools for interactive editing.

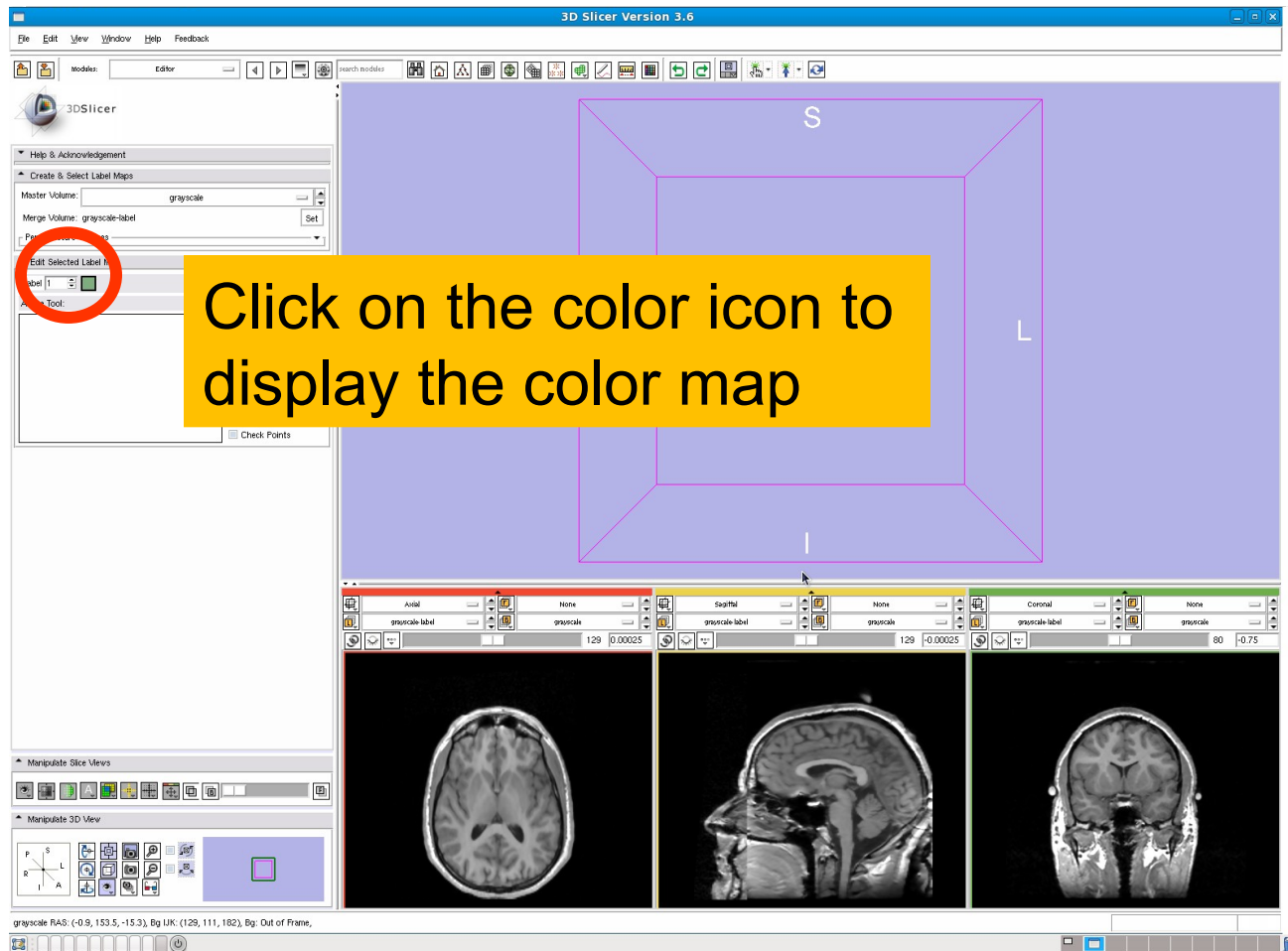
The screenshot shows the 3D Slicer software interface. The 'Edit Selected Label Map' panel on the left is circled in red. A yellow text box is overlaid on the right side of the interface, containing the text: 'Slicer creates the empty label map **grayscale-label** and displays the frame which contains the different tools for interactive editing.' The interface includes a menu bar, a toolbar, a central 3D view area, and a bottom panel with three slice views (Axial, Sagittal, Coronal). The 'grayscale-label' volume is selected in the 'grayscale-label' panel.



Part 2: Editing a single label map

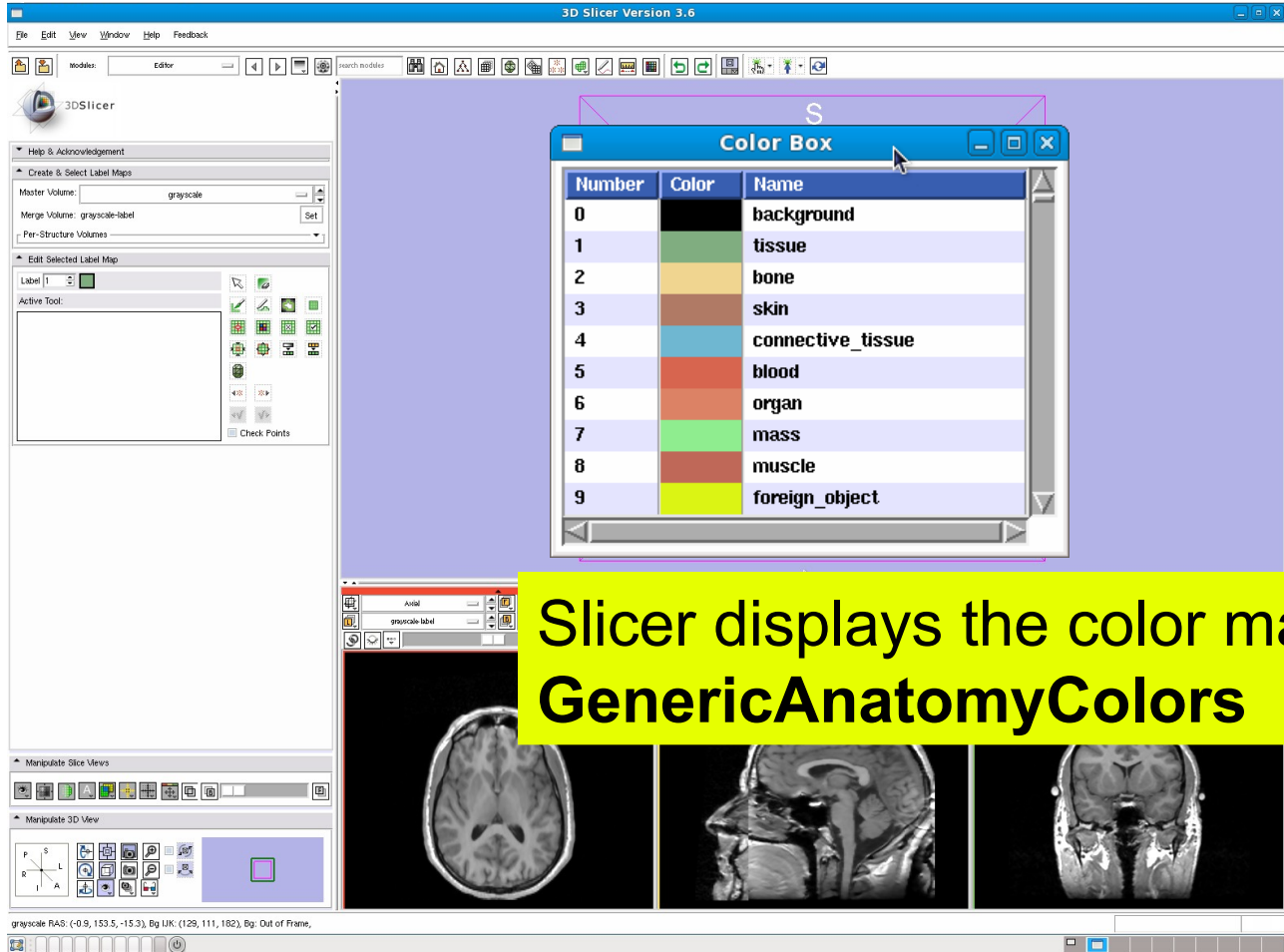


Label Map Editing





Label Map Editing



Slicer displays the color map
GenericAnatomyColors



Label Map Editing

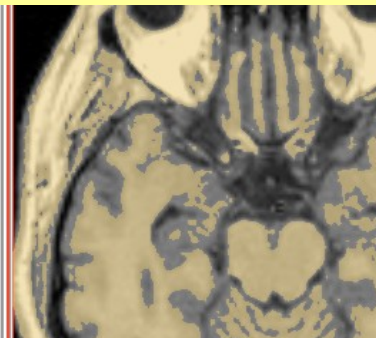
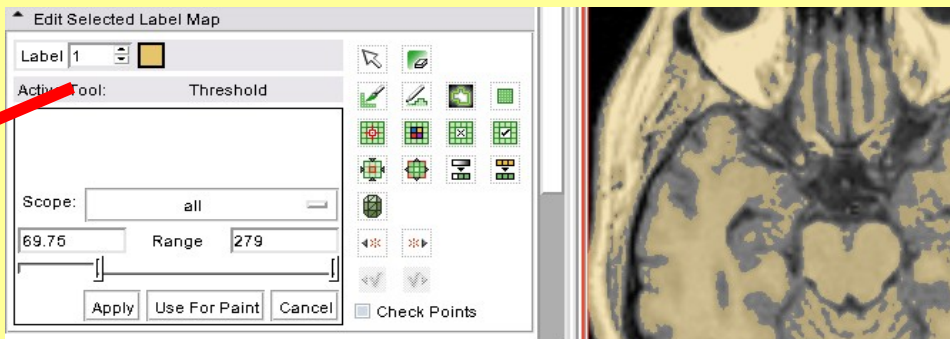
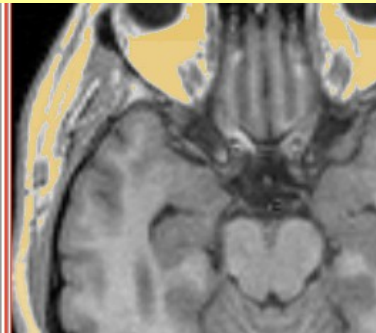
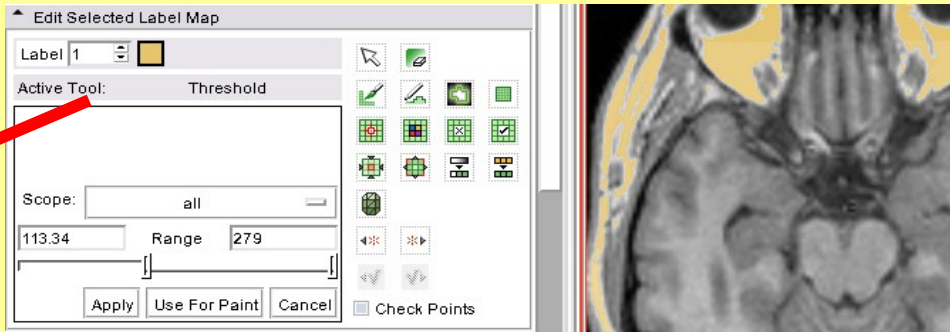
Browse through the list of 307 labels to explore the color map **GenericAnatomyColors**

Select the label #3 'Skin'

Number	Color	Name
125		pia_mater
126		muscles_of_head
127		salivary_glands
128		lips
129		nose
130		tongue
131		soft_palate
132		right_inner_ear
133		left_inner_ear
134		right_external_ear
135		left_external_ear
136		right_middle_ear
137		left_middle_ear
138		right_eyeball
139		left_eyeball
140		skull
141		right_frontal_bone
142		left_frontal_bone
143		right_parietal_bone
144		left_parietal_bone
145		right_temporal_bone
146		left_temporal_bone
147		right_sphenoid_bone
148		left_sphenoid_bone
149		right_ethmoid_bone
150		left_ethmoid_bone
151		occipital_bone
152		maxilla
153		right_zygomatic_bone
154		right_lacrimal_bone
155		vomer_bone
156		right_palatine_bone
157		left_palatine_bone
158		mandible
159		neck
160		muscles_of_neck
161		pharynx
162		larynx
163		thyroid_gland
164		right_parathyroid_glands
165		left_parathyroid_glands




Threshold



Description: The grey level volume voxels for which the intensity is within the specified range will be assigned the same label in the label map.



Threshold Effect

Select the Threshold tool 

Use the threshold slider to set the min and max values close to **24** and **120** and click on **Apply**

3D Slicer Version 3.6

File Edit View Window Help Feedback

modules: Editor

3DSlicer

Help & Acknowledgement

Create & Select Label Maps

Master Volume: grayscale

Merge Volume: grayscale-label

Per-Structure Volumes

Edit Selected Label Map

Label 3

Active Tool: Threshold

Scope: all

Range 80 320

Apply Use For Paint Cancel Checkpoints

Manipulate Slice Views

Manipulate 3D View

Feedback

3D View: Axial, Sagittal, Coronal

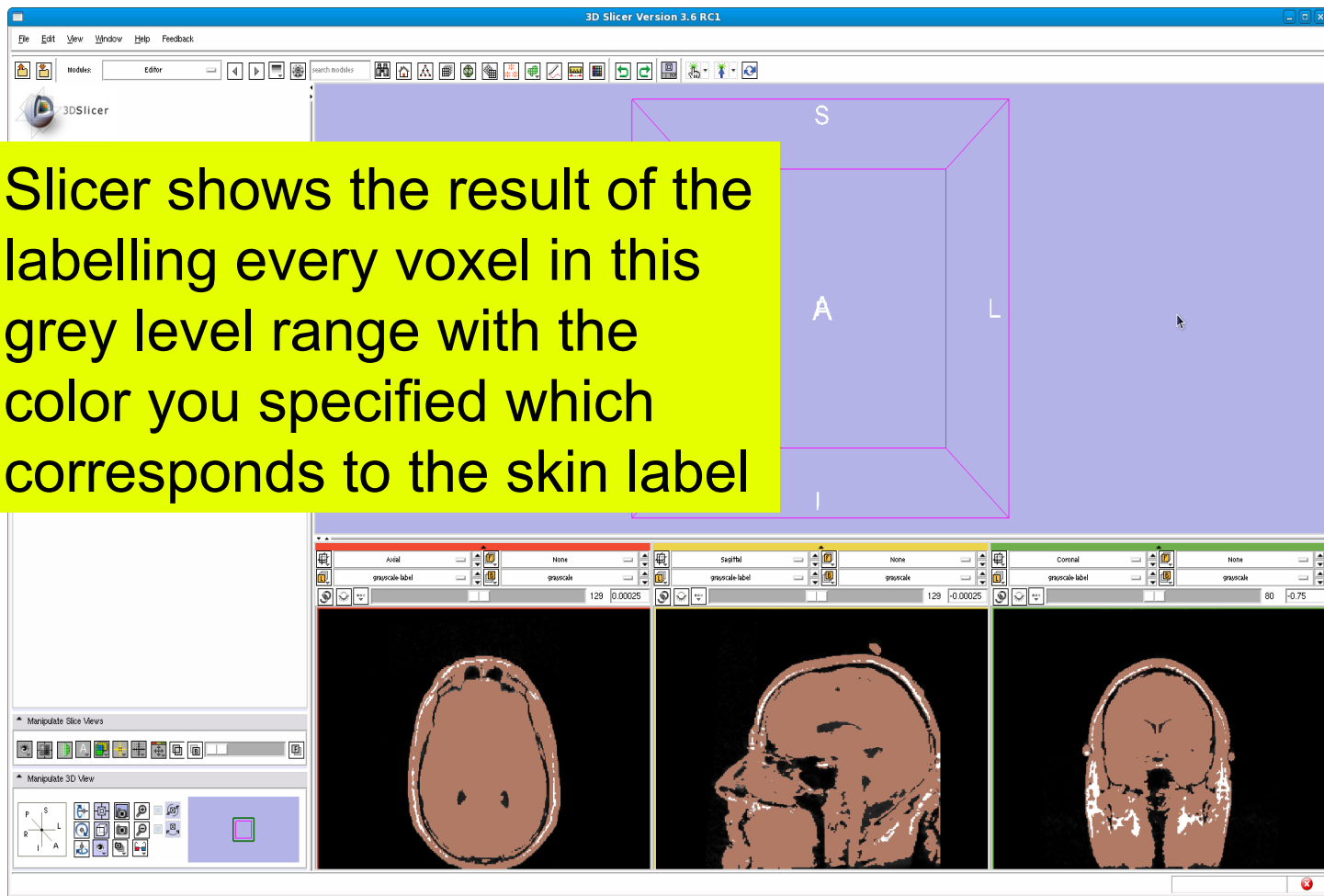
grayscale-label, grayscale-label, grayscale-label

129 0.00025, 129 -0.00025, 80 -0.75



Threshold Effect

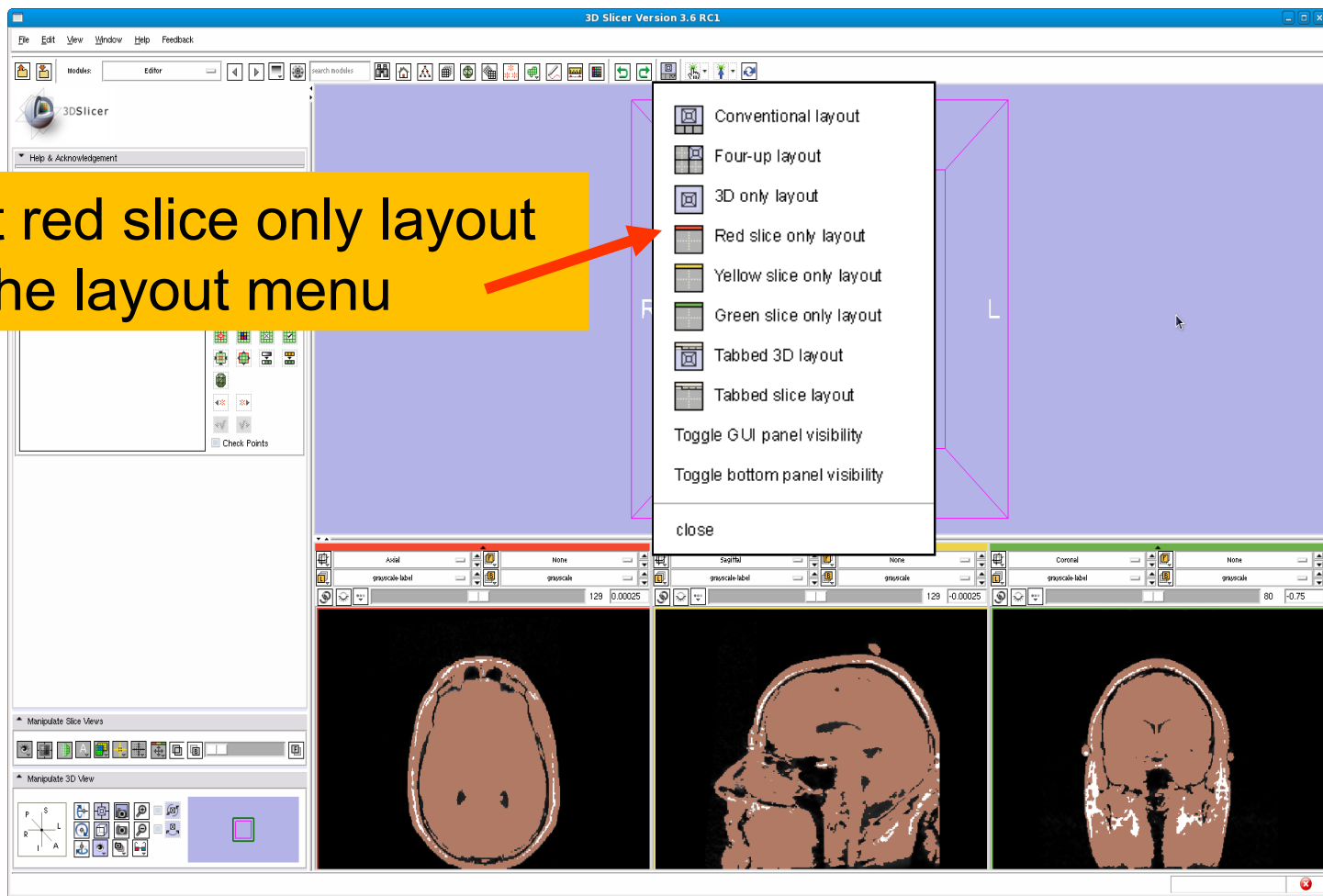
Slicer shows the result of the labelling every voxel in this grey level range with the color you specified which corresponds to the skin label





Threshold Effect

Select red slice only layout from the layout menu





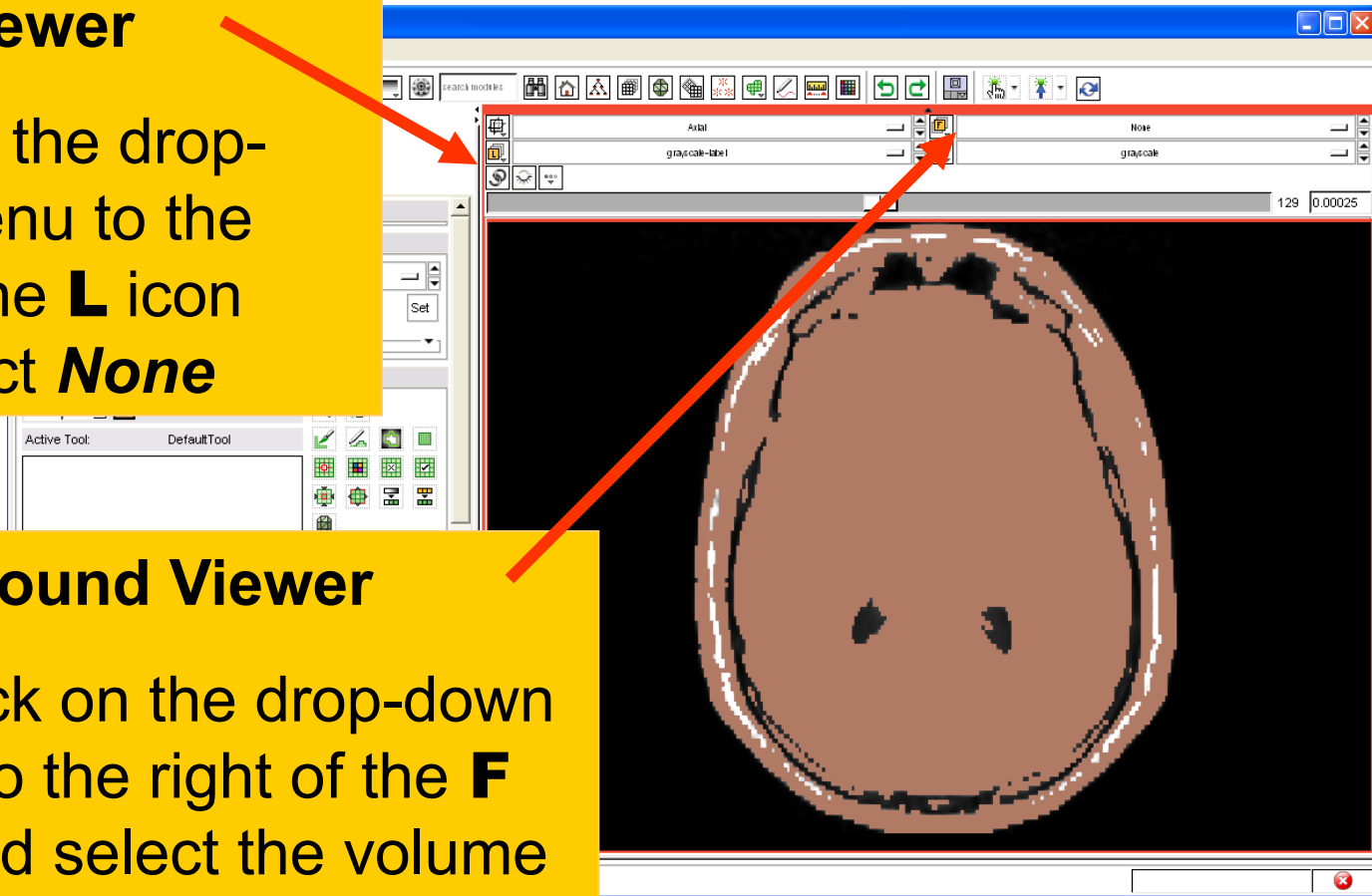
Threshold Effect

Label Viewer

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

Foreground Viewer

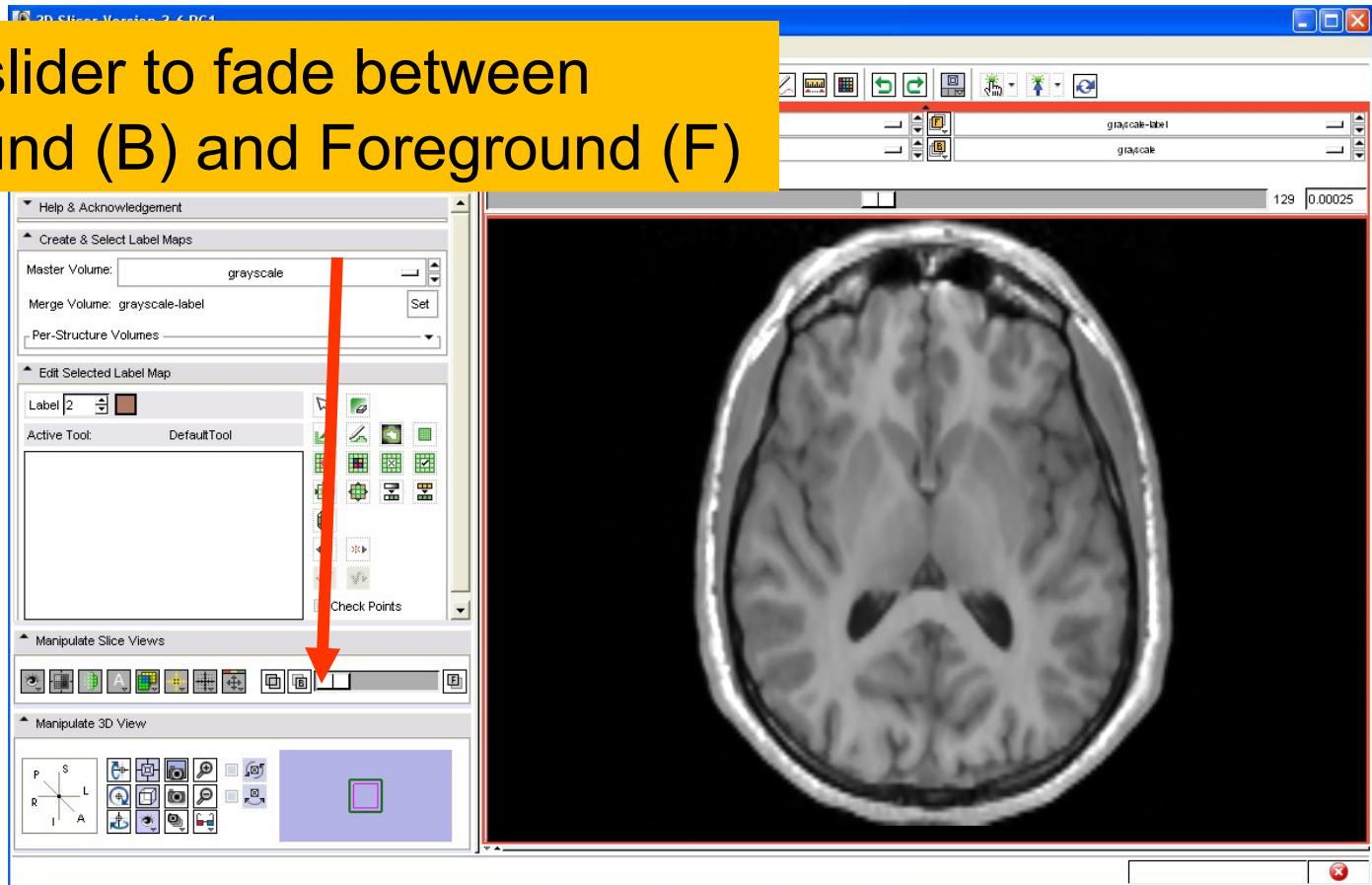
Left click on the drop-down menu to the right of the **F** icon and select the volume **grayscale-label**





Threshold Effect

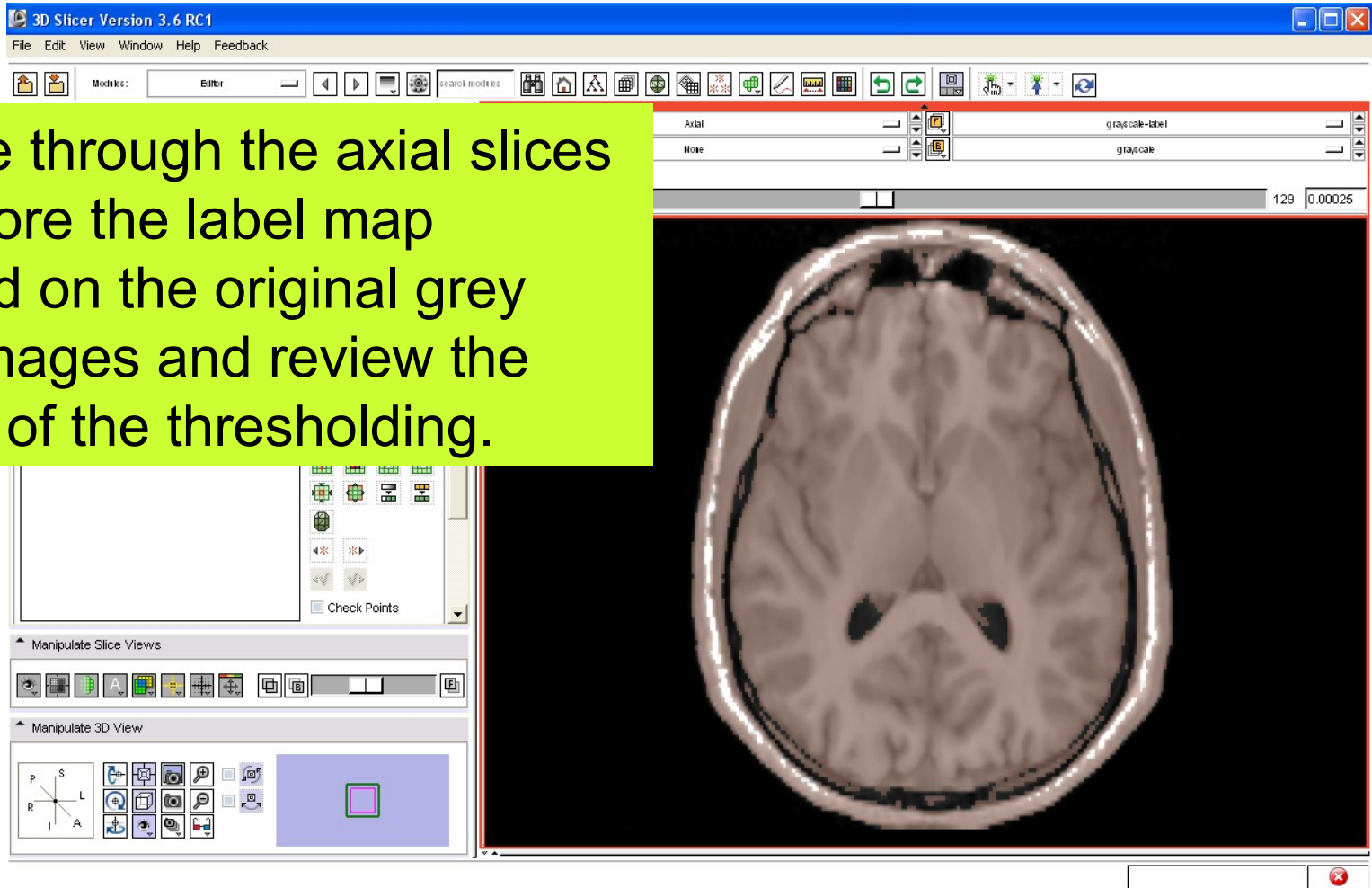
Use the slider to fade between Background (B) and Foreground (F)





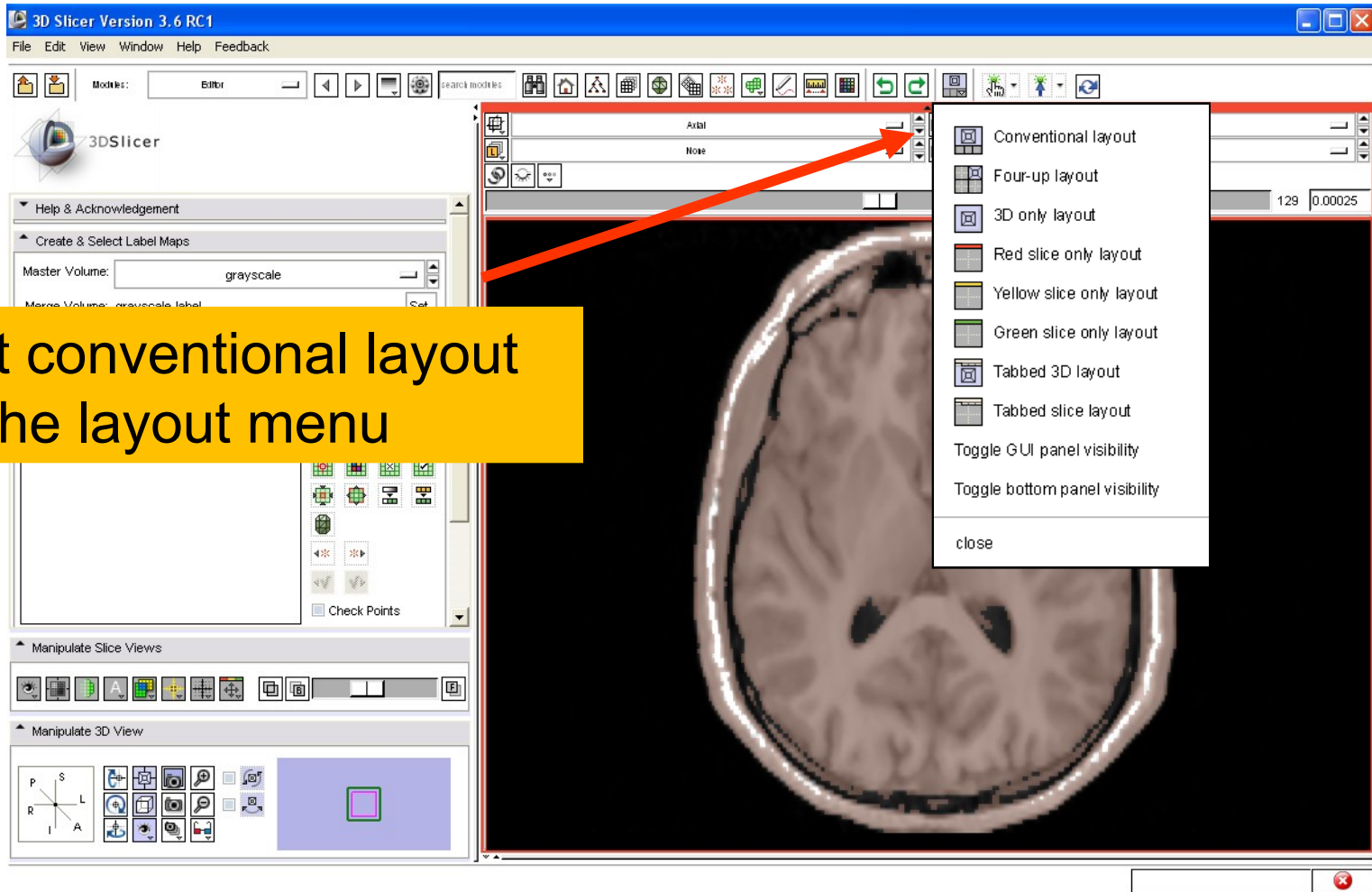
Exploring the result

Browse through the axial slices to explore the label map overlaid on the original grey level images and review the results of the thresholding.

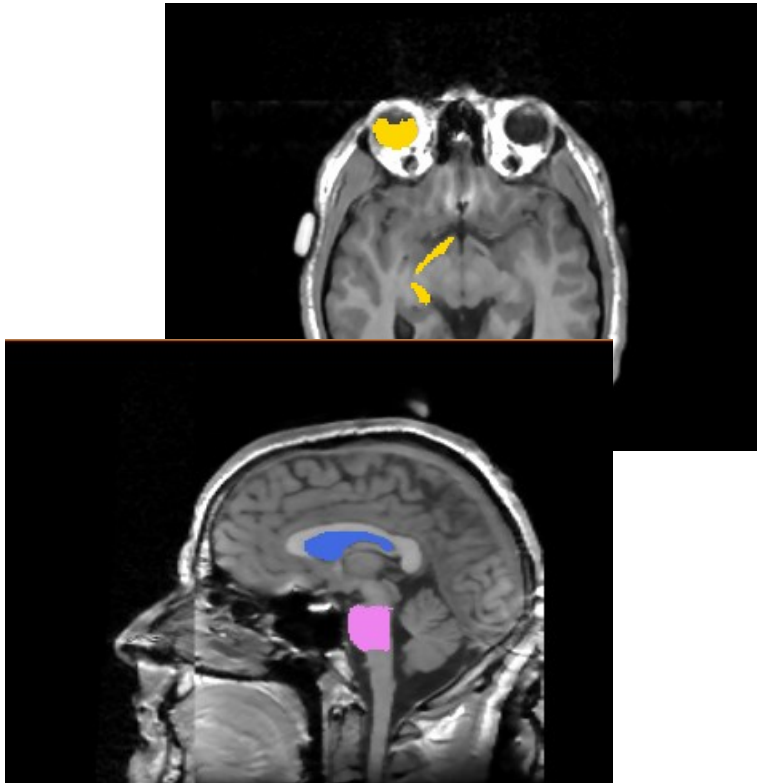




Threshold Effect



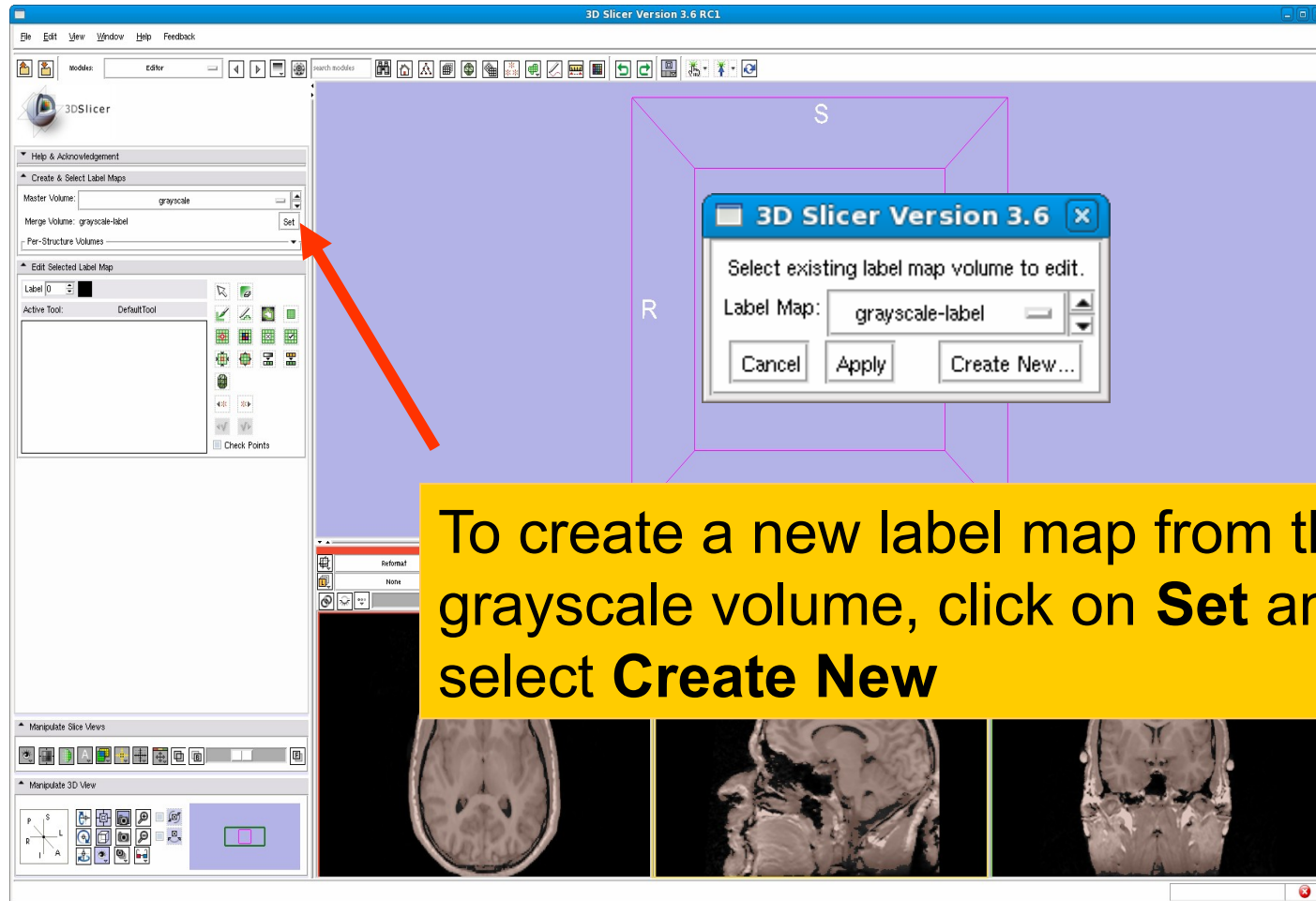
Select conventional layout
from the layout menu



Part 3: Creating and editing a label map with multiple labels



Creating a map with multiple labels

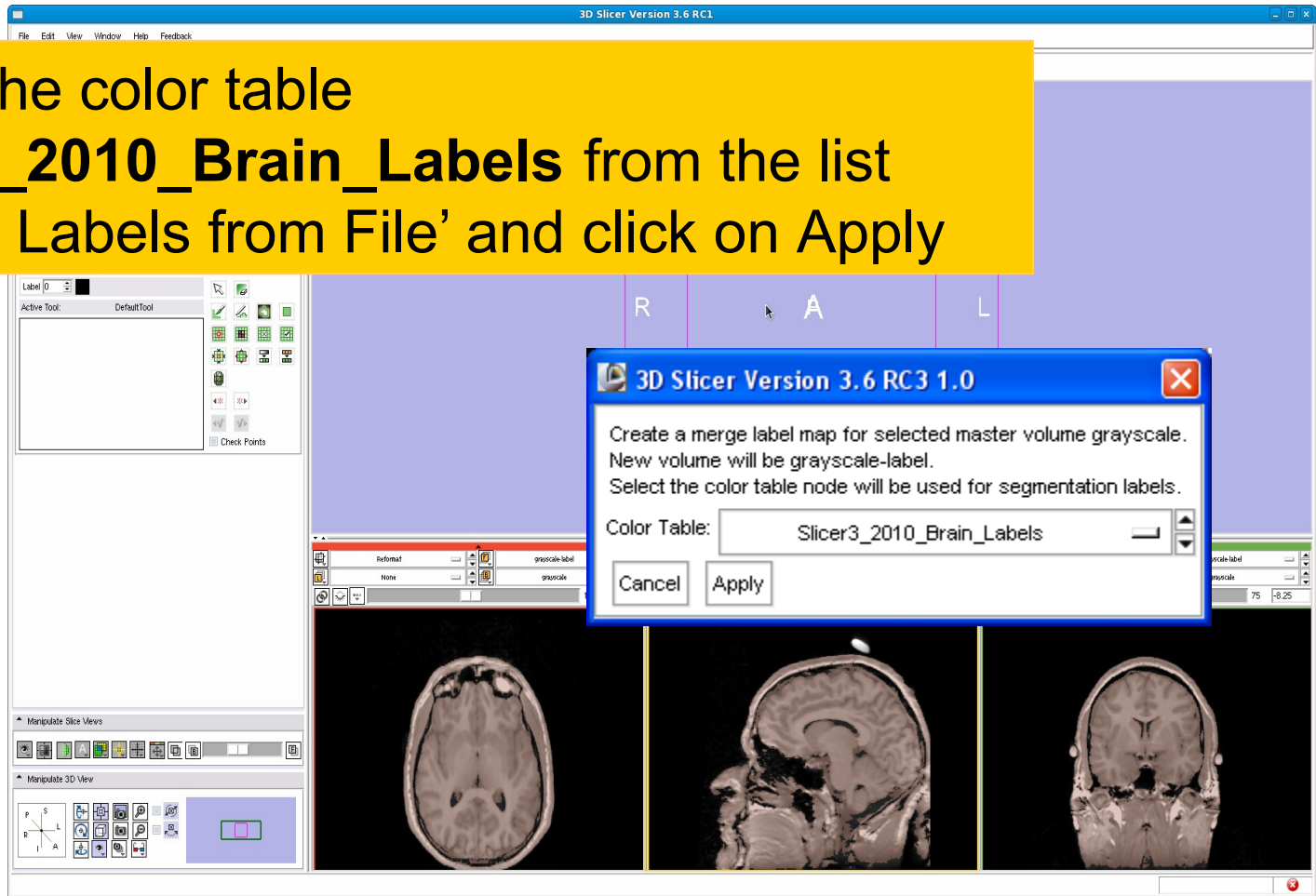




Creating a map with multiple labels

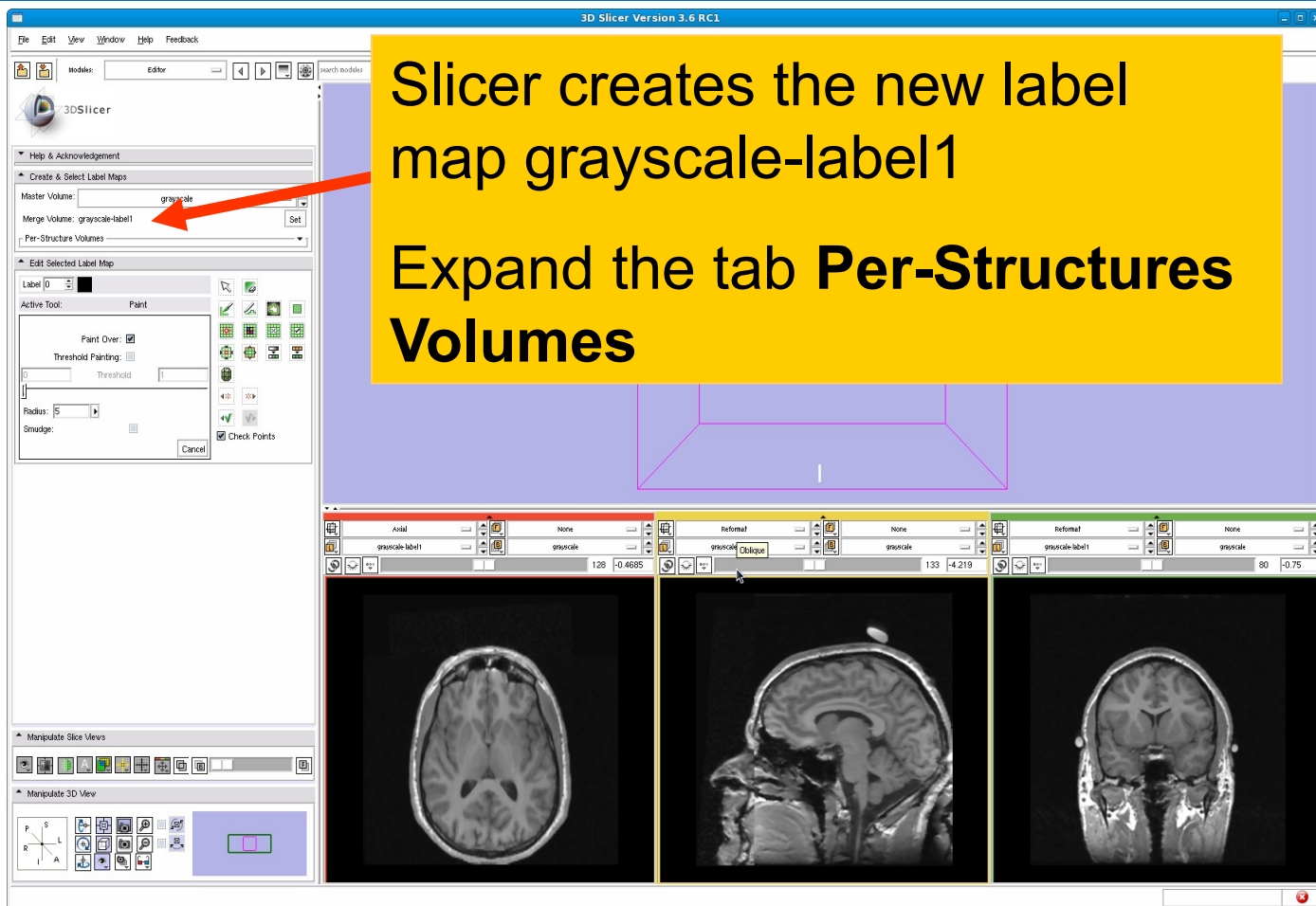
Select the color table

Slicer3_2010_Brain_Labels from the list
'Default Labels from File' and click on Apply





Creating a map with multiple labels





Adding a structure

Click on **Add Structure**, browse through the list of labels in the color map and select the color label #14 'Structure_1'

Number	Color	Name
6	Blue	Ventricles
7	Red	Arteries
8	Dark Blue	Veins
9	Gray	Gray_matter
10	White	White_matter
11	Green	Tumor
12	Cyan	Edema
13	Purple	Necrosis
14	Magenta	Structure_1
15	Yellow	Structure_2



Drawing

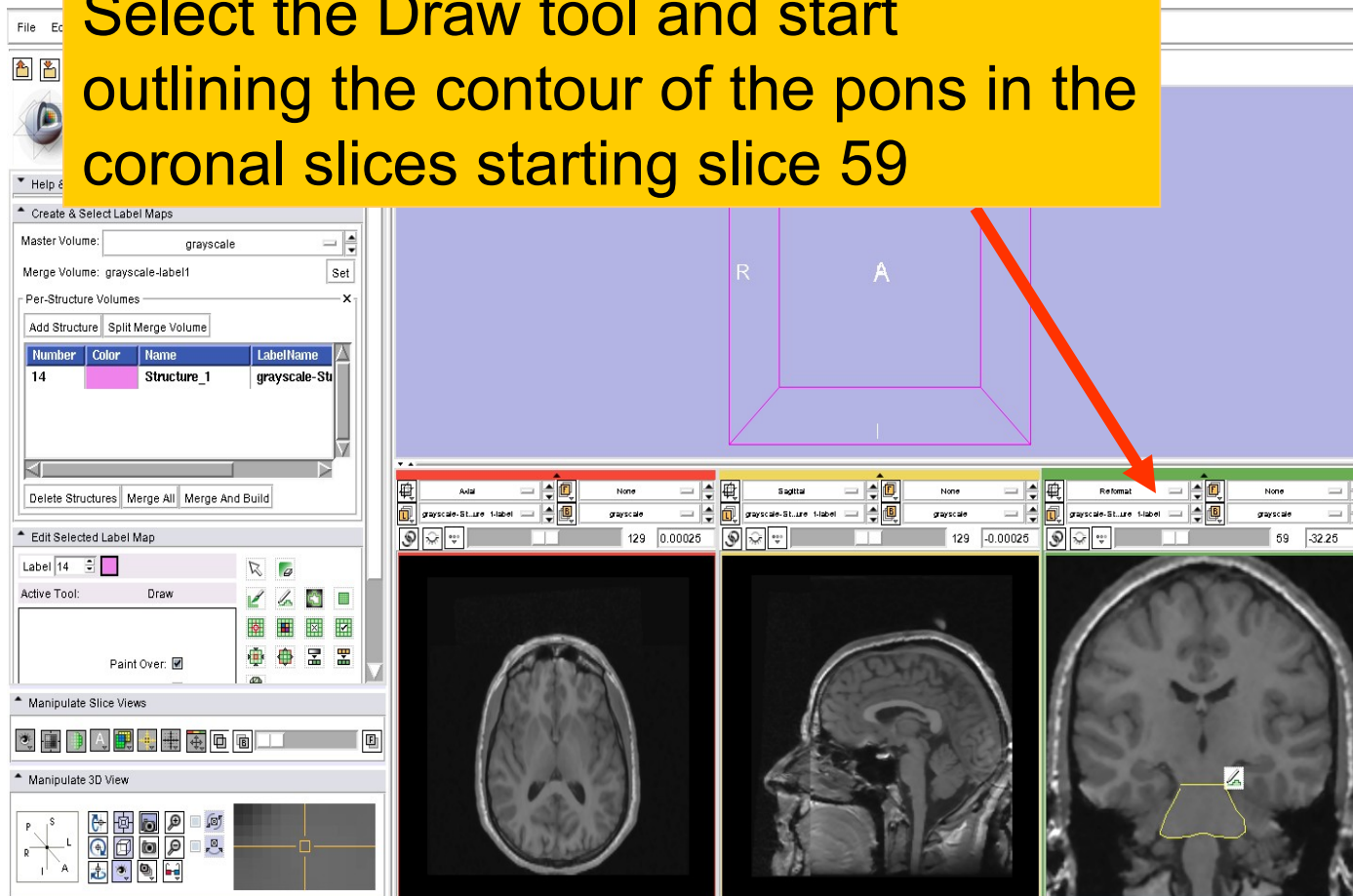


Description: The draw tool is an intuitive tool that can be used to manually outline structures in the grey level images.



Draw Tool

Select the Draw tool and start outlining the contour of the pons in the coronal slices starting slice 59





Draw Tool

File Edit View Window Help Feedback

Modules: Editor

3DSlicer

Per-Structure Volumes

Number	Color	Name	LabelName
14		Structure_1	grayscale-Stu

Delete Structures Merge All Merge And Build

Edit Selected Label Map

Label 14

Active Tool: Draw

Paint Over:

Threshold Painting:

Threshold: 1

Cancel Apply Check Points

Manipulate Slice Views

Manipulate 3D View

grayscale RAS: (-2.8, 125.1, 204.9), Lb: Slice not shown, Bg: Slice not shown.

Click on **Apply** to update the values of the label map pixels

R A L

Reformat None grayscale 129 0.00025

Sagittal None grayscale 129 -0.00025

Reformat None grayscale 60 -30.75



Draw Tool

Repeat the process to draw the outline of the pons from coronal slice between ~ slice 59 and slice 67

Number	Color	Name	LabelName
14	[Pink]	Structure_1	grayscale-Stu

grayscale RAS: (-2.8, 125.1, 204.9), Lb: Slice not shown, Bg: Slice not shown,



Adding a second structure

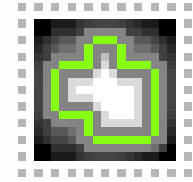
Click on **Add Structure** and select the label #6 'Ventricles'

Number	Color	Name
0	Black	Background
1	Gold	Bone
2	Brown	Skin
3	Red	Muscles
4	Yellow	Fat
5	Cyan	CSF
6	Blue	Ventricles
7	Orange	Arteries
8	Teal	Veins
9	Gray	Gray_matter

grayscale RAS: (77.3, -27.8, 126.7), Lb: Slice not shown, Bg: Slice not shown.



Level Tracing

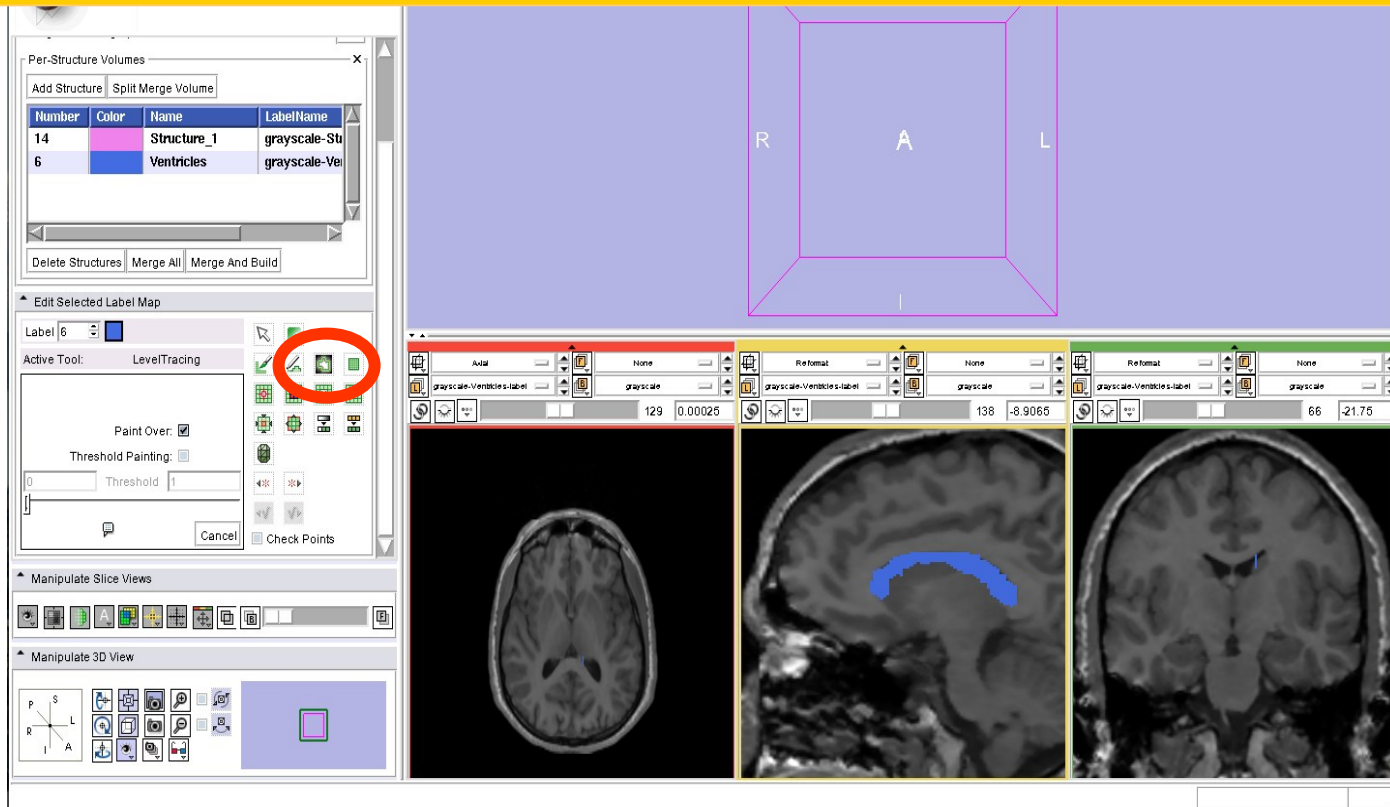


Description: By moving the mouse in the grey level images, you'll define in the label map volume an outline where the pixels all have the same value as the current background pixel.




Level Tracing

Use the **Level Tracing tool**  to trace the outline of the left lateral ventricle on slice 138





Level Tracing

Repeat the process using the Level Tracing tool  from sagittal slice 163 to slice 127

Per-Structure Volumes

Number	Color	Name	LabelName
14		Structure_1	grayscale-St
6		Ventricles	grayscale-Ve

Edit Selected Label Map

Label: 6

Active Tool: LevelTracing

Paint Over:

Threshold Painting:

Threshold: 1

Manipulate Slice Views

Manipulate 3D View

grayscale RAS: (-1.4, 72.9, 86.0), Lb: Slice not shown, Bg: Slice not shown



Level Tracing

Explore the outline of the left lateral ventricles in all three anatomical views

The screenshot displays a software interface for medical image processing. On the left, there are several panels:

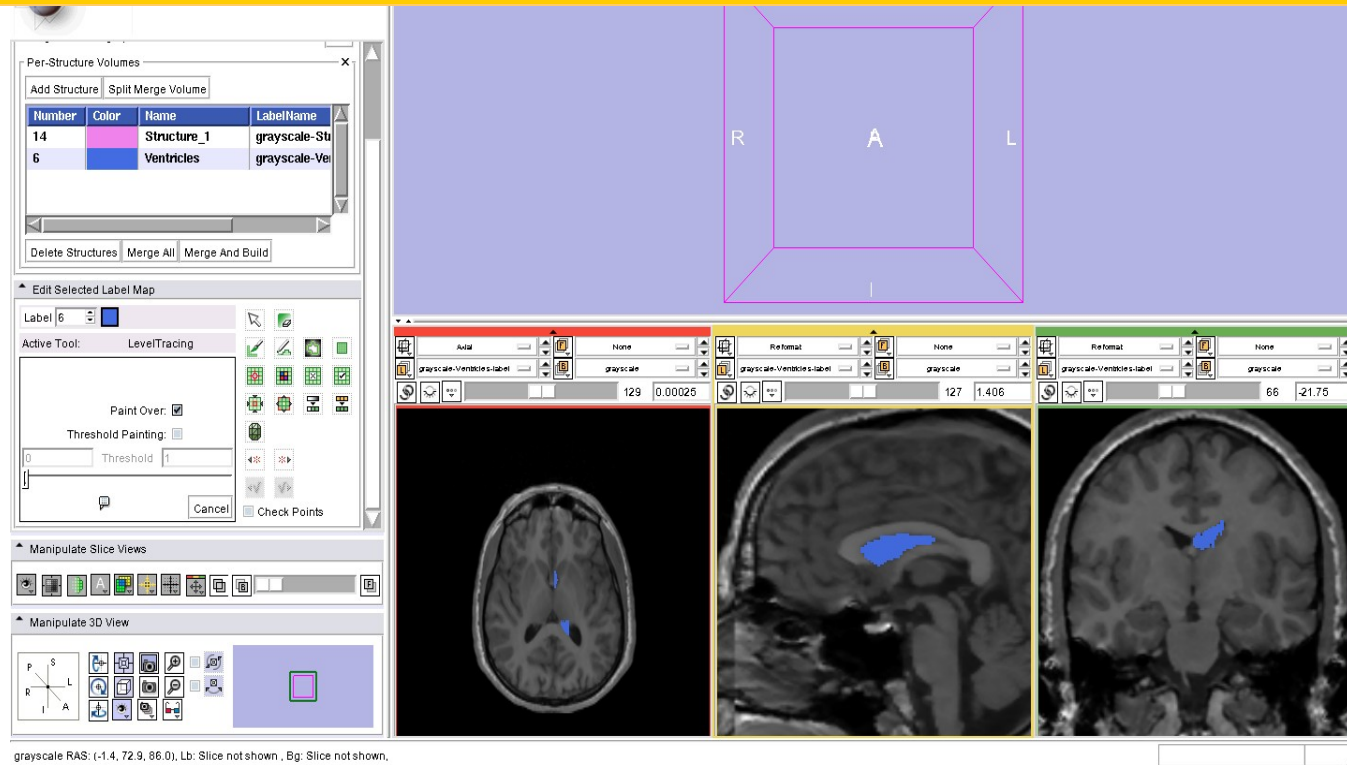
- Per-Structure Volumes:** A table with columns 'Number', 'Color', 'Name', and 'LabelName'. It lists 'Structure_1' (grayscale-Stu) and 'Ventricles' (grayscale-Ven).
- Edit Selected Label Map:** Shows 'Label 6' and 'Active Tool: LevelTracing'. It includes options for 'Paint Over', 'Threshold Painting', and 'Check Points'.
- Manipulate Slice Views:** A set of icons for navigating between different slice views.
- Manipulate 3D View:** A 3D orientation diagram and a small 3D view window.

The main workspace shows three anatomical views of a brain slice: Axial (left), Sagittal (middle), and Coronal (right). A purple outline is drawn around the left lateral ventricle in the Axial view. Below the views, there are three control panels for each view, showing parameters like 'Reformat', 'None', and 'grayscale'. The bottom status bar indicates 'grayscale RAS: (-1.4, 72.9, 86.0), Lb: Slice not shown, Bg: Slice not shown'.



Level Tracing

Repeat the same process to outline the contours of the right ventricle





Adding a third structure

Click on **Add Structure** and select the label #15 'Structure_2'

The screenshot shows the 3DSlicer interface. On the left, the 'Per-Structure Volumes' panel is open, displaying a table of existing structures:

Number	Color	Name	LabelName
14	Blue	Structure_1	grayscale-Stu
6	Red	Ventricles	grayscale-Ve

Below this table, the 'Add Structure' button is visible. The 'Edit Selected Label Map' panel shows 'Label 6' selected. The 'Manipulate Slice Views' and 'Manipulate 3D View' panels are also visible.

In the center, a list of structures is displayed:

Number	Color	Name
6	Blue	Ventricles
7	Red	Arteries
8	Blue	Veins
9	Gray	Gray_matter
10	Yellow	White_matter
11	Green	Tumor
12	Cyan	Edema
13	Purple	Necrosis
14	Blue	Structure_1
15	Yellow	Structure_2

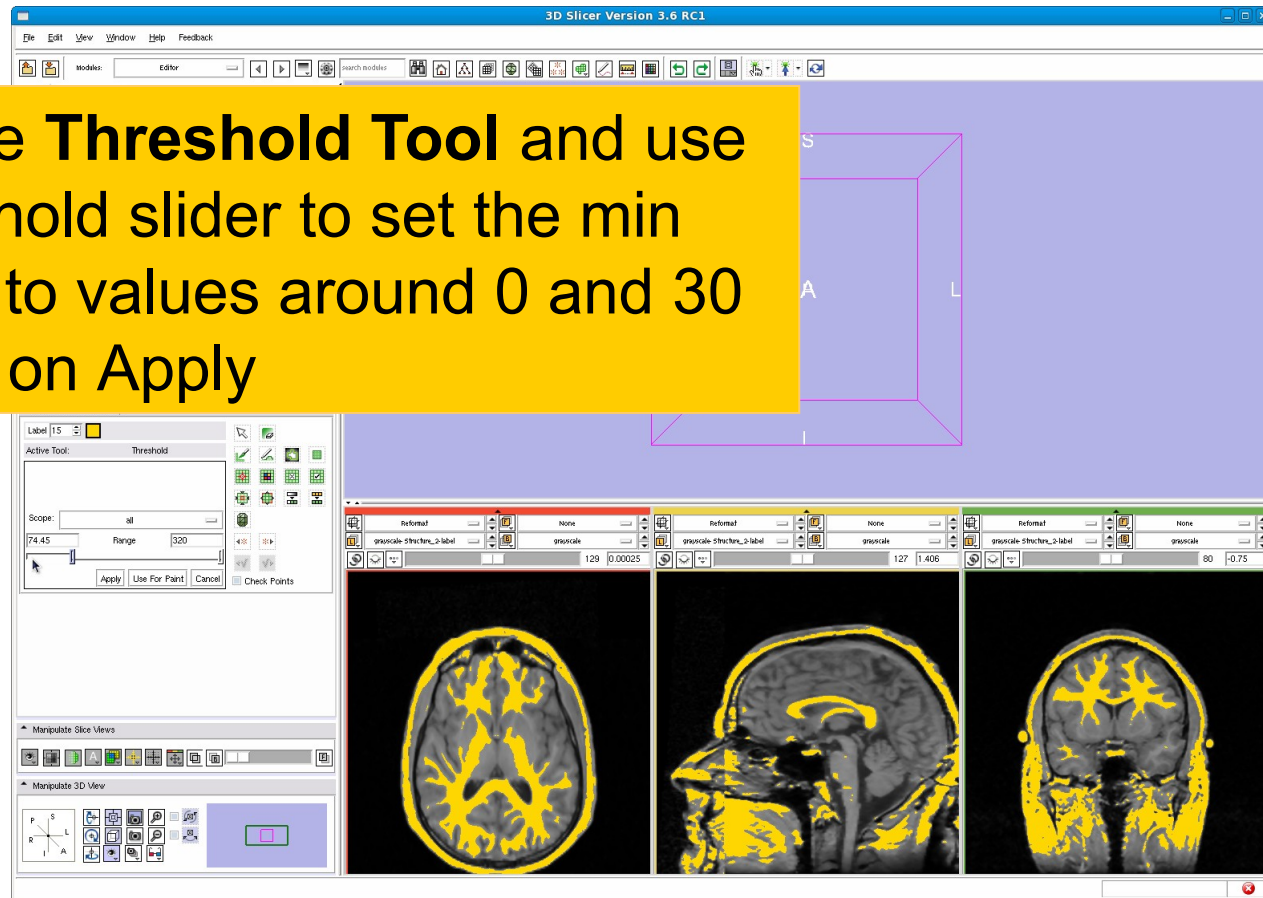
The right side of the image shows three MRI brain slices. The top slice is a 3D view with a purple bounding box. The bottom three slices are 2D axial, sagittal, and coronal views, with a blue structure (Structure_2) highlighted in the center of the brain.

At the bottom left, the text reads: 'grayscale RAS: (-1.4, 72.9, 86.0), Lb: Slice not shown, Bg: Slice not shown.'



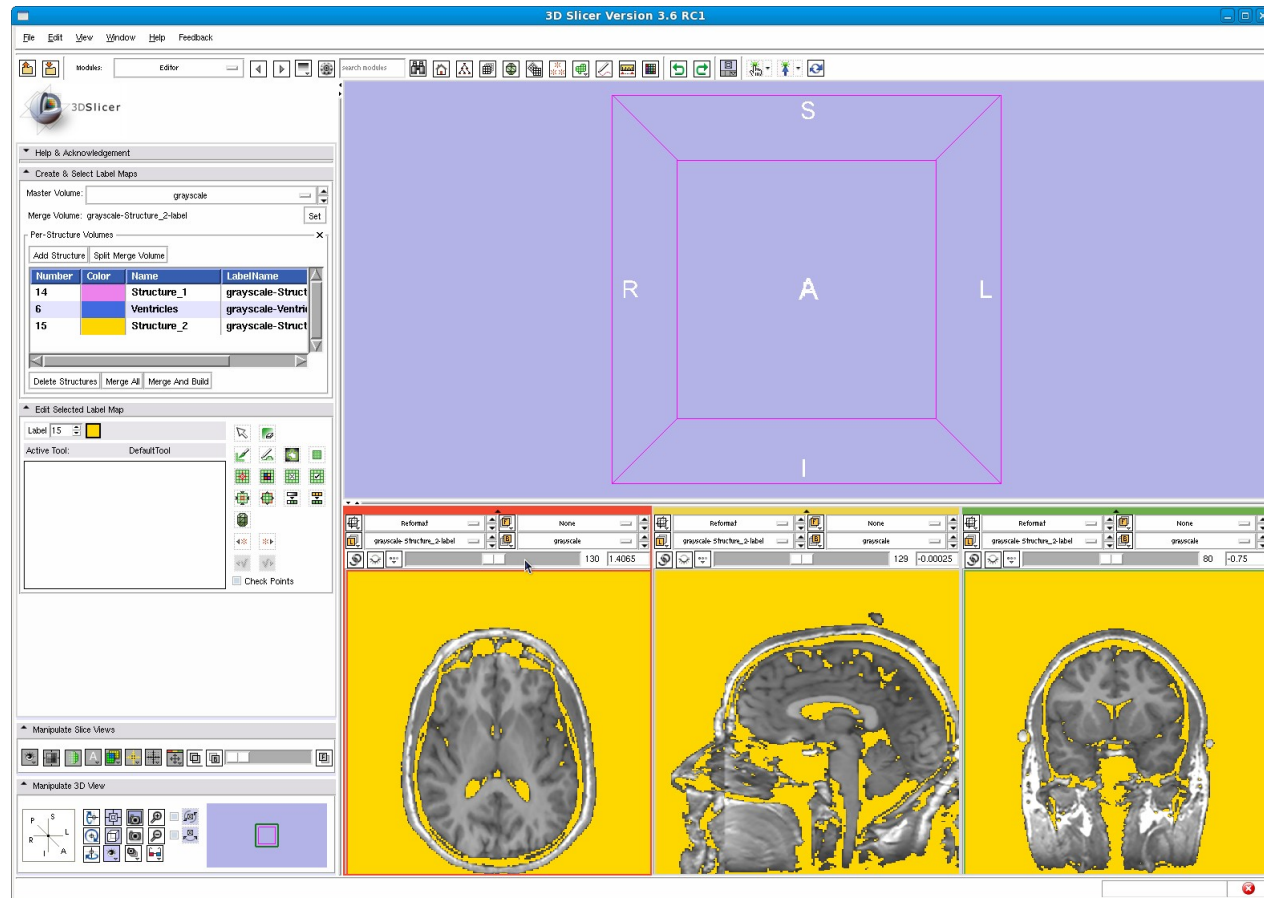
Threshold tool

Select the **Threshold Tool** and use the threshold slider to set the min and max to values around 0 and 30 and click on Apply





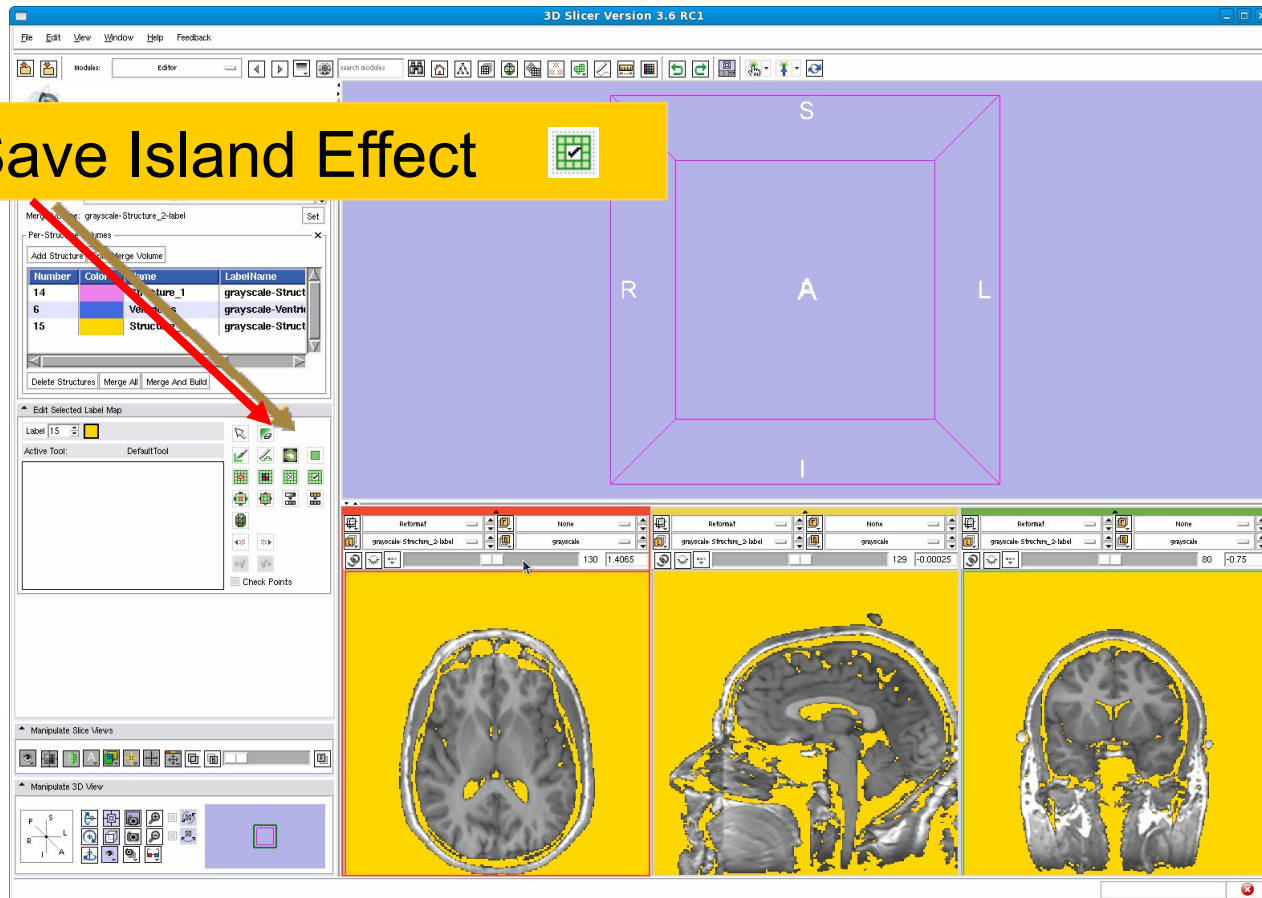
Threshold tool





Save Island

Select the Save Island Effect





Save Island

Click in the region of the right eyeball to isolate the structure

The screenshot displays the 3D Slicer software interface. The main window shows a brain MRI scan with a yellow region of interest (ROI) around the right eyeball. The interface includes a 'Per-Structure Volumes' panel, an 'Edit Selected Label Map' panel, and three view windows (axial, sagittal, and coronal) showing the isolated structure.

Per-Structure Volumes Panel:

Number	Color	Name	LabelName
14	Blue	Structure_1	grayscale-Stu
6	Yellow	Ventricles	grayscale-Ve
15	Red	Structure_2	grayscale-Stu

Edit Selected Label Map Panel:

Label: 15

Active Tool: Threshold

Scope: all

80 Range 320

Apply Use For Paint Cancel

Check Points

View Windows:

- Axial view: grayscale RAS: (146.9, 140.1, -13.6), Lb: Slice not shown, Bg: Slice not shown.
- Sagittal view: Bg: grayscale, None; Lb: grayscale-Ventricles-label; Reformat Sp: 0.936mm.
- Coronal view: Bg I: 45, Bg J: 97, Bg K: 04; Lb: grayscale-Ventricles-label; Reformat Sp: 1.5mm.



Dilate Effect

Select the Dilate Effect

3DSlicer

Number	Color	Name	LabelName
14		Structure_1	grayscale-Stu
6		Ventricles	grayscale-Ve
15		Structure_2	grayscale-Stu

Label 15

Active Tool: Savelsland

Scope: all

Manipulate Slice Views

Manipulate 3D View

Reformat: None, grayscale

Bg I: 45, Bg J: 97, Bg K: 64

Lb: grayscale-ventricles-label

Reformat Sp: 1.6mm

Lb: 0 Background, R: 77.3, A: -23.2, S: -28.3



Dilate Effect

Click on **Apply** to add a single layer of pixels to the eyeball structure

The screenshot displays a medical image processing software interface. The main window shows a 3D view of a brain slice with a purple rectangular region of interest (ROI) labeled 'A' in the center, and 'S' (Superior), 'R' (Right), 'L' (Left), and 'I' (Inferior) at the corners. Below the main window, there are three smaller windows showing different views of the brain slice: a coronal view on the left, a sagittal view in the middle, and an axial view on the right. The axial view shows a yellow highlighted region on the left side of the brain, representing the dilated effect on the eyeball structure. The software interface includes a toolbar at the top, a panel on the left for structure management, and a panel on the right for slice manipulation. The structure management panel shows a list of structures: Structure_1 (grayscale-Stu), Ventricles (grayscale-Ve), and Structure_2 (grayscale-Stu). The slice manipulation panel shows the active tool as 'Removelslands' and the scope as 'visible'. The bottom status bar indicates the middle button is for panning and the right button is for zooming.



Dilate Effect

Browse through the axial slices of the segmented eyeball

The screenshot displays a medical image segmentation software interface. The main window shows a 3D view of a segmented eyeball structure, with a purple wireframe box indicating the dilated effect. The 3D view is labeled with 'R' (Right), 'L' (Left), 'S' (Superior), and 'I' (Inferior). Below the 3D view, three axial slices are shown, each with a corresponding control panel. The control panels include 'Reformat' buttons, 'Label' dropdowns, and 'Background' (Bg) settings. The first slice (107) shows a yellow dilated region. The second slice (111) shows a gray dilated region. The third slice (66) shows a gray dilated region. The interface also includes a 'Per-Structure Volumes' table, an 'Edit Selected Label Map' panel, and 'Manipulate Slice Views' and 'Manipulate 3D View' panels.

Number	Color	Name	LabelName
14	Blue	Structure_1	grayscale-Stu
6	Yellow	Ventricles	grayscale-Ven
15	Orange	Structure_2	grayscale-Stu

Label 15

Active Tool: RemovIslands

Scope: visible

Fully Connected

Cancel Apply Check Points

Manipulate Slice Views

Manipulate 3D View

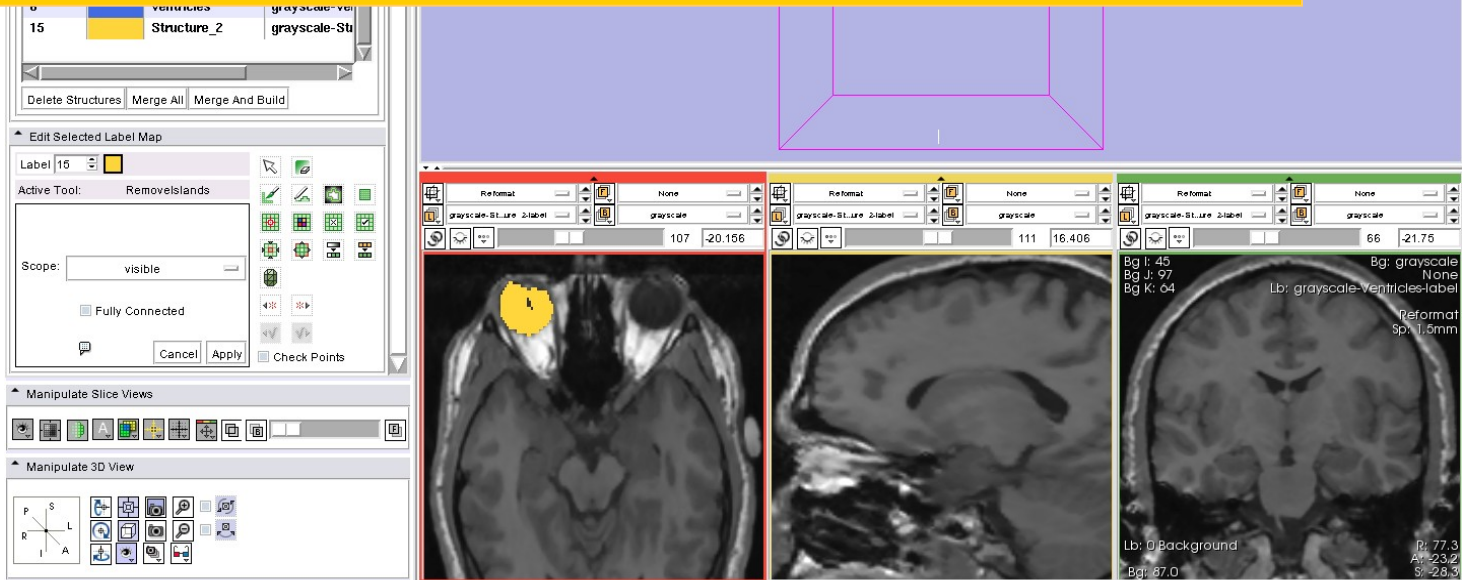
Middle Button: Pan; Right Button: Zoom



Remove Island

Select the **Remove Island**  tool

Select **Scope: visible** and click on **Apply** to remove the isolated pixels inside the segmented structure



Middle Button: Pan; Right Button: Zoom



Remove Island

Repeat the process in the slices that contain isolated pixels in the eyeball structure

Per-Structure Volumes

Number	Color	Name	LabelName
14	grayscale	Structure_1	grayscale-St
6	blue	Ventricles	grayscale-Ve
15	yellow	Structure_2	grayscale-St

Edit Selected Label Map

Label: 16

Active Tool: RemoveIslands

Scope: visible

Manipulate Slice Views

Manipulate 3D View

Middle Button: Pan; Right Button: Zoom

Reformat: None, grayscale, grayscale

Bg I: 45, Bg J: 97, Bg K: 04

Lb: 0 Background, Lb: grayscale-Ventricles-label

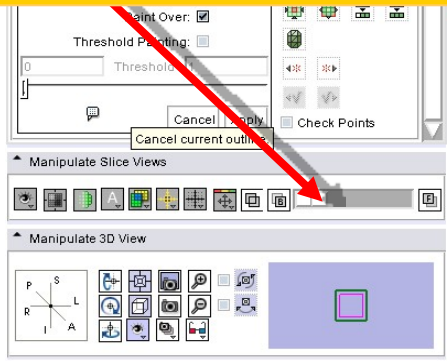
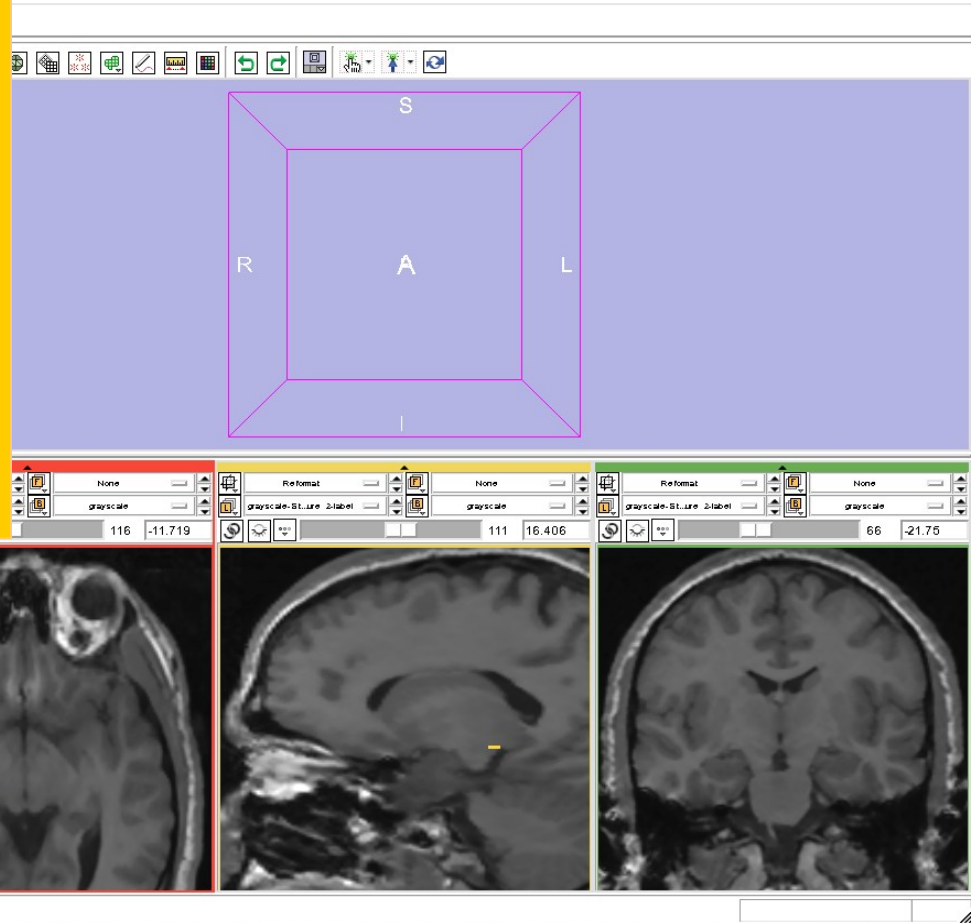
P: 77.3, A: 23.2, S: 28.3

Bg: 47.0



Adding more structures

Zoom in using the right mouse button, and use the drawing tool to outline the contour of the right lateral geniculate body and optic tract in the axial view.

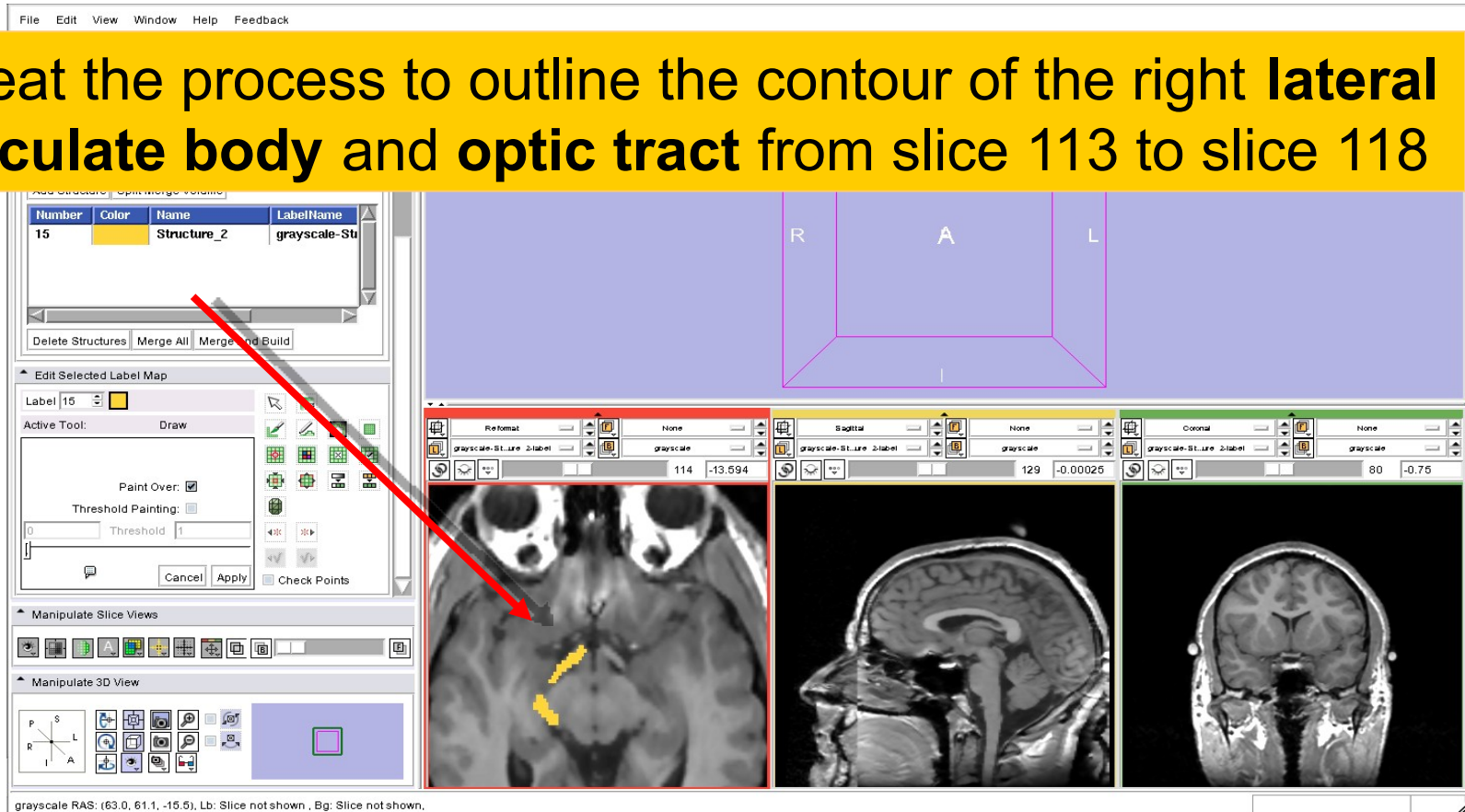


grayscale RAS: (79.9, 31.4, -12.7), Bg IJK: (42, 114, 100), Lb: 0 Background, Bg: 2.0



Adding more structures

Repeat the process to outline the contour of the right **lateral geniculate body** and **optic tract** from slice 113 to slice 118





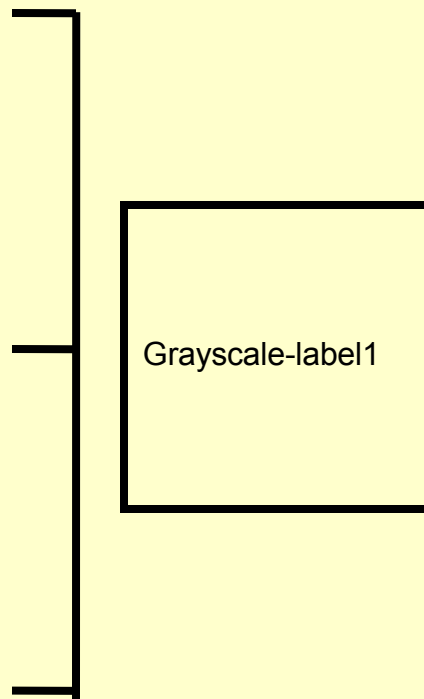
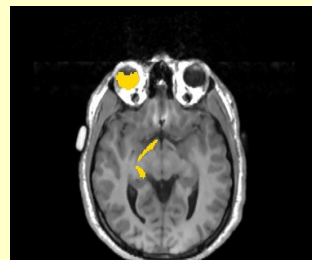
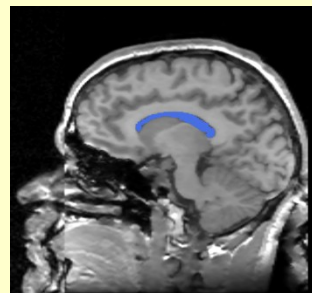
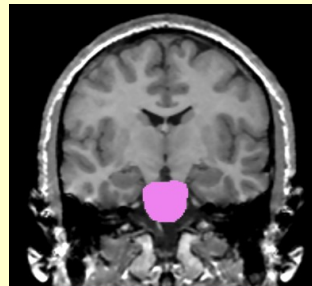
Merge And Build

The three labels correspond to the three different label maps that we have edited for the pons (pink), the ventricles (blue) and the right eyeball, lateral geniculate body and optic tract (yellow).

Number	Color	Name	LabelName
14	Pink	Structure_1	grayscale-Struct
6	Blue	Ventricles	grayscale-Ventri
15	Yellow	Structure_2	grayscale-Struct



Merging label maps



The Merge tool will merge the label maps of the anatomical structures that we have edited into a single label map



Merge And Build

Click on Merge And Build button to put the different structures in the Merge volume and build the models from the segmented structures.

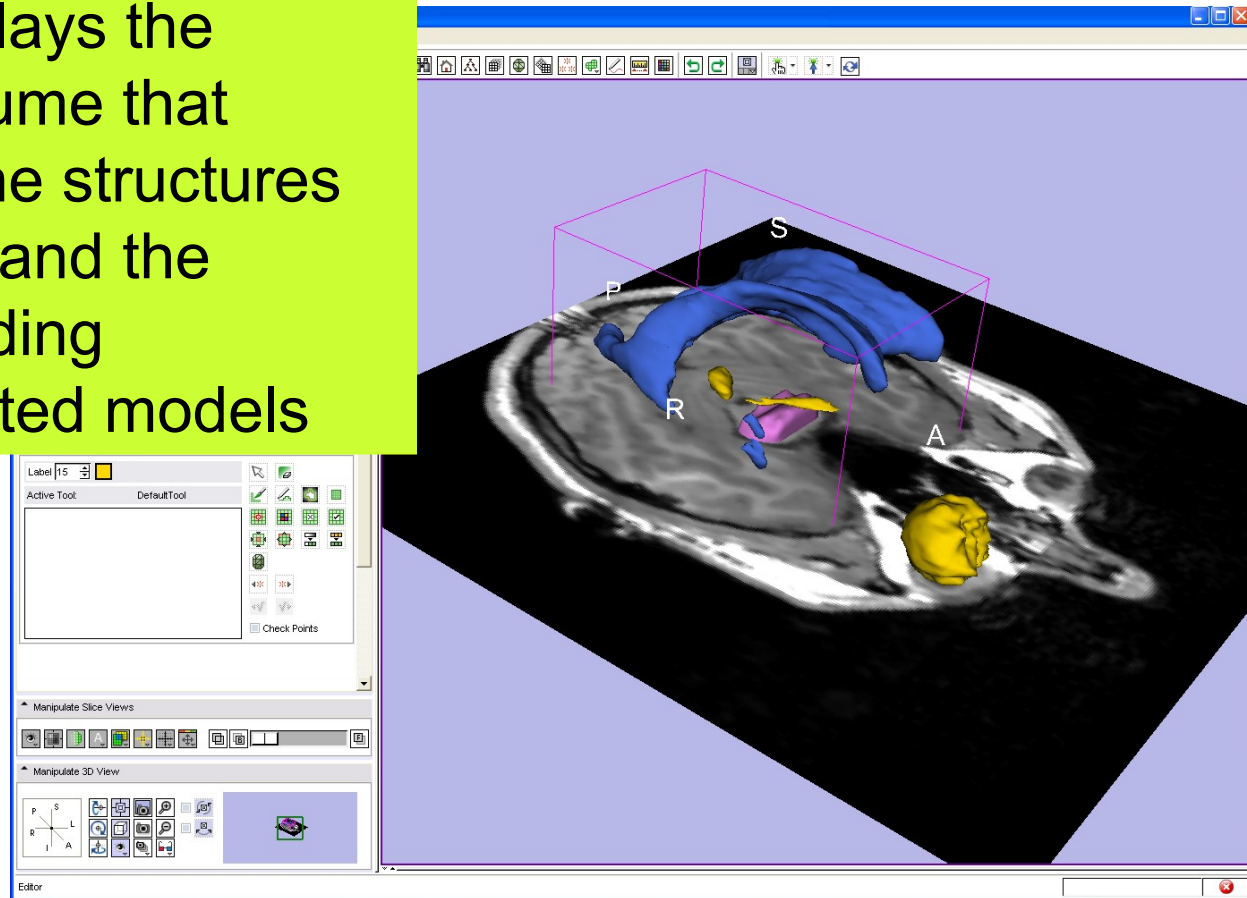
The three label maps will be merged in the order that they appear in the table.

Number	Color	Name	LabelName
14	Blue	Structure_1	grayscale-Struct
6	Green	Ventricles	grayscale-Ventri
15	Yellow	Structure_2	grayscale-Struct



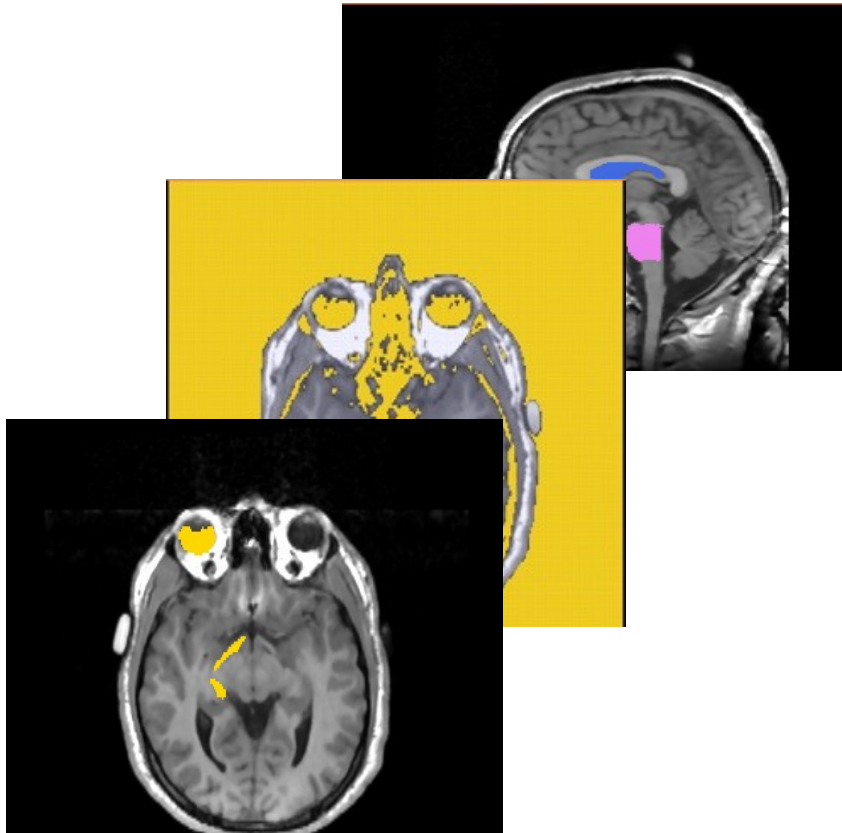
Merge And Build

Slicer displays the merge volume that contains the structures of interest and the corresponding reconstructed models





Conclusion



This tutorial guided you through the tools for interactive editing of label maps created from scalar images using the Editor module of Slicer3.6.

www.slicer.org



Acknowledgments



National Alliance for Medical Image Computing

NIH U54EB005149



Neuroimage Analysis Center

NIH P41RR013218



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