



NA-MIC

National Alliance for Medical Image Computing

<http://na-mic.org>

Interactive Editor tutorial

Sonia Pujol, Ph.D.

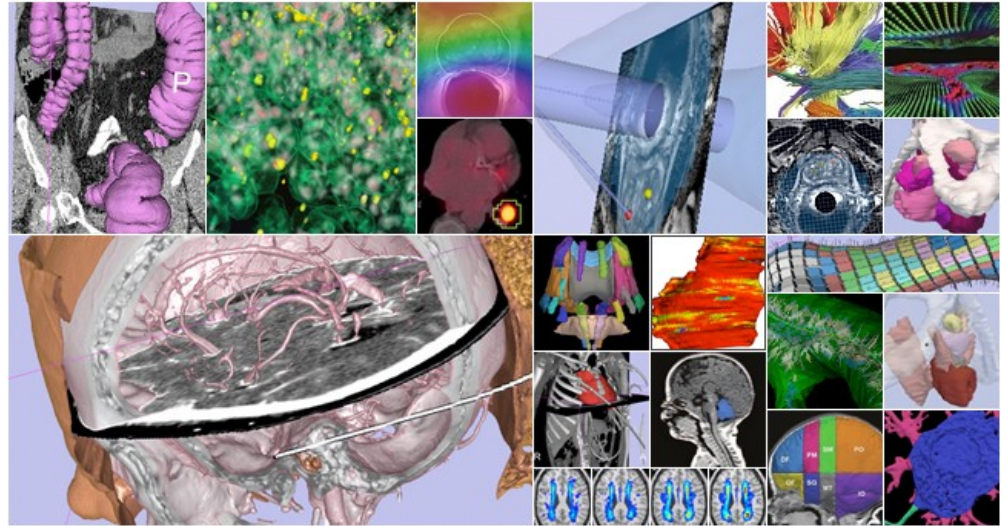
Surgical Planning Laboratory

Harvard Medical School



Slicer3.6

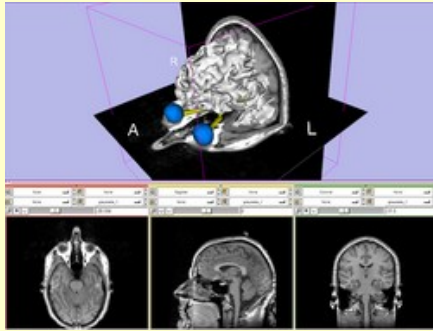
- An **end-user application** for image analysis
- An **open-source environment** for software development
- A software platform that is both **easy to use for clinical researchers** and **easy to extend for programmers**





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>

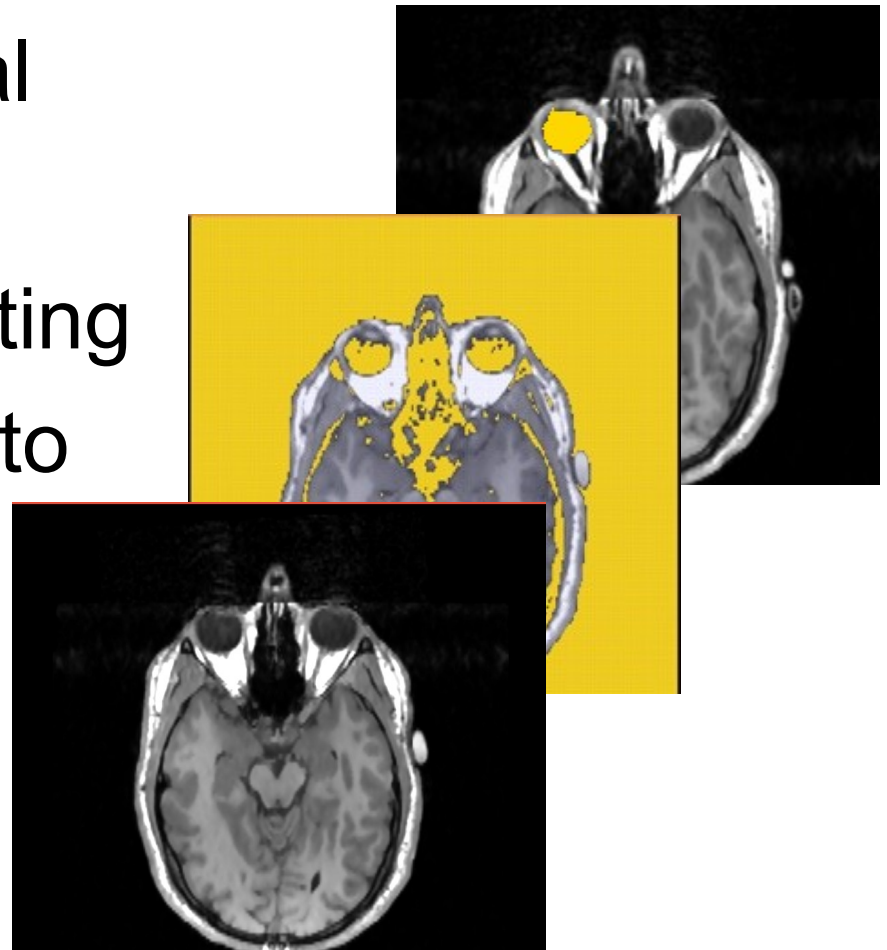
Disclaimer

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.





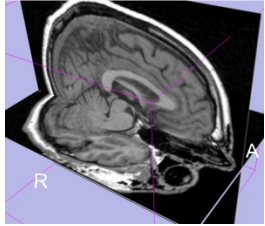
Label map



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



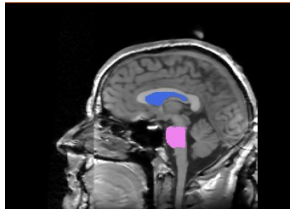
Overview



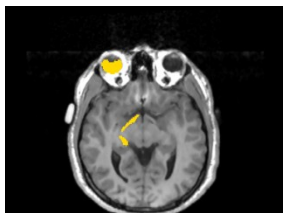
Part 1: Creating a single label map

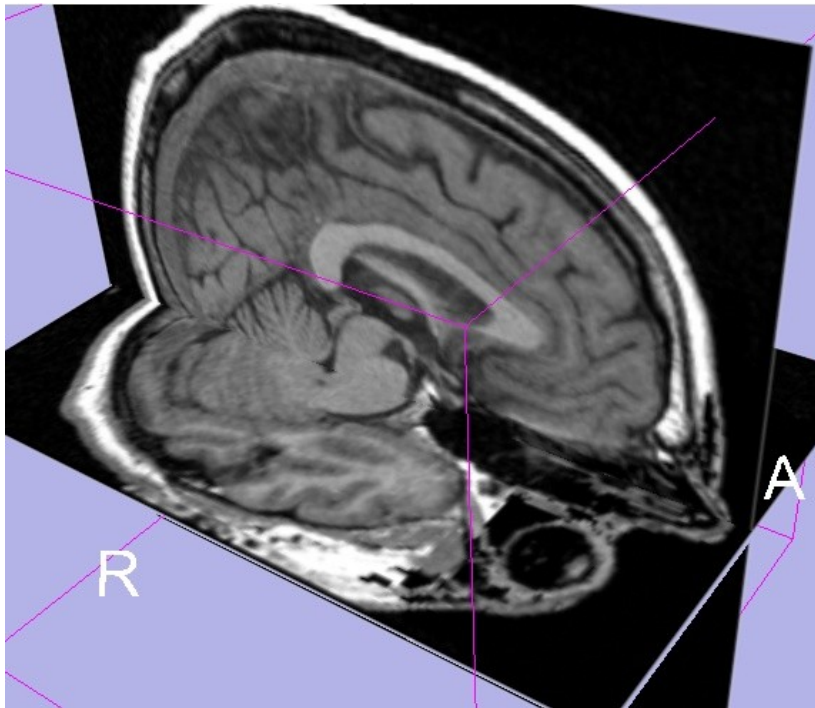


Part 2: Editing a single label map



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

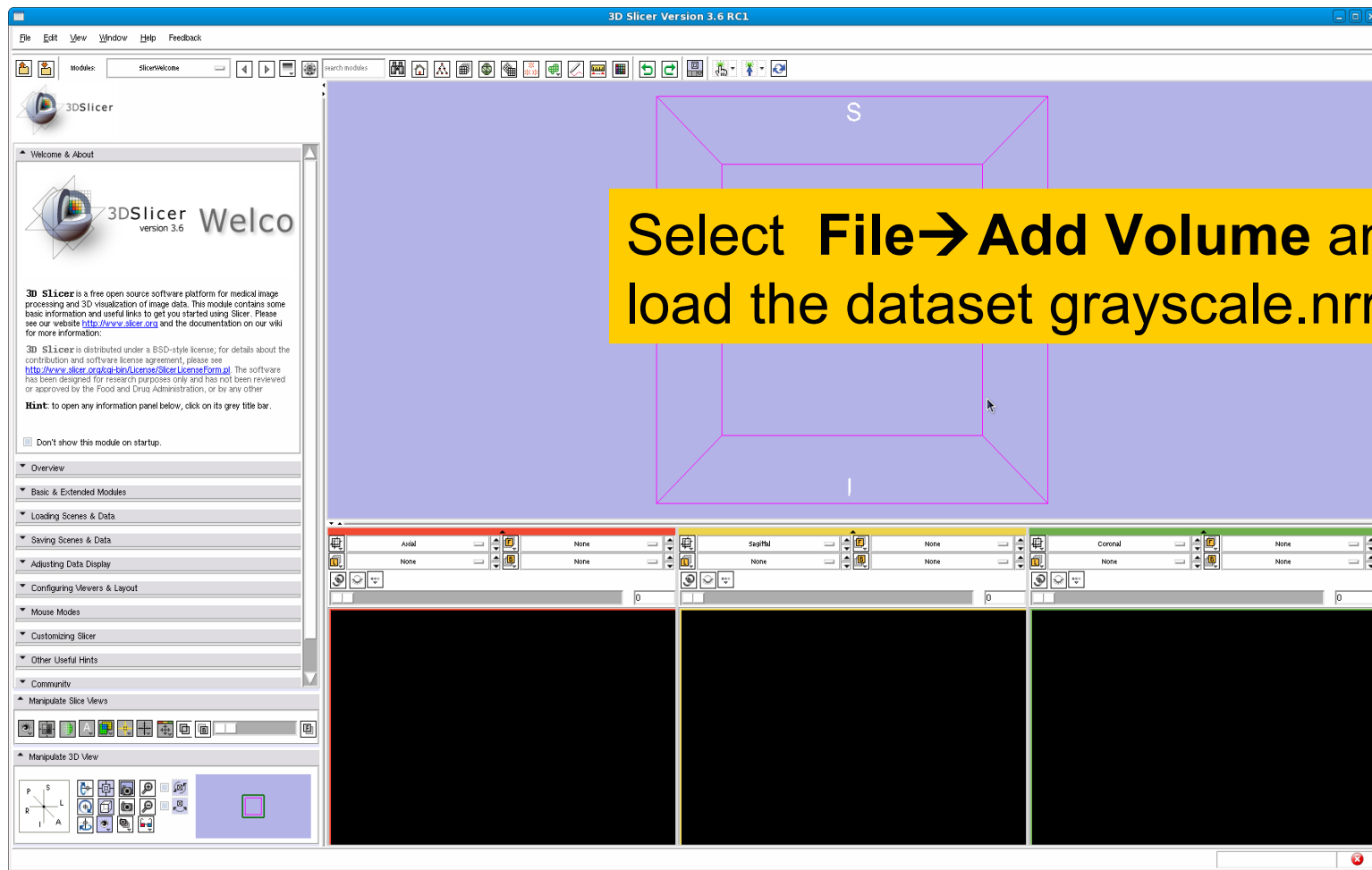




Part 1: Creating a single label map

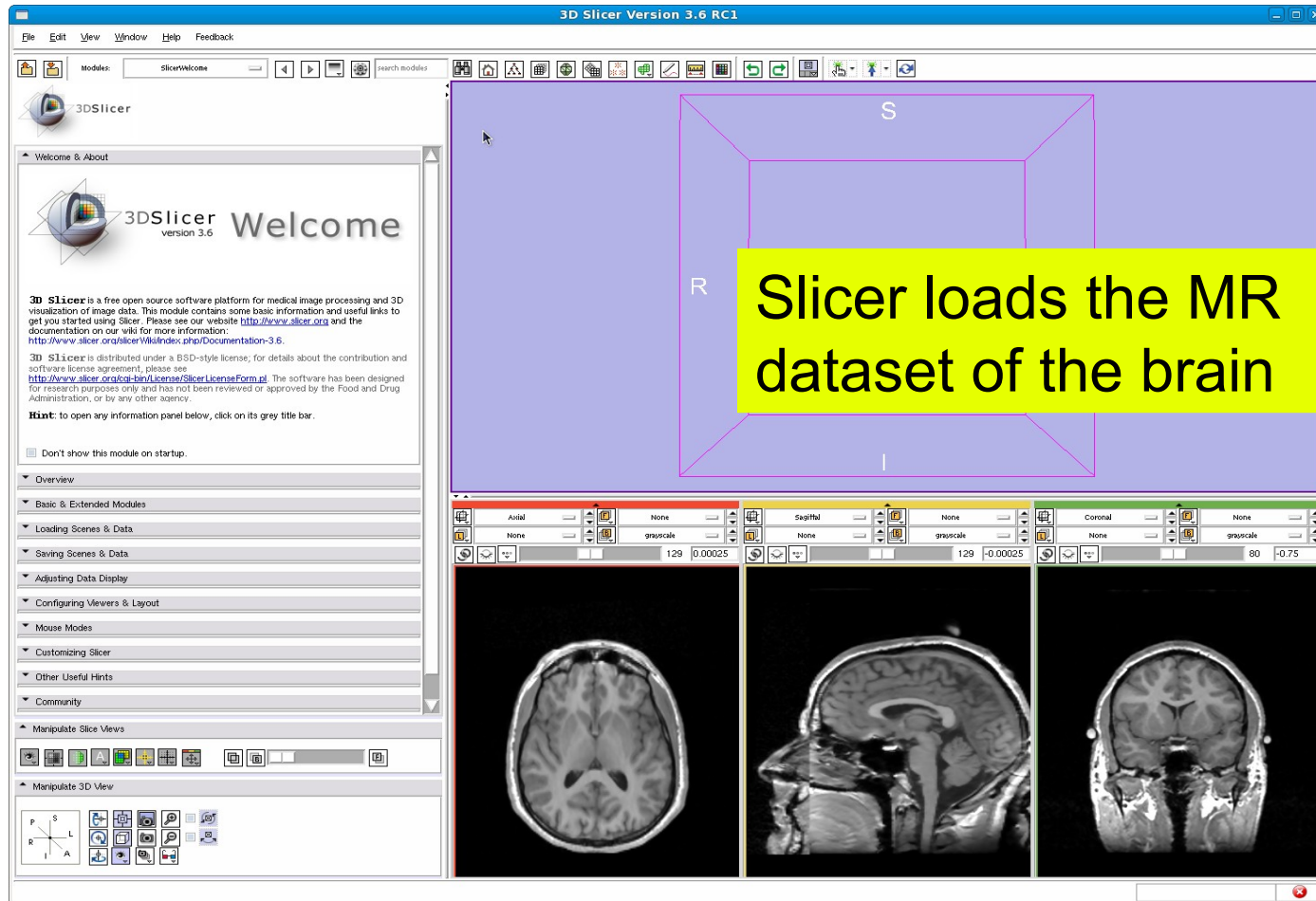


Data Loading



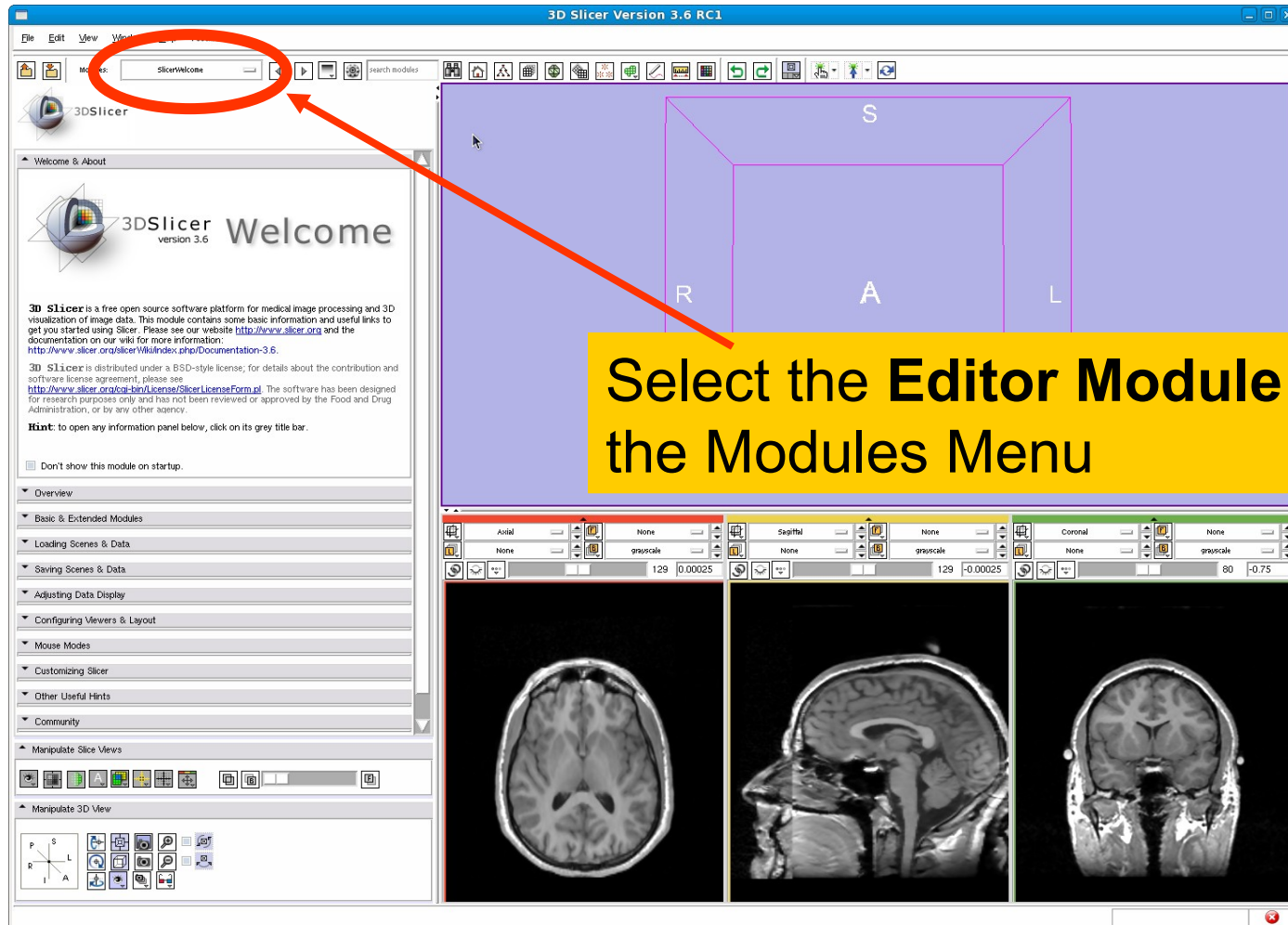


Data Loading





Data Loading





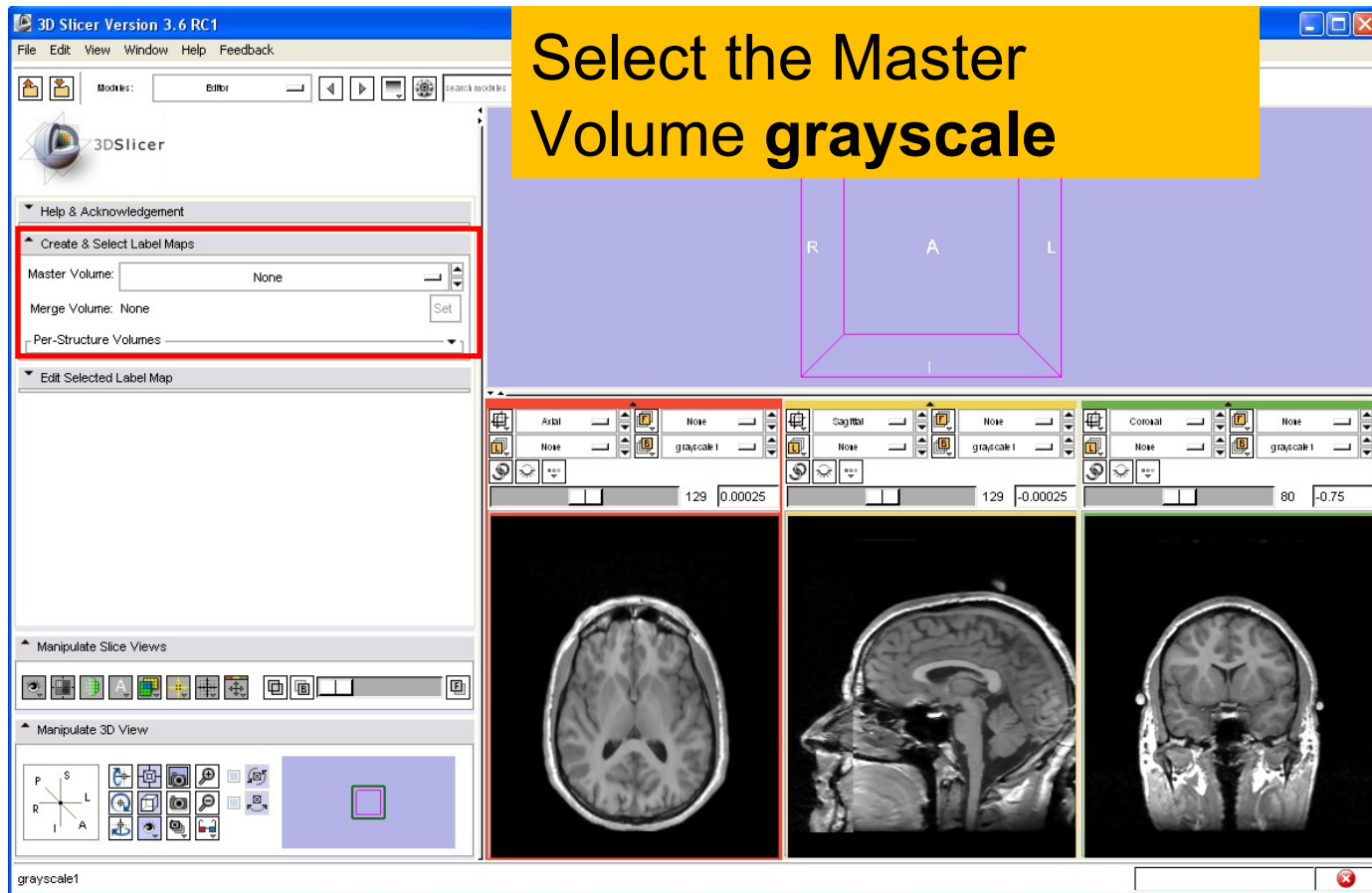
Editor Module

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.

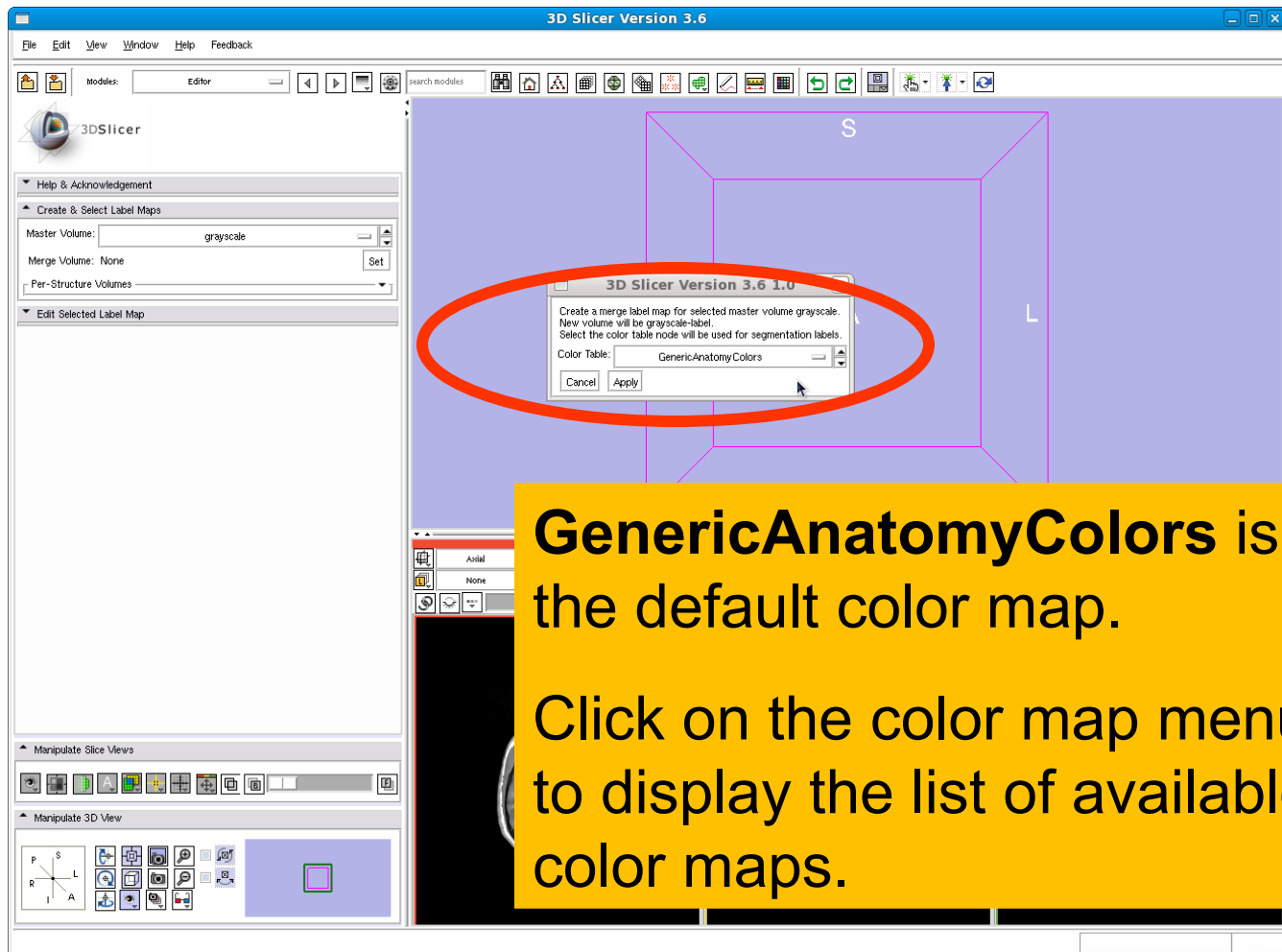


Label Map Creation





Label Map Creation

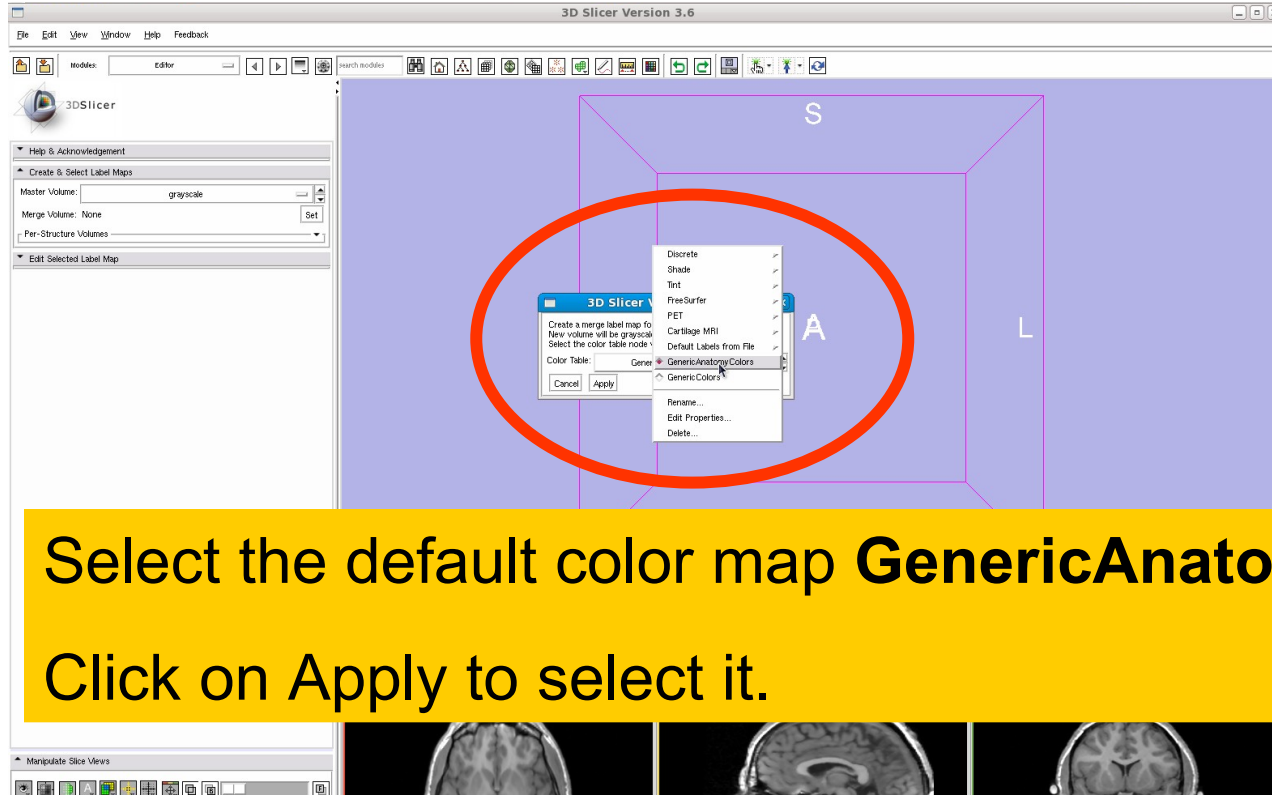


GenericAnatomyColors is the default color map.

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



Label Map Creation



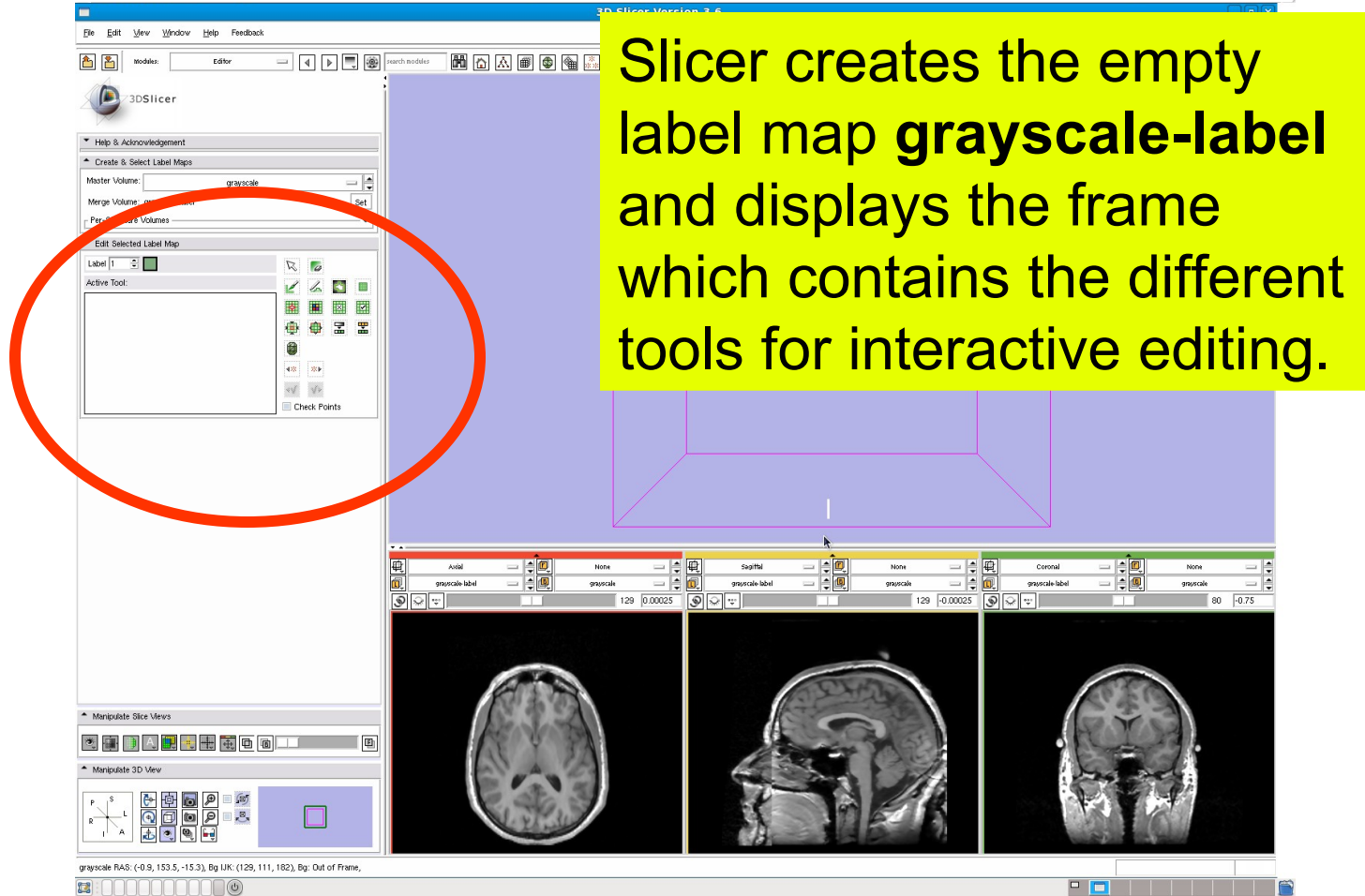
Select the default color map **GenericAnatomyColors**

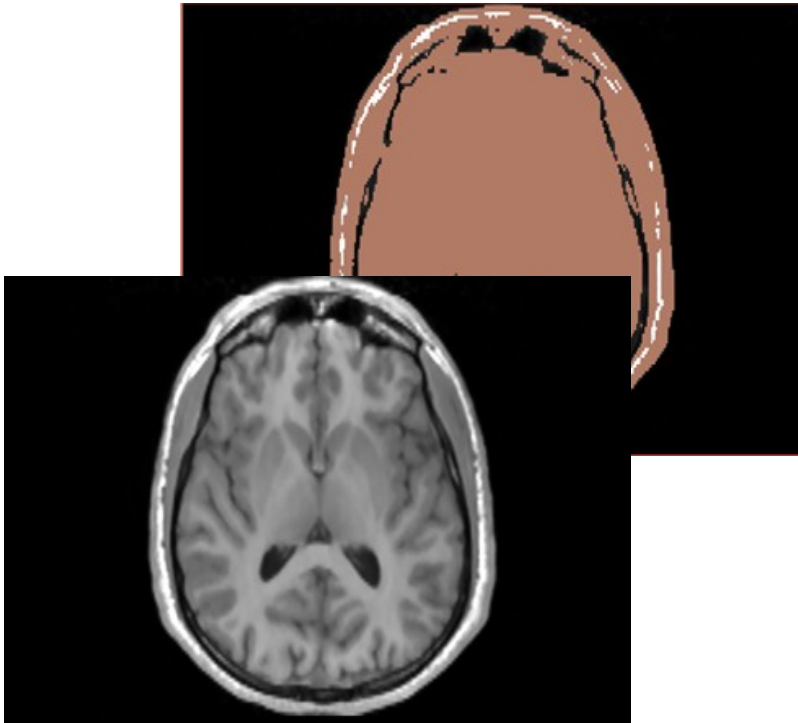
Click on Apply to select it.

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



Label Map Creation

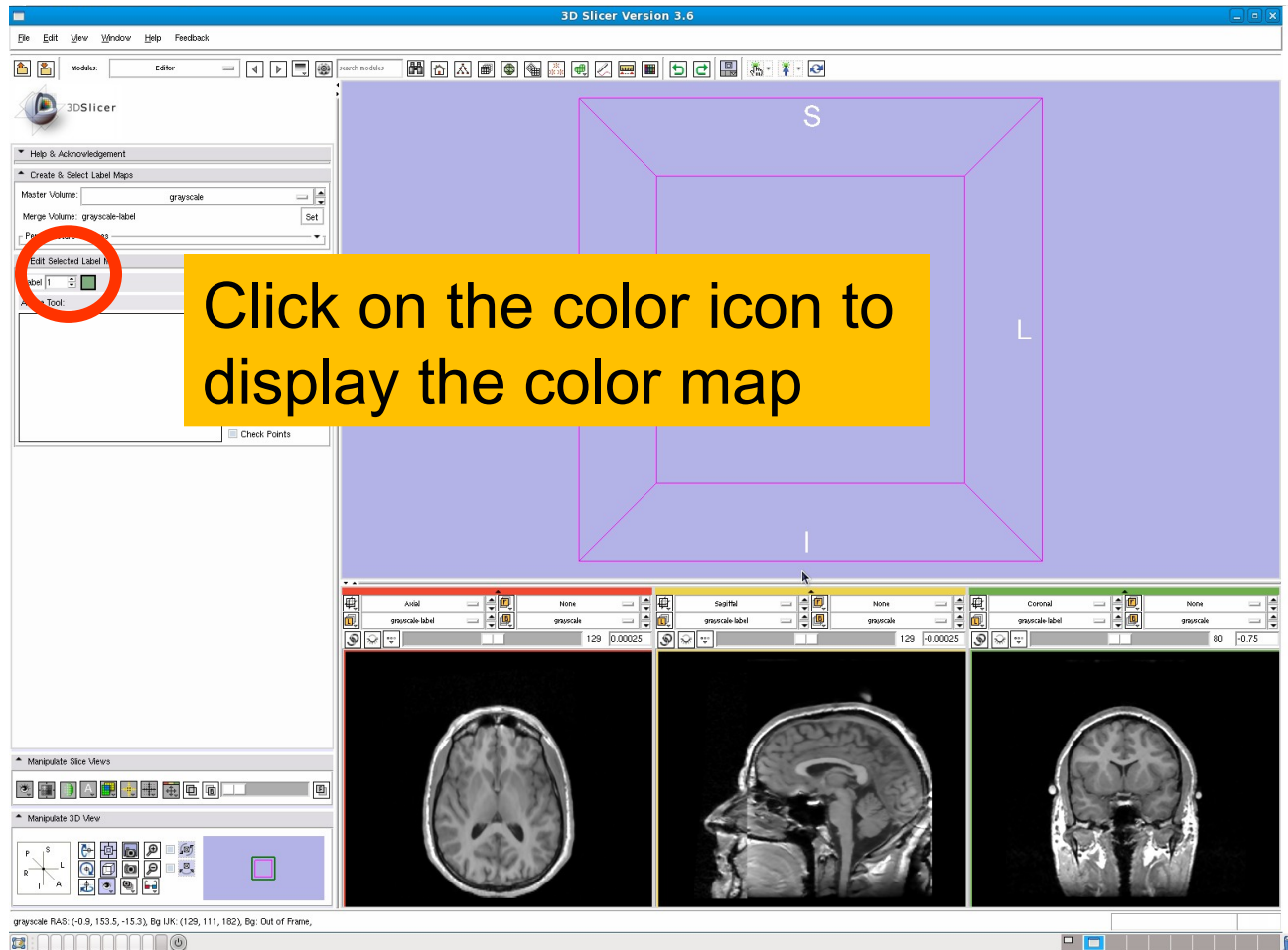




Part 2: Editing a single label map



Label Map Editing





Label Map Editing

Number	Color	Name
0	Black	background
1	Green	tissue
2	Yellow	bone
3	Brown	skin
4	Blue	connective_tissue
5	Red	blood
6	Orange	organ
7	Light Green	mass
8	Dark Red	muscle
9	Yellow-Green	foreign_object

**Slicer displays the color map
GenericAnatomyColors**



Label Map Editing

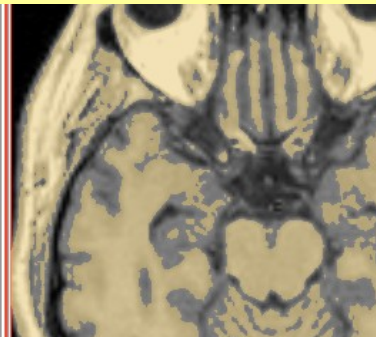
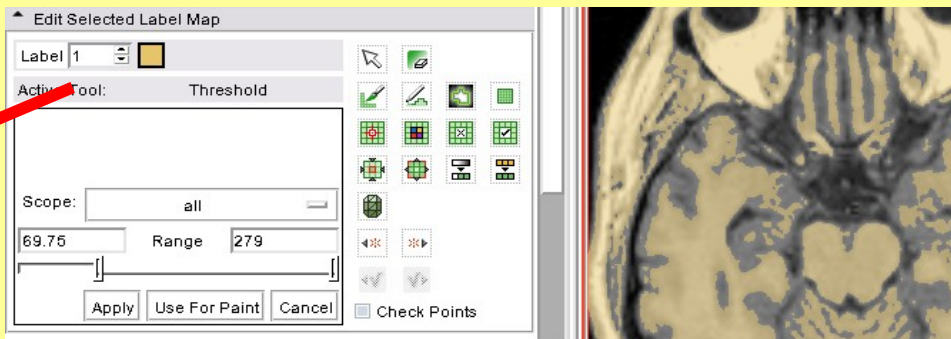
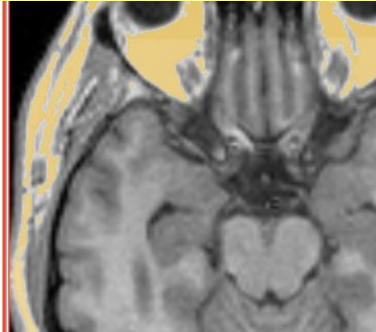
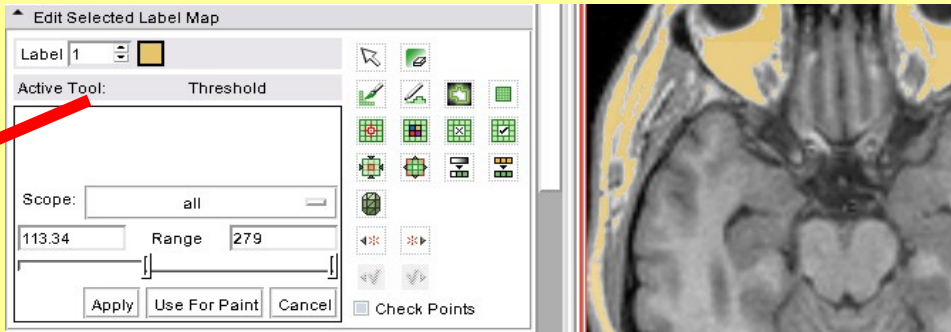
Browse through the list of 307 labels to explore the color map **GenericAnatomyColors**

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

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

Select the Threshold tool

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

Manipulate Slice Views

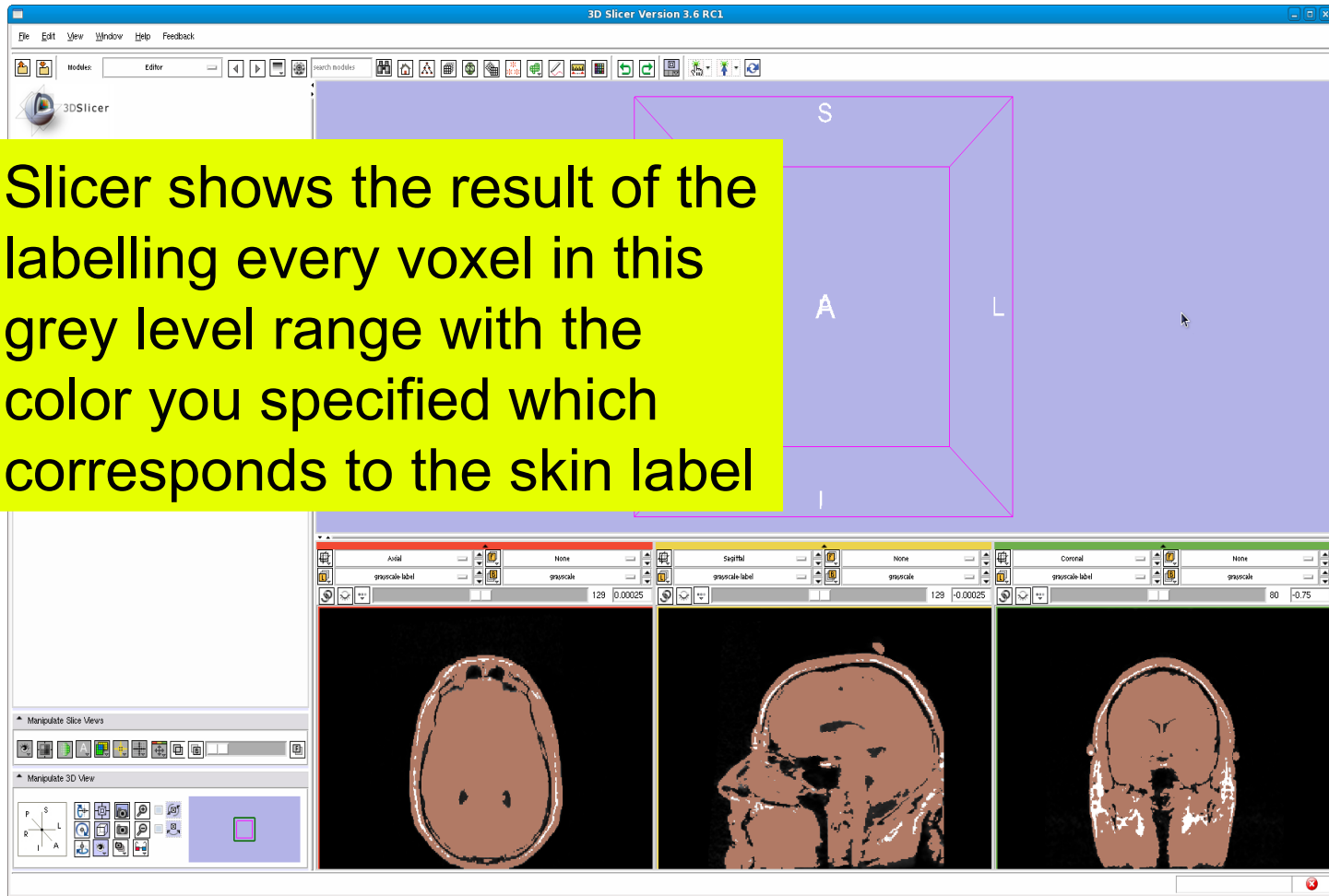
Manipulate 3D View

Feedback



Threshold Effect

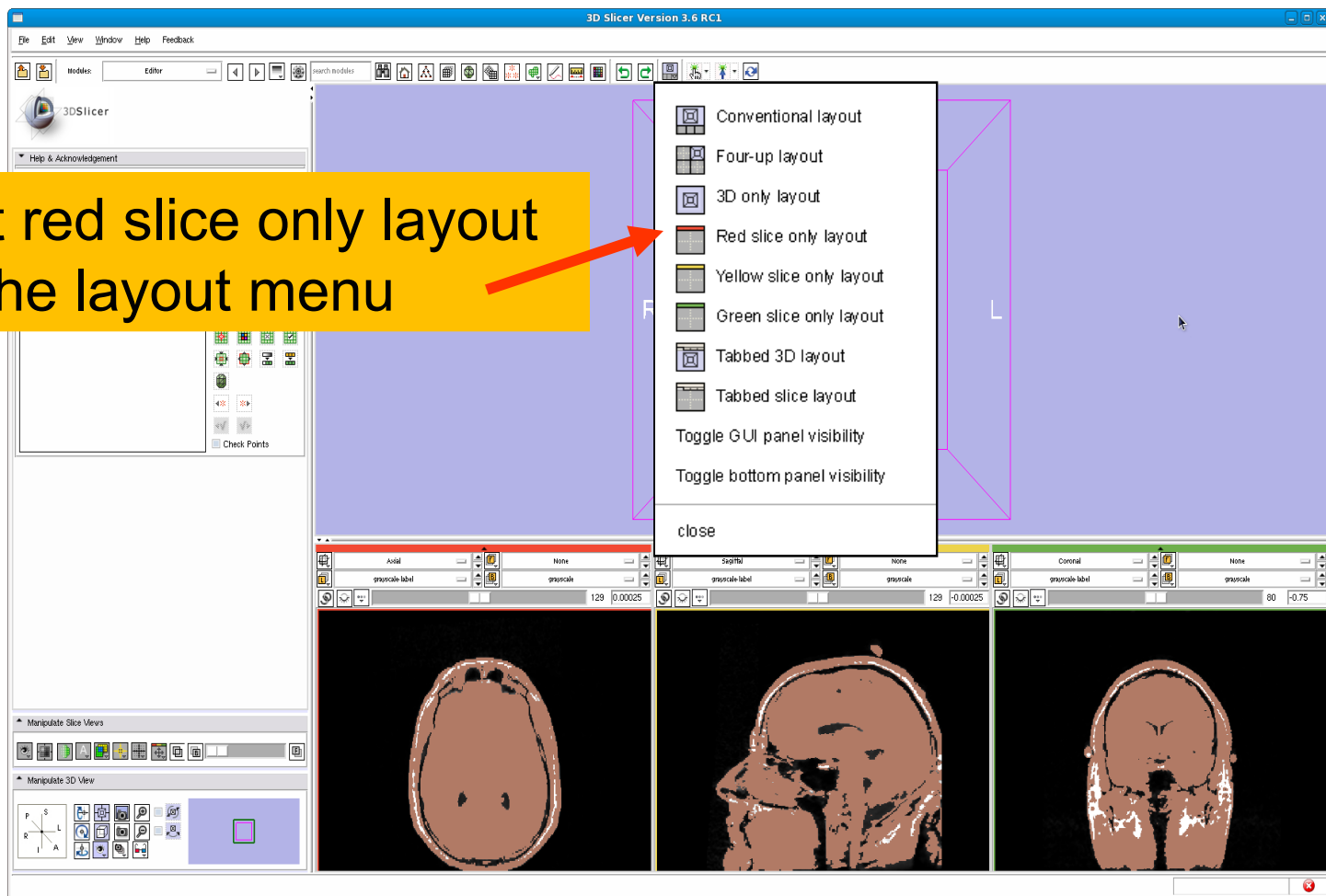
Slicer shows the result of the labelling every voxel in this grey level range with the color you specified which corresponds to the skin label





Threshold Effect

Select red slice only layout from the layout menu





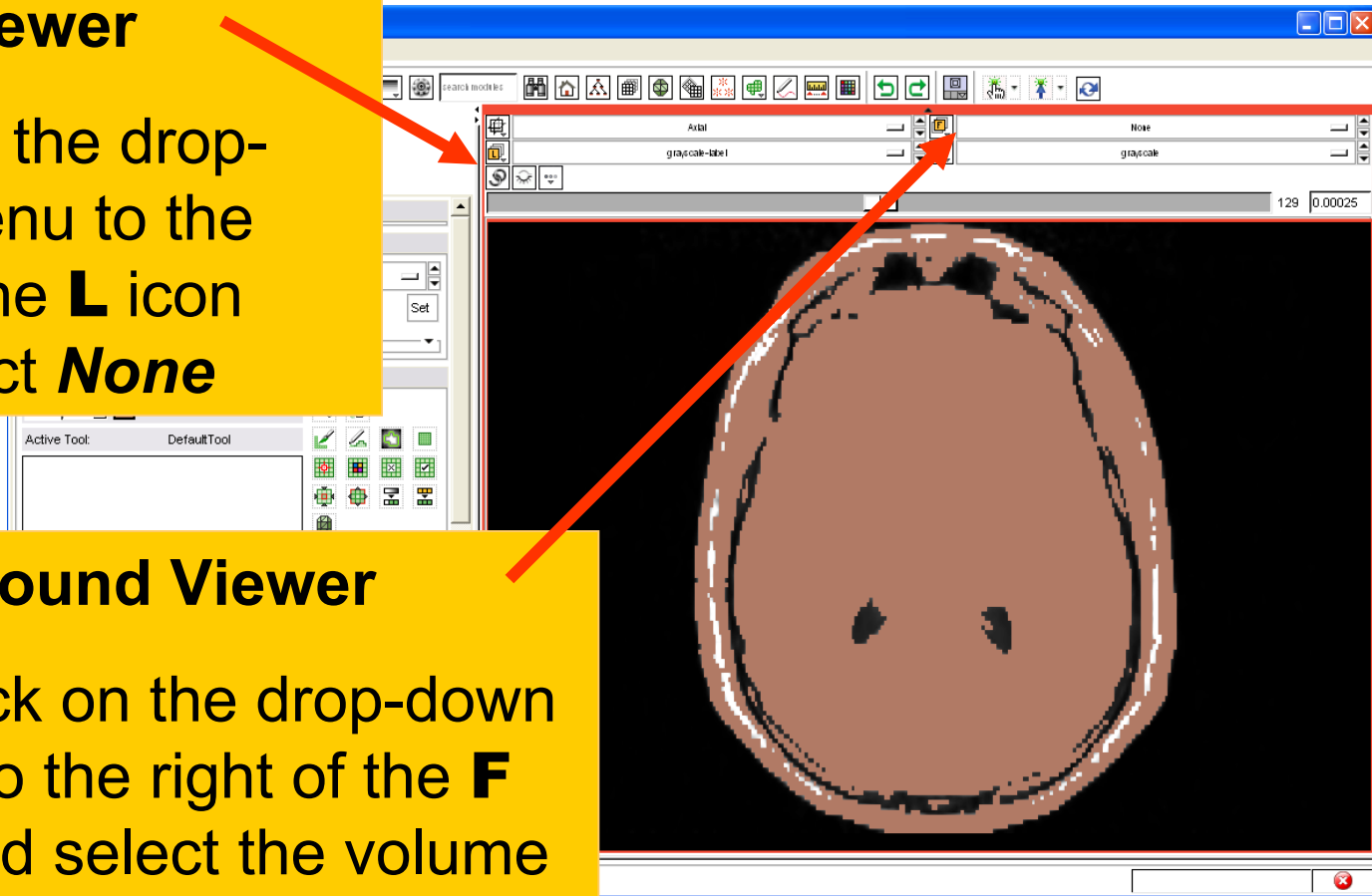
Threshold Effect

Label Viewer

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

Foreground Viewer

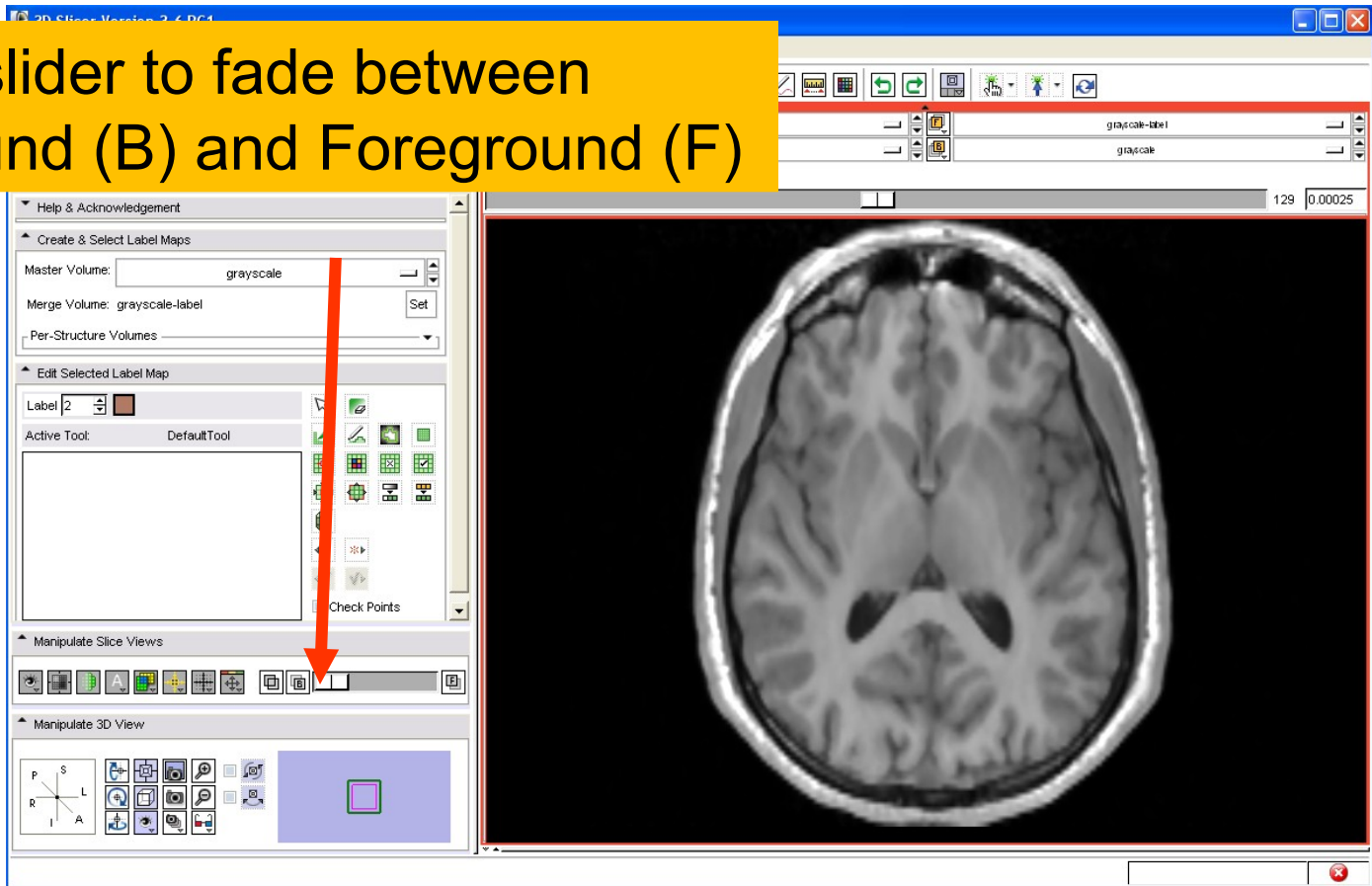
Left click on the drop-down menu to the right of the **F** icon and select the volume **grayscale-label**





Threshold Effect

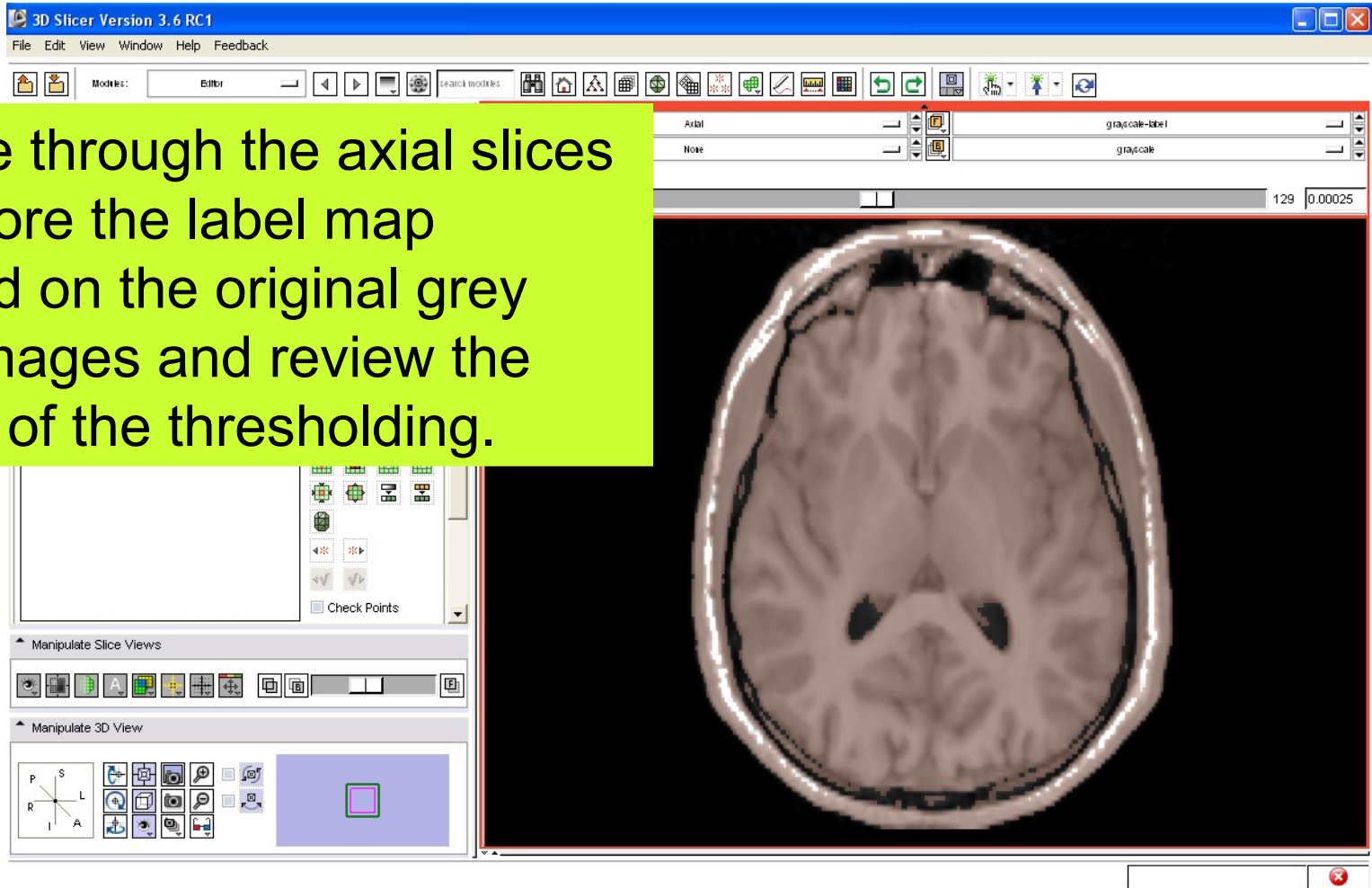
Use the slider to fade between Background (B) and Foreground (F)





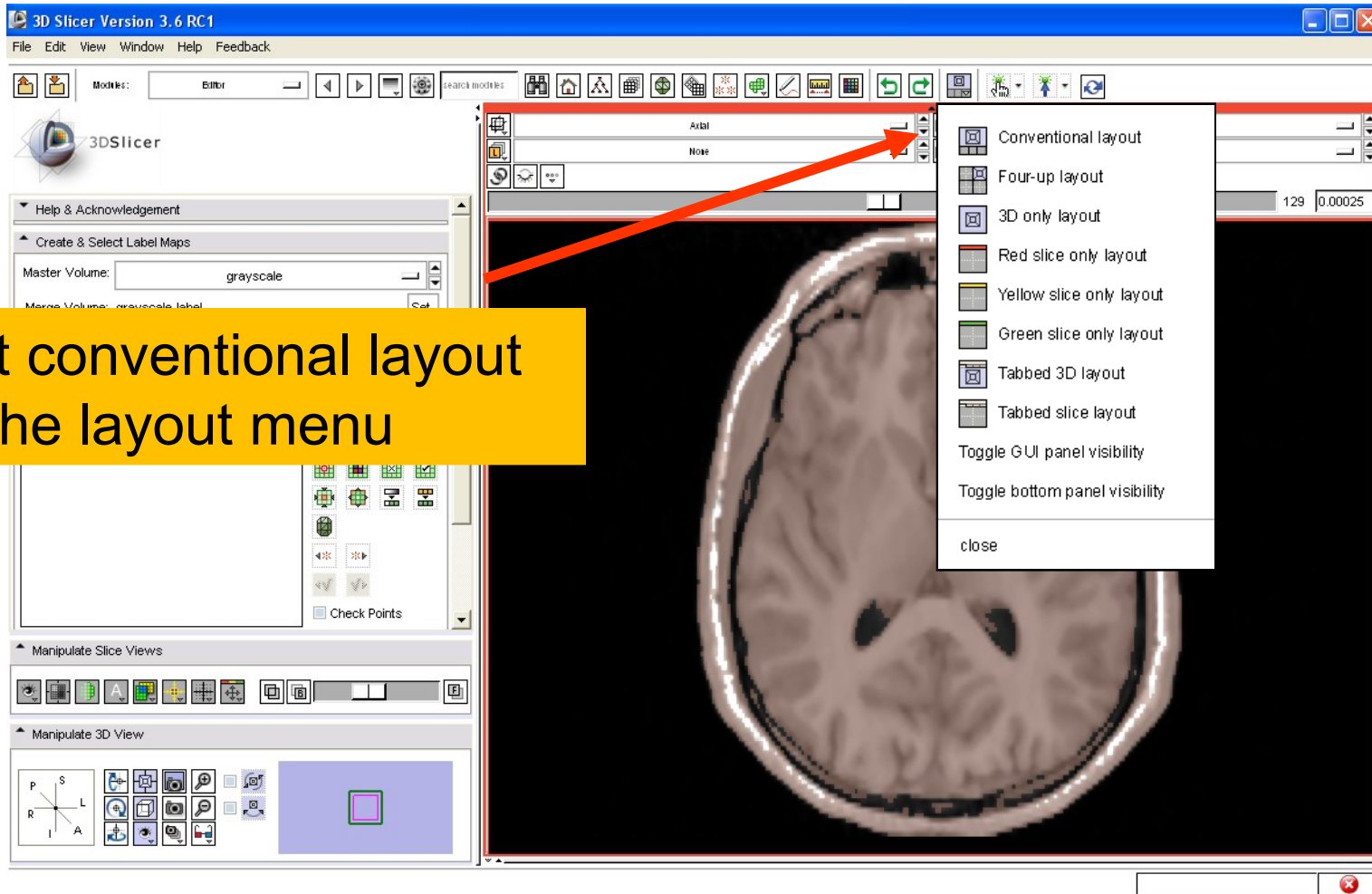
Exploring the result

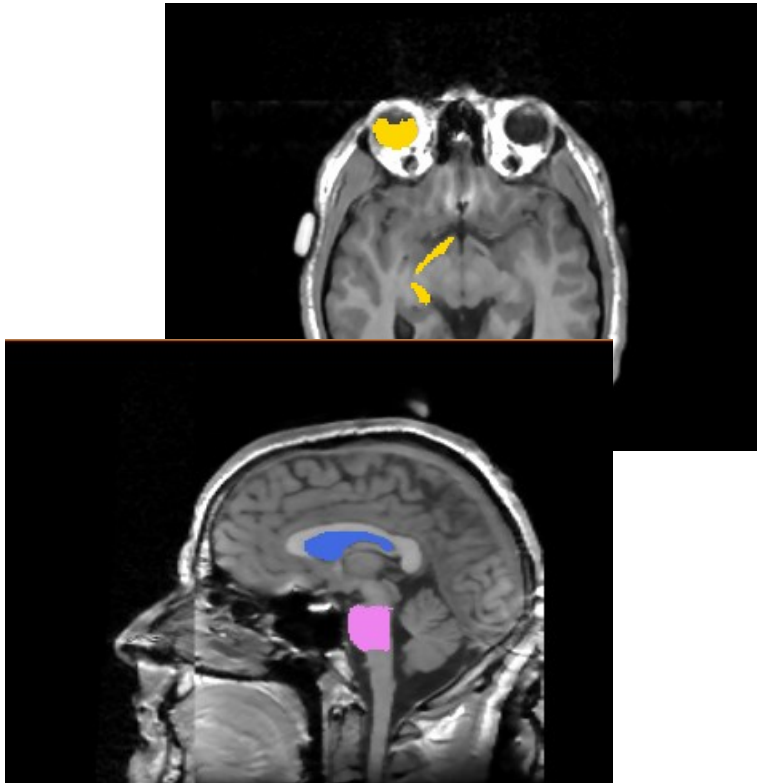
Browse through the axial slices to explore the label map overlaid on the original grey level images and review the results of the thresholding.





Threshold Effect

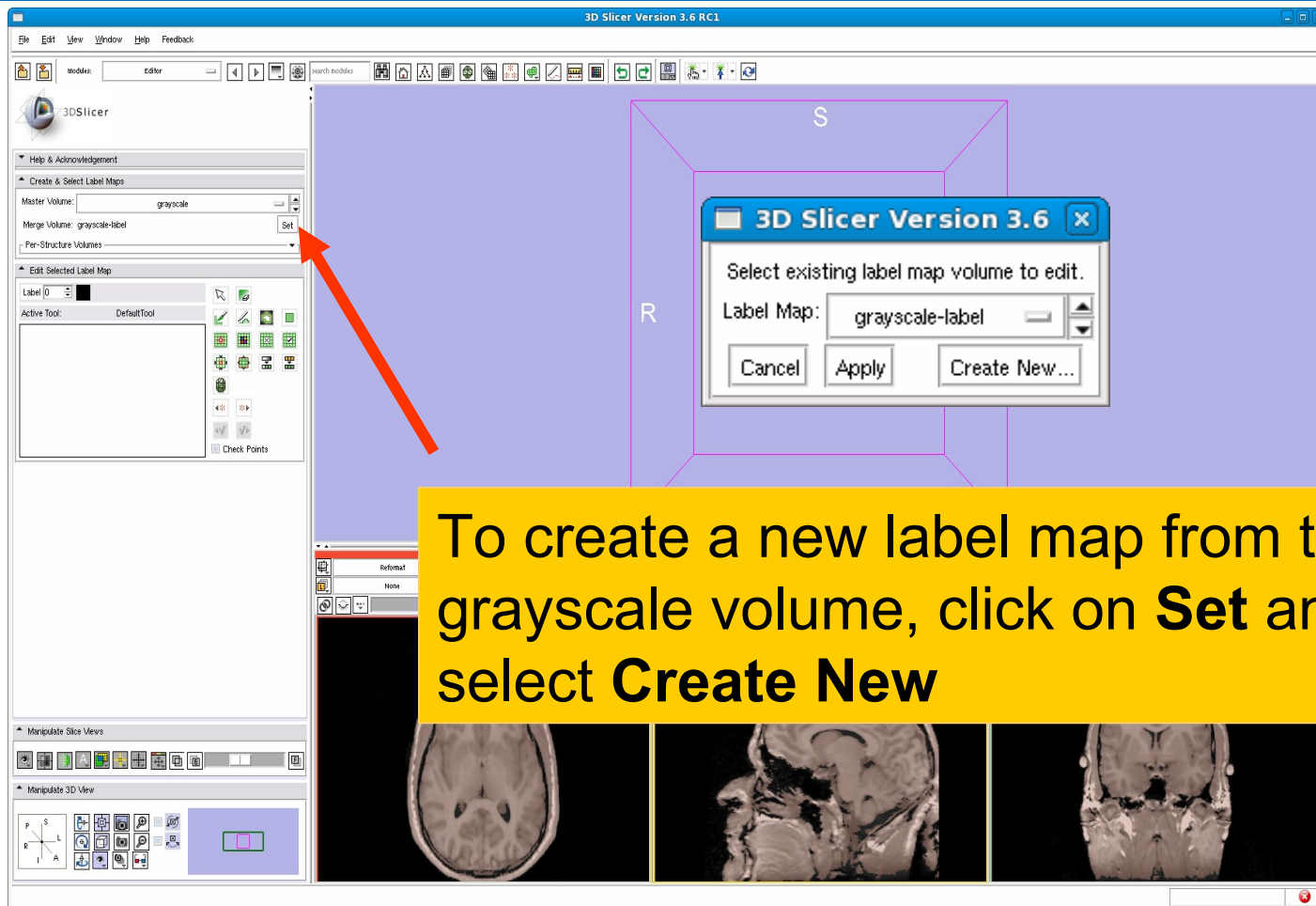




Part 3: Creating and editing a label map with multiple labels



Creating a map with multiple labels

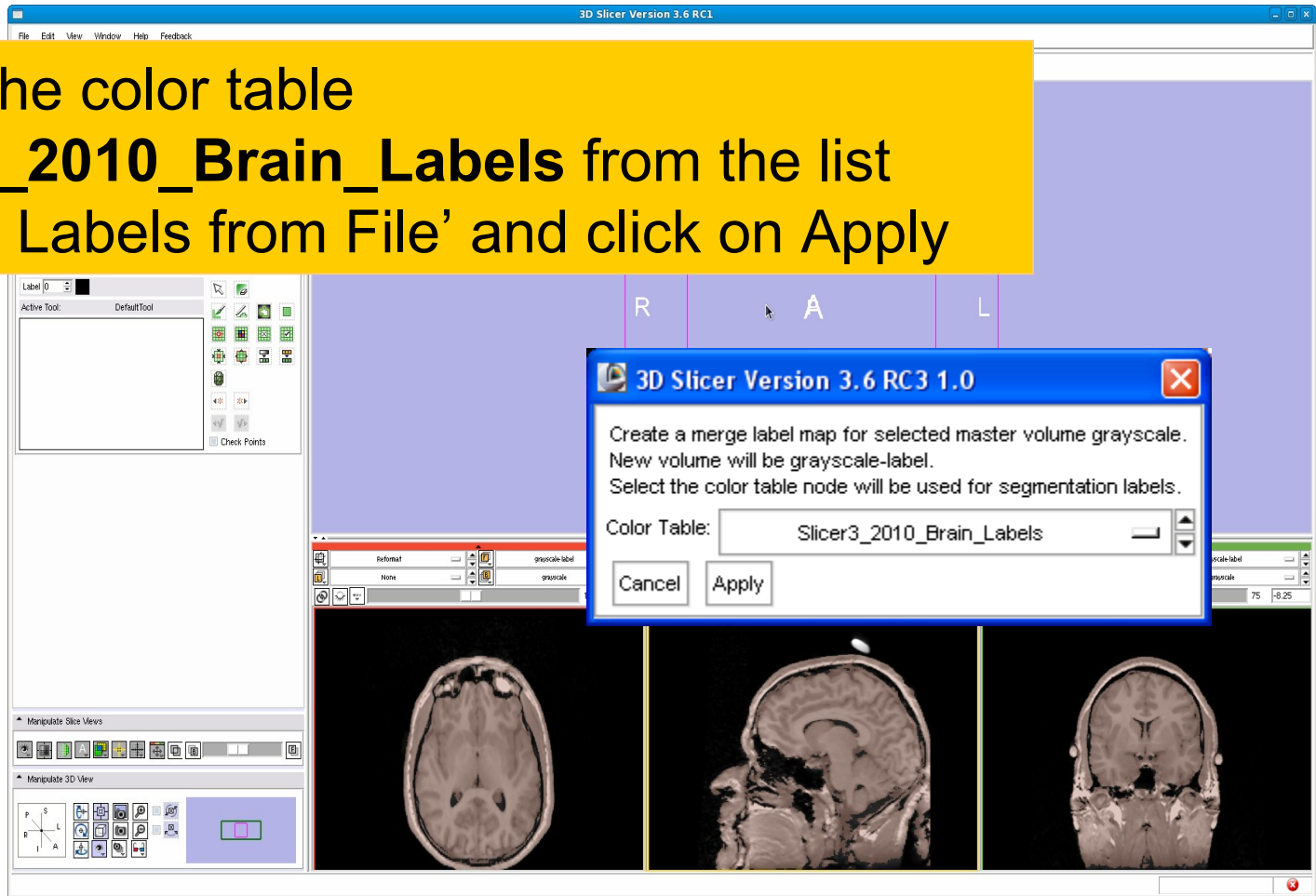




Creating a map with multiple labels

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

Slicer creates the new label map grayscale-label1

Expand the tab **Per-Structures Volumes**



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

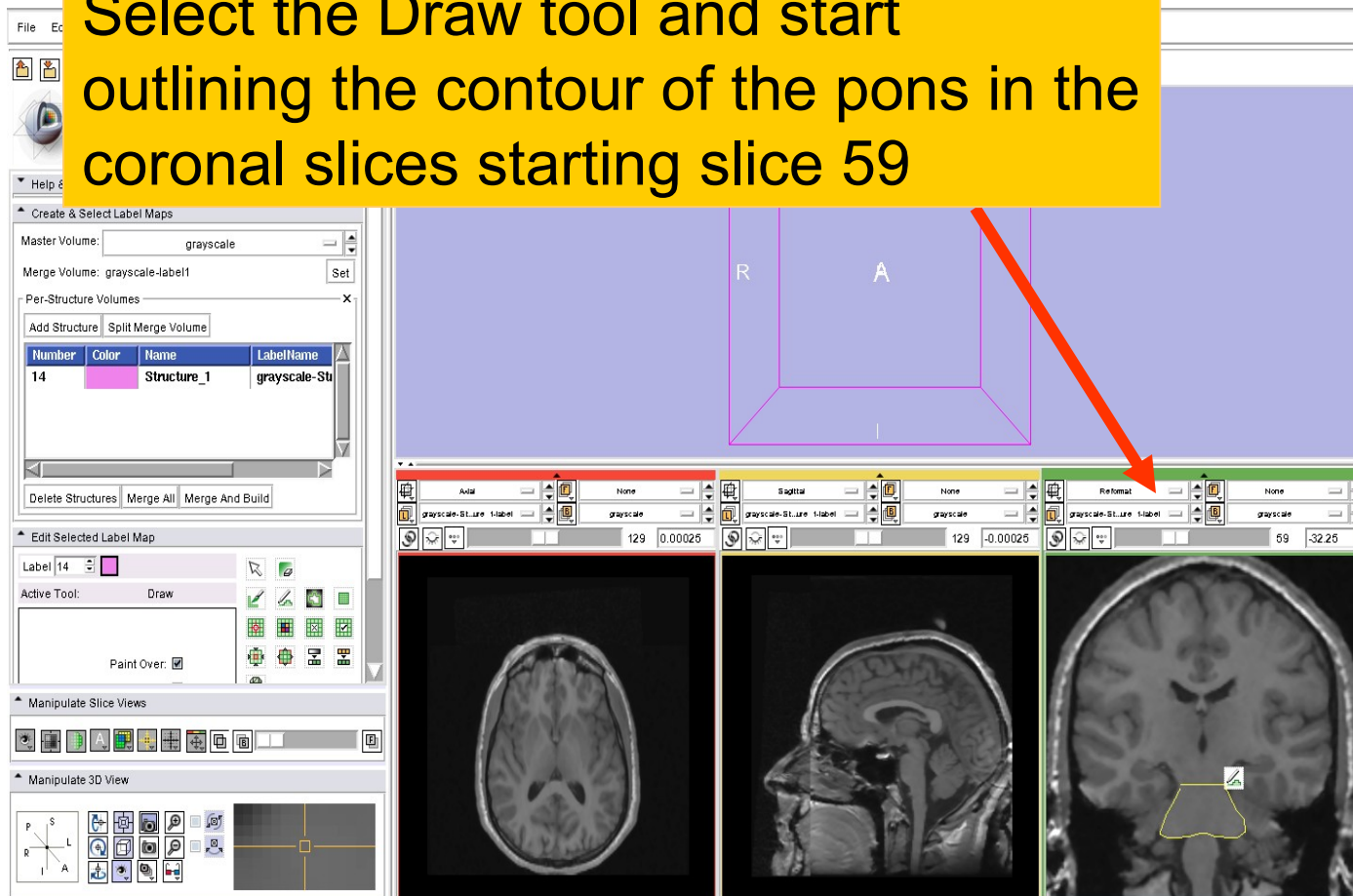


Description: The draw tool is an intuitive tool that can be used to manually outline structures in the grey level images.



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 grayscale-ST_Lure 1-label 129 0.00025

Sagittal None grayscale grayscale-ST_Lure 1-label 129 -0.00025

Reformat None grayscale grayscale-ST_Lure 1-label 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'

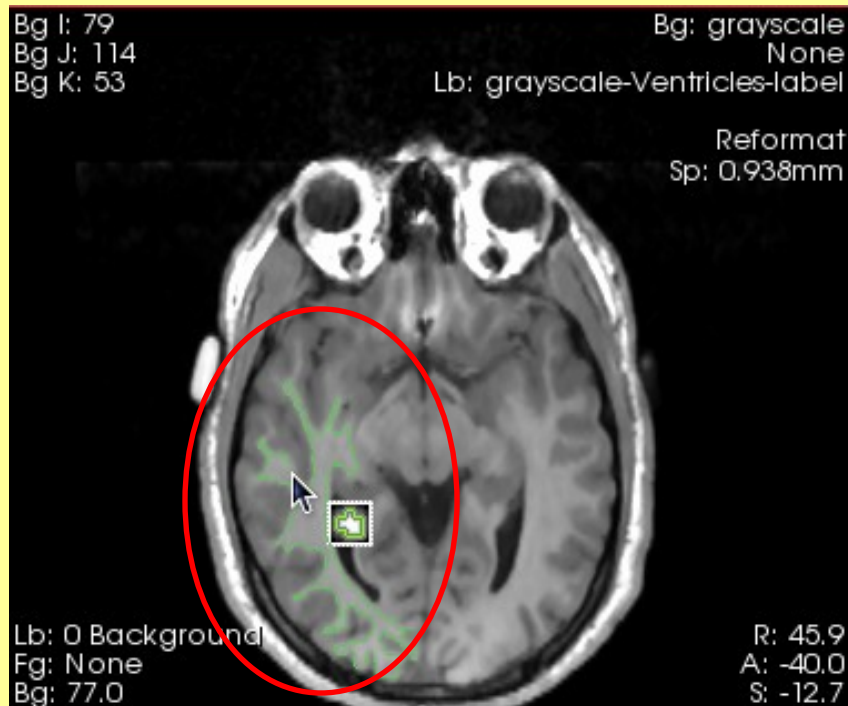
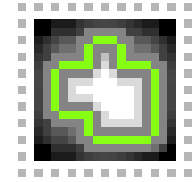
Number	Color	Name	LabelName
14		Structure_1	grayscale-Stu

Number	Color	Name
0		Background
1		Bone
2		Skin
3		Muscles
4		Fat
5		CSF
6		Ventricles
7		Arteries
8		Veins
9		Gray_matter

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



Level Tracing

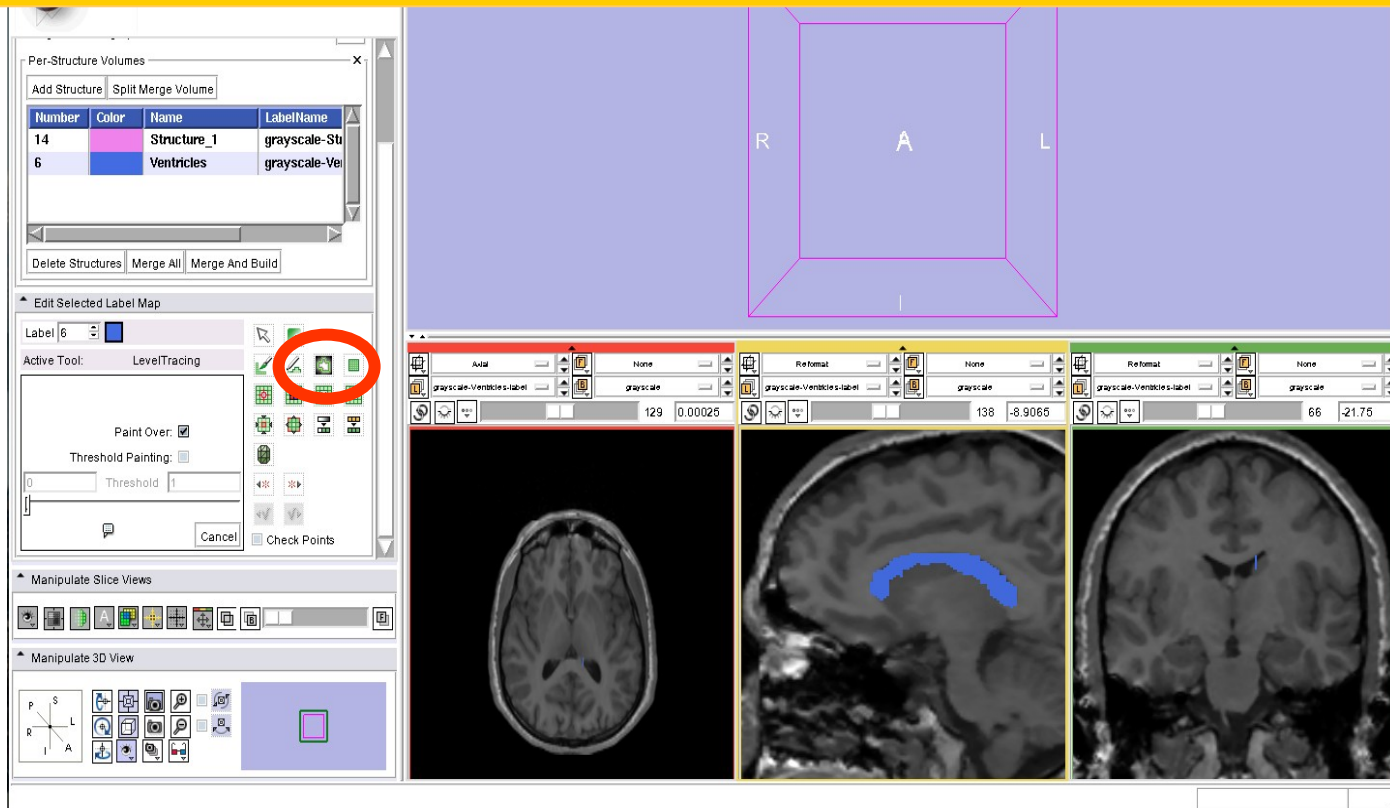


Description: By moving the mouse in the grey level images, you'll define in the label map volume an outline where the pixels all have the same value as the current background pixel.



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



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

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:

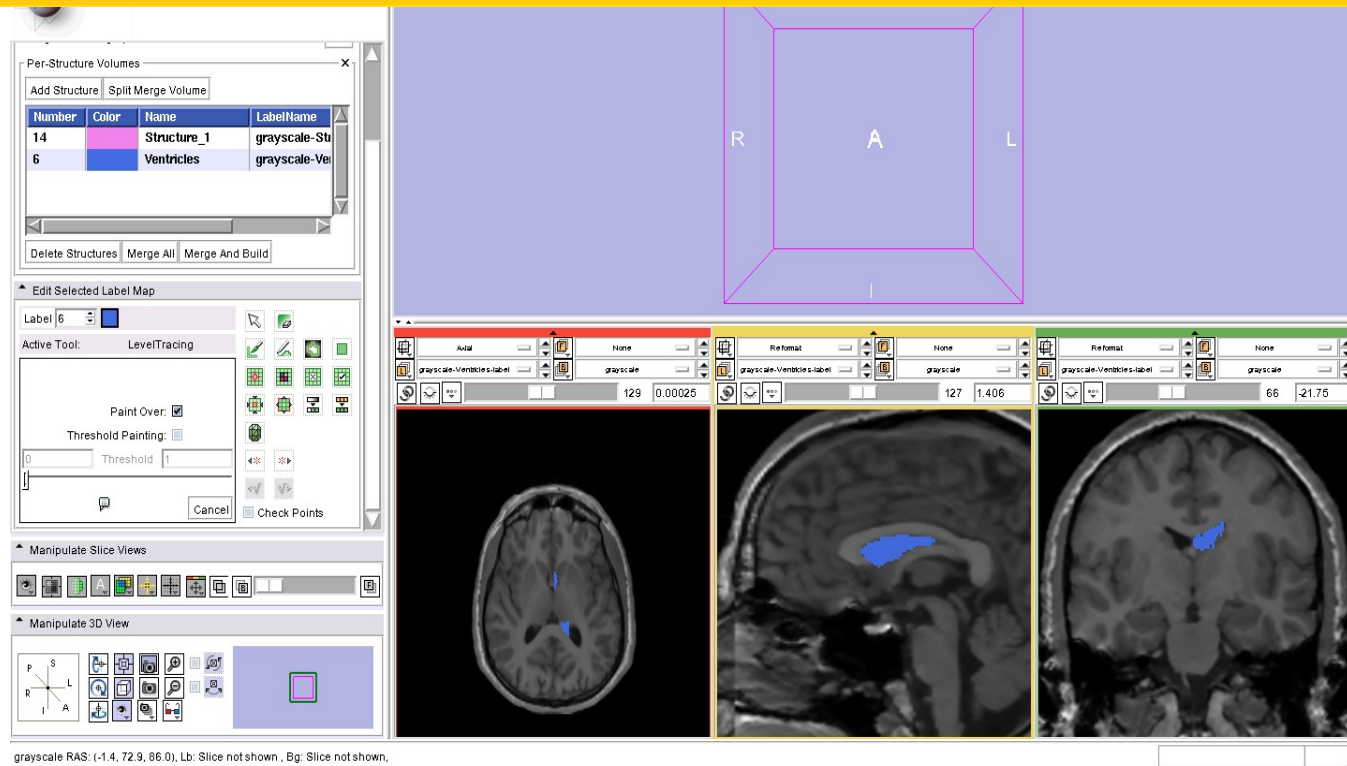
- Per-Structure Volumes:** A table with columns for Number, Color, Name, and LabelName. It lists 'Structure_1' (grayscale-Stu) and 'Ventricles' (grayscale-Vel).
- Edit Selected Label Map:** Shows 'Label 6' and 'Active Tool: LevelTracing'. It includes options for 'Paint Over', 'Threshold Painting', and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

The main workspace shows three anatomical views of a brain slice: Axial, Sagittal, and Coronal. A purple outline is drawn around the left lateral ventricle in the top view. Below the views, there are three panels for each view, each with a 'Reformat' button and a 'grayscale-Ventricles-label' button. The bottom status bar shows coordinates for the 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, the 'Edit Selected Label Map' panel shows 'Label 6' selected. The 'Active Tool' is 'LevelTracing'. The 'Threshold Painting' section has a 'Threshold' of 1. The 'Manipulate Slice Views' and 'Manipulate 3D View' panels are also visible.

In the center, a 'Label Map' window is open, showing a list of labels:

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

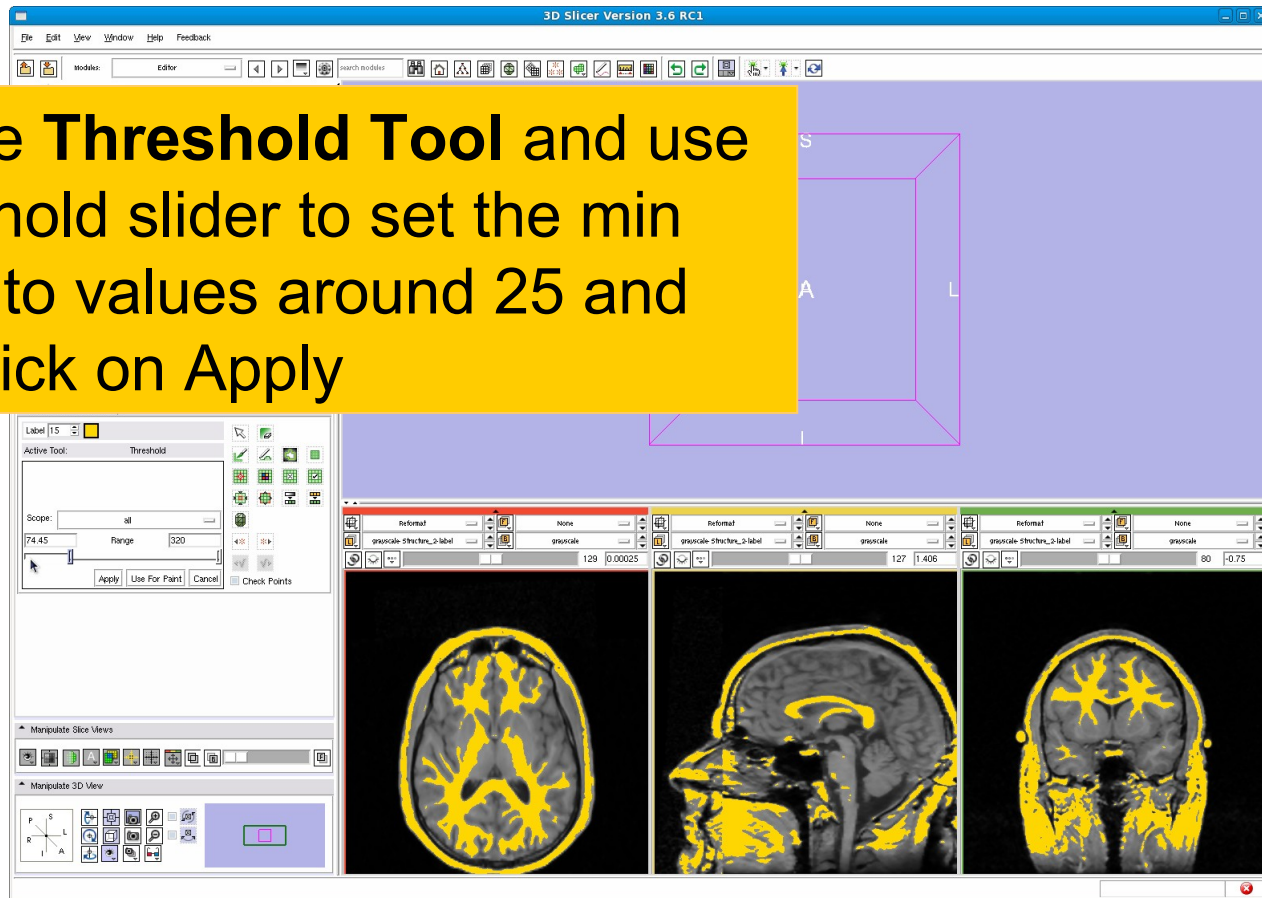
The 3D view on the right shows a brain slice with a yellow box highlighting a region. The box is labeled 'S' at the top and 'L' on the right side. The 3D view also shows a blue region representing the 'Structure_1'.

At the bottom, the 'grayscale RAS' coordinates are shown: (-1.4, 72.9, 86.0). The 'Lb' and 'Bg' slice positions are also indicated as 'not shown'.



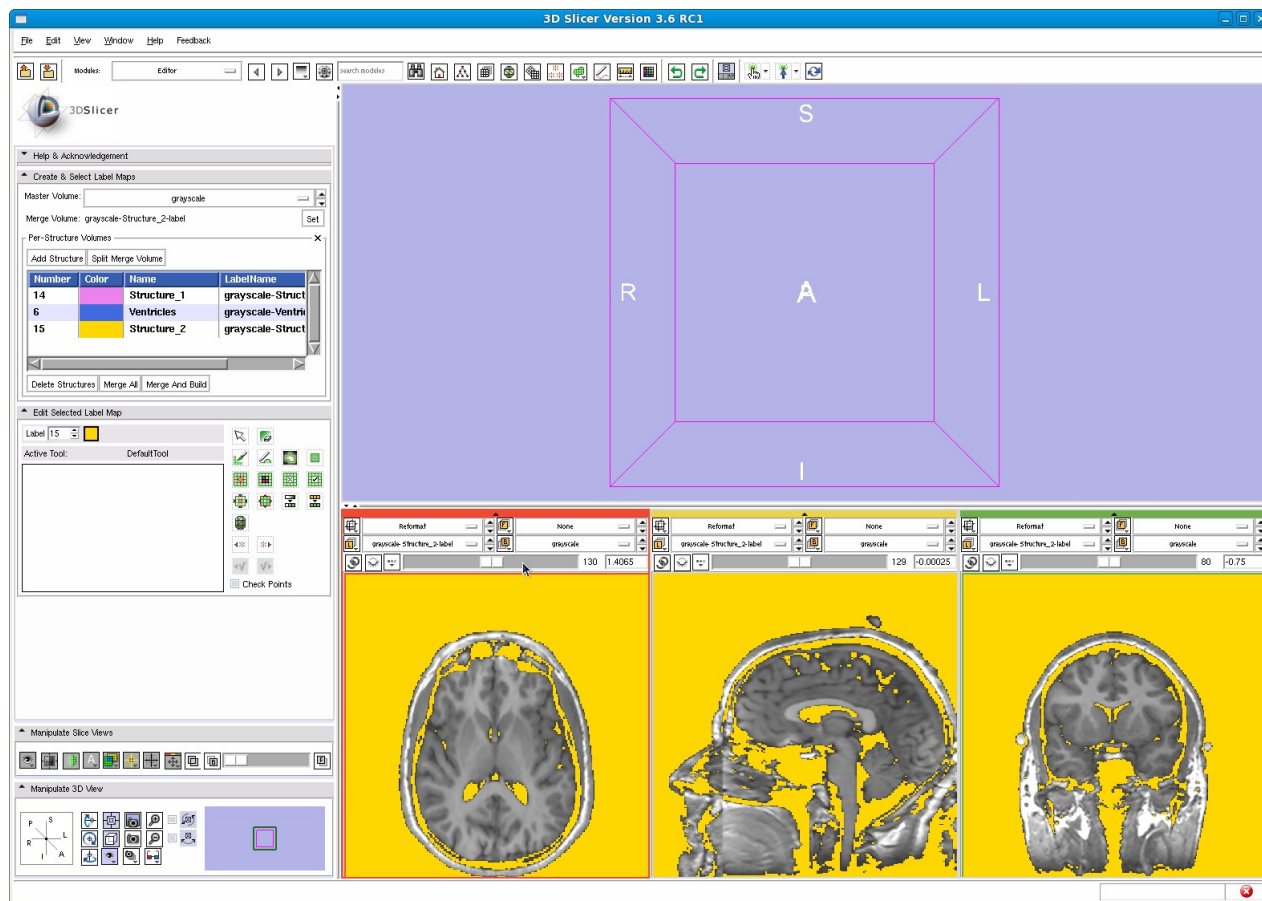
Threshold tool

Select the **Threshold Tool** and use the threshold slider to set the min and max to values around 25 and 35 and click on Apply





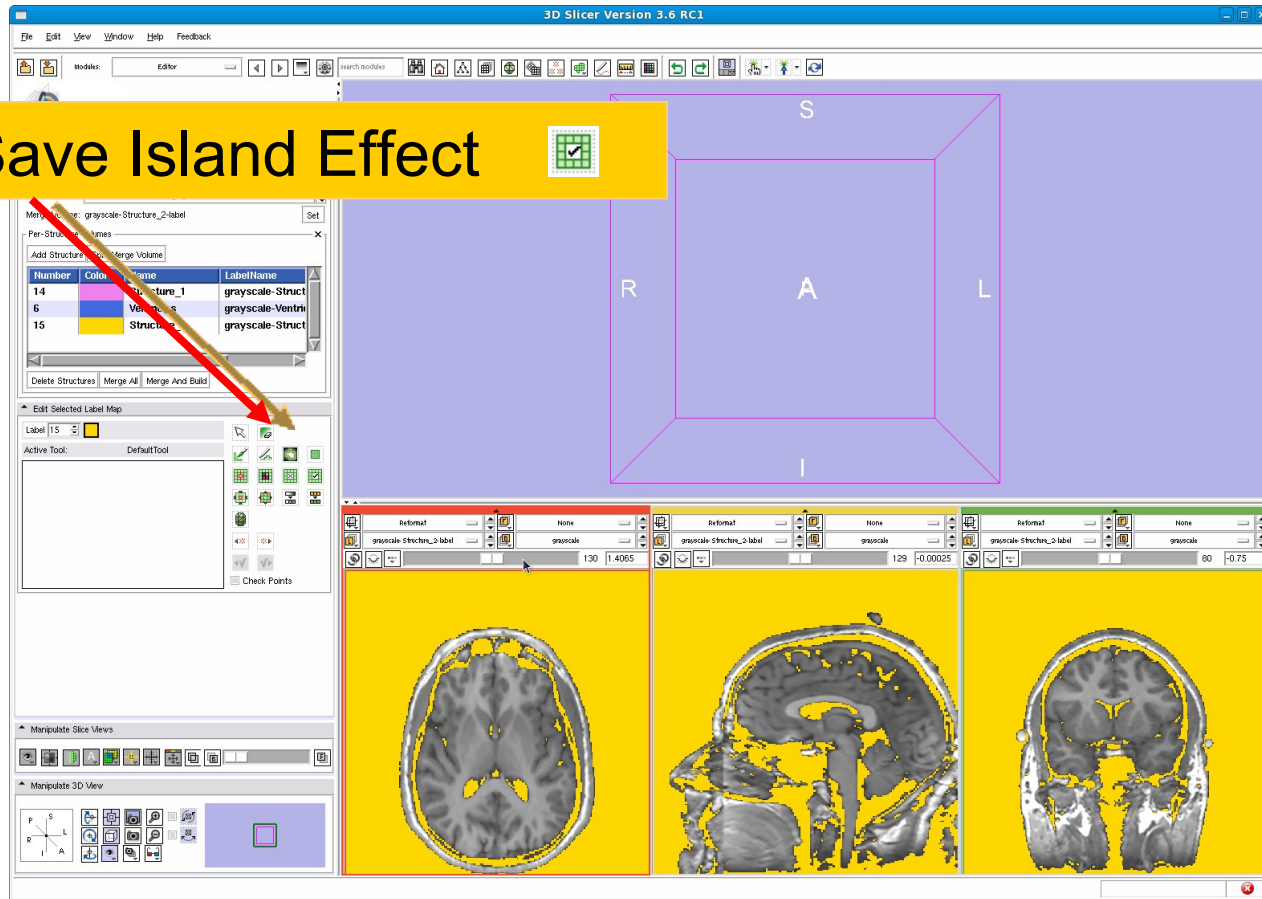
Threshold tool





Save Island

Select the Save Island Effect 





Save Island

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

3DSlicer

Per-Structure Volumes

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

Label 15

Active Tool: Threshold

Scope: all

80 Range 320

Apply Use For Paint Cancel Check Points

Manipulate Slice Views

Manipulate 3D View

grayscale RAS: (146.9, 140.1, -13.6), Lb: Slice not shown, Bg: Slice not shown.



Dilate Effect

Select the Dilate Effect

3DSlicer

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

Label 15

Active Tool: Savelsland

Scope: all

Manipulate Slice Views

Manipulate 3D View

Reformat: None, grayscale-St. label, 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 image properties and labels.

Structure List:

Label	Color	Structure Name	Grayscale Label
14	Pink	Structure_1	grayscale-Stu
6	Blue	Ventricles	grayscale-Ve
15	Yellow	Structure_2	grayscale-Stu

Active Tool: Removelslands

Scope: visible

Buttons: Cancel, Apply, Check Points

Manipulate Slice Views: [Icons for slice manipulation]

Manipulate 3D View: [Icons for 3D view manipulation]

Middle Button: Pan; Right Button: Zoom



Dilate Effect

Browse through the axial slices of the segmented eyeball

The screenshot displays a medical image segmentation software interface. On the left, there are several panels: 'Per-Structure Volumes' with a table of structures, 'Edit Selected Label Map' with tool options, and 'Manipulate Slice Views' and 'Manipulate 3D View' sections. The main window shows a large axial slice of a brain with a purple rectangular region of interest (ROI) labeled 'A'. Below this, three smaller axial slices are shown, each with a different ROI: a yellow circle labeled 'I', a green circle labeled 'J', and a red circle labeled 'K'. The software interface includes various toolbars and a status bar at the bottom.

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

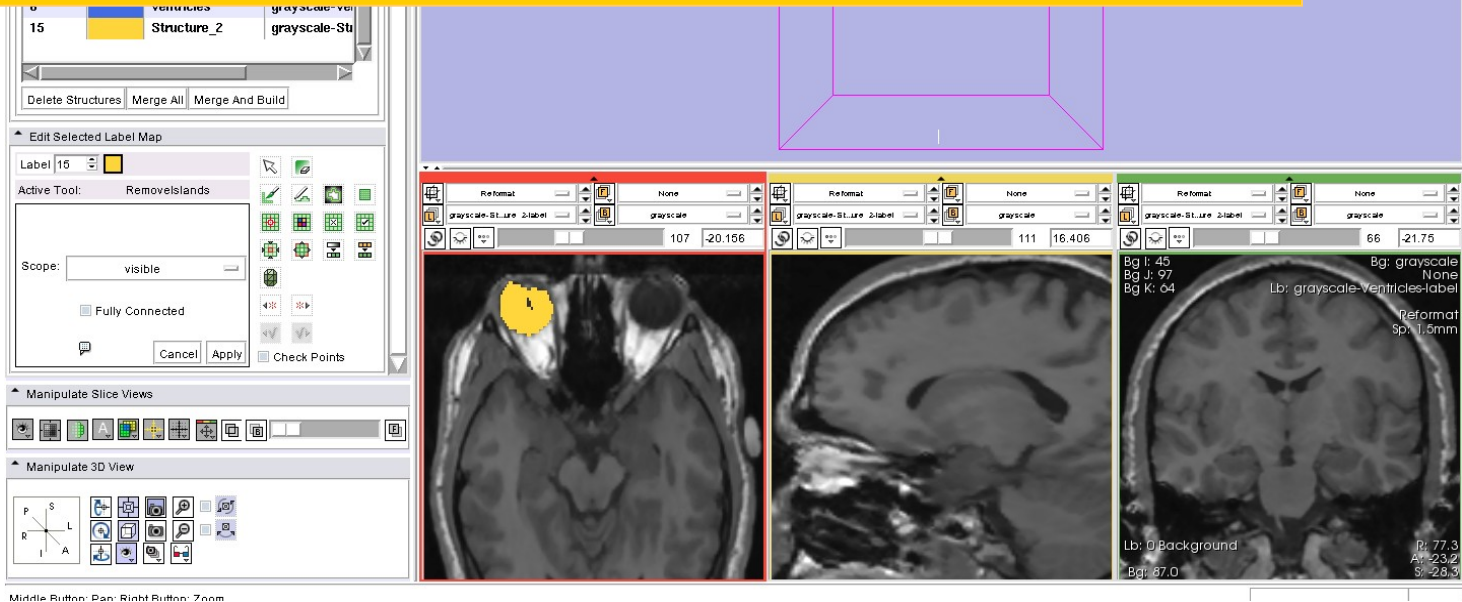
Middle Button: Pan; Right Button: Zoom



Remove Island

Select the **Remove Island**  tool

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





Remove Island

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

3DSlicer

Per-Structure Volumes

Number	Color	Name	LabelName
14	Structure_1	Structure_1	grayscale-St
6	Ventricles	Ventricles	grayscale-Ve
15	Structure_2	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-ST_Lure 2:label: grayscale

107 -20.156

Reformat: None

grayscale-ST_Lure 2:label: grayscale

111 16.406

Reformat: None

grayscale-ST_Lure 2:label: grayscale

66 -21.75

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

Bg: grayscale None

Lb: grayscale-Ventricles-label

Reformat Sp: 11.0mm

Lb: 0 Background

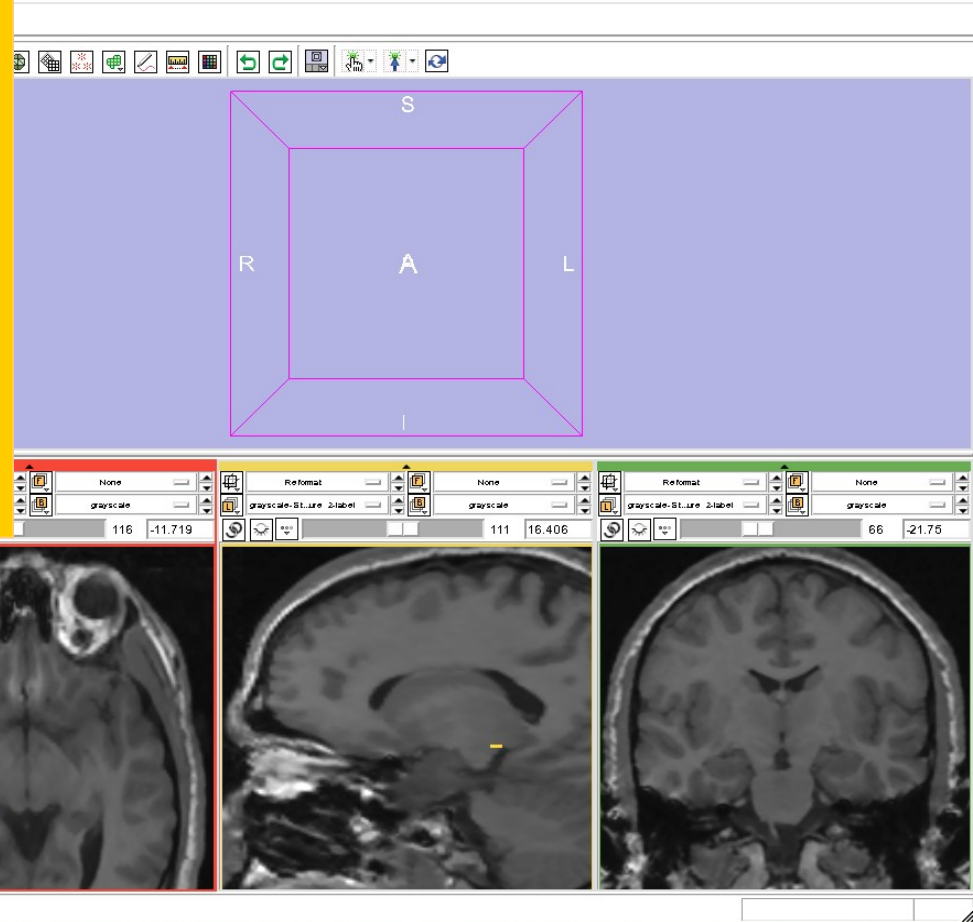
Bg: 47.0

P: 77.3 A: 23.2 S: 28.3



Adding more structures

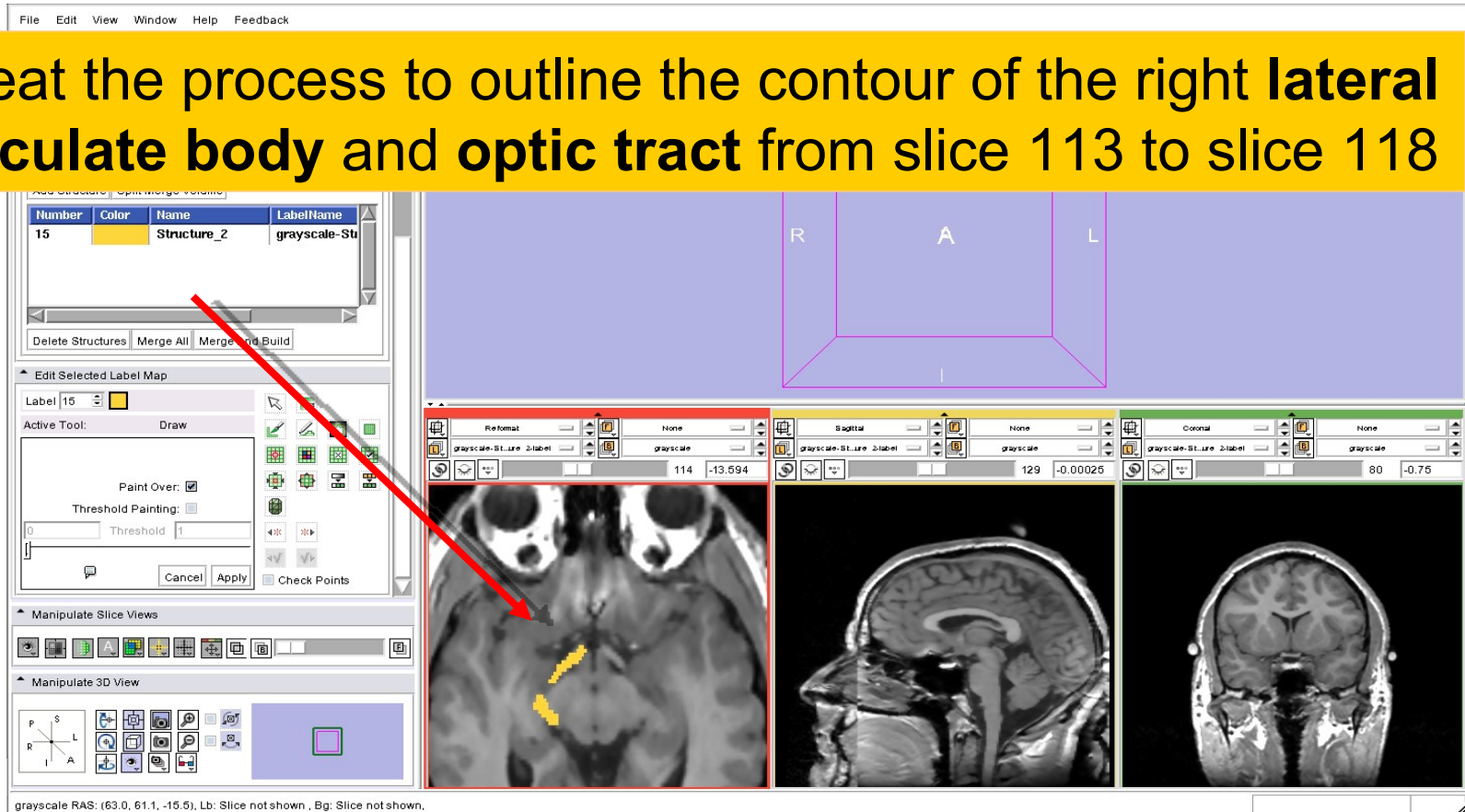
Zoom in using the right mouse button, and use the drawing tool to outline the contour of the right lateral geniculate body and optic tract in the axial view.





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





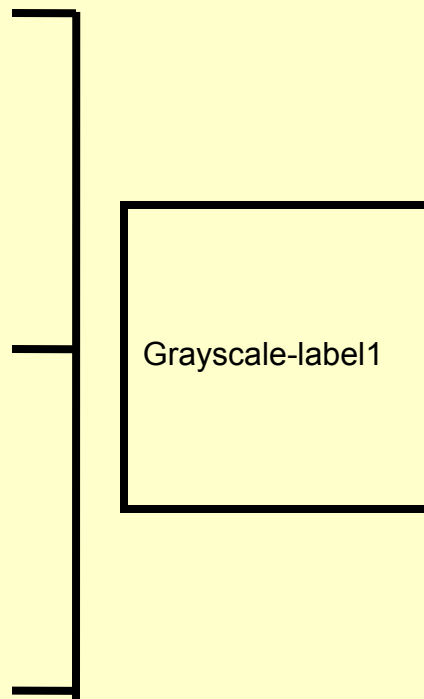
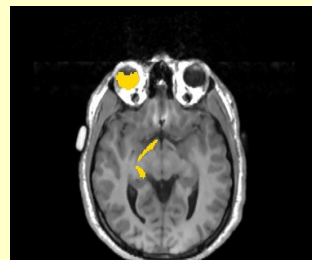
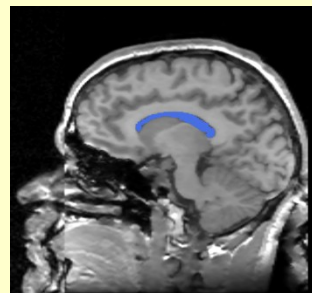
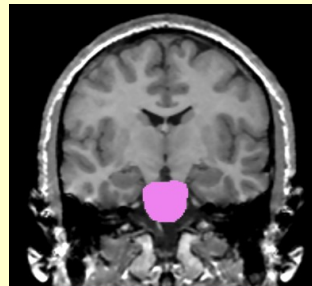
Merge And Build

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.

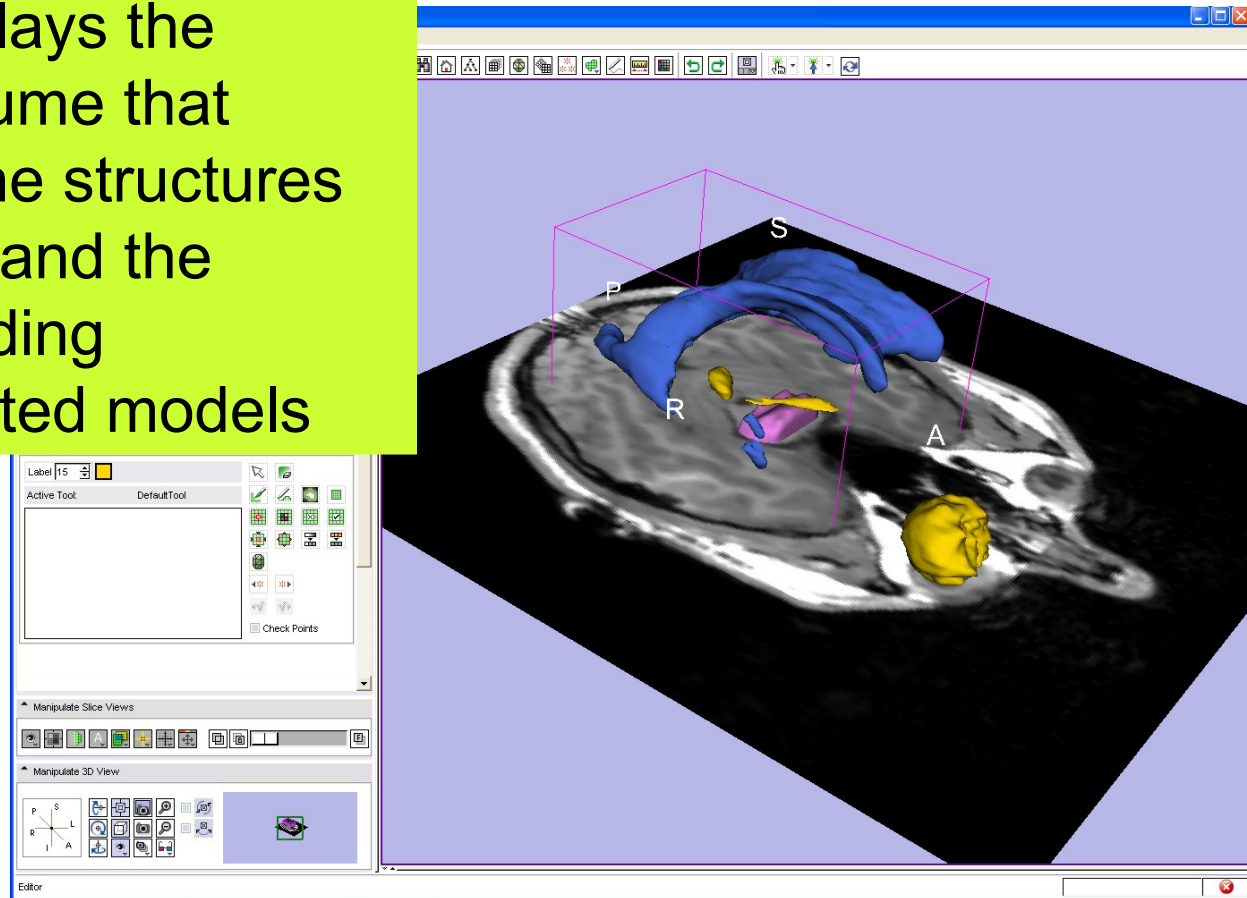
The three label maps will be merged in the order that they appear in the table.

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



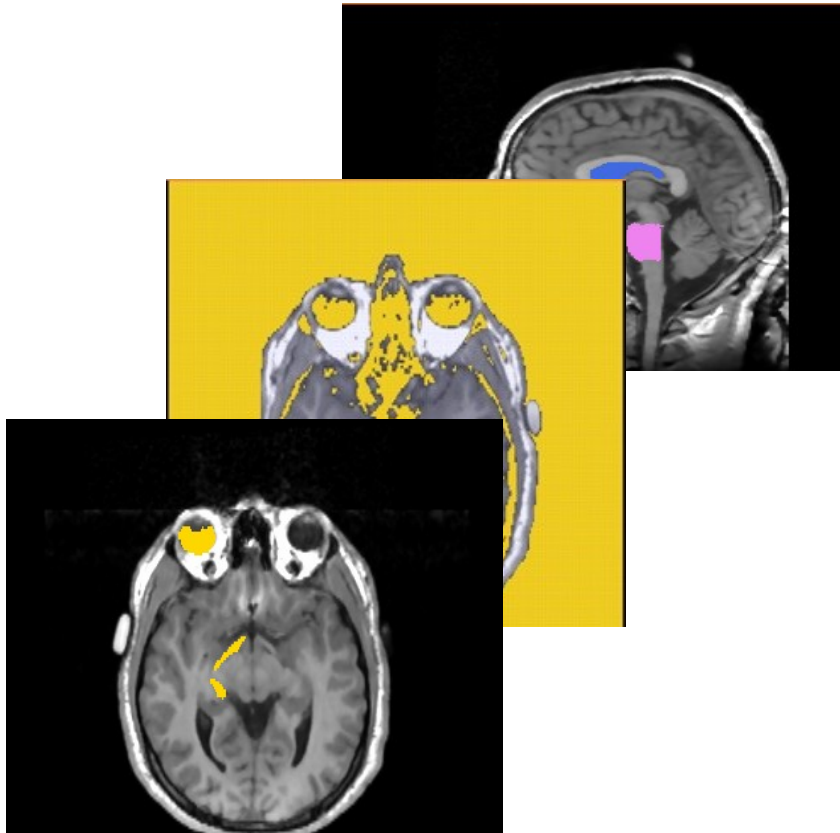
Merge And Build

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



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