



NA-MIC

National Alliance for Medical Image Computing

<http://na-mic.org>

Interactive Editor tutorial

Sonia Pujol, Ph.D.

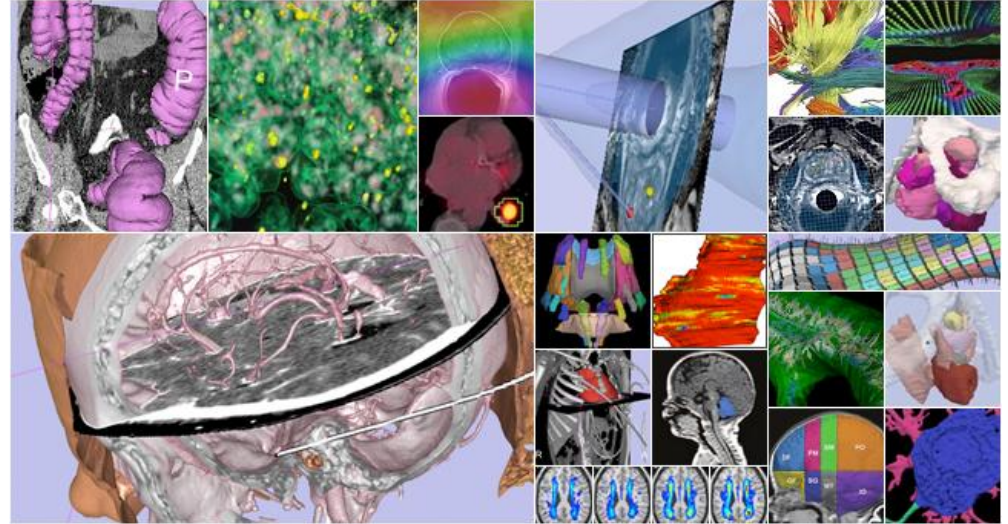
Surgical Planning Laboratory

Harvard Medical School



Slicer3.6

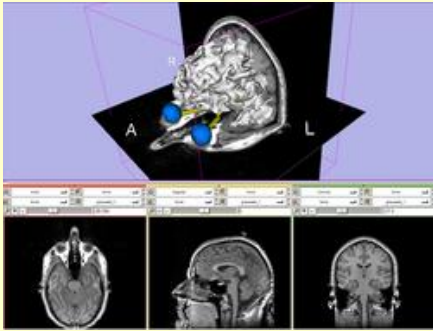
- An **end-user application** for image analysis
- An **open-source environment** for software development
- A software platform that is both **easy to use for clinical researchers** and **easy to extend for programmers**





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>

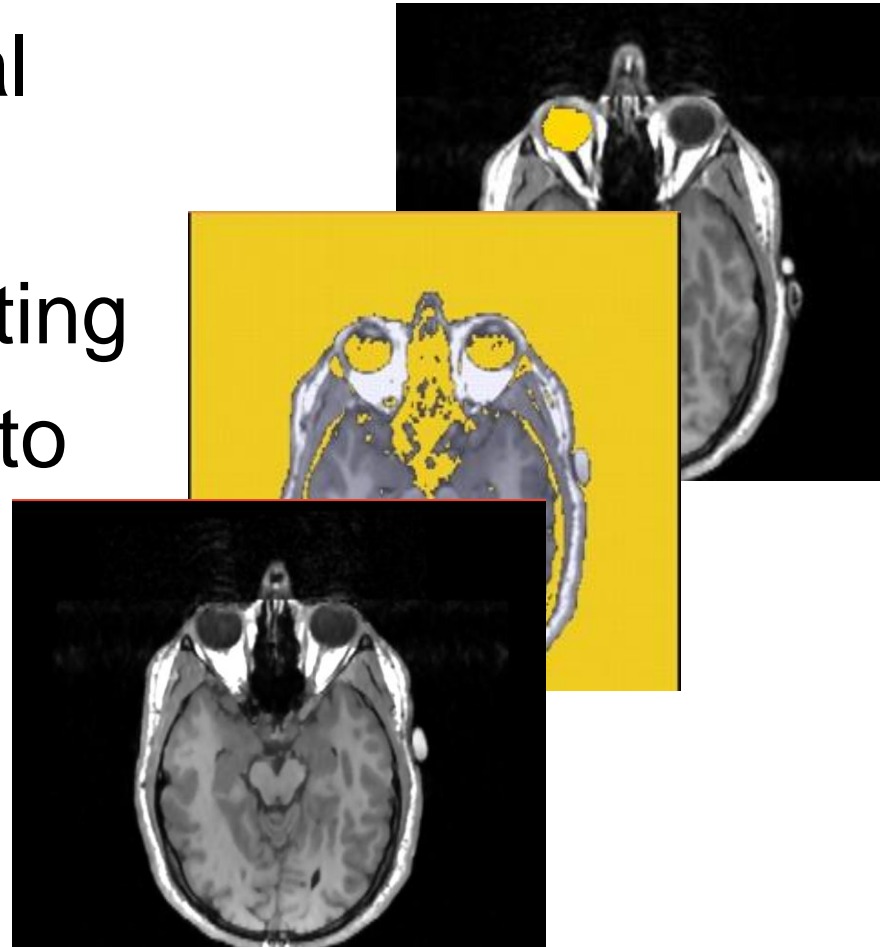
Disclaimer

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.



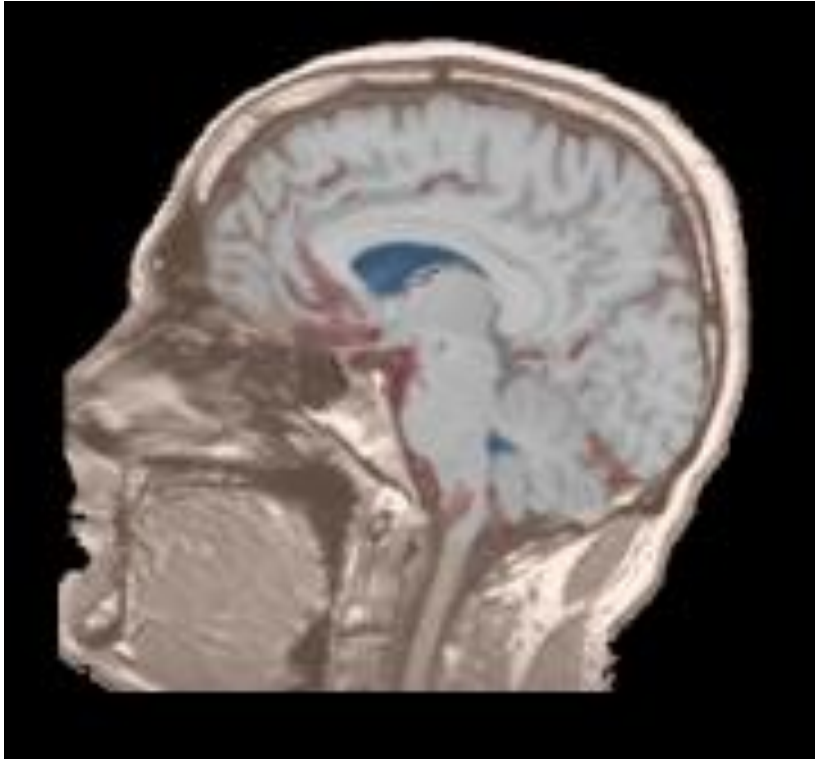
Learning Objective

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.





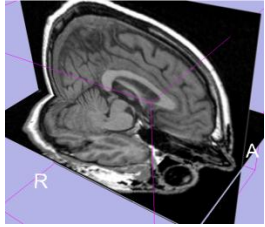
Label map



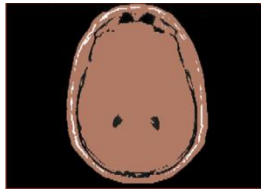
A **label map** has a number at each pixel representing the anatomy present at that point.



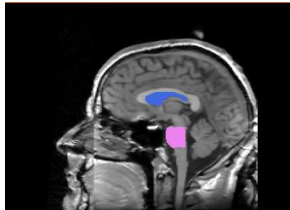
Overview



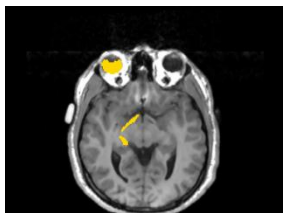
Part 1: Creating a single label map

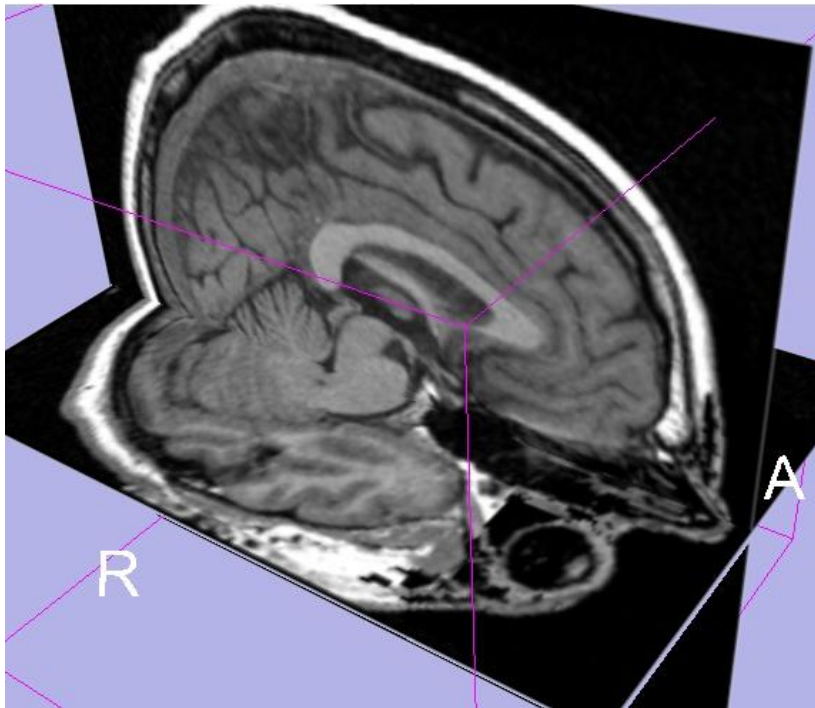


Part 2: Editing a single label map



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

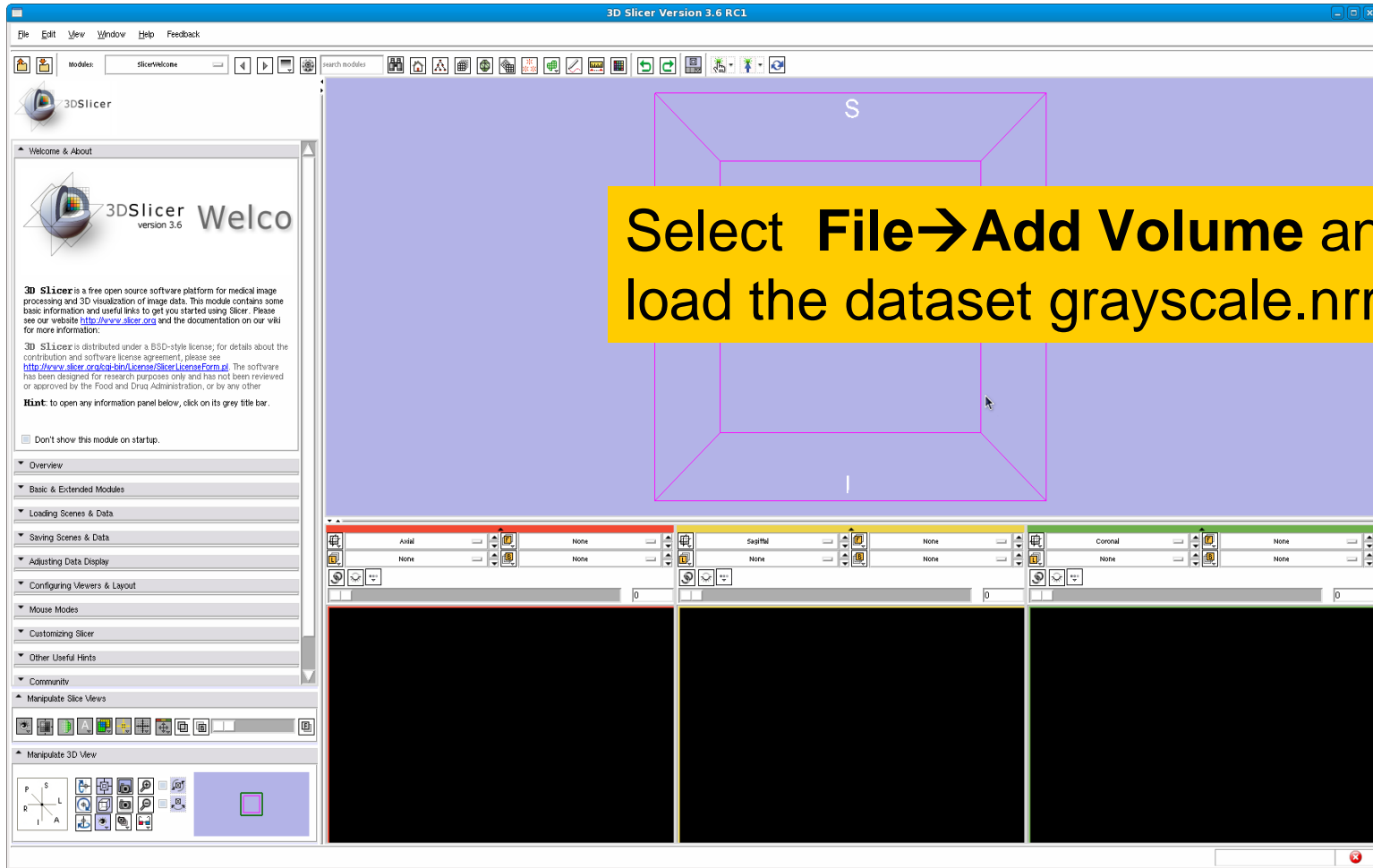




Part 1: Creating a single label map



Data Loading



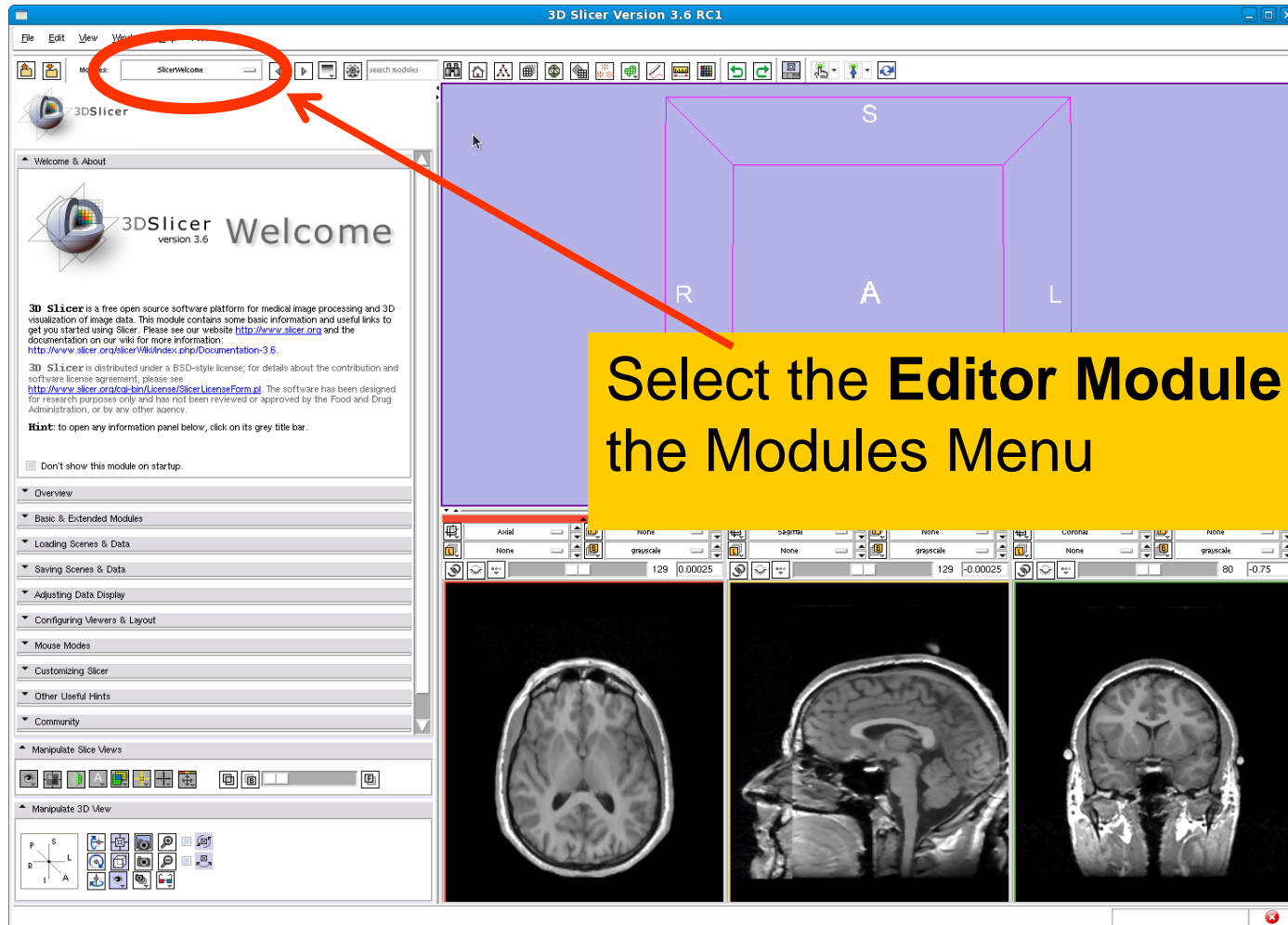


Data Loading





Data Loading





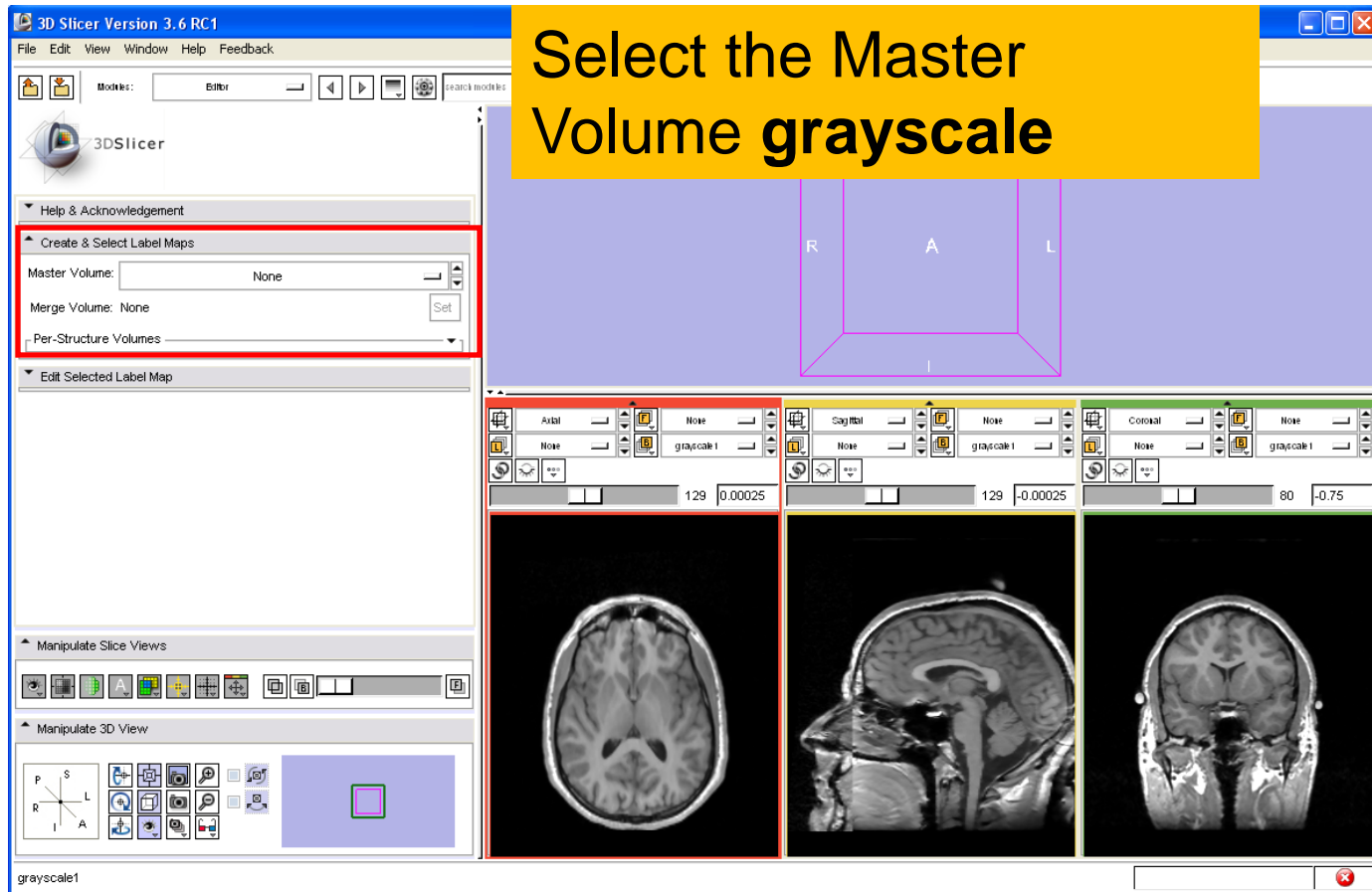
Editor Module

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.

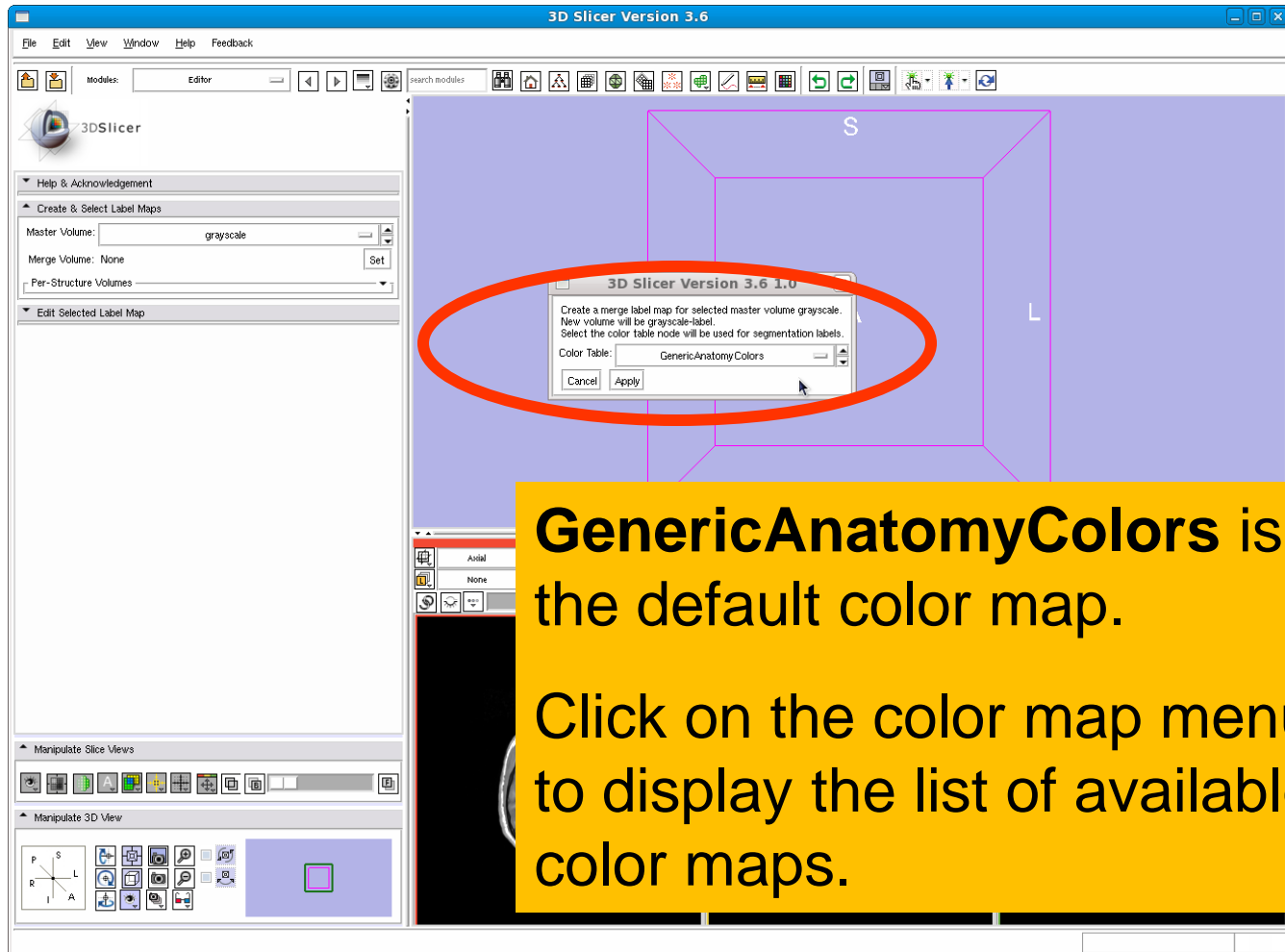


Label Map Creation





Label Map Creation

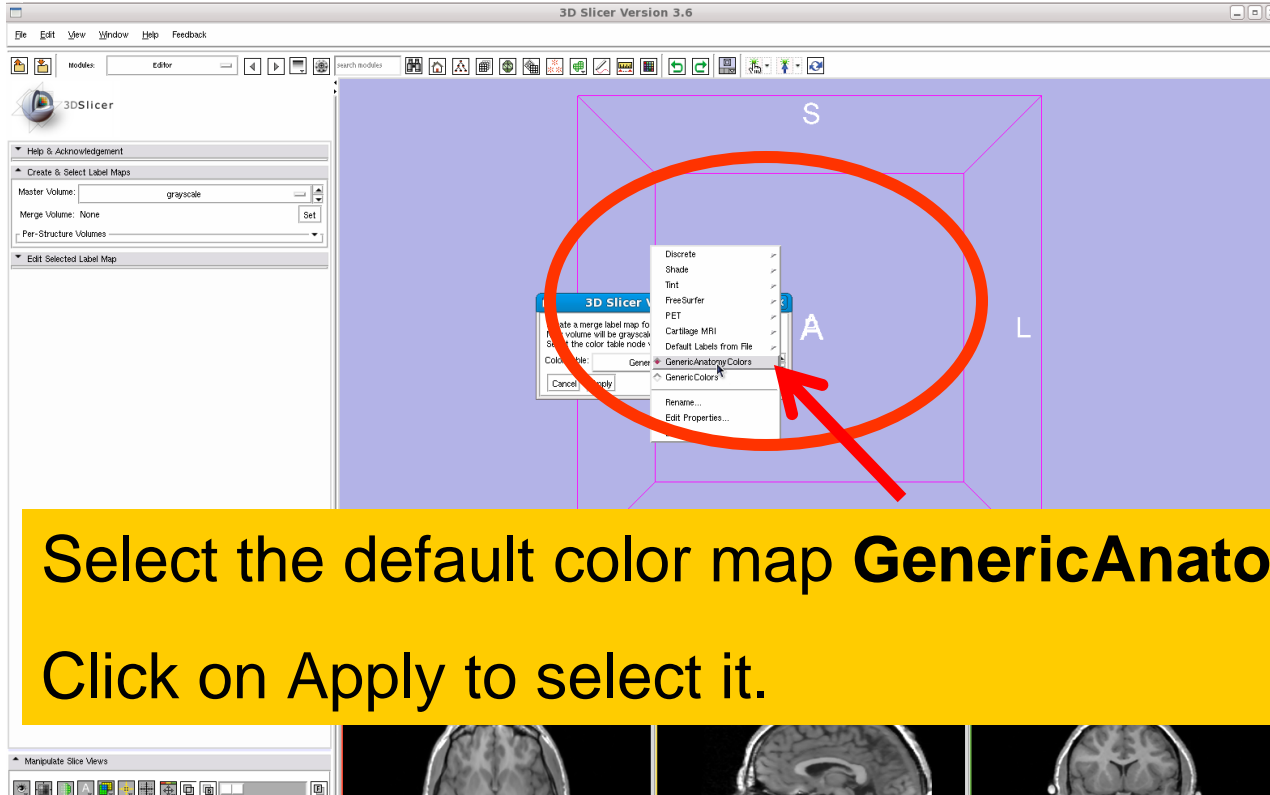


GenericAnatomyColors is the default color map.

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.

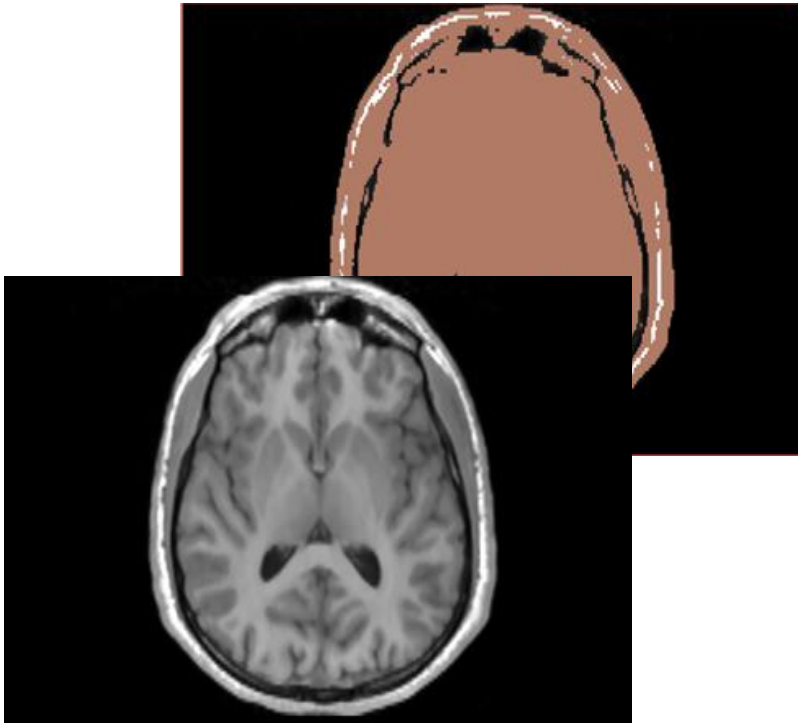
Note: You may use the Colors module if you need a custom or application specific color map



Label Map Creation

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

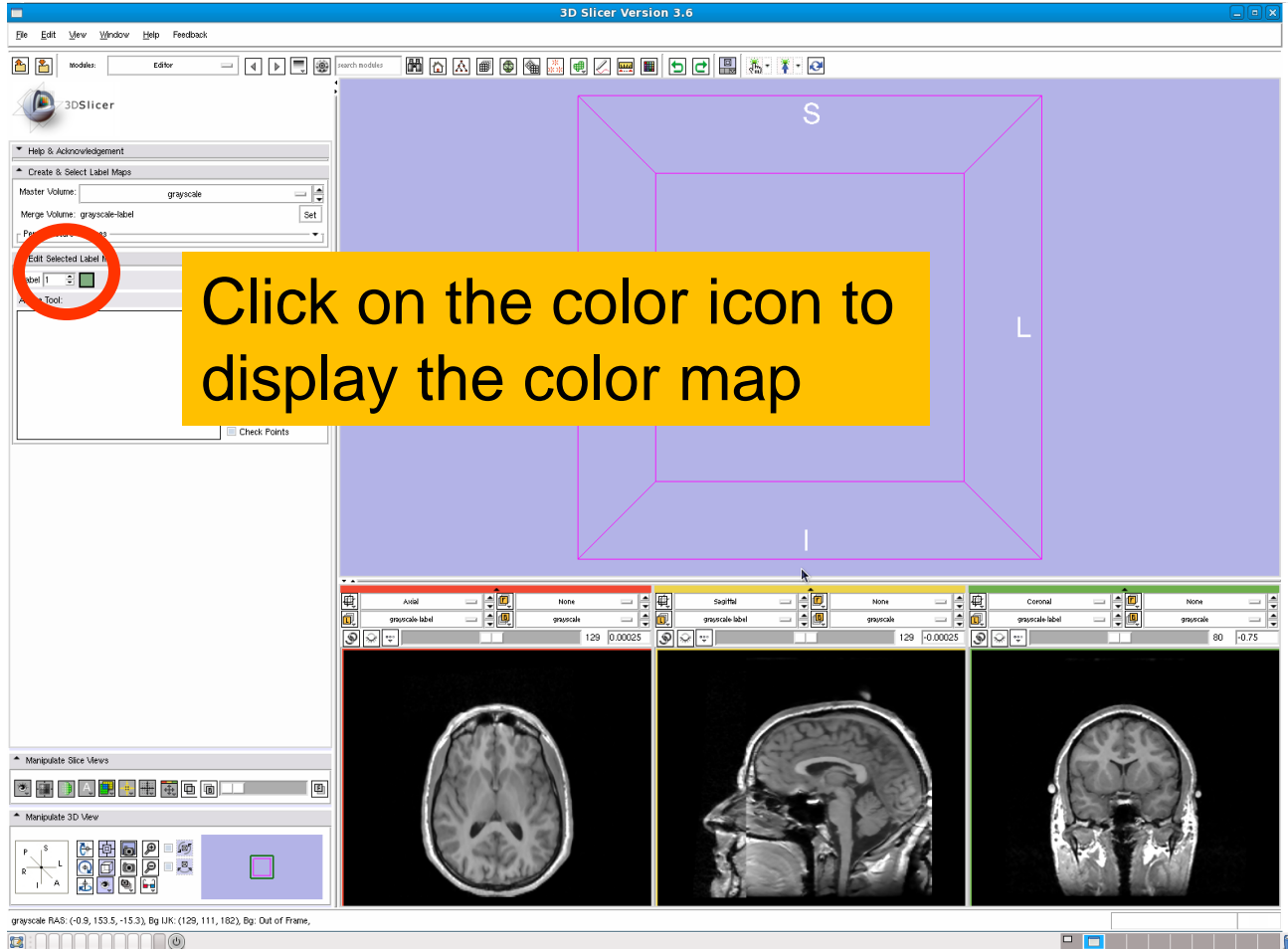
The screenshot shows the 3D Slicer software interface. The 'Edit Selected Label Map' panel on the left is circled in red. A yellow text box is overlaid on the right side of the interface, containing the text: 'Slicer creates the empty label map **grayscale-label** and displays the frame which contains the different tools for interactive editing.' The interface displays a 3D view of a brain slice and three 2D slice views (Axial, Sagittal, Coronal) at the bottom. The 'grayscale-label' volume is selected in the 'grayscale-label' panel.



Part 2: Editing a single label map



Label Map Editing





Label Map Editing

3D Slicer Version 3.6

Color Box

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

grayscale RAS: (-0.9, 153.5, -15.3), Bp LJK: (129, 111, 182), Bq: Out of Frame.

Slicer displays the color map
GenericAnatomyColors



Label Map Editing

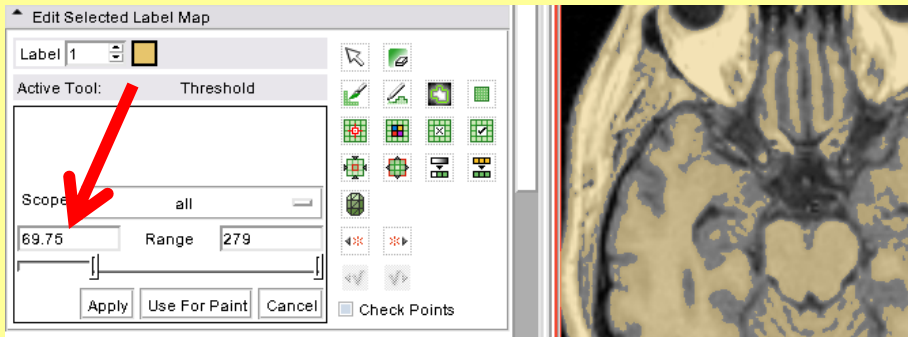
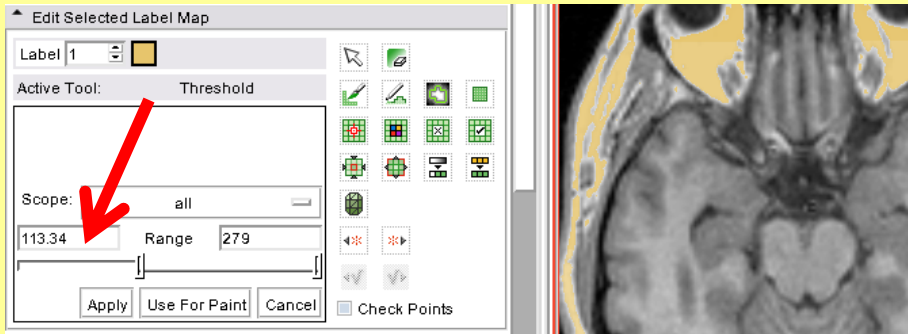
Browse through the list of 307 labels to explore the color map **GenericAnatomyColors**

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



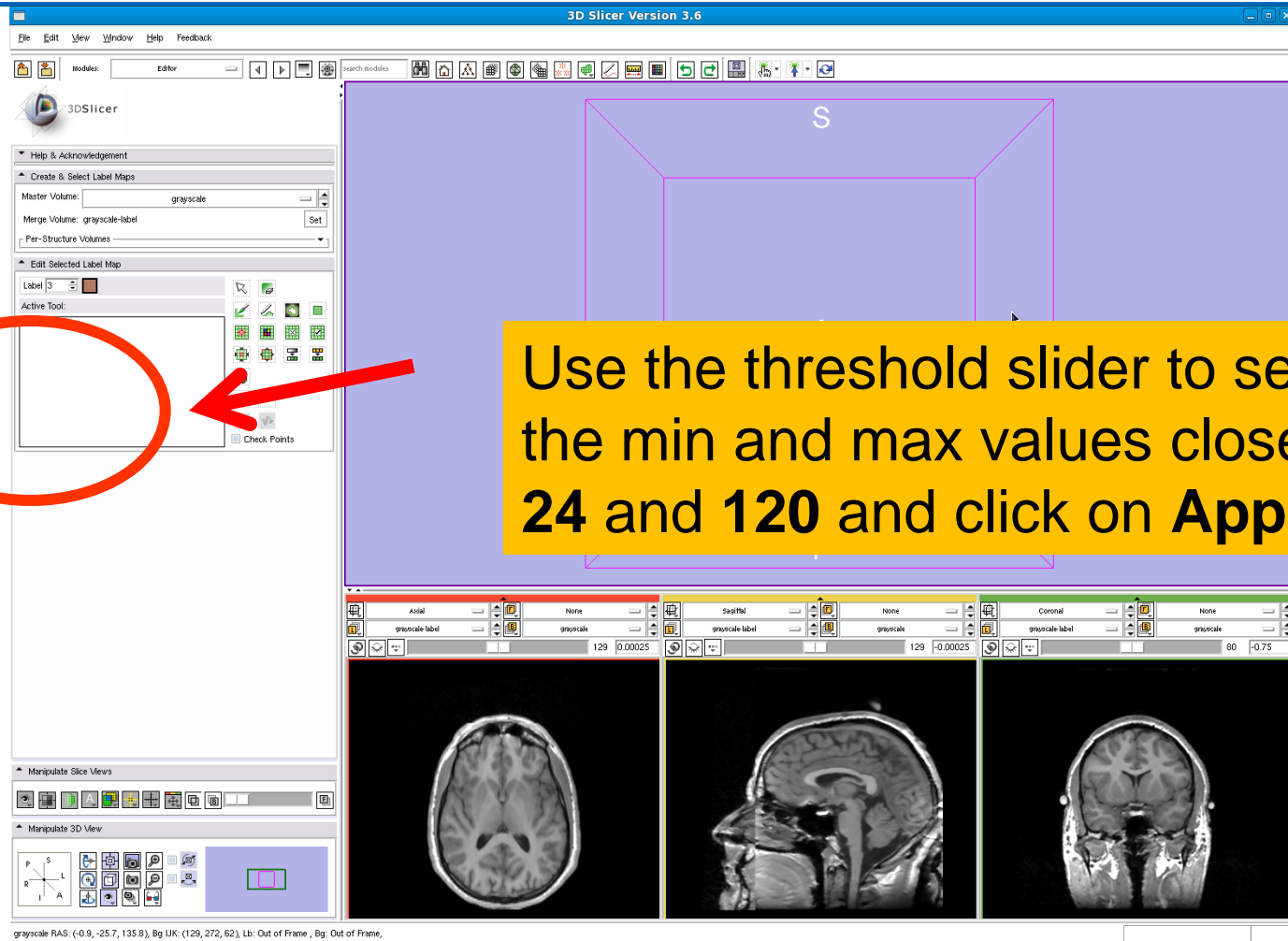
Threshold



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





Threshold Effect

3D Slicer Version 3.6

File Edit View Window Help Feedback

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 Print 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**

Axial None grayscale-label 129 0.00025

Sagittal None grayscale-label 129 -0.00025

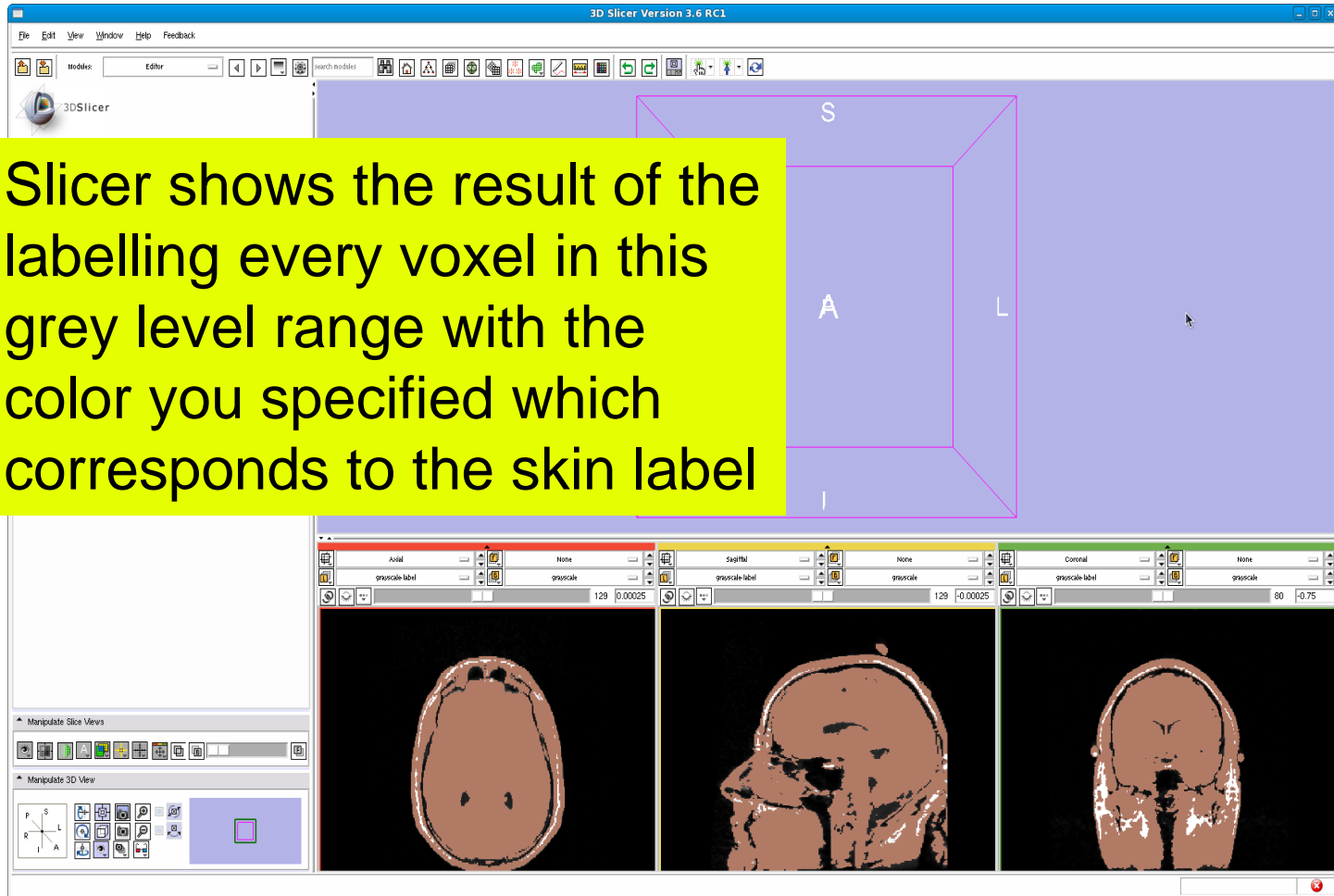
Coronal None grayscale-label 80 -0.75

Feedback



Threshold Effect

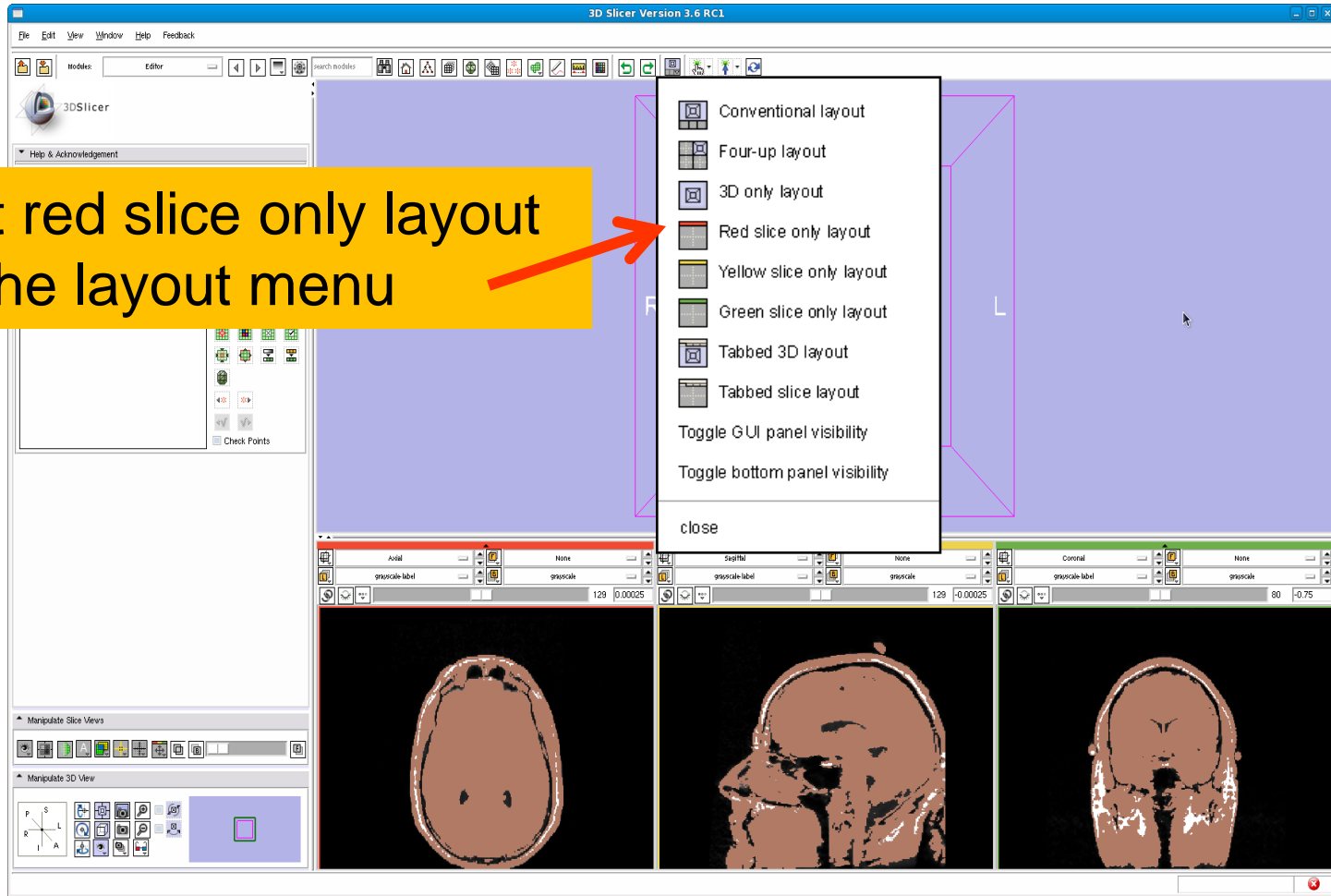
Slicer shows the result of the labelling every voxel in this grey level range with the color you specified which corresponds to the skin label





Threshold Effect

Select red slice only layout
from the layout menu





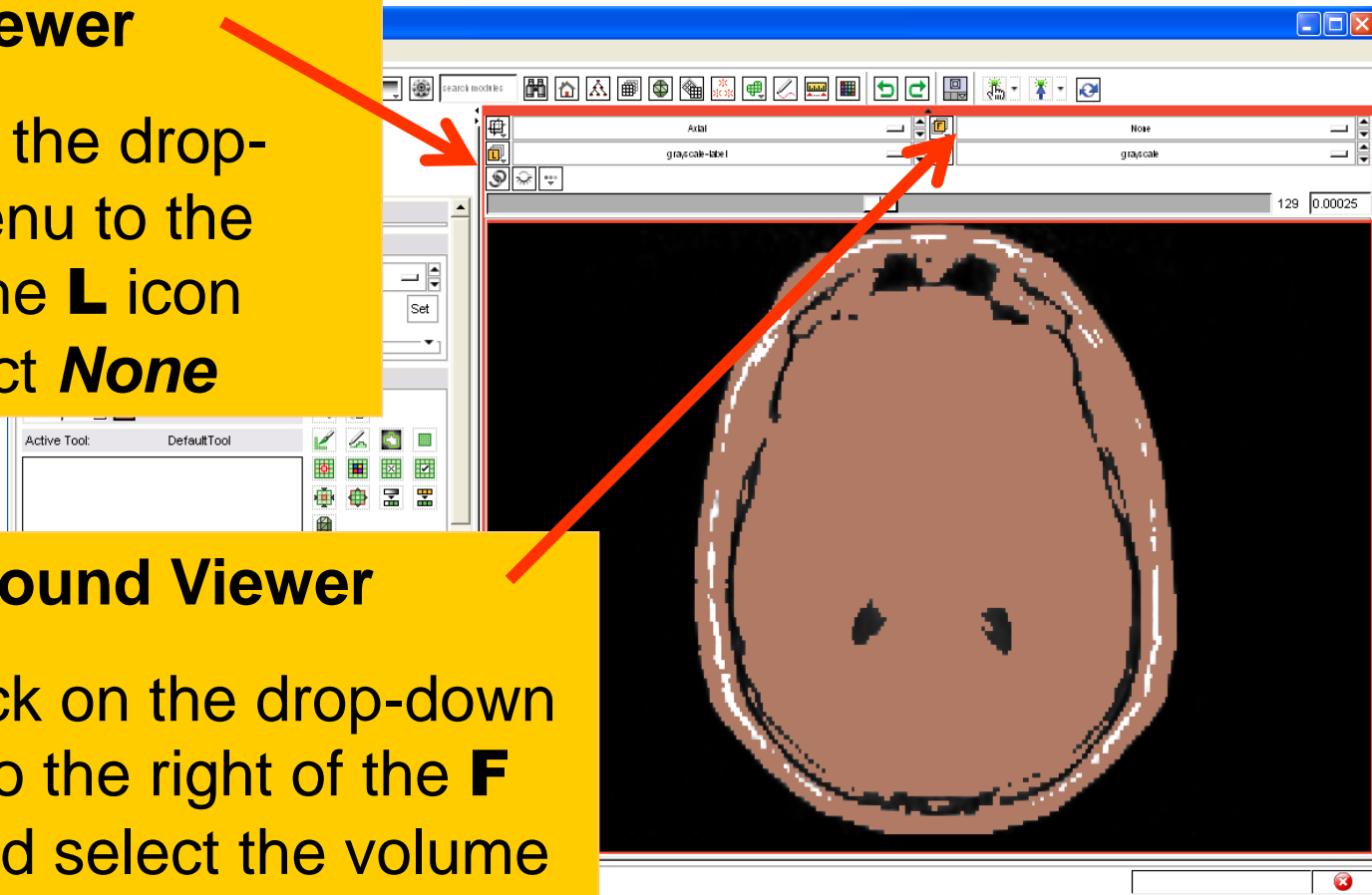
Threshold Effect

Label Viewer

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

Foreground Viewer

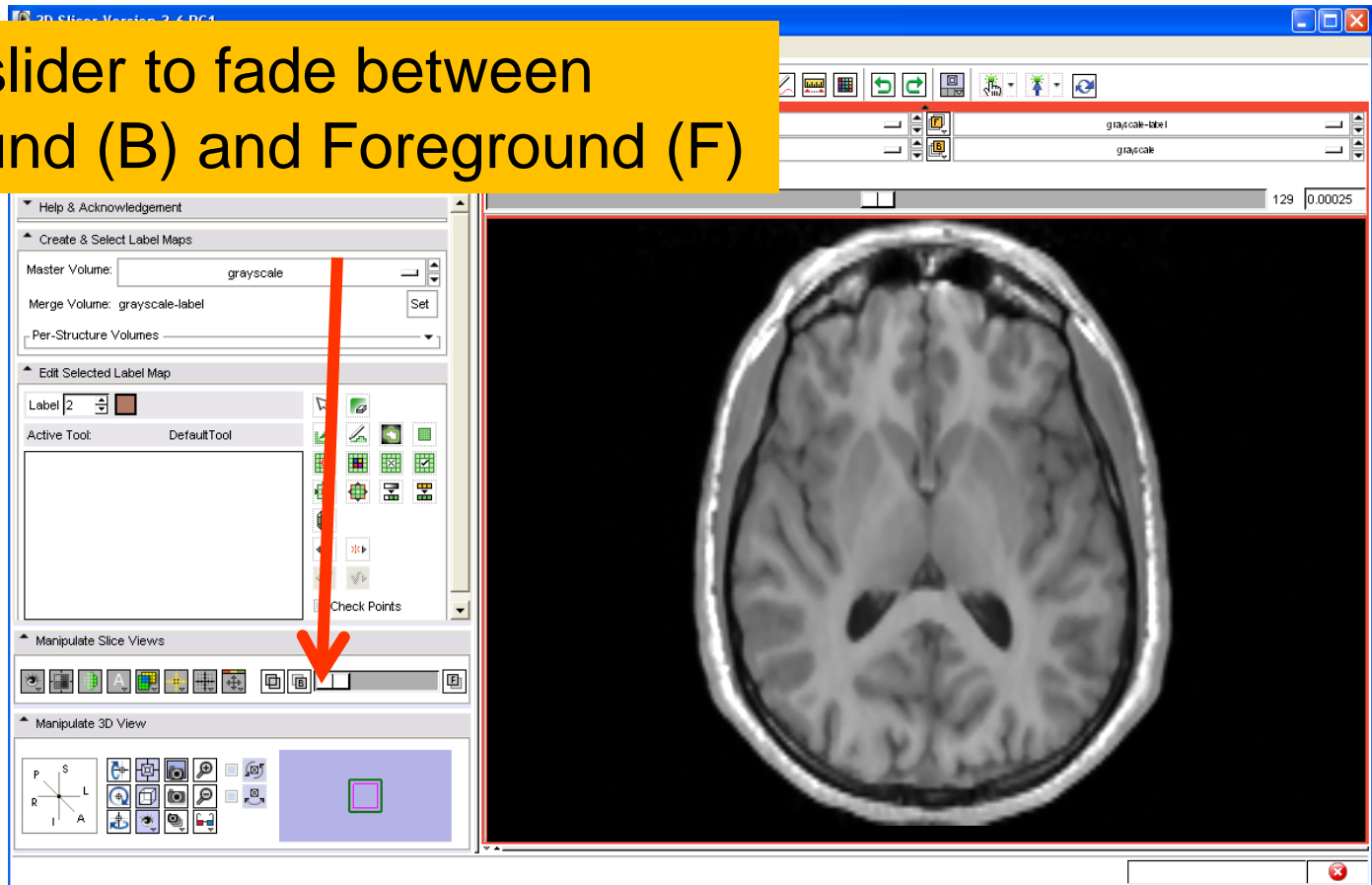
Left click on the drop-down menu to the right of the **F** icon and select the volume **grayscale-label**





Threshold Effect

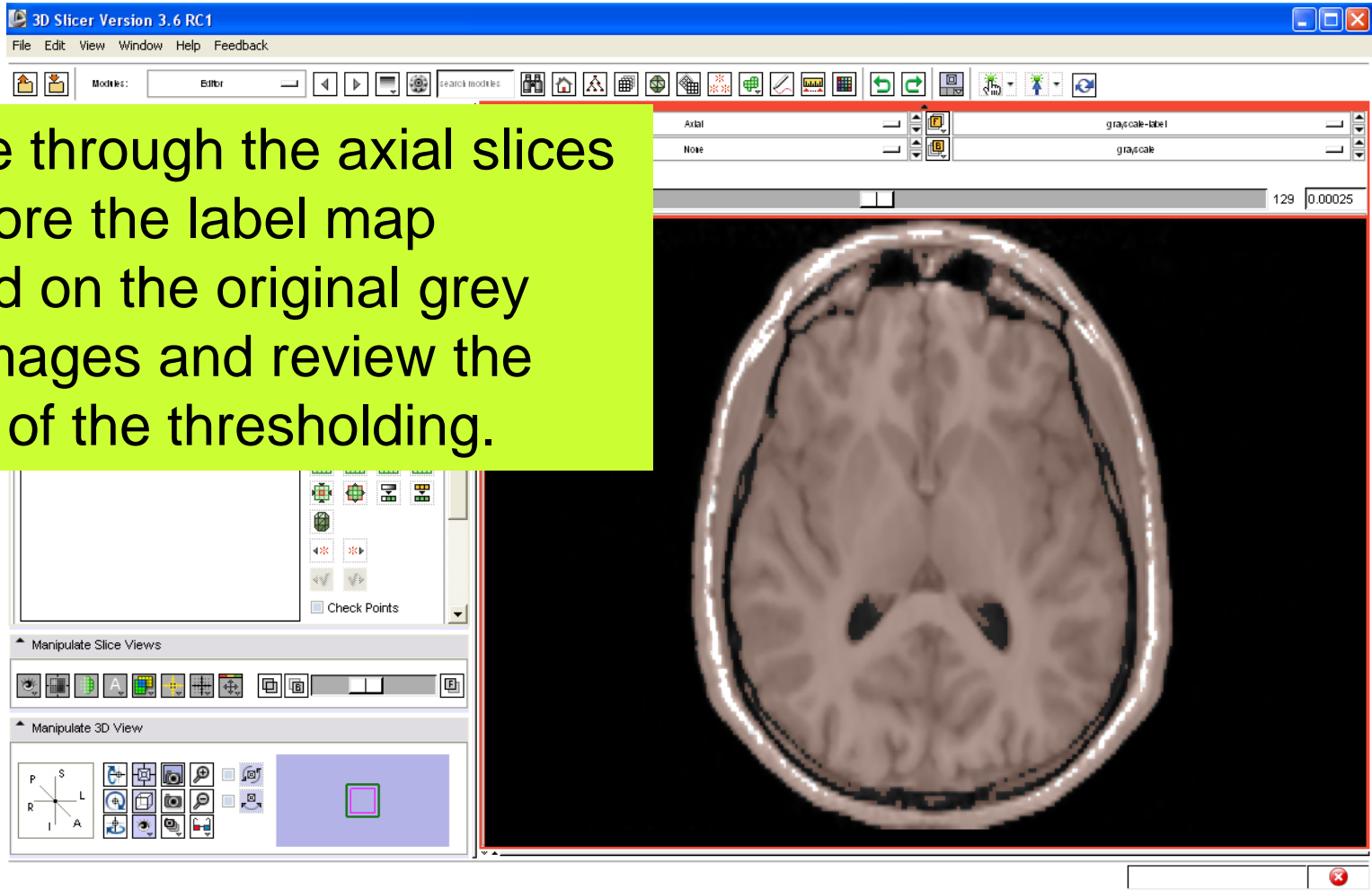
Use the slider to fade between Background (B) and Foreground (F)





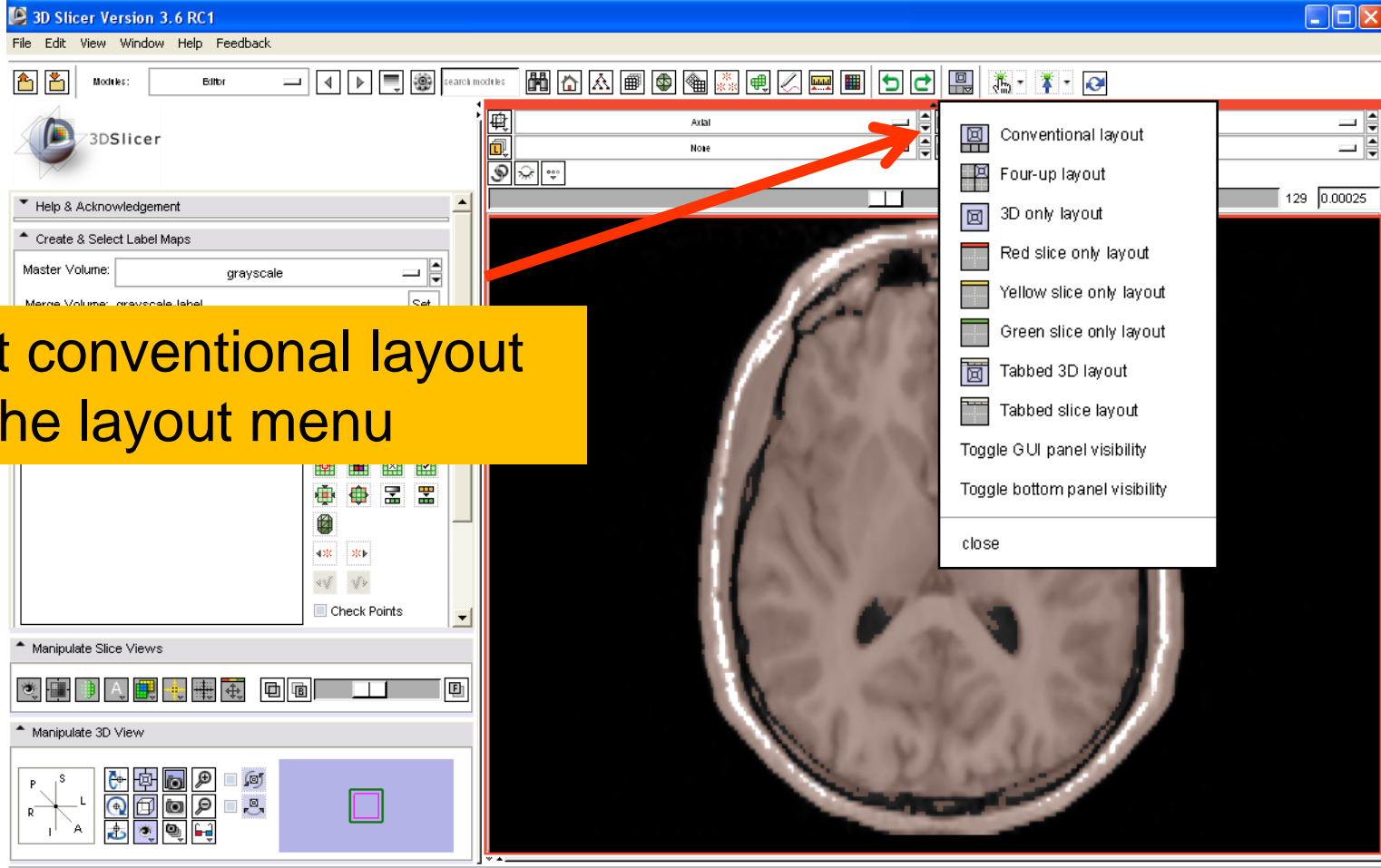
Exploring the result

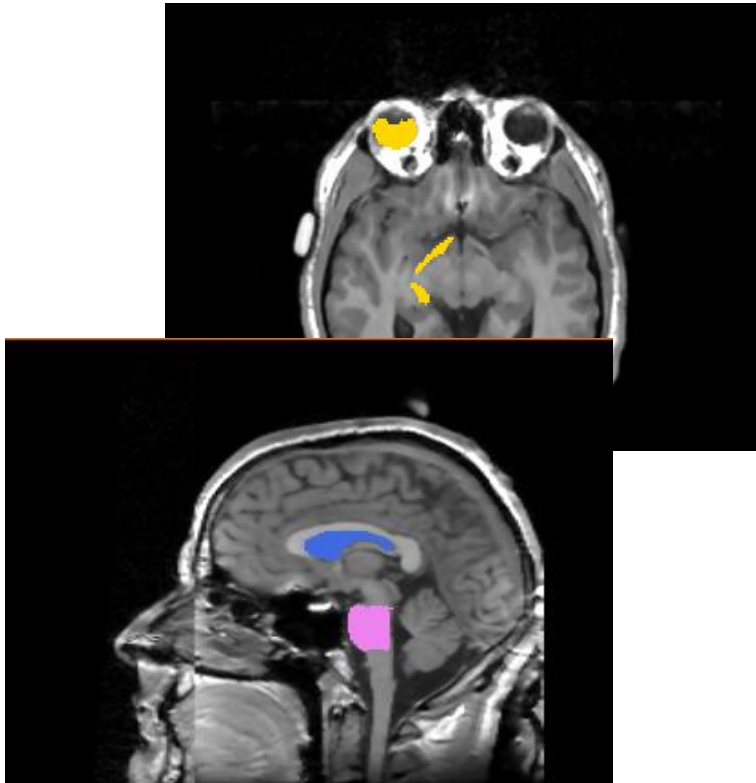
Browse through the axial slices to explore the label map overlaid on the original grey level images and review the results of the thresholding.





Threshold Effect

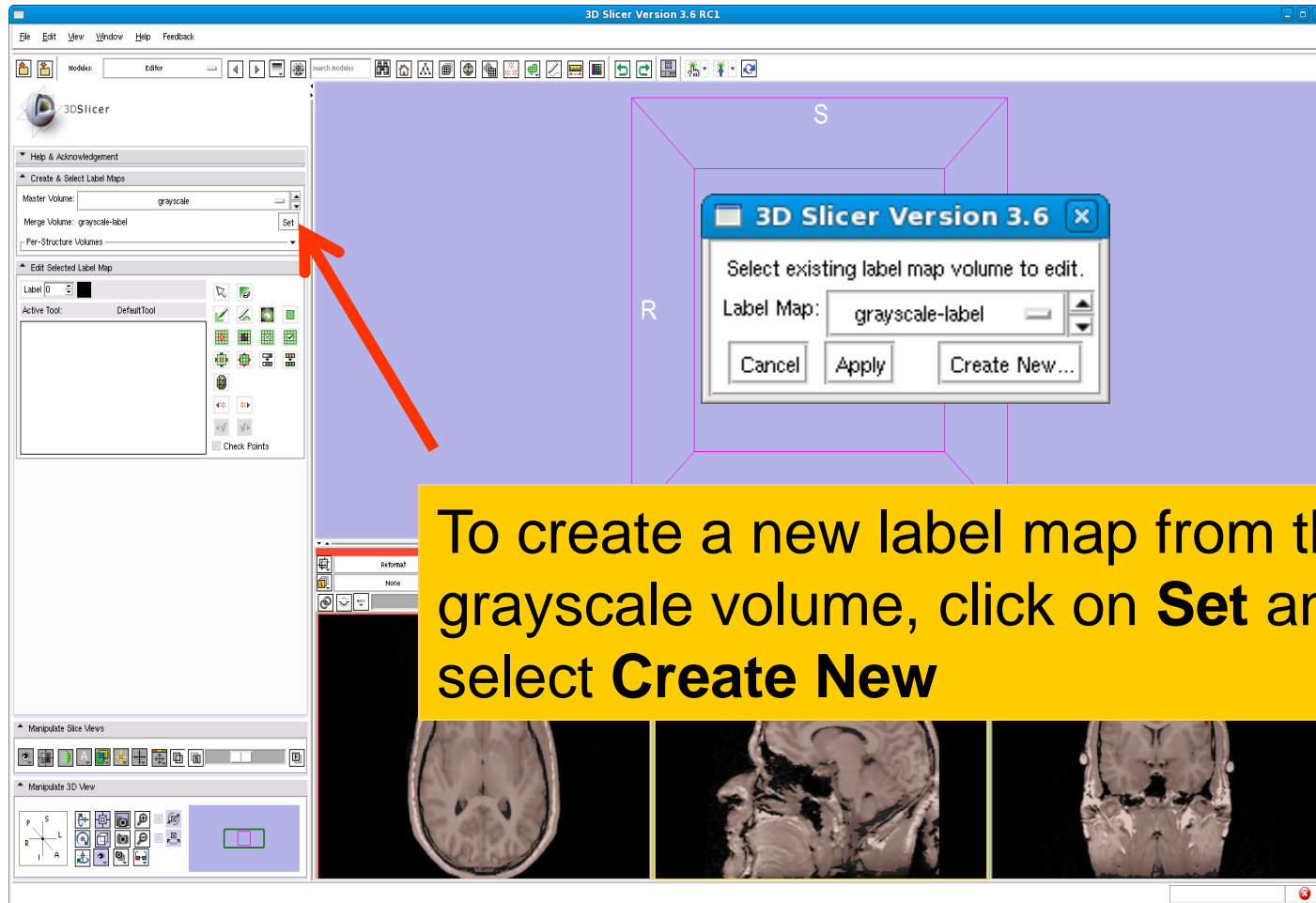




Part 3: Creating and editing a label map with multiple labels



Creating a map with multiple labels



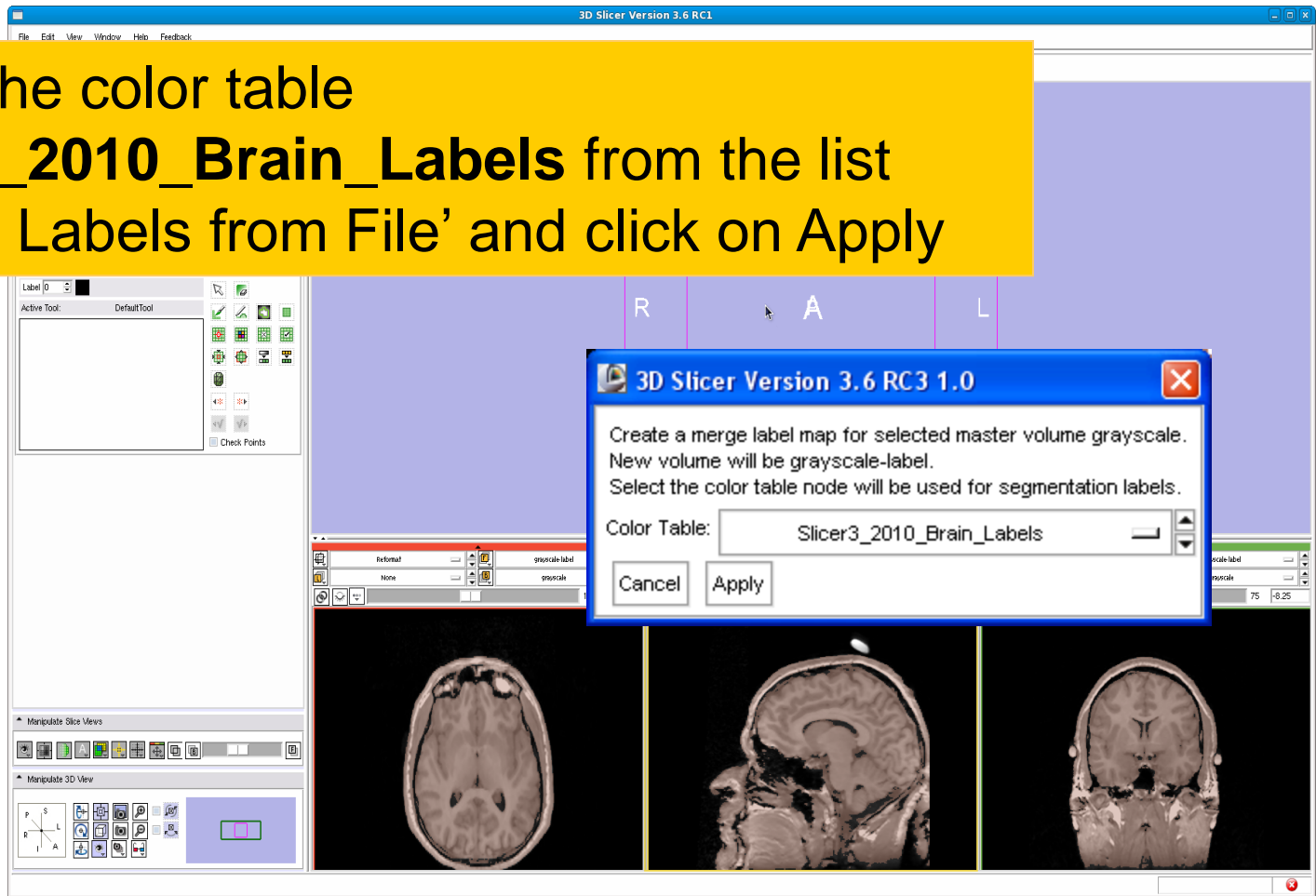


Creating a map with multiple labels

Select the color table

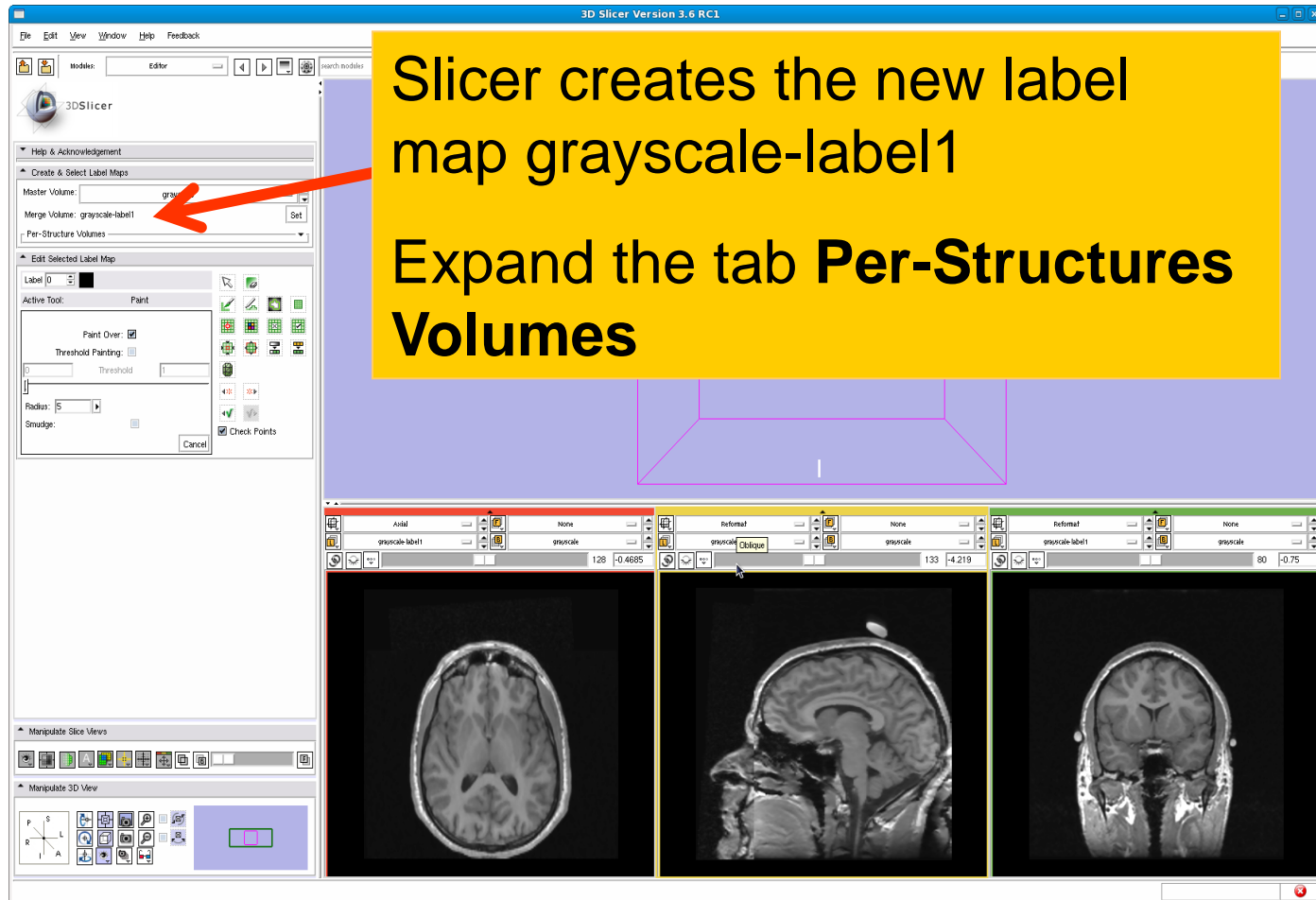
Slicer3_2010_Brain_Labels from the list

'Default Labels from File' and click on Apply





Creating a map with multiple labels





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	Pink	Structure_1
15	Yellow	Structure_2



Draw Tool

3D Slicer Version 3.6.3-beta

File Edit View Window Help Feedback

Modes:

3DSlicer

Help & Acknowledgement

Create & Select Label Maps

Master Volume: grayscale

Merge Volume: grayscale-label1

Per-Structure Volumes

Add Structure Split Merge Volume

Number	Color	Name
14		Structure_1

Replace Models

Delete Structures Merge All Merge And Build

Edit Selected Label Map

Label 14

Active Tool:

Manipulate Slice Views

Manipulate 3D View

grayscale RAS: (-36.6, -133.0, 0.9), Lb: Slice not shown, Bg: Slice not shown,

Left click on the color cell to select it



Drawing

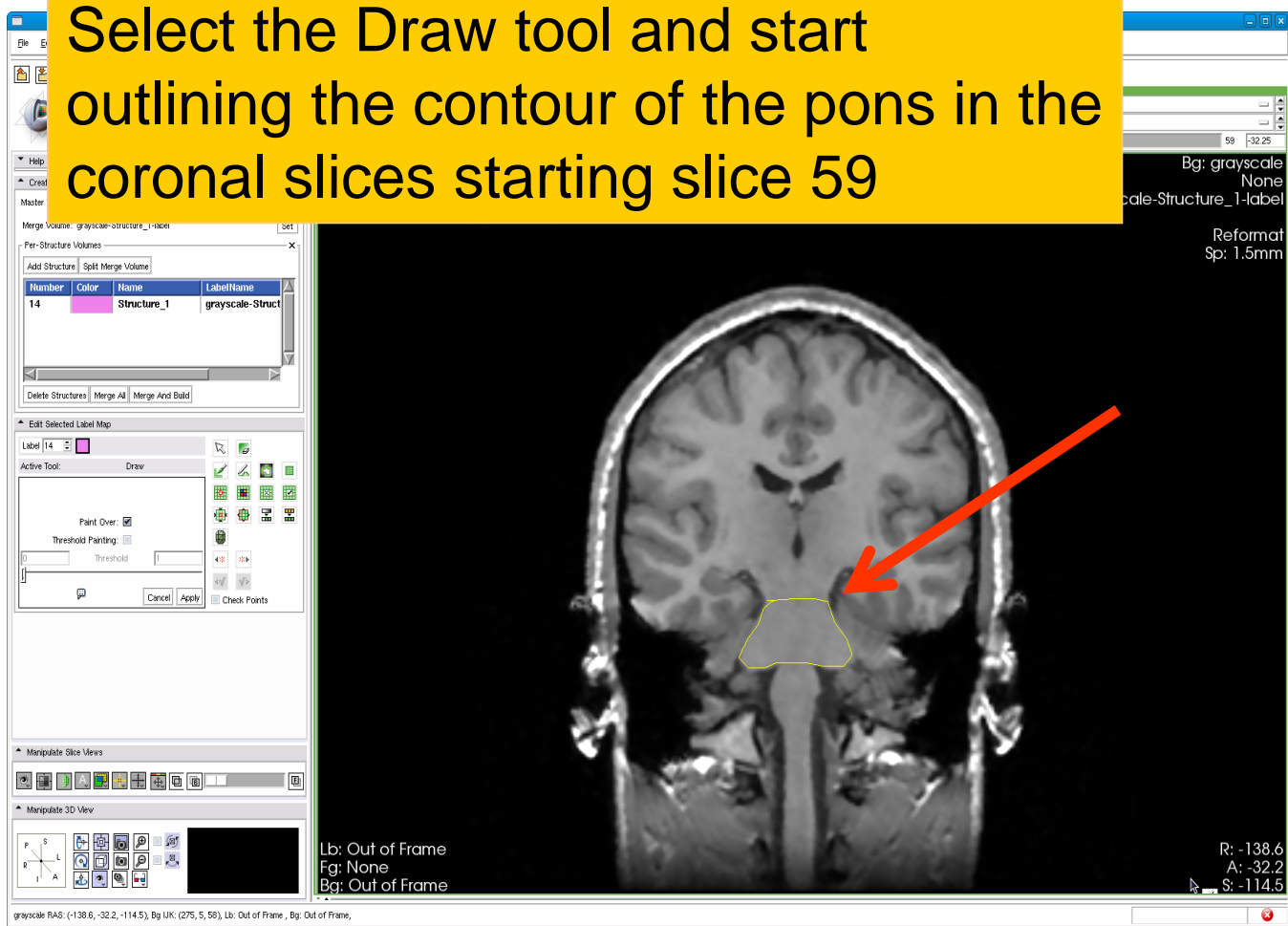


Description: The draw tool is an intuitive tool that can be used to manually outline structures in the grey level images.



Draw Tool

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





Draw Tool

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

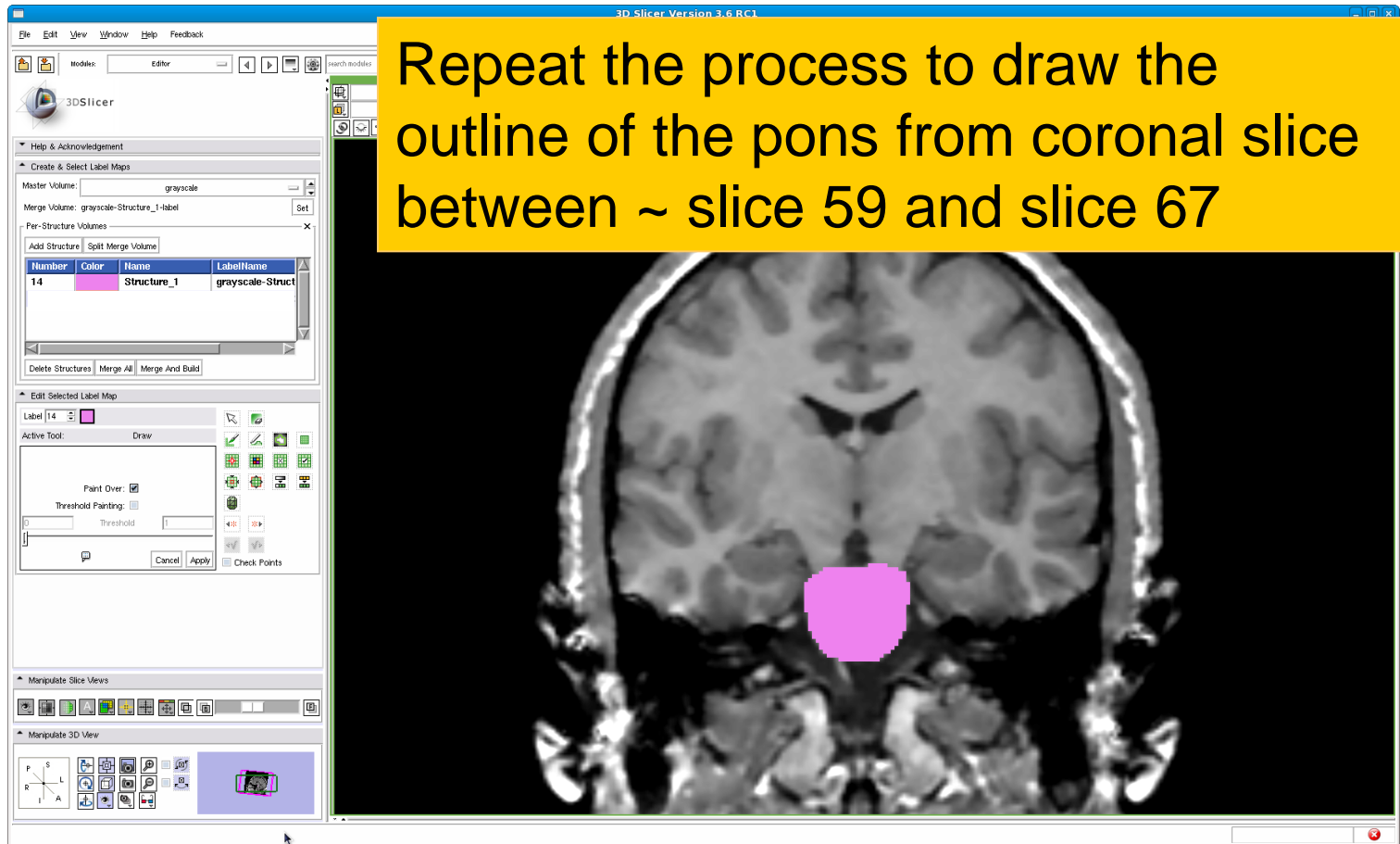
Number	Color	Name	LabelName
14		Structure_1	grayscale-Struct

grayscale RAS: (31.5, -32.2, -21.4), Bg UR: (94, 105, 58), Lb: 0 Background, Bg: 56.0

R: 31.5
A: -32.2
S: -21.4



Draw Tool





Adding a second structure

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

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

3D Slicer Version 3.6 RC1

grayscale RAS: (-37.7, -30.8, 29.2), Bg IJK: (168, 159, 59), Lb: 0 Background, Bg: 61.0

Reformat Sp: 1.5mm

R: -37.7
A: -30.8
S: 29.2

Lb: 0 Background
Fg: None
Bg: 81.0



Adding a second structure

3D Slicer Version 3.6 RC1

Left-click on the color cell to select it

Number	Color	Name	Label
14		Structure_1	Structure_1-label
6		Ventricles	Ventricles-label

Help & Acknowledgement
Create & Select Label Maps
Master Volume: grayscale
Merge Volume: grayscale-Structure_1-label
Per-Structure Volumes
Add Structure Split Merge Volume
Delete Structures Merge All Merge And Back

Edit Selected Label Map
Label [6]
Active Tool: Default Tool
Check Points

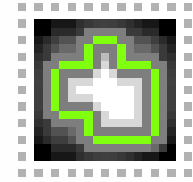
Manipulate Slice Views
Manipulate 3D View

grayscale RAS: (-37.7, -30.8, 29.2), Bg IJK: (168, 159, 59), Lb: 0 Background, Bg: 61.0

Bg I: 168
Bg J: 159
Bg K: 59
Bg: grayscale
None
Lb: grayscale-Ventricles-label
Reformat
Sp: 1.5mm
R: -37.7
A: -30.8
S: 29.2
Lb: 0 Background
Fg: None
Bg: 81.0



Level Tracing

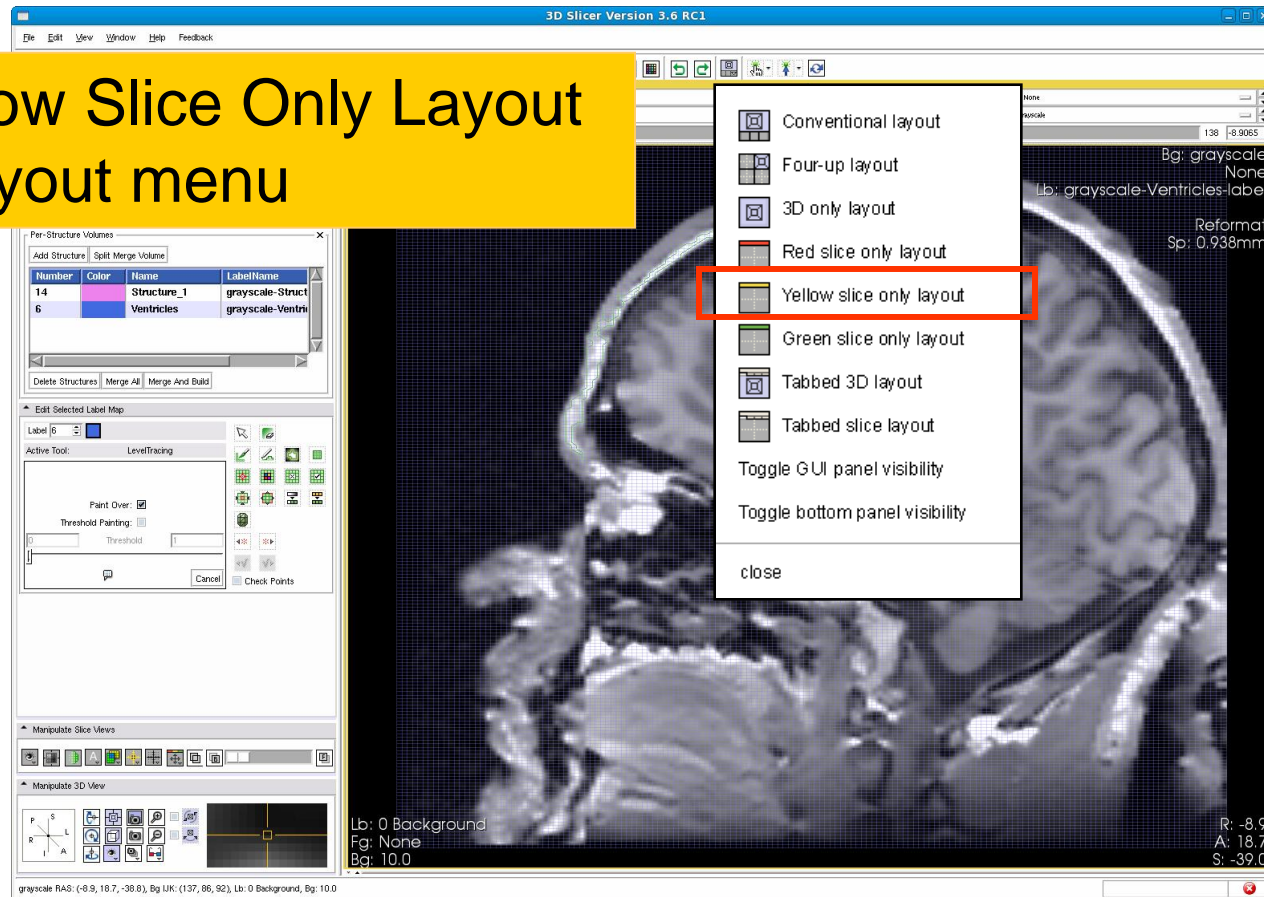


Description: By moving the mouse in the grey level images, you'll define in the label map volume an outline where the pixels all have the same value as the current background pixel.



Level Tracing

Select Yellow Slice Only Layout
from the layout menu





Level Tracing

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



Per-Structure Volumes

Number	Color	Name	LabelName
14		Structure_1	grayscale-Struct
6		Ventricles	grayscale-Ventri

Active Tool: LevelTracing

Paint Over: Threshold Painting:

Threshold: 1

Cancel Check Points

Manipulate Slice Views

Manipulate 3D View

grayscale RAS: (-6.9, 10.7, -38.0), Bg LK: (137, 96, 92), Lb: 0 Background, Bg: 10.0


Bg: grayscale
None
Lb: grayscale-Ventricles-label
Reformat
Sp: 0.938mm

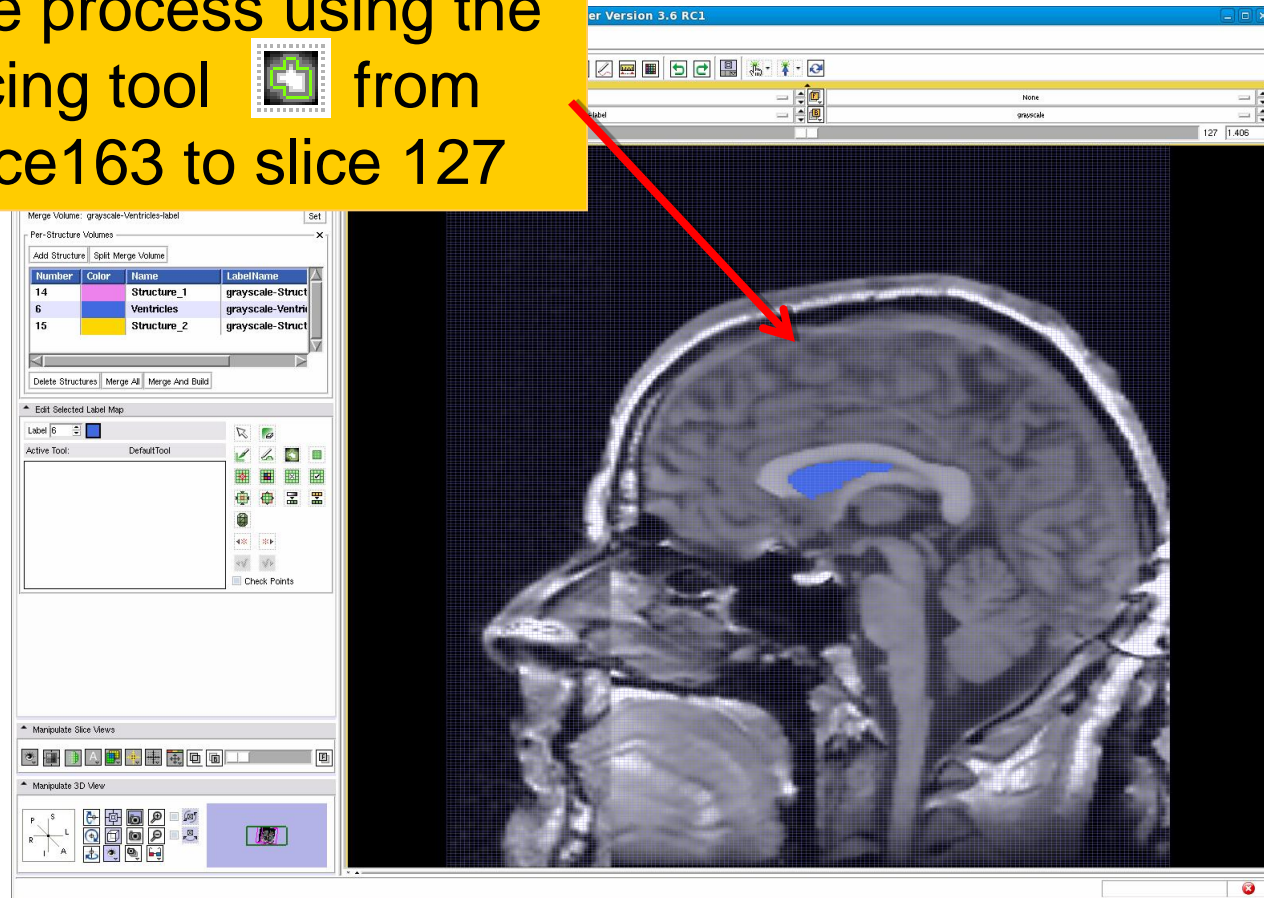
Lb: 0 Background
Fg: None
Bg: 10.0

R: -8.9
A: 18.7
S: -39.0



Level Tracing

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

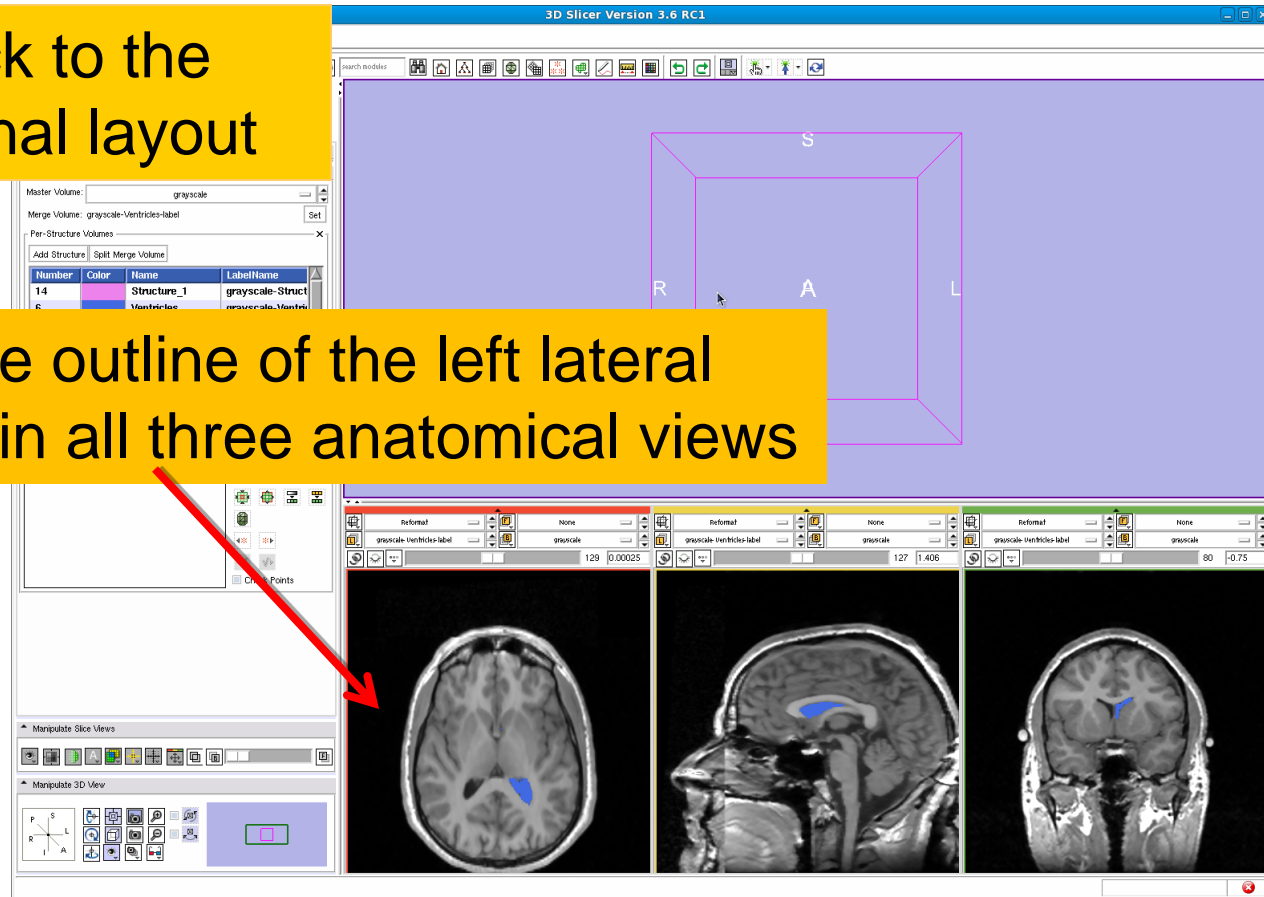




Level Tracing

Come back to the conventional layout

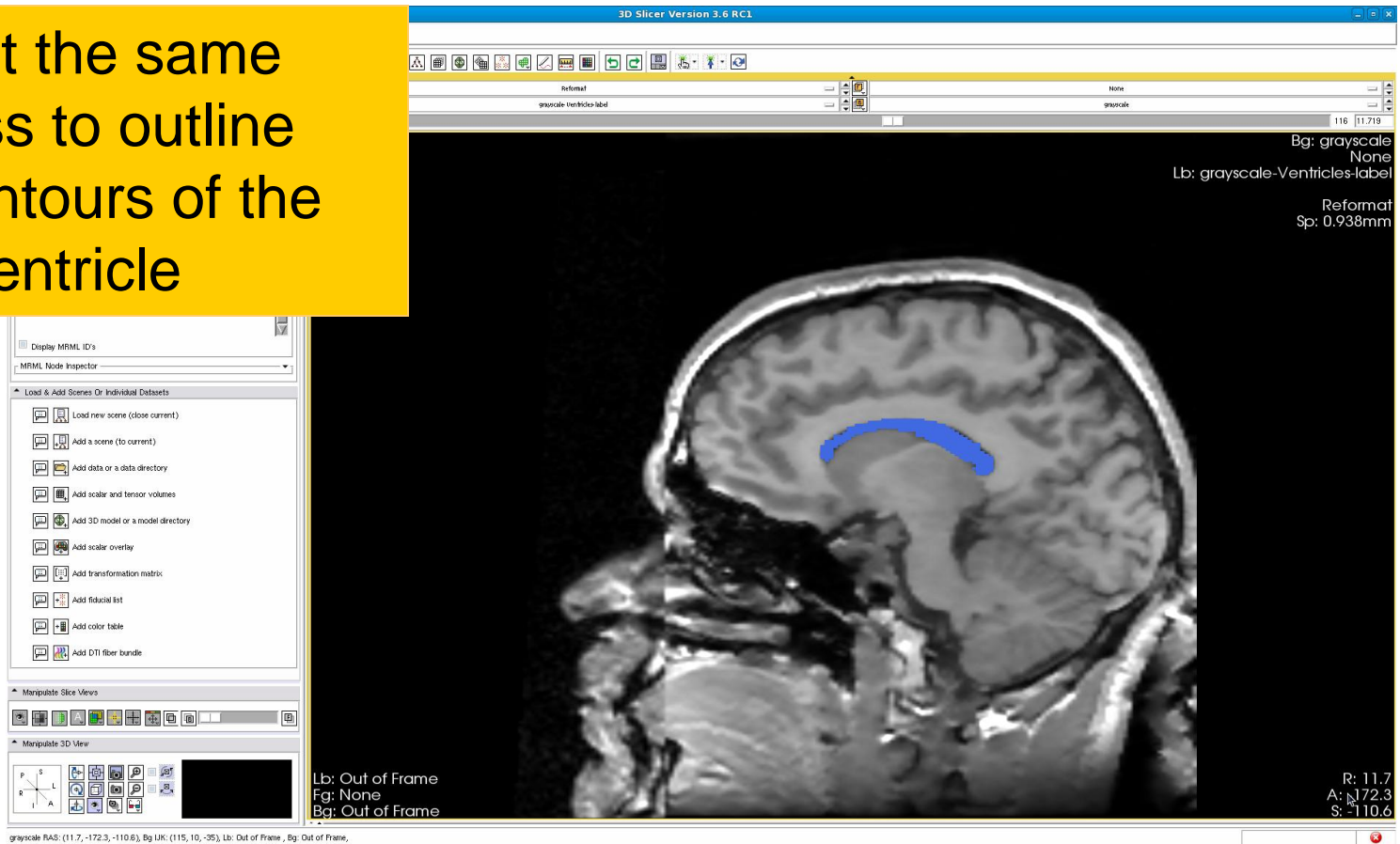
Explore the outline of the left lateral ventricles in all three anatomical views





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 MRML software interface. On the left, the 'MRML Tree' panel lists the current scene structure:

- Scene
 - View1
 - Camera1
 - grayscale
 - grayscale-label
 - grayscale-Structure_1-label
 - grayscale-Ventricles-label
 - grayscale-Structure_2-label

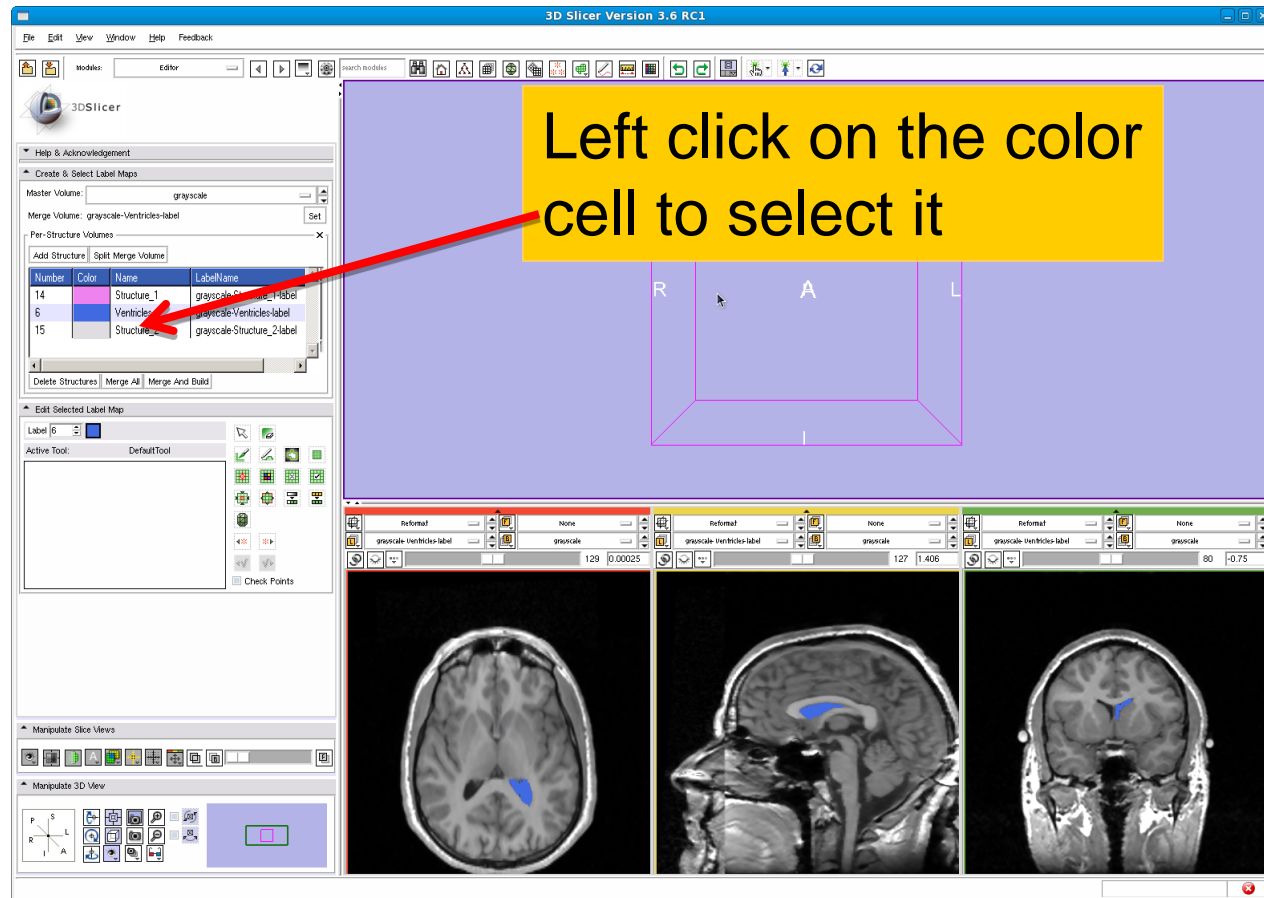
Below the tree is the 'Load & Add Scenes Or Individual Datasets' panel, which includes the 'Add Structure' button. A context menu is open over the 'Add Structure' button, displaying a list of structures:

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

The main 3D view shows a brain slice with a purple bounding box around a region. The bottom of the interface shows three orthogonal views (axial, sagittal, and coronal) of the brain slice.



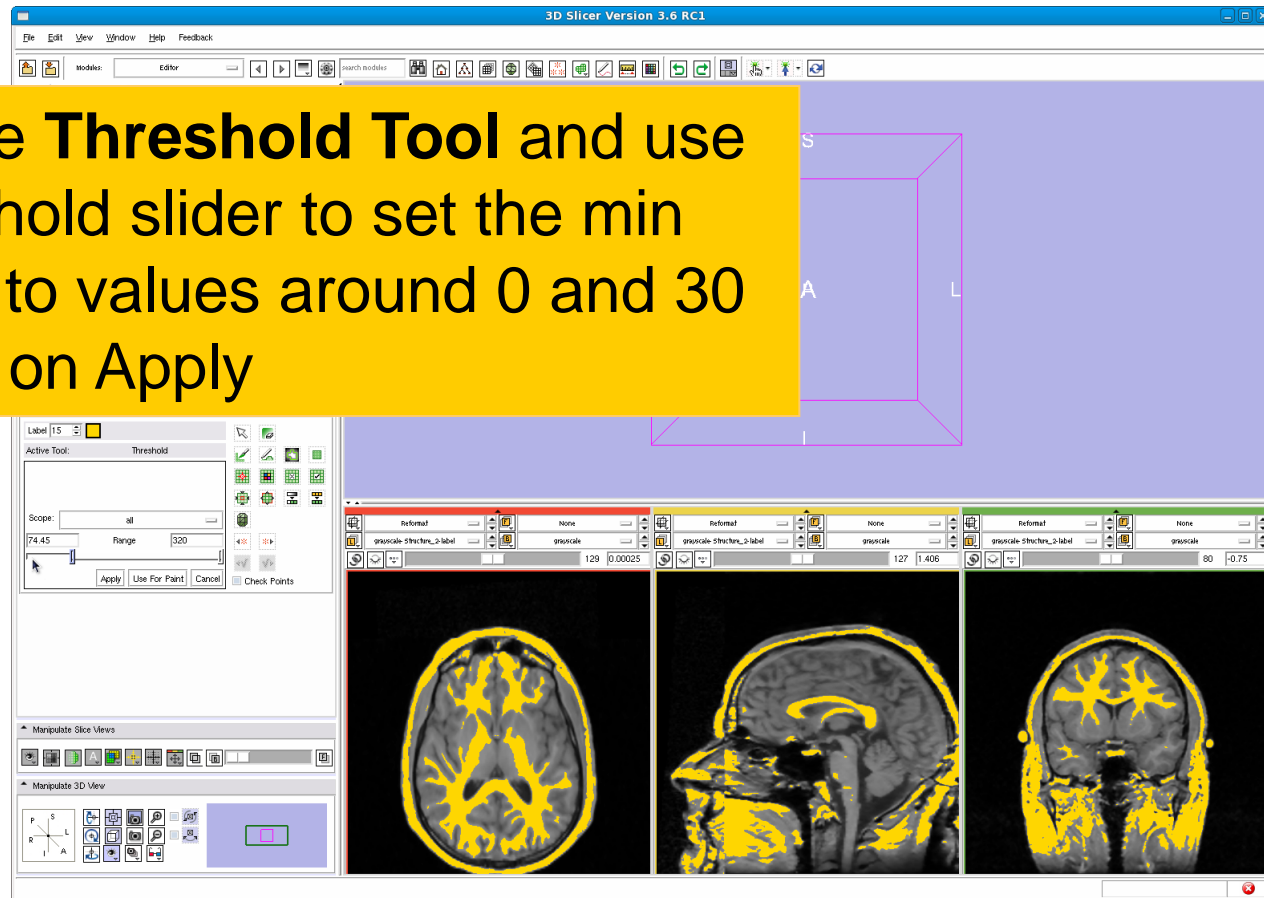
Adding a third structure





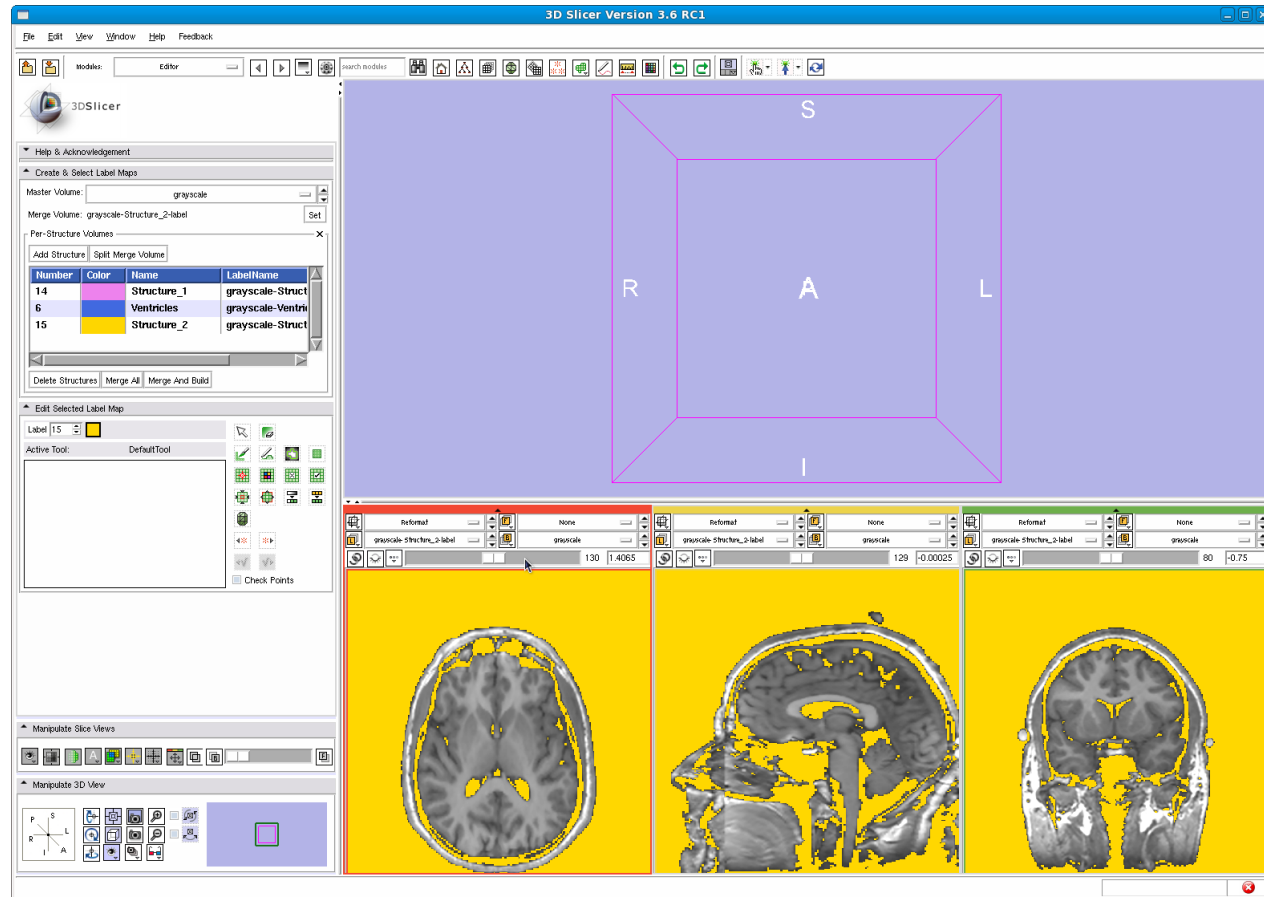
Threshold tool

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






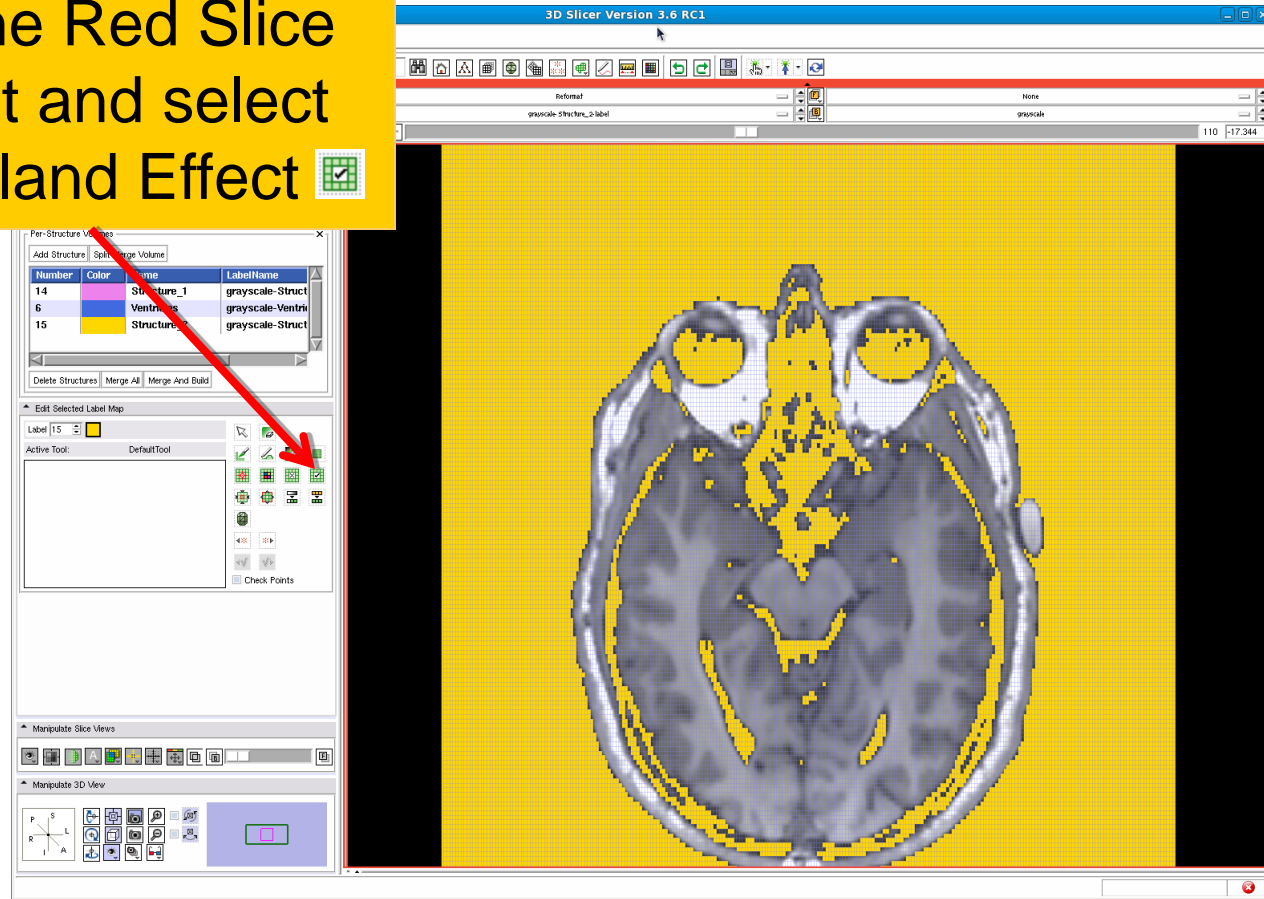
Threshold tool





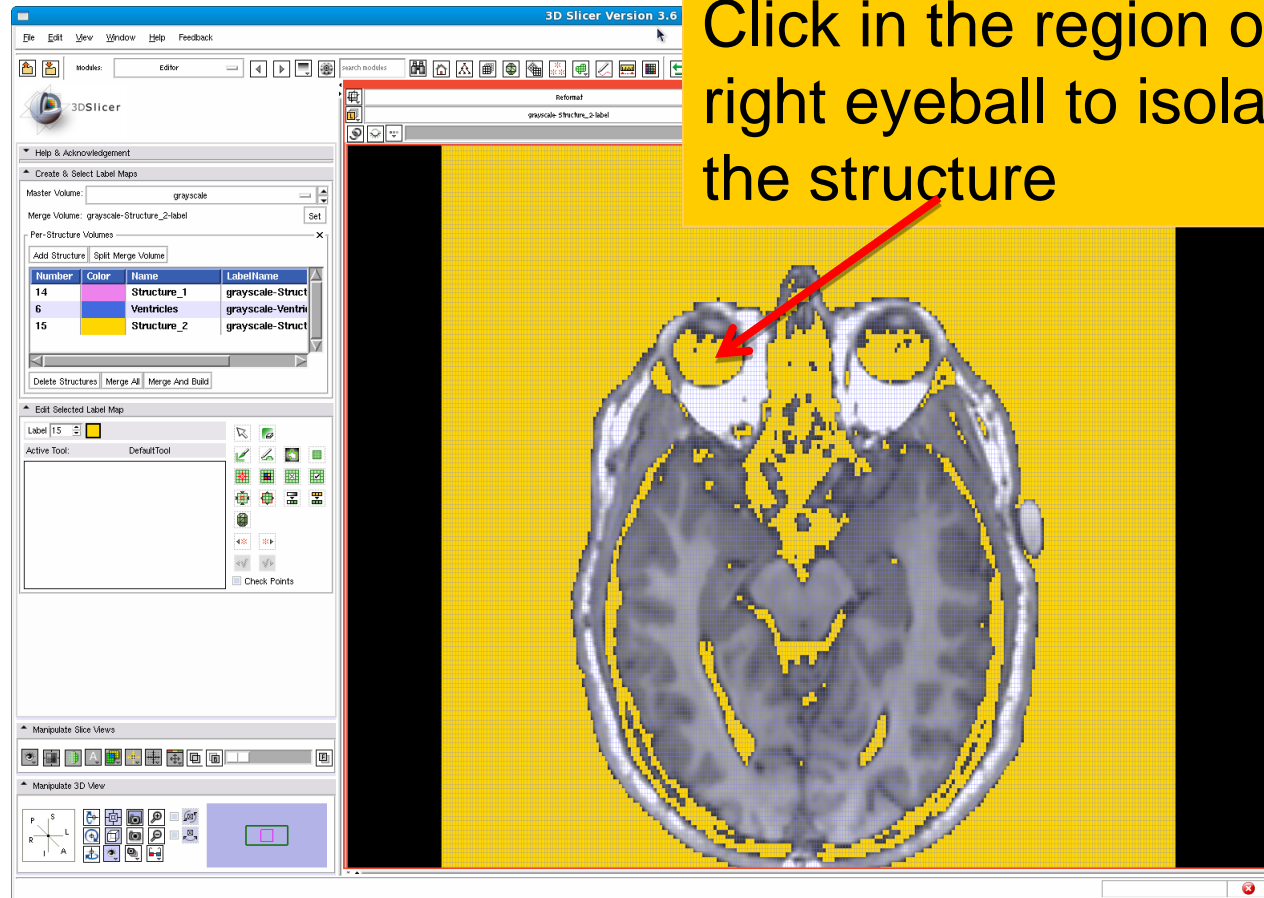
Save Island

Switch to the Red Slice Only Layout and select the Save Island Effect 





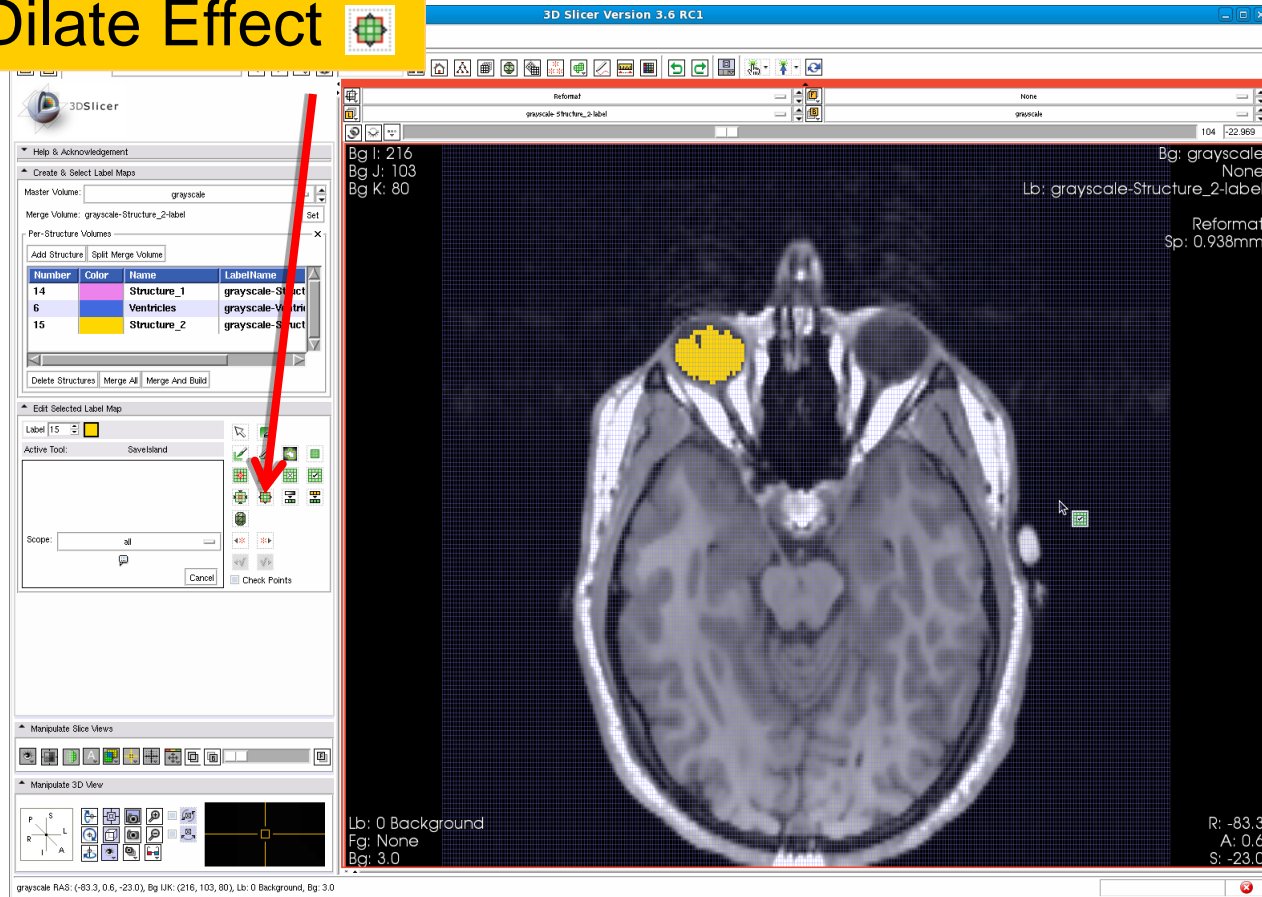
Save Island





Dilate Effect

Select the Dilate Effect





Dilate Effect

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

3D Slicer Version 3.6 RC1

Reformat: None
grayscale-Structure_2-label: grayscale

Bg: grayscale
None
Lb: grayscale-Structure_2-label
Reformat
Sp: 0.938mm

Number	Color	Name	Label Name
14		Structure_1	grayscale-Struct
6		Ventricles	grayscale-Ventri
15		Structure_2	grayscale-Struct

Label: 15
Active Tool: DilateLabel
Scope: all
Background Label: 0
 Eight Neighbors
 Four Neighbors
Cancel Apply Check Points

Manipulate Slice Views
Manipulate 3D View

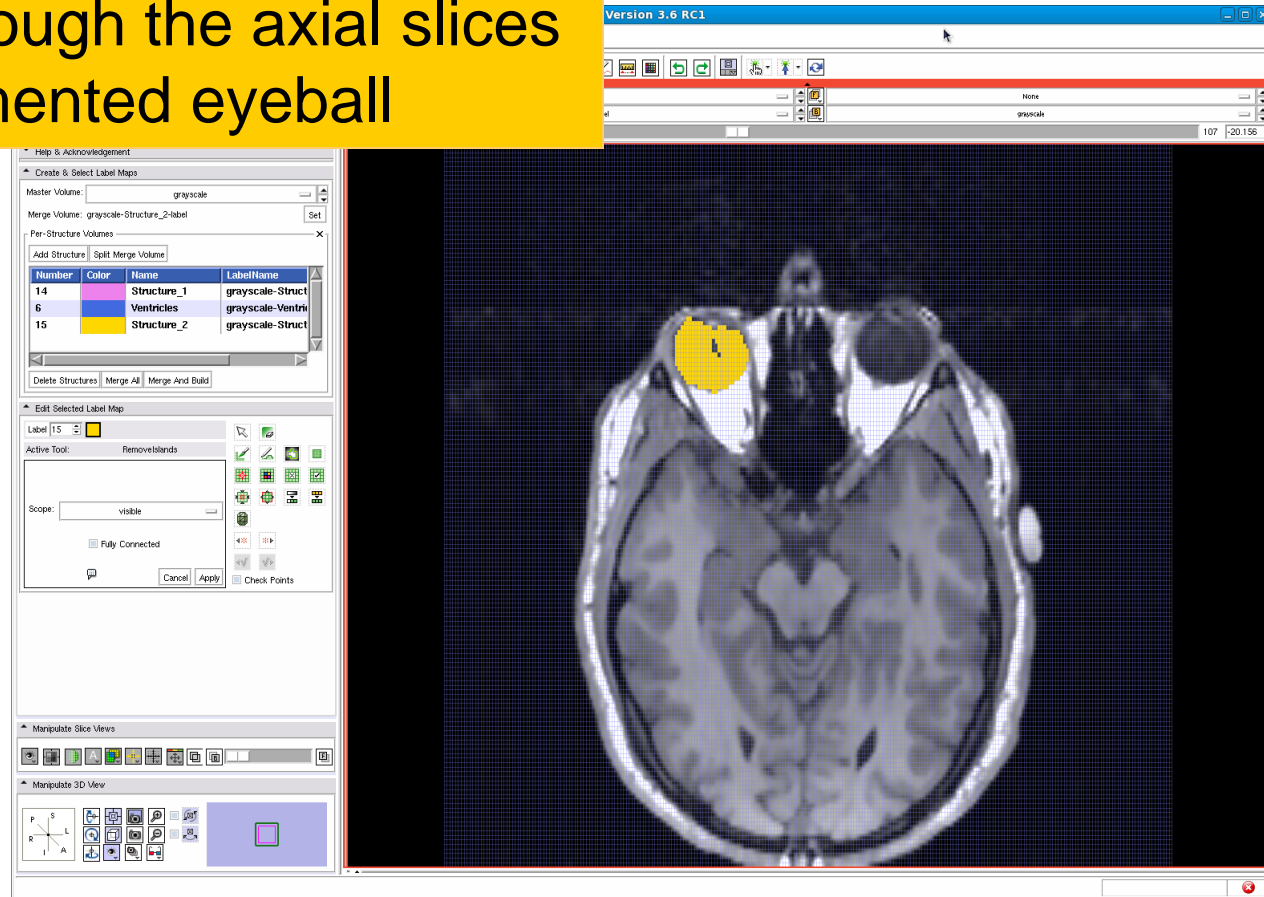
grayscale RAS: (4.0, -21.6, -23.0), Bg IJK: (123, 103, 65), Lb: 0 Background, Bg: 62.0

R: 4.0
A: -21.6
S: -23.0



Dilate Effect

Browse through the axial slices of the segmented eyeball

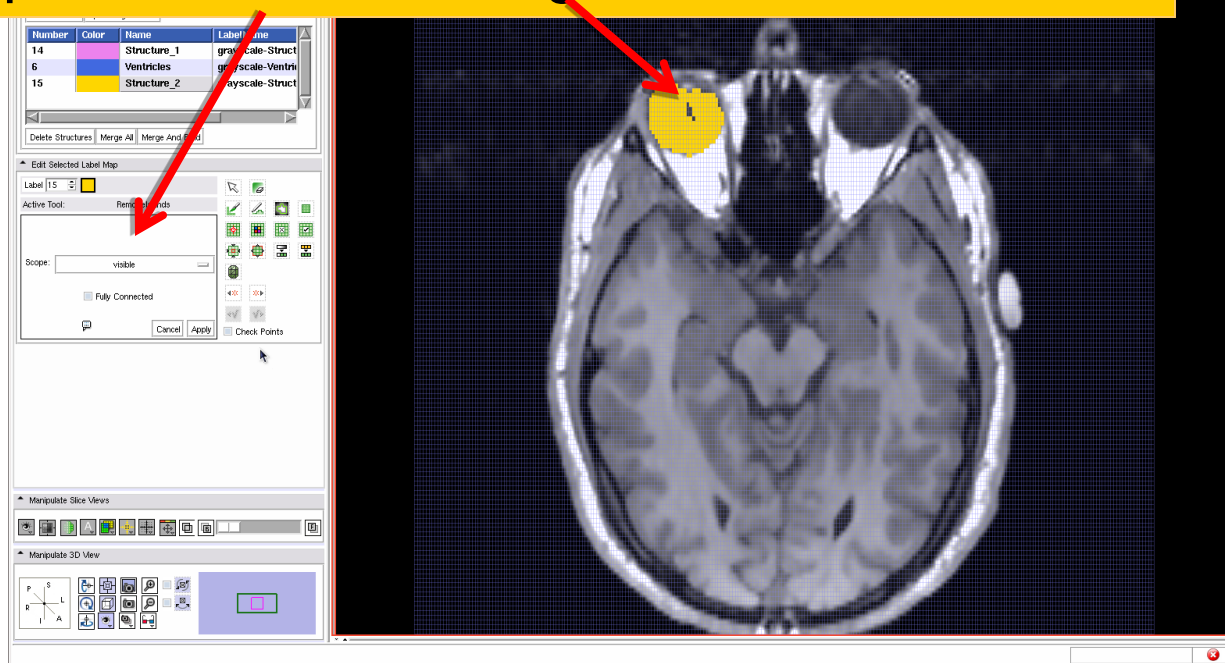




Remove Island

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

Per-Structure Volumes

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

Edit Selected Label Map

Label: 15 (Yellow)

Active Tool: Removelands

Scope: visible

Fully Connected

Check Points

Status Panels:

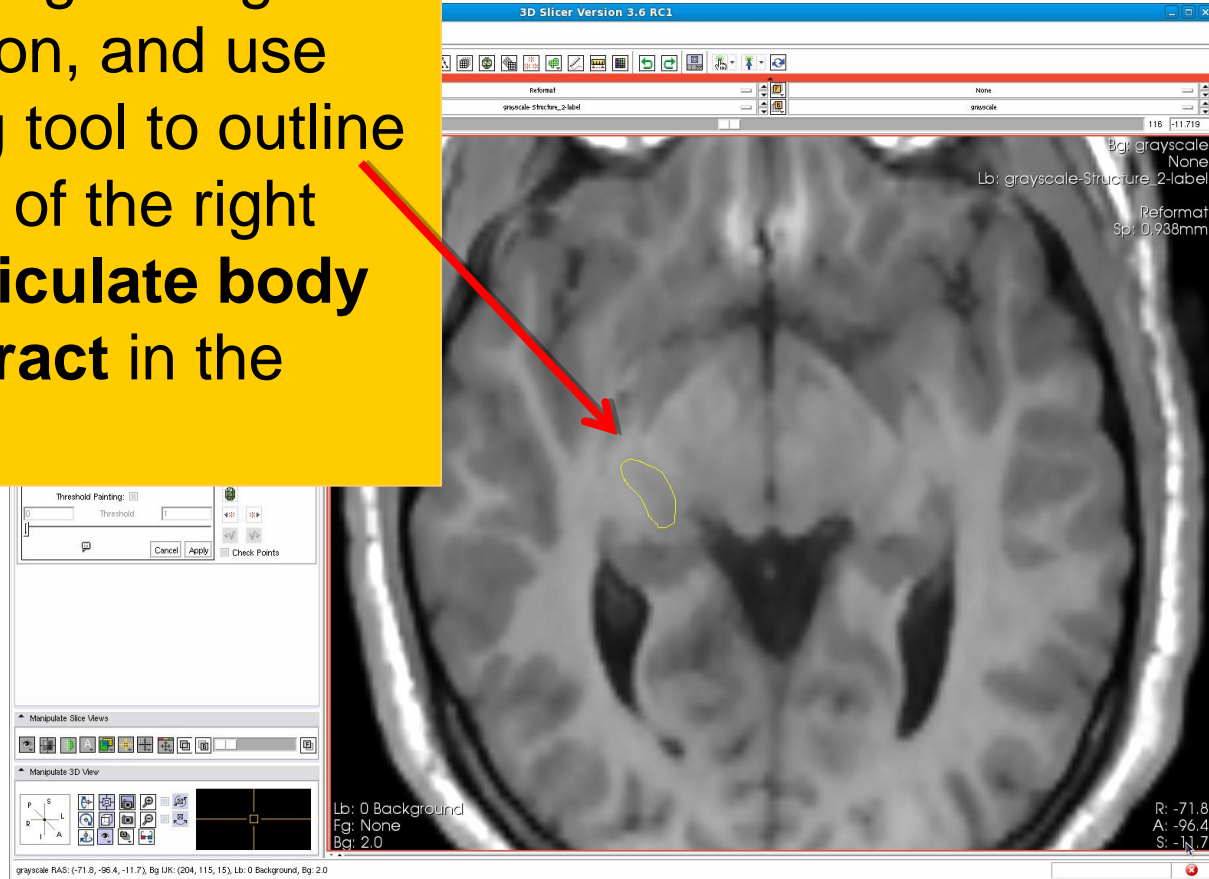
- Top Left: Bg I: 93, Bg J: 106, Bg K: 112
- Top Right: Bg: grayscale, Lb: grayscale-Structure_2-label, Reformat Sp: 0.938mm
- Bottom Left: Lb: 15 Structure_2, Fg: None, Bg: 31.0
- Bottom Right: R: 32.0, A: 49.2, S: -20.2

grayscale RAS: (32.0, 49.2, -20.2), Bg IJK: (93, 106, 112), Lb: 15 Structure_2, Bg: 31.0



Adding more structures

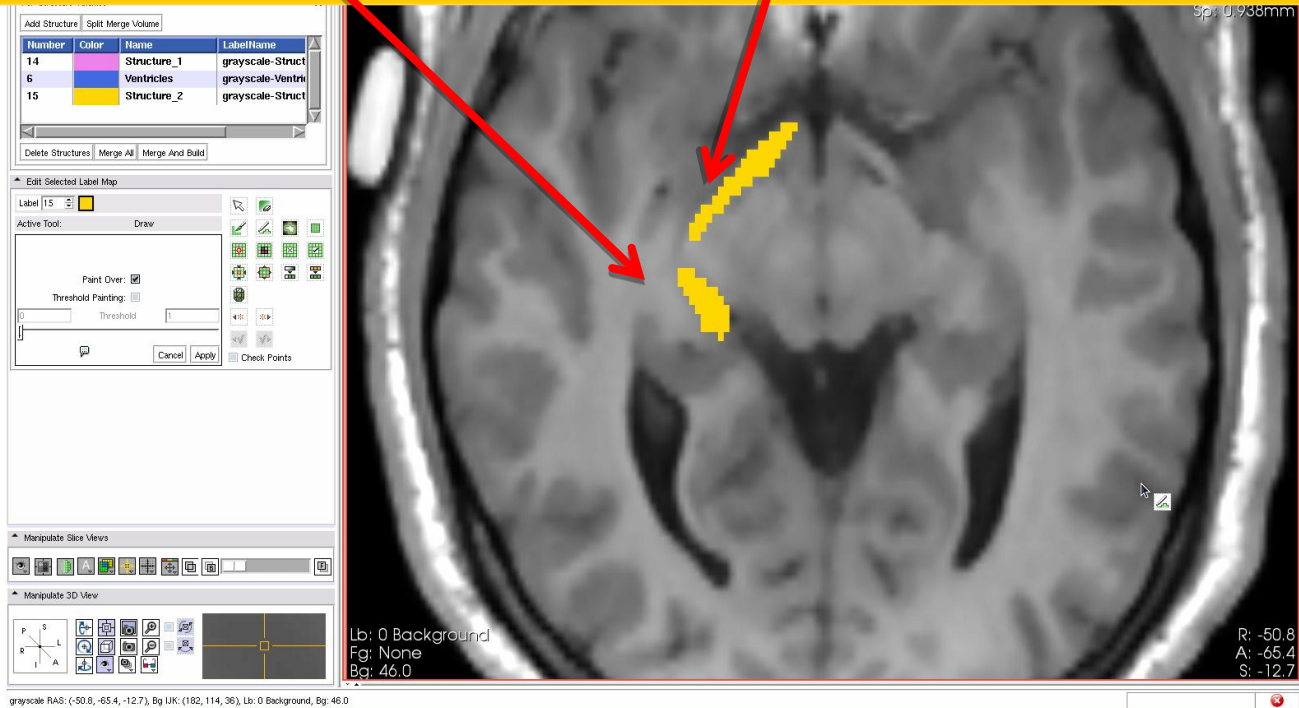
Zoom in using the right mouse button, and use the drawing tool to outline the contour of the right lateral geniculate body and optic tract in the axial view.





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





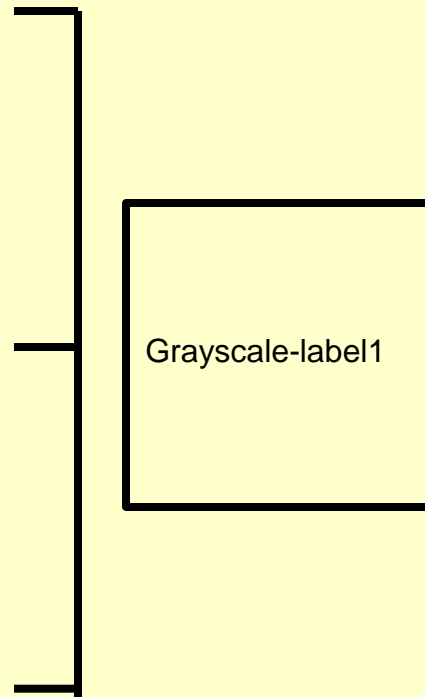
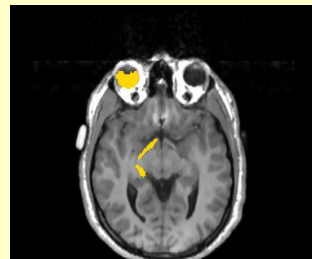
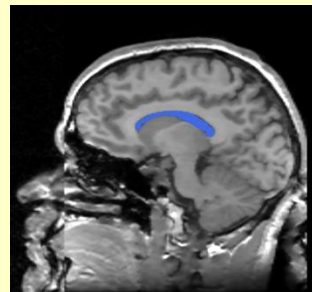
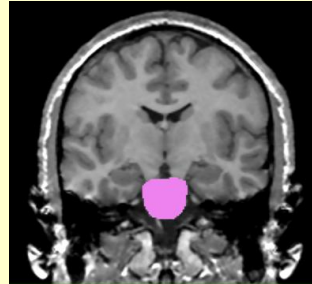
Merge And Build

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.

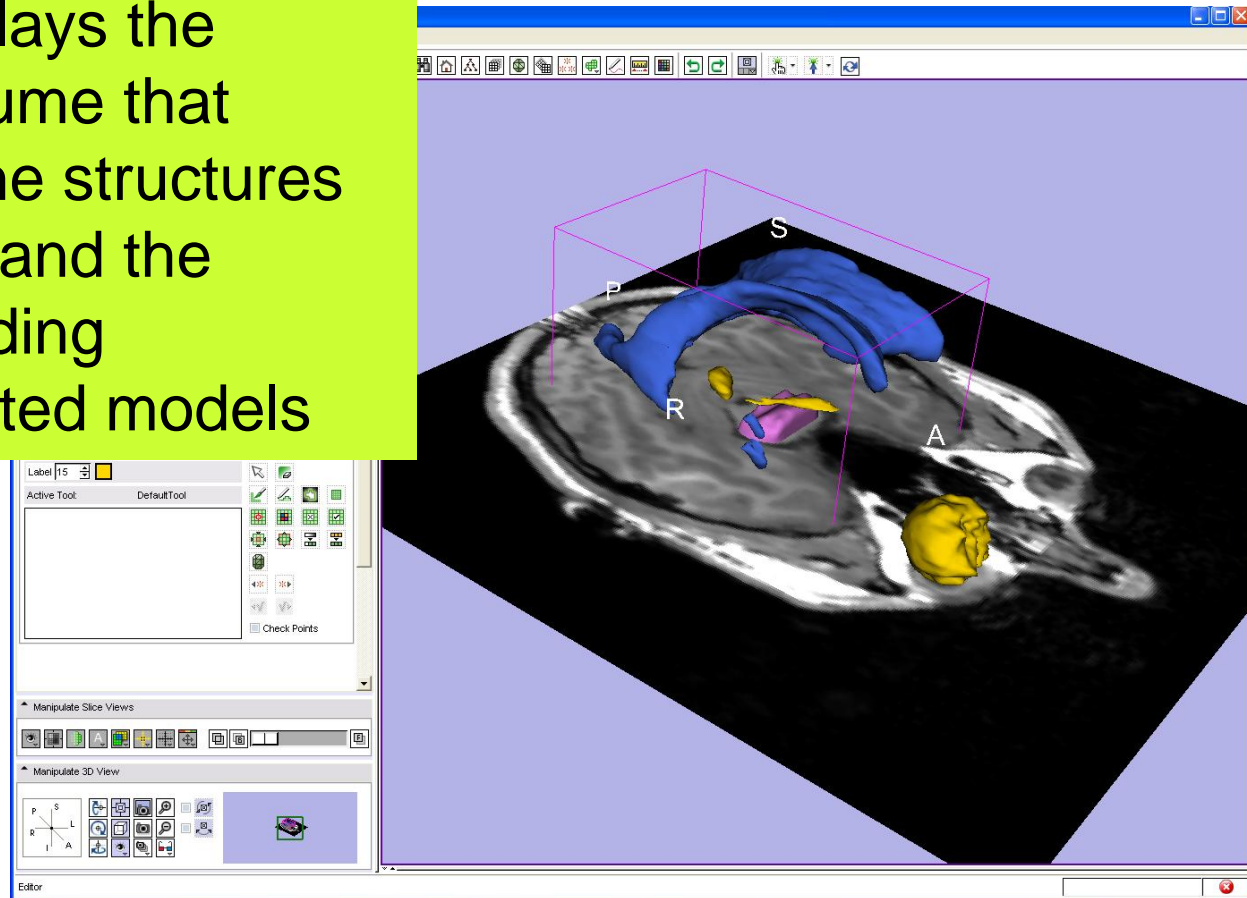
The three label maps will be merged in the order that they appear in the table.

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



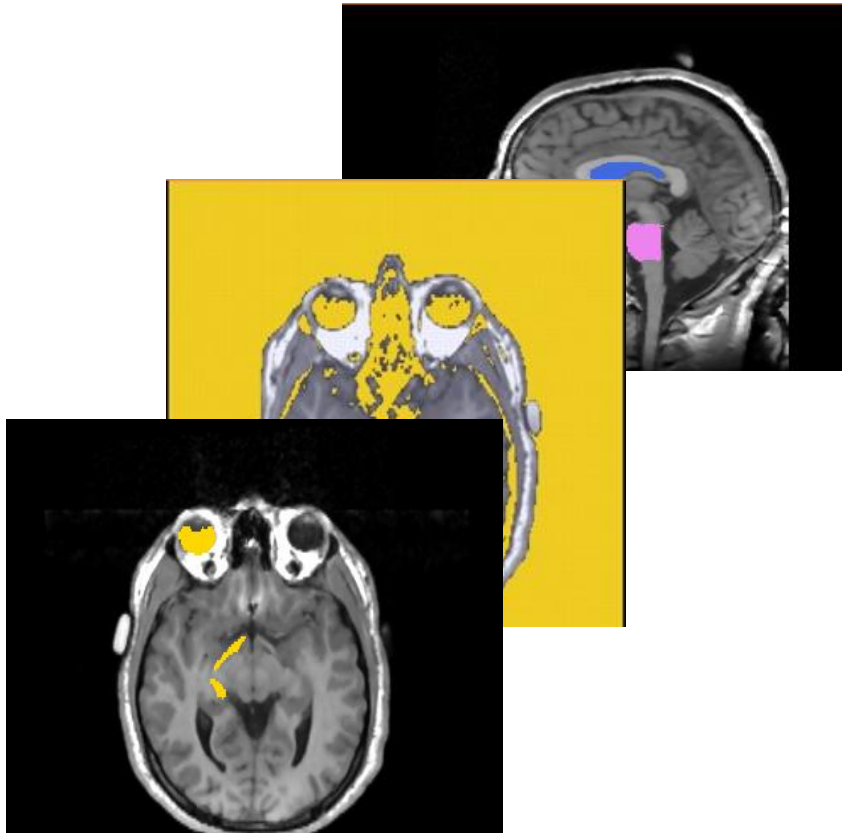
Merge And Build

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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