



NA-MIC

National Alliance for Medical Image Computing

<http://na-mic.org>

Interactive Editor tutorial

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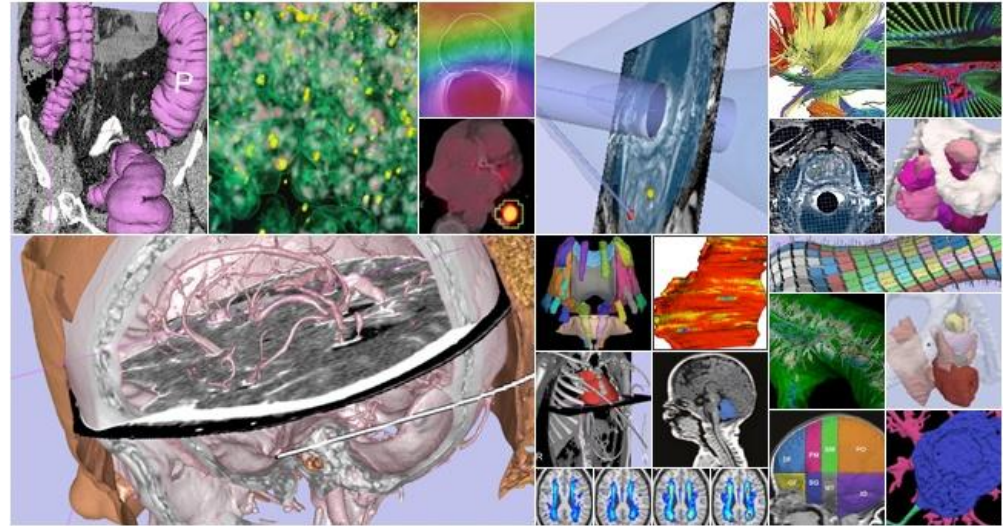
Harvard Medical School



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**



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>

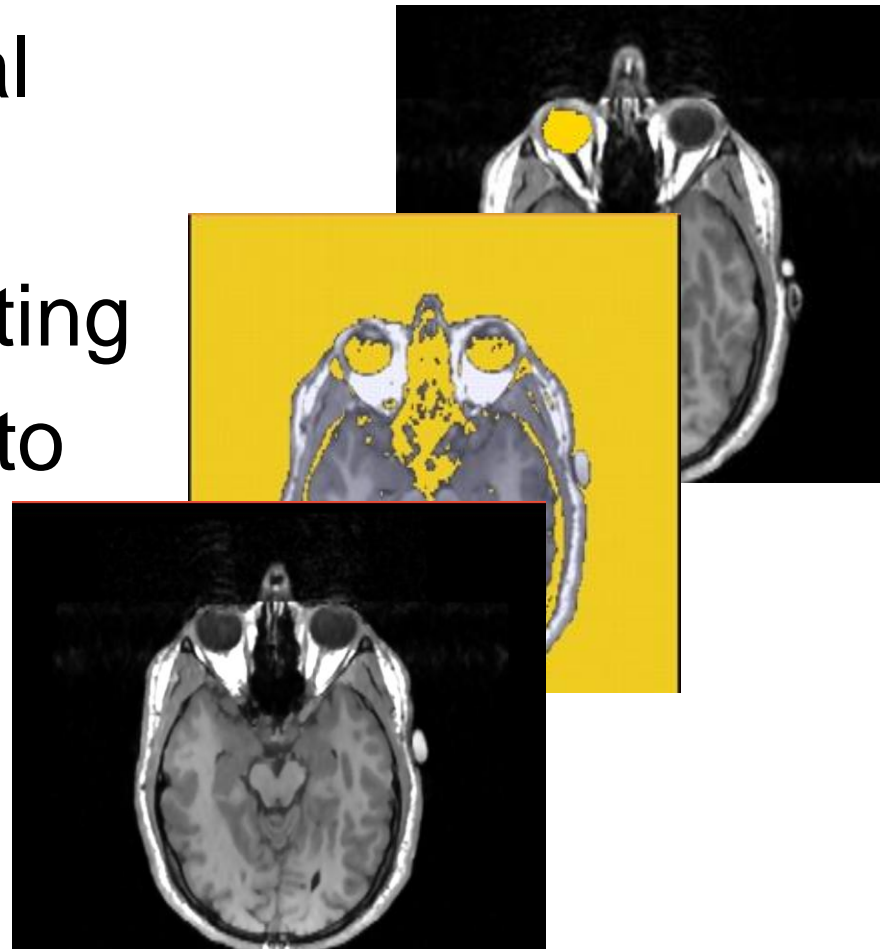
Disclaimer

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.



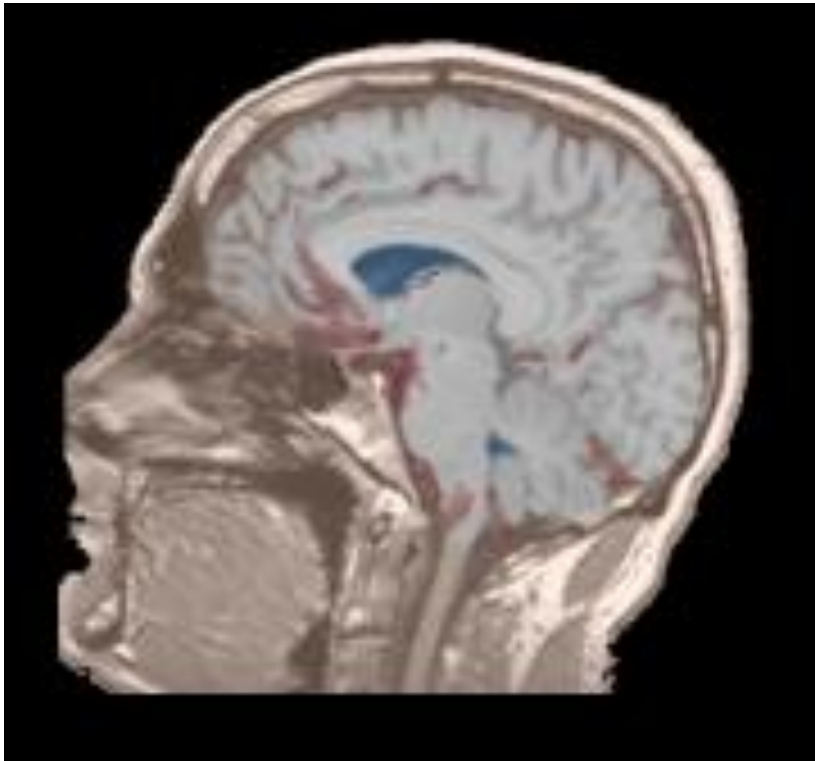
Learning Objective

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.





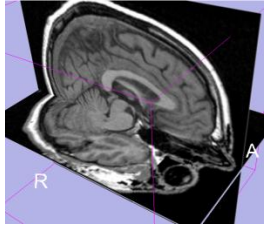
Label map



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



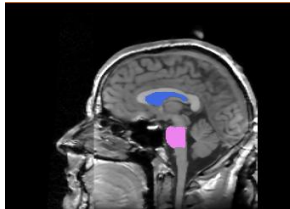
Overview



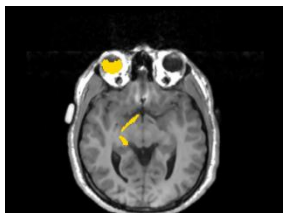
Part 1: Creating a single label map

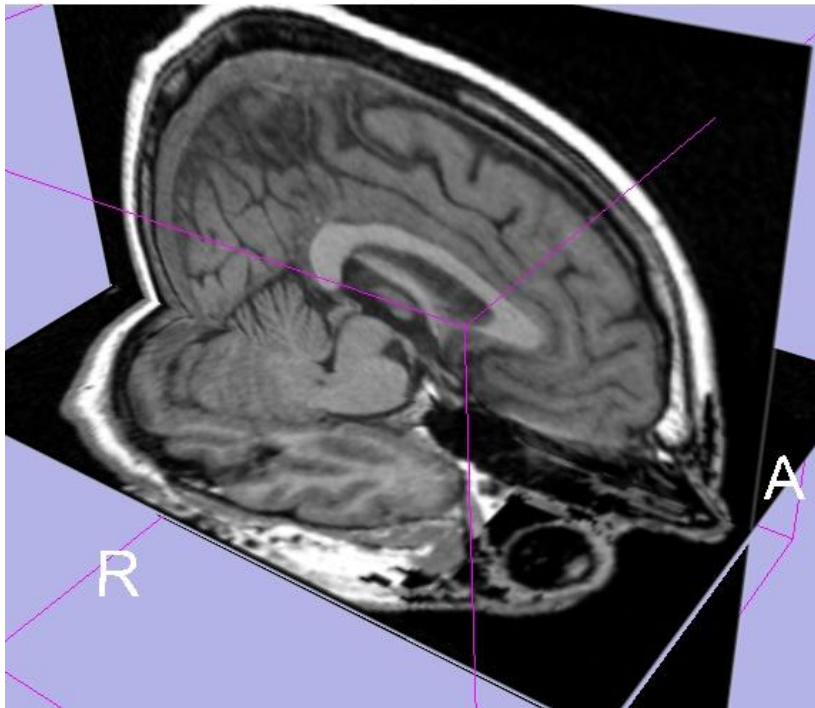


Part 2: Editing a single label map



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

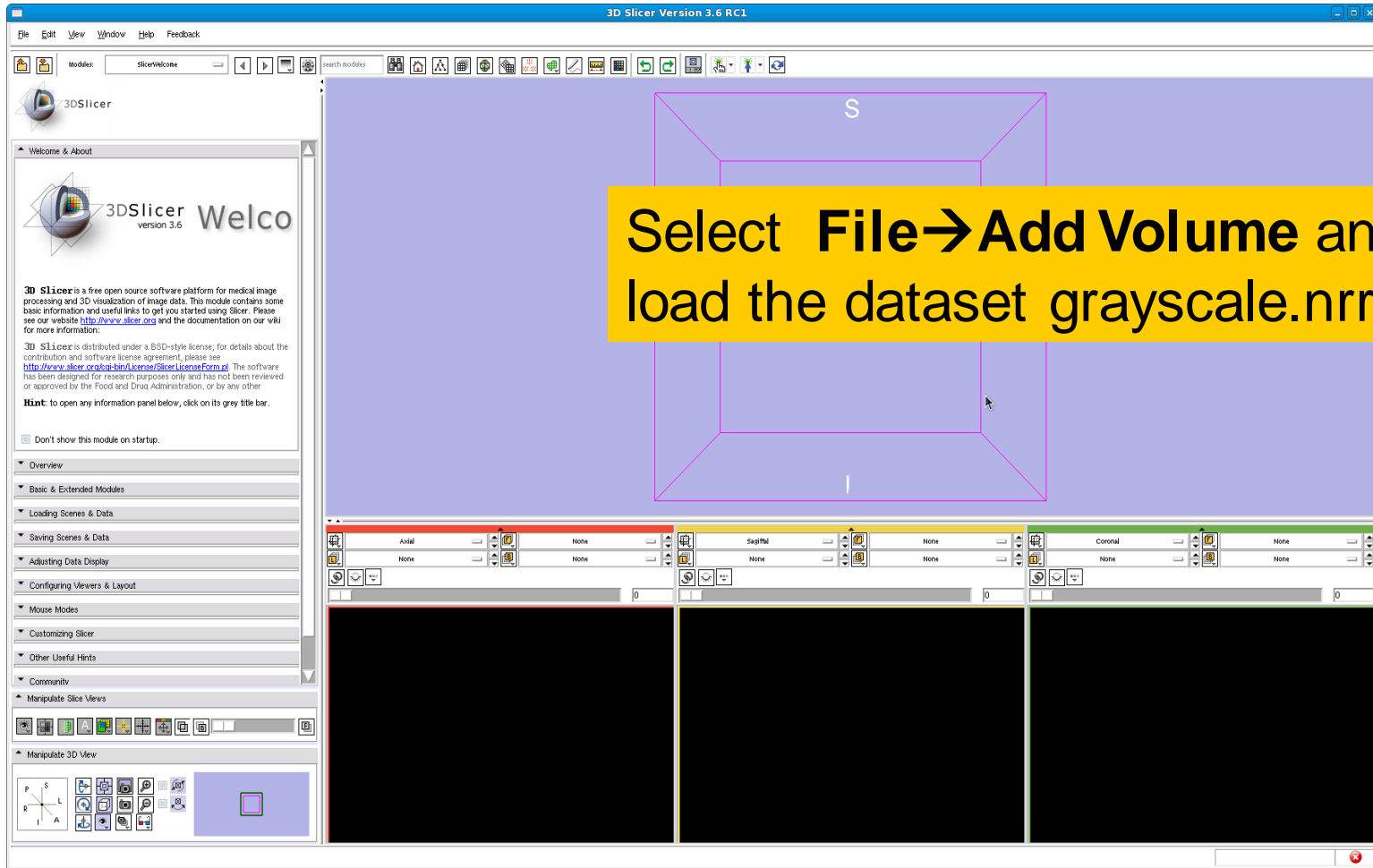




Part 1: Creating a single label map

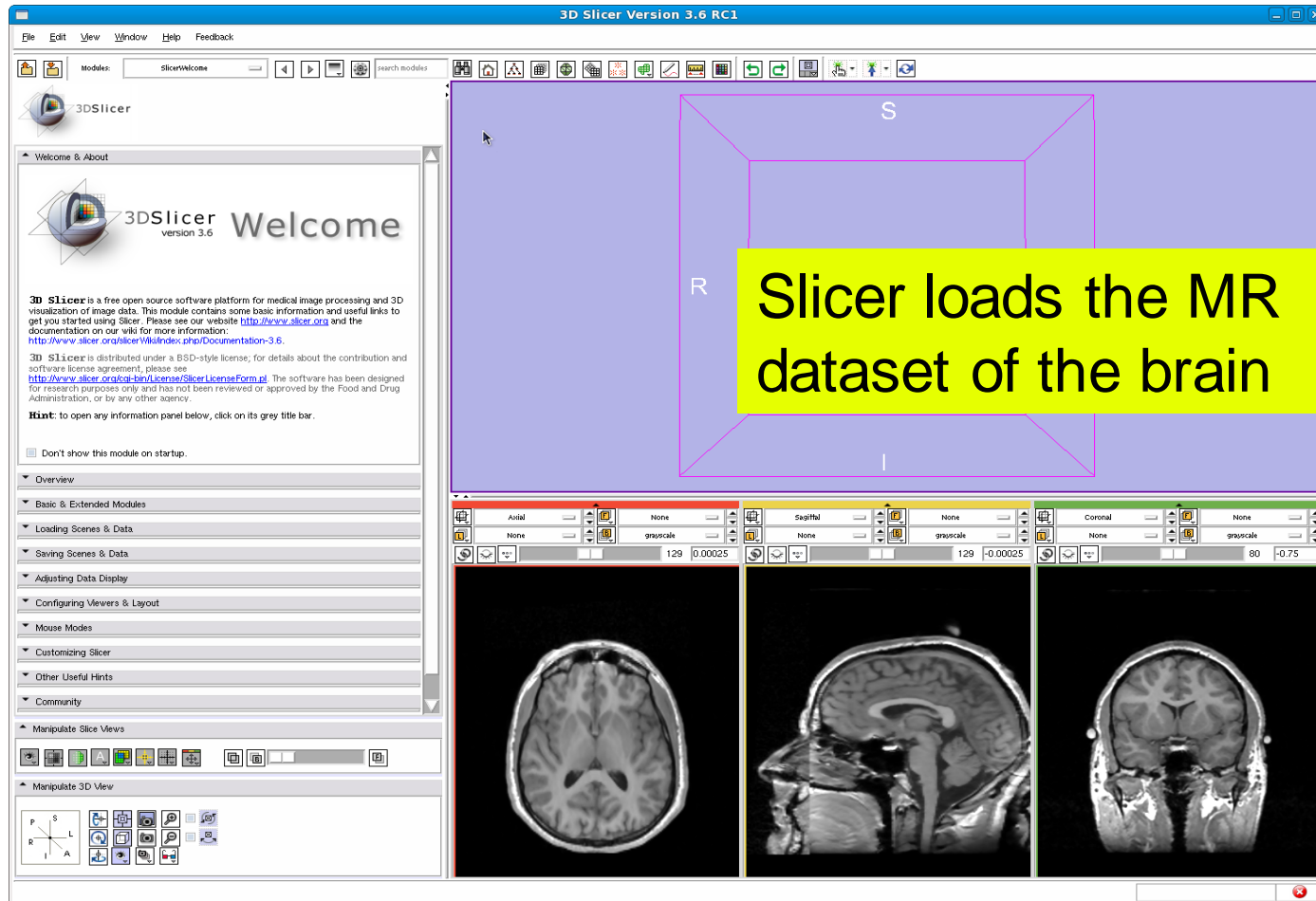


Data Loading



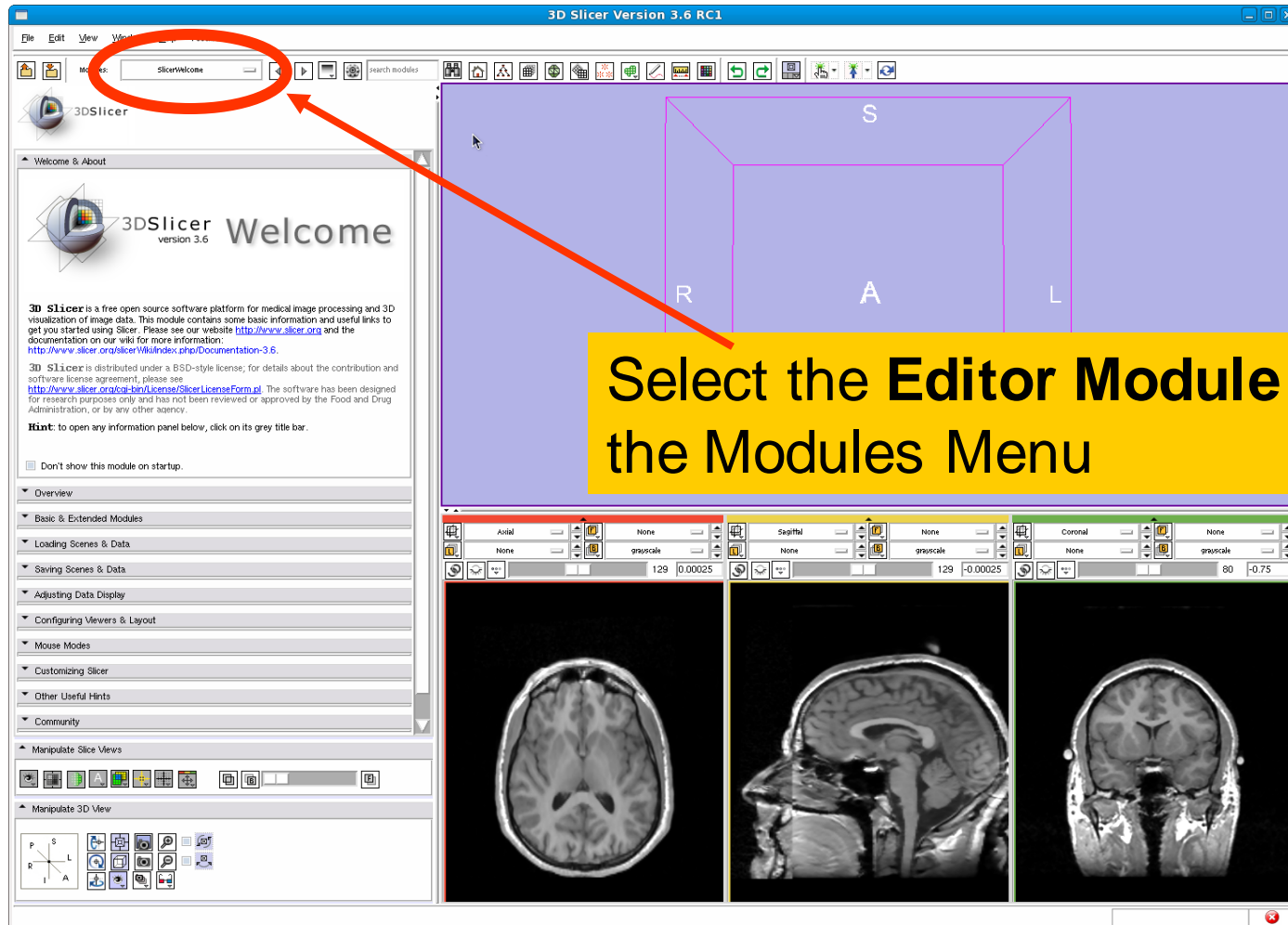


Data Loading





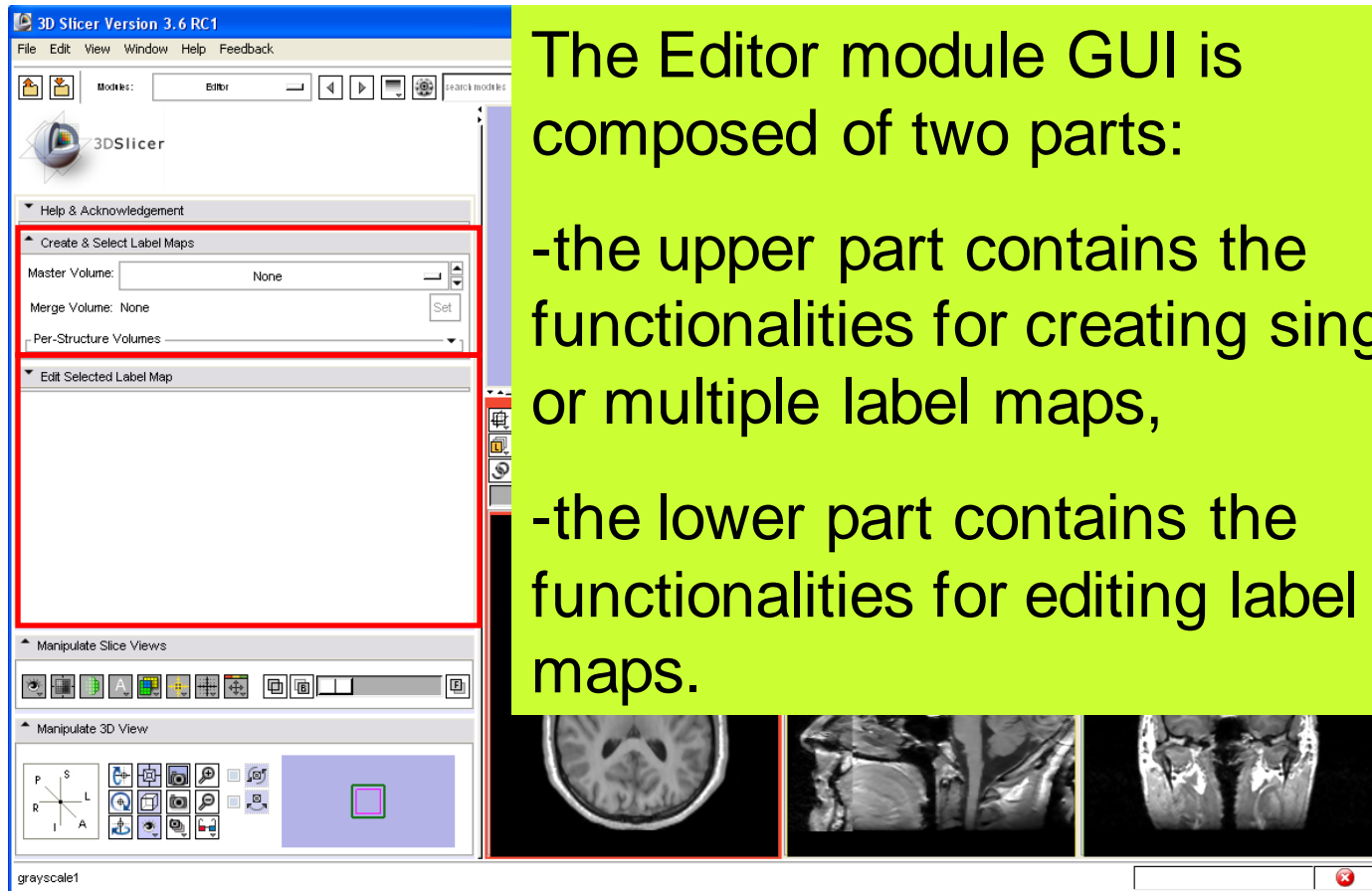
Data Loading



Select the **Editor Module** from the Modules Menu



Editor Module

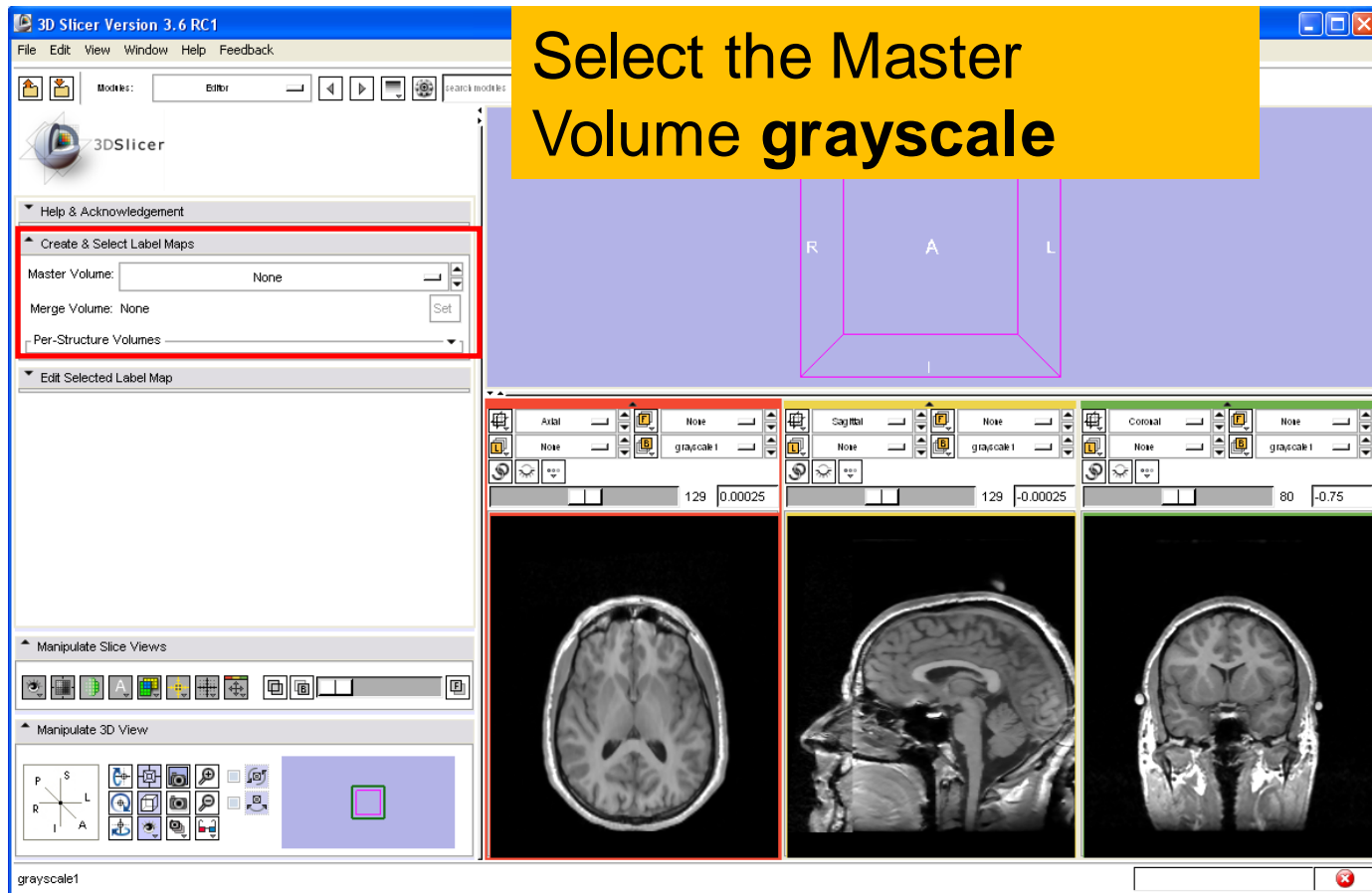


The Editor module GUI is composed of two parts:

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

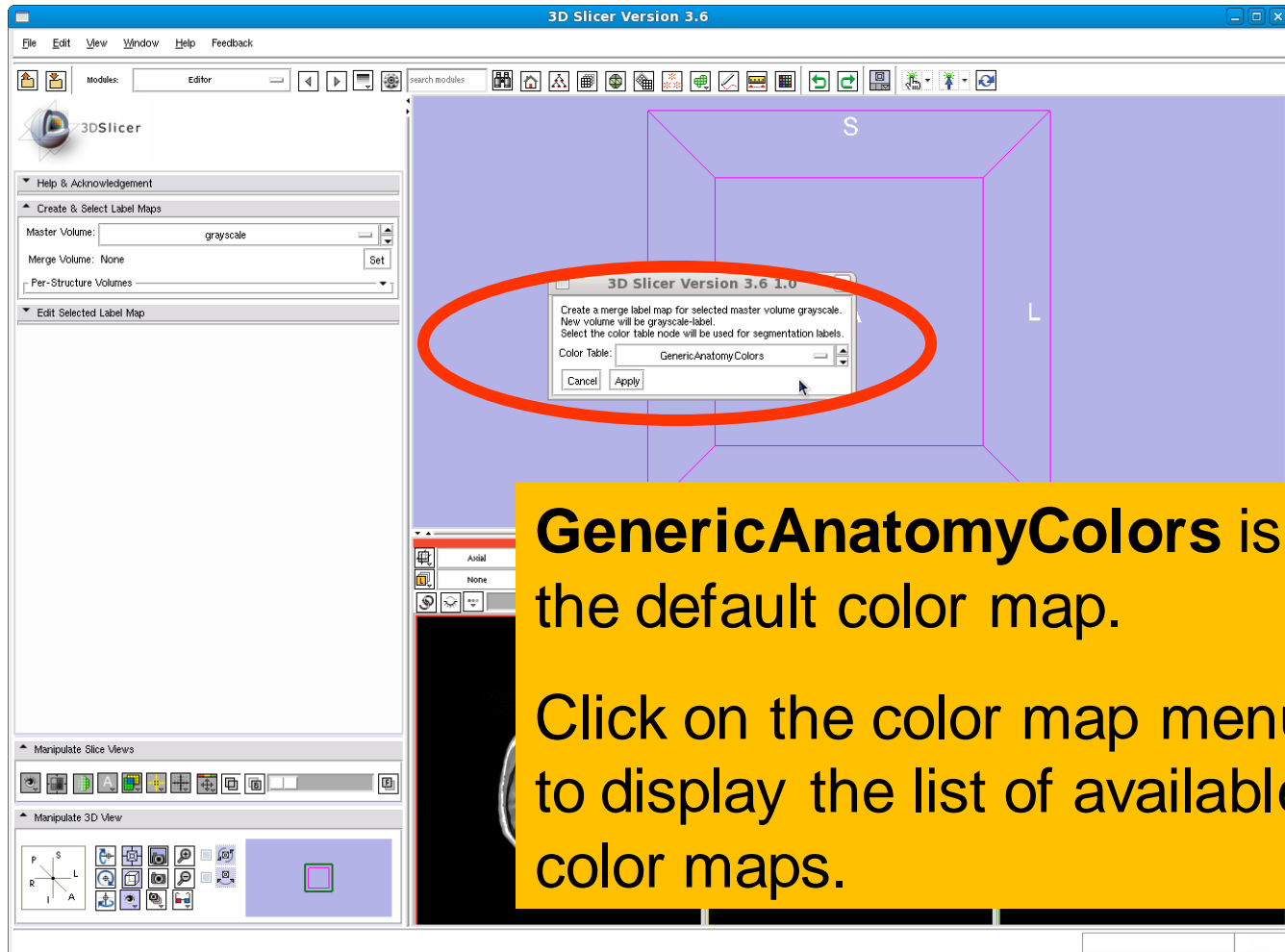


Label Map Creation



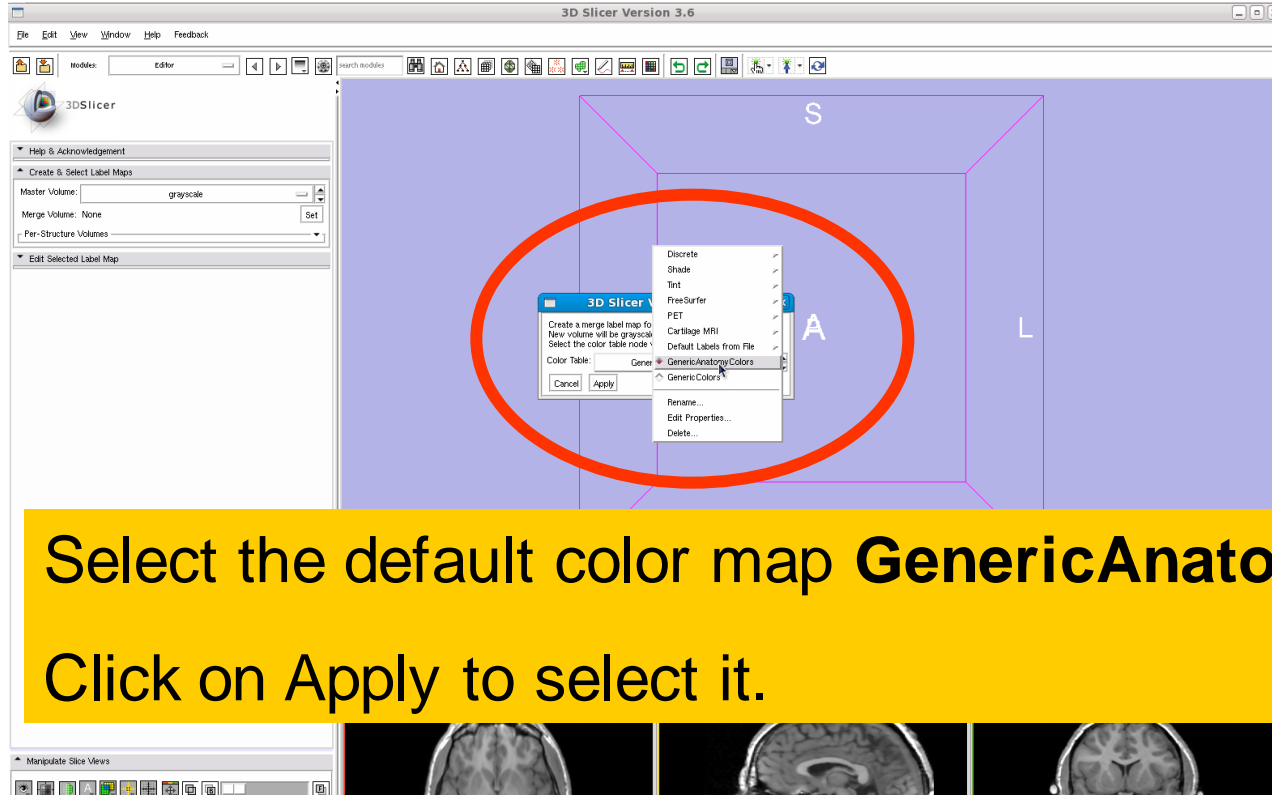


Label Map Creation





Label Map Creation



Select the default color map **GenericAnatomyColors**

Click on Apply to select it.

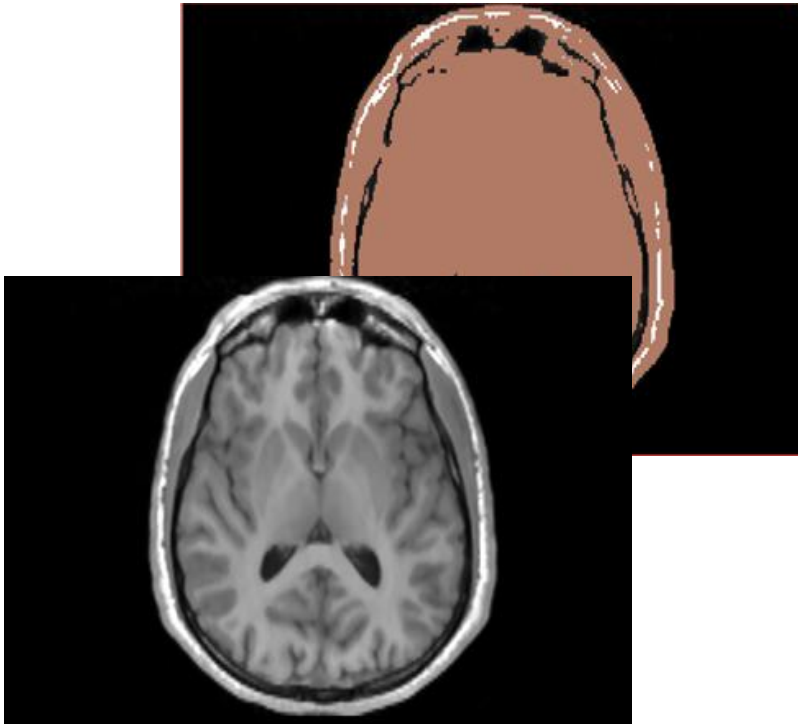
Note: You may use the Colors module if you need a custom or application specific color map



Label Map Creation

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

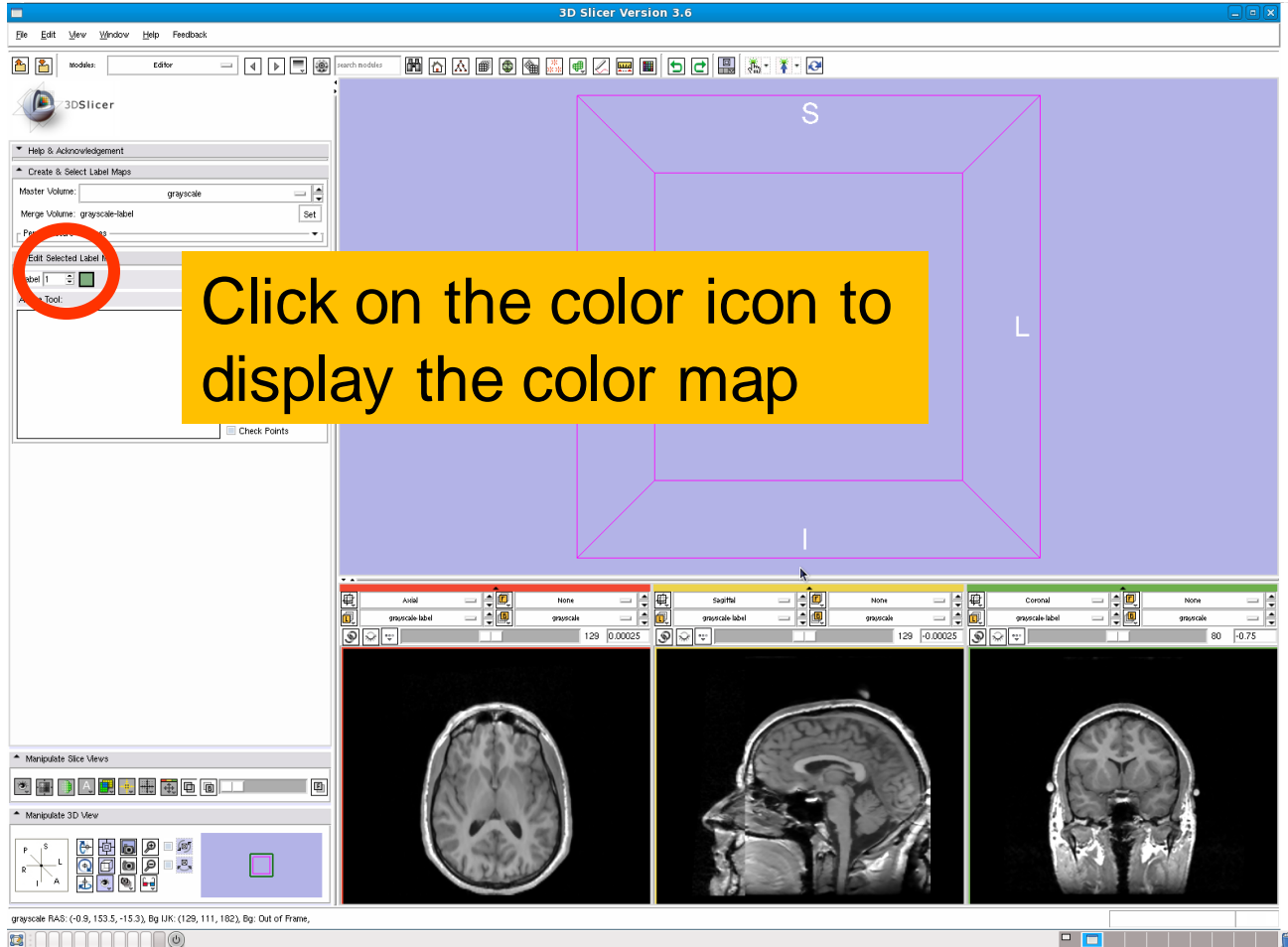
The screenshot shows the 3D Slicer software interface. The 'Edit Selected Label Map' panel on the left is circled in red. A yellow text box is overlaid on the right side of the interface, containing the text: 'Slicer creates the empty label map **grayscale-label** and displays the frame which contains 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 visible in the slice views.



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

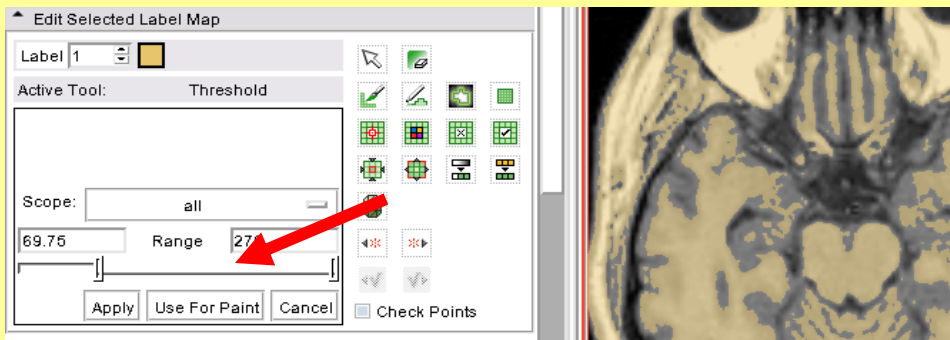
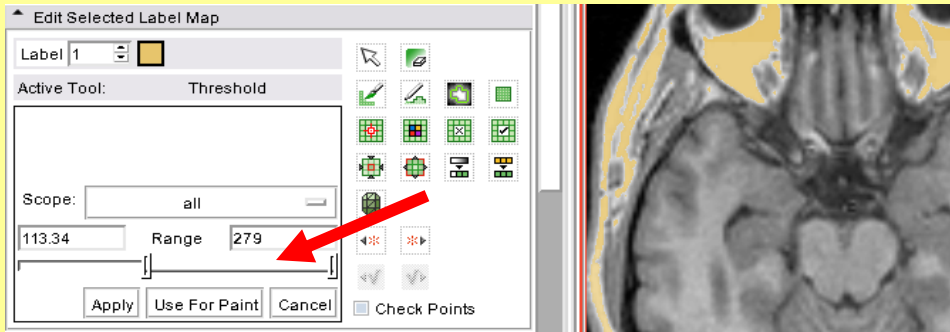
Browse through the list of 307 labels to explore the color map **GenericAnatomyColors**

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

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 80 120

Apply Use For Print Cancel Checkpoints

Manipulate Slice Views

Manipulate 3D View

Feedback

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

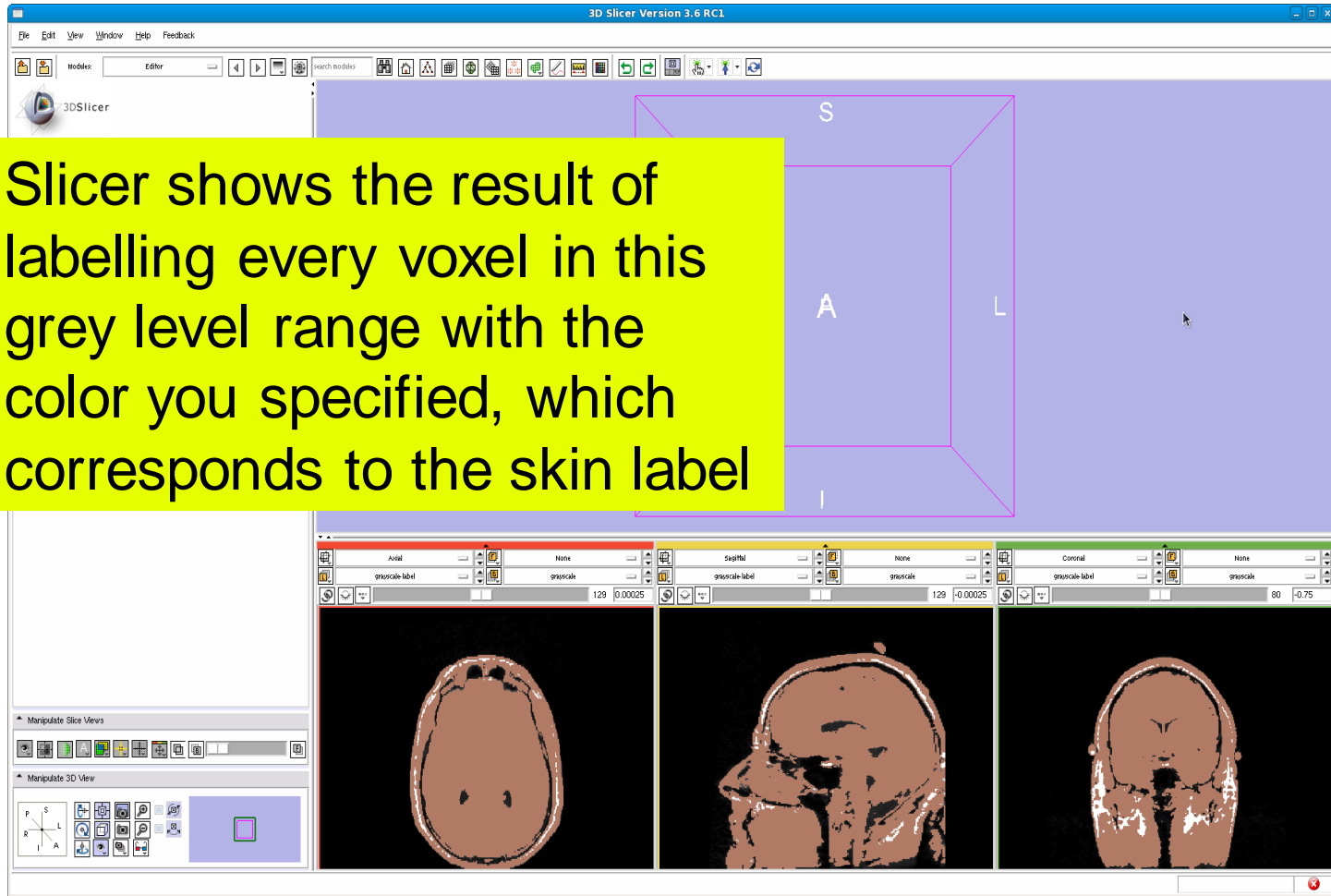
Sagittal None grayscale-label 129 -0.00025

Coronal None grayscale-label 80 -0.75



Threshold Effect

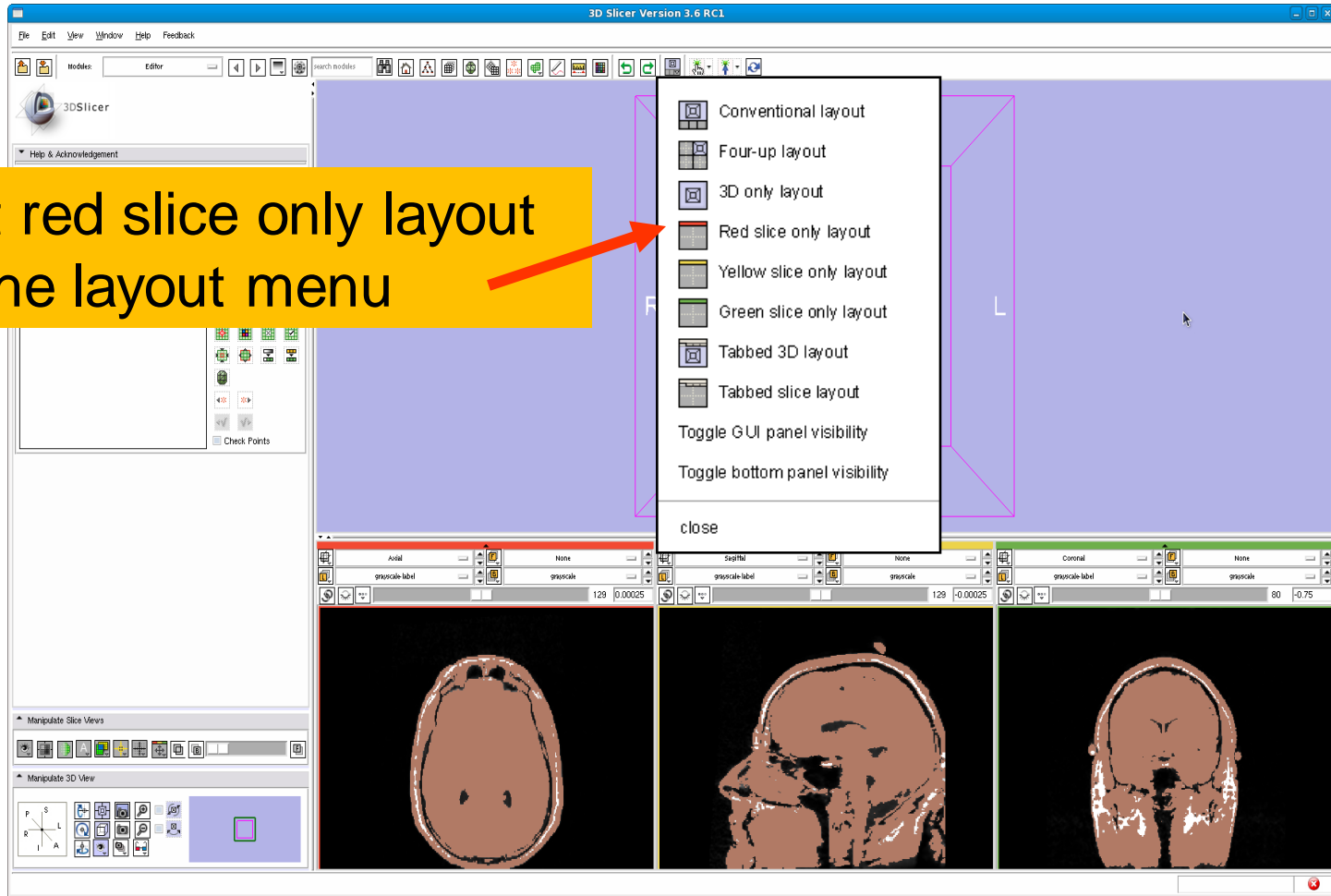
Slicer shows the result of labelling every voxel in this grey level range with the color you specified, which corresponds to the skin label





Threshold Effect

Select red slice only layout
from the layout menu





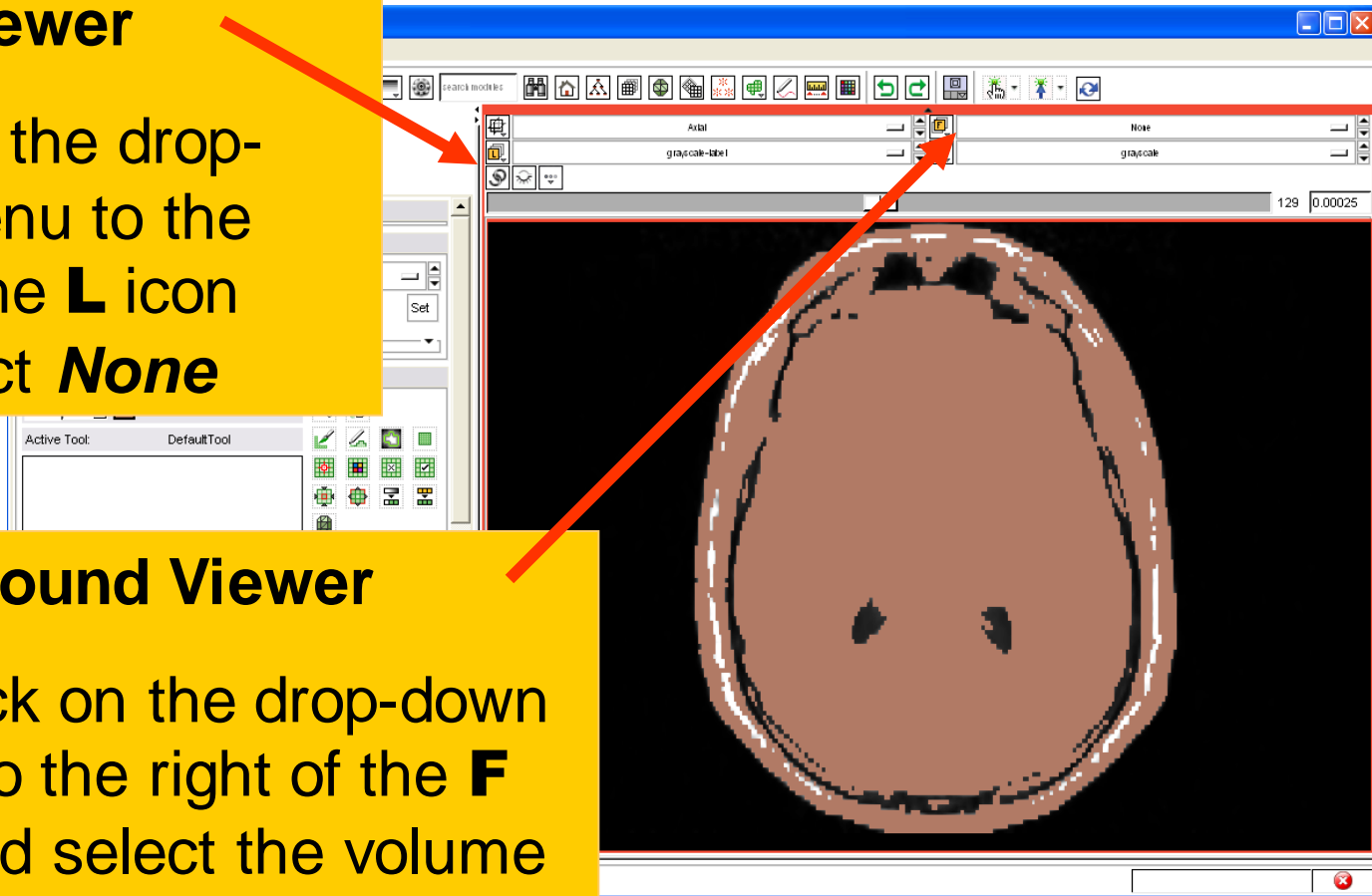
Threshold Effect

Label Viewer

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

Foreground Viewer

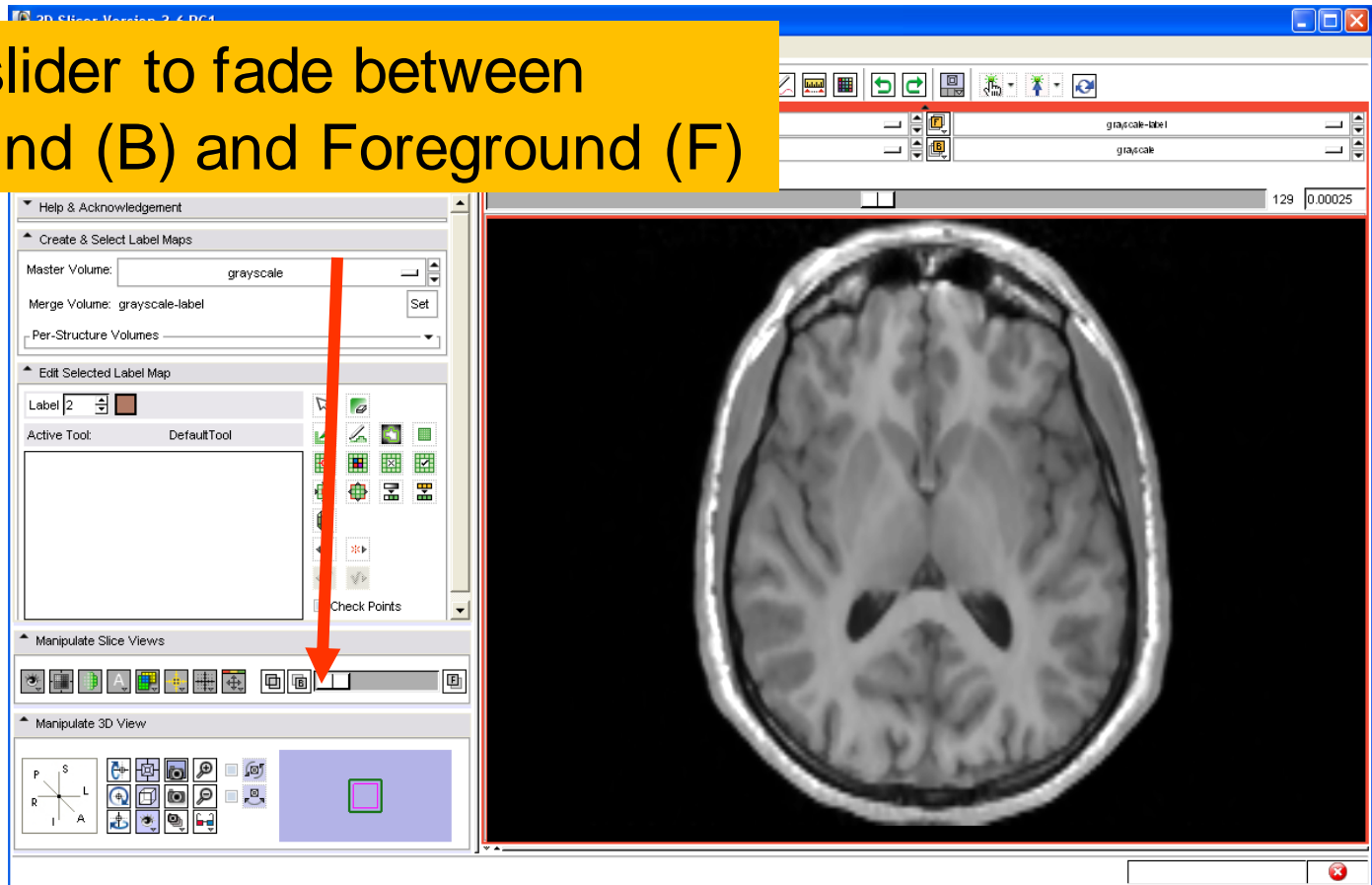
Left click on the drop-down menu to the right of the **F** icon and select the volume **grayscale-label**





Threshold Effect

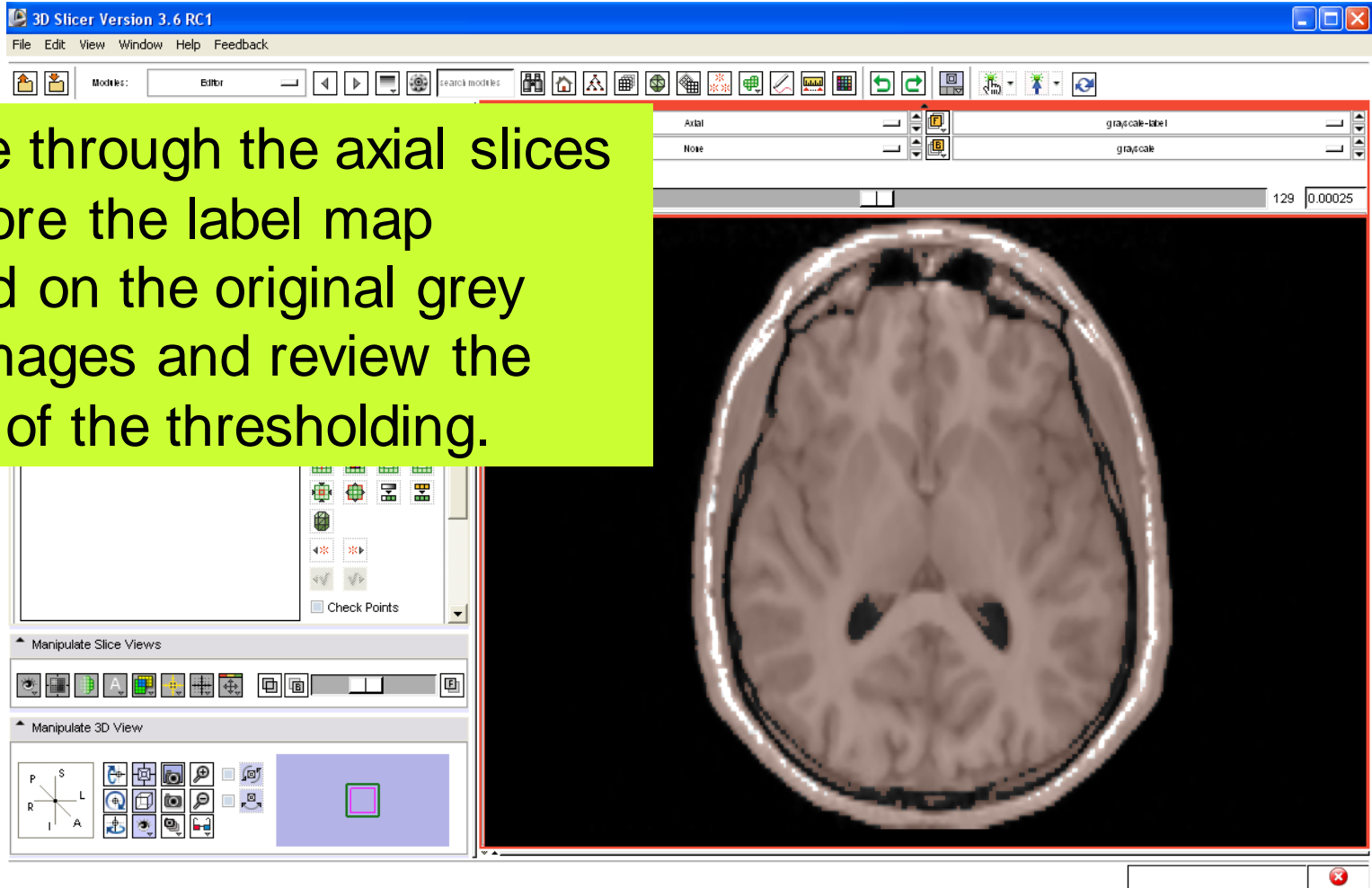
Use the slider to fade between Background (B) and Foreground (F)





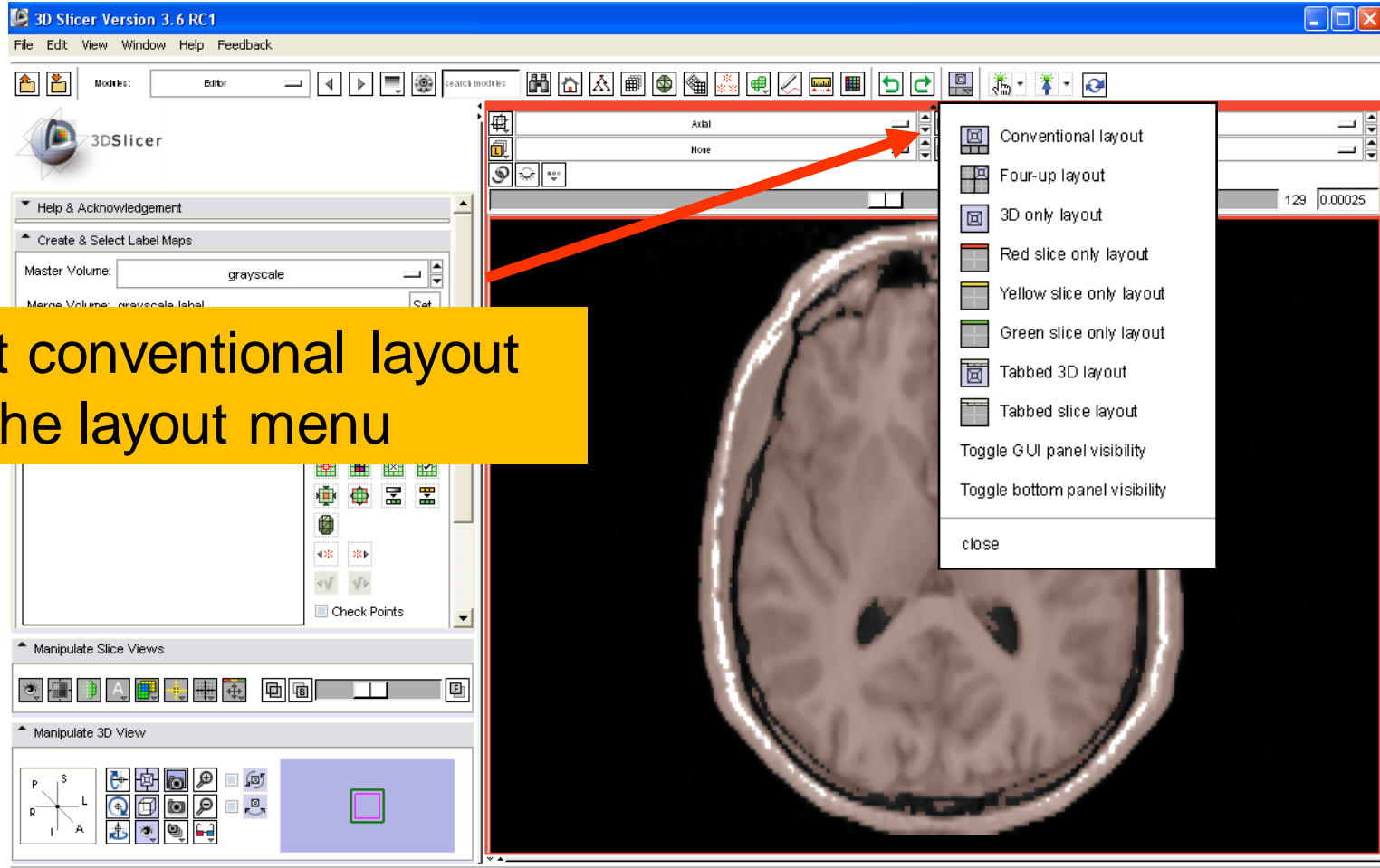
Exploring the result

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

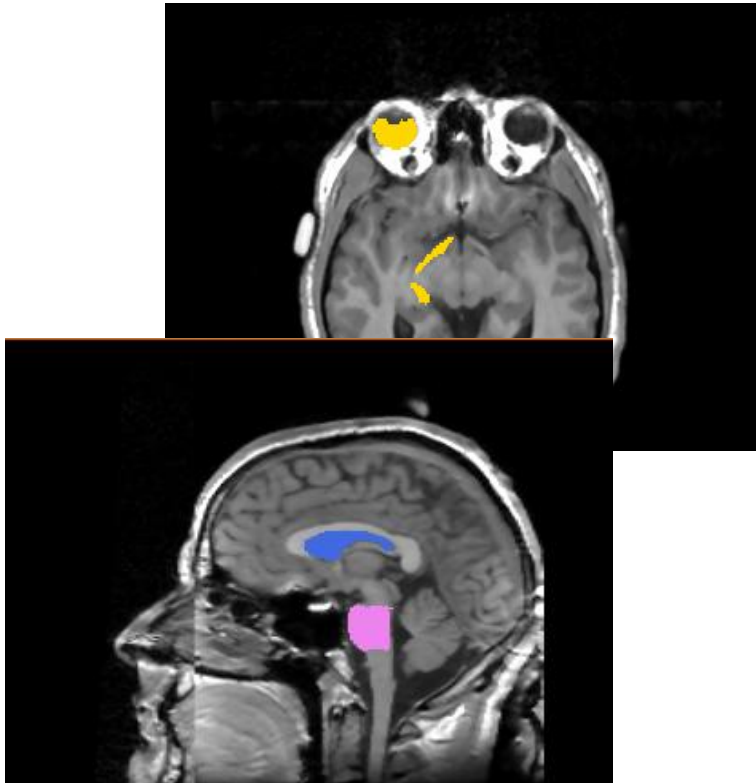




Threshold Effect



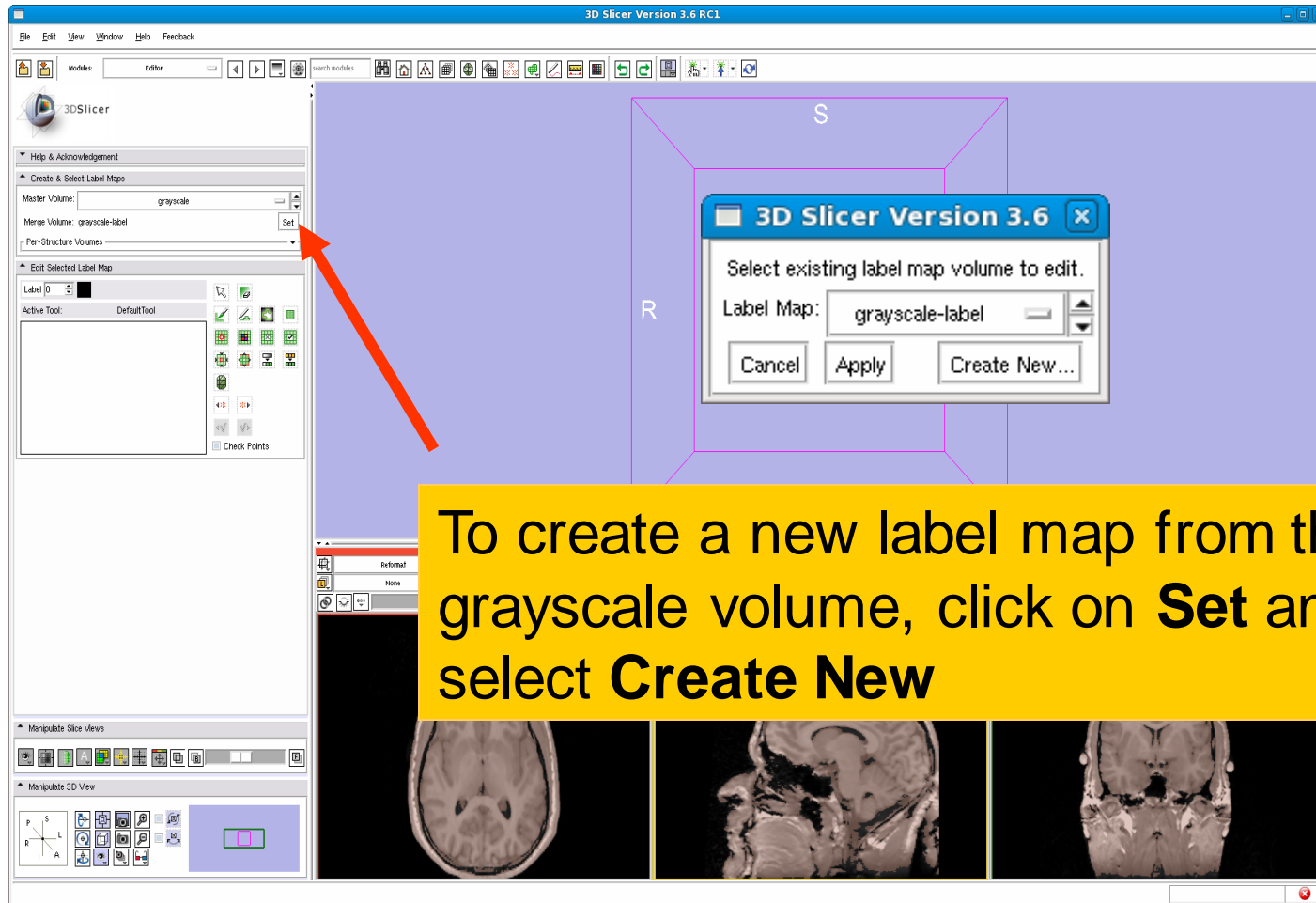
Select conventional layout
from the layout menu



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



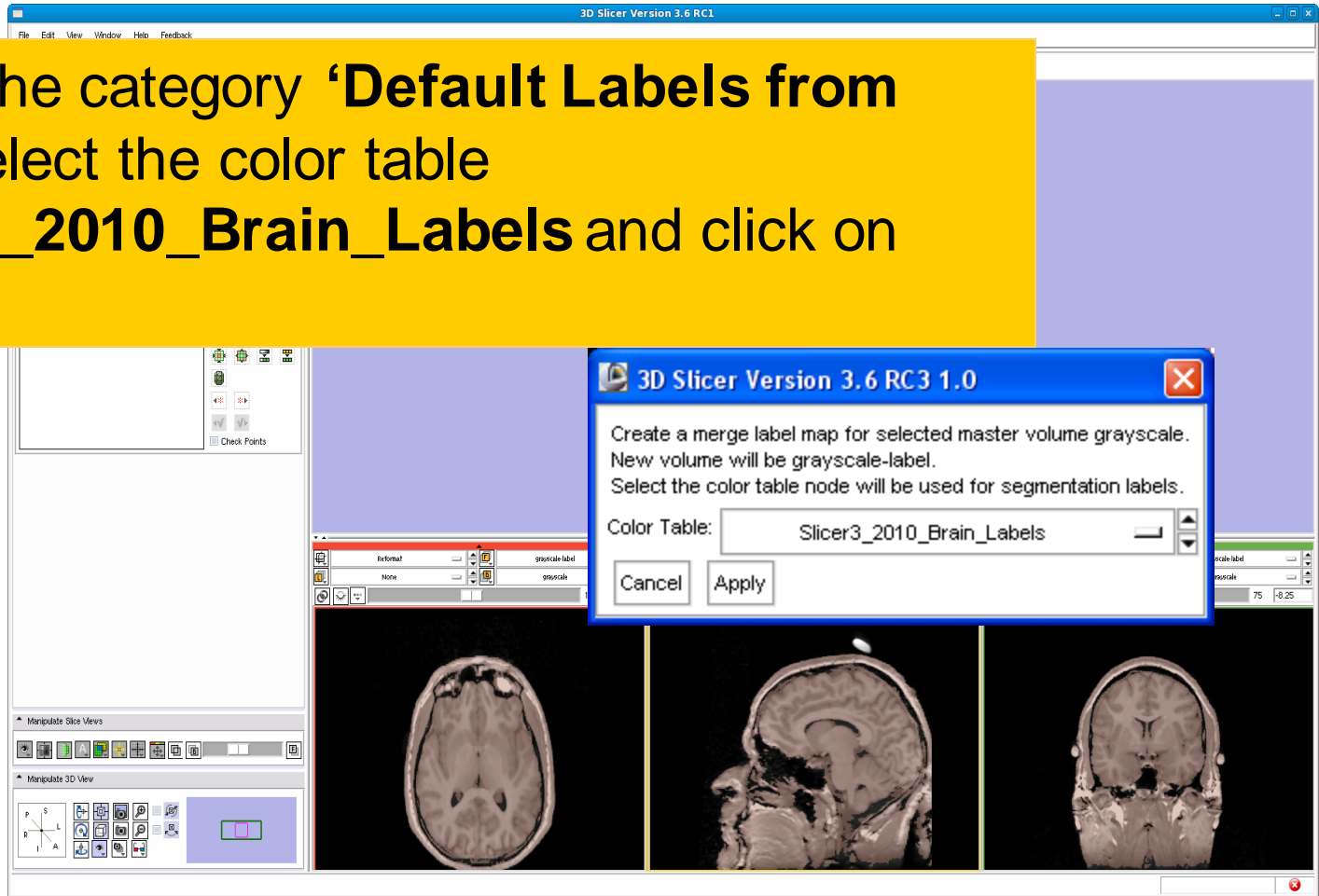
Creating a map with multiple labels





Creating a map with multiple labels

Select the category '**Default Labels from File**', select the color table **Slicer3_2010_Brain_Labels** 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

The screenshot displays a medical image processing software interface. On the left, there is a 'Create & Select Label Maps' panel with a table of structures:

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

Below this table, the 'Active Tool' is set to 'Draw'. The main workspace shows three MRI views: Axial, Sagittal, and Coronal. The Coronal view is active, showing a yellow outline of the pons. A red arrow points from the text box to the 'Draw' tool icon in the 'Active Tool' section. The interface also includes various control panels for volume selection, slice manipulation, and 3D view manipulation.



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

The screenshot displays the 3D Slicer software interface. The top menu bar includes File, Edit, View, Window, Help, and Feedback. The main window is divided into several panels:

- Per-Structure Volumes:** A table with columns for Number, Color, Name, and LabelName. The first row shows '14' in the Number column, a pink color swatch in the Color column, 'Structure_1' in the Name column, and 'grayscale-Stu' in the LabelName column.
- Edit Selected Label Map:** Shows 'Label 14' with a pink color swatch. The 'Active Tool' is set to 'Draw'. There are options for 'Paint Over' (checked), 'Threshold Painting', and a 'Threshold' value of '1'. Buttons for 'Cancel' and 'Apply' are present.
- Manipulate Slice Views:** Contains icons for various slice view manipulations.
- Manipulate 3D View:** Contains icons for 3D view manipulations and a small 3D preview window.

At the bottom, there are three slice views: an axial view, a sagittal view, and a coronal view. The sagittal view shows a pink structure drawn on the pons. The coronal view shows a pink structure drawn on the pons. The status bar at the bottom indicates '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'

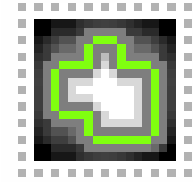
Number	Color	Name	LabelName
14		Structure_1	grayscale-Stu

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

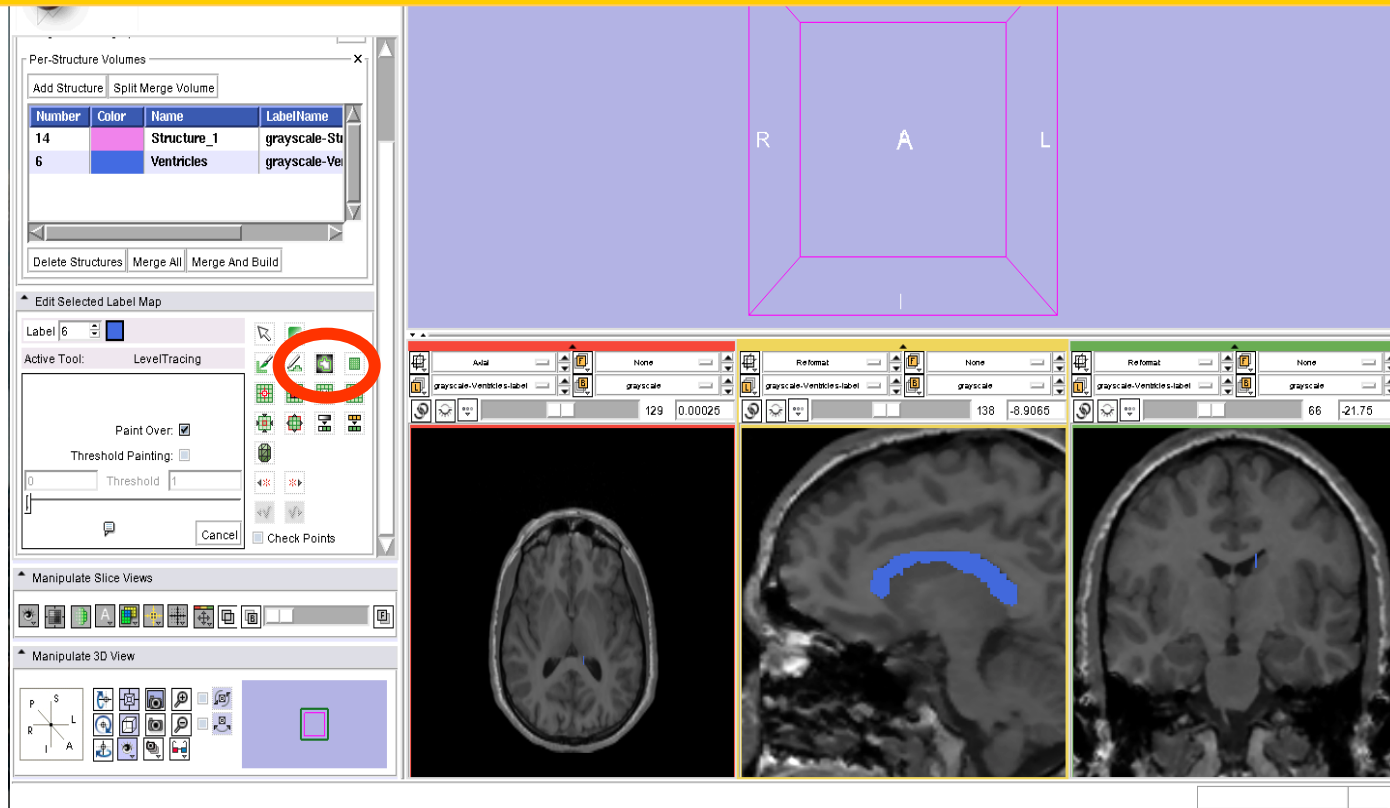


Description: By moving the mouse in the grey level images, you'll define in the label map volume an outline where the pixels all have the same value as the current background pixel.




Level Tracing

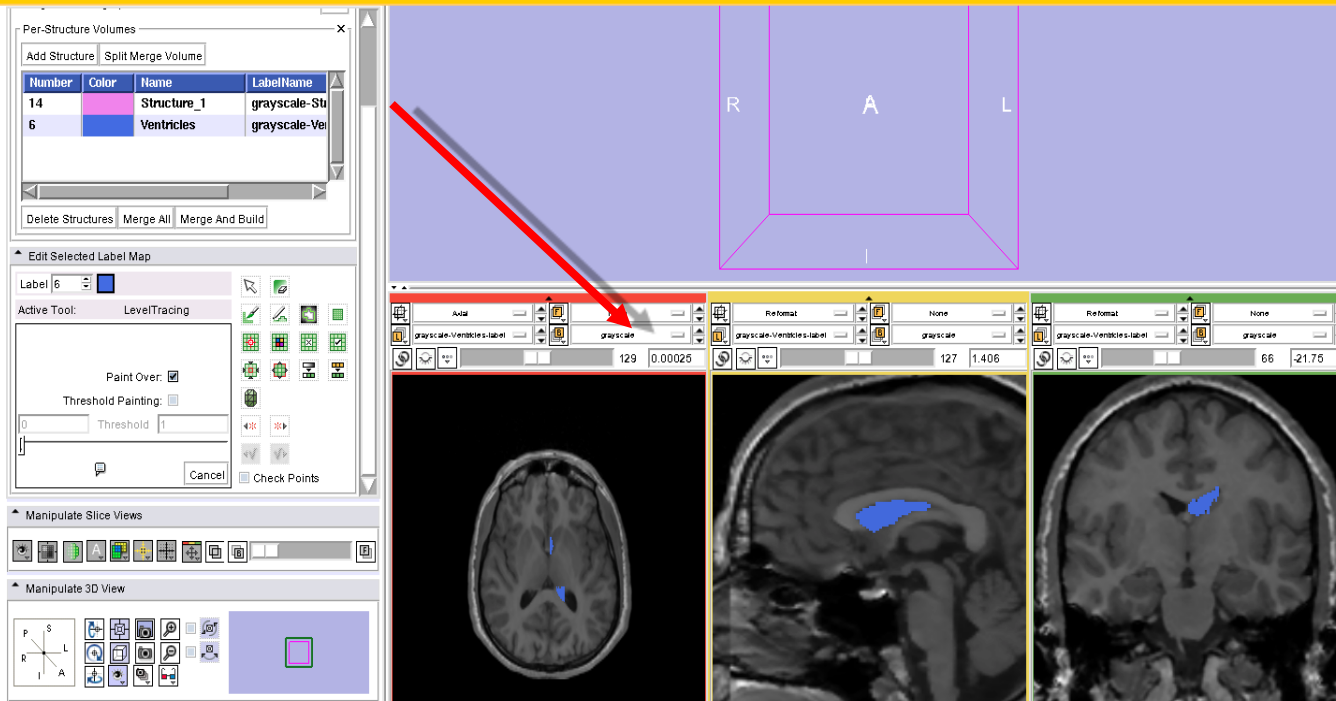
Use the **Level Tracing tool**  to trace the outline of the left lateral ventricle on slice 138





Level Tracing

Repeat the process using the Level Tracing tool  from sagittal slice163 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-Ve).
- 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 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 MRI slice:

- Axial View (Left):** Shows a cross-section of the brain with a blue outline of the left lateral ventricle.
- Sagittal View (Middle):** Shows a side view of the brain with a blue outline of the left lateral ventricle.
- Coronal View (Right):** Shows a front view of the brain with a blue outline of the left lateral ventricle.

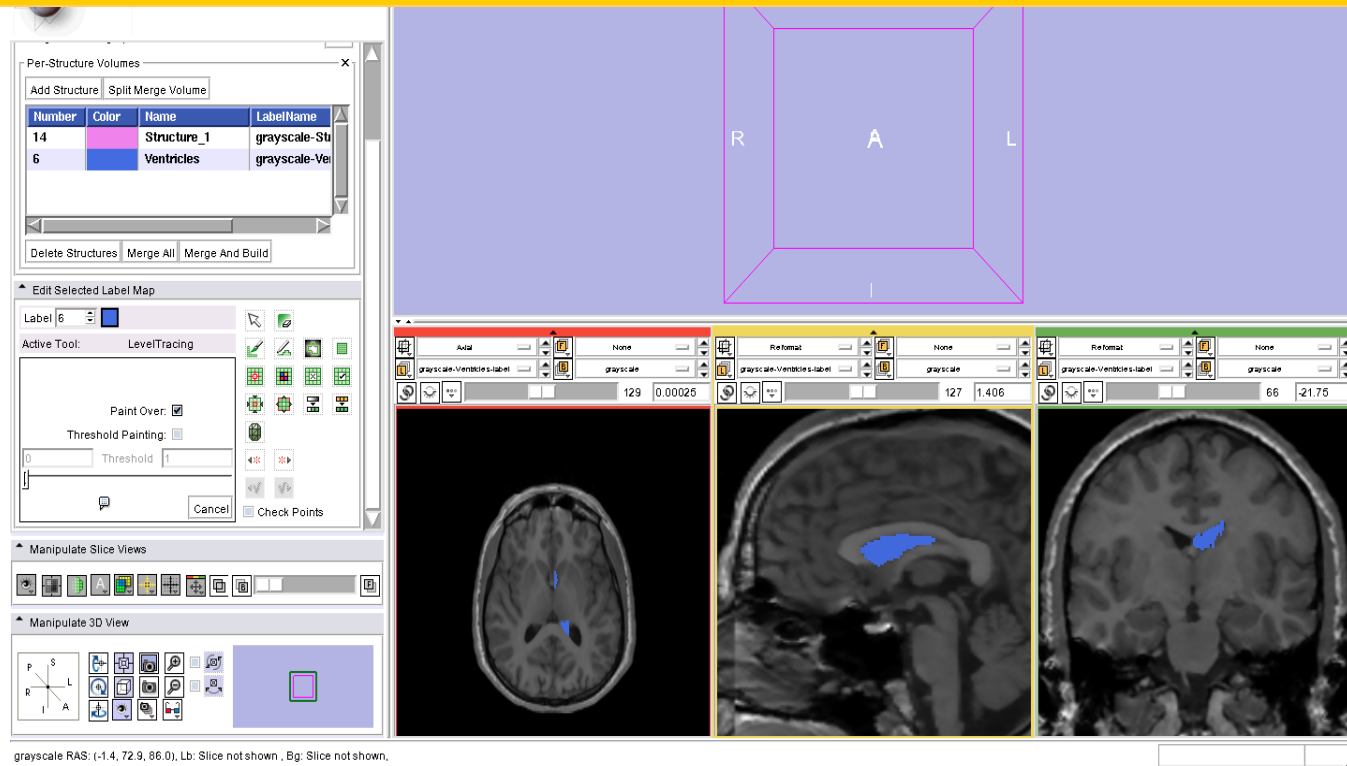
Below the views, there are control panels for each view, including 'Reformat' and 'None' options, and numerical values for slice position and thickness.

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 with columns 'Number', 'Color', 'Name', and 'LabelName'. Below this, there are buttons for 'Add Structure', 'Split Merge Volume', 'Delete Structures', 'Merge All', and 'Merge And Build'. The 'Edit Selected Label Map' panel is also visible, showing 'Label 6' and 'Active Tool: LevelTracing'. The main window displays a brain MRI slice with a yellow box highlighting a region. A list of structures is overlaid on the slice, showing labels 6 through 15. The list is as follows:

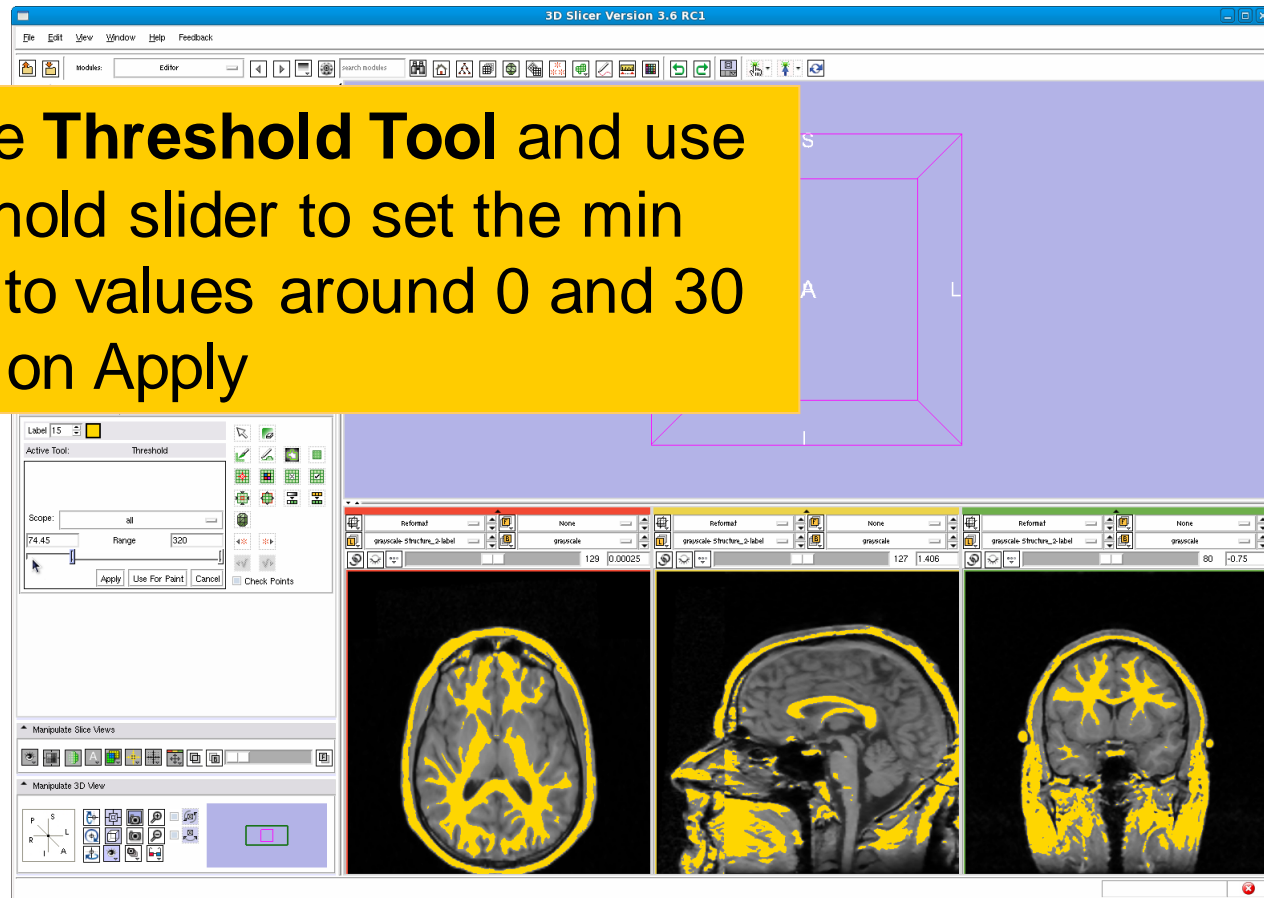
Number	Color	Name
6	Blue	Ventricles
7	Red	Arteries
8	Dark Blue	Veins
9	Gray	Gray_matter
10	Yellow	White_matter
11	Green	Tumor
12	Cyan	Edema
13	Purple	Necrosis
14	Pink	Structure_1
15	Yellow	Structure_2

At the bottom of the interface, there is a status bar with the text: 'grayscale RAS: (-1.4, 72.9, 86.0), Lb: Slice not shown, Bg: Slice not shown.'



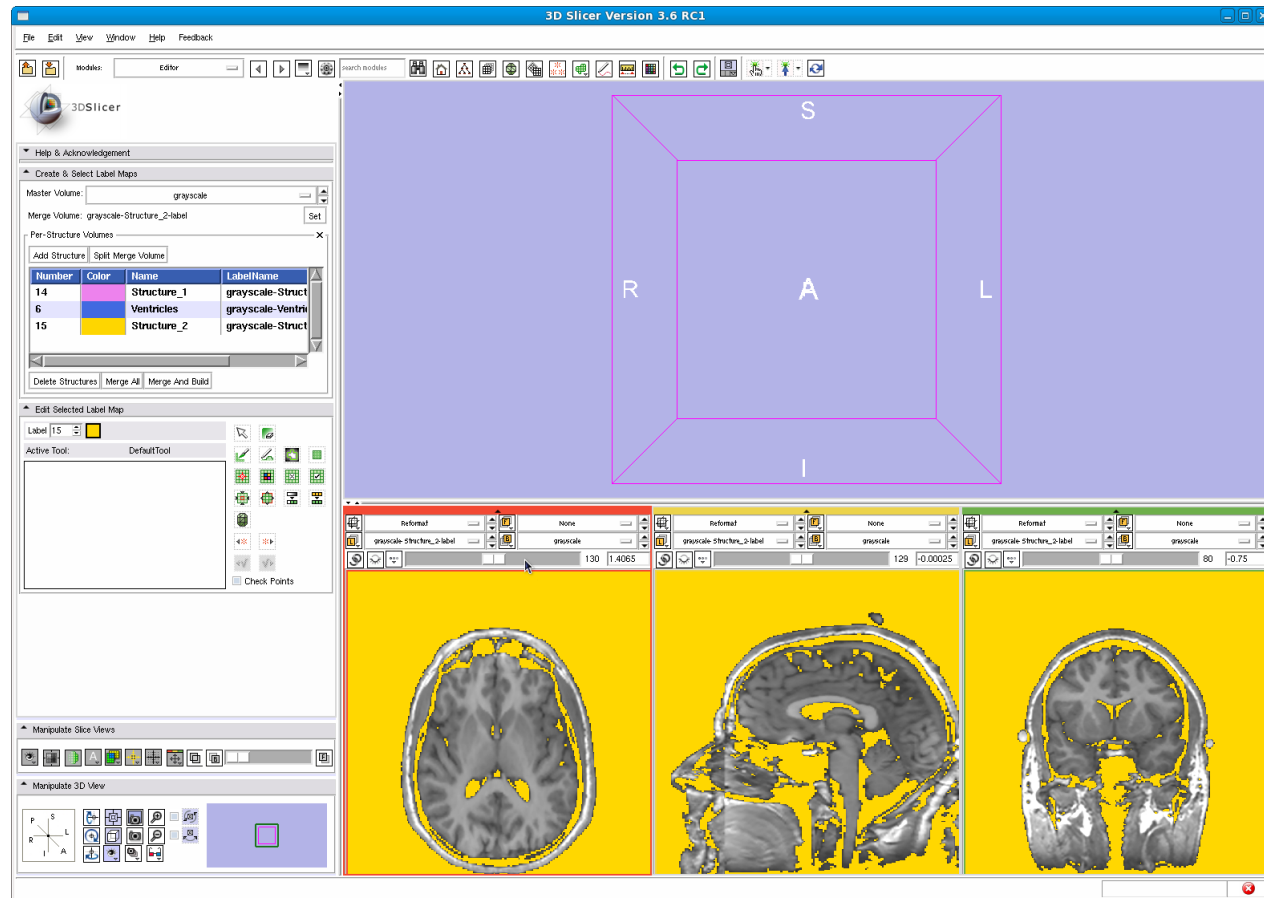
Threshold tool

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





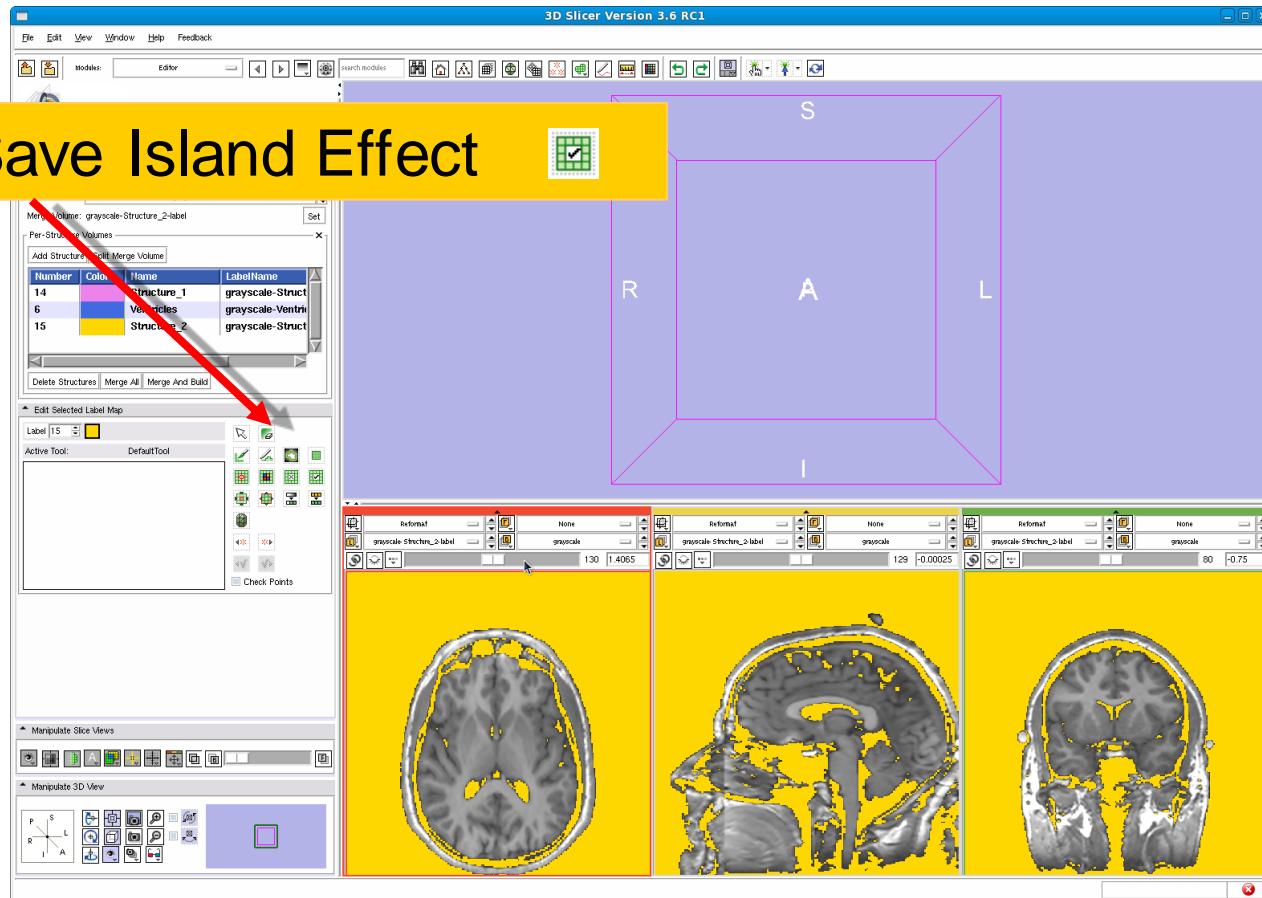
Threshold tool





Save Island

Select the Save Island Effect 





Save Island

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

3DSlicer

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

Label 15

Active Tool: Threshold

Scope: all

80 Range 320

Apply Use For Paint Cancel

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	Yellow	Ventricles	grayscale-Ve
15	Red	Structure_2	grayscale-Stu

Label 15

Active Tool: Savelsland

Scope: all

Manipulate Slice Views

Manipulate 3D View

Reformat: None, grayscale-St. Lure 2-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 layers 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 (left), a sagittal view (middle), and an axial view (right). The axial view shows a yellow highlighted region on the right side of the brain, representing the dilated effect on the eyeball structure. The interface includes a toolbar at the top, a panel on the left for structure management, and a panel on the right for label map editing. The structure management panel shows a list of structures: Structure_1 (grayscale-Stu), Ventricles (grayscale-Ve), and Structure_2 (grayscale-Stu). The label map editing panel shows the active tool 'RemovIslands' and the scope 'visible'. The bottom status bar indicates the middle button is for pan and the right button is for zoom.

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

Active Tool: RemovIslands
Scope: visible
Fully Connected
Cancel Apply Check Points

Manipulate Slice Views
Manipulate 3D View

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 control panels:

- Per-Structure Volumes:** A table listing structures with their IDs, colors, names, and label names.
- Edit Selected Label Map:** A panel for editing the selected label map, including an active tool (Removalslands) and various manipulation options.
- Manipulate Slice Views:** A panel with icons for navigating between different slice views.
- Manipulate 3D View:** A panel with icons for manipulating the 3D view, including a directional crosshair.

The main 3D view shows a purple rectangular volume with axes labeled S (Superior), I (Inferior), R (Right), and L (Left). Below it, three slice views are shown:

- Left View (Axial):** Shows a cross-section of the brain with a yellow highlighted region in the right eye area. The slice index is 107, with a range of -20.156.
- Middle View (Sagittal):** Shows a sagittal cross-section of the brain. The slice index is 111, with a range of 16.406.
- Right View (Coronal):** Shows a coronal cross-section of the brain. The slice index is 66, with a range of -21.75. The label is 'grayscale-Ventricles-label'.

At the bottom left, there is a small directional crosshair with labels P, S, R, L, I, A.

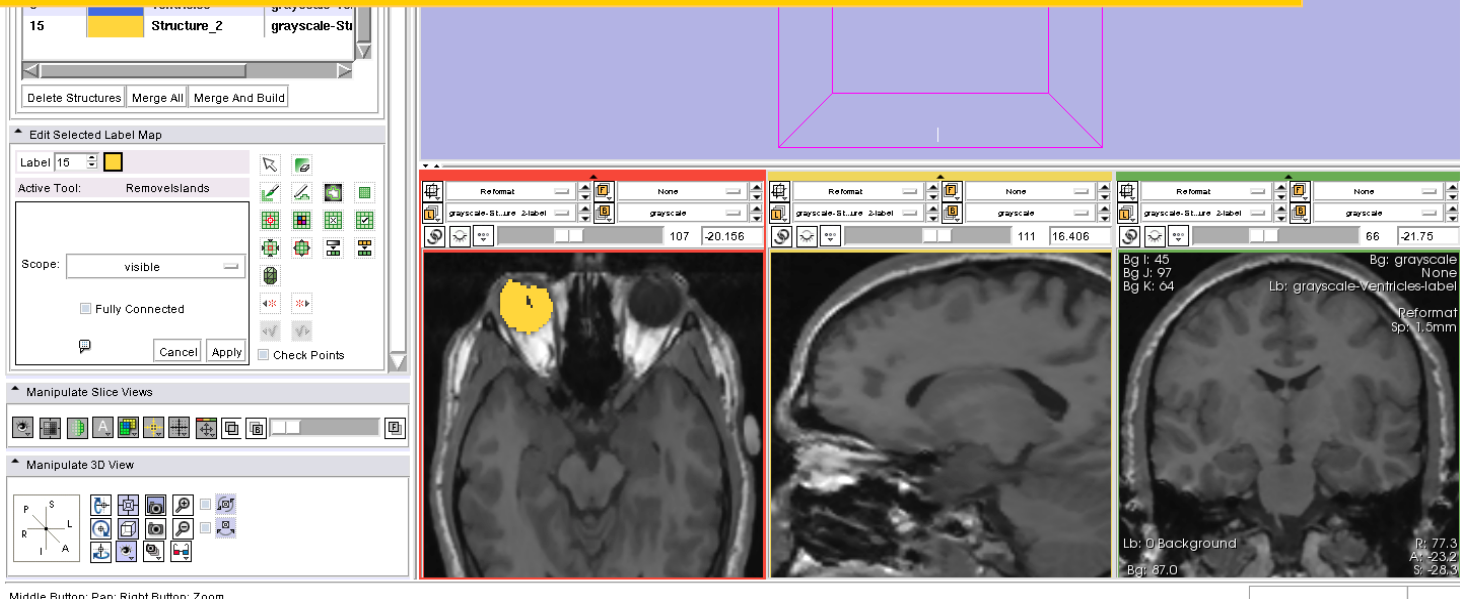
Middle Button: Pan; Right Button: Zoom



Remove Island

Select the **Remove Island**  tool

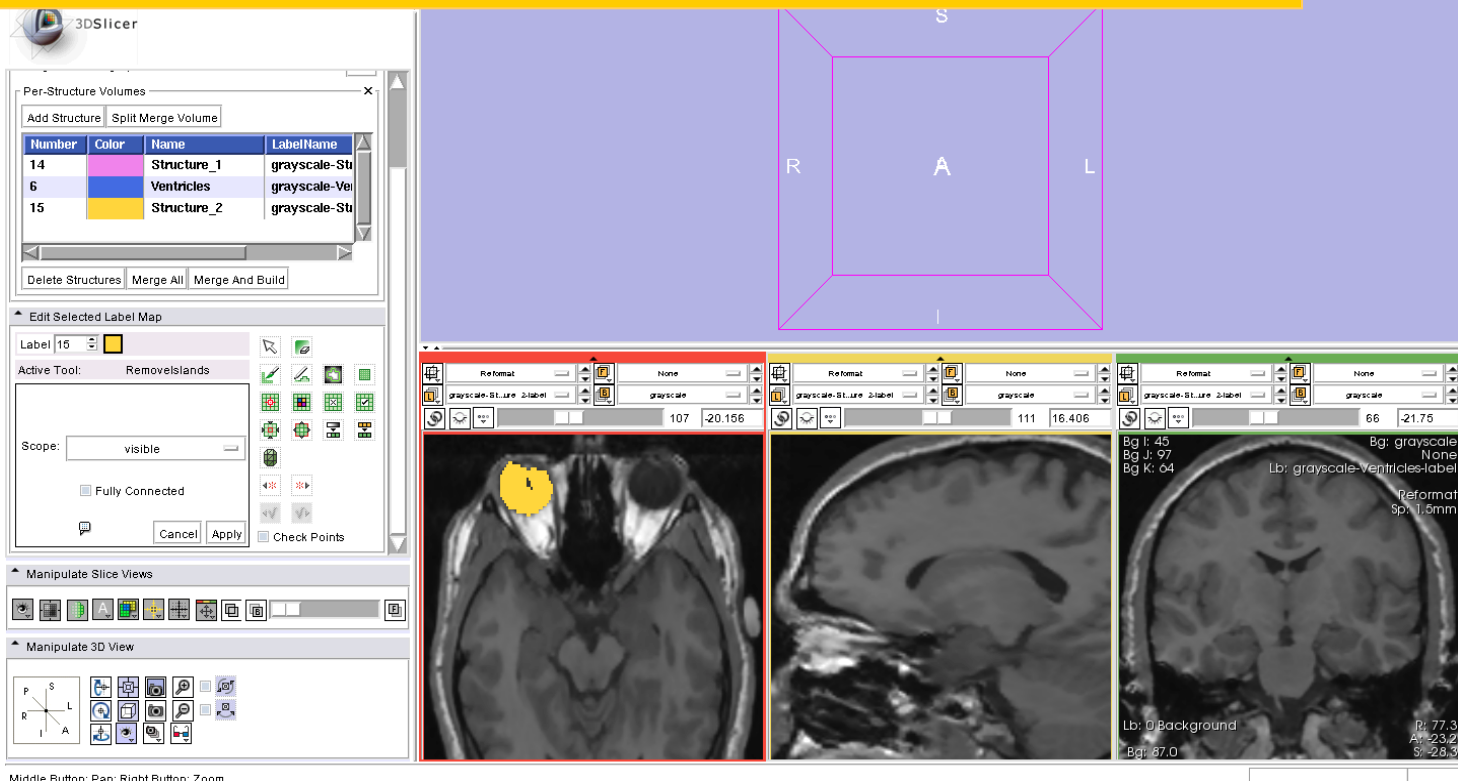
Select **Scope: visible** and click on **Apply** to remove the isolated pixels inside the segmented structure





Remove Island

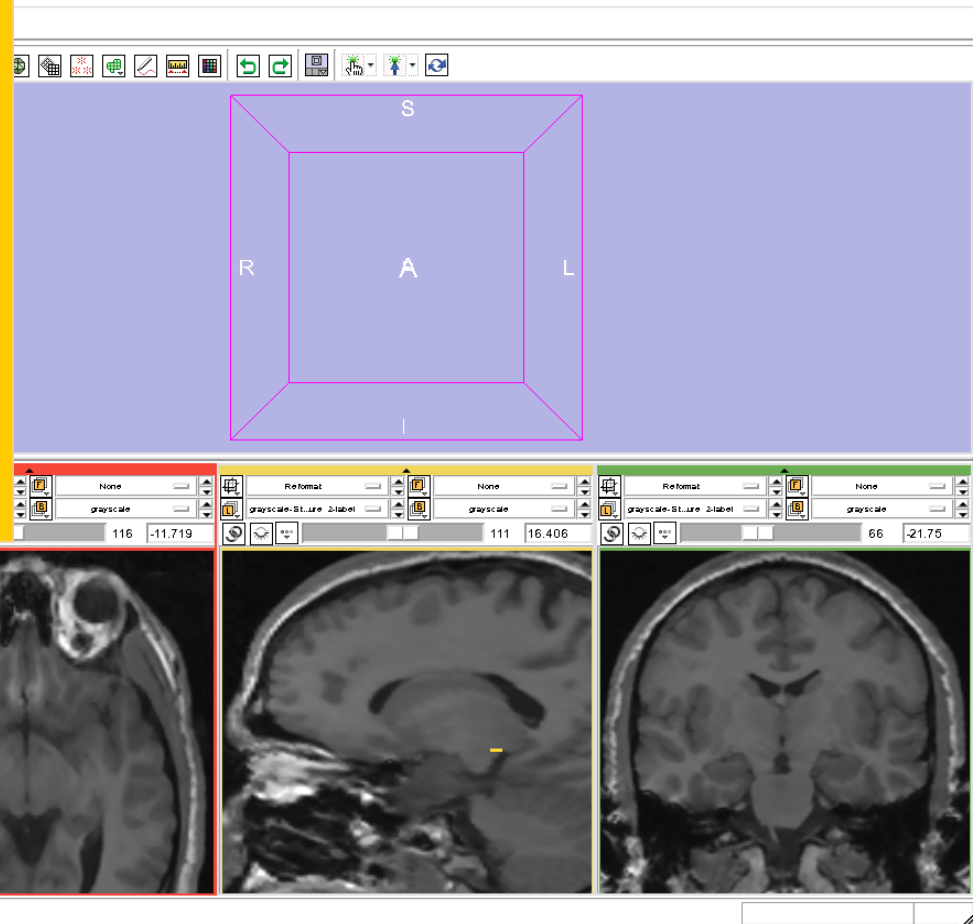
Repeat the process in the slices that contain isolated pixels in the eyeball structure





Adding more structures

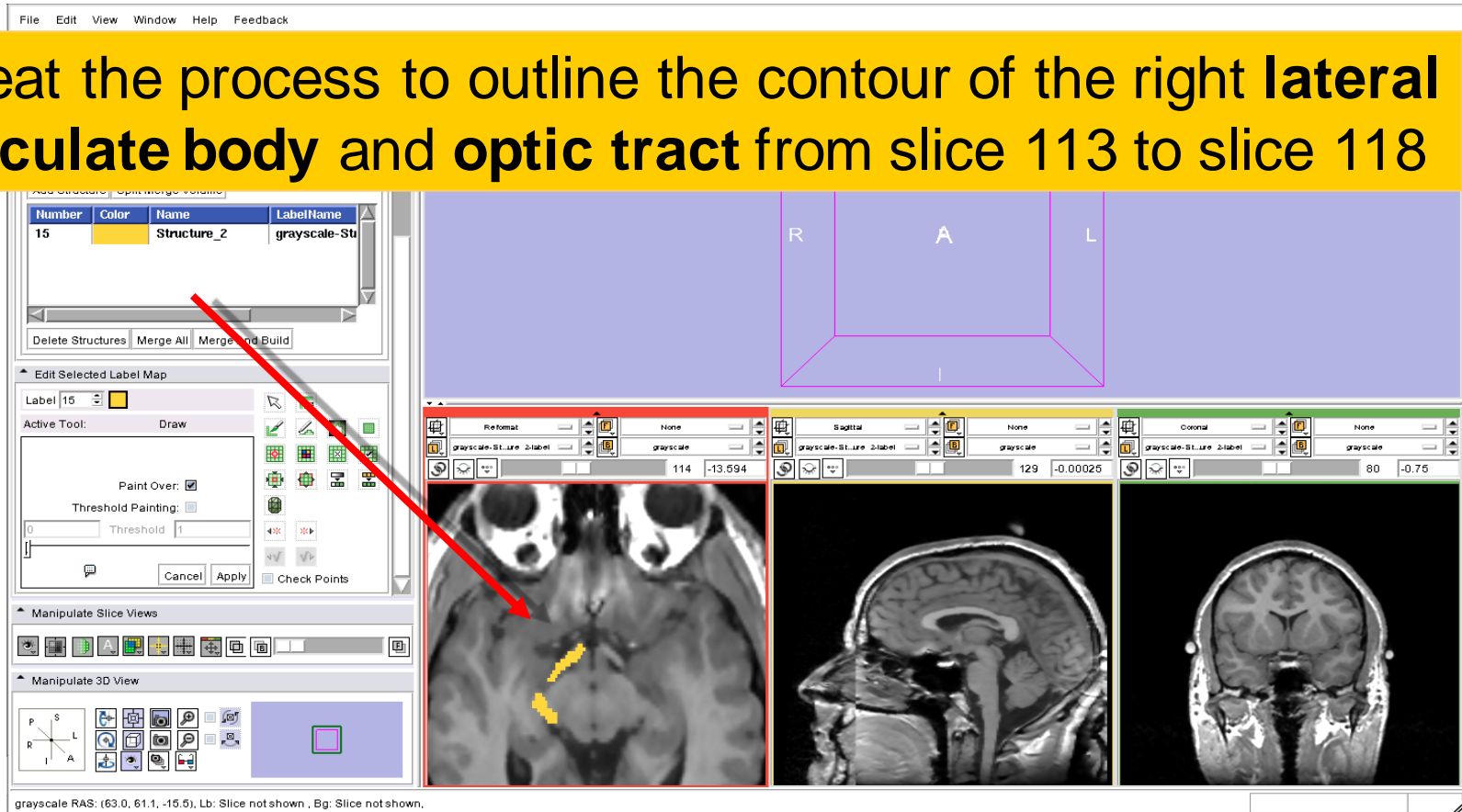
Zoom in using the right mouse button, and use the drawing tool to outline the contour of the right lateral geniculate body and optic tract in the axial view.





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





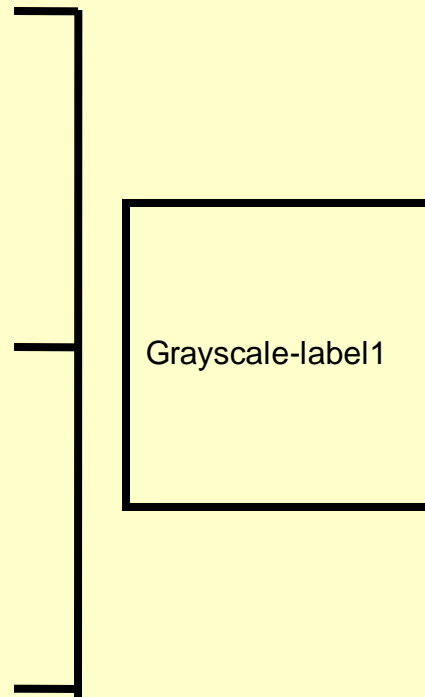
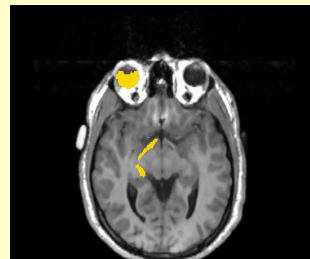
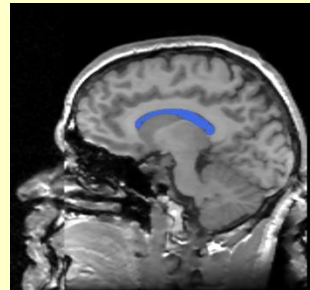
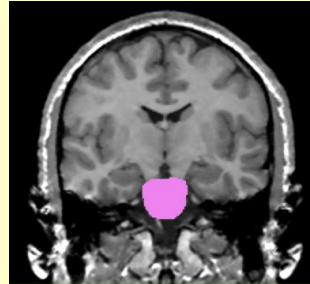
Merge And Build

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



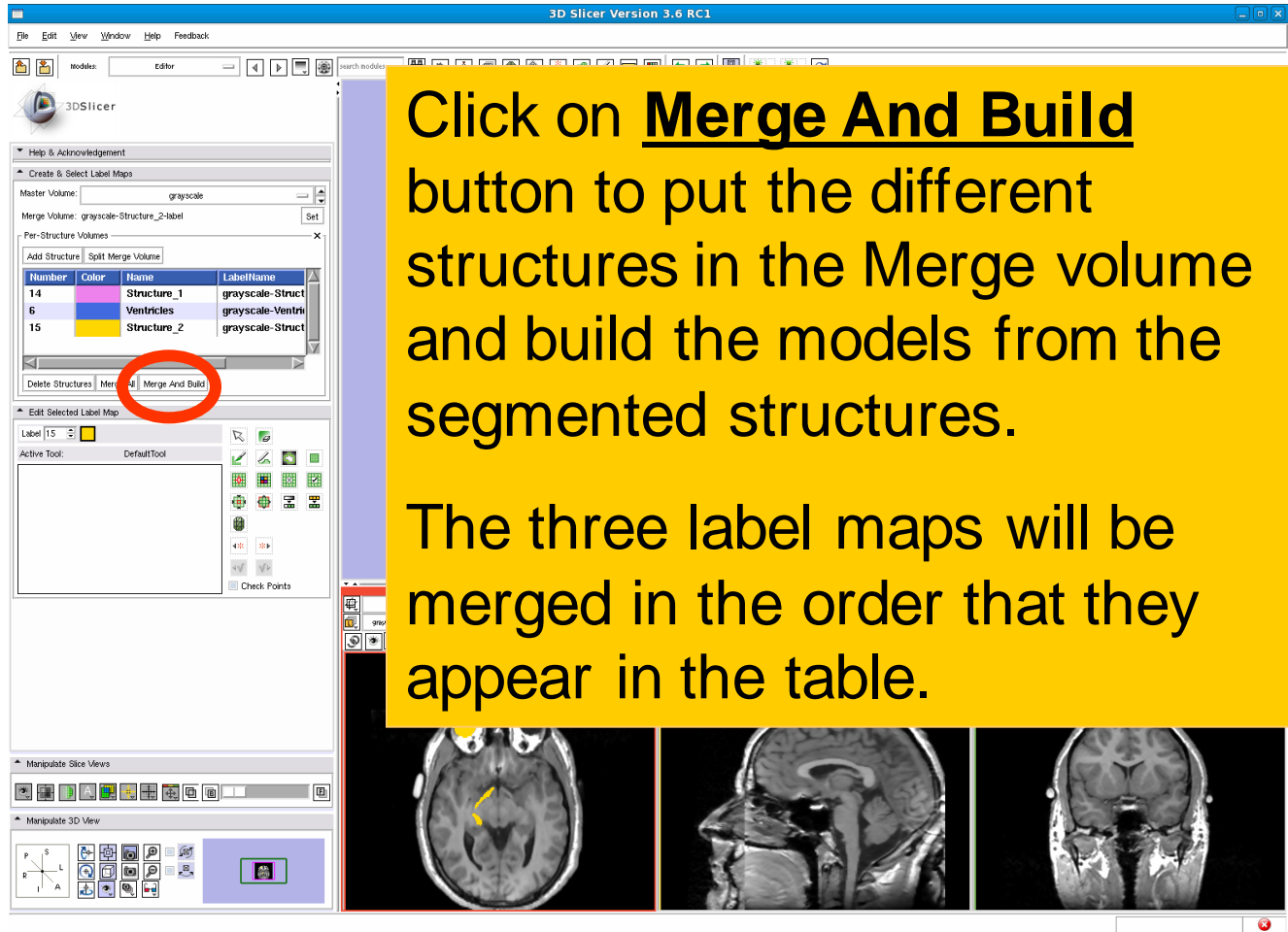
Merging label maps



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



Merge And Build



3D Slicer Version 3.6 RC1

File Edit View Window Help Feedback

modules: Editor

3DSlicer

Help & Acknowledgement

Create & Select Label Maps

Master Volume: grayscale

Merge Volume: grayscale-Structure_2-label Set

Per-Structure Volumes

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

Delete Structures Merge **Merge And Build**

Edit Selected Label Map

Label 15

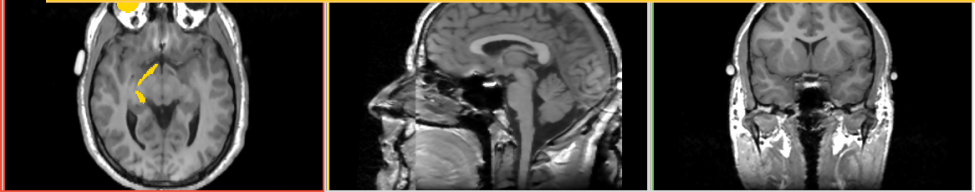
Active Tool: DefaultTool

Manipulate Slice Views

Manipulate 3D View

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

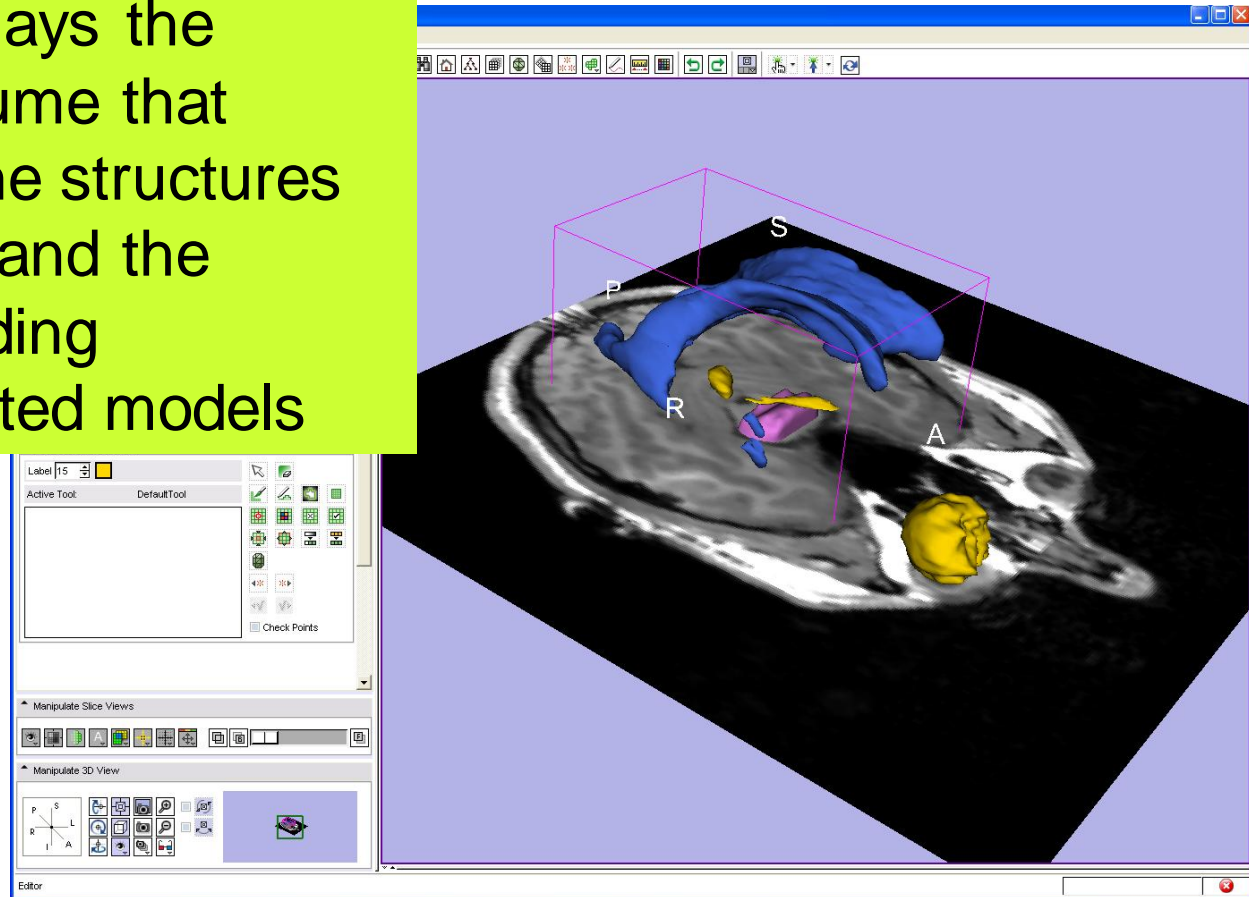
The three label maps will be merged in the order that they appear in the table.





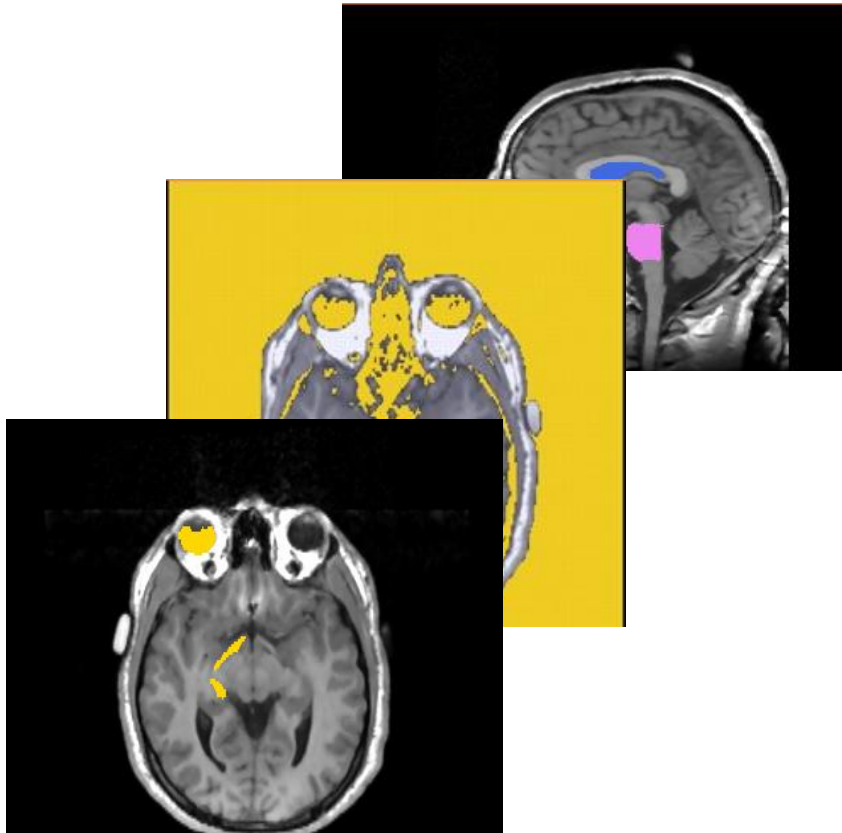
Merge And Build

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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