



NA-MIC

National Alliance for Medical Image Computing

<http://na-mic.org>

Interactive Editor tutorial

Sonia Pujol, Ph.D.

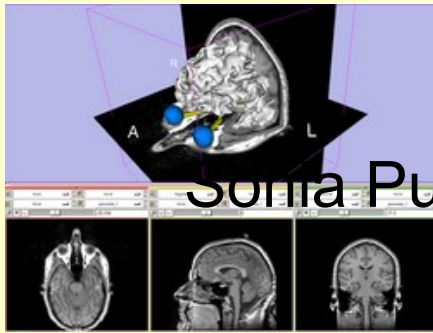
Surgical Planning Laboratory

Harvard Medical School



Pre-requisite

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



'Slicer3 Data Loading and Visualization'

Sonja 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>

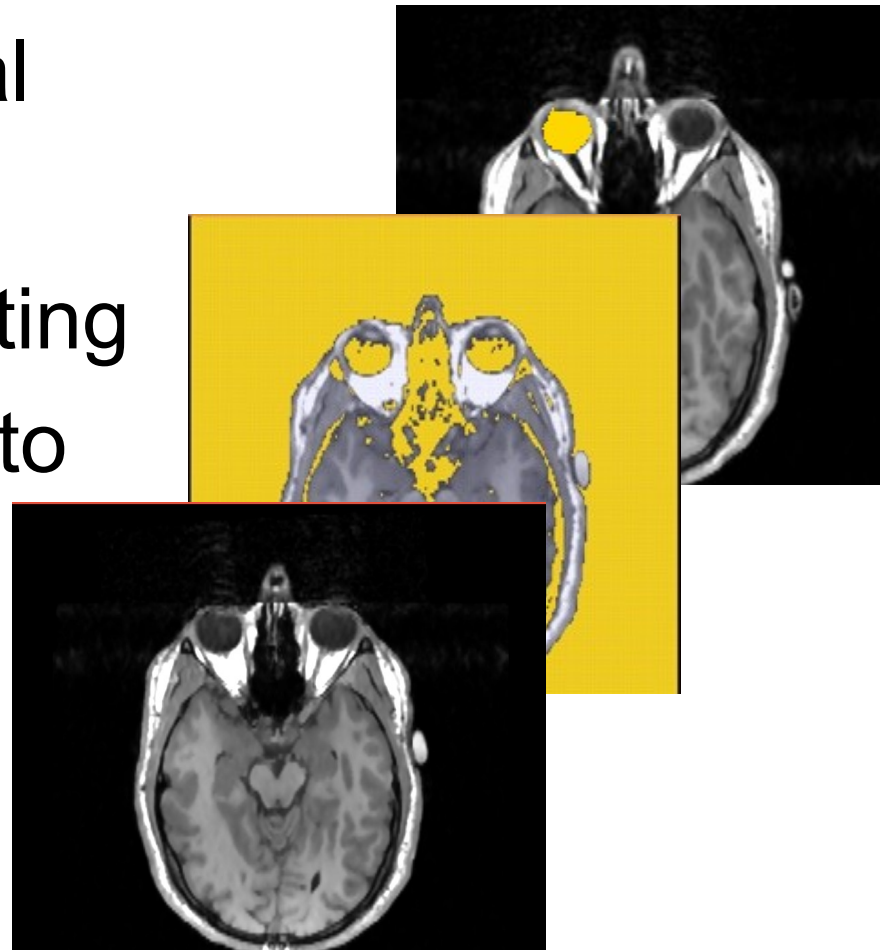
Disclaimer

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.





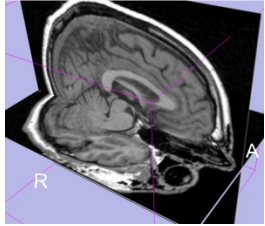
Label map



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



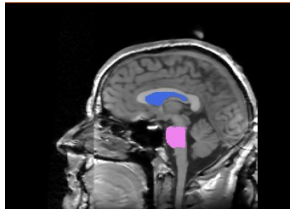
Overview



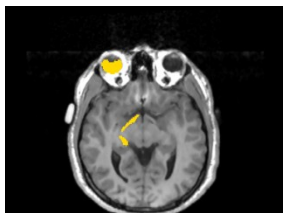
Part 1: Creating a single label map

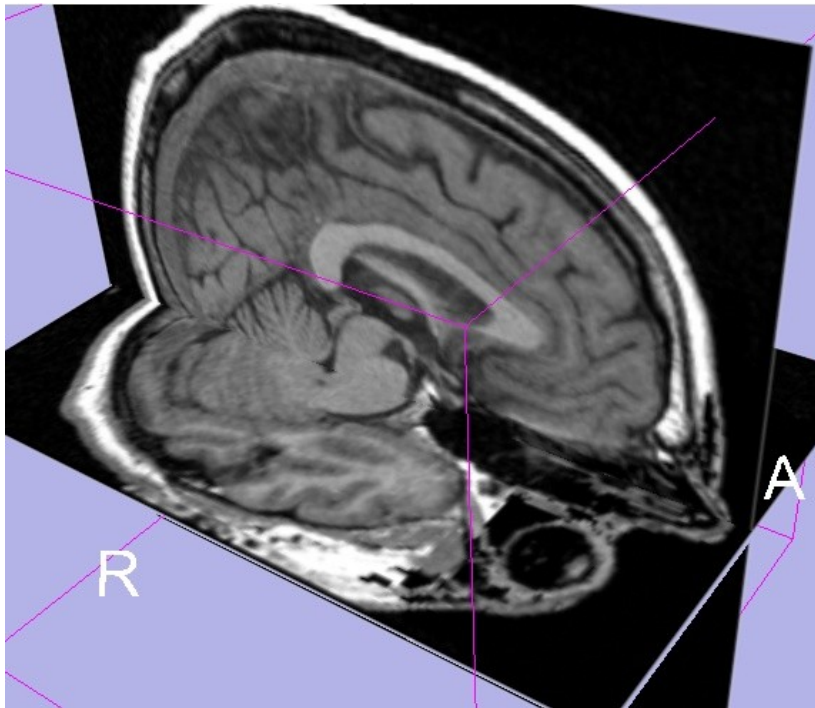


Part 2: Editing a single label map



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

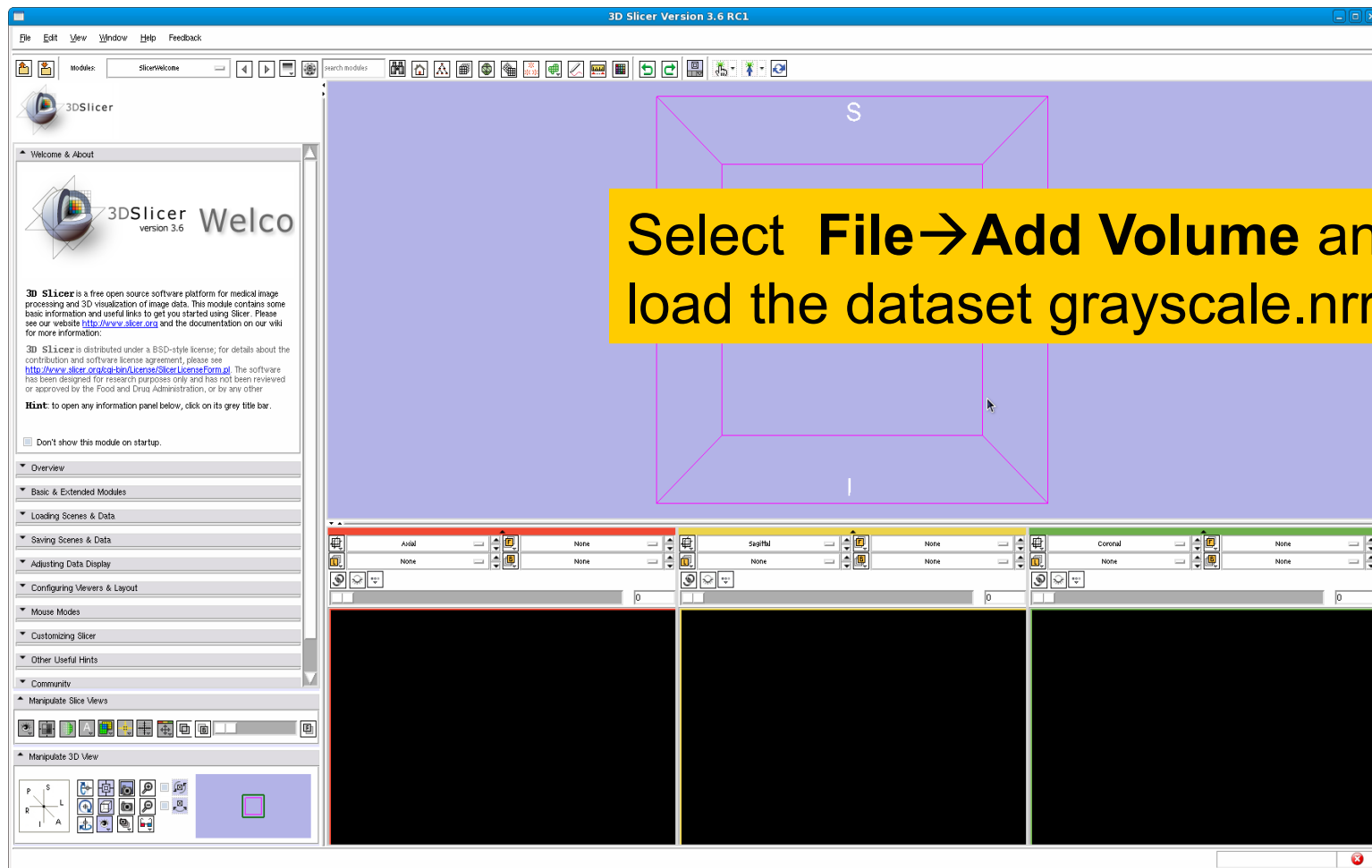




Part 1: Creating a single label map

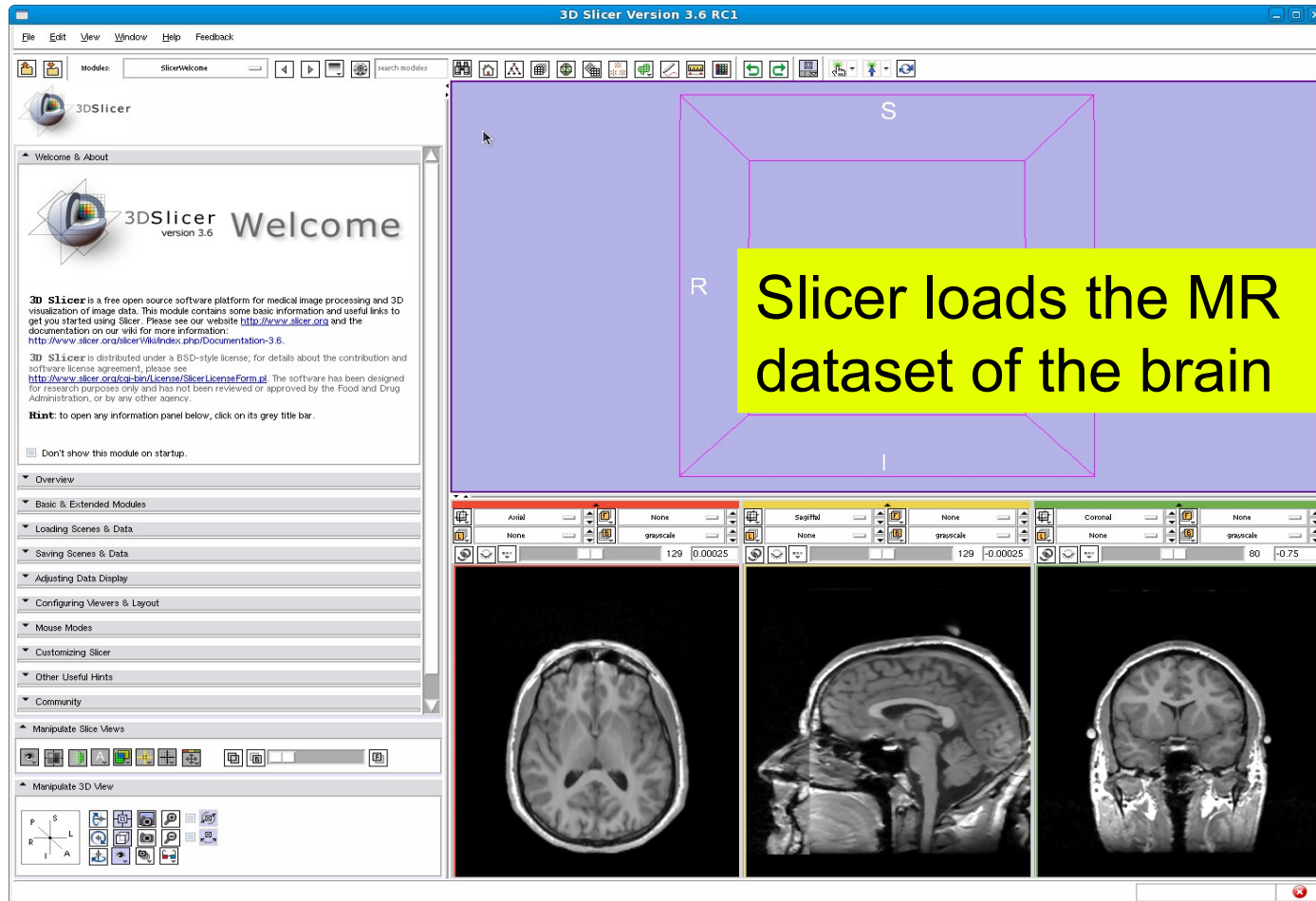


Data Loading



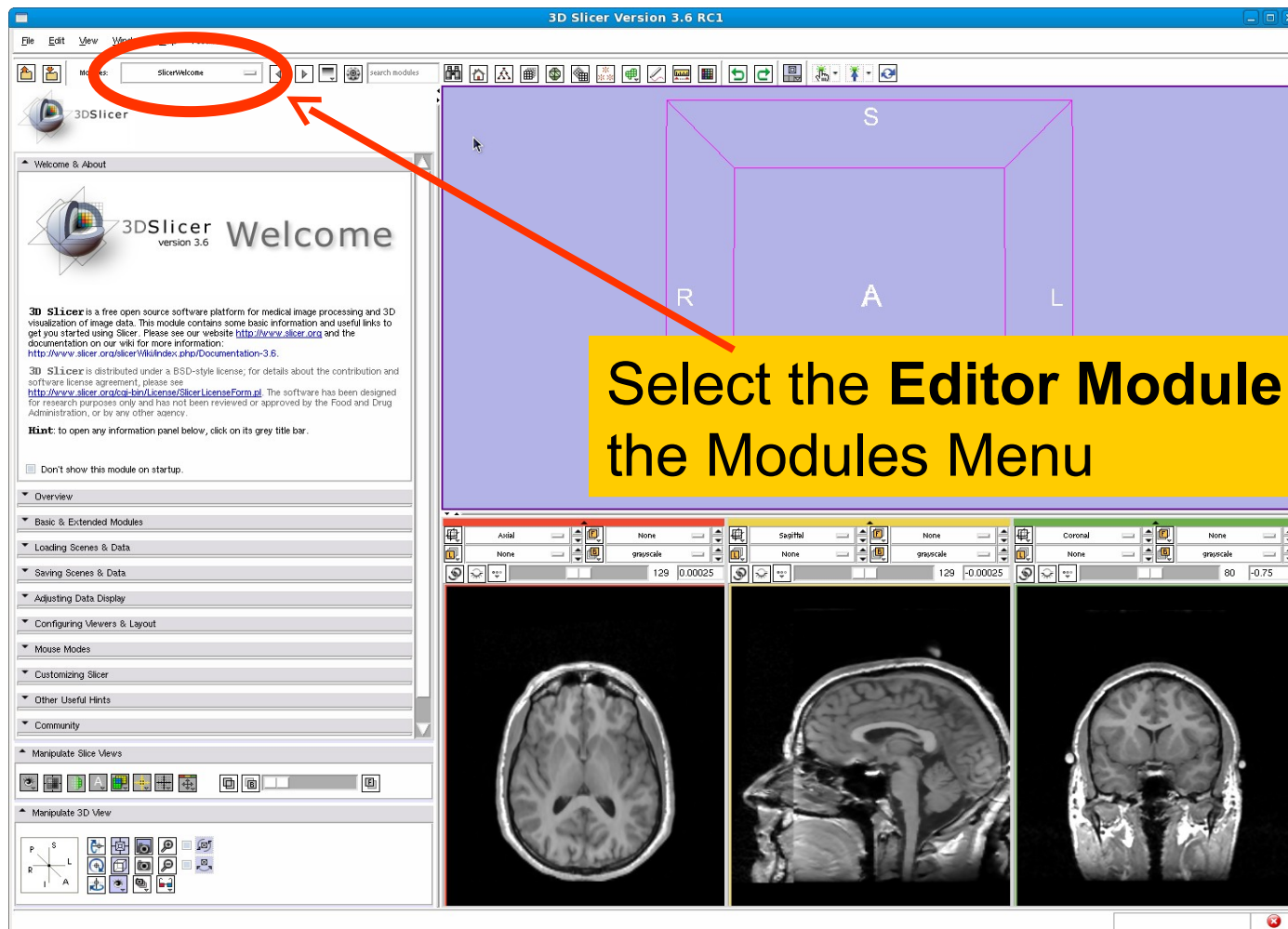


Data Loading



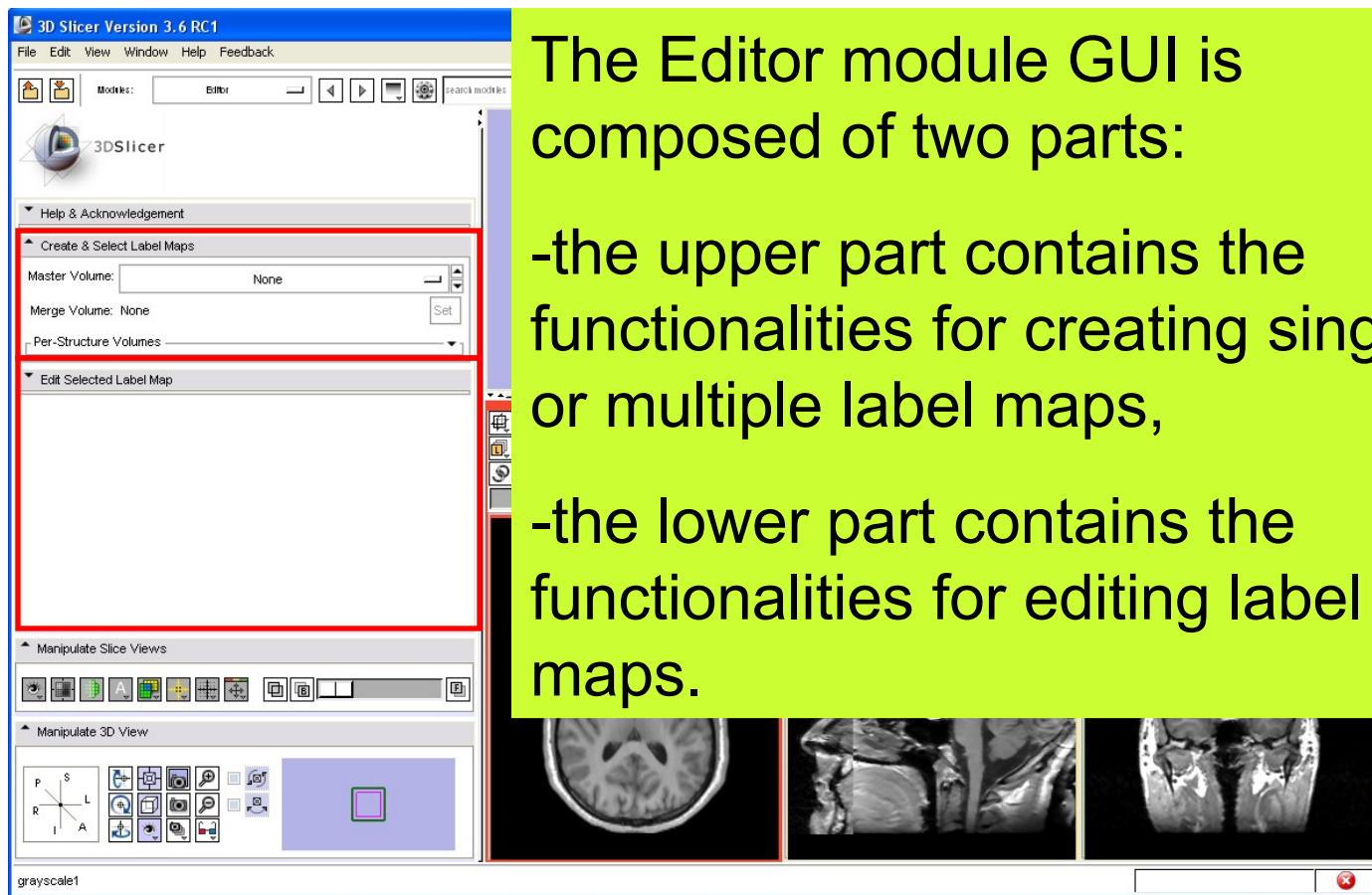


Data Loading





Editor Module

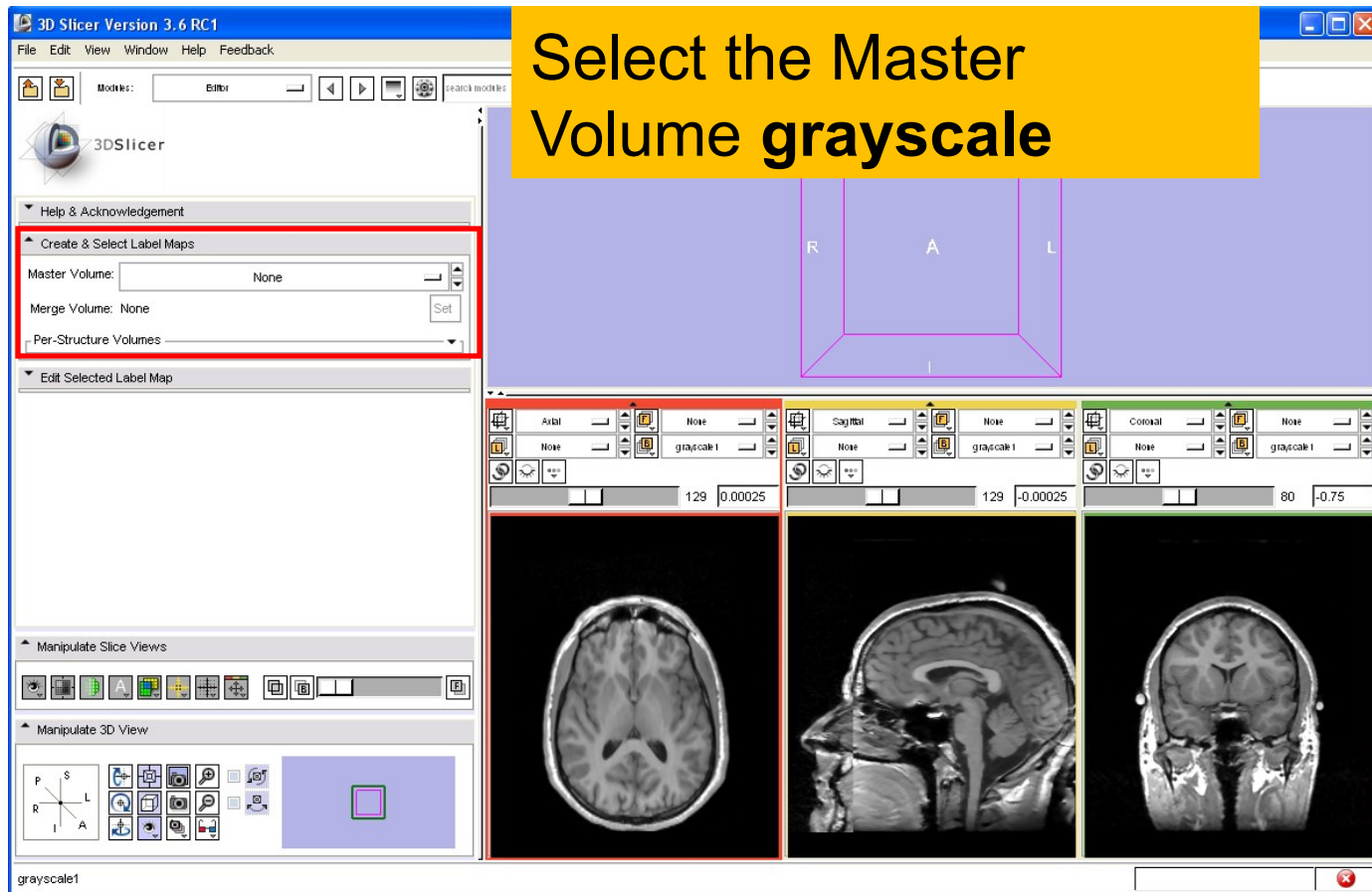


The Editor module GUI is composed of two parts:

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

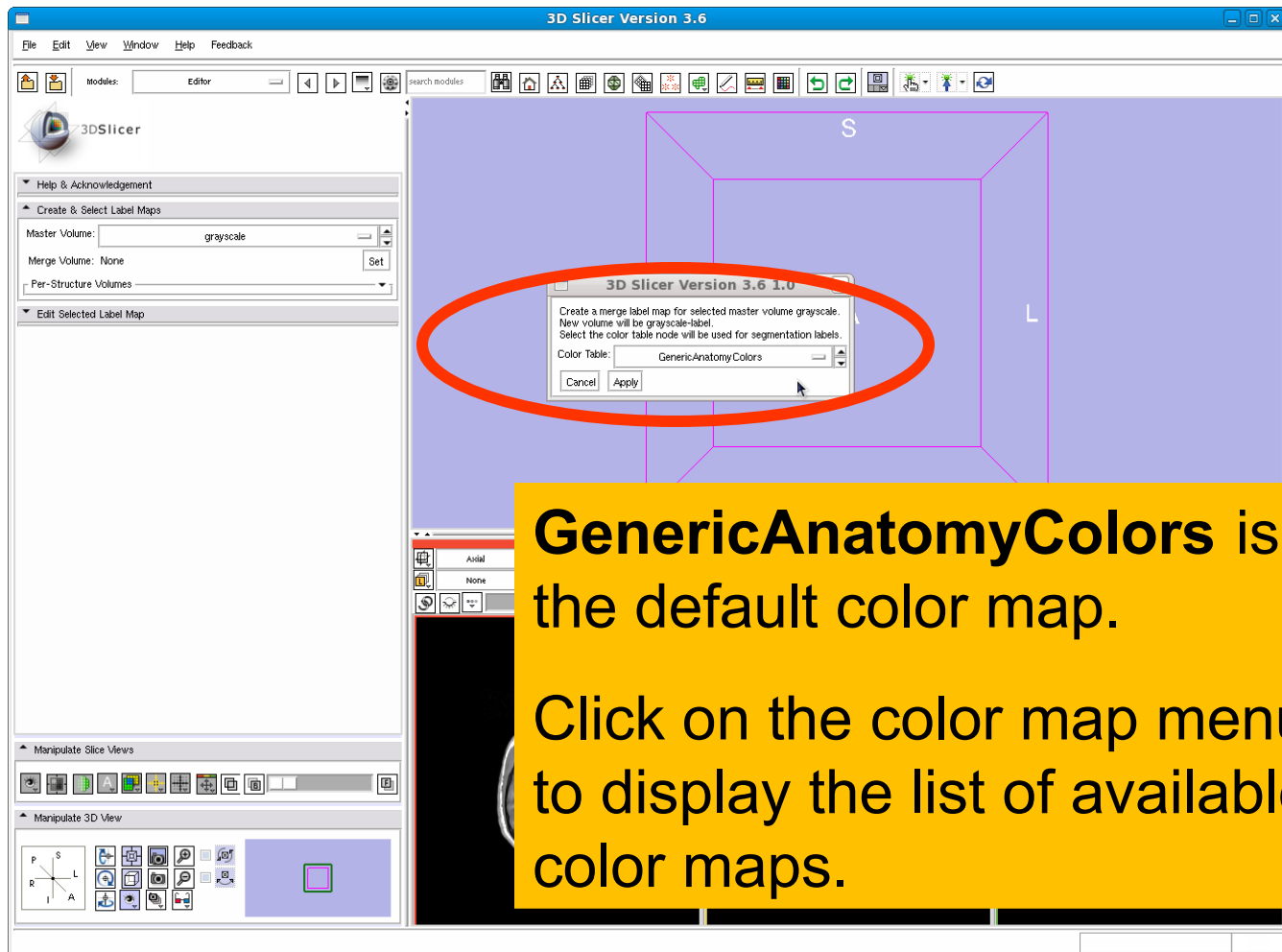


Label Map Creation



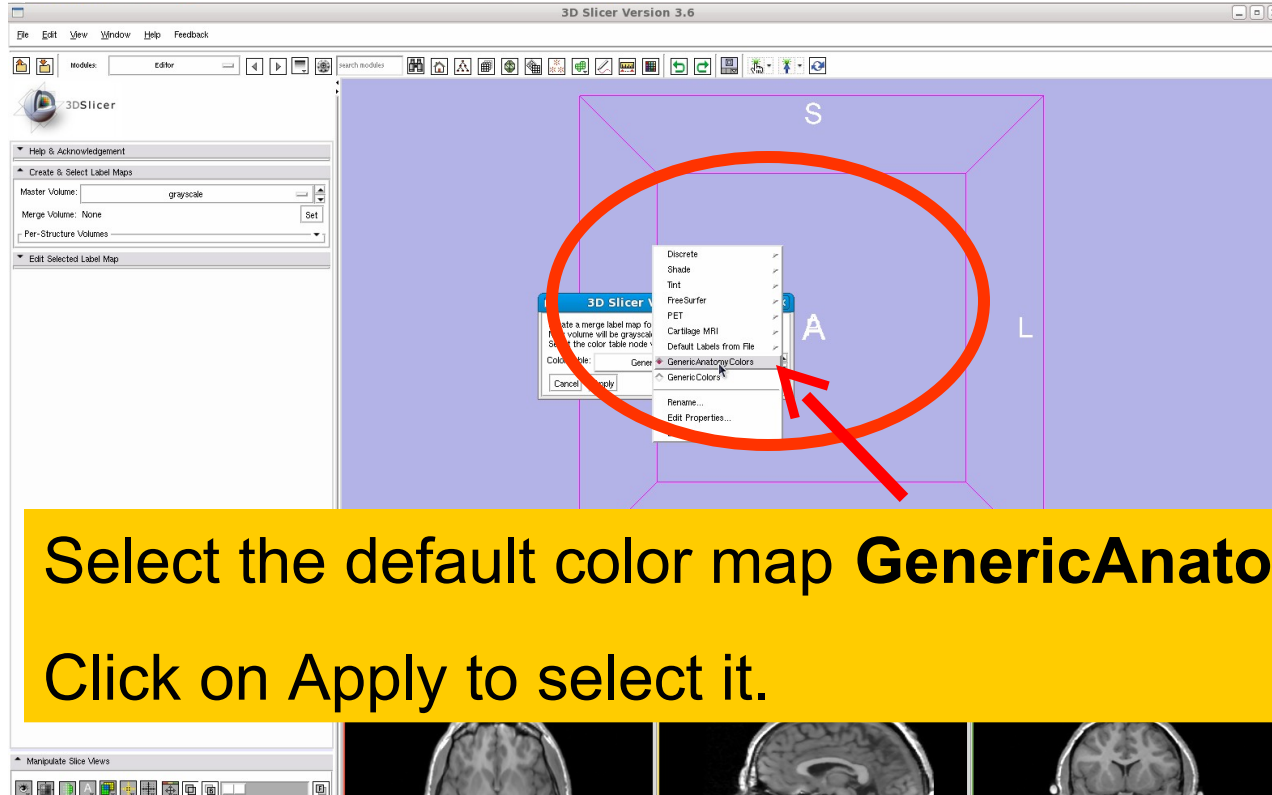


Label Map Creation





Label Map Creation



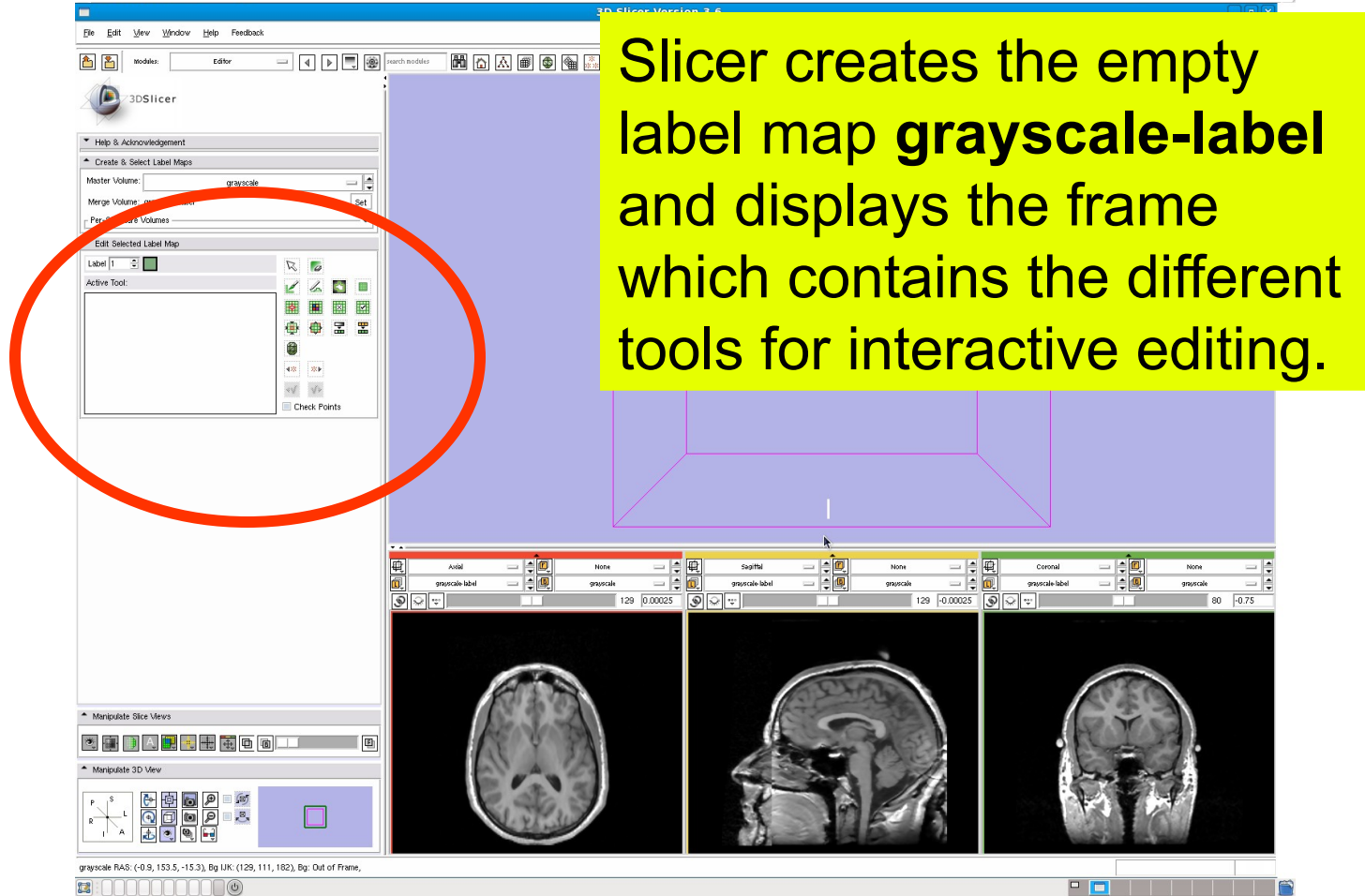
Select the default color map **GenericAnatomyColors**

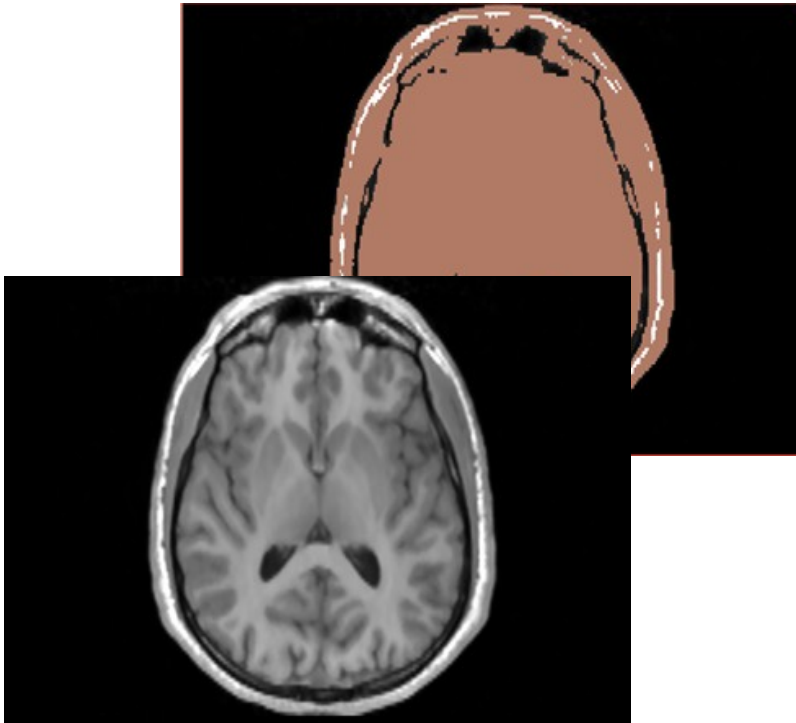
Click on Apply to select it.

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



Label Map Creation

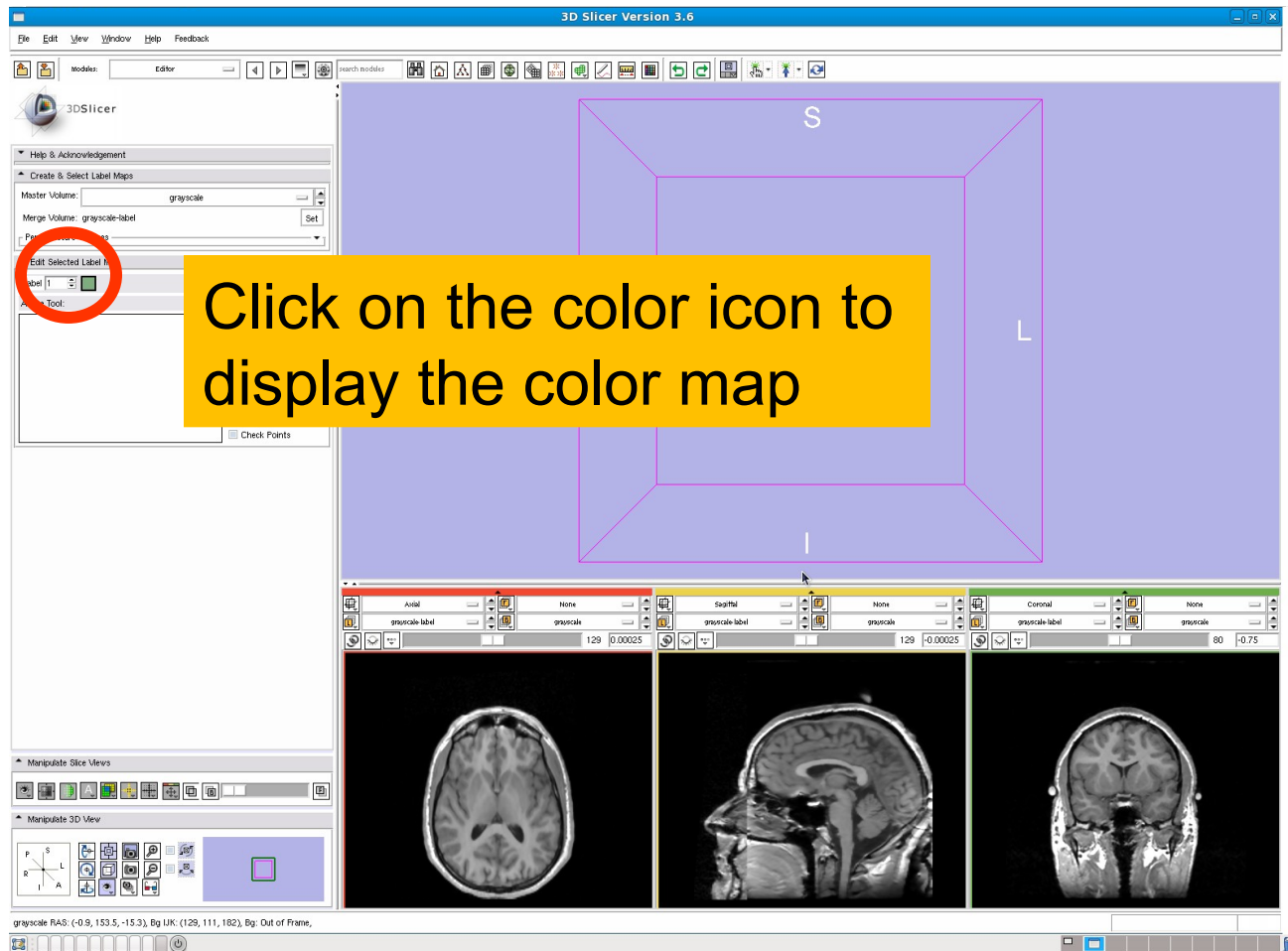




Part 2: Editing a single label map



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

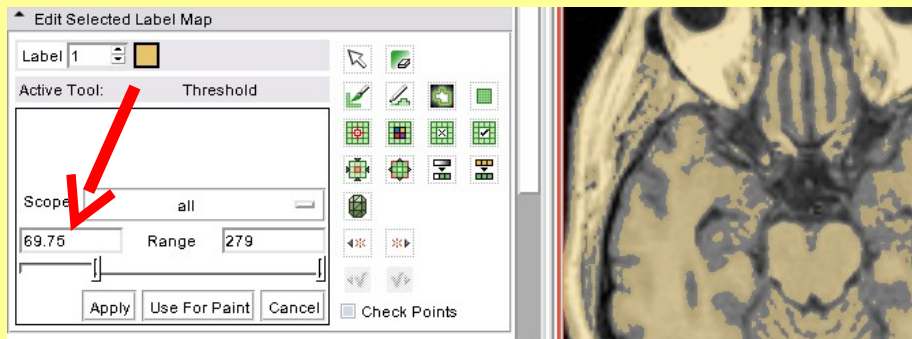
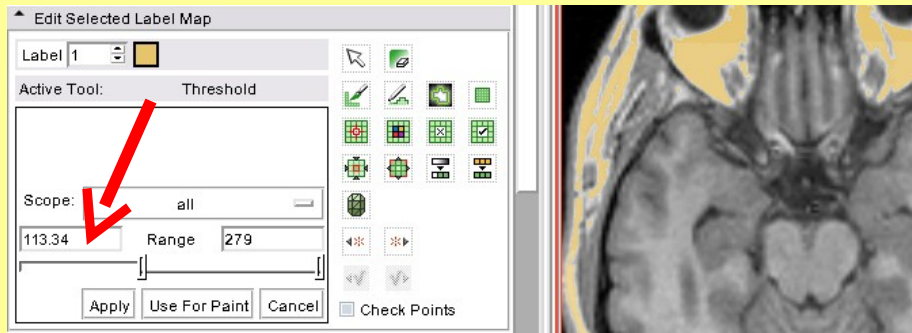
Browse through the list of 307 labels to explore the color map **GenericAnatomyColors**

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:

Check Points

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

Axial None Sagittal None Coronal None

grayscale-label grayscale grayscale-label grayscale grayscale-label grayscale

129 0.00025 129 0.00025 80 -0.75

grayscale RAS: (-0.9, -25.7, 135.8), Bg IJK: (129, 272, 62), Lb: Out of Frame, Bg: Out of Frame



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**

Axial None grayscale-label grayscale 129 | 0.00025

Sagittal None grayscale-label grayscale 129 | -0.00025

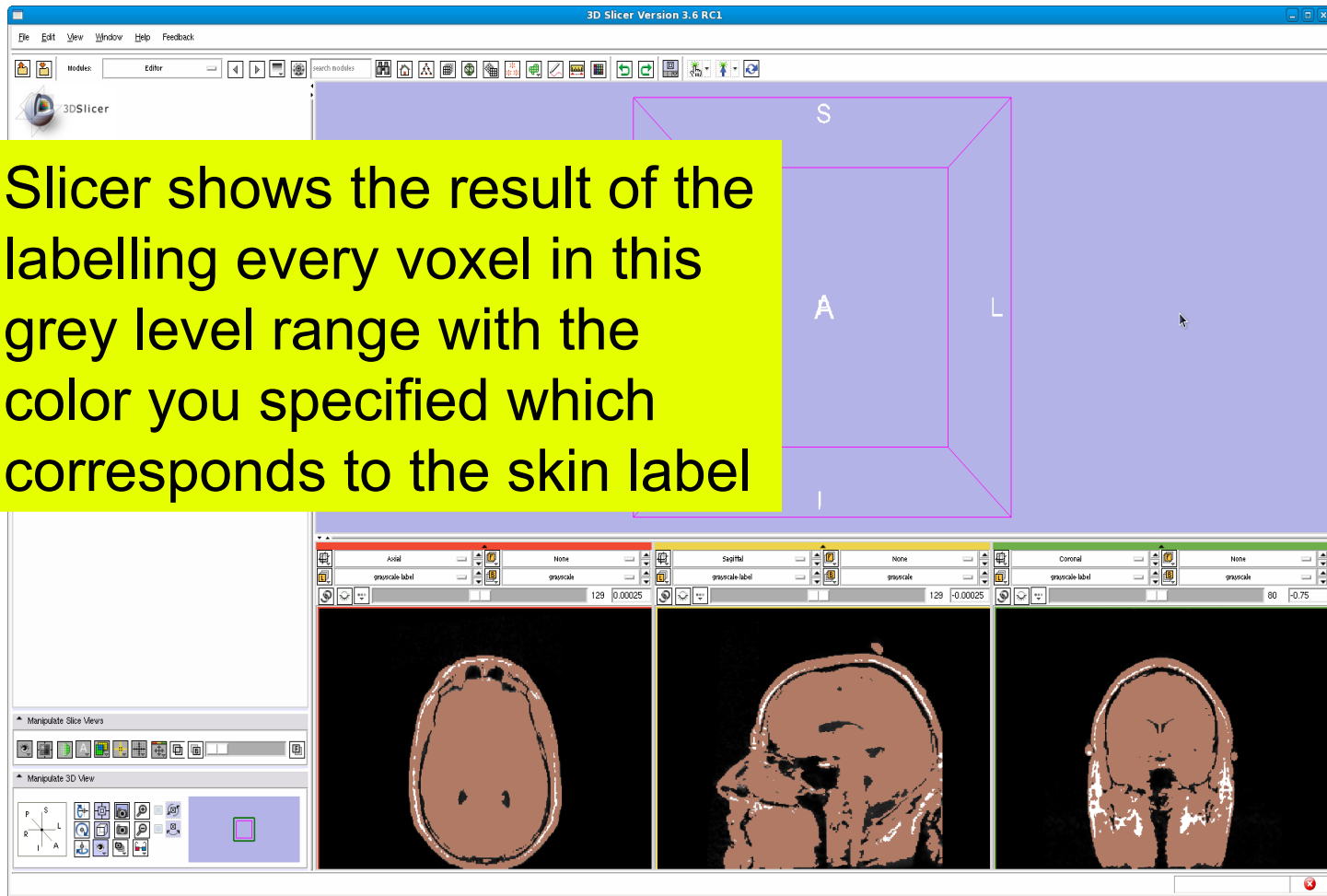
Coronal None grayscale-label grayscale 80 | -0.75

Feedback



Threshold Effect

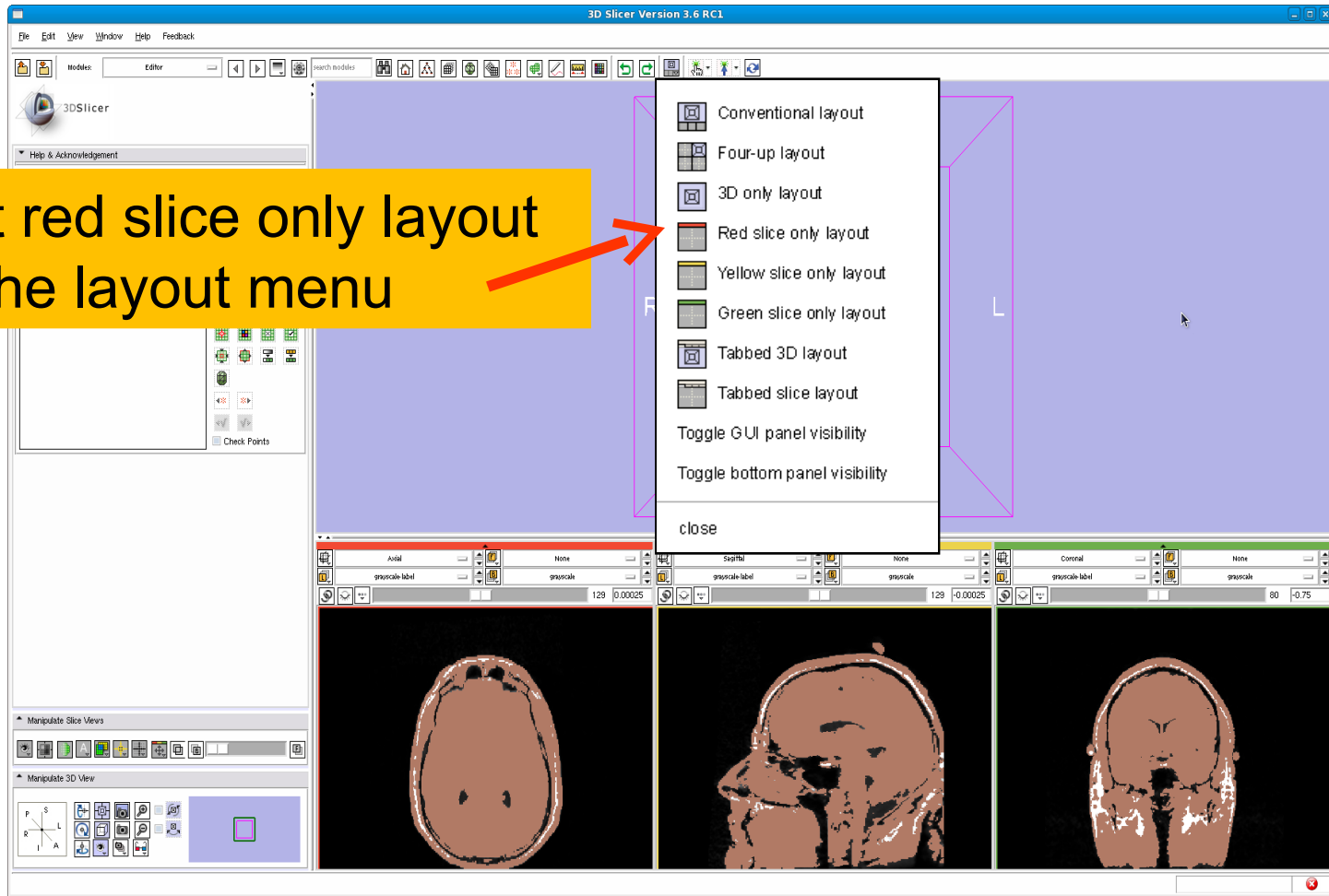
Slicer shows the result of the labelling every voxel in this grey level range with the color you specified which corresponds to the skin label





Threshold Effect

Select red slice only layout from the layout menu





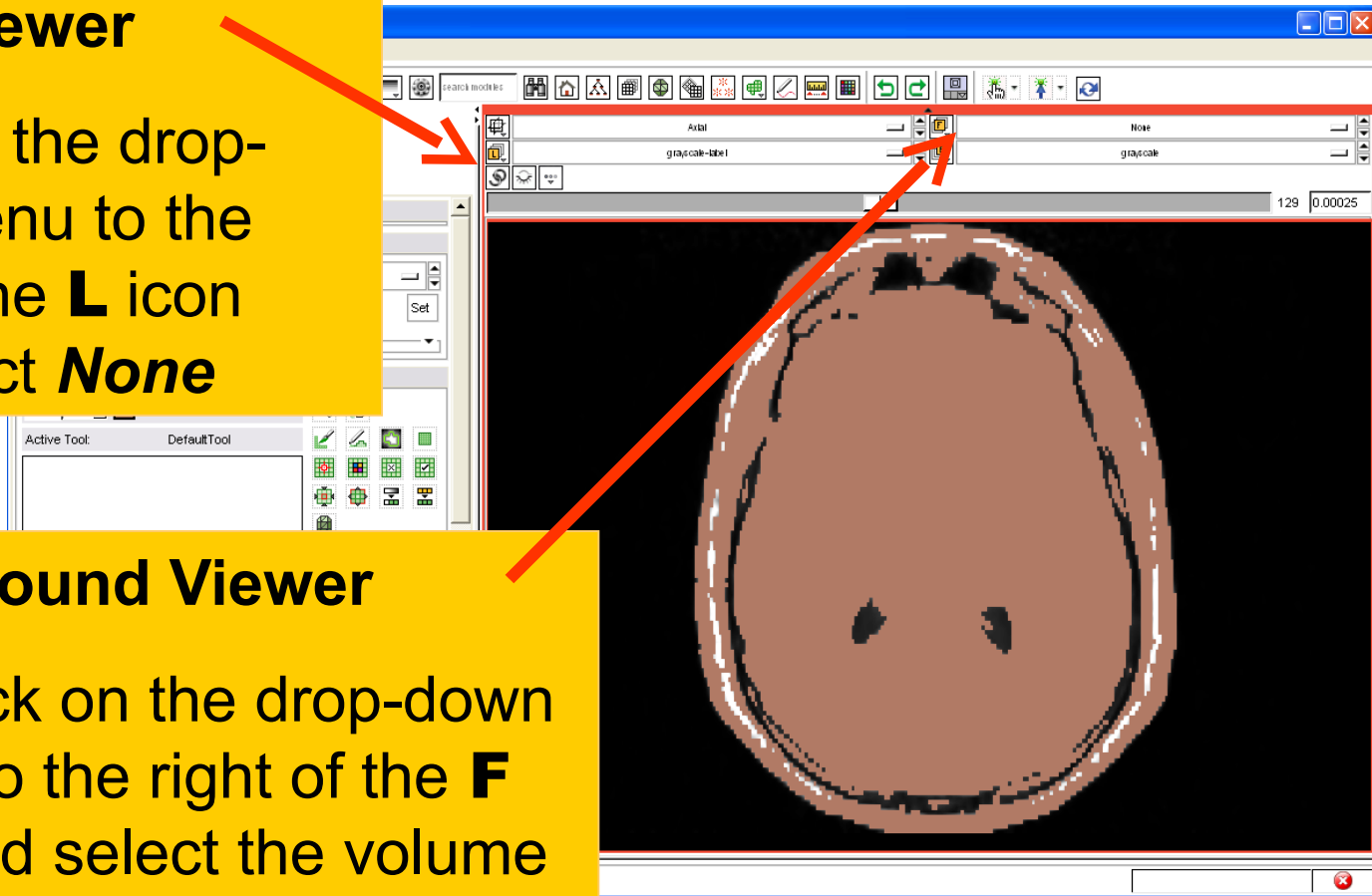
Threshold Effect

Label Viewer

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

Foreground Viewer

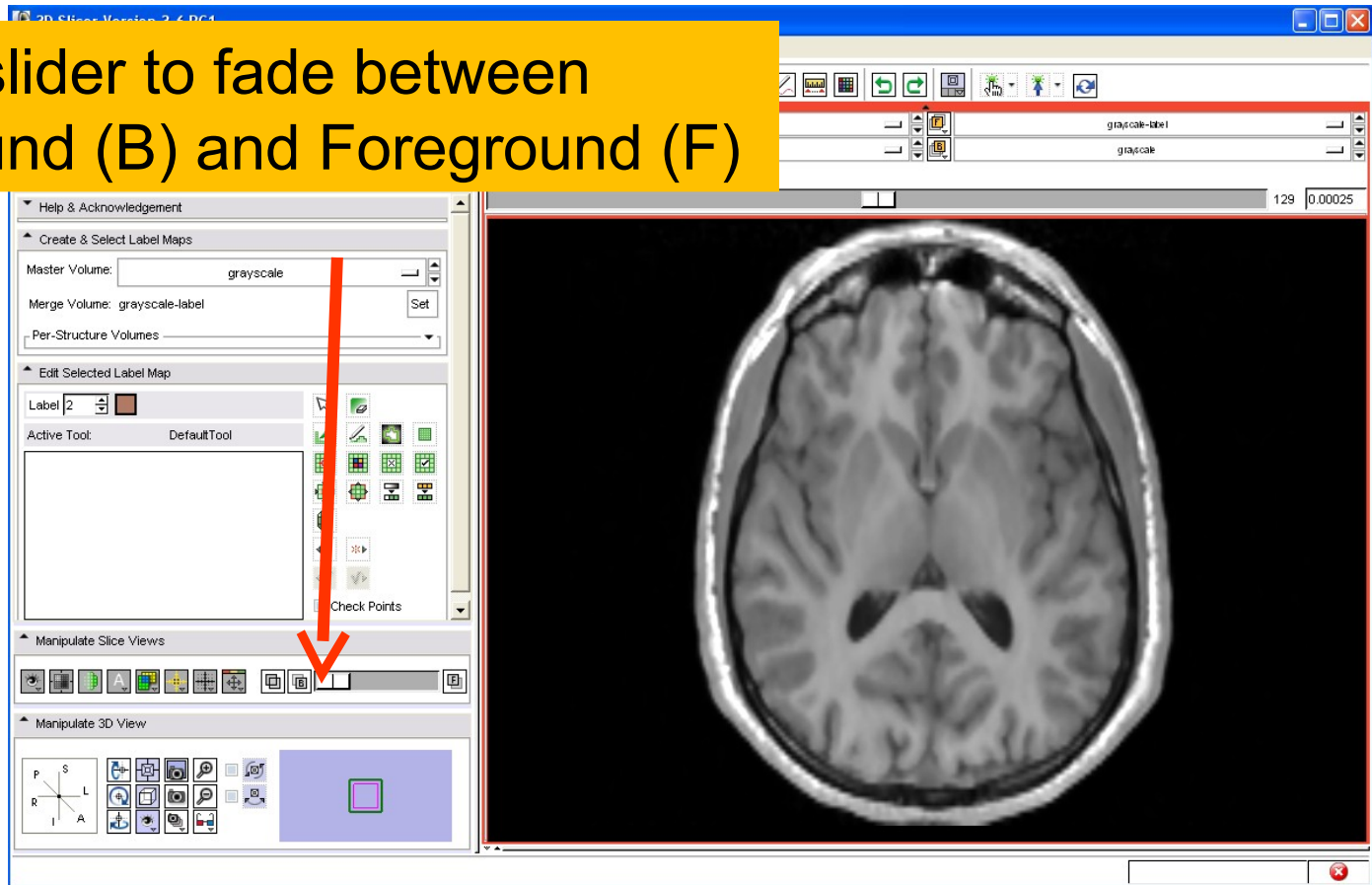
Left click on the drop-down menu to the right of the **F** icon and select the volume **grayscale-label**





Threshold Effect

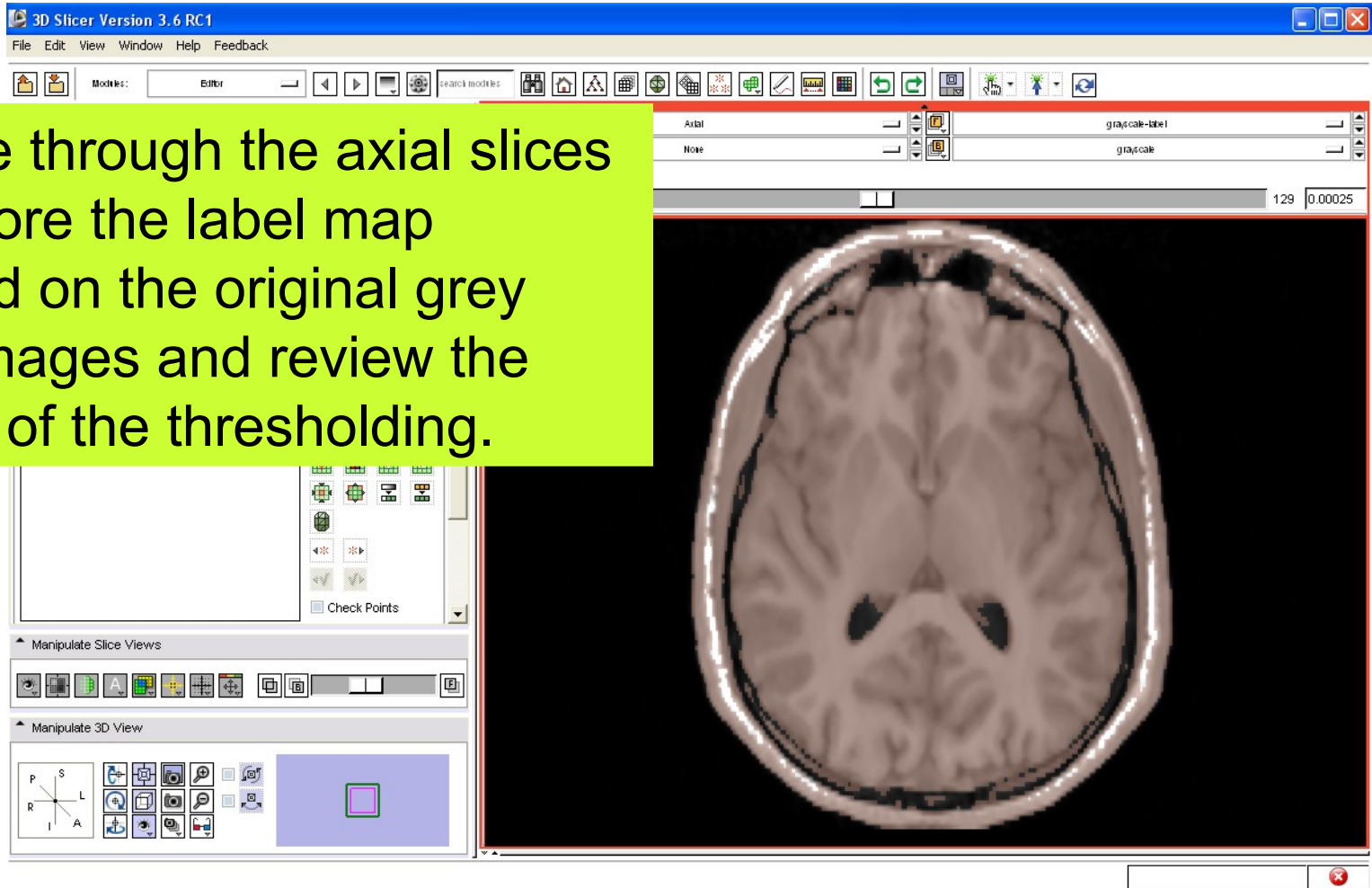
Use the slider to fade between Background (B) and Foreground (F)





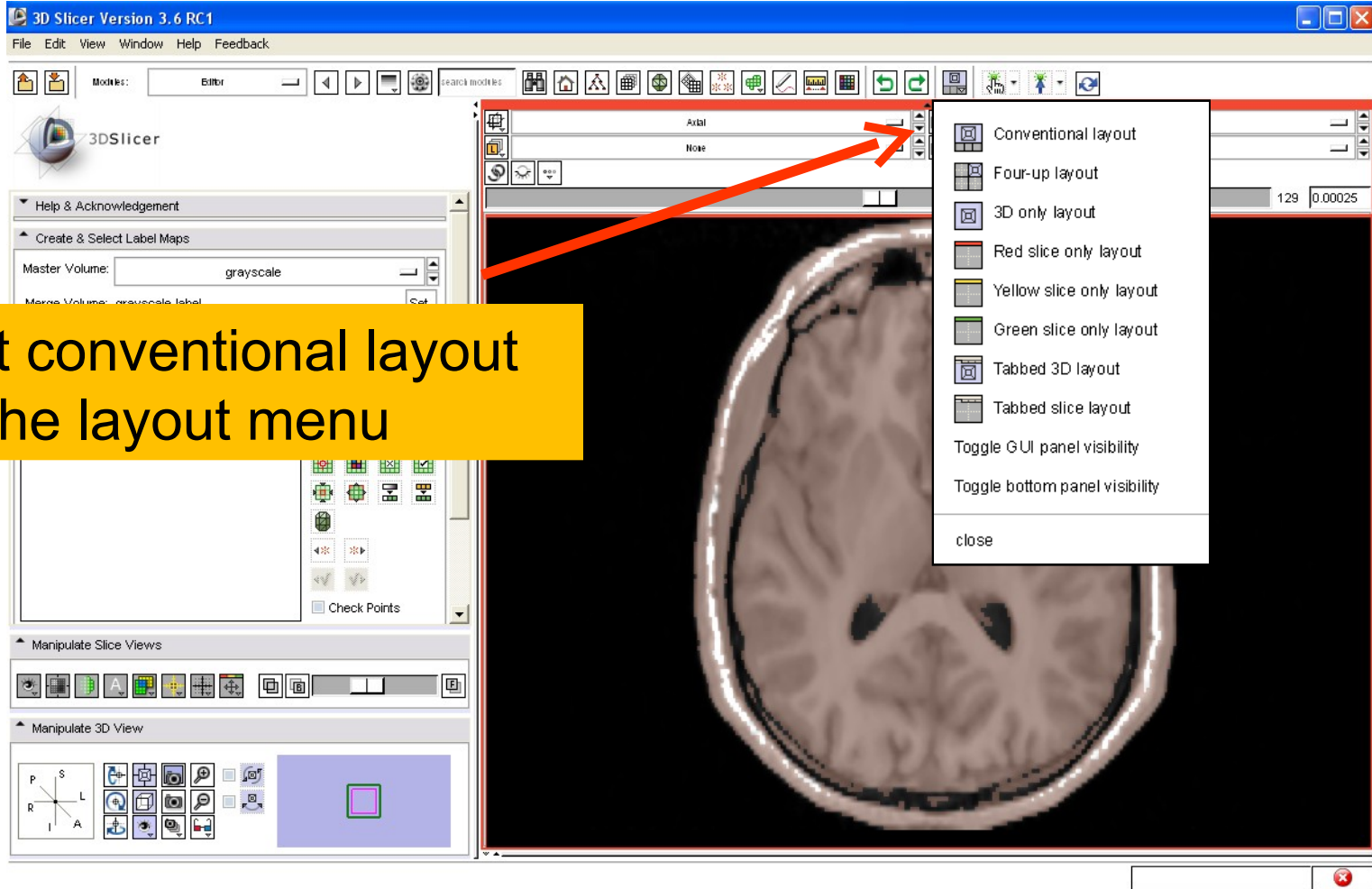
Exploring the result

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

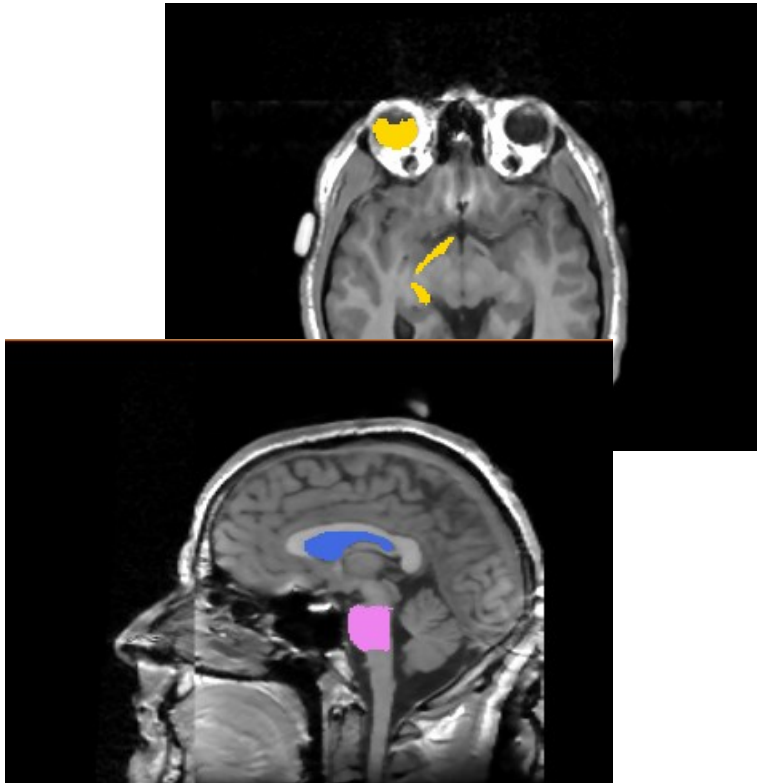




Threshold Effect



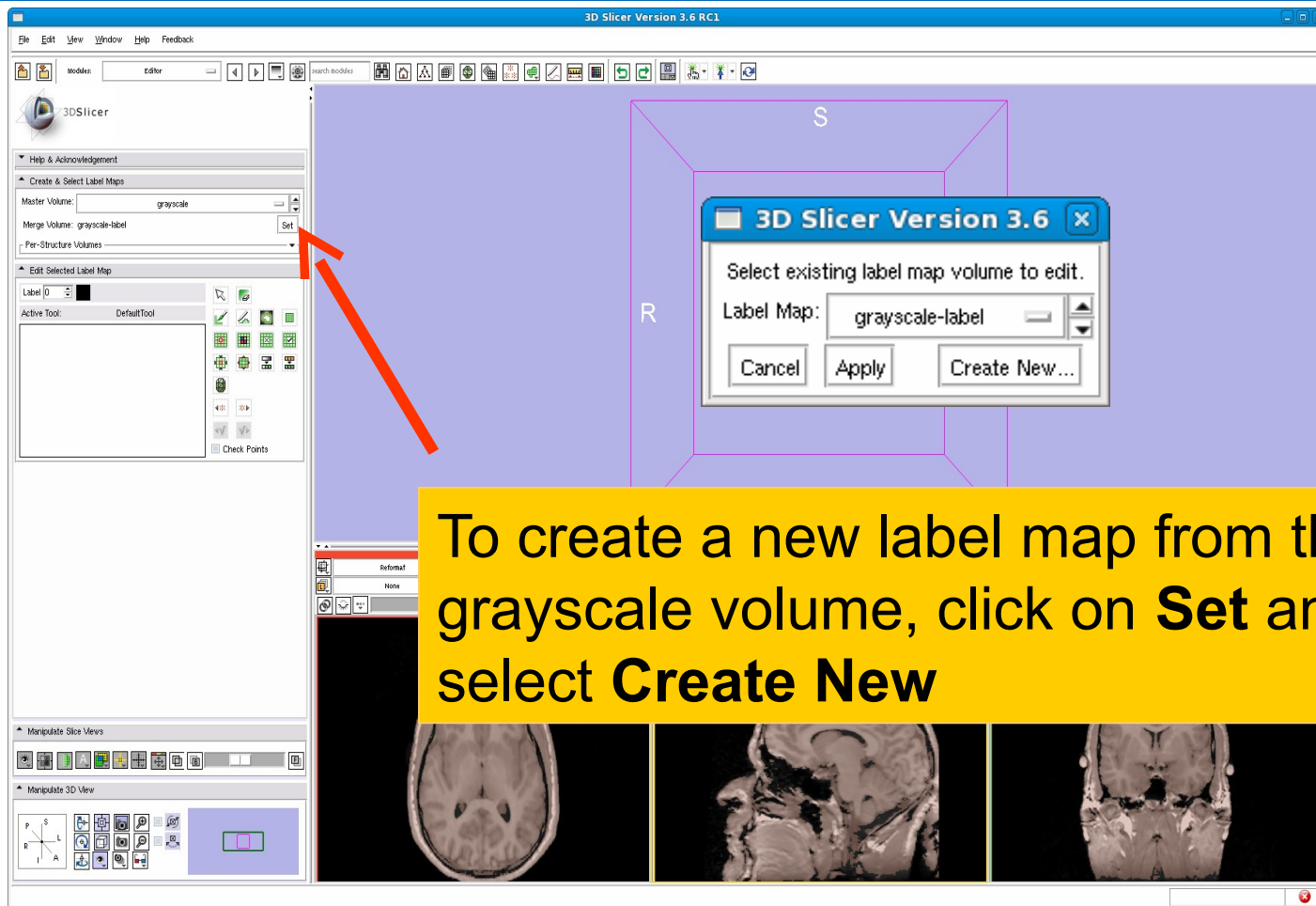
Select conventional layout
from the layout menu



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



Creating a map with multiple labels

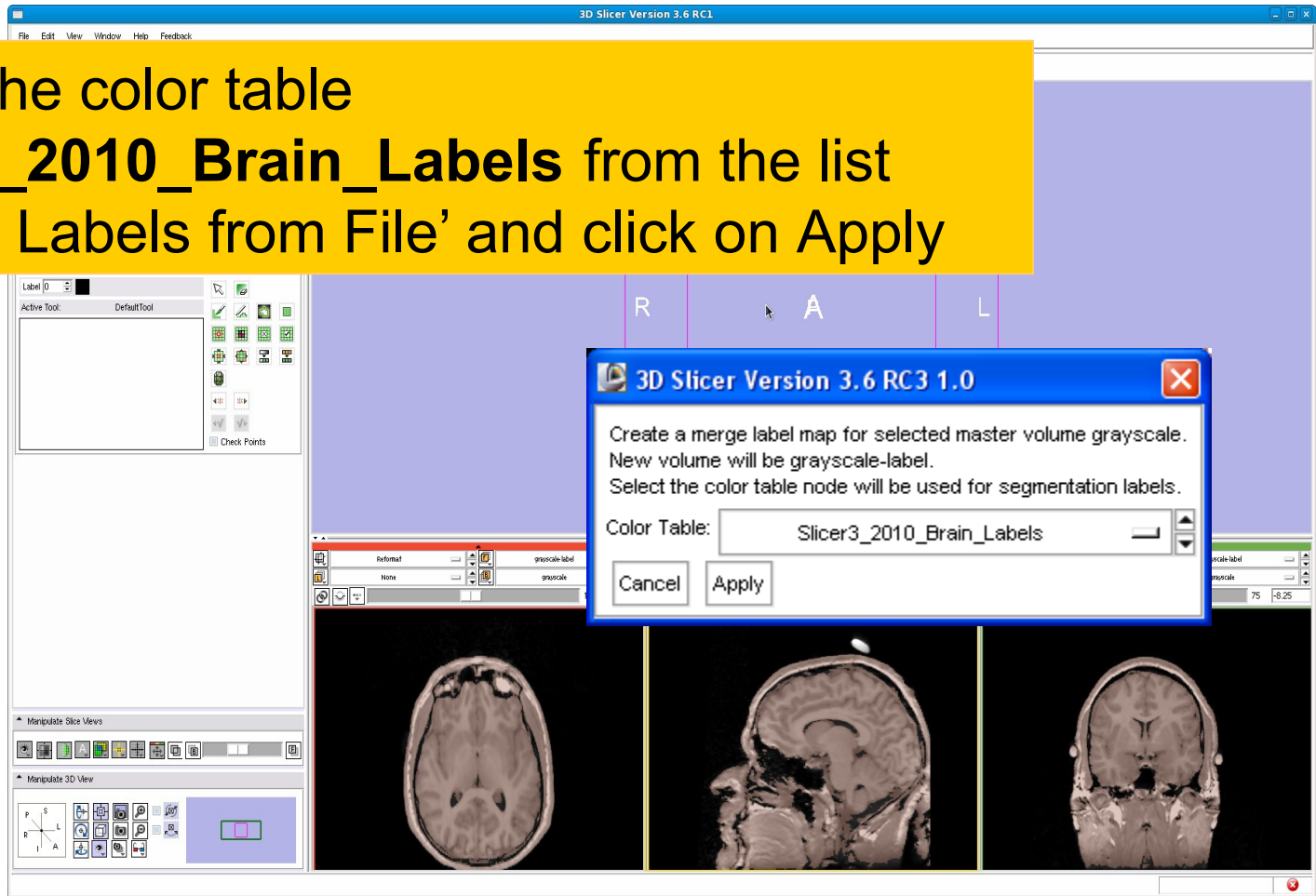




Creating a map with multiple labels

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

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 | Pink | Structure_1 |
| 15 | Yellow | Structure_2 |



Drawing

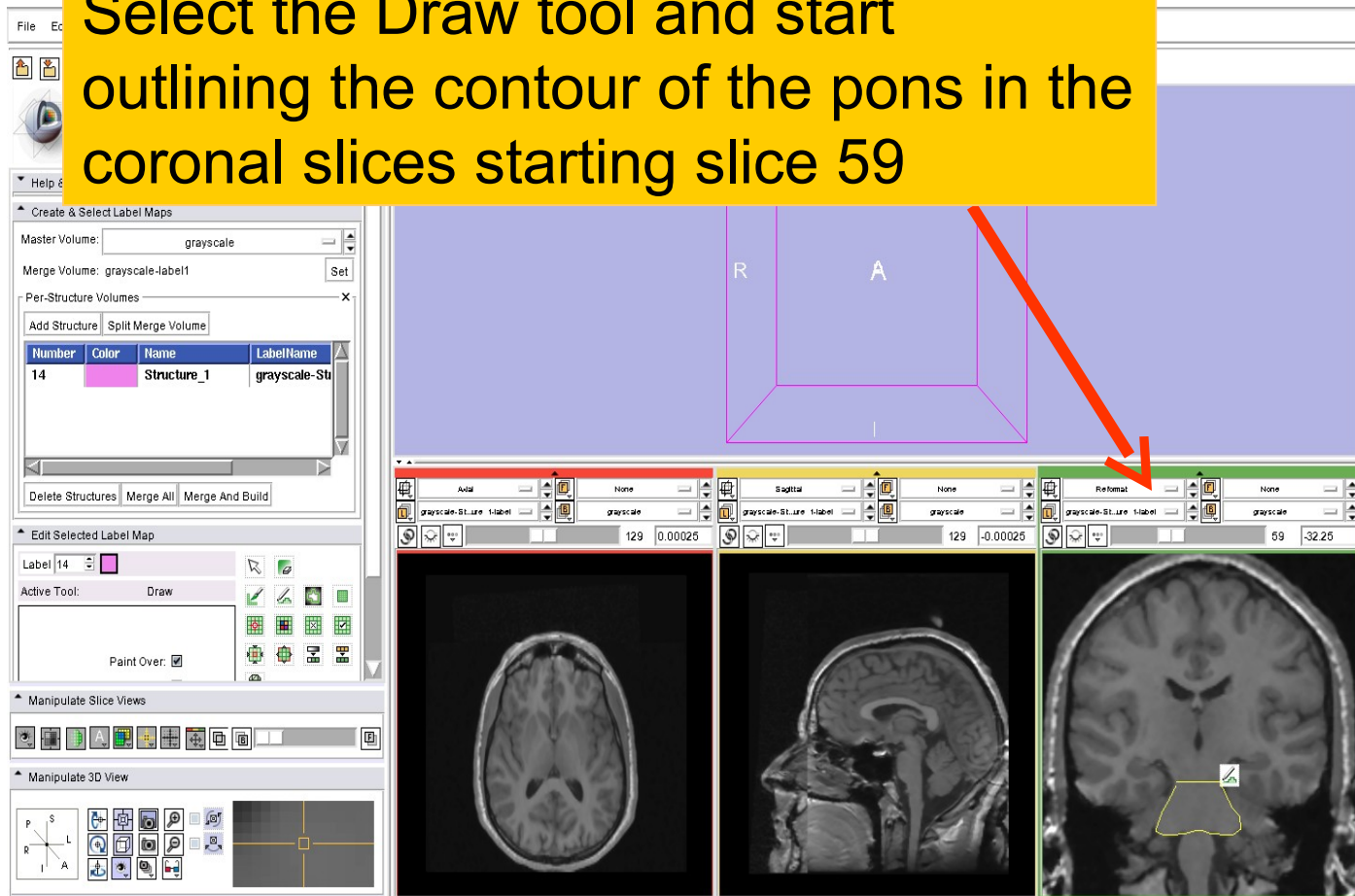


Description: The draw tool is an intuitive tool that can be used to manually outline structures in the grey level images.



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

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

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



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 | | 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'

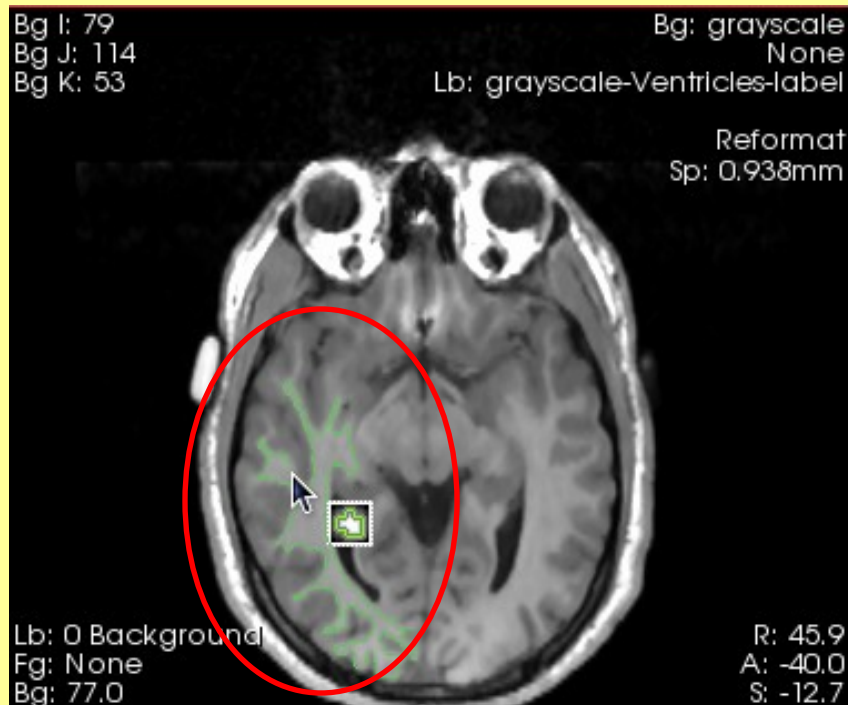
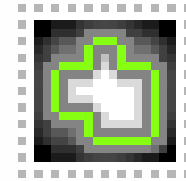
| Number | Color | Name | LabelName |
|--------|-------|-------------|---------------|
| 14 | | Structure_1 | grayscale-Stu |

| 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

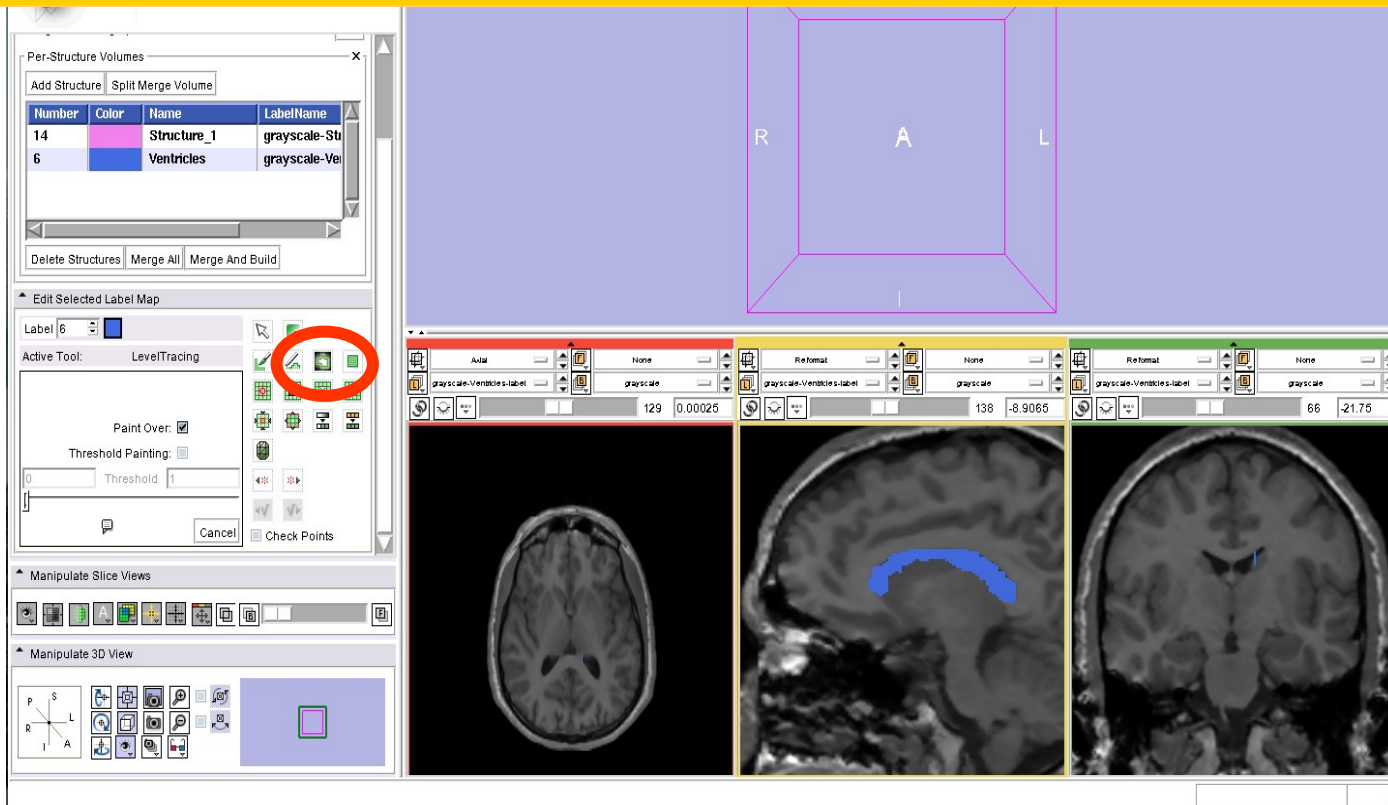


Description: By moving the mouse in the grey level images, you'll define in the label map volume an outline where the pixels all have the same value as the current background pixel.




Level Tracing

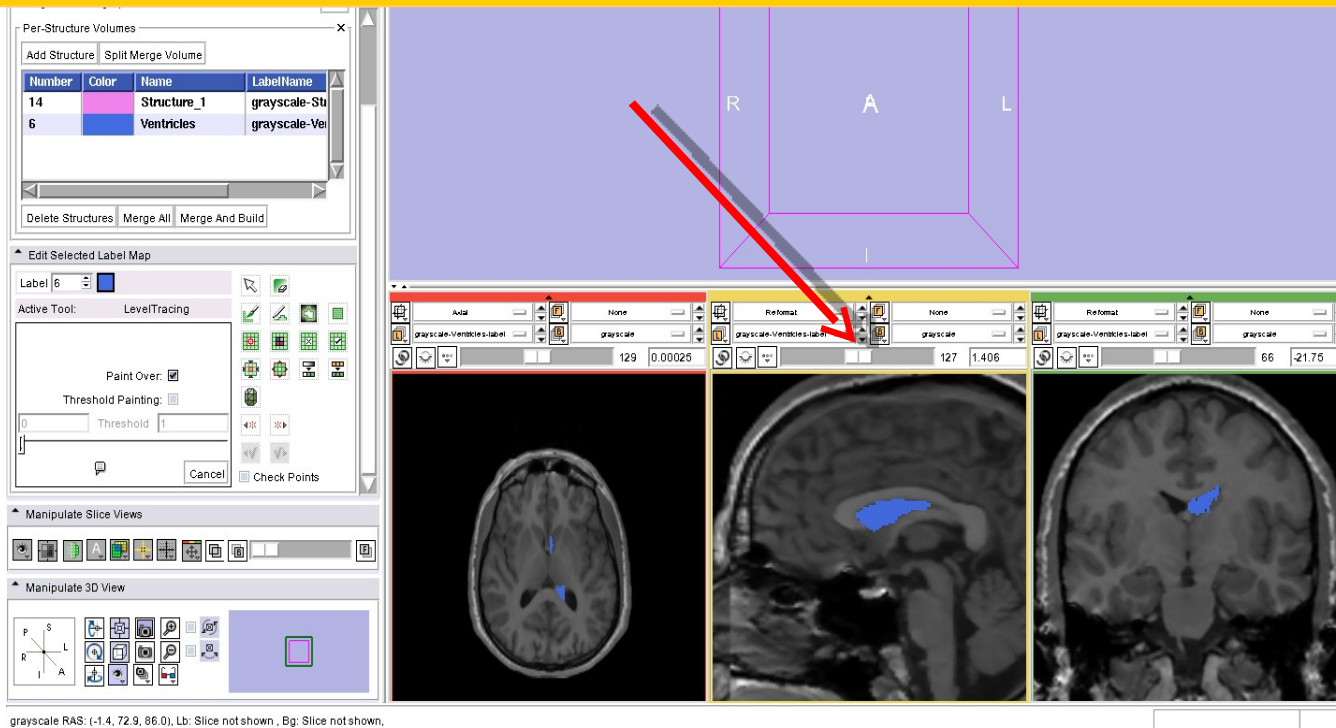
Use the **Level Tracing tool**  to trace the outline of the left lateral ventricle on slice 138





Level Tracing

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



Per-Structure Volumes

| Number | Color | Name | LabelName |
|--------|-------|-------------|---------------|
| 14 | | Structure_1 | grayscale-St |
| 6 | | Ventricles | grayscale-Ver |

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 two panels: 'Per-Structure Volumes' and 'Edit Selected Label Map'. The 'Per-Structure Volumes' panel contains a table with the following data:

| Number | Color | Name | LabelName |
|--------|--------|-------------|---------------|
| 14 | [Pink] | Structure_1 | grayscale-Stu |
| 6 | [Blue] | Ventricles | grayscale-Ven |

The 'Edit Selected Label Map' panel shows 'Label 6' selected, with the 'LevelTracing' tool active. Below this are options for 'Paint Over' (checked), 'Threshold Painting', and 'Threshold' (set to 1). At the bottom left, there are 'Manipulate Slice Views' and 'Manipulate 3D View' sections with various icons.

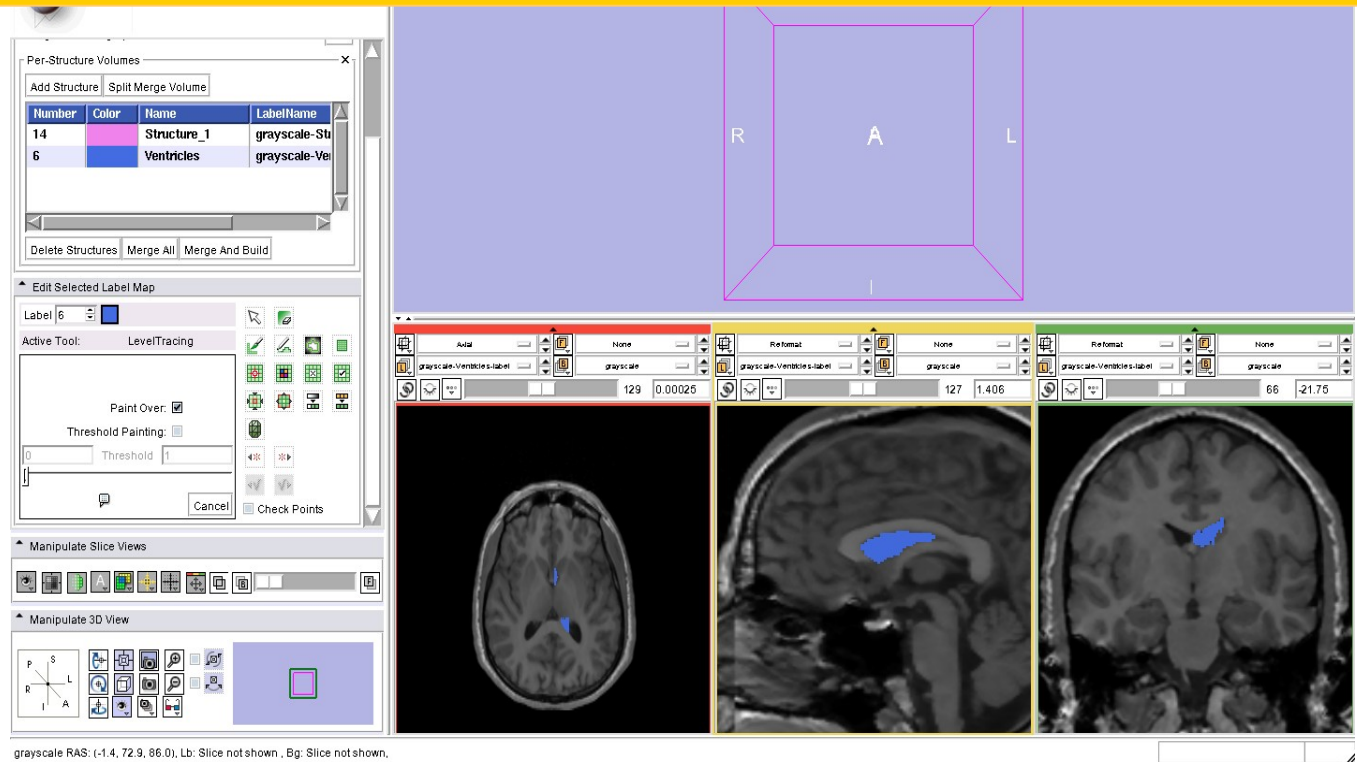
The main window shows a 3D view of a brain slice with a red arrow pointing to a blue outline of the left lateral ventricle. The slice is labeled with 'R', 'A', and 'L'. Below the 3D view are three 2D slice views: Axial, Sagittal, and Coronal. Each slice view shows the brain with a blue outline of the ventricle. The software interface includes various toolbars and a status bar at the bottom.

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 the following data:

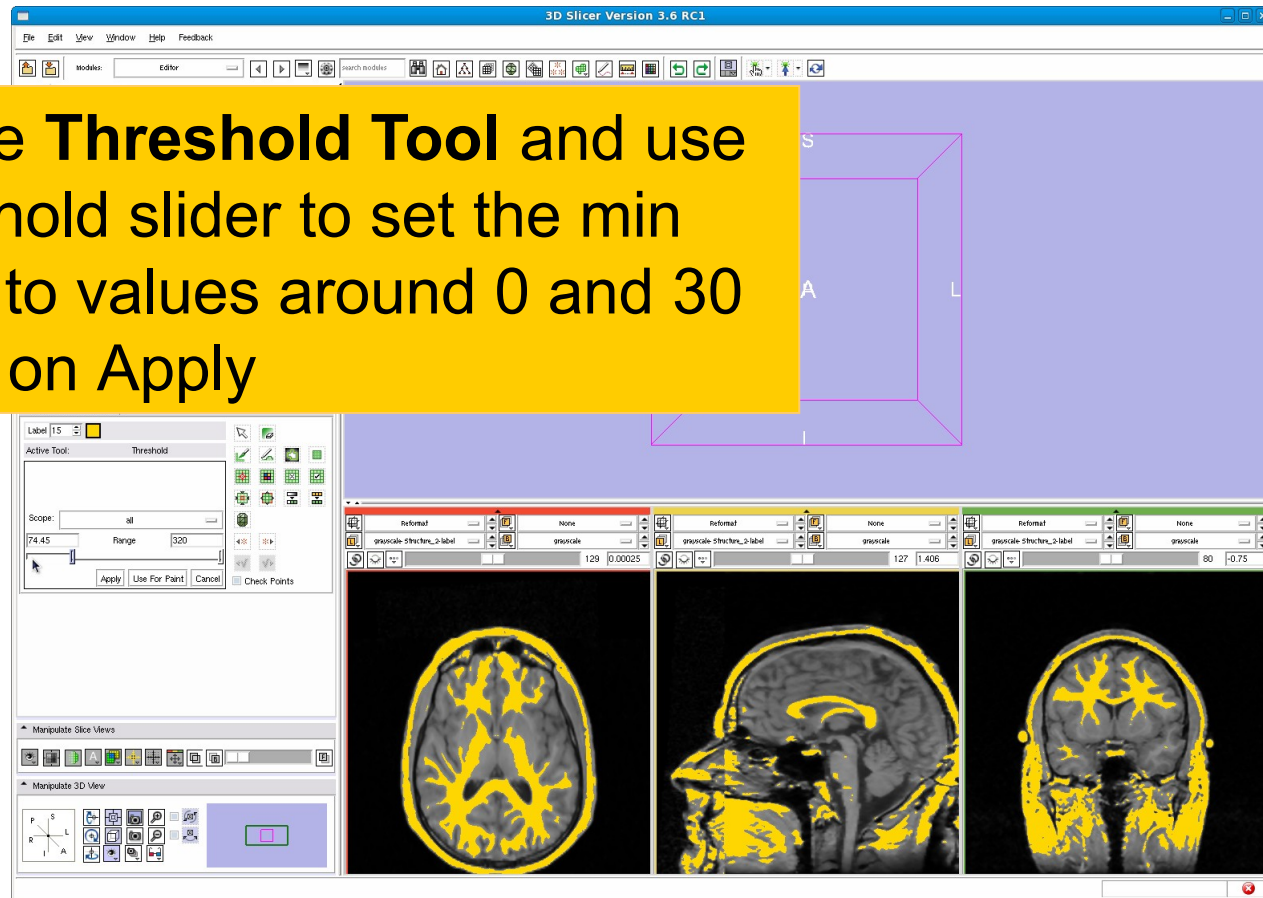
| Number | Color | Name |
|--------|-----------|--------------|
| 6 | Blue | Ventricles |
| 7 | Red | Arteries |
| 8 | Dark Blue | Veins |
| 9 | Gray | Gray_matter |
| 10 | Yellow | White_matter |
| 11 | Green | Tumor |
| 12 | Cyan | Edema |
| 13 | Purple | Necrosis |
| 14 | Pink | Structure_1 |
| 15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

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



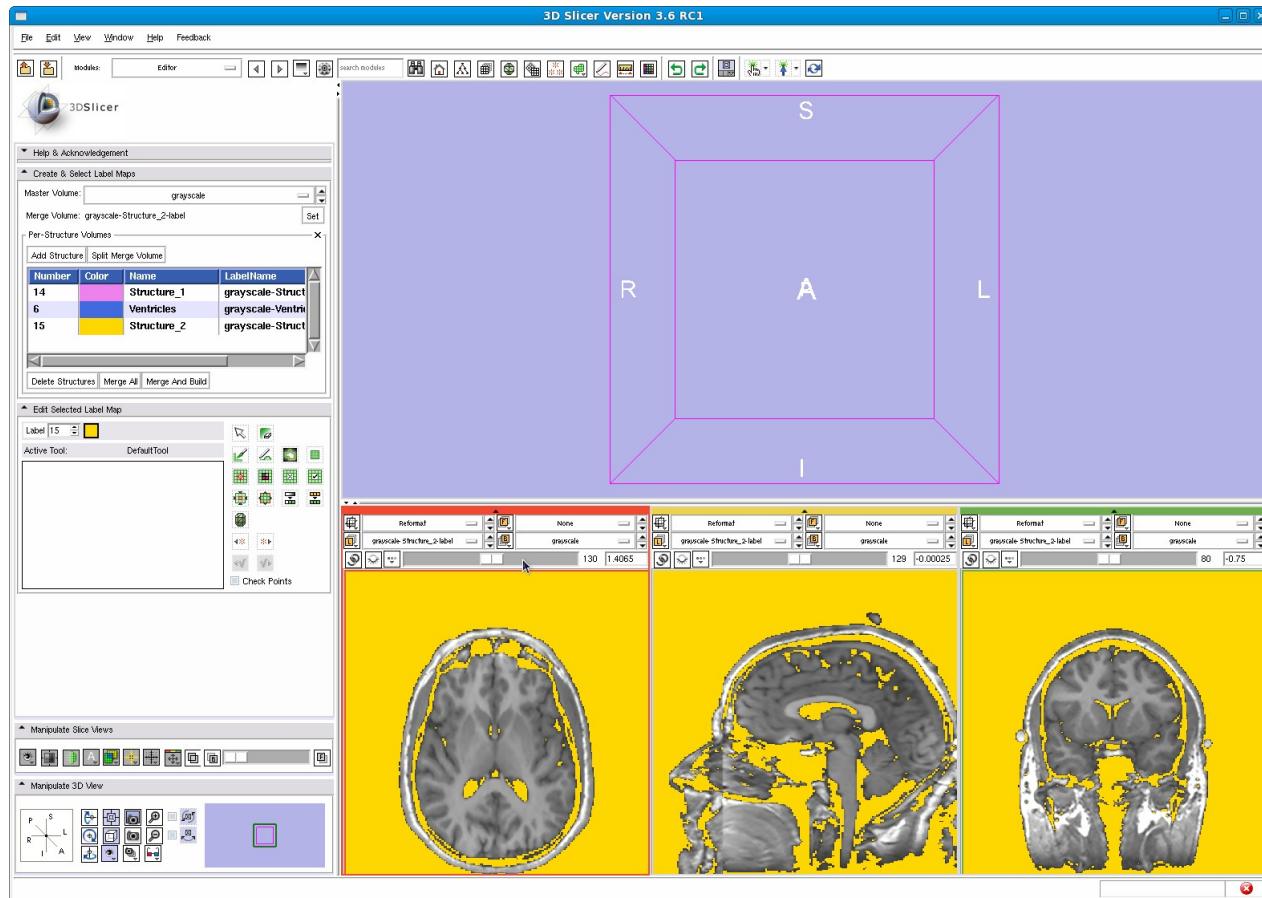
Threshold tool

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





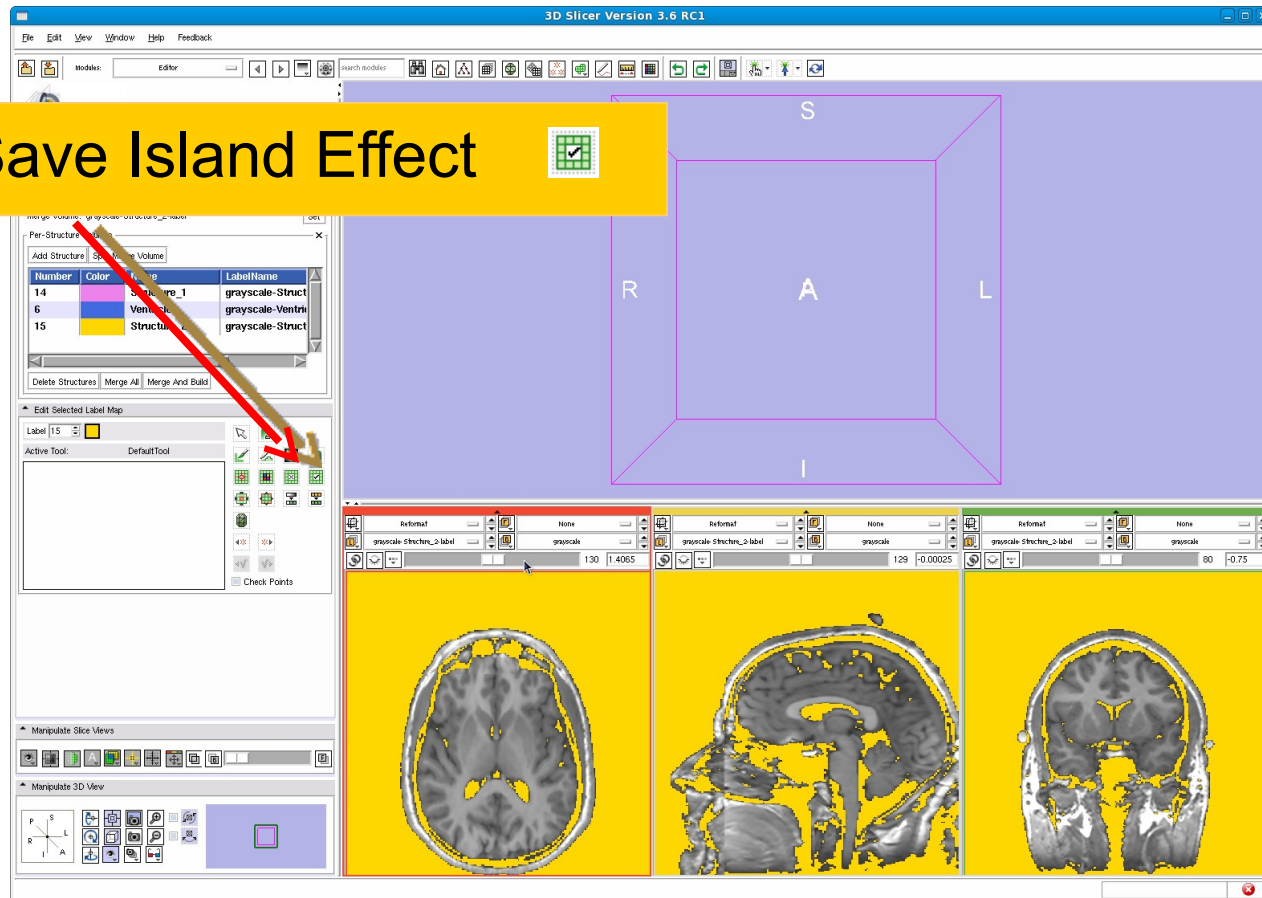
Threshold tool





Save Island

Select the Save Island Effect





Save Island

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

3DSlicer

Per-Structure Volumes

| Number | Color | Name | LabelName |
|--------|-------|-------------|---------------|
| 14 | | Structure_1 | grayscale-Stu |
| 6 | | Ventricles | grayscale-Ven |
| 15 | | 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

Per-Structure Volumes

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

Edit Selected Label Map

Label 15

Active Tool: Savelsland

Scope: all

Manipulate Slice Views

Manipulate 3D View

Reformat: None, grayscale-St. Lure 2-label, grayscale

Reformat: None, grayscale-St. Lure 2-label, grayscale

Reformat: None, grayscale-St. Lure 2-label, grayscale

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

Bg: grayscale, None, 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 software interface for medical image processing. On the left, a panel titled 'Edit Selected Label Map' shows a list of structures: 'Structure_1' (pink), 'Ventricles' (blue), and 'Structure_2' (yellow). Below this, the 'Active Tool' is set to 'Removelslands'. The 'Scope' is 'visible', and the 'Fully Connected' checkbox is checked. The 'Apply' button is highlighted with a red arrow. A yellow arrow points from the 'Apply' button to a yellow pixel on a brain slice in the main view. The main view shows a 3D brain model with axes labeled S (Superior), I (Inferior), R (Right), and L (Left). Below the main view are three smaller brain slices: an axial slice with a yellow pixel on the left side, a sagittal slice, and a coronal slice. The bottom of the interface shows a toolbar with icons for pan, zoom, and other functions.



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:** A table listing structures with their respective colors and labels.
- Edit Selected Label Map:** A panel for editing the selected label map, including a scope dropdown and various tool icons.
- 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 window shows a 3D view of a segmented eyeball structure (labeled 'A') with a purple outline, and three axial slices (labeled 'I', 'J', and 'K') showing the structure in different orientations. The 3D view is labeled with 'S' (Superior), 'I' (Inferior), 'R' (Right), and 'L' (Left). The axial slices are labeled with 'I', 'J', and 'K' and show the structure in different orientations. The 3D view is labeled with 'S' (Superior), 'I' (Inferior), 'R' (Right), and 'L' (Left). The axial slices are labeled with 'I', 'J', and 'K' and show the structure in different orientations.

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

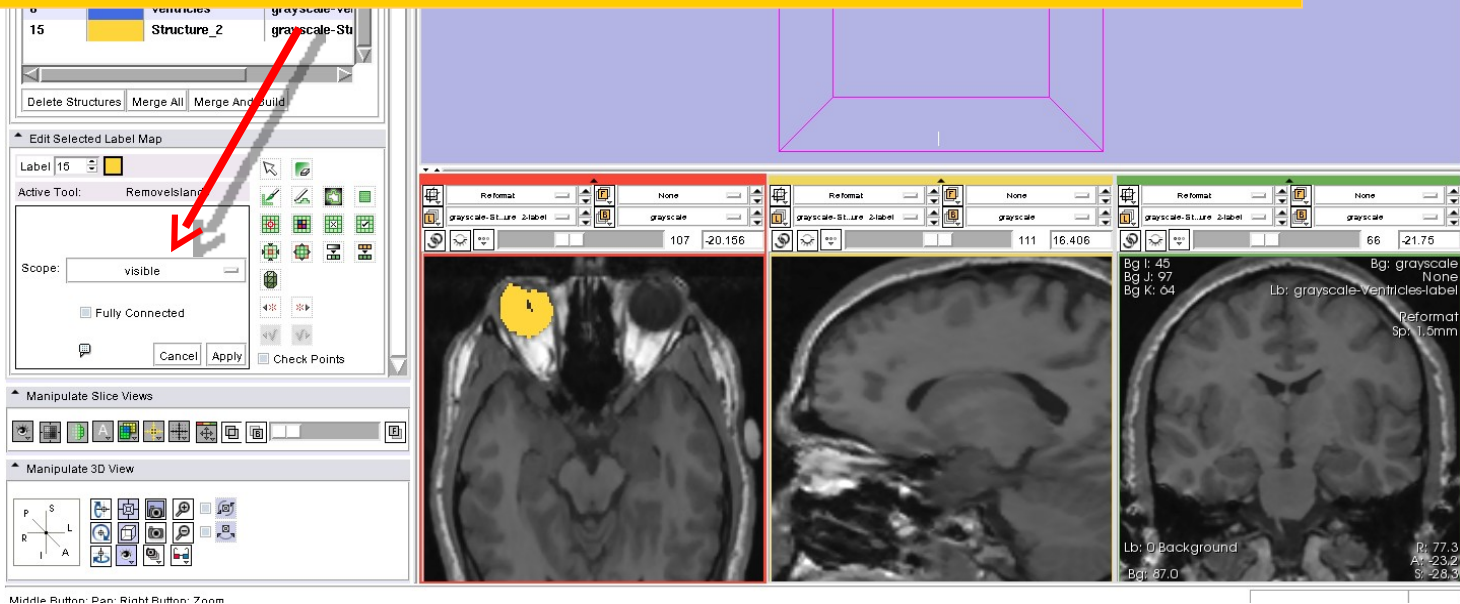
Middle Button: Pan; Right Button: Zoom



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

The screenshot displays the 3D Slicer software interface. On the left, the 'Per-Structure Volumes' table is visible:

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

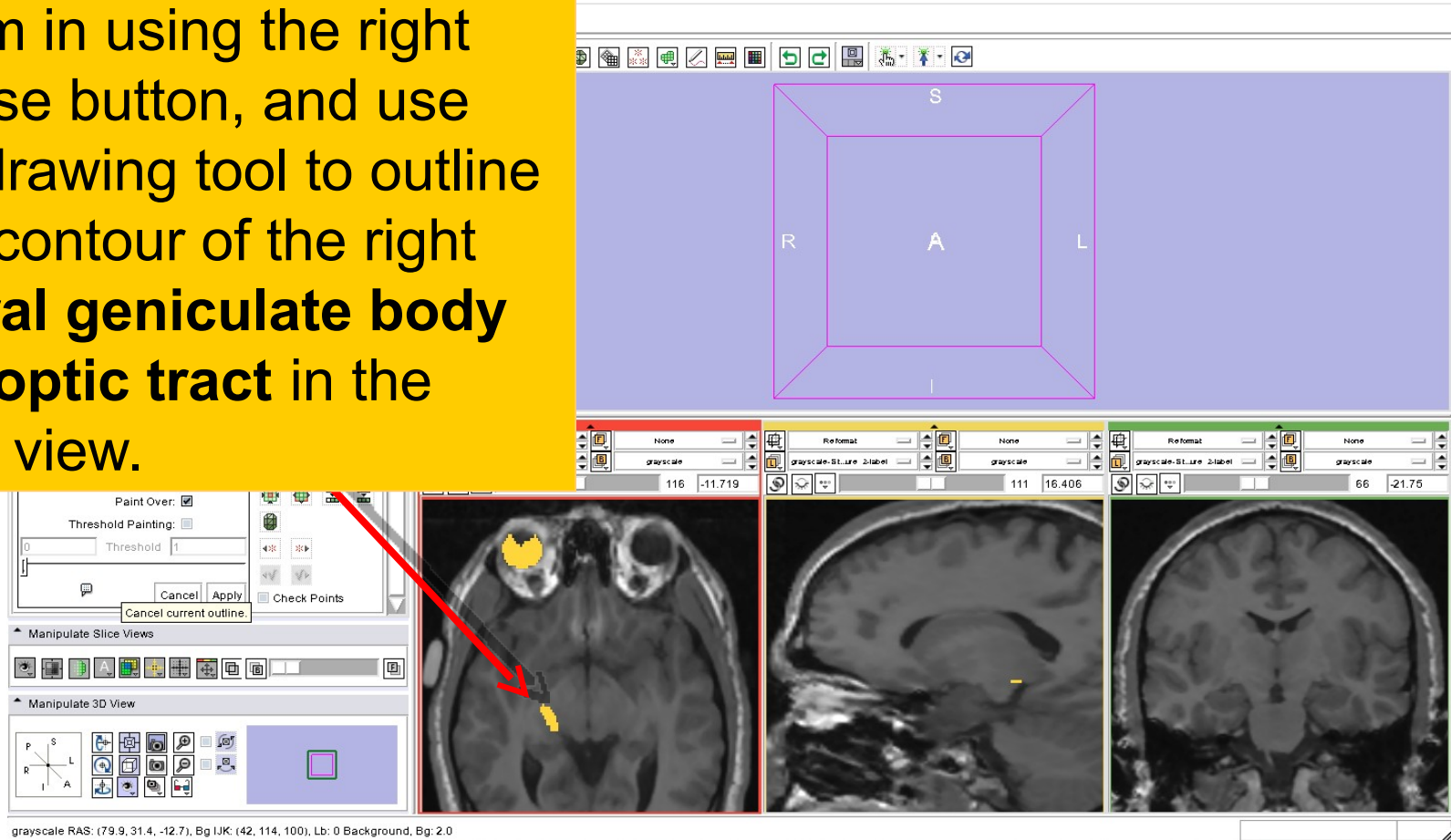
Below this table is the 'Edit Selected Label Map' panel, where the 'Active Tool' is set to 'RemovesIslands'. The 'Scope' is set to 'visible'. The 'Manipulate Slice Views' and 'Manipulate 3D View' panels are also visible.

The main window shows three slice views: an axial view (left) with a yellow highlighted region, a sagittal view (middle), and a coronal view (right). The coronal view shows a yellow highlighted region in the eyeball structure. The interface includes various toolbars and a 3D view at the bottom.



Adding more structures

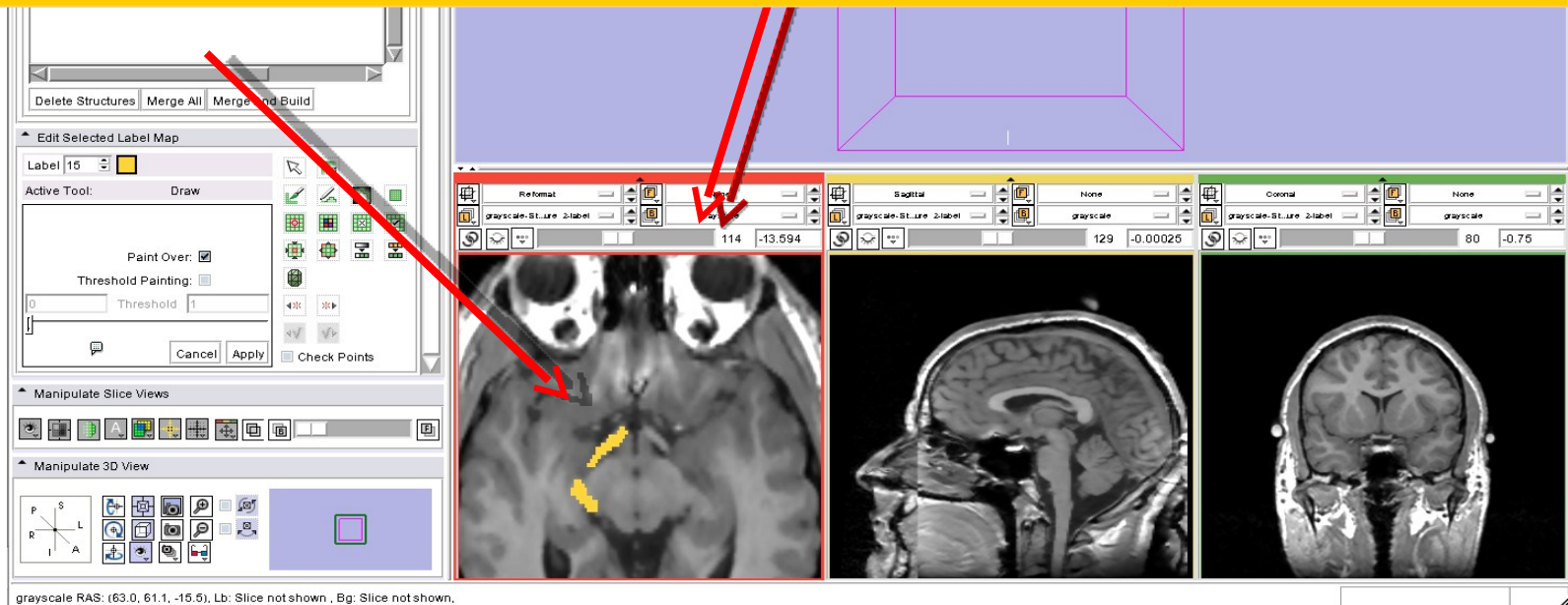
Zoom in using the right mouse button, and use the drawing tool to outline the contour of the right lateral geniculate body and optic tract in the axial view.





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





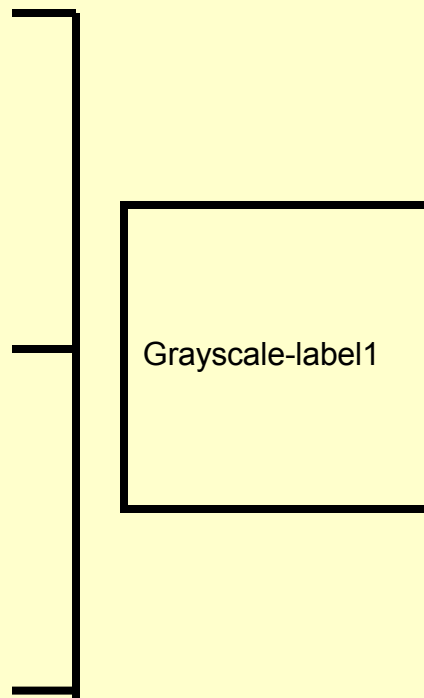
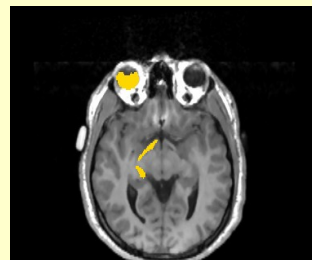
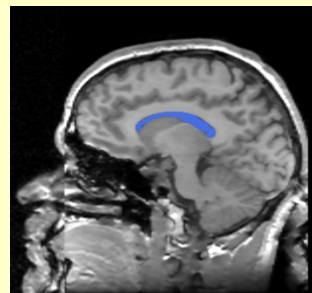
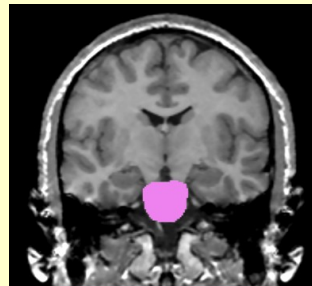
Merge And Build

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.

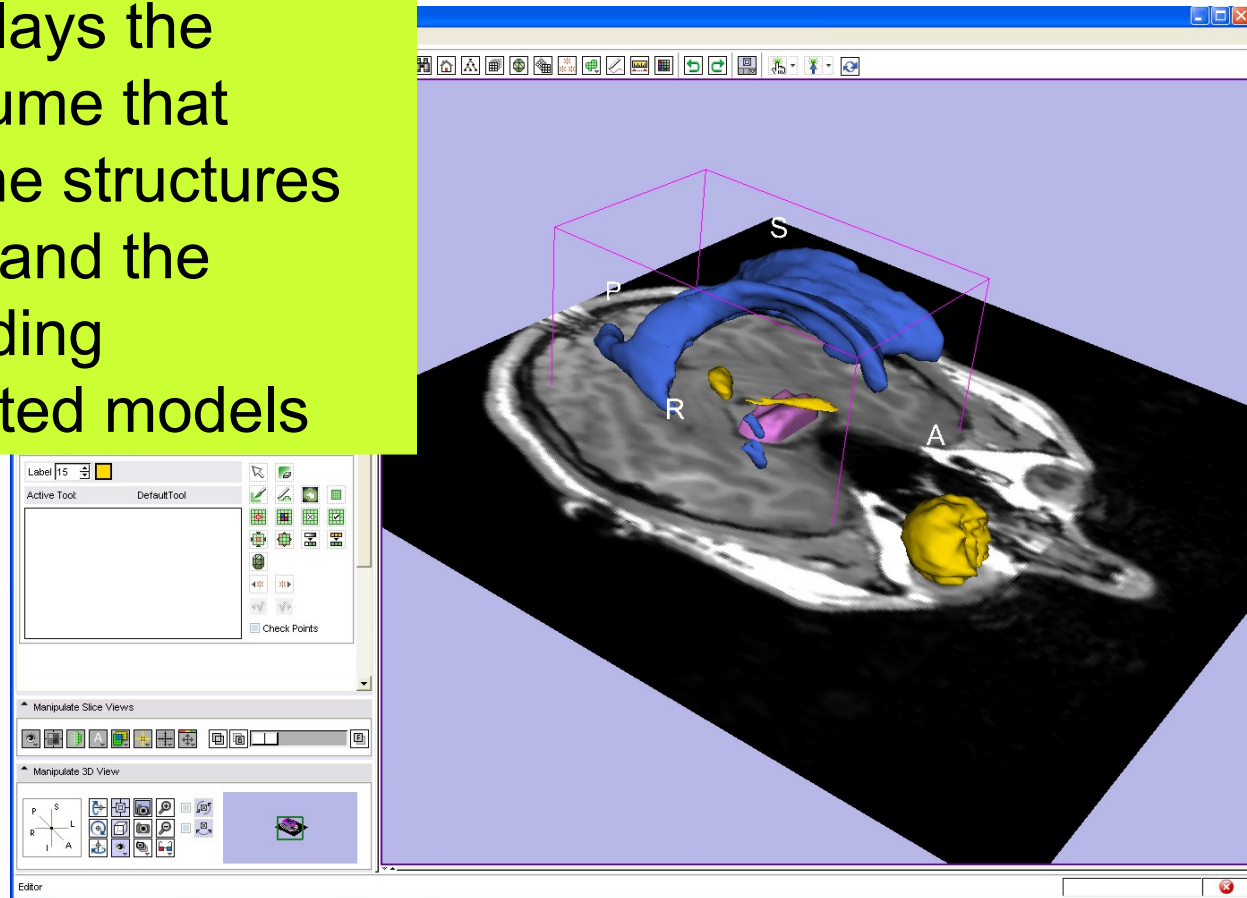
The three label maps will be merged in the order that they appear in the table.

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



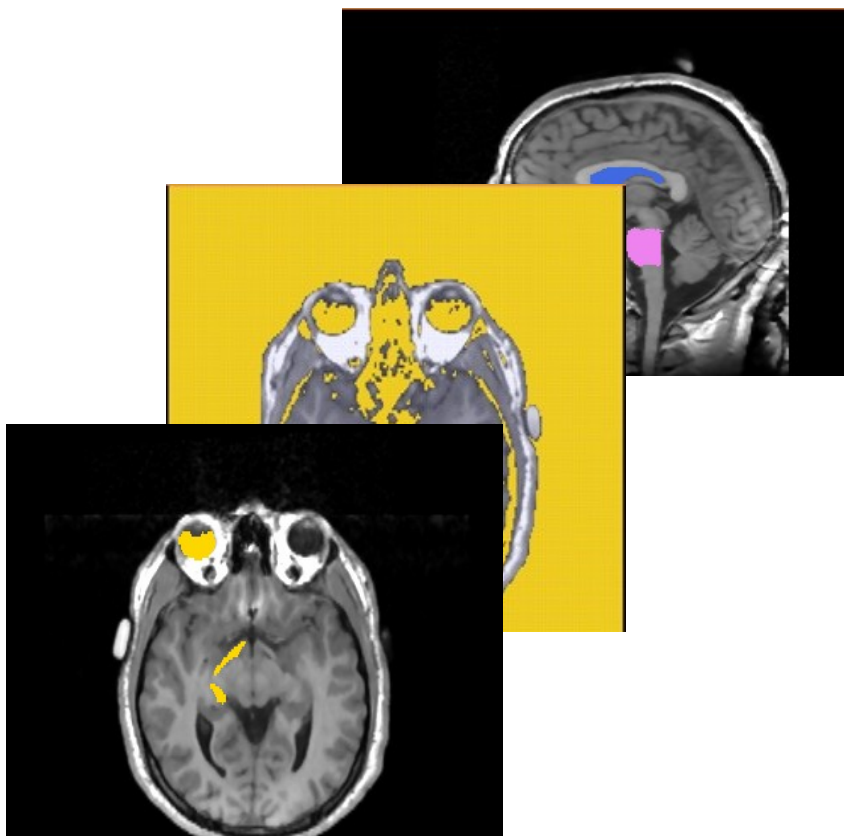
Merge And Build

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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