



NA-MIC

National Alliance for Medical Image Computing

<http://na-mic.org>

Interactive Editor tutorial

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Harvard Medical School

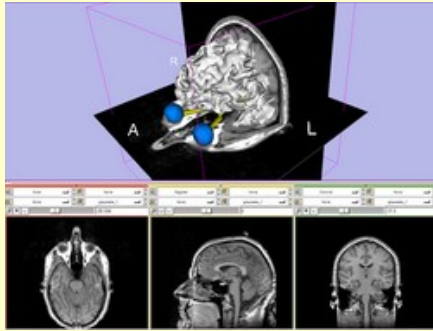


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Pre-requisite

- 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>

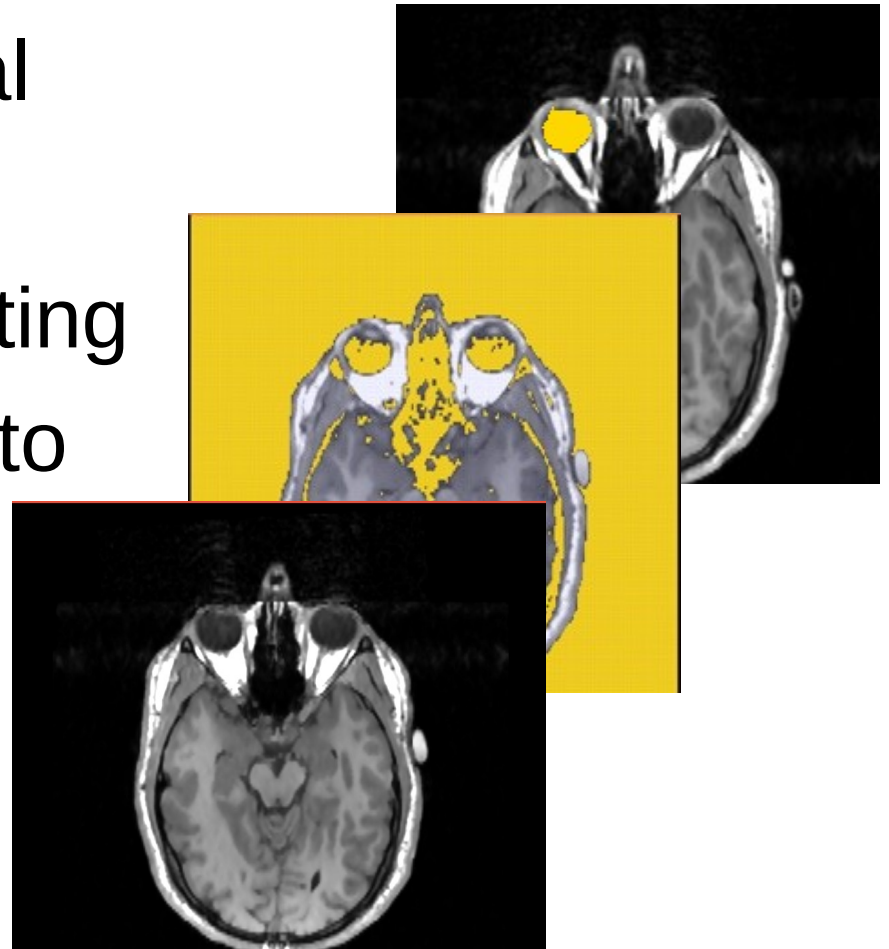
Disclaimer

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.





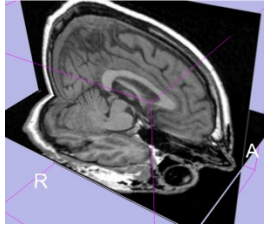
Label map



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



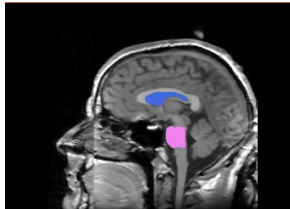
Overview



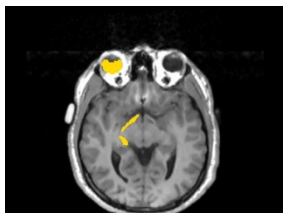
Part 1: Creating a single label map

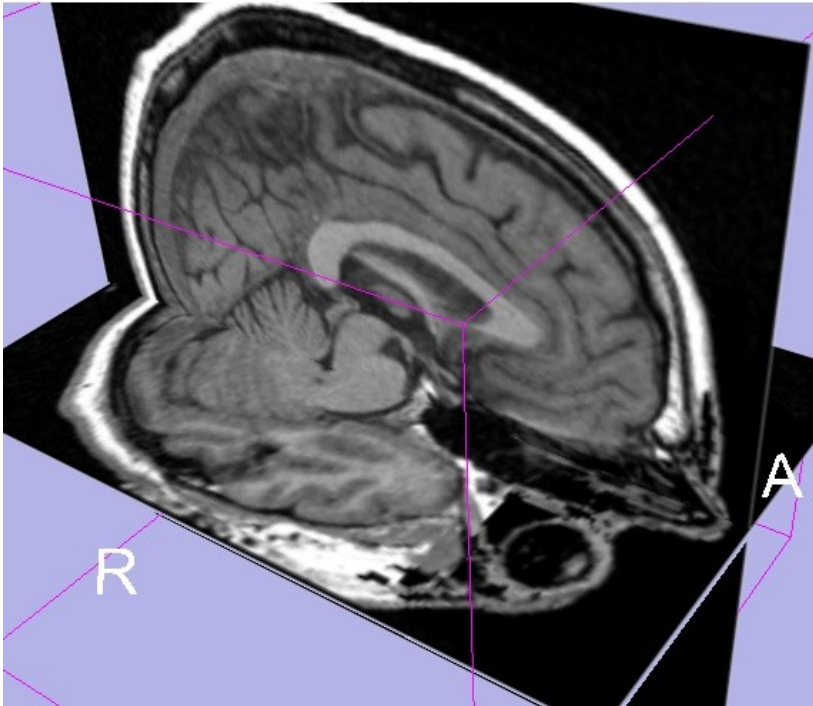


Part 2: Editing a single label map



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

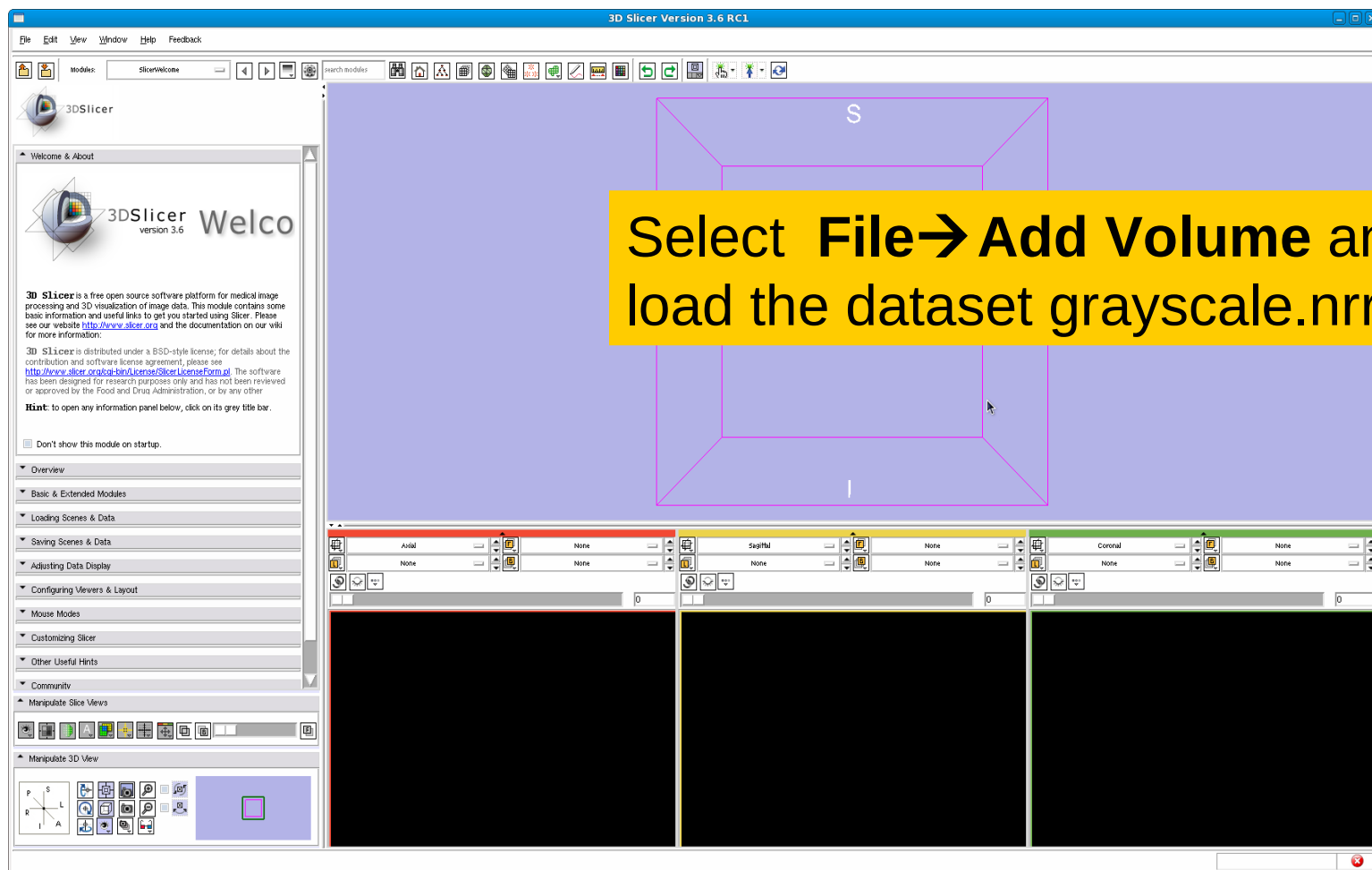




Part 1: Creating a single label map

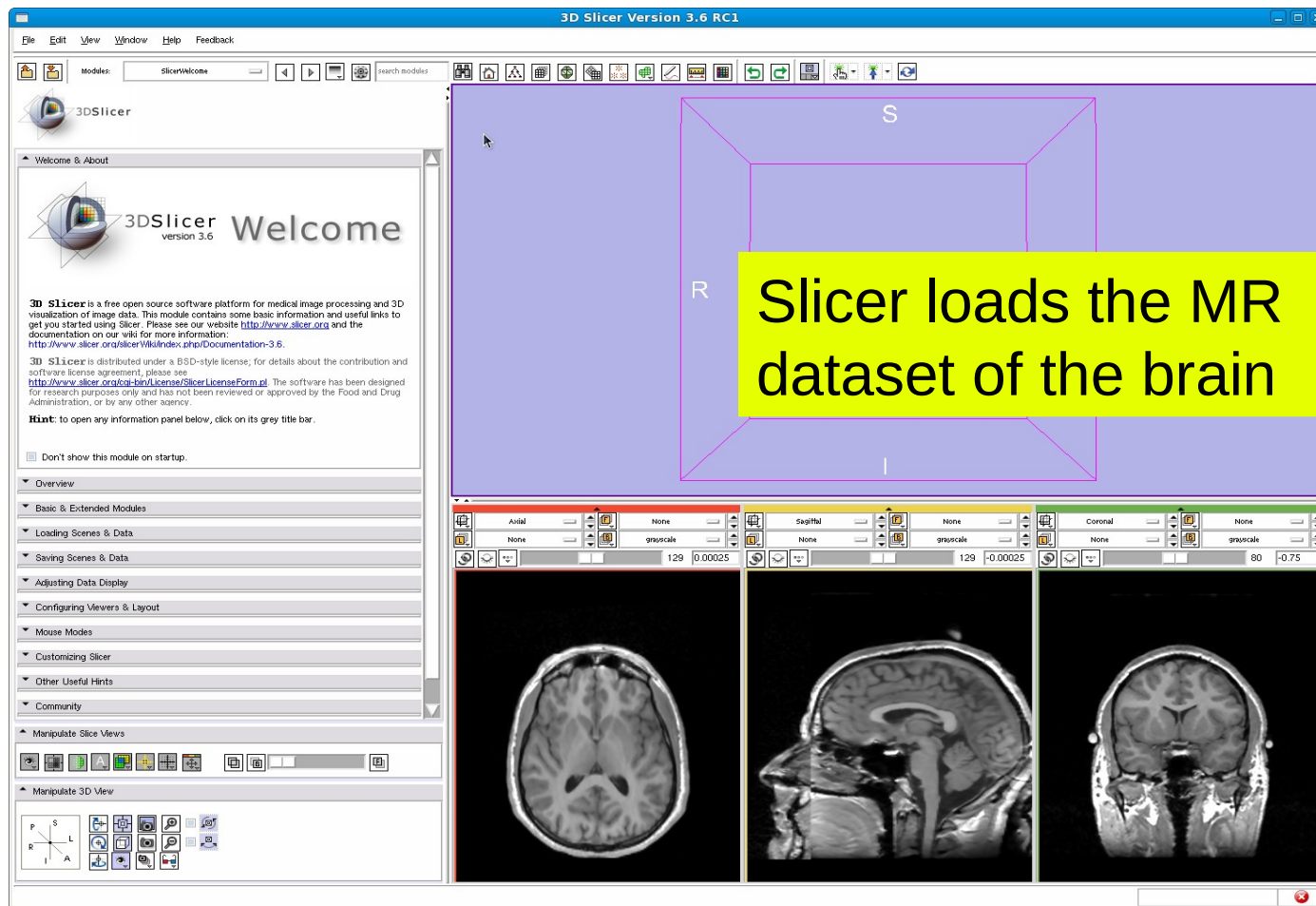


Data Loading



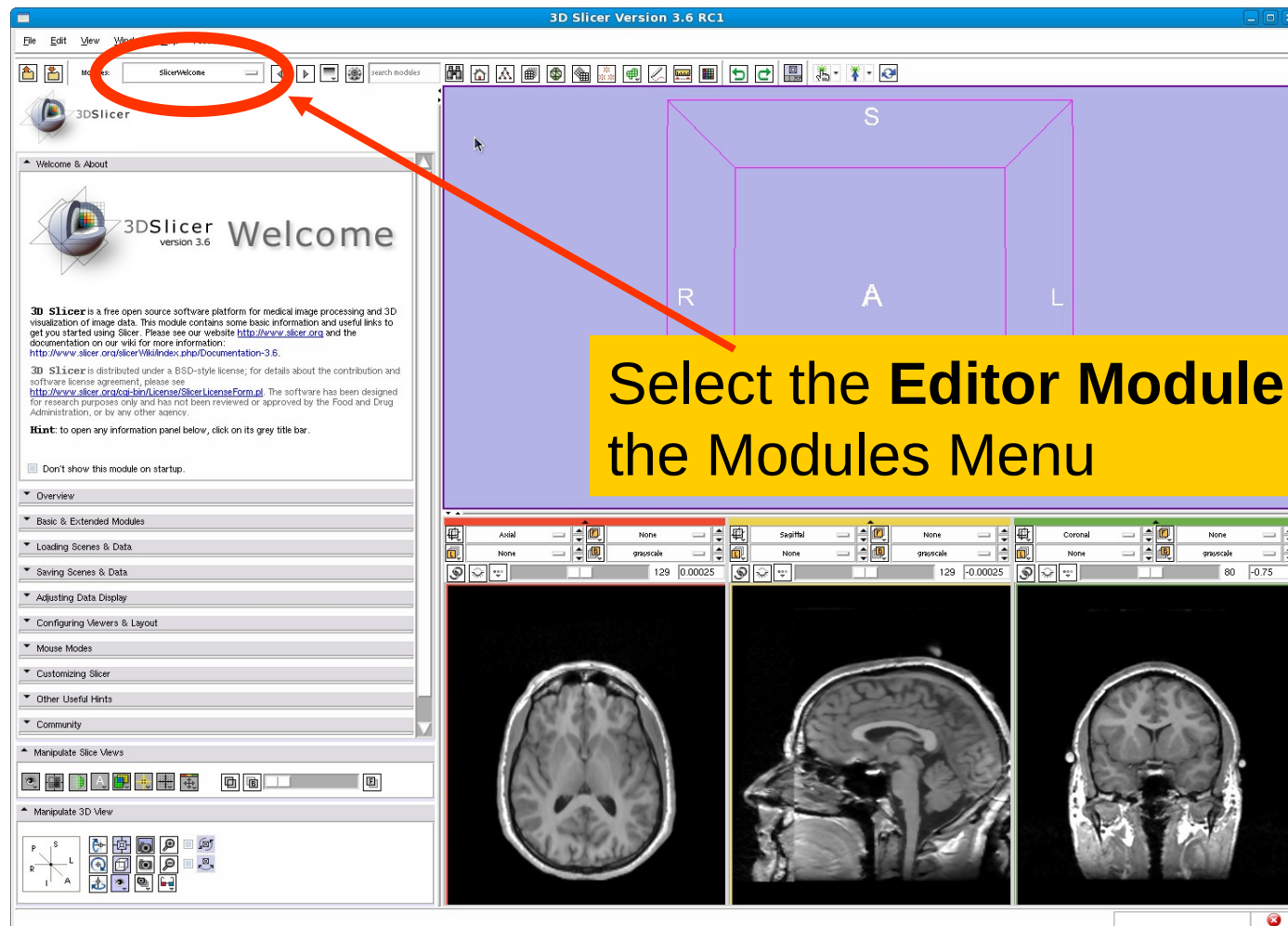


Data Loading



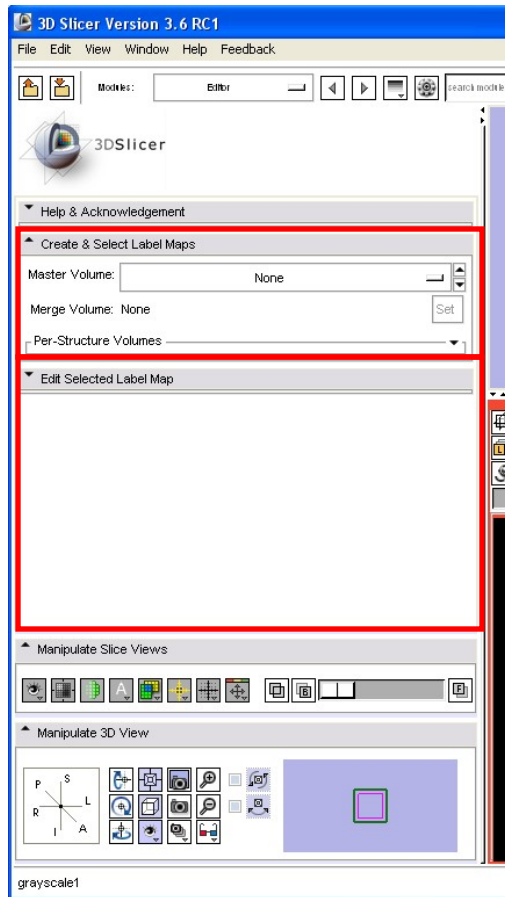


Data Loading





Editor Module

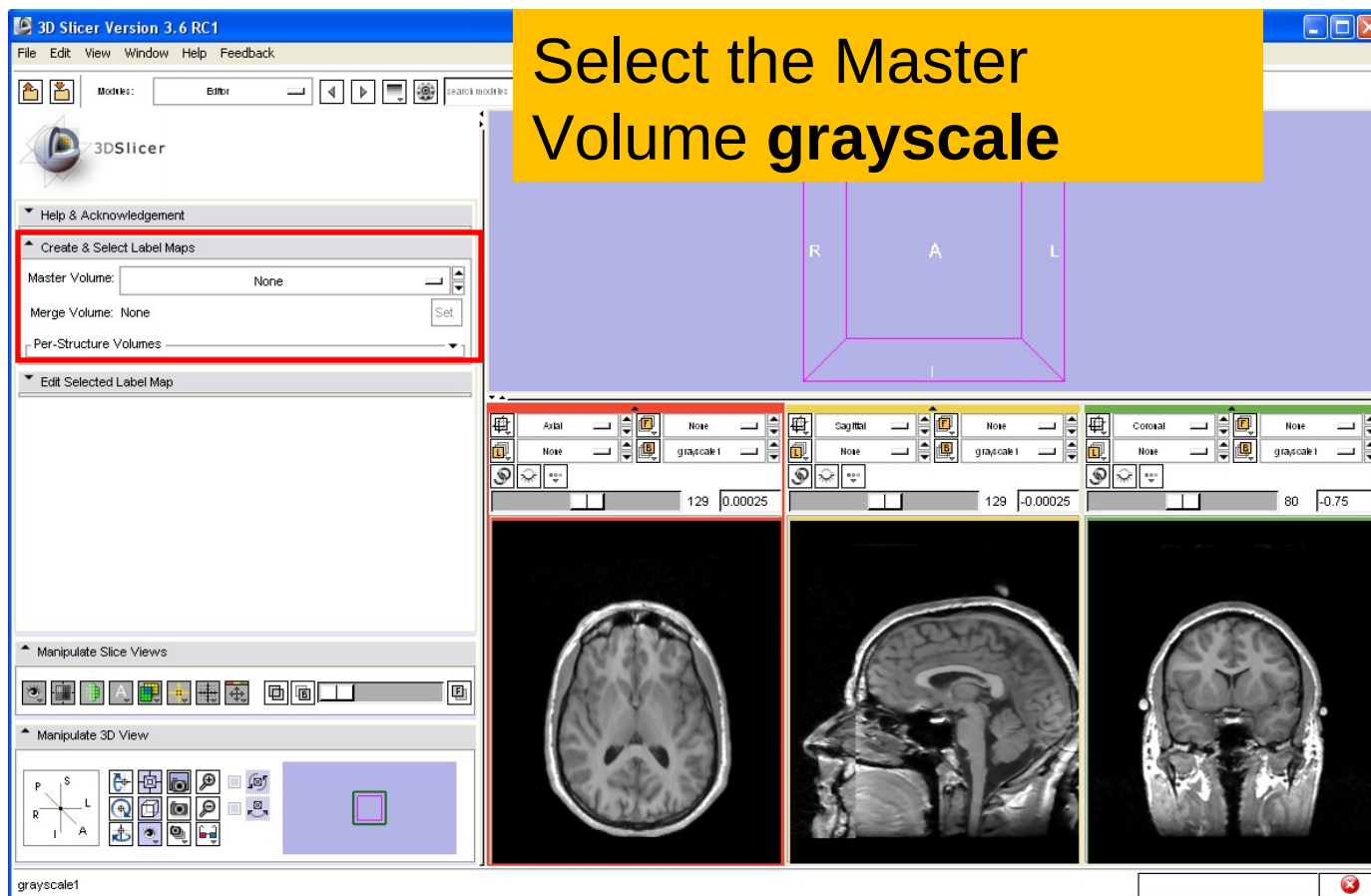


The Editor module GUI is composed of two parts:

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

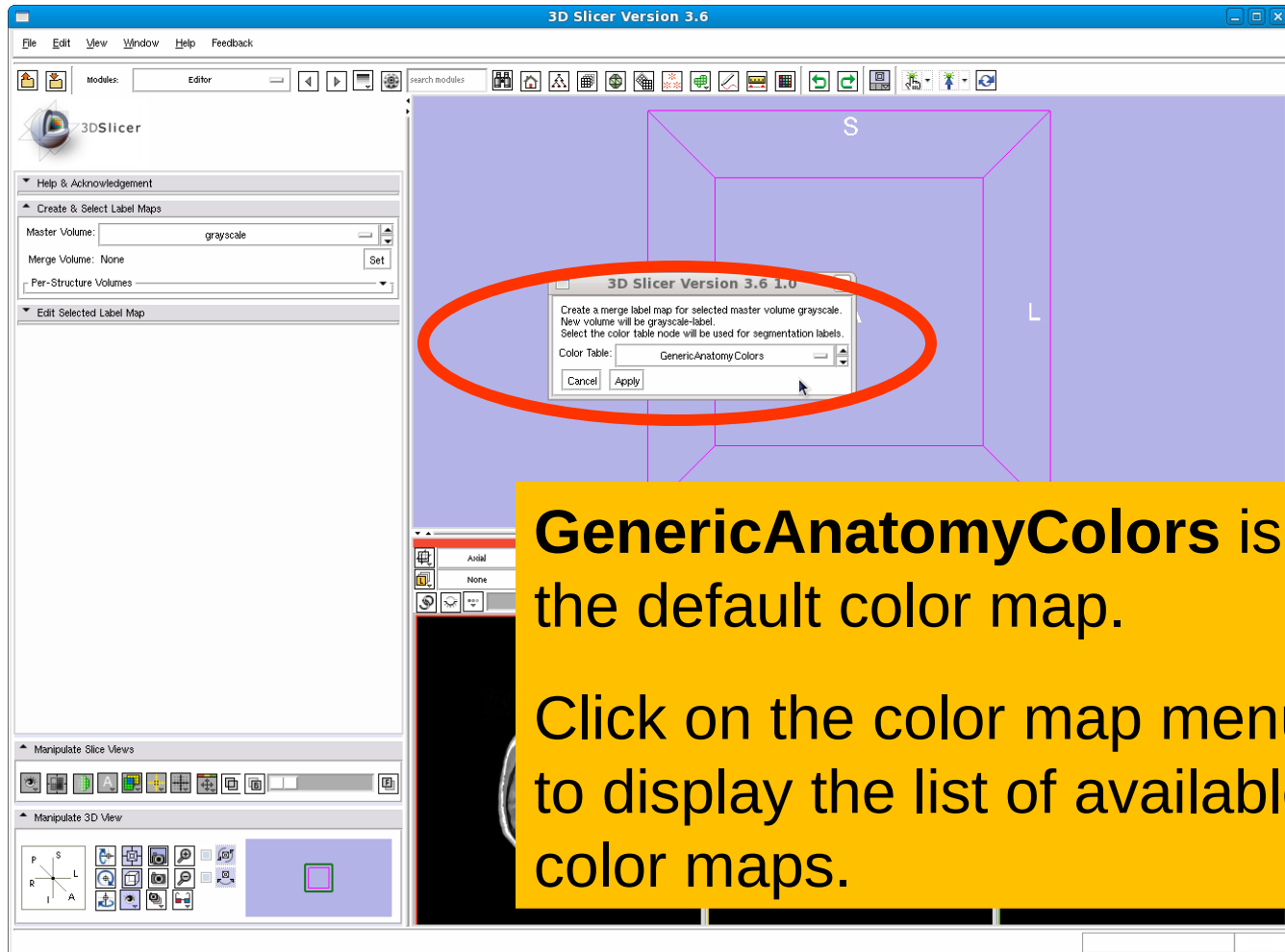


Label Map Creation



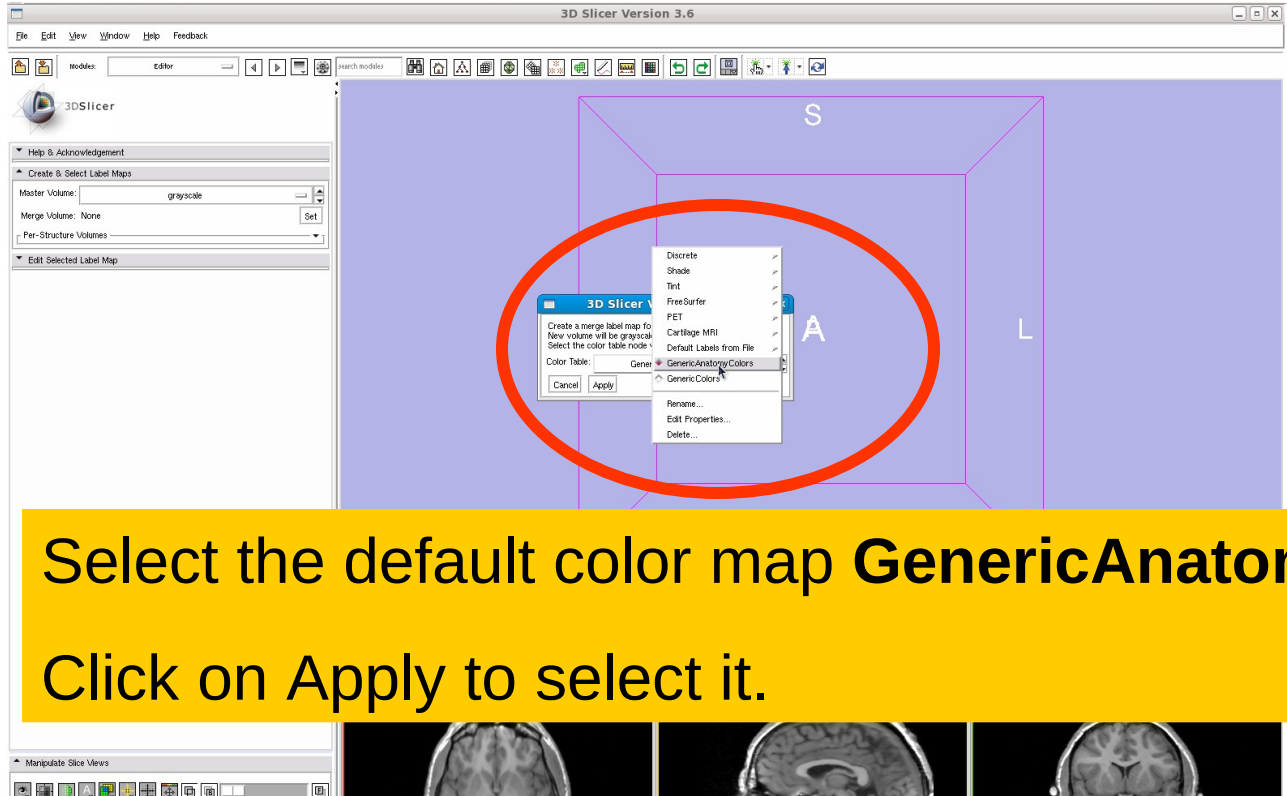


Label Map Creation





Label Map Creation

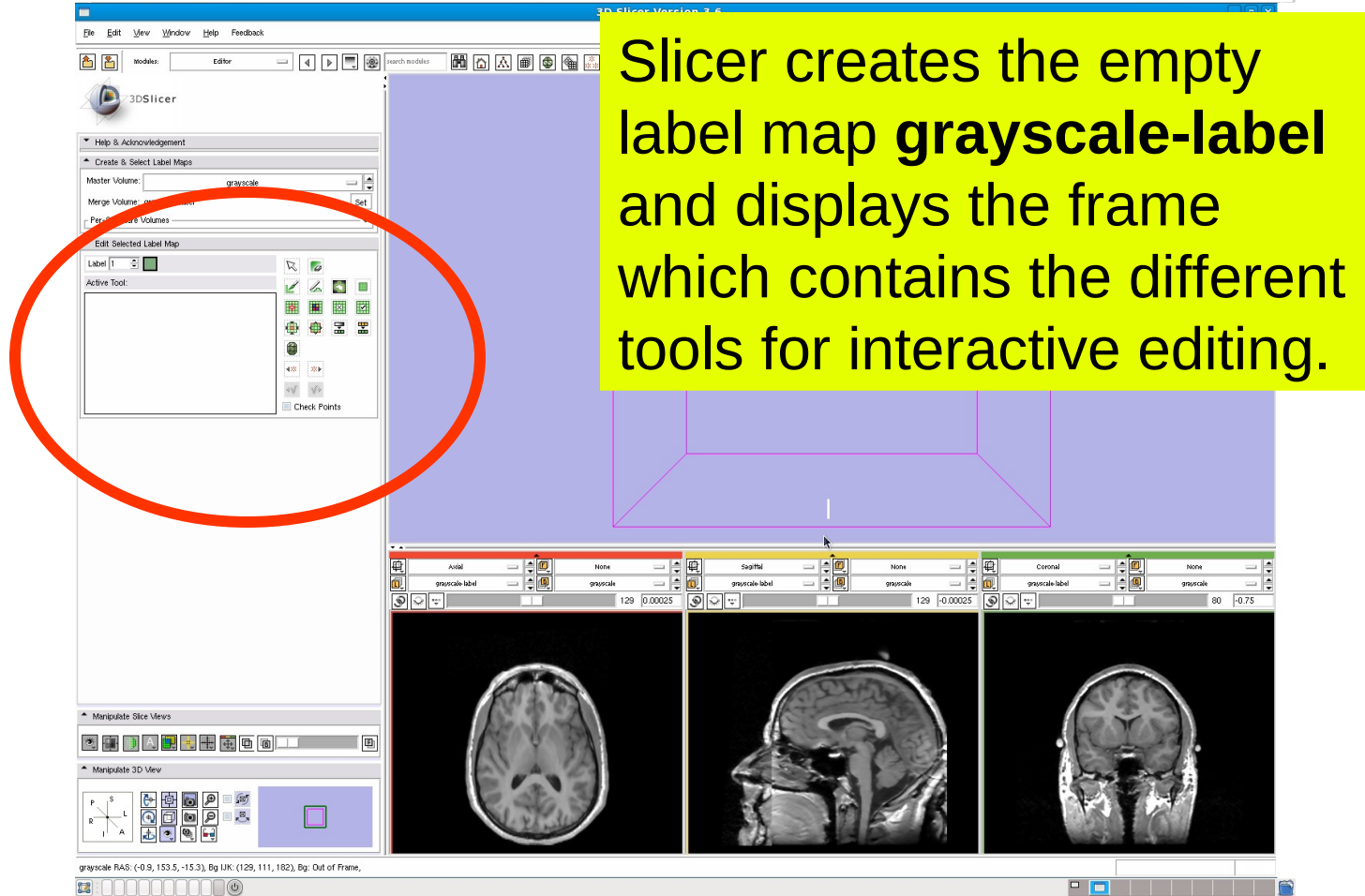


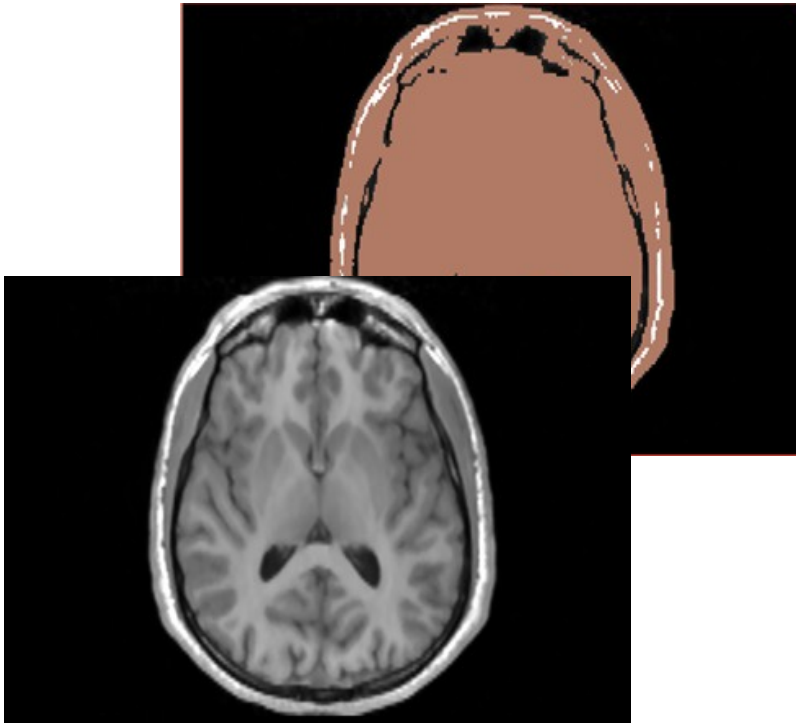
Select the default color map **GenericAnatomyColors**
Click on Apply to select it.

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



Label Map Creation

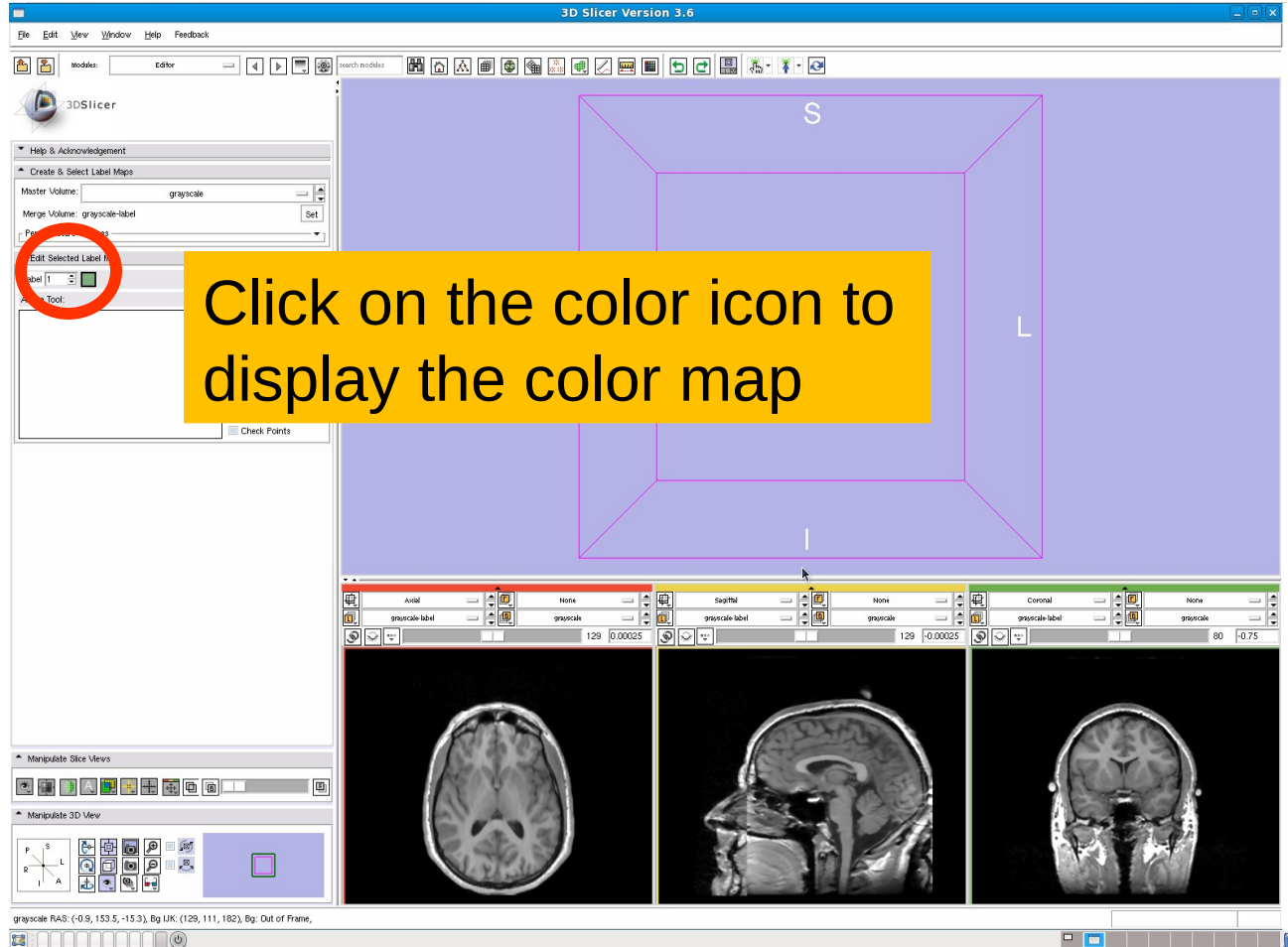




Part 2: Editing a single label map

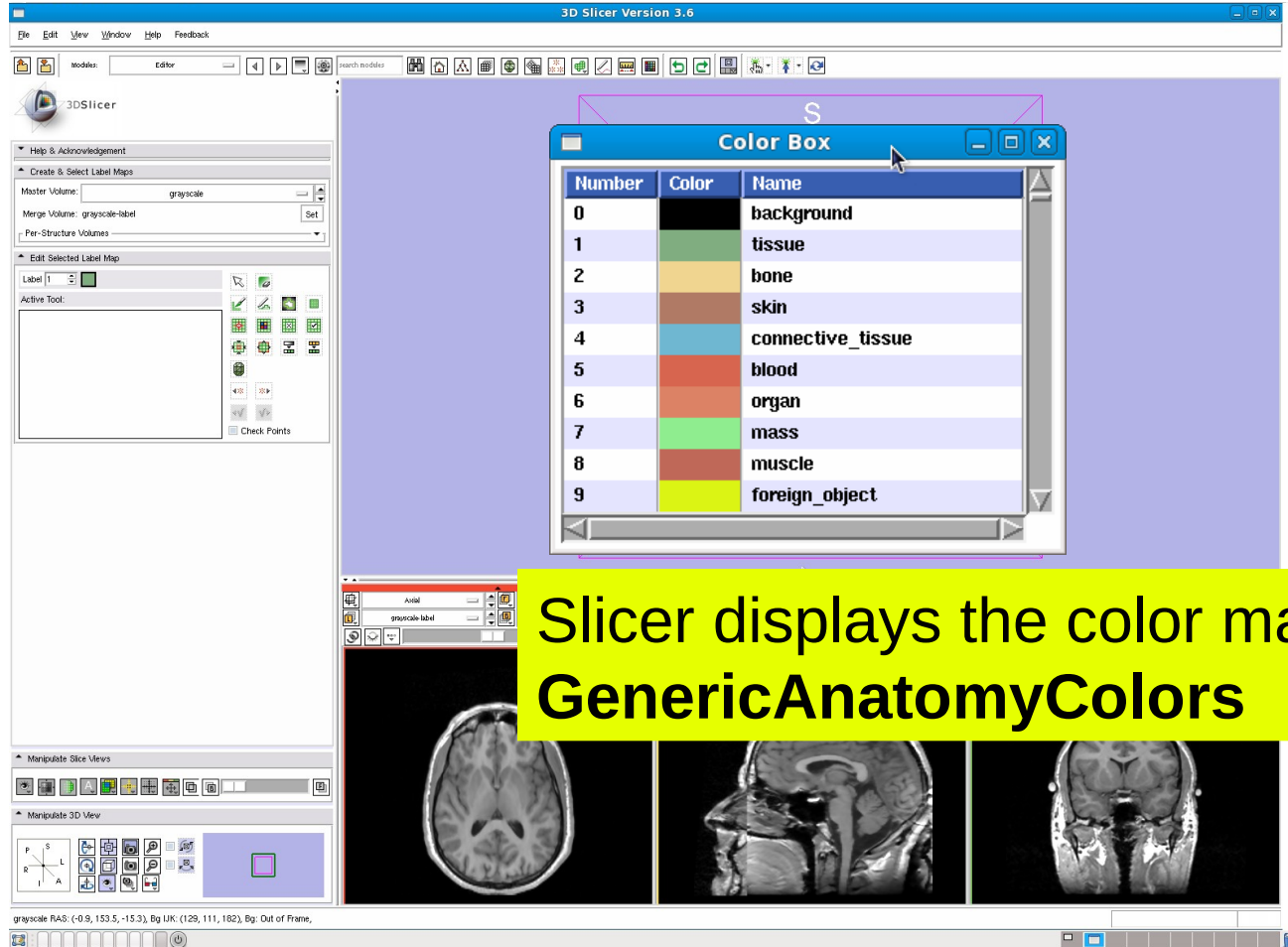


Label Map Editing





Label Map Editing





Label Map Editing

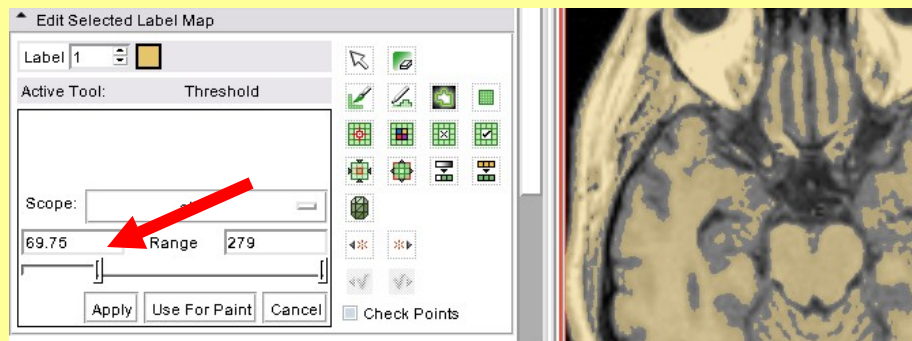
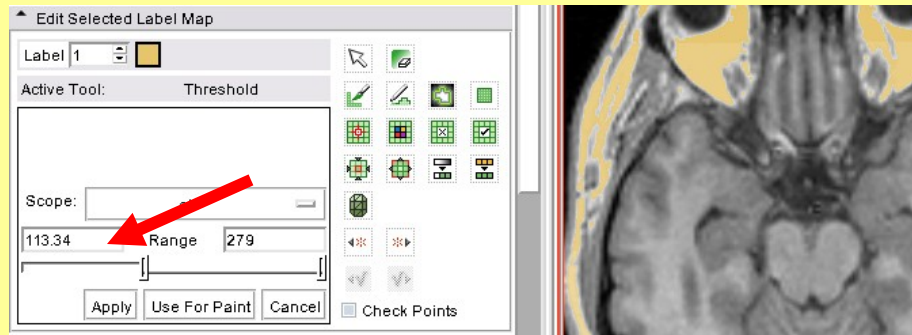
The screenshot shows the 3D Slicer software interface. On the left, the 'Color Box' panel is open, displaying a list of 307 labels with corresponding color swatches. The labels are organized into categories: 'pia_mater', 'muscles_of_head', 'salivary_glands', 'lips', 'nose', 'tongue', 'soft_palate', 'right_inner_ear', 'left_inner_ear', 'right_external_ear', 'left_external_ear', 'right_middle_ear', 'left_middle_ear', 'right_eyeball', 'left_eyeball', 'skull', 'right_frontal_bone', 'left_frontal_bone', 'right_parietal_bone', 'left_parietal_bone', 'right_temporal_bone', 'left_temporal_bone', 'right_sphenoid_bone', 'left_sphenoid_bone', 'right_ethmoid_bone', 'left_ethmoid_bone', 'occipital_bone', 'maxilla', 'right_zygomatic_bone', 'right_lacrimal_bone', 'vomer_bone', 'right_palatine_bone', 'left_palatine_bone', 'mandible', 'neck', 'muscles_of_neck', 'pharynx', 'larynx', 'thyroid_gland', 'right_parathyroid_glands', and 'left_parathyroid_glands'. The 'Skin' label is highlighted in yellow. The main 3D view shows a sagittal slice of a brain scan with a yellow box highlighting the 'Skin' label. The text 'Browse through the list of 307 labels to explore the color map GenericAnatomyColors' is overlaid on the yellow box. The text 'Select the label #3 'Skin'' is overlaid on the orange box. The 3D Slicer interface also shows the '3D Slicer Version 3.6' window and the '3D Slicer' logo.

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

Select the label #3 'Skin'



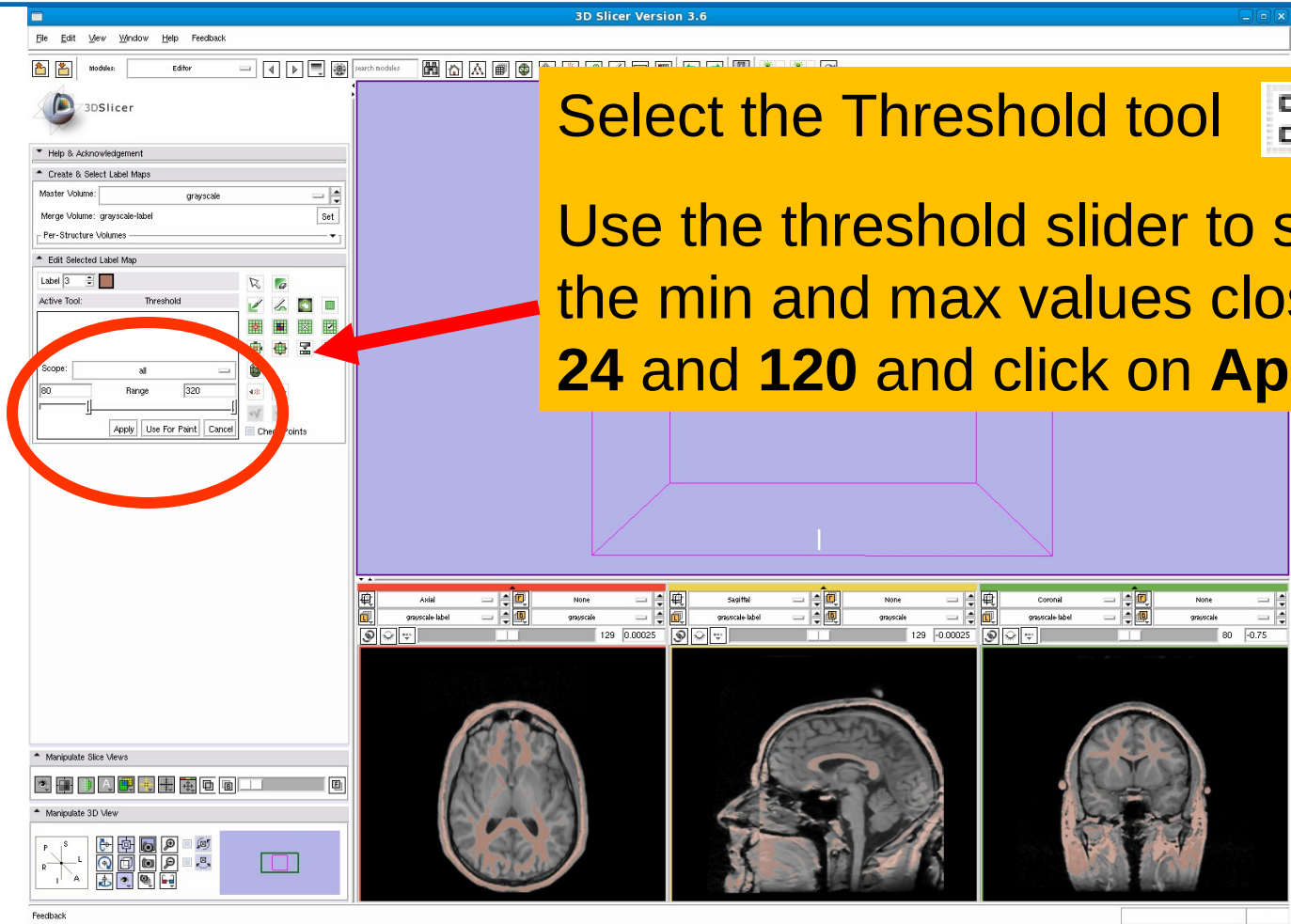
Threshold



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.



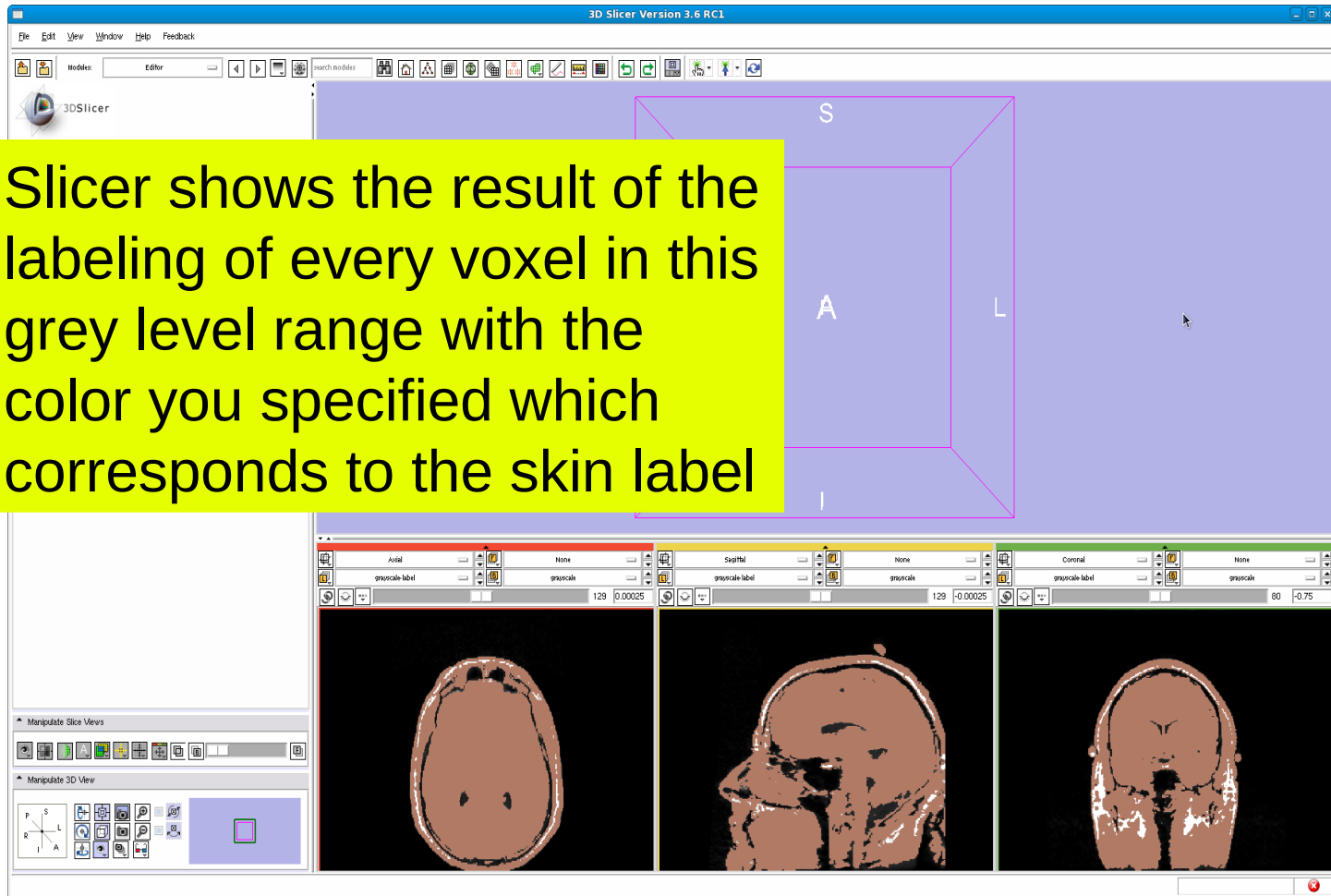
Threshold Effect





Threshold Effect

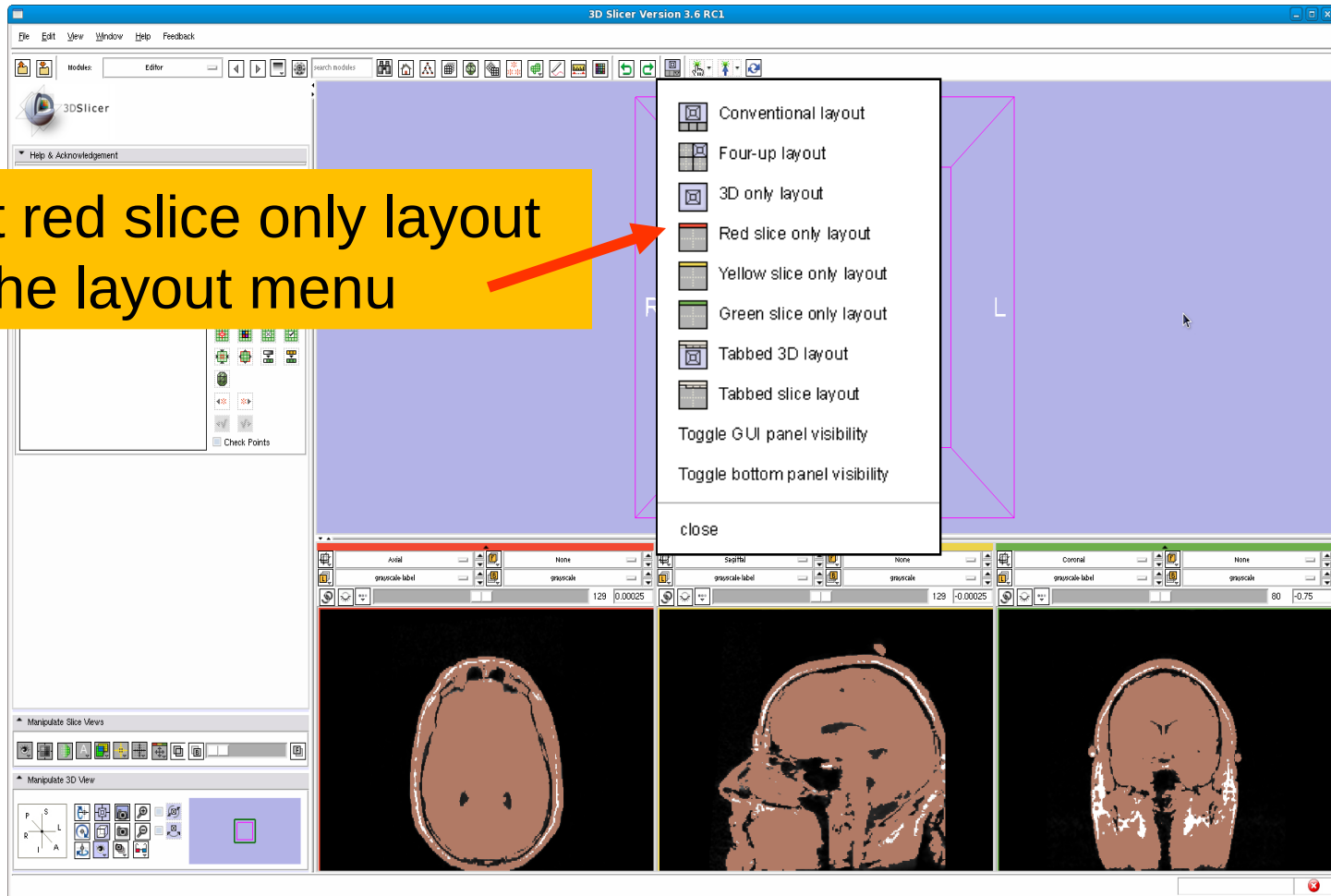
Slicer shows the result of the labeling of every voxel in this grey level range with the color you specified which corresponds to the skin label





Threshold Effect

Select red slice only layout
from the layout menu





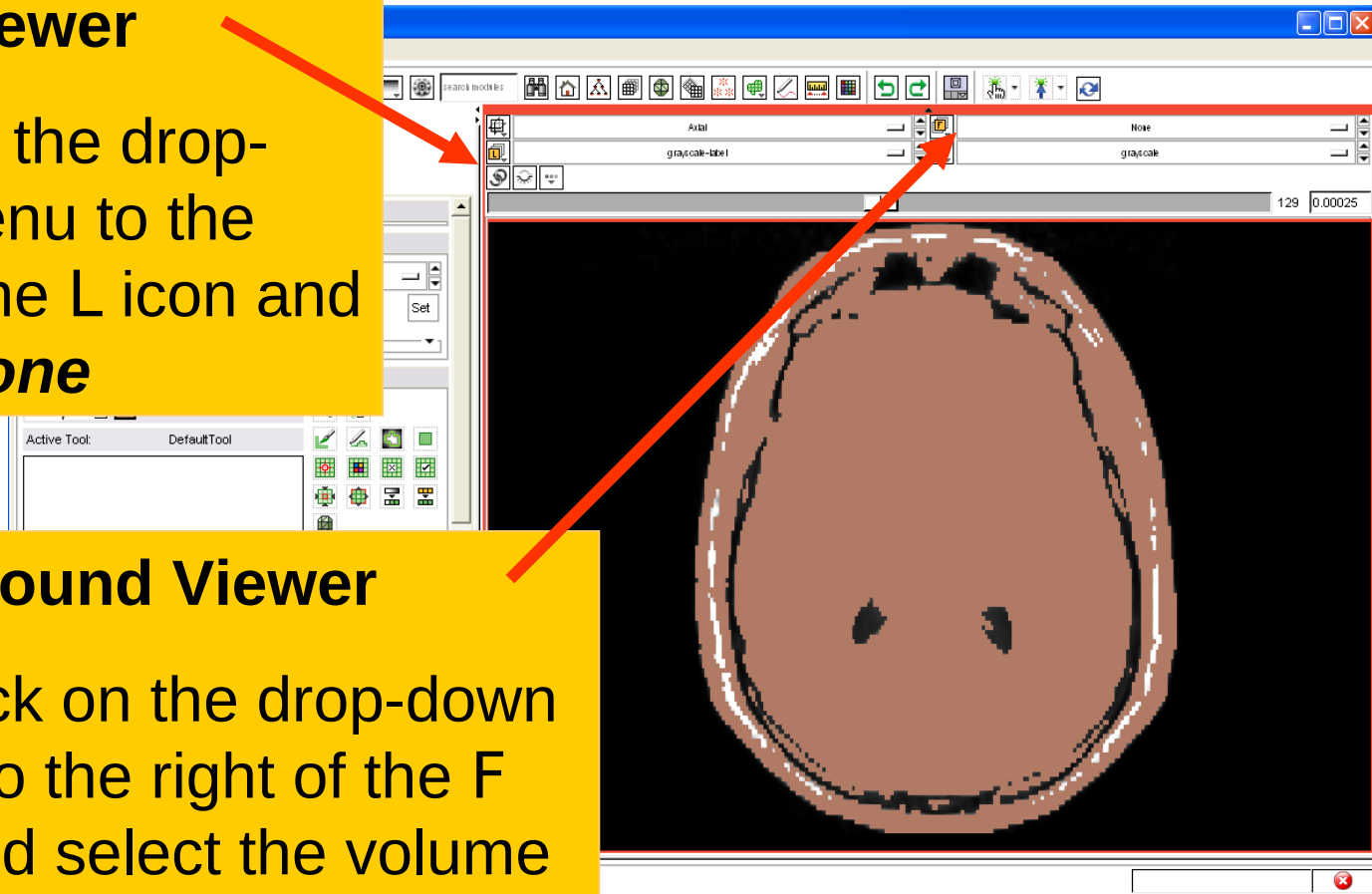
Threshold Effect

Label Viewer

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

Foreground Viewer

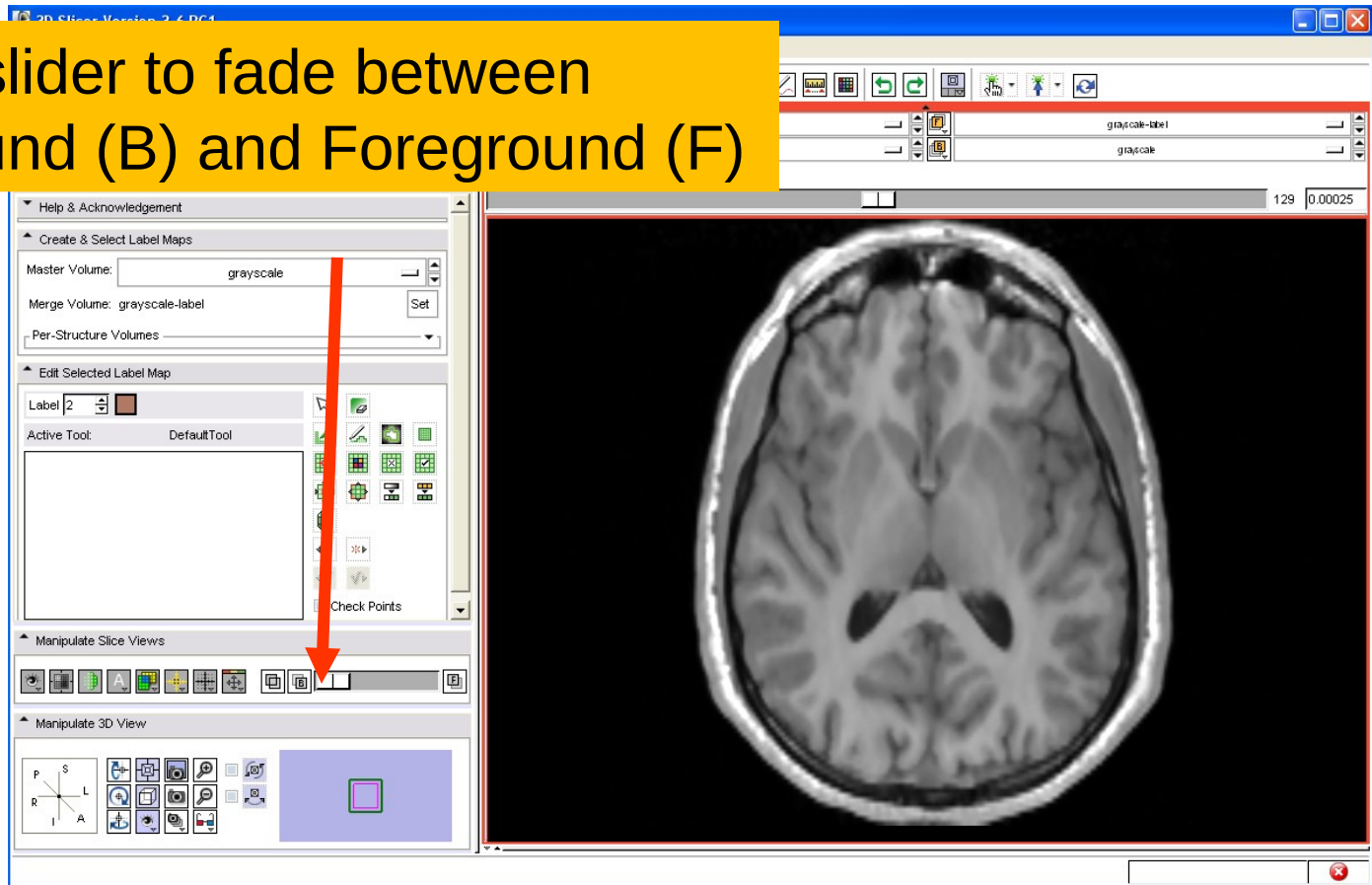
Left click on the drop-down menu to the right of the F icon and select the volume ***grayscale-label***





Threshold Effect

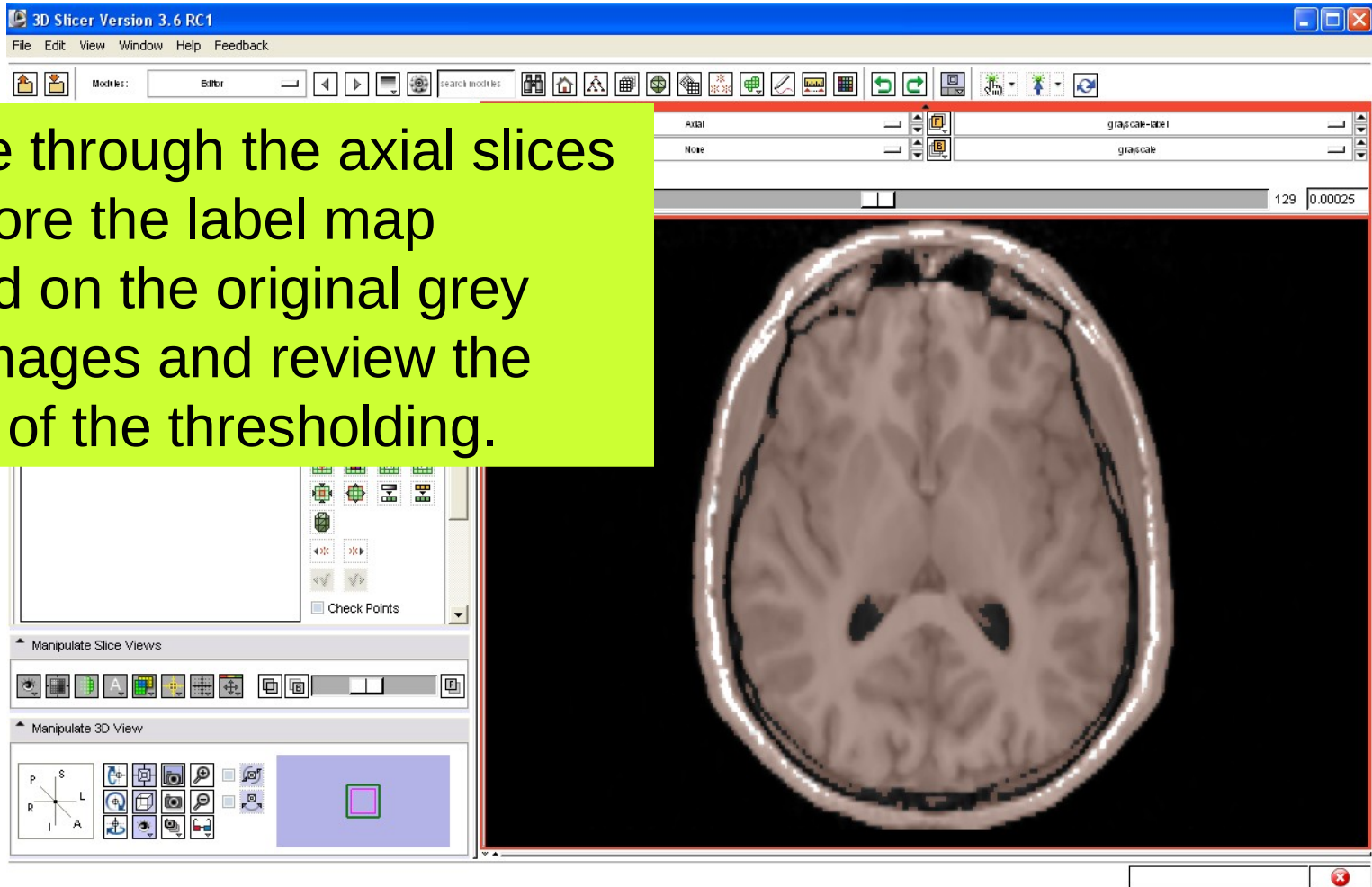
Use the slider to fade between Background (B) and Foreground (F)





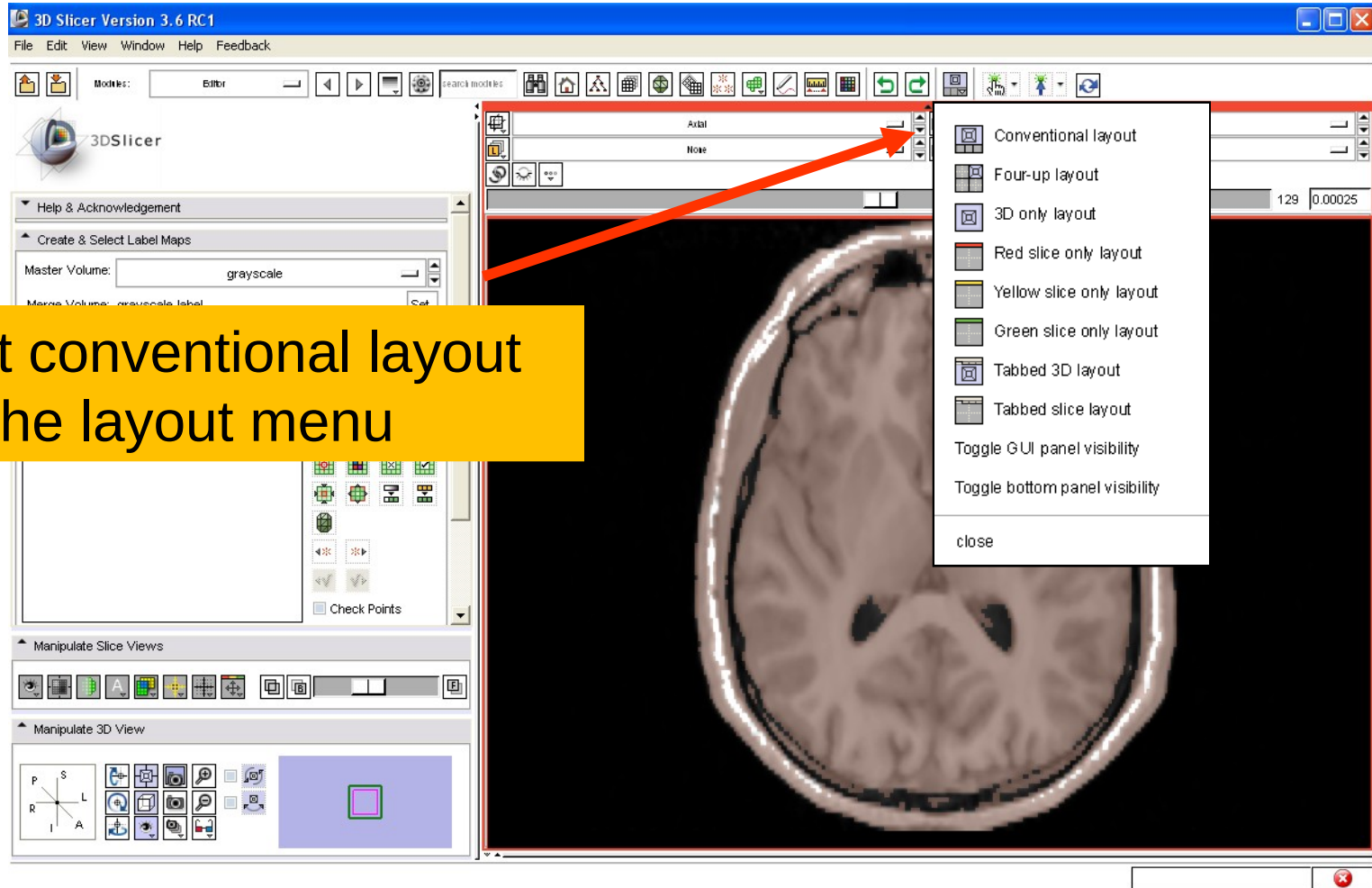
Exploring the result

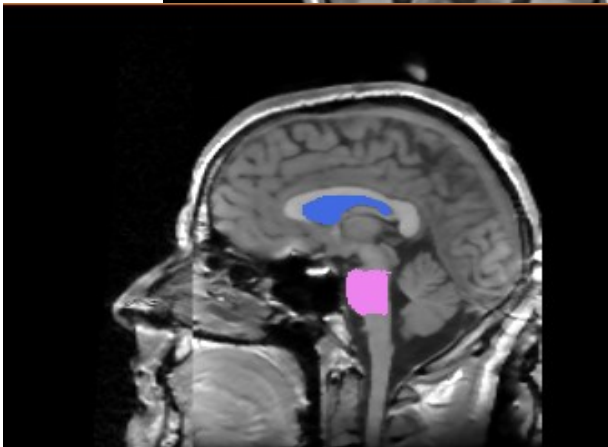
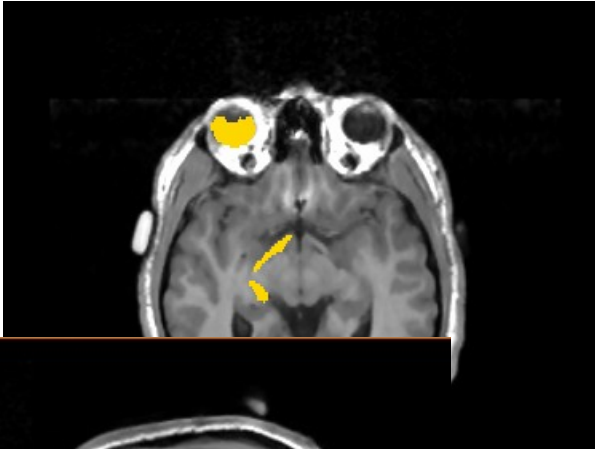
Browse through the axial slices to explore the label map overlaid on the original grey level images and review the results of the thresholding.





Threshold Effect

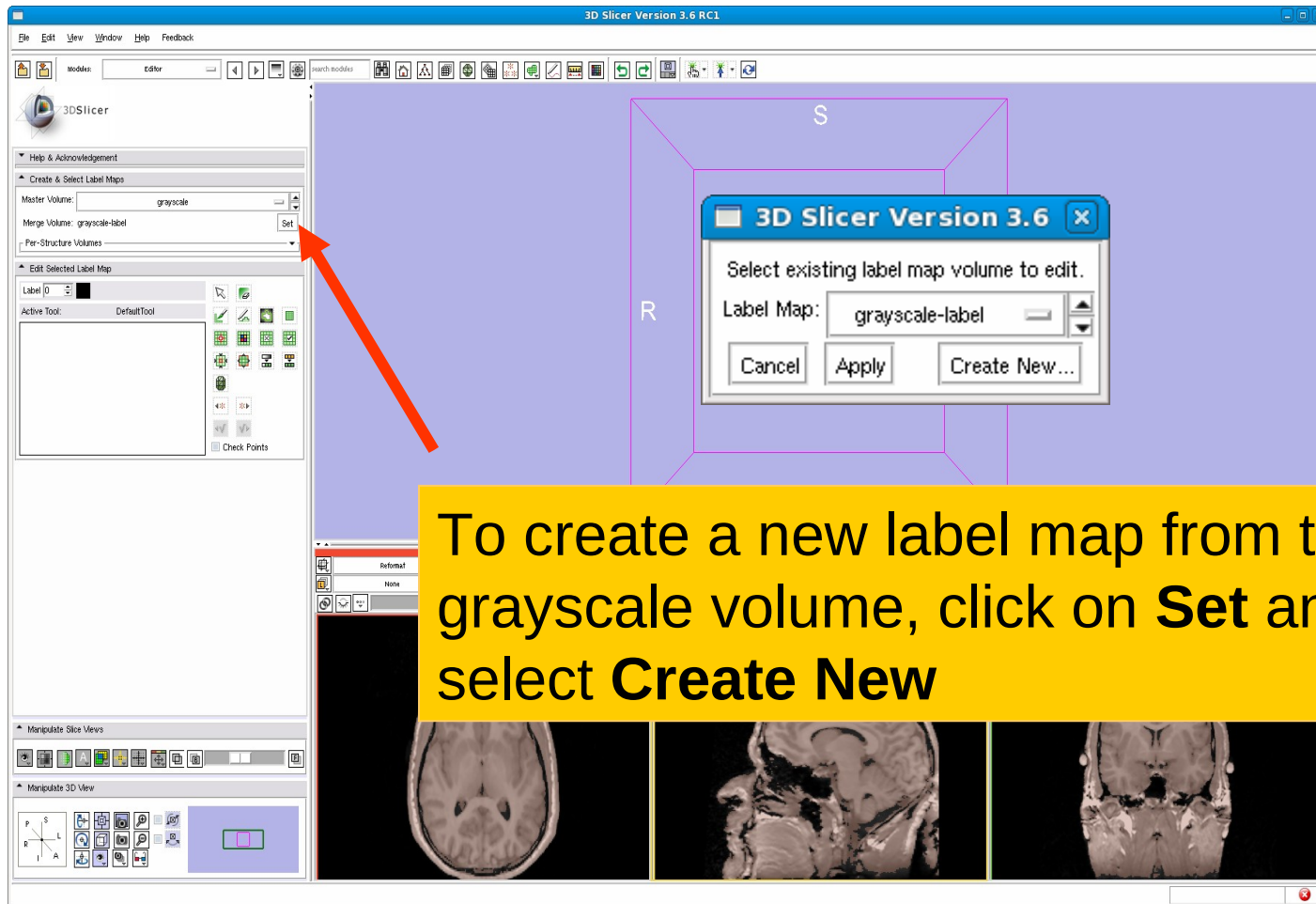




Part 3: Creating and editing a label map with multiple labels



Creating a map with multiple labels

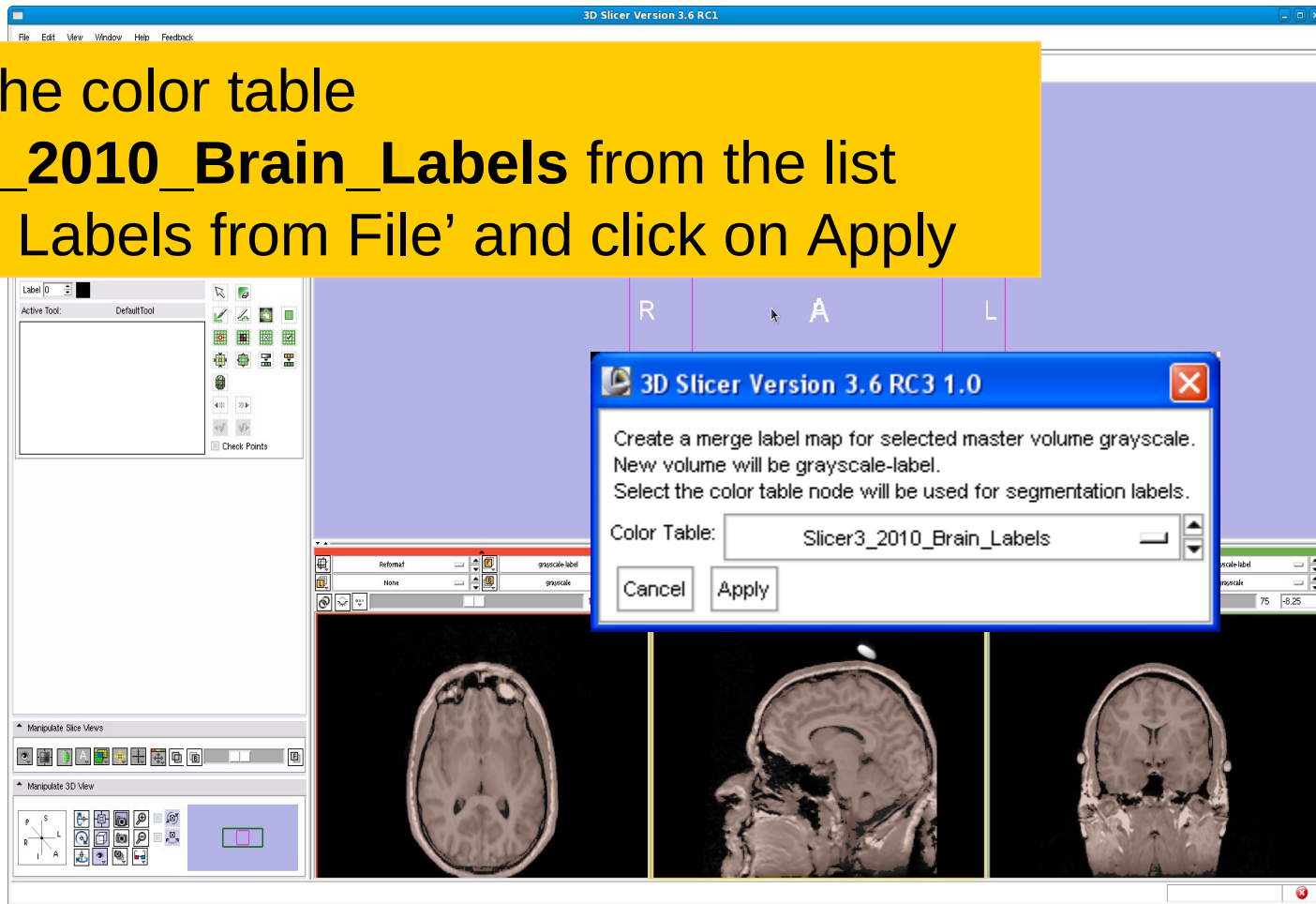




Creating a map with multiple labels

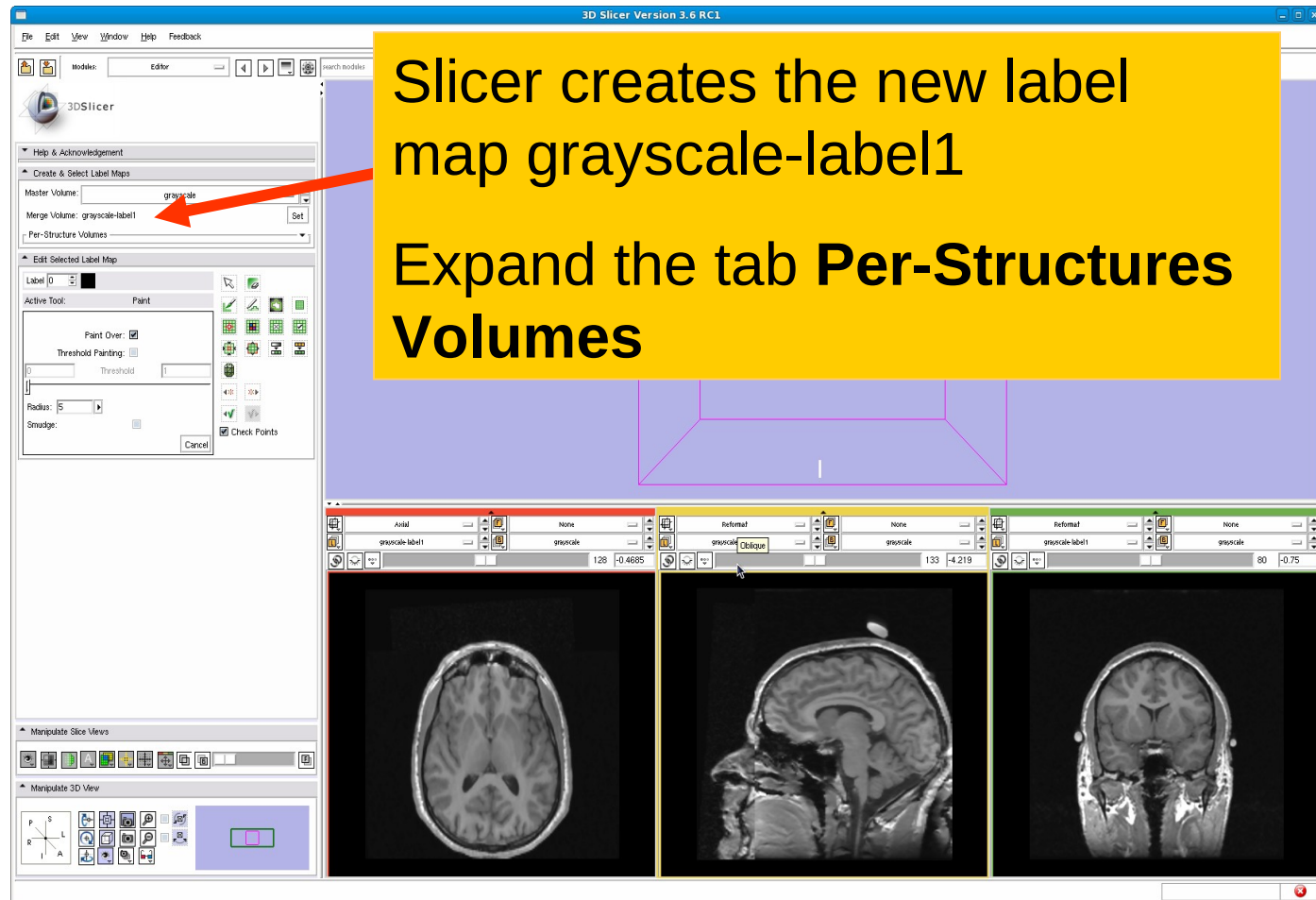
Select the color table

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	Magenta	Structure_1
15	Yellow	Structure_2



Drawing

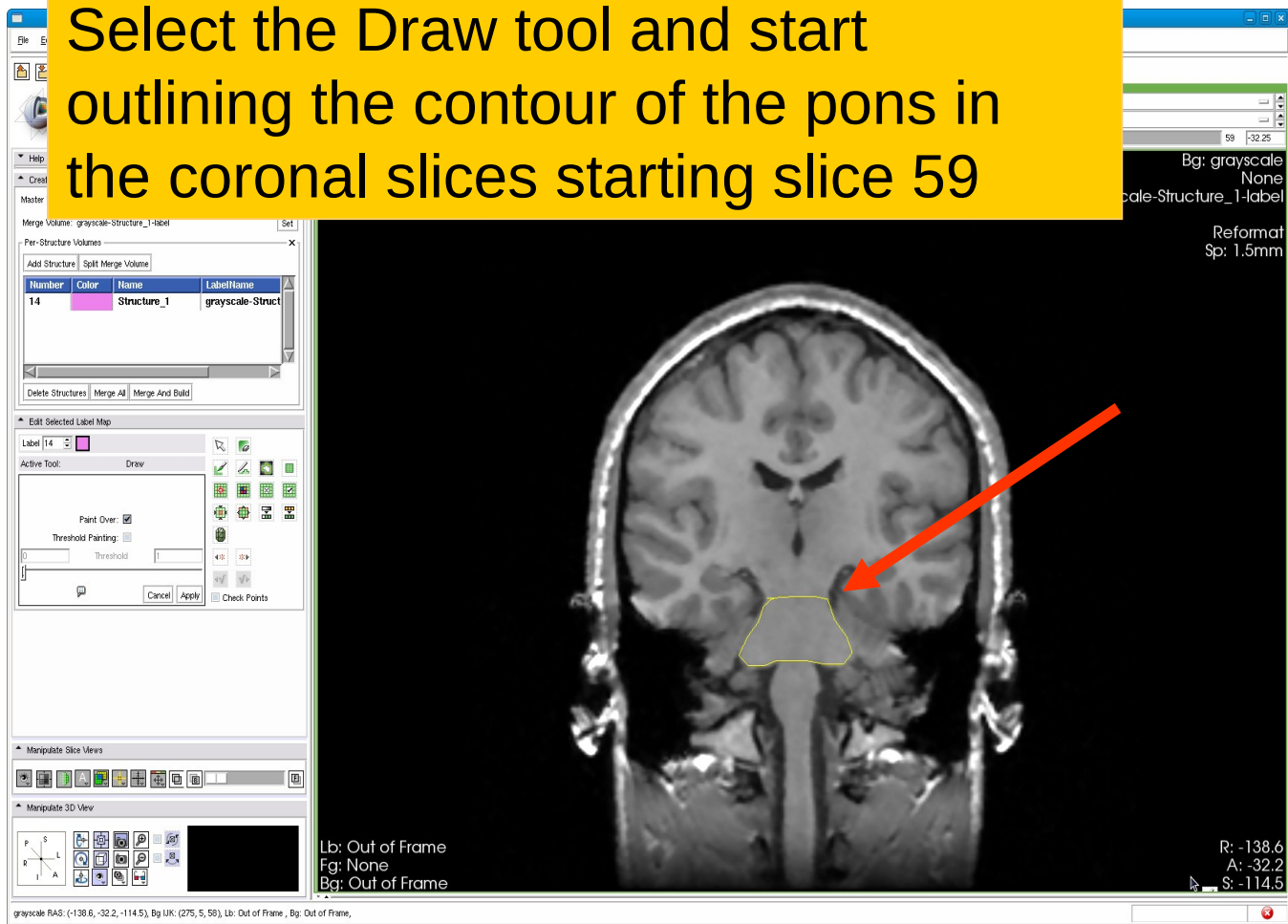


Description: The draw tool is an intuitive tool that can be used to manually outline structures in the grey level images.



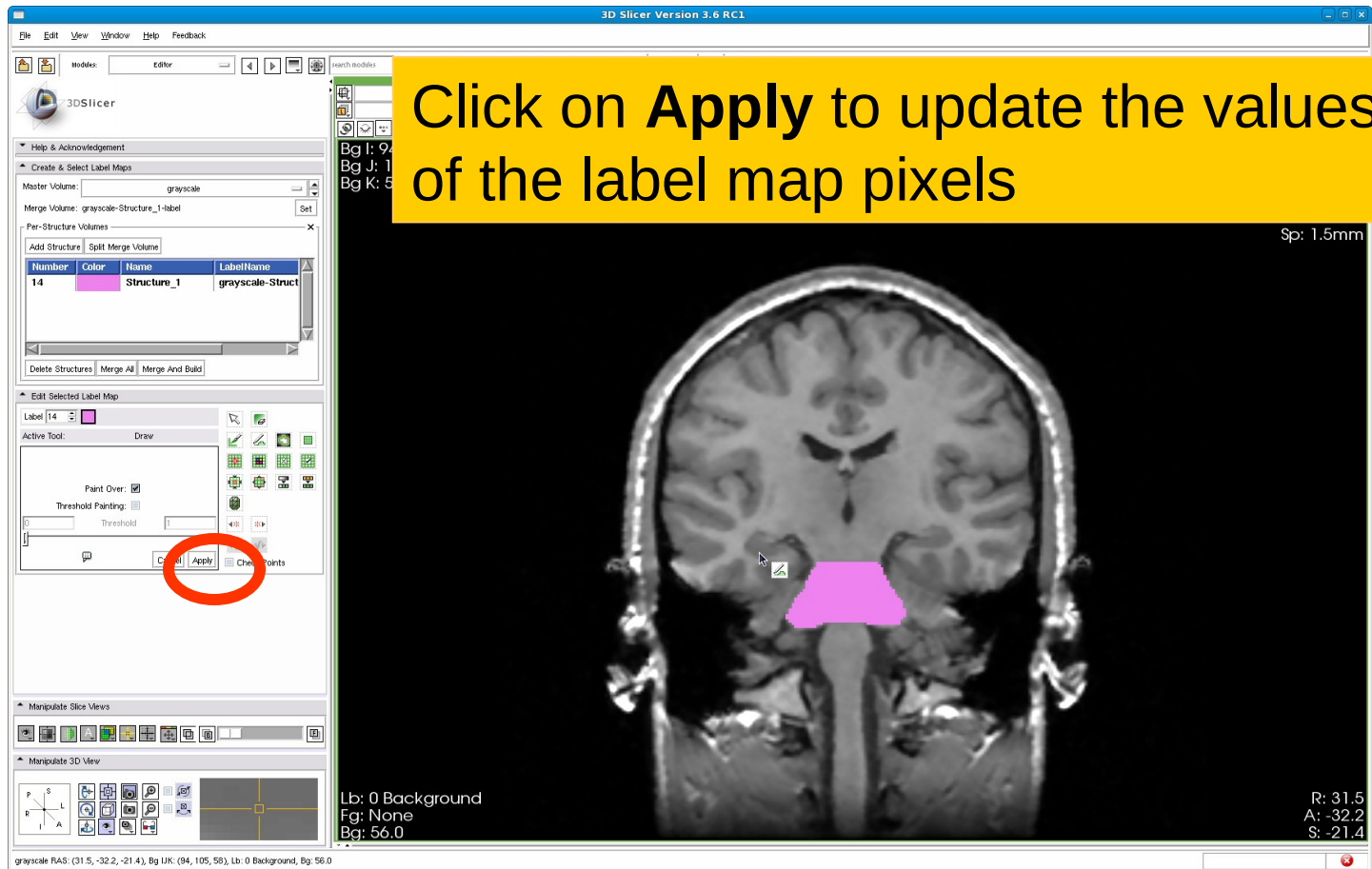
Draw Tool

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



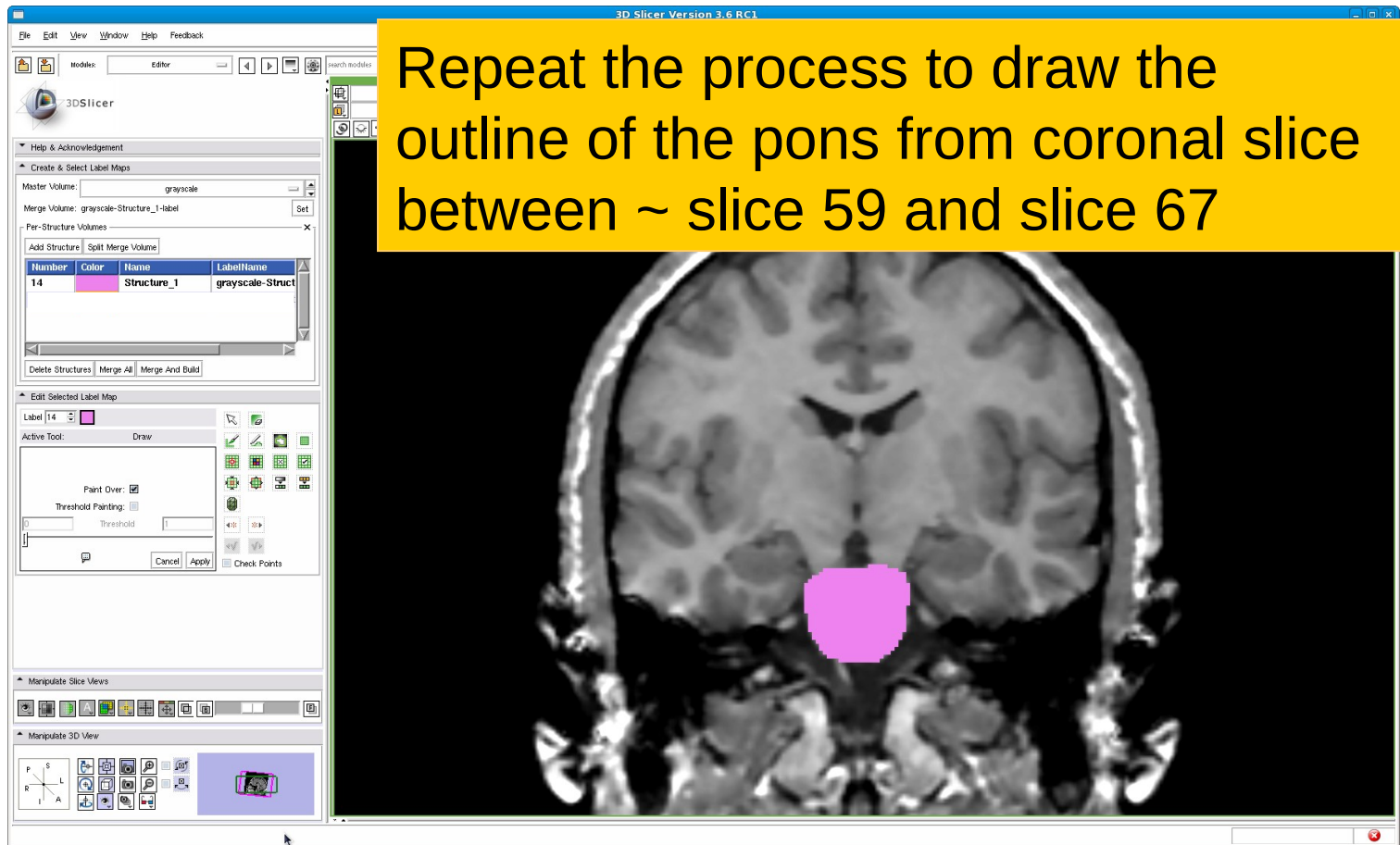


Draw Tool





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	Brown	Skin
3	Red	Muscles
4	Yellow	Fat
5	Cyan	CSF
6	Blue	Ventricles
7	Red	Arteries
8	Blue	Veins
9	Gray	Gray_matter

3D Slicer Version 3.6 RC1

Reformat Sp: 1.5mm

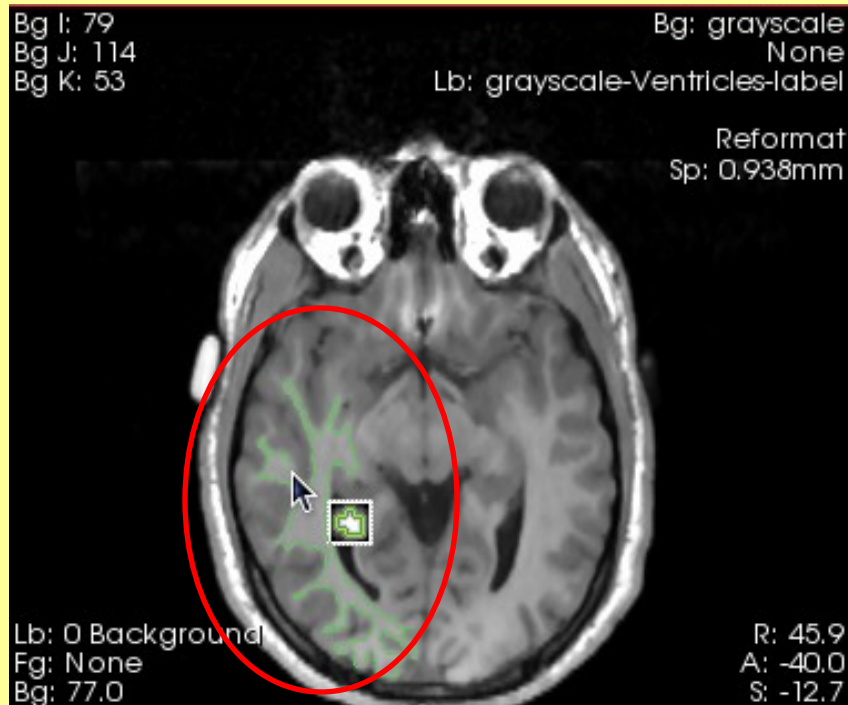
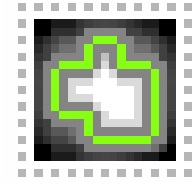
Lb: 0 Background
Fg: None
Bg: 81.0

R: -37.7
A: -30.8
S: 29.2

grayscale RAS: (-37.7, -30.8, 29.2), Bg LK: (168, 159, 59), Lb: 0 Background, Bg: 81.0



Level Tracing

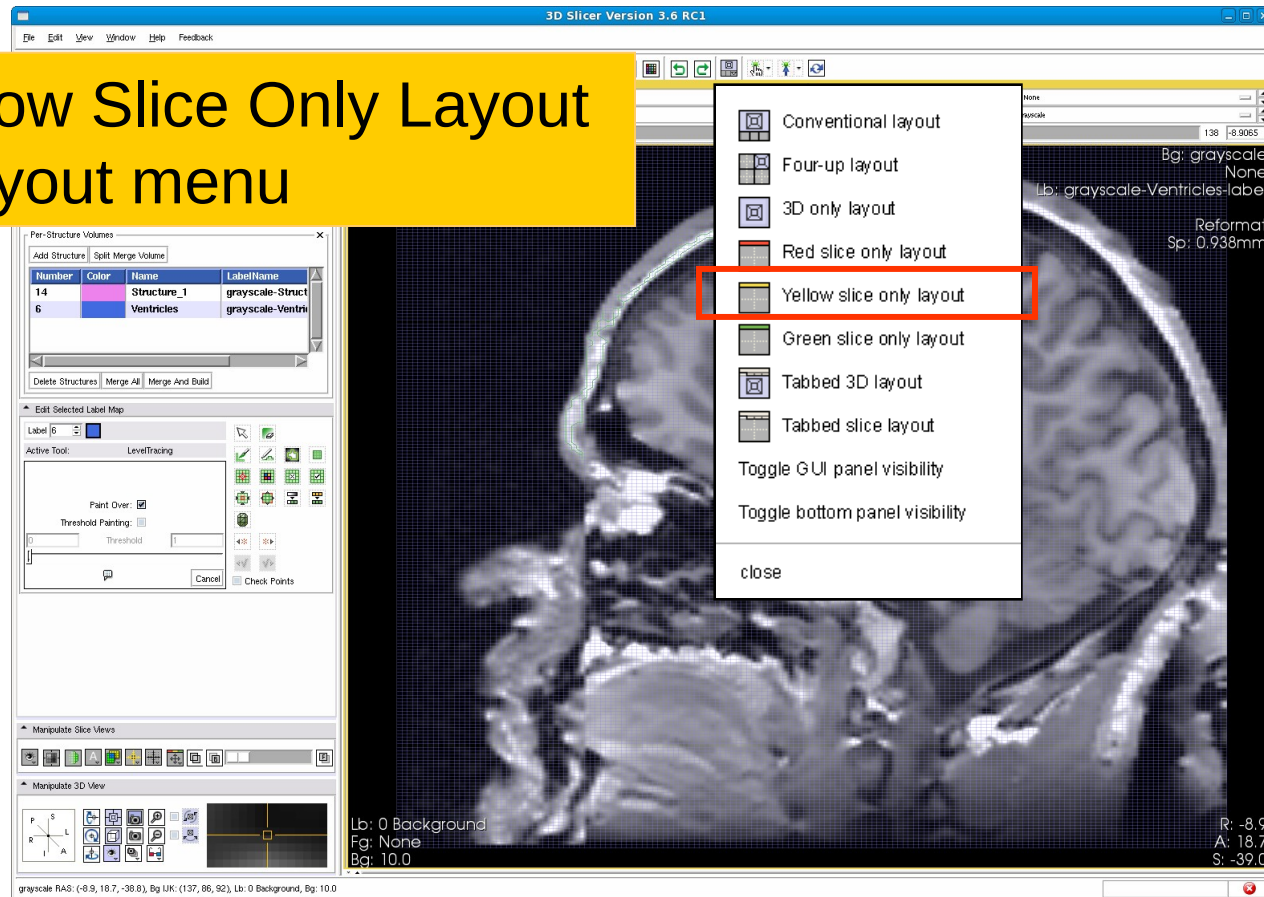


Description: By moving the mouse in the grey level images, you'll define in the label map volume an outline where the pixels all have the same value as the current background pixel.



Level Tracing

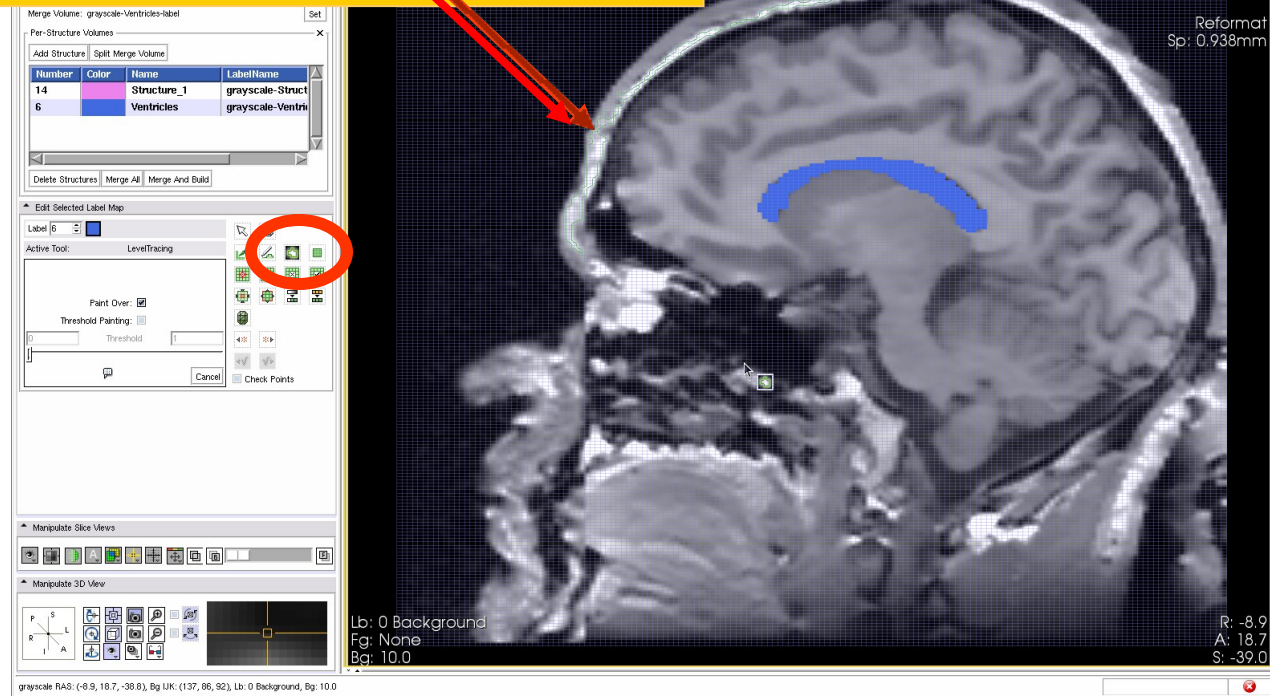
Select Yellow Slice Only Layout
from the layout menu





Level Tracing

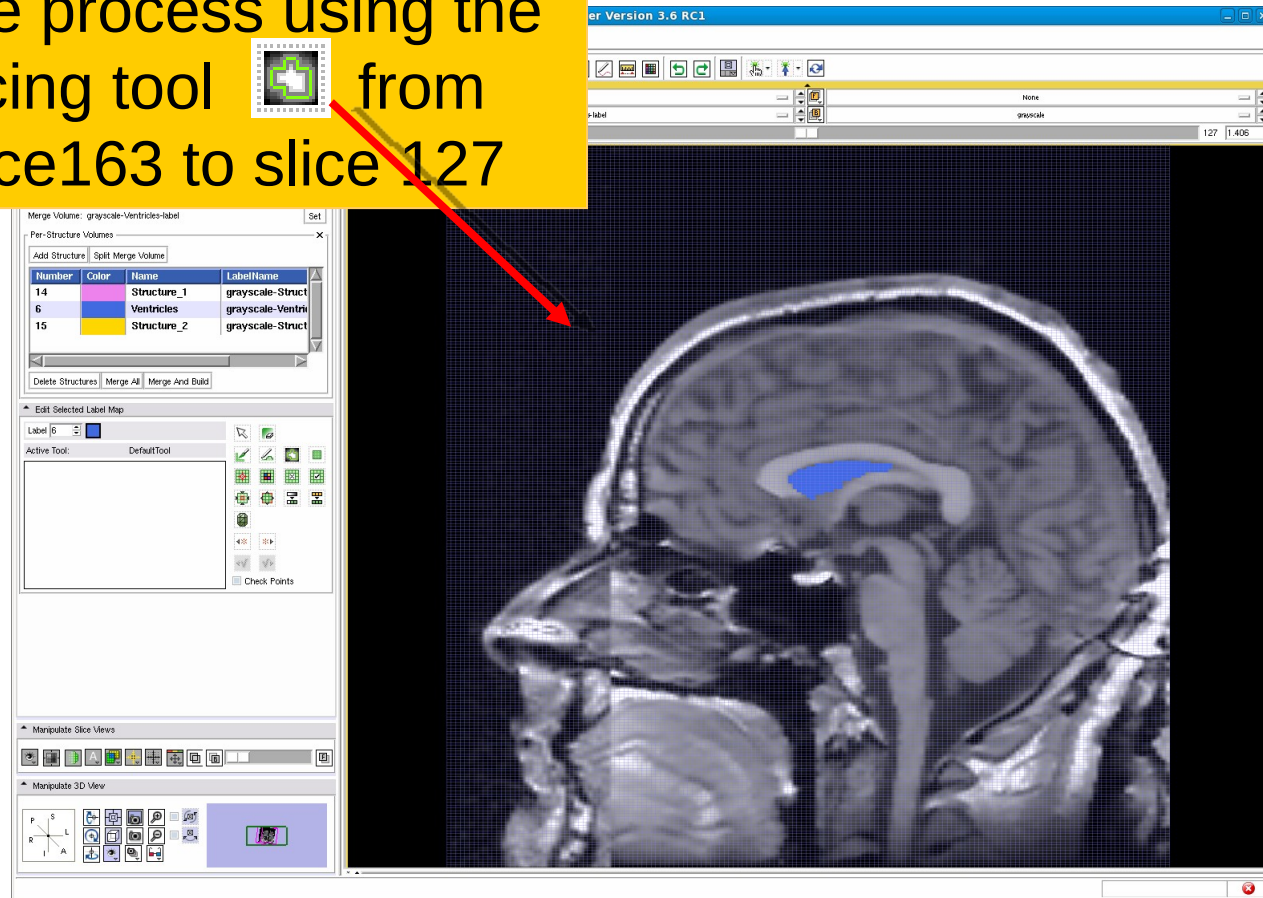
Use the **Level Tracing** tool to trace the outline of the left lateral ventricle on slice 138





Level Tracing

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

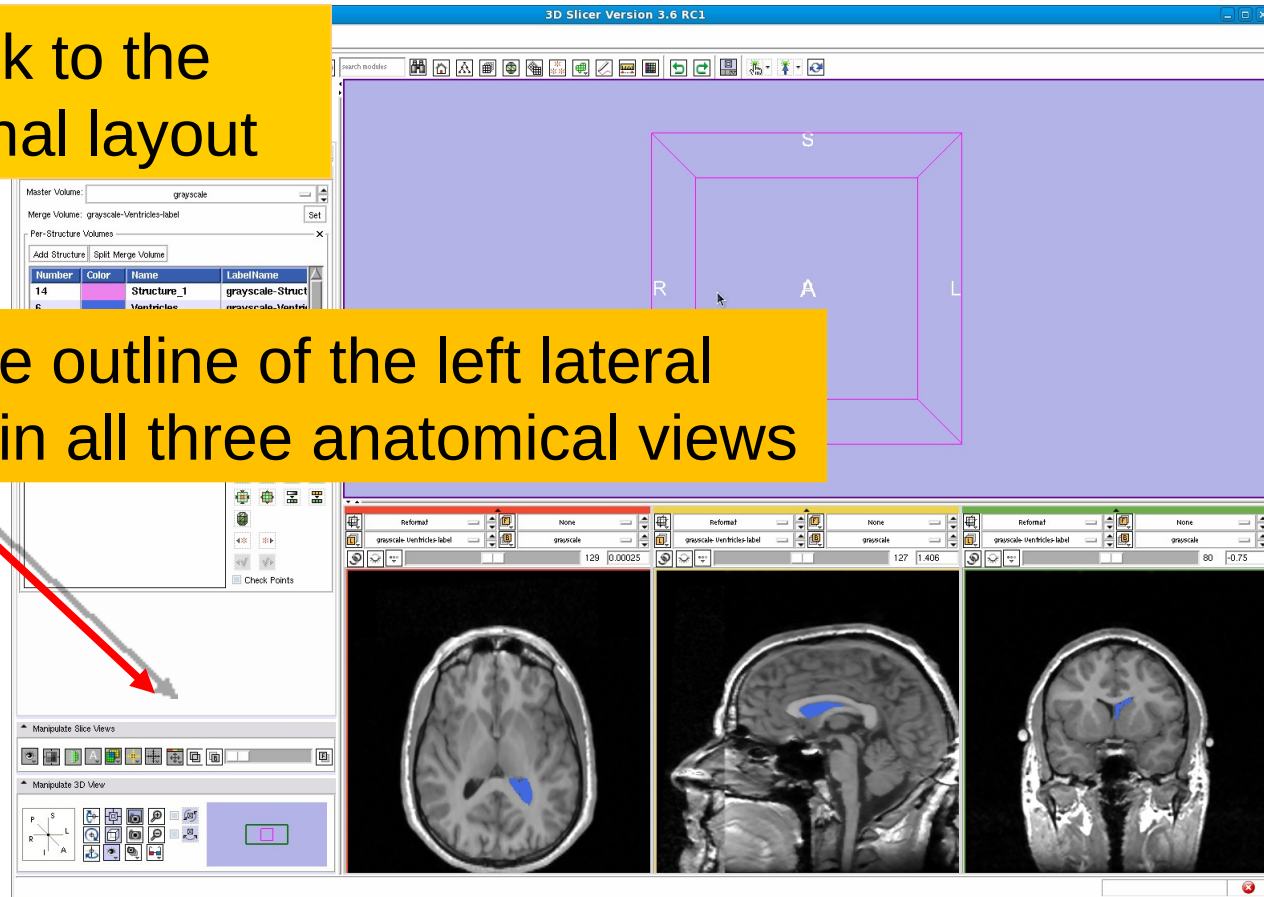




Level Tracing

Come back to the conventional layout

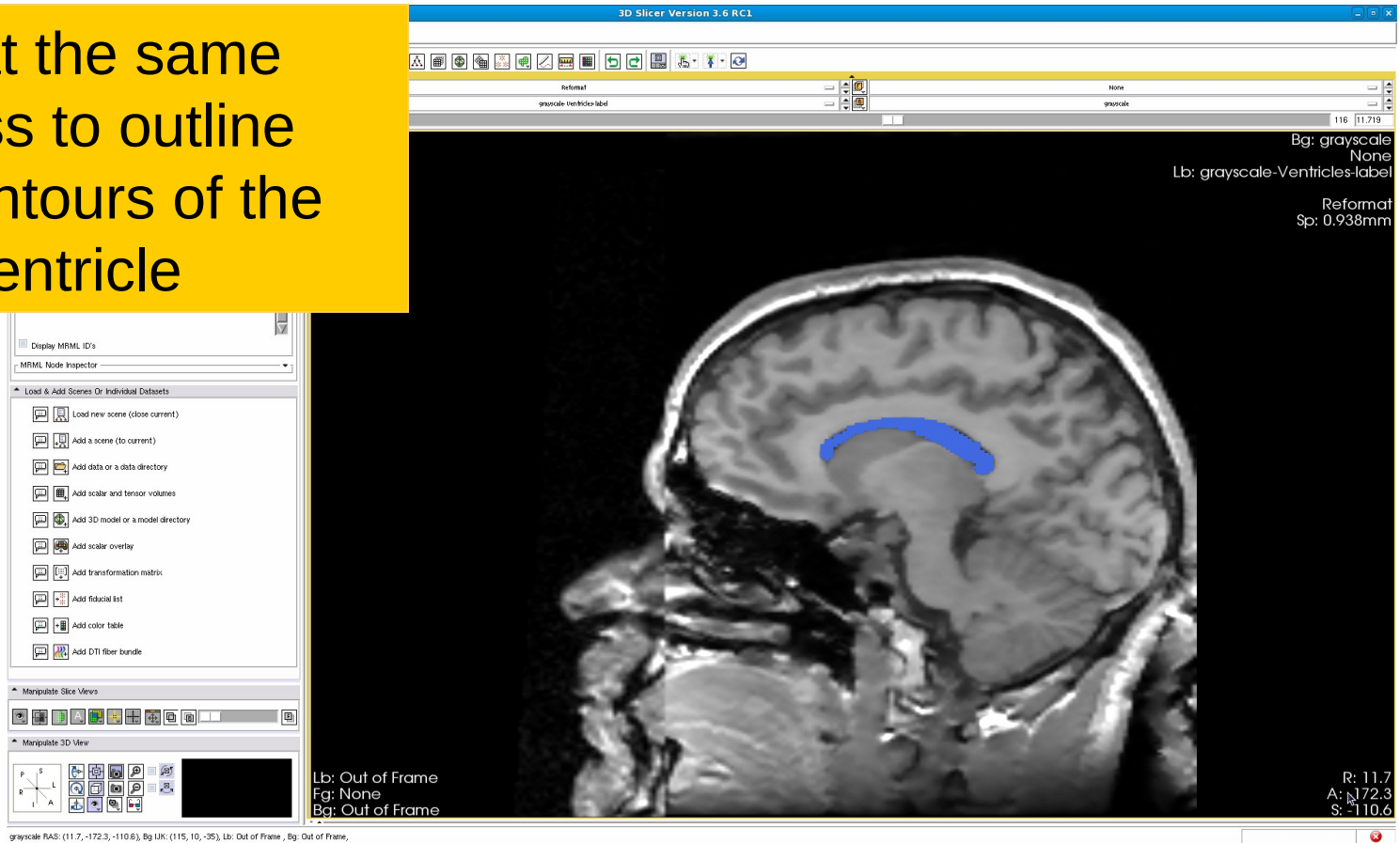
Explore the outline of the left lateral ventricles in all three anatomical views





Level Tracing

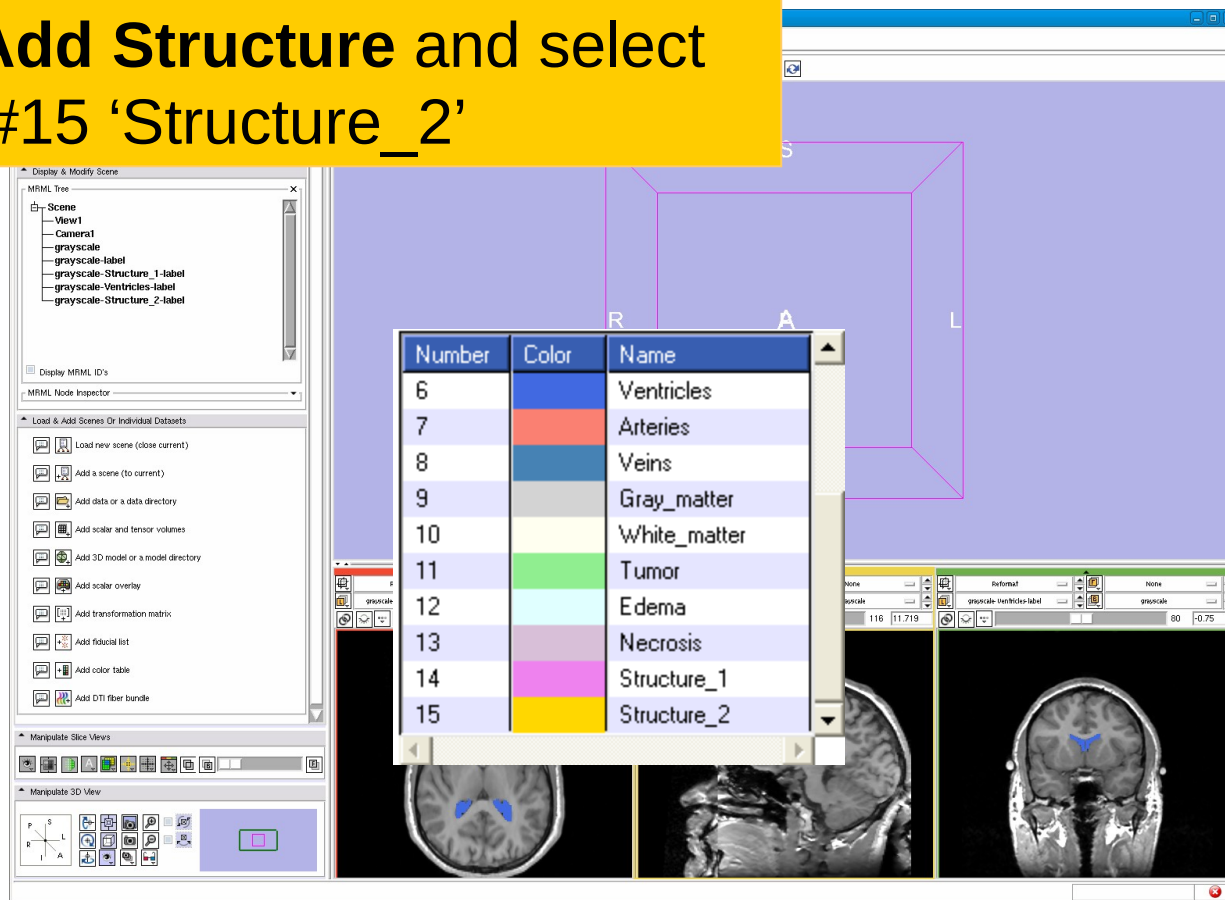
Repeat the same process to outline the contours of the right ventricle





Adding a third structure

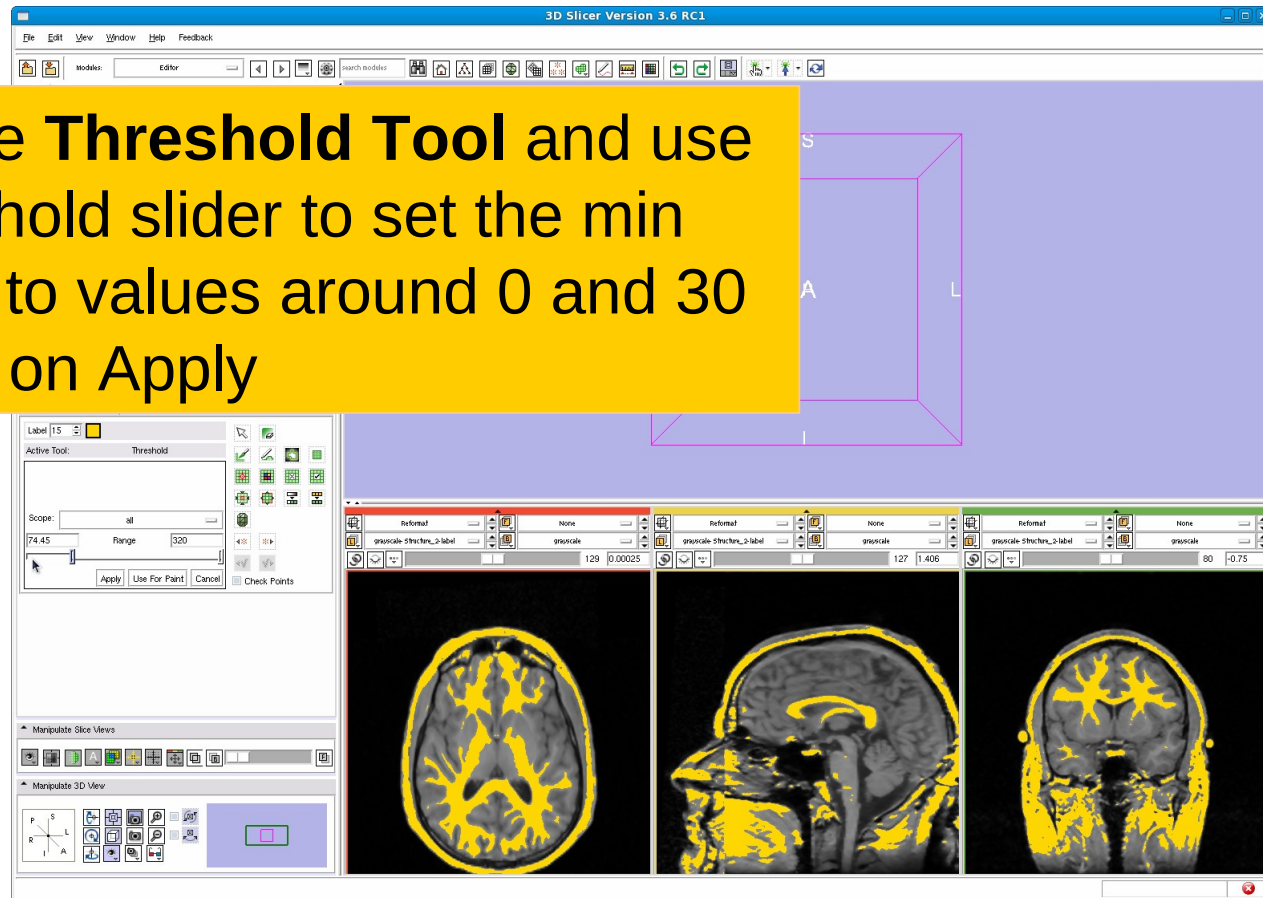
Click on **Add Structure** and select the label #15 'Structure_2'





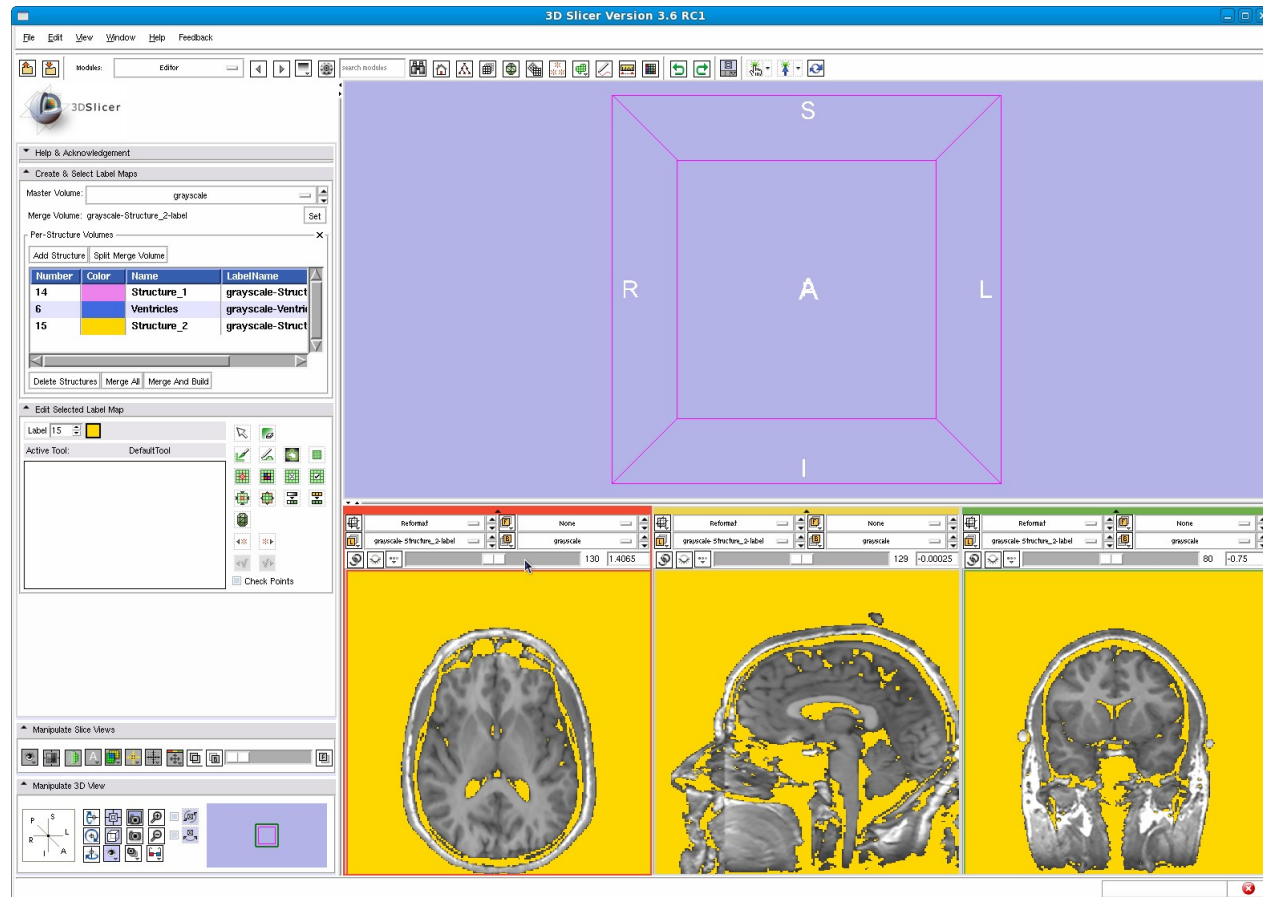
Threshold tool

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





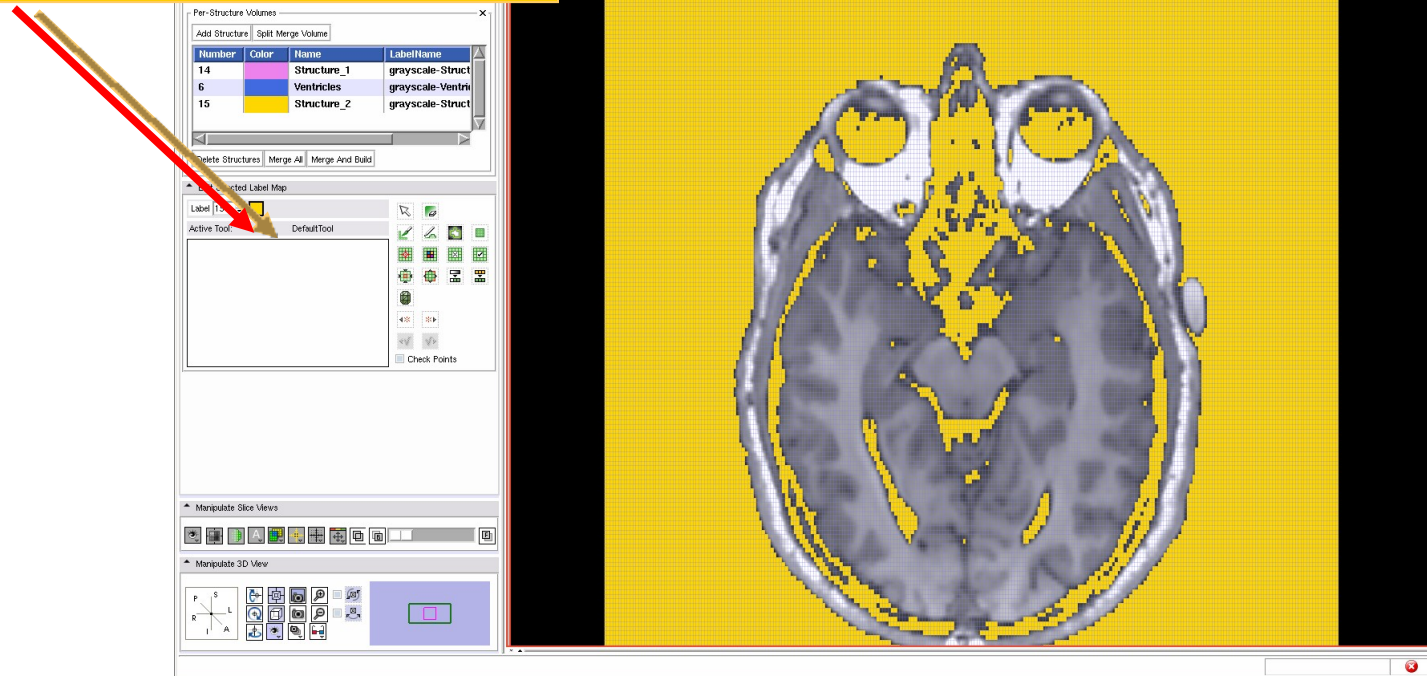
Threshold tool





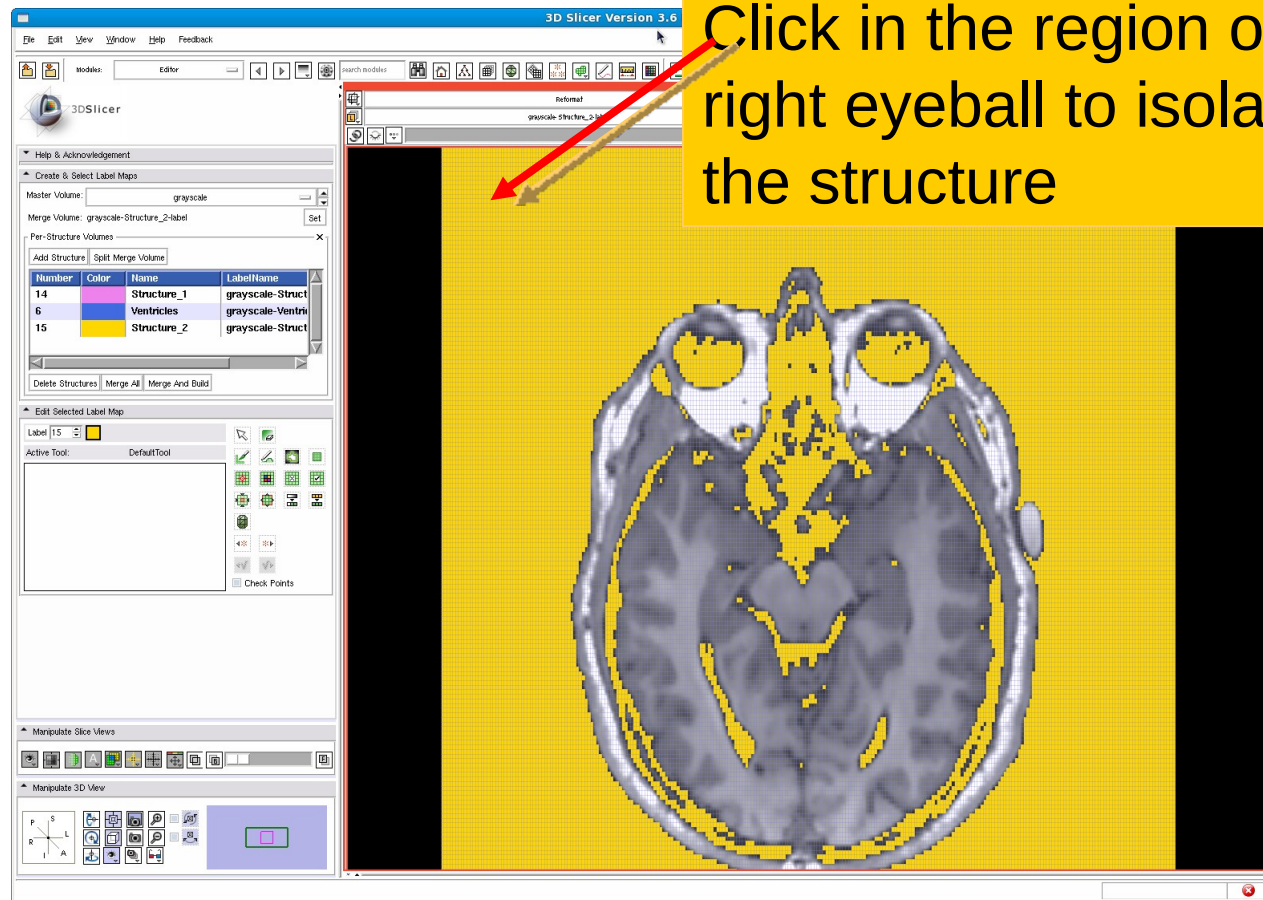
Save Island

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





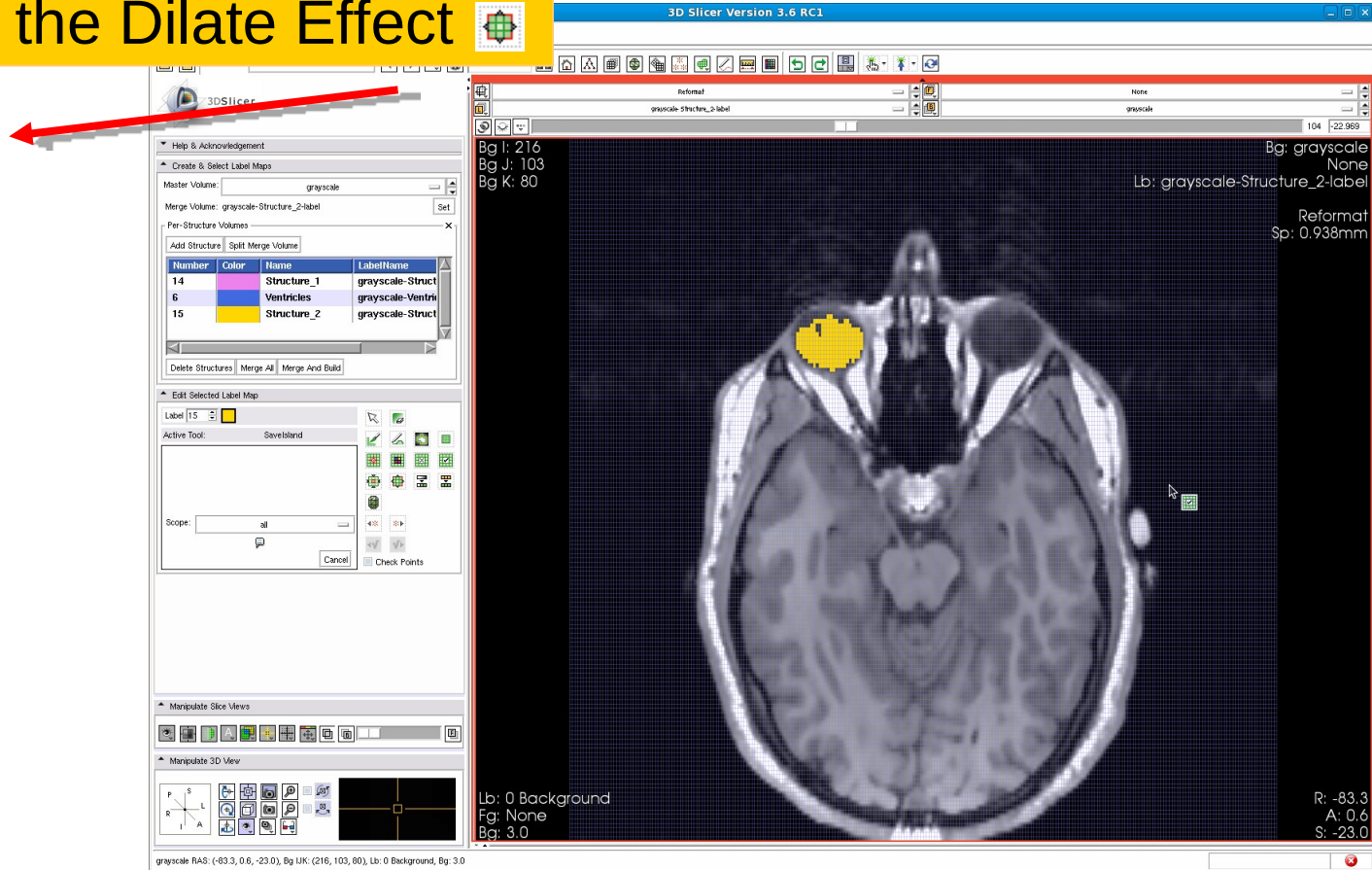
Save Island





Dilate Effect

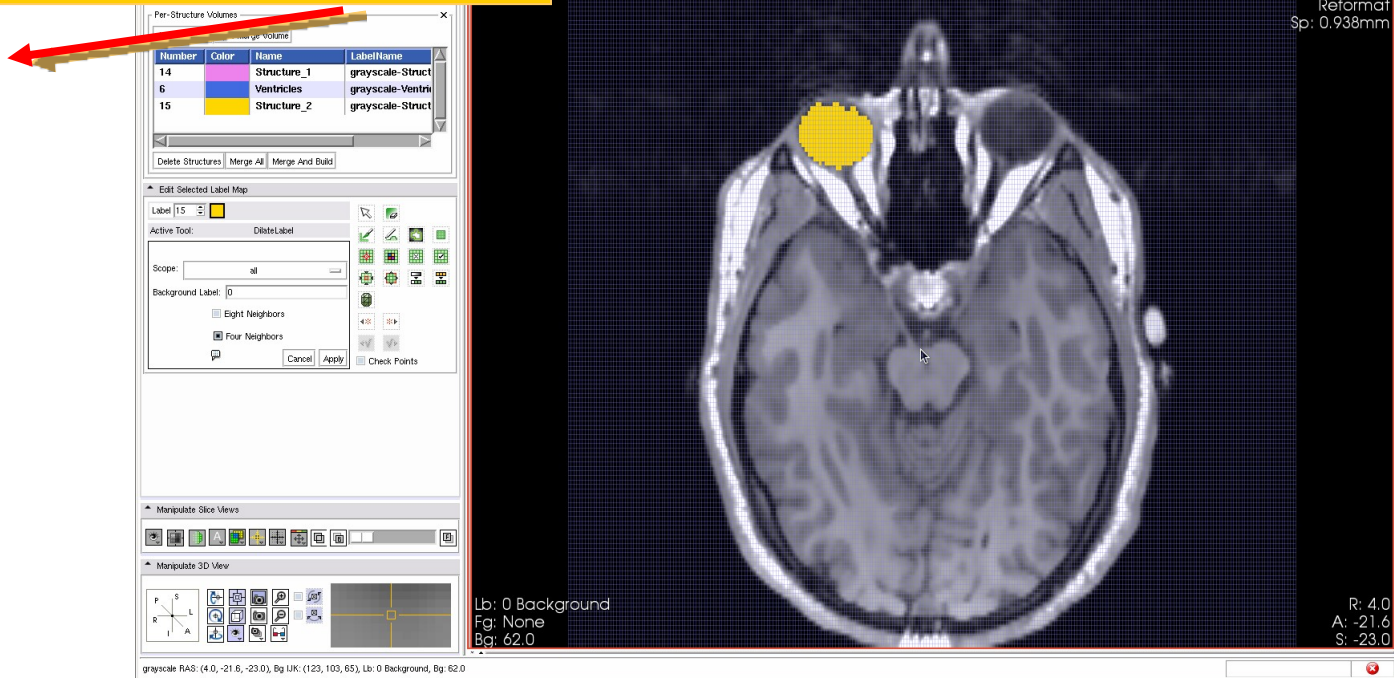
Select the Dilate Effect





Dilate Effect

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





Dilate Effect

Browse through the axial slices of the segmented eyeball

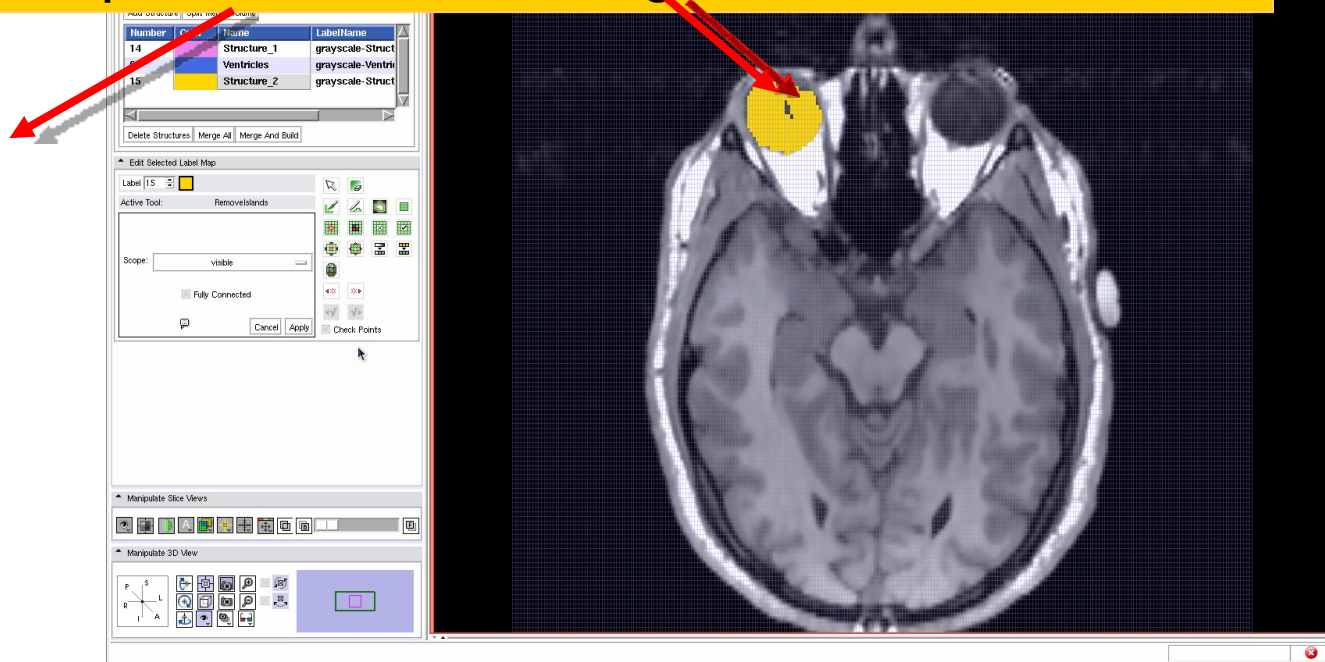




Remove Island

Select the **Remove Island**  tool

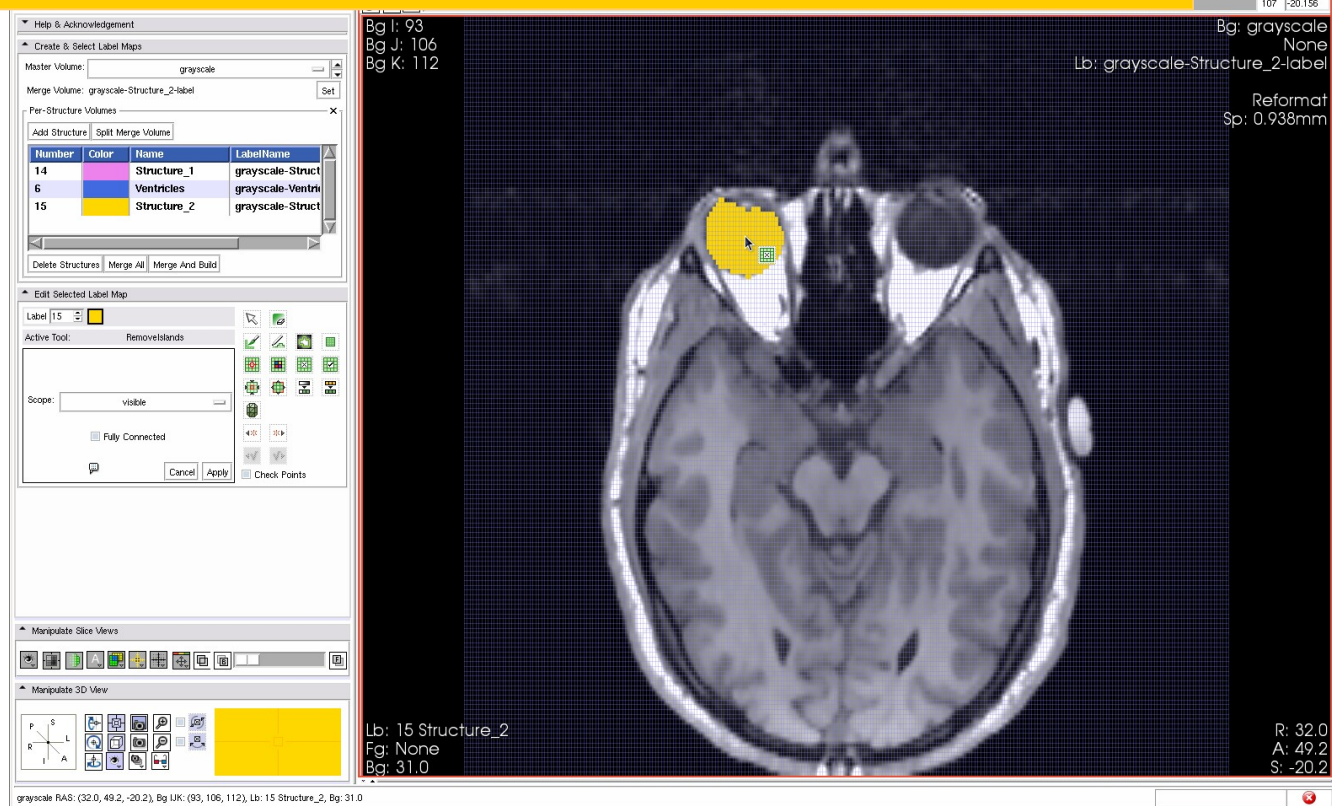
Select **Scope: visible** and click on **Apply** to remove the isolated pixels inside the segmented structure





Remove Island

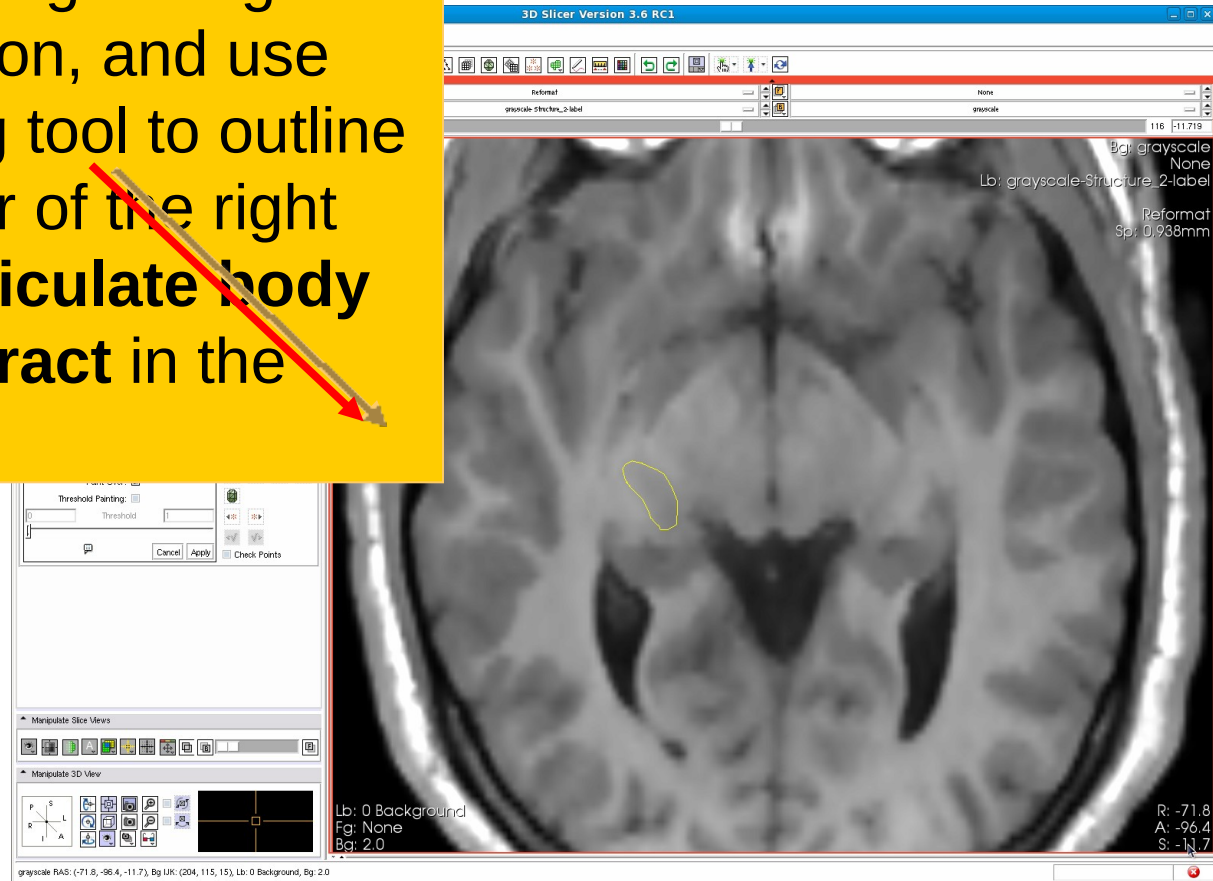
Repeat the process in the slices that contain isolated pixels in the eyeball structure





Adding more structures

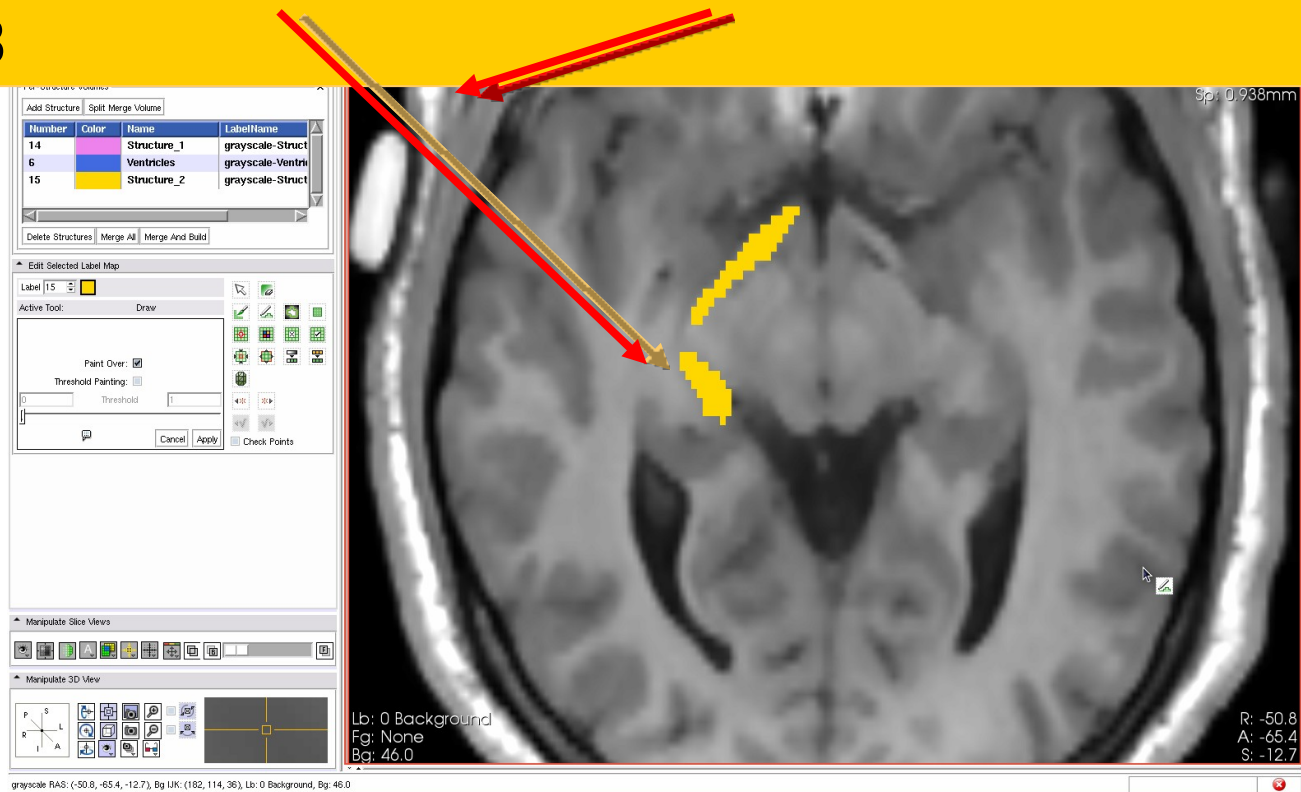
Zoom in using the right mouse button, and use the drawing tool to outline the contour of the right lateral geniculate body and optic tract in the axial view.





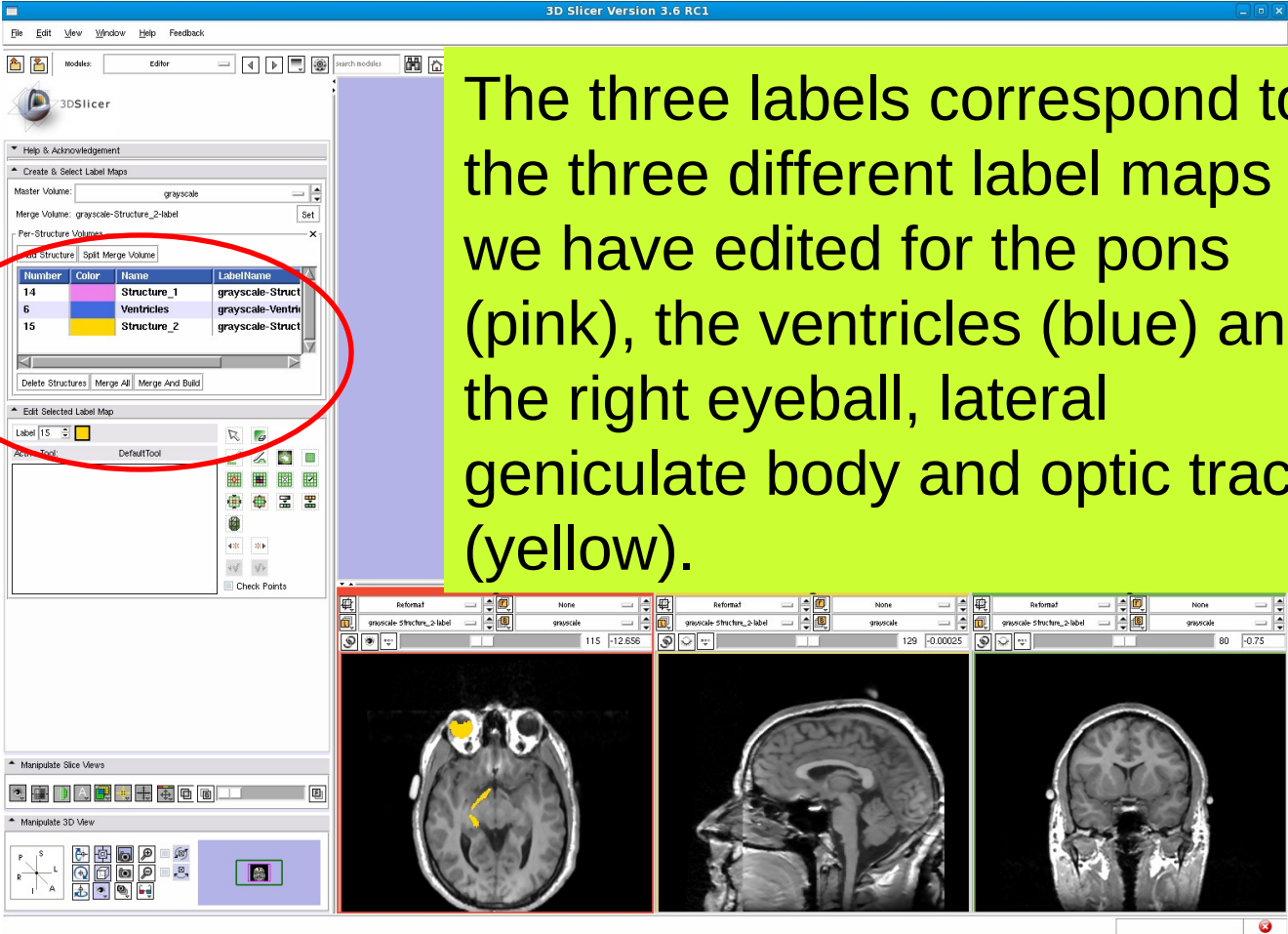
Adding more structures

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



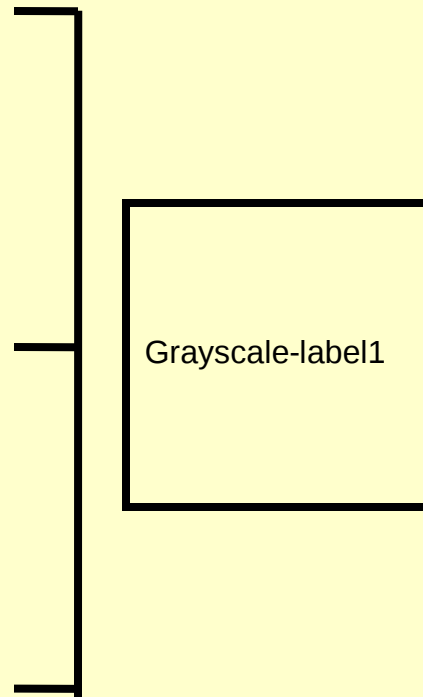
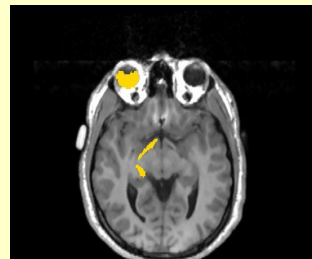
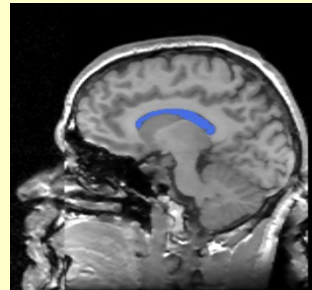
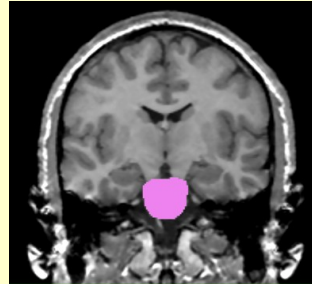
The three labels correspond to the three different label maps that we have edited for the pons (pink), the ventricles (blue) and the right eyeball, lateral geniculate body and optic tract (yellow).

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

The screenshot shows the 3D Slicer interface with three viewports at the bottom: an axial view, a sagittal view, and a coronal view. The 'Per-Structure Volumes' table is highlighted with a red circle. The 'Edit Selected Label Map' panel shows 'Label 15' selected. The 'Manipulate 3D View' panel shows a 3D model of the brain with the three structures highlighted in pink, blue, and yellow.



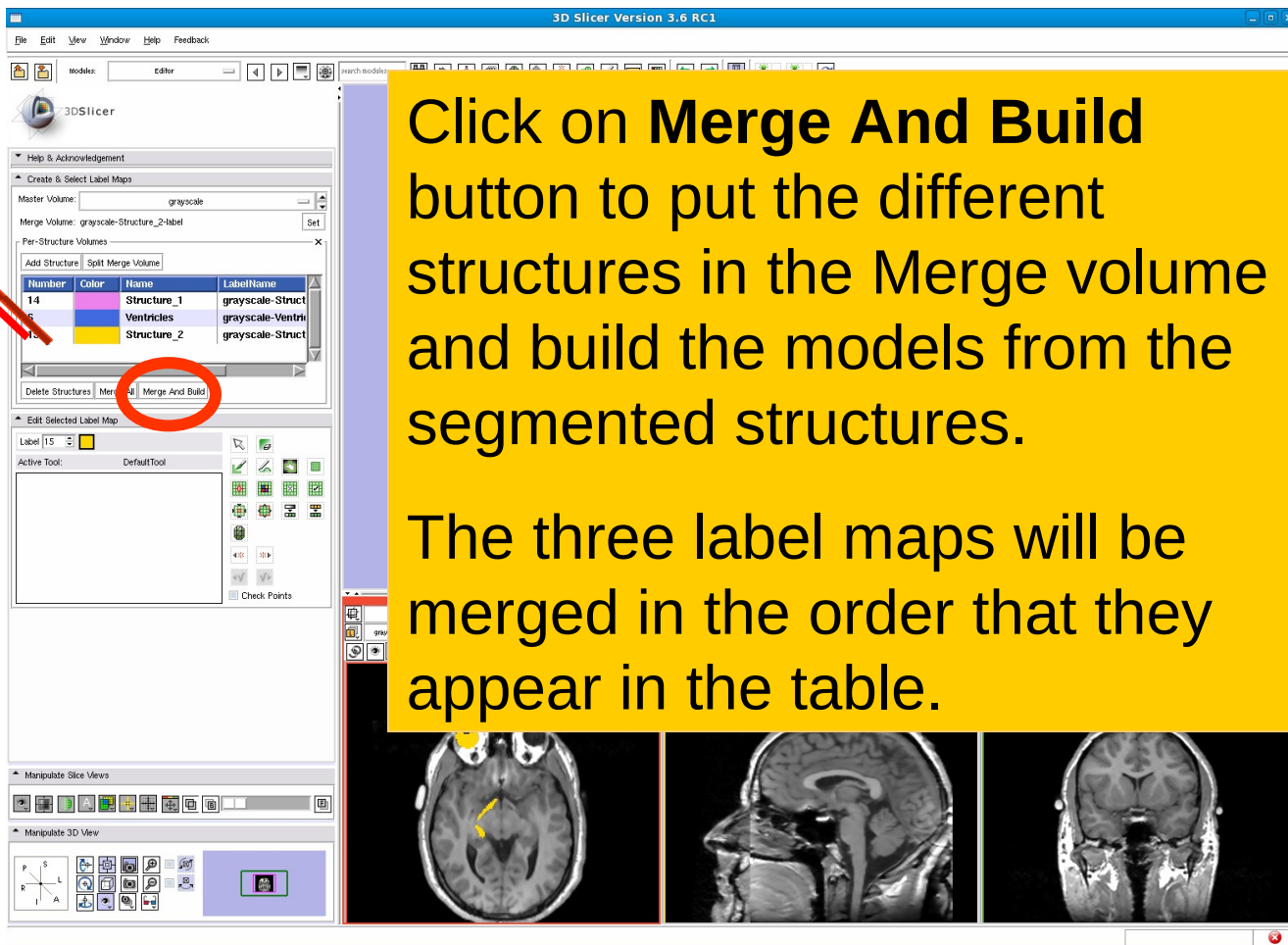
Merging label maps



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



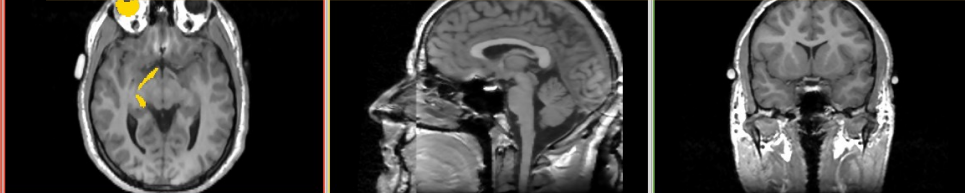
Merge And Build



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.

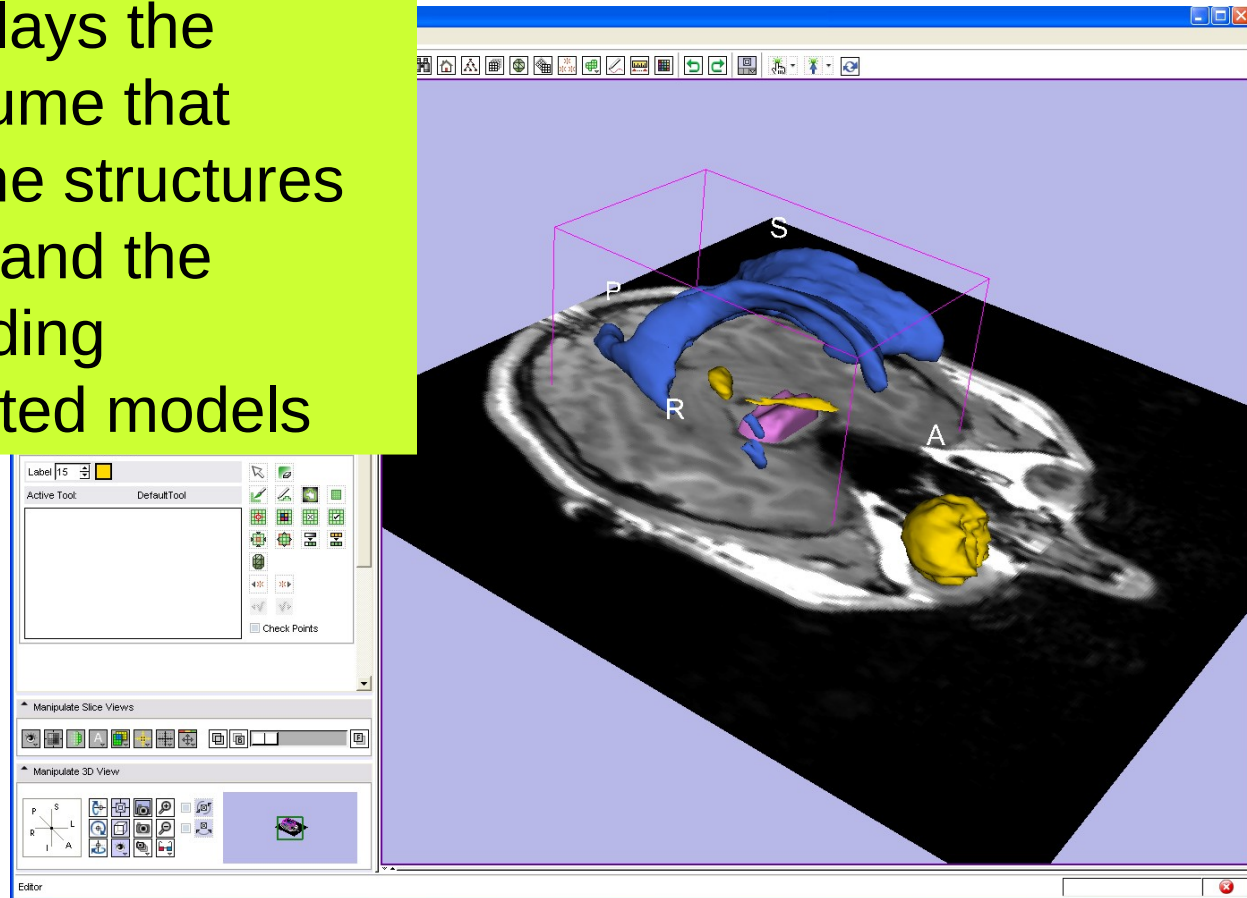
Number	Color	Name	LabelName
14		Structure_1	grayscale-Struct
6		Ventricles	grayscale-Ventri
15		Structure_2	grayscale-Struct





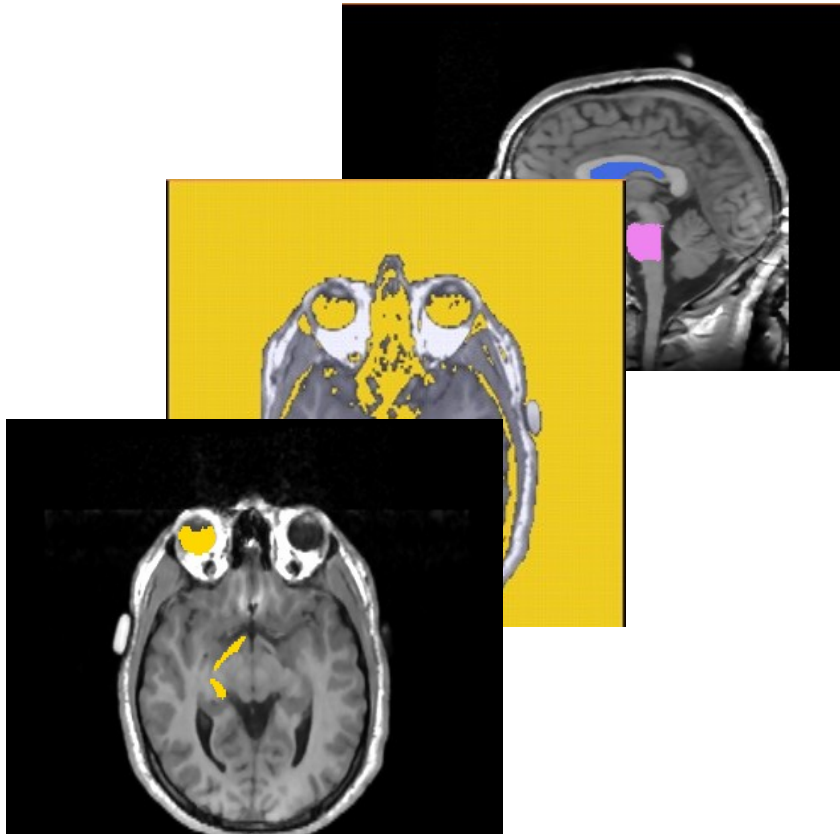
Merge And Build

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



Acknowledgments



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NIH U54EB005149



Neuroimage Analysis Center

NIH P41RR013218



Ron Kikinis, Steve Pieper, Sota Oguro, Randy Gollub