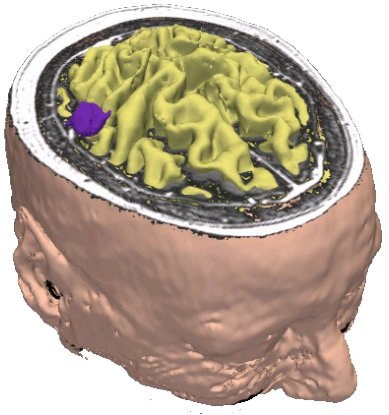
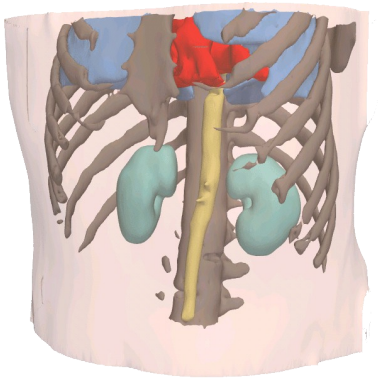
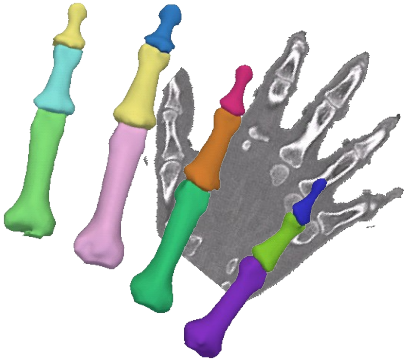
EMSegmenter Tutorial (Advanced Mode)

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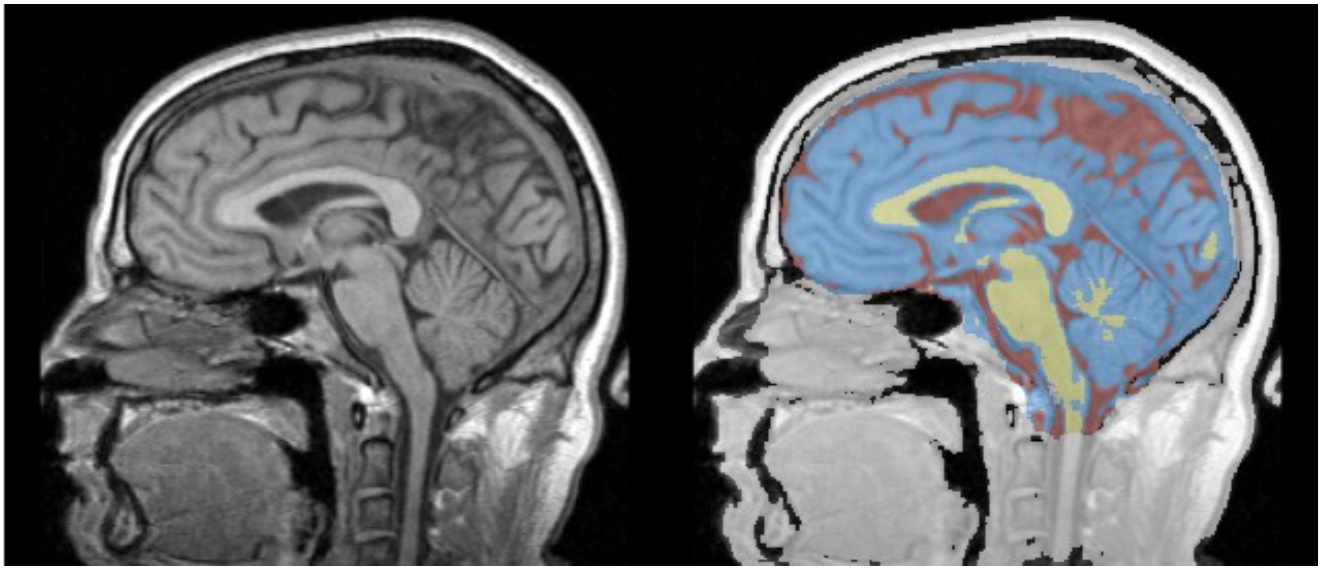
Overview

The goal of this tutorial is to apply the EMSegmenter to MRI brain scans. We will segment the clinical T1 scan shown below into grey matter, white matter, and cerebrospinal fluid.

The tutorial is based on Slicer 3.6.2 .

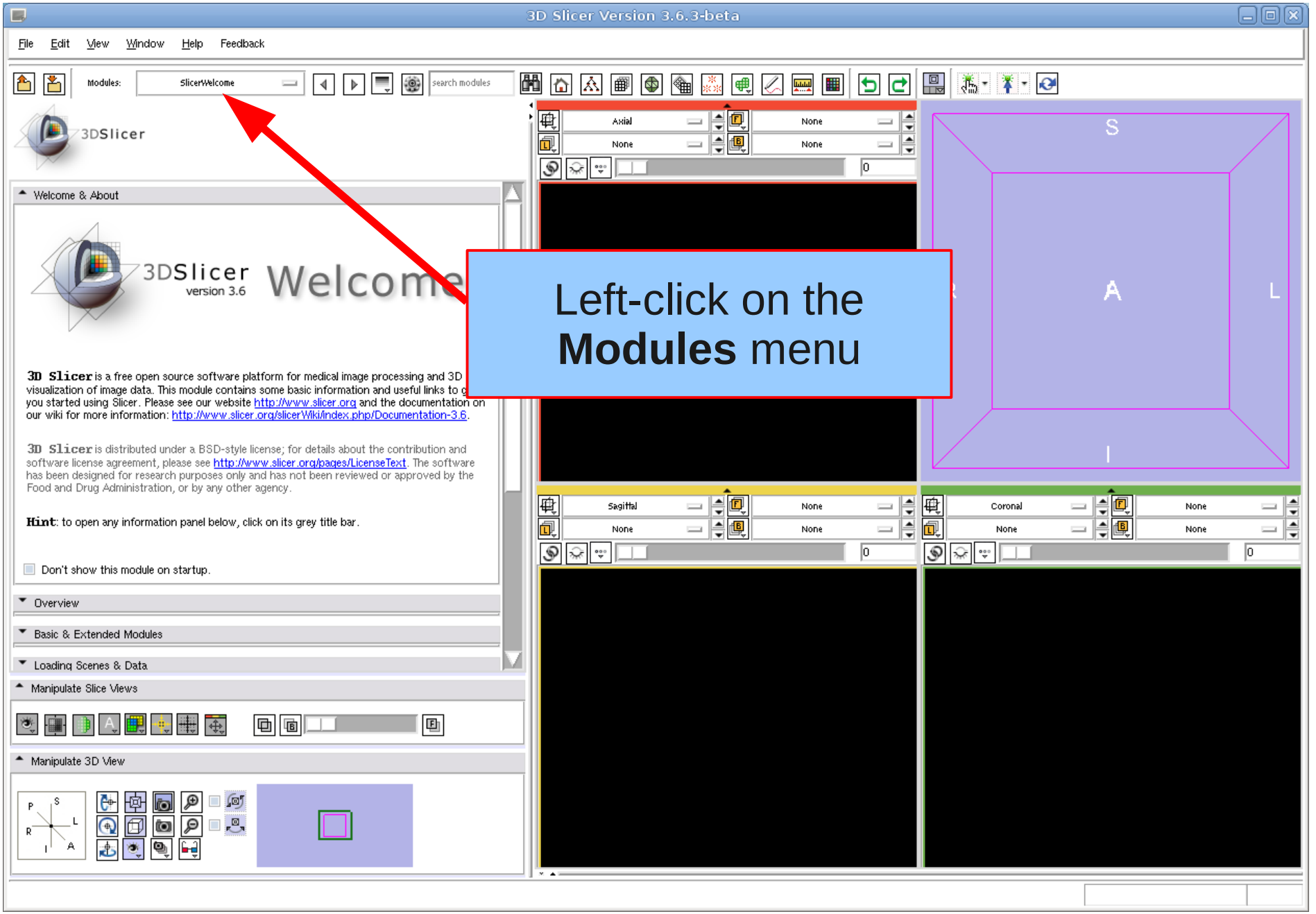
Before  After

Overview

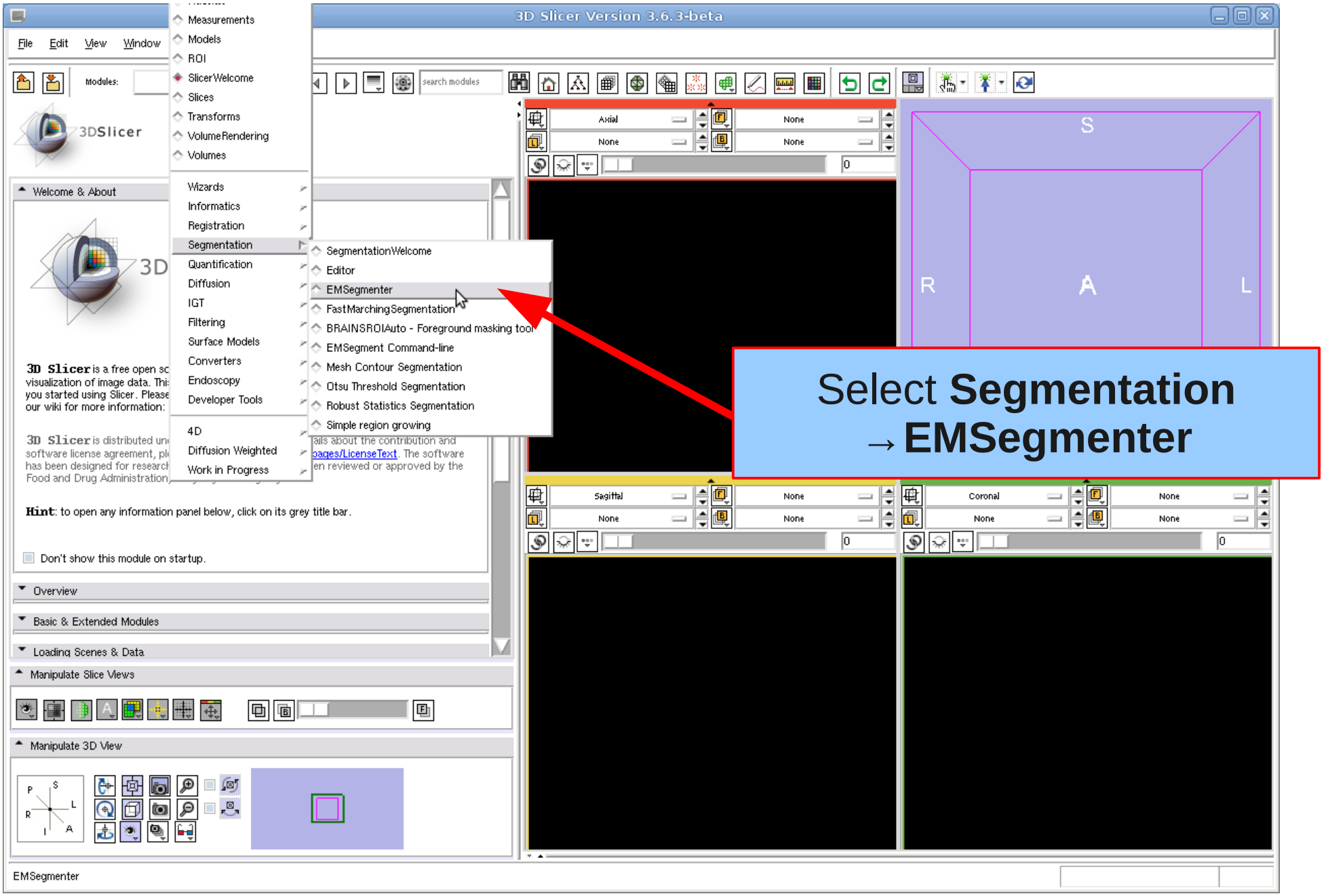
This tutorial leads you through the EMSegmenter steps.

The user has to
- create a new task
- specify the pre-processing
- specify the anatomical structures to segment
- assign atlas data
- tweak the EMSegmenter parameter
- run the segmentation

EMSegmenter (Advanced mode)



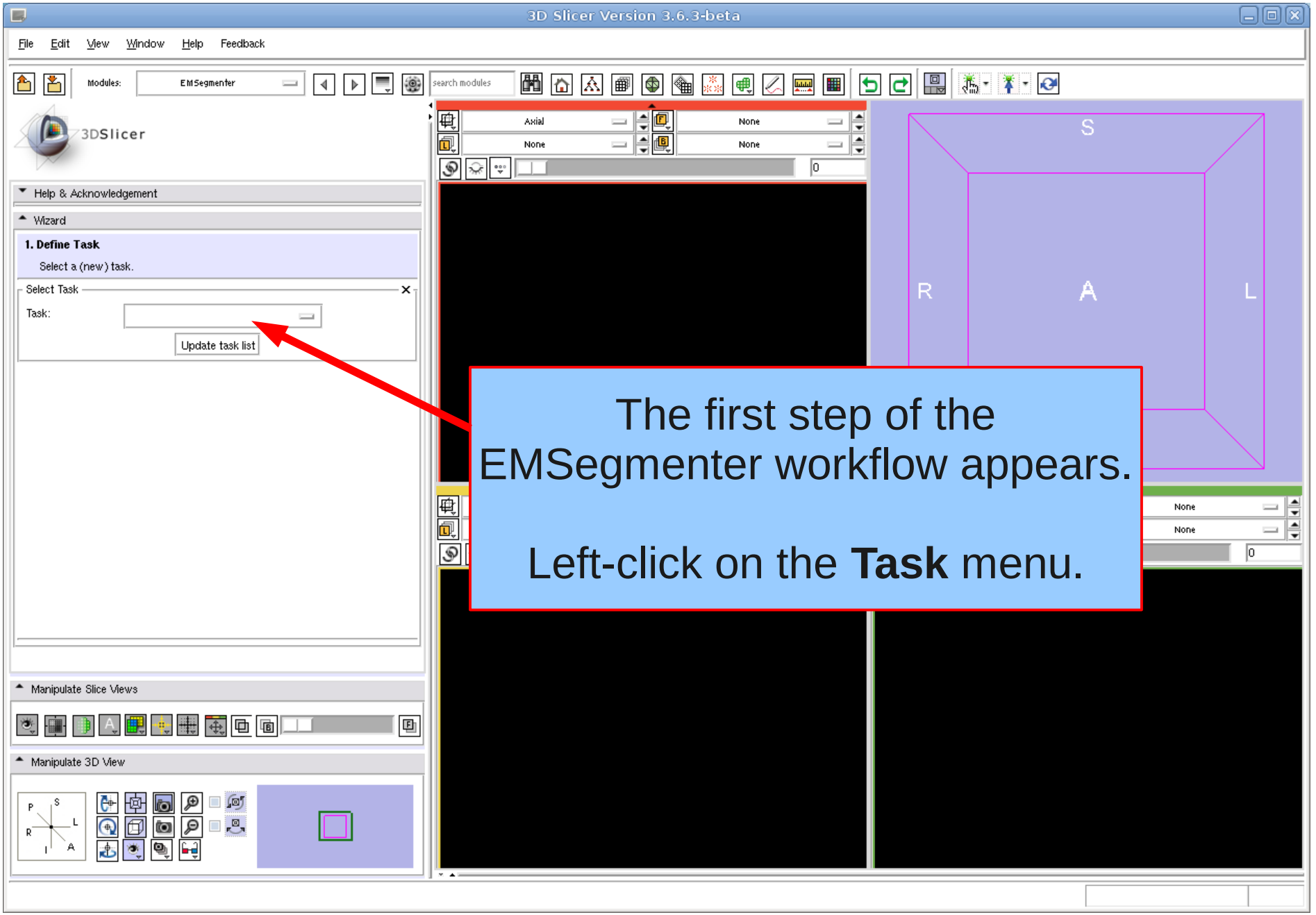
Select EMSegmenter Module



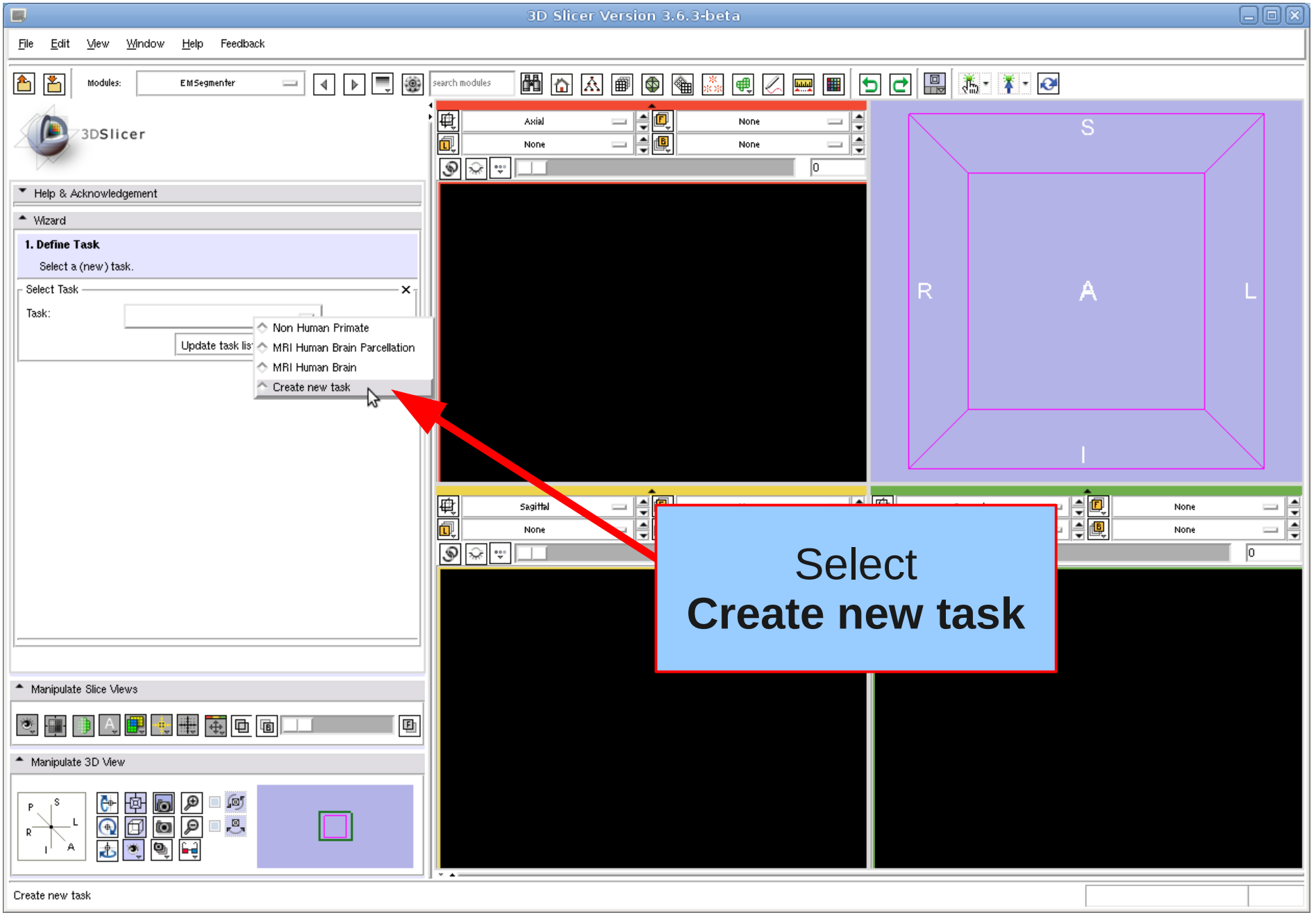
Define Task

Step 1

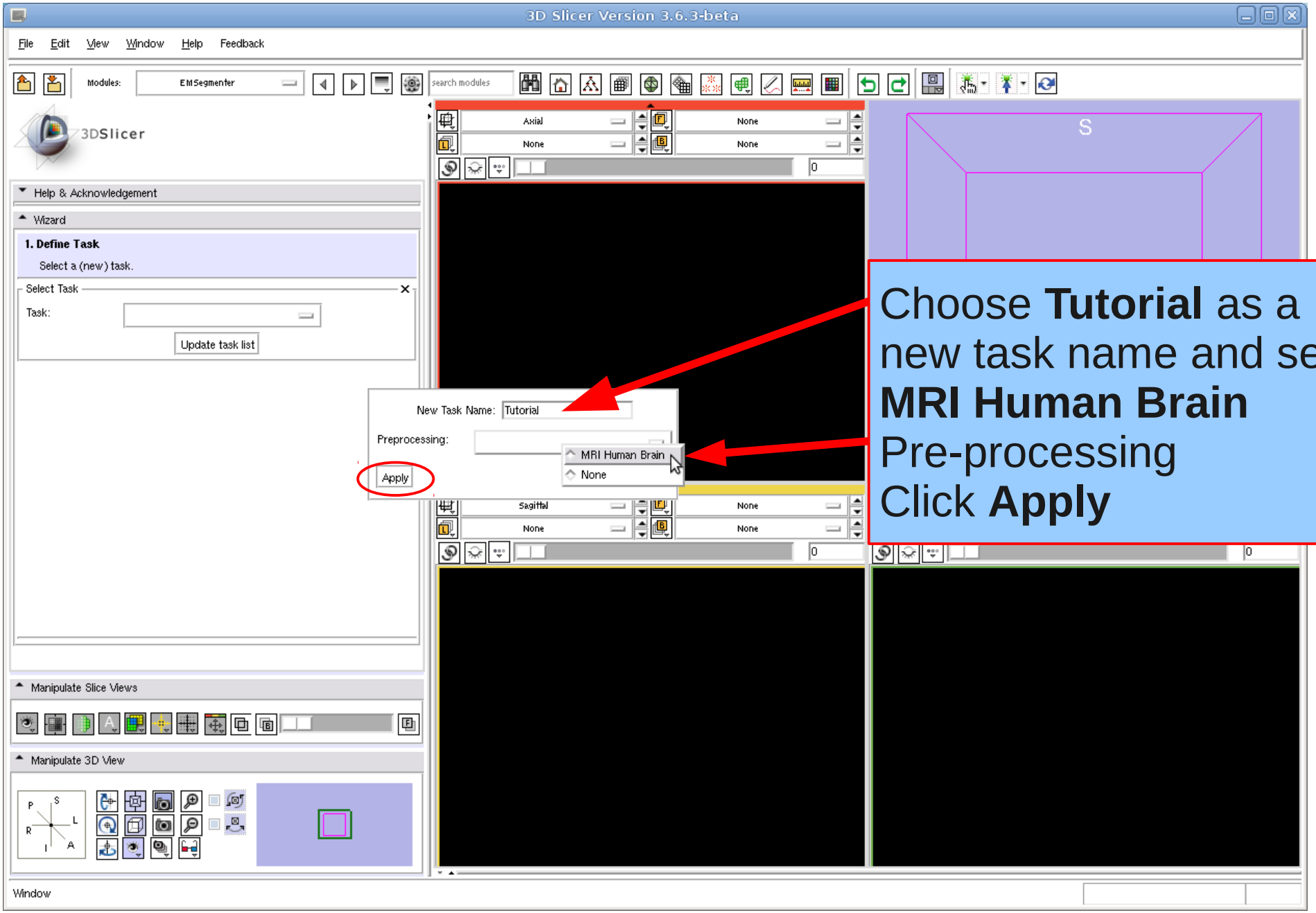
Select Task


3D Slicer Version 3.6.3-beta
File Edit View Window Help Feedback
Modules: EMSegmenter
search modules
3DSlicer
Help & Acknowledgement
Wizard
1. Define Task
Select a (new) task.
Select Task
Task:
Update task list
Manipulate Slice Views
Manipulate 3D View
Axial
None
S
R
A
L
The first step of the EMSegmenter workflow appears.
Left-click on the **Task** menu.

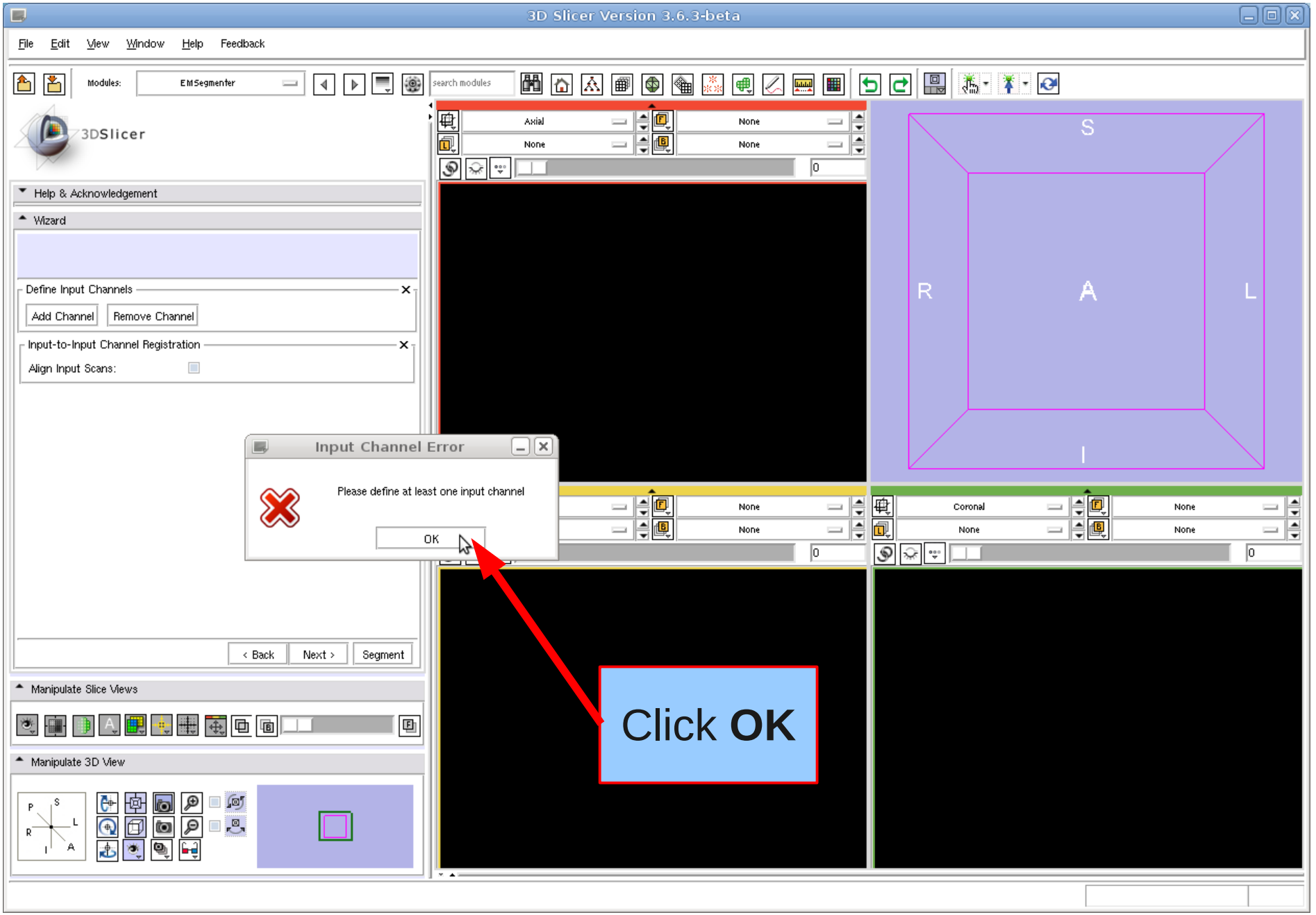
Create New Task



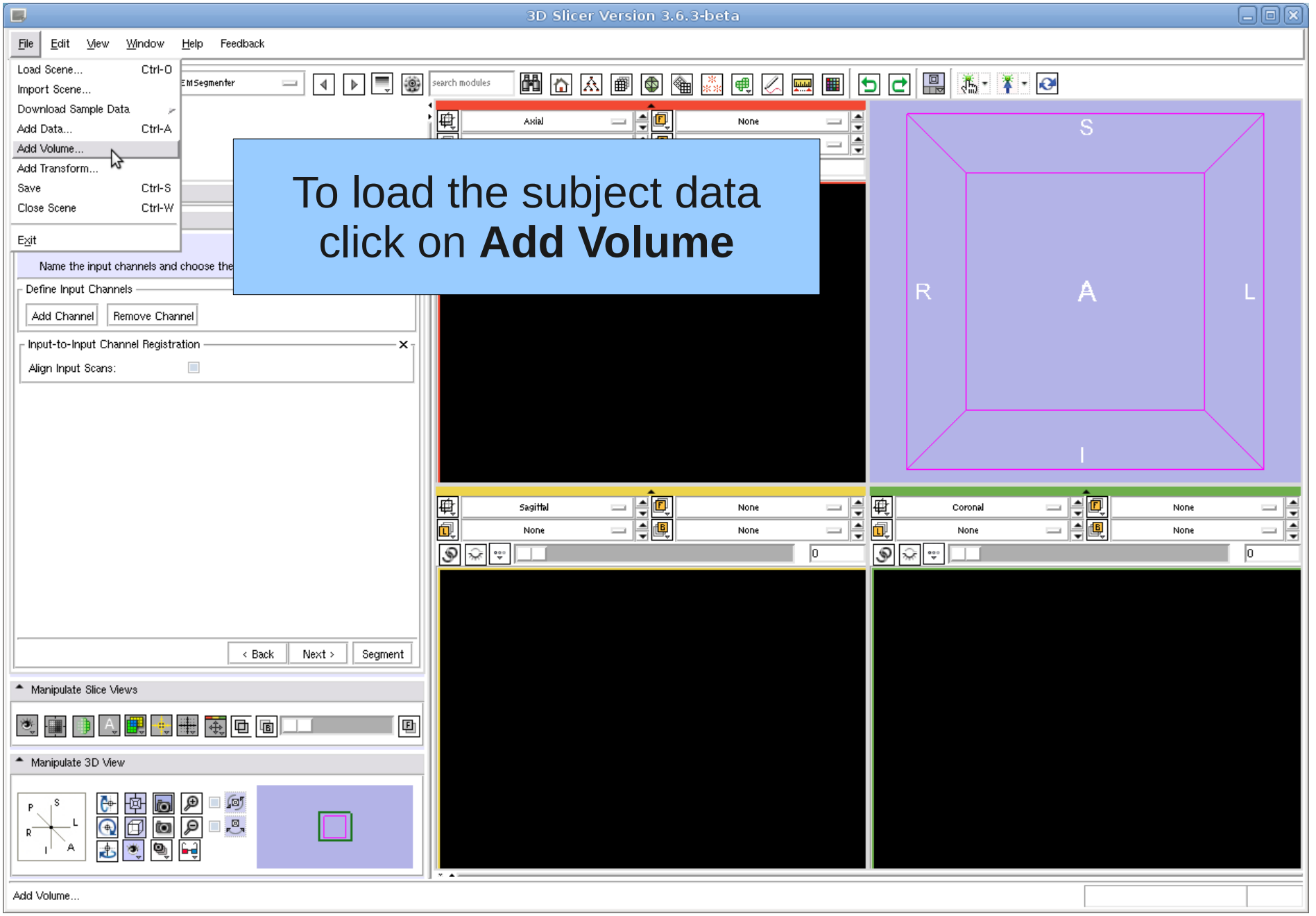
Create New Task



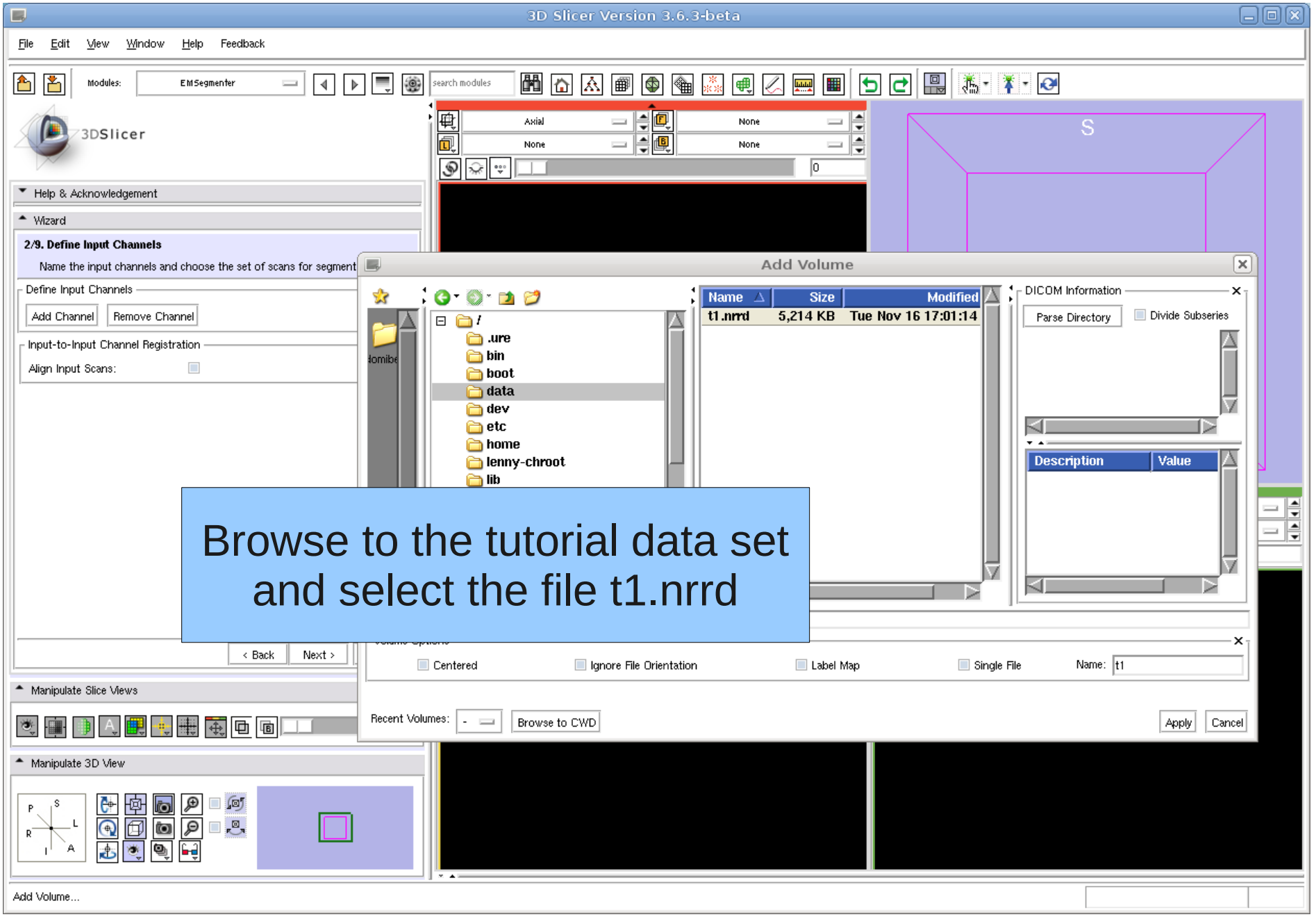
Define Input Channels



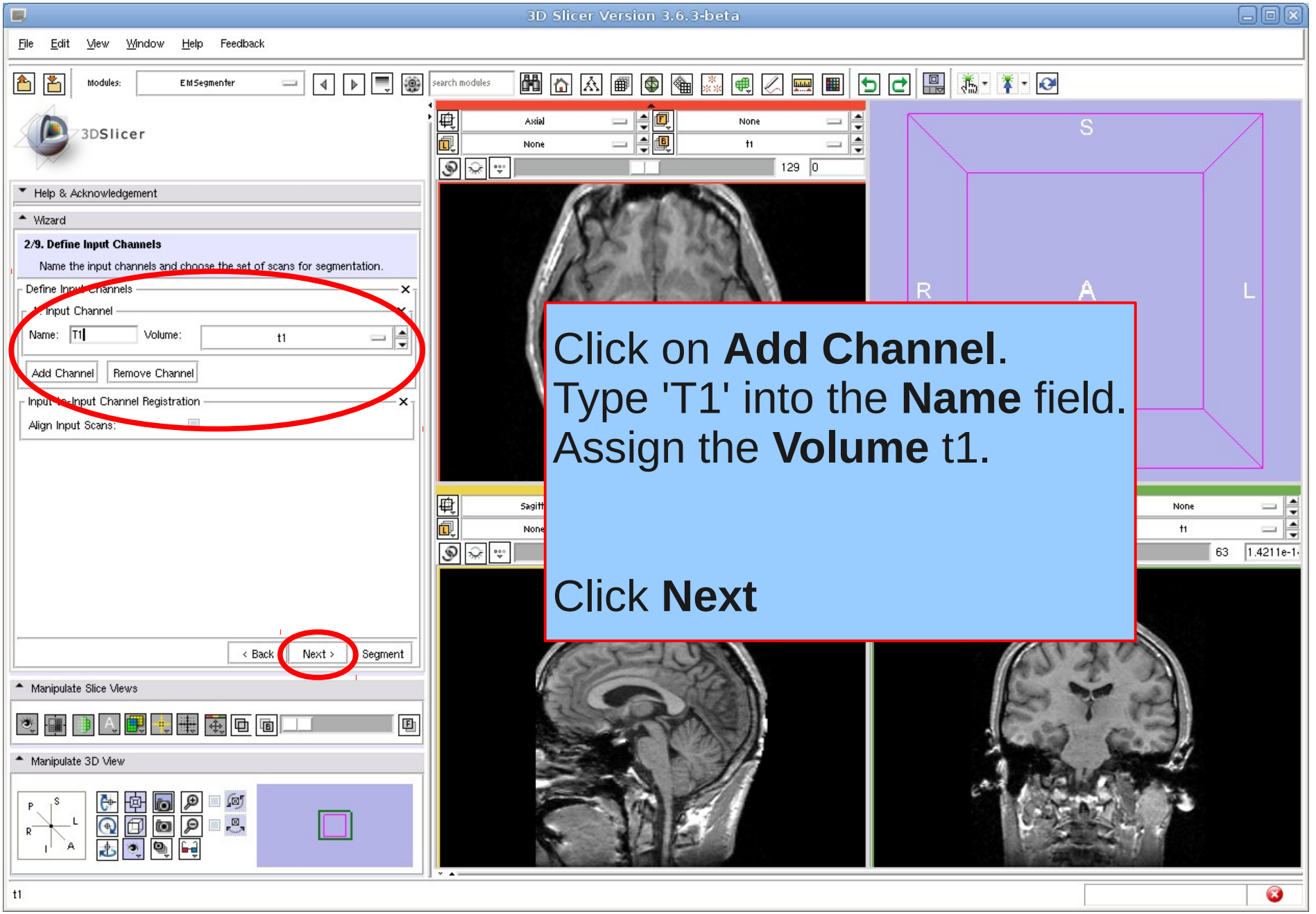
Add Subject Data



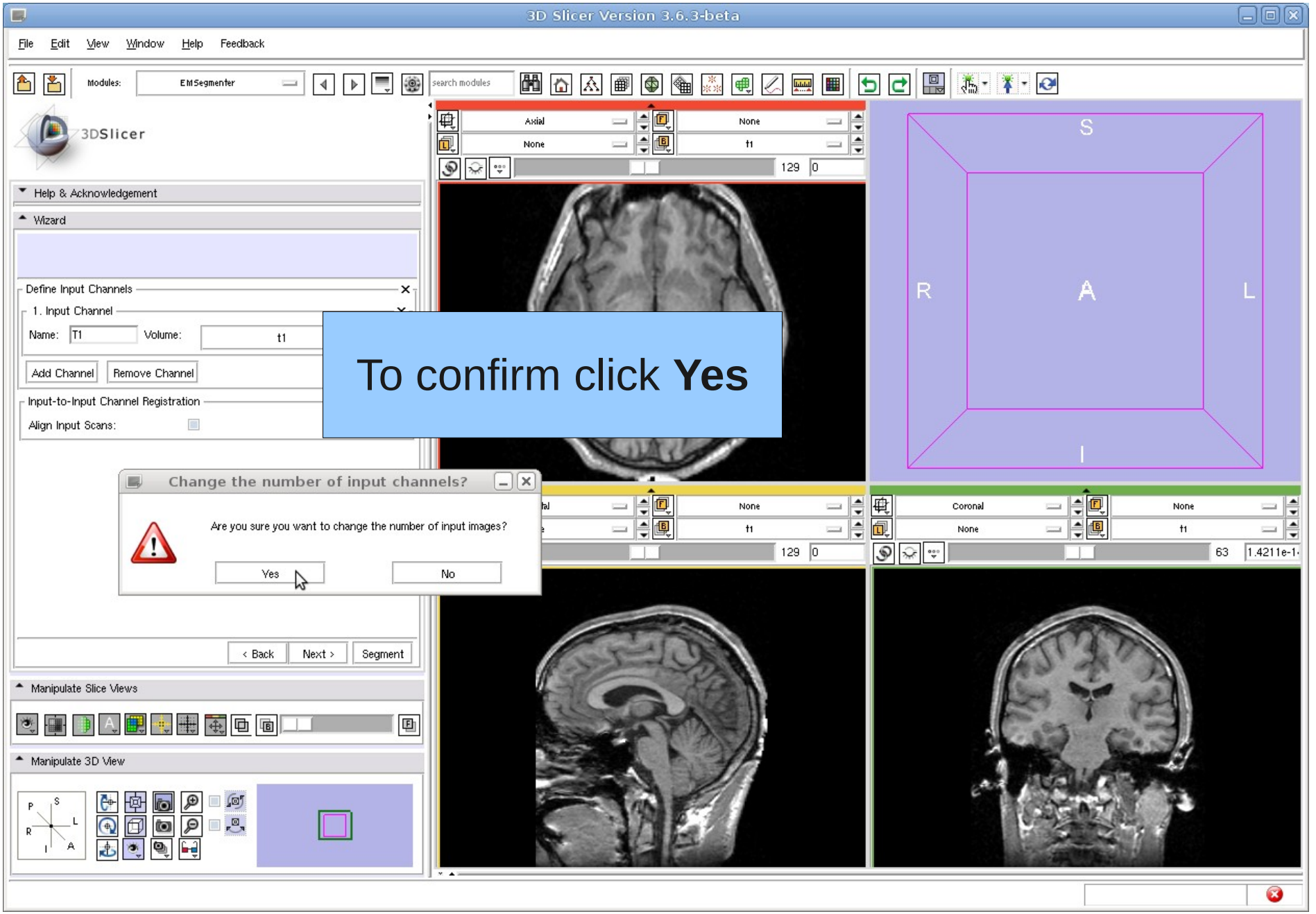
Load Subject Data



Define Input Channel



Define Input Channel



Define Anatomical Tree

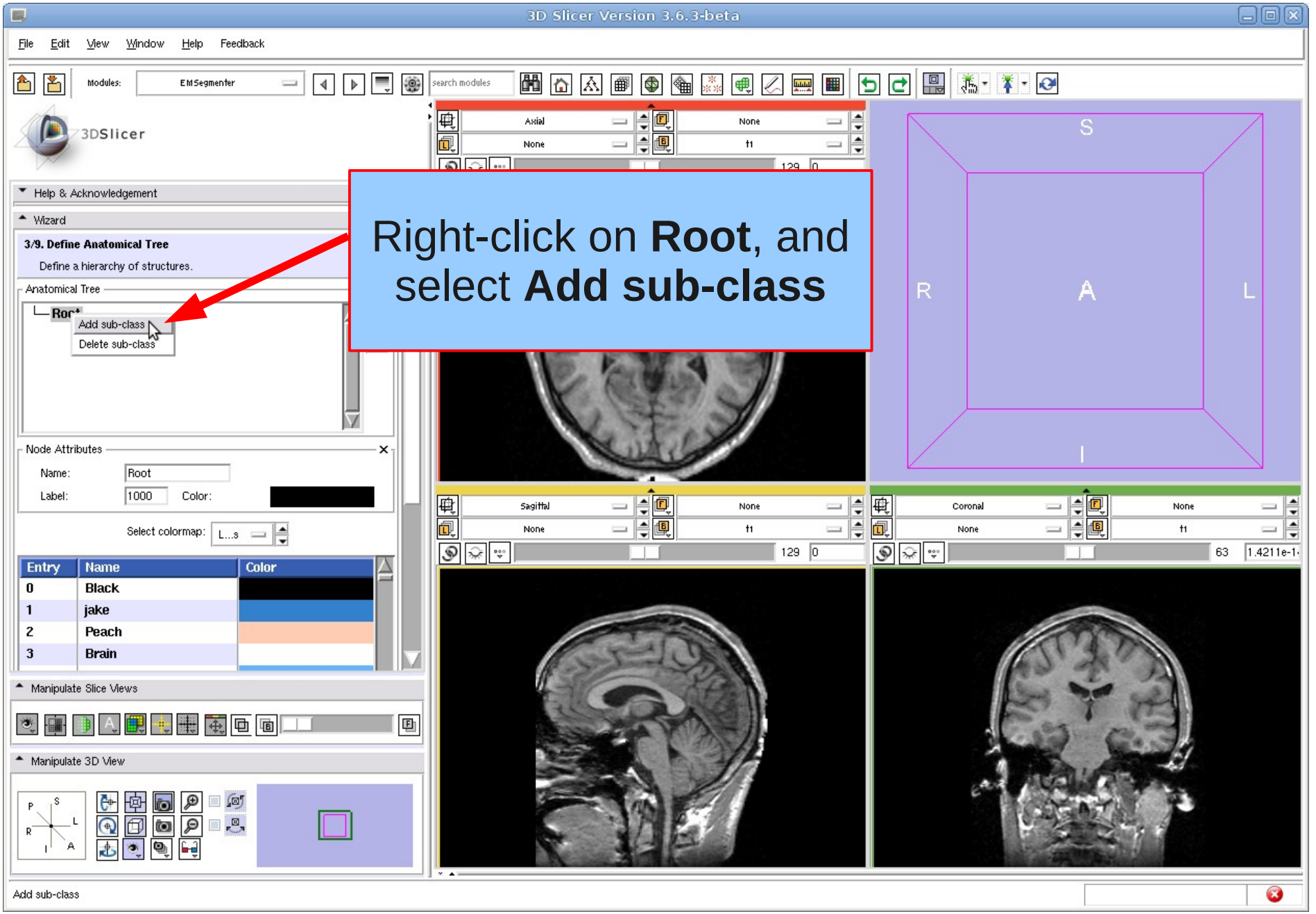
Step 3

In this step we are defining the anatomical structures we want to segment and store the information in a tree data structure.

Each node represents a anatomical structure.

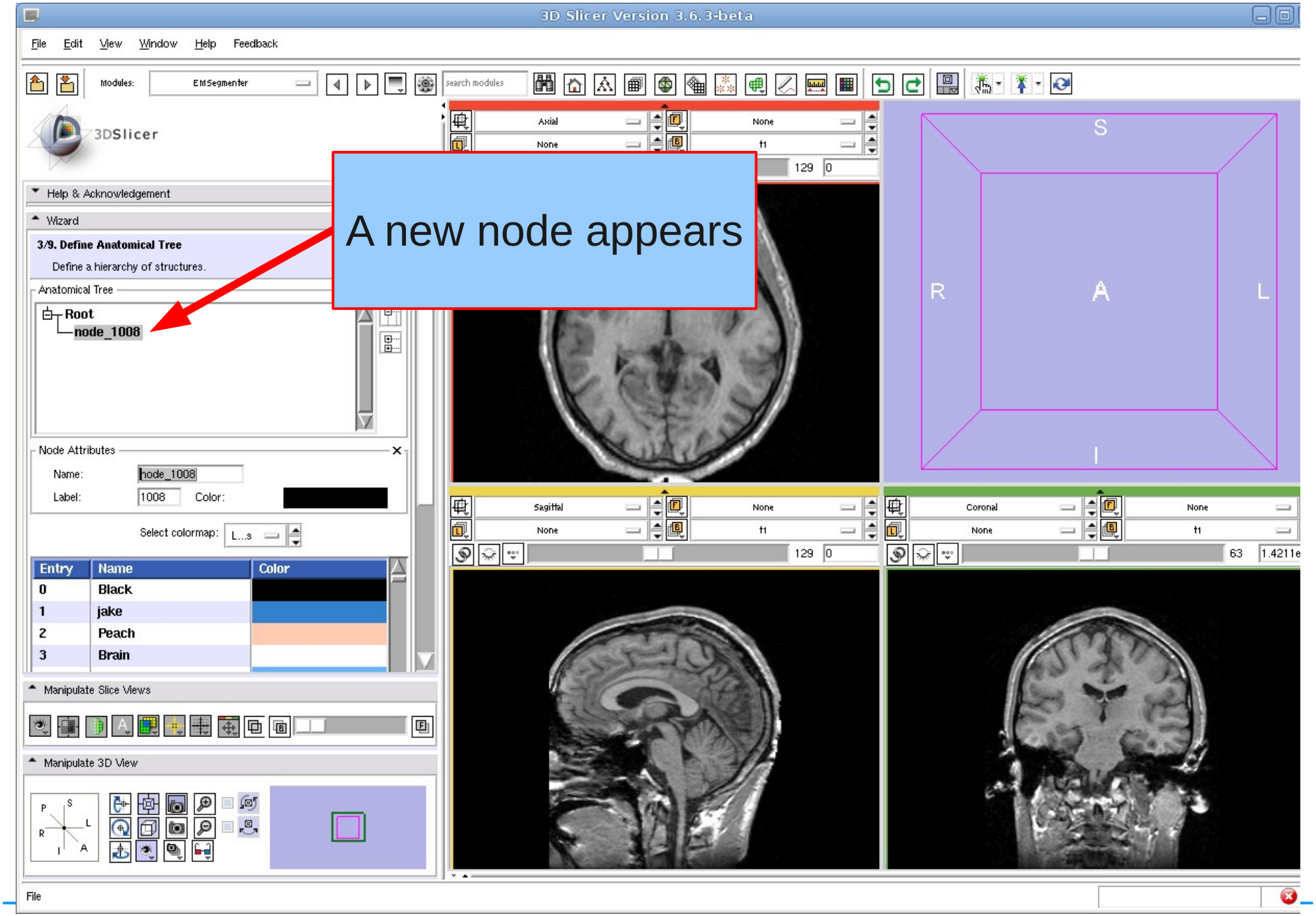
Additionally, a color can be assigned to each node for a better visualization of the segmentation result.

Define Anatomical Tree

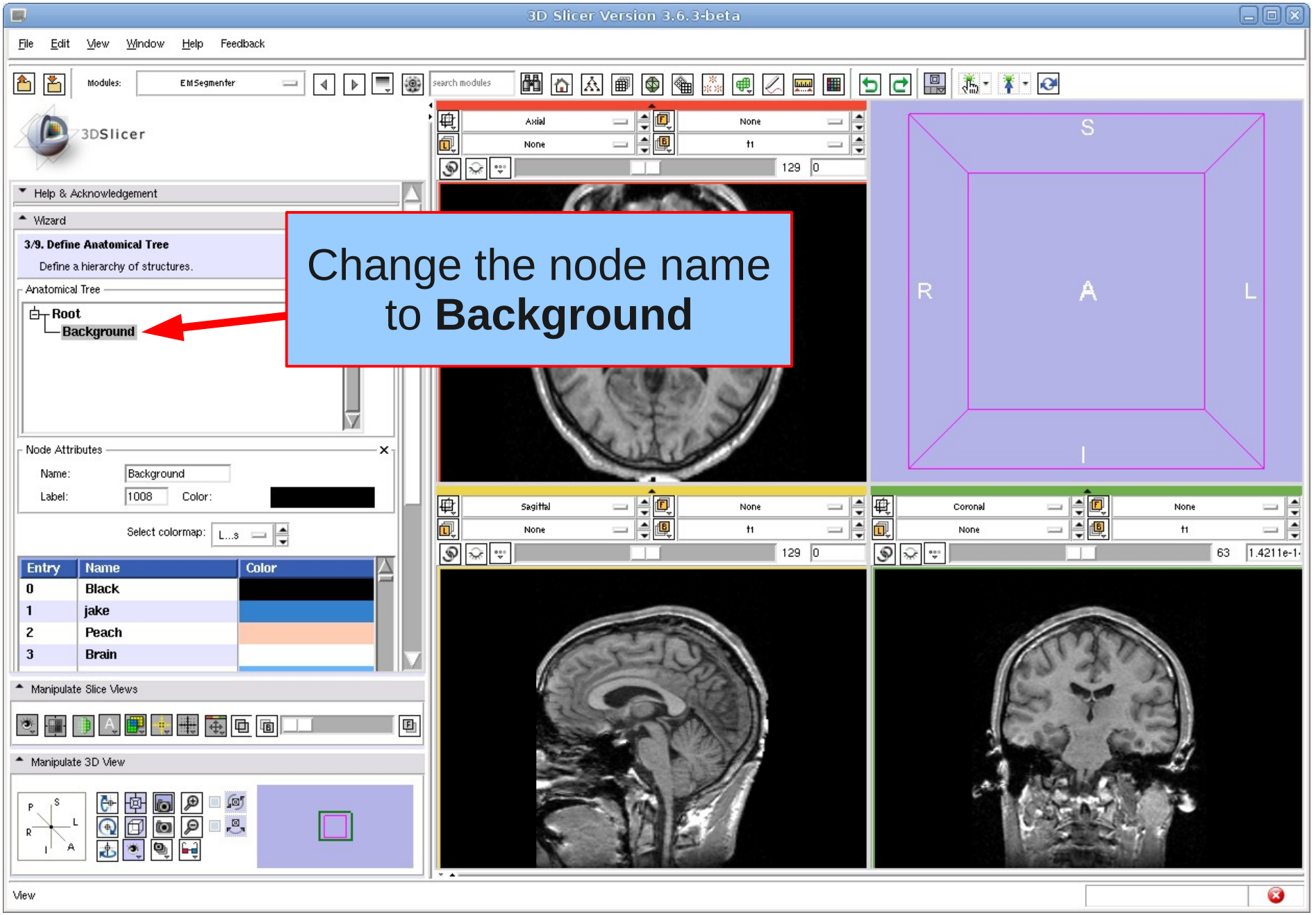


Right-click on **Root**, and select **Add sub-class**

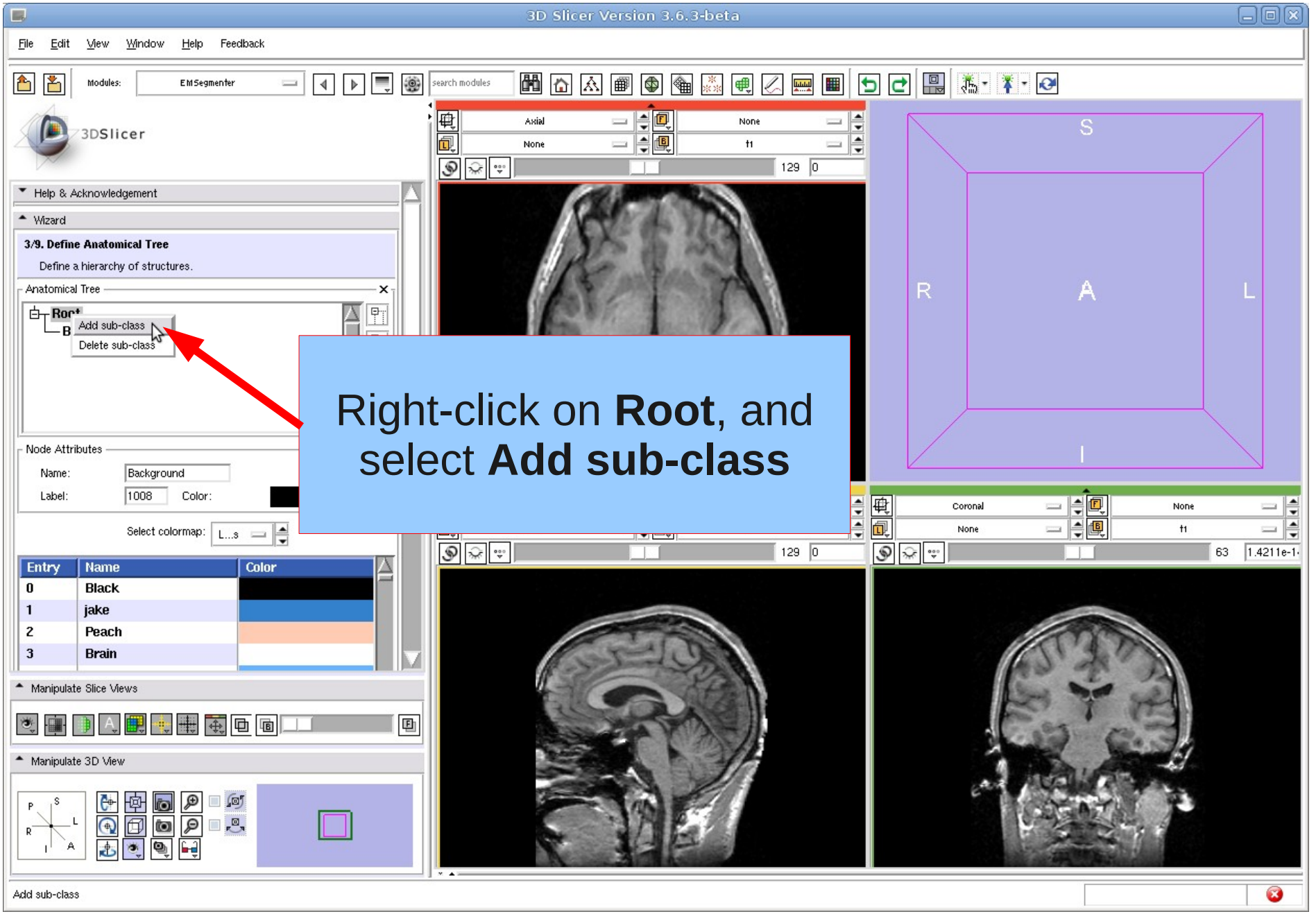
Define Anatomical Tree



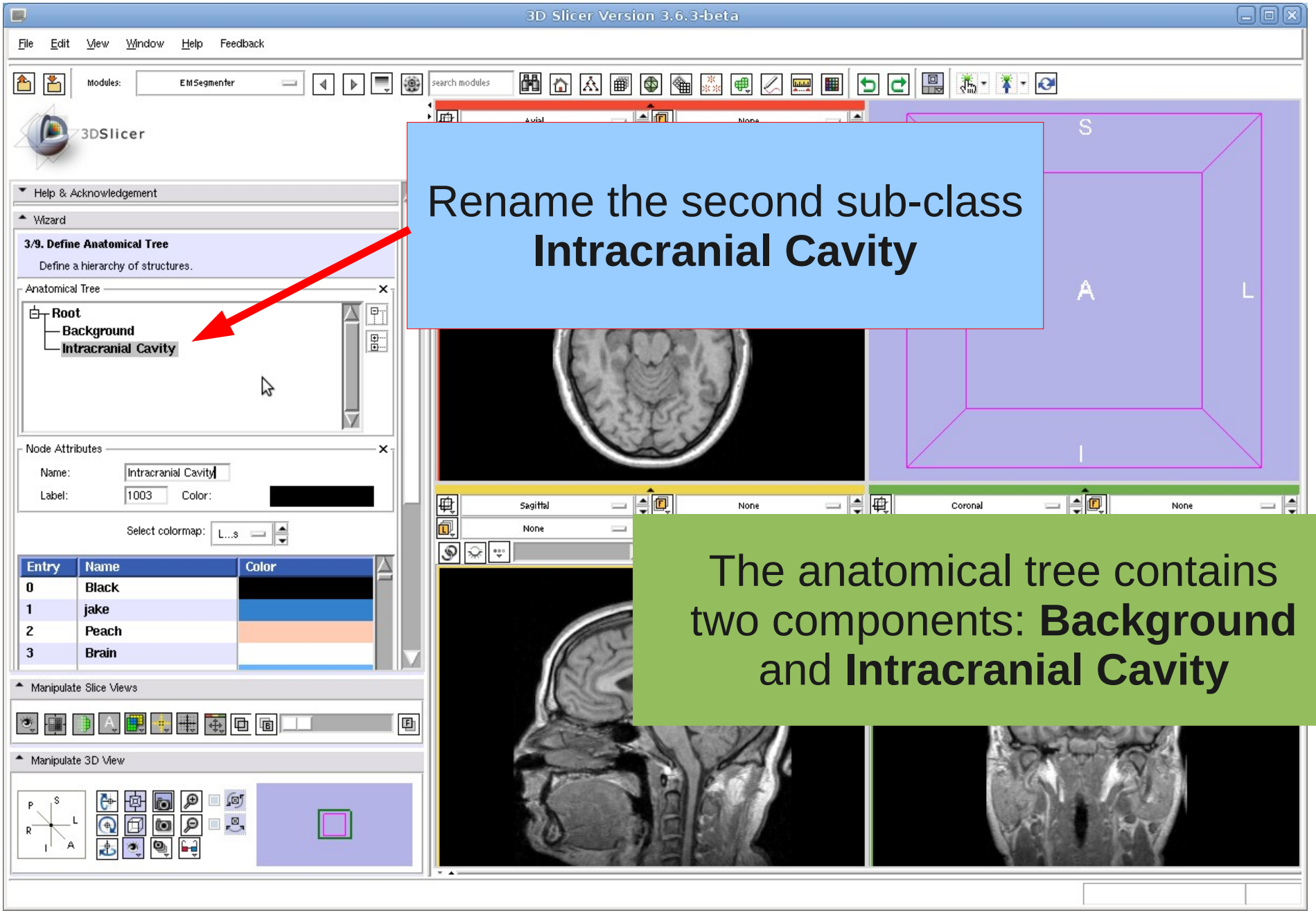
Define Anatomical Tree



Define Anatomical Tree



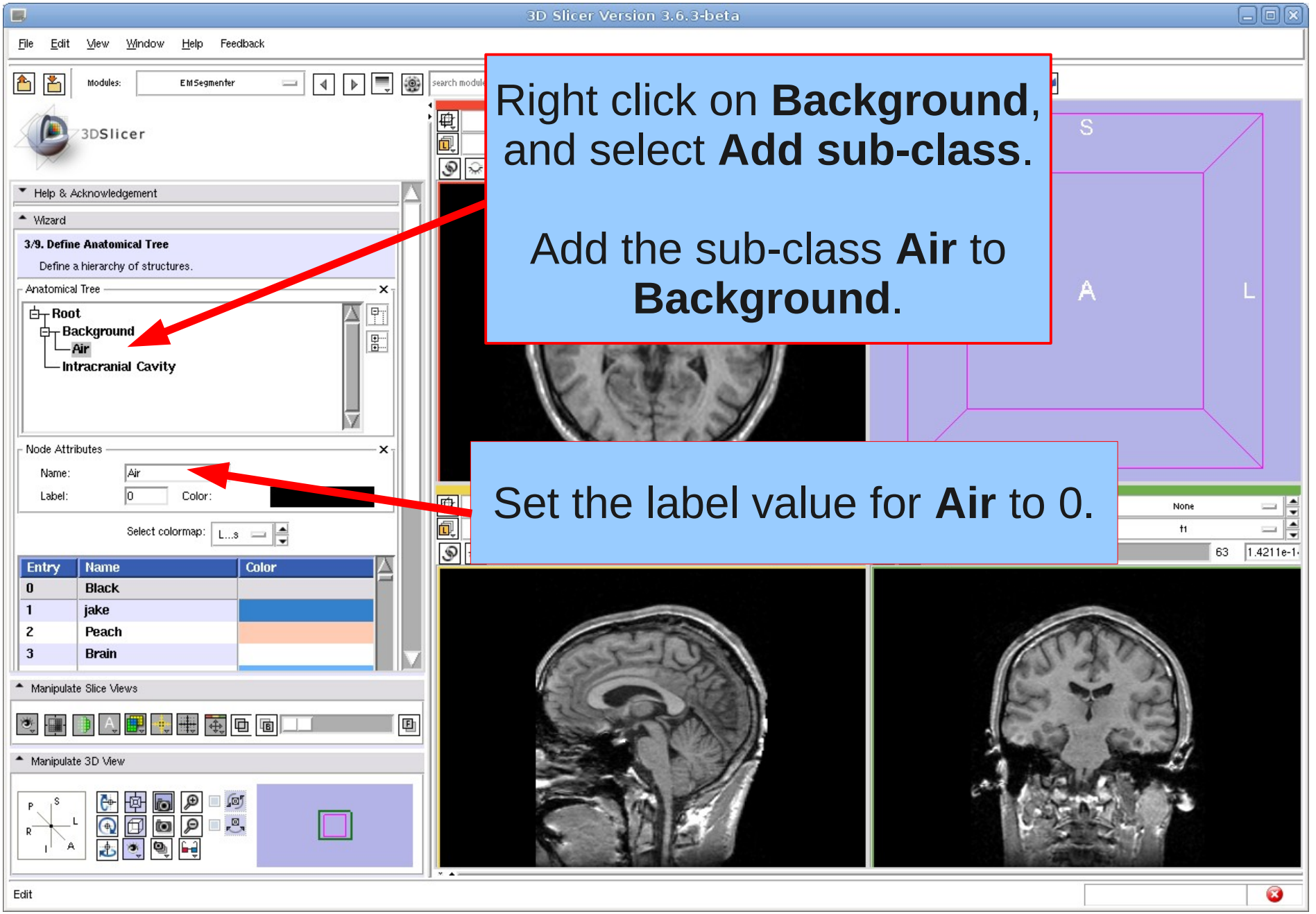
Define Anatomical Tree



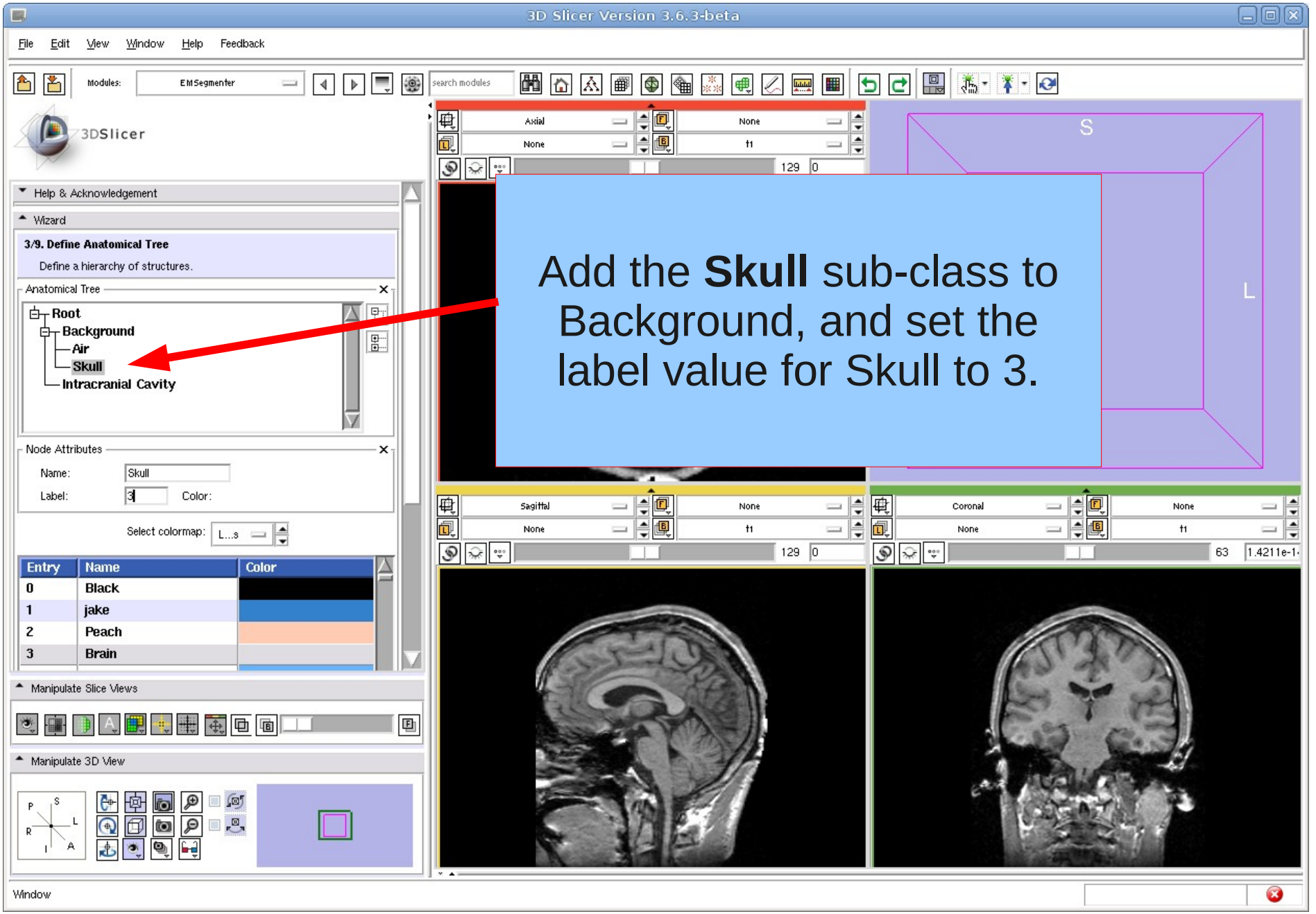
Rename the second sub-class **Intracranial Cavity**

The anatomical tree contains two components: **Background** and **Intracranial Cavity**

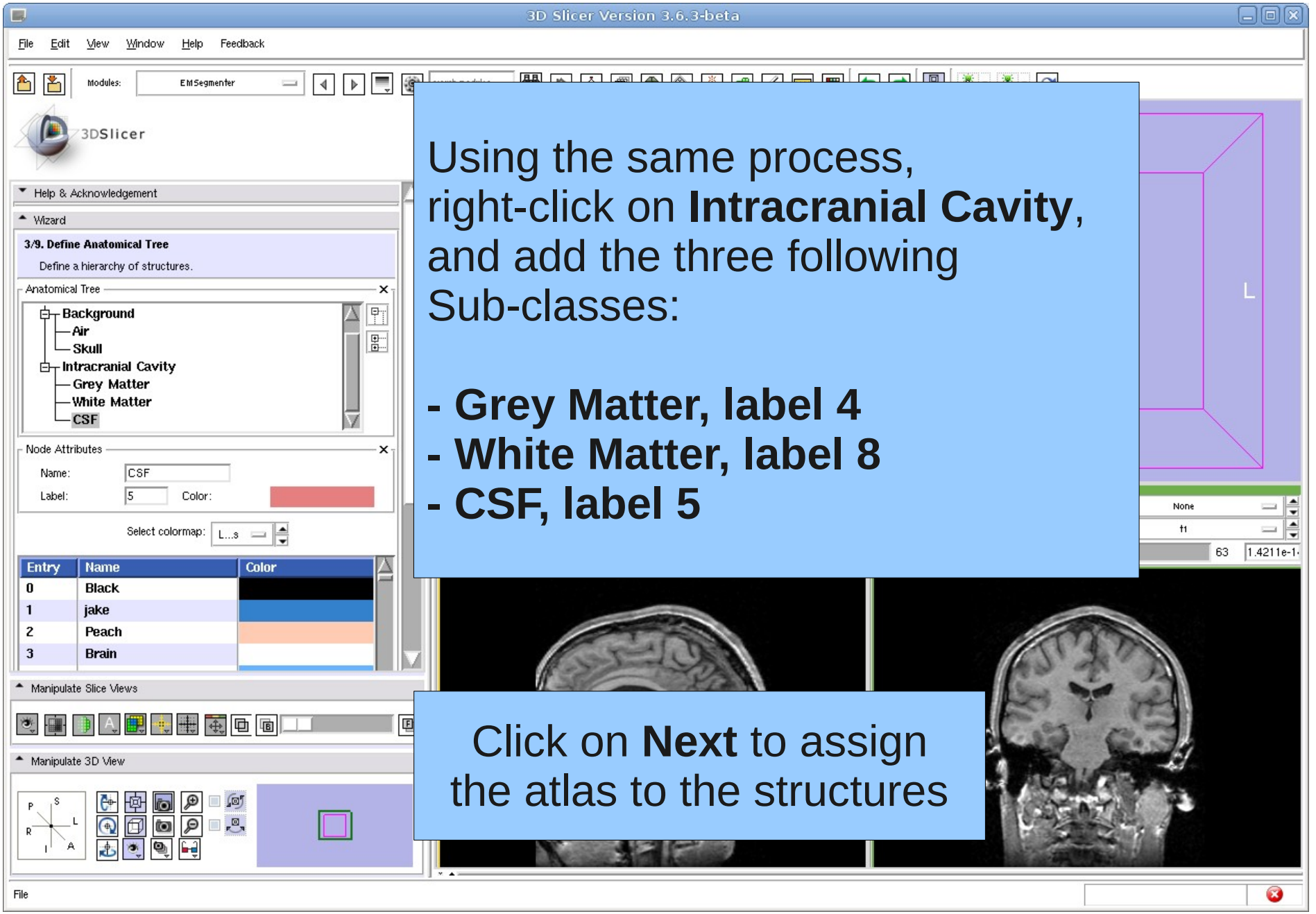
Define Anatomical Tree



Define Anatomical Tree



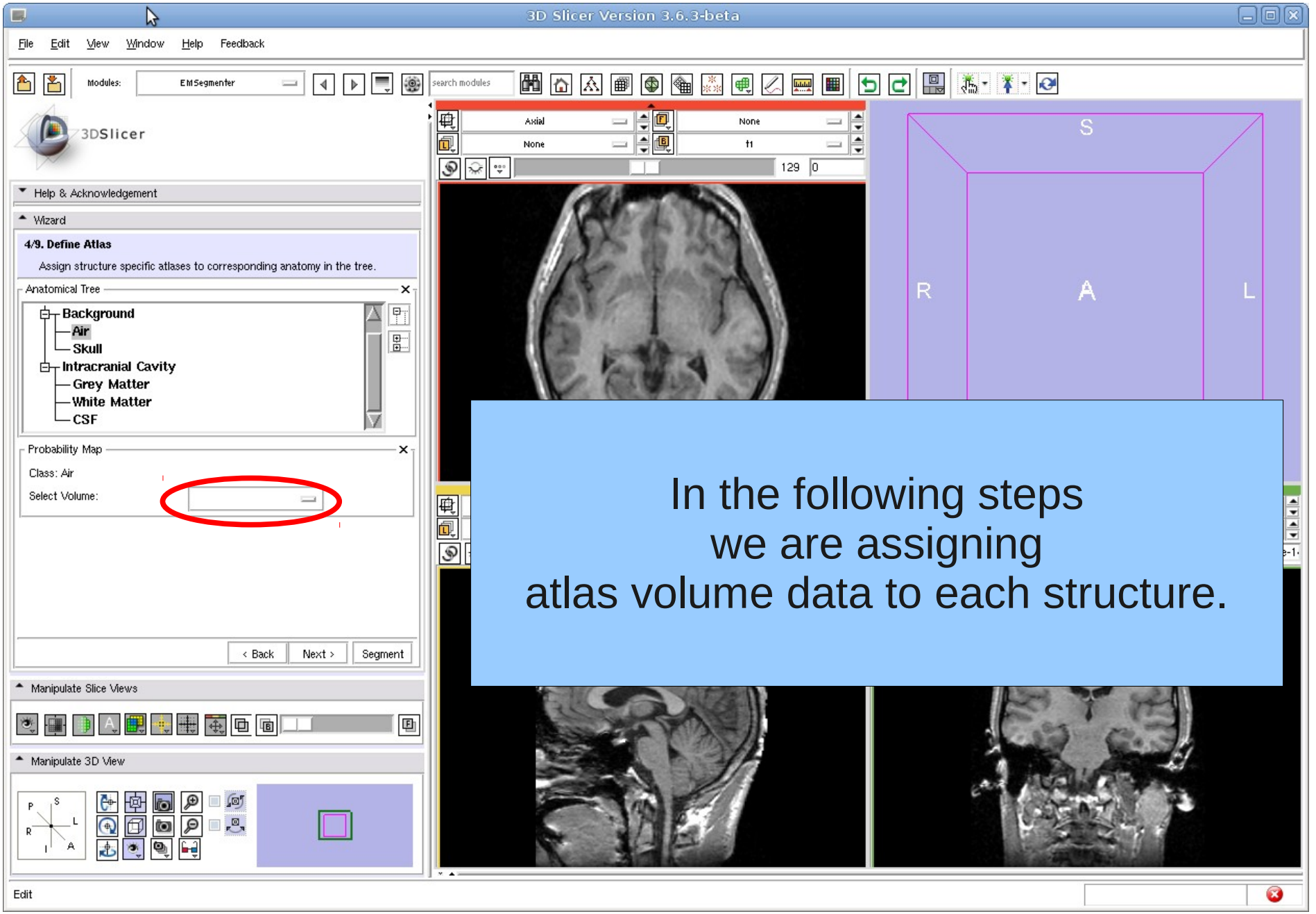
Define Anatomical Tree



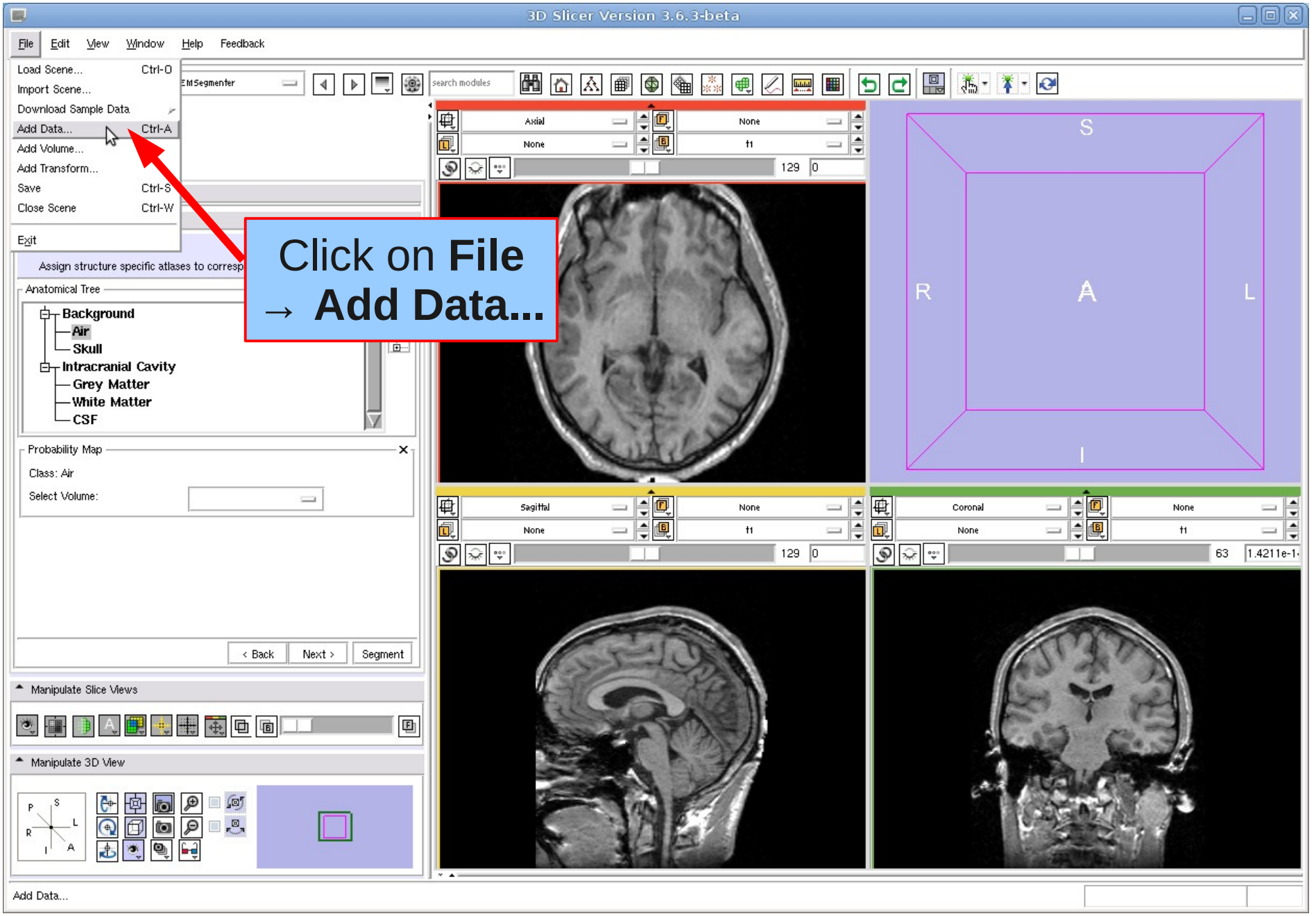
Define Atlas

Step 4

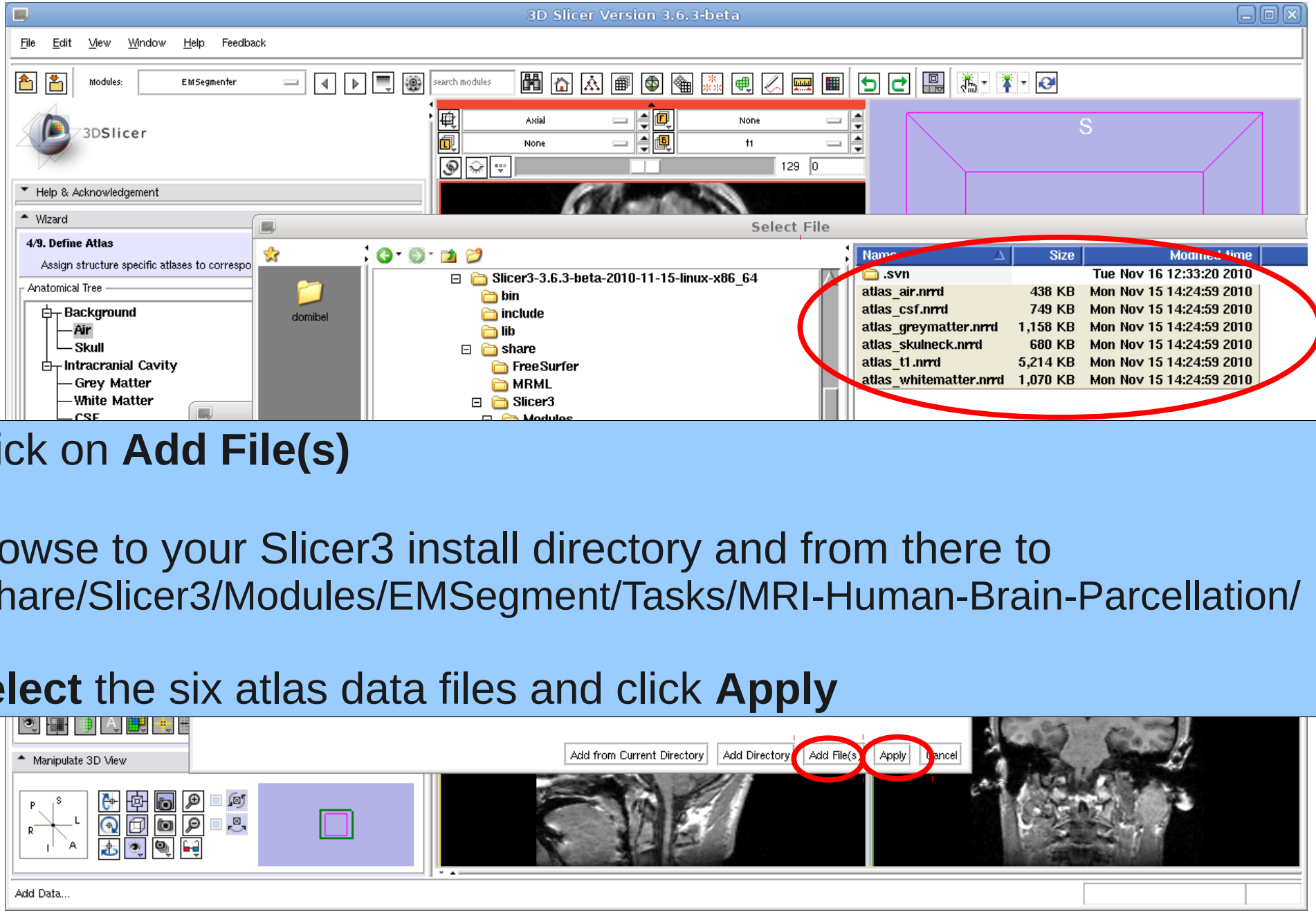
Define Atlas



Load Atlas Data



Load Atlas Data

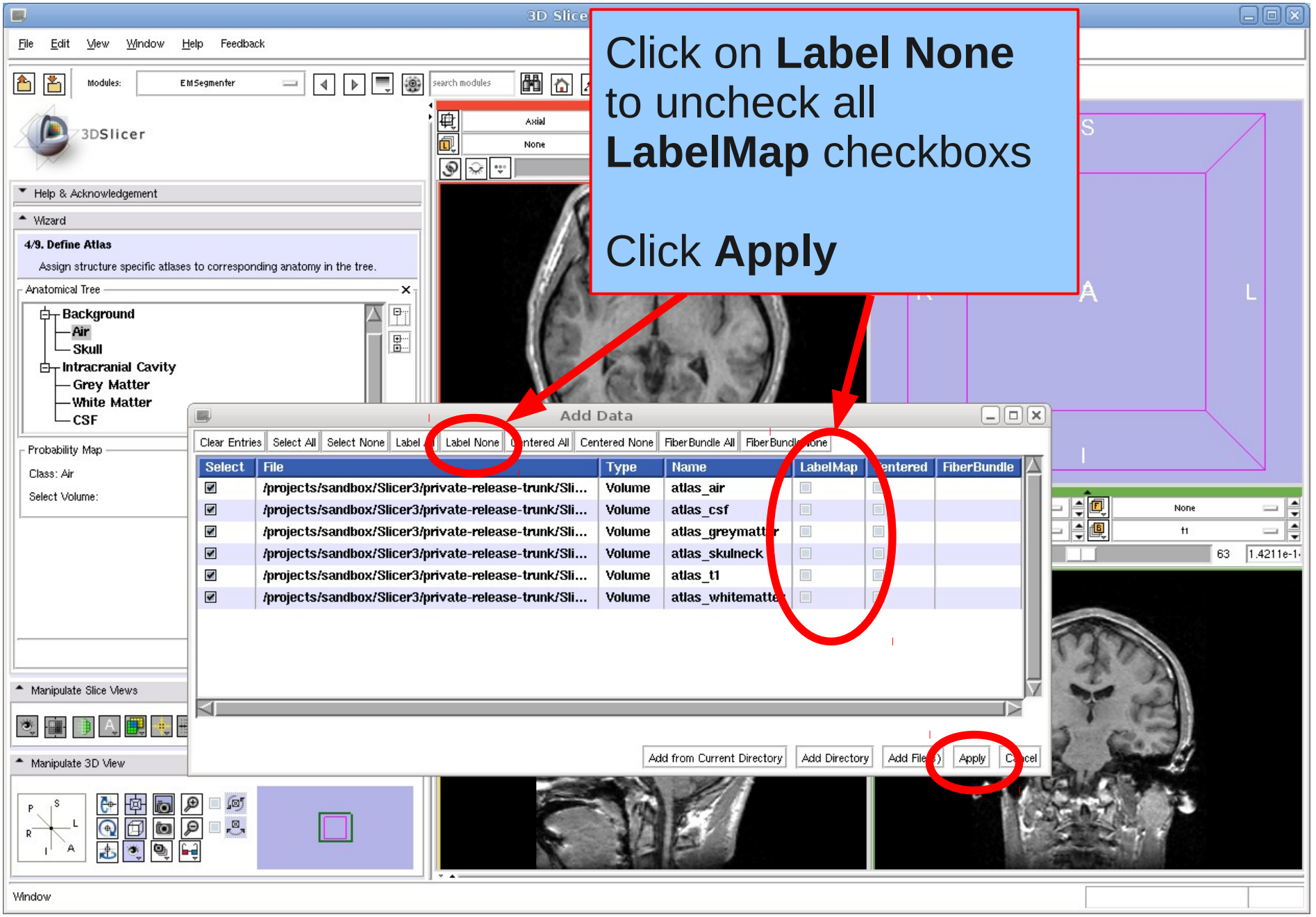


Click on **Add File(s)**

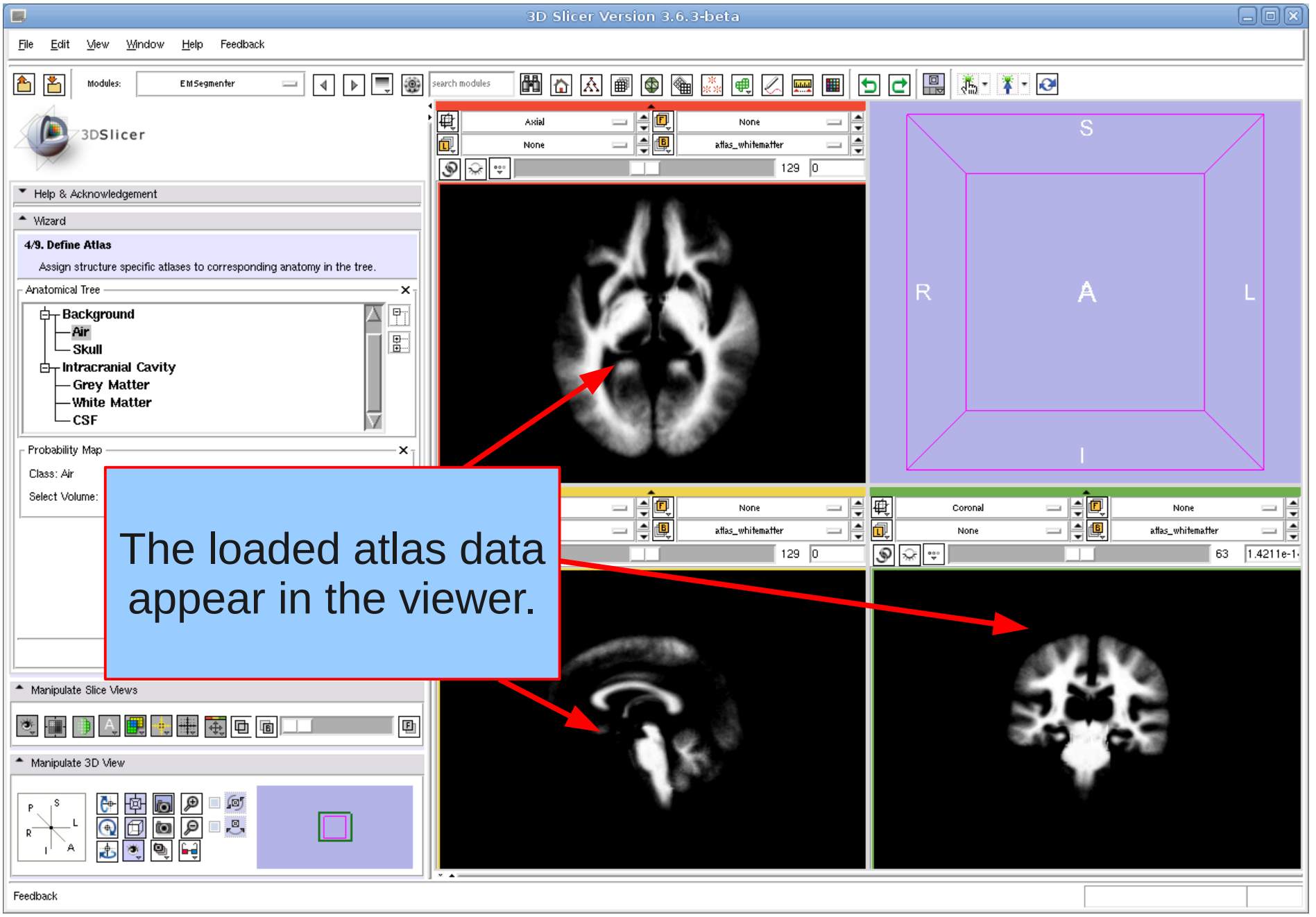
Browse to your Slicer3 install directory and from there to ./share/Slicer3/Modules/EMSegment/Tasks/MRI-Human-Brain-Parcellation/

Select the six atlas data files and click **Apply**

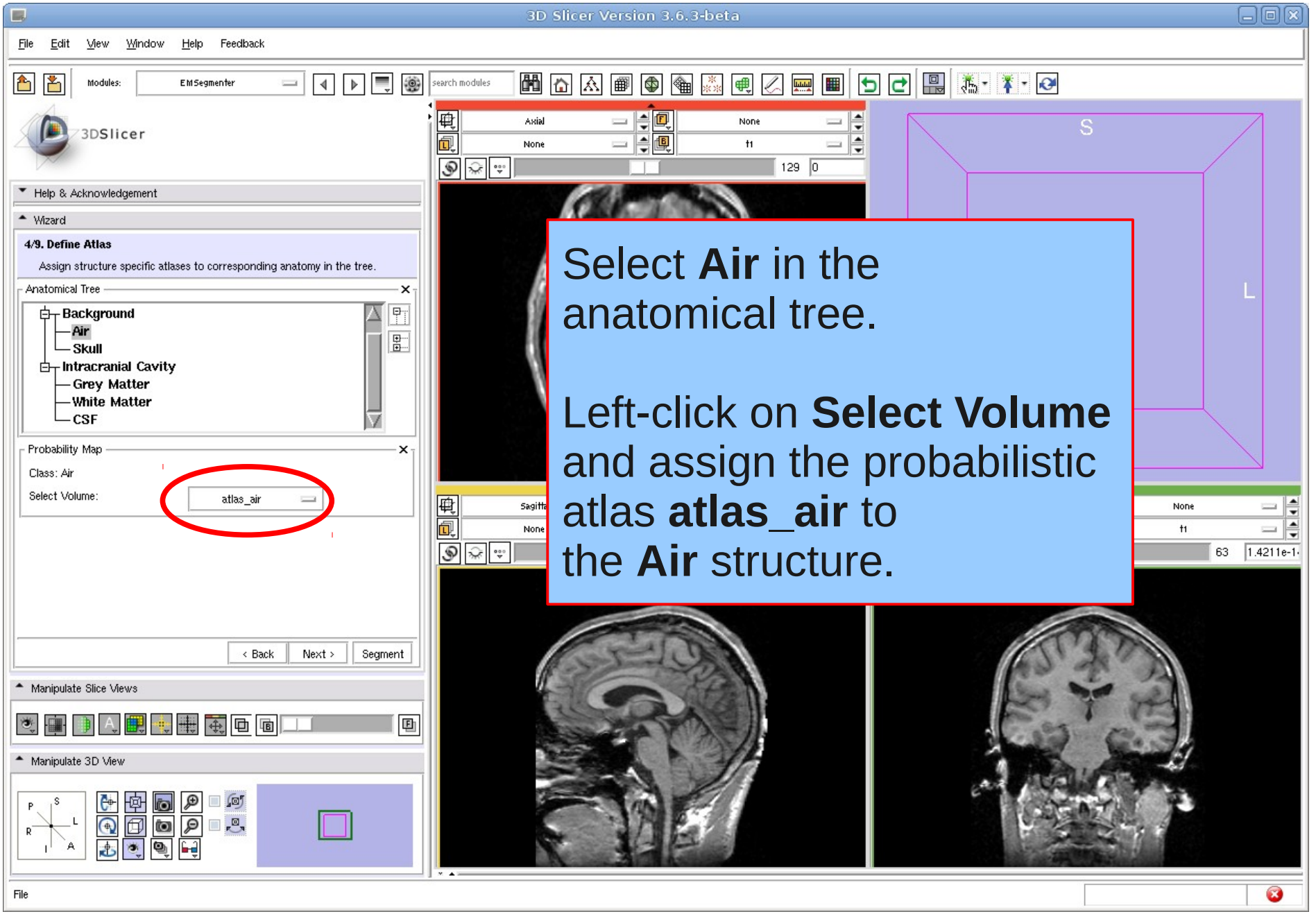
Load Atlas Data



Load Atlas Data



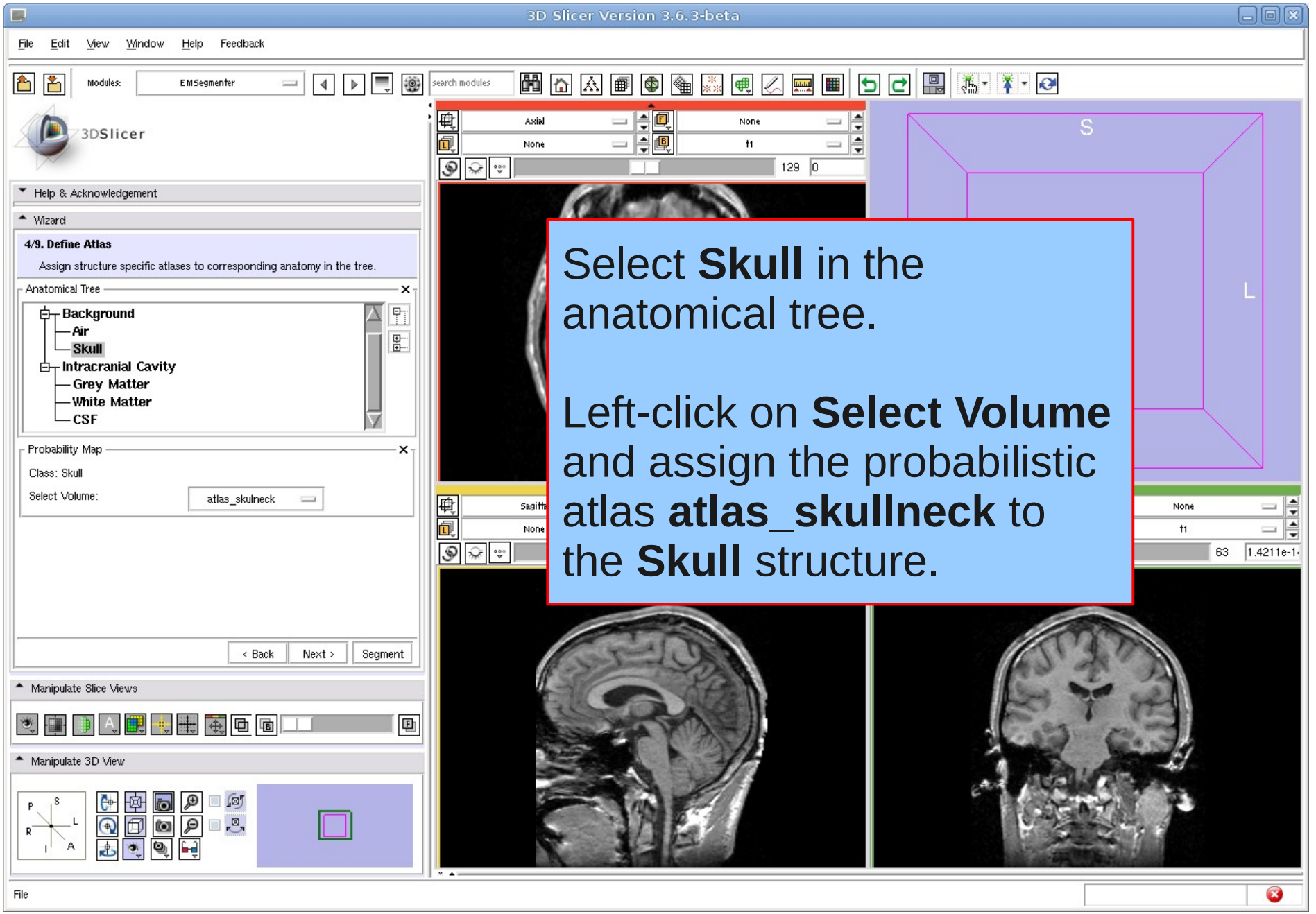
Define Atlas



Select **Air** in the anatomical tree.

Left-click on **Select Volume** and assign the probabilistic atlas **atlas_air** to the **Air** structure.

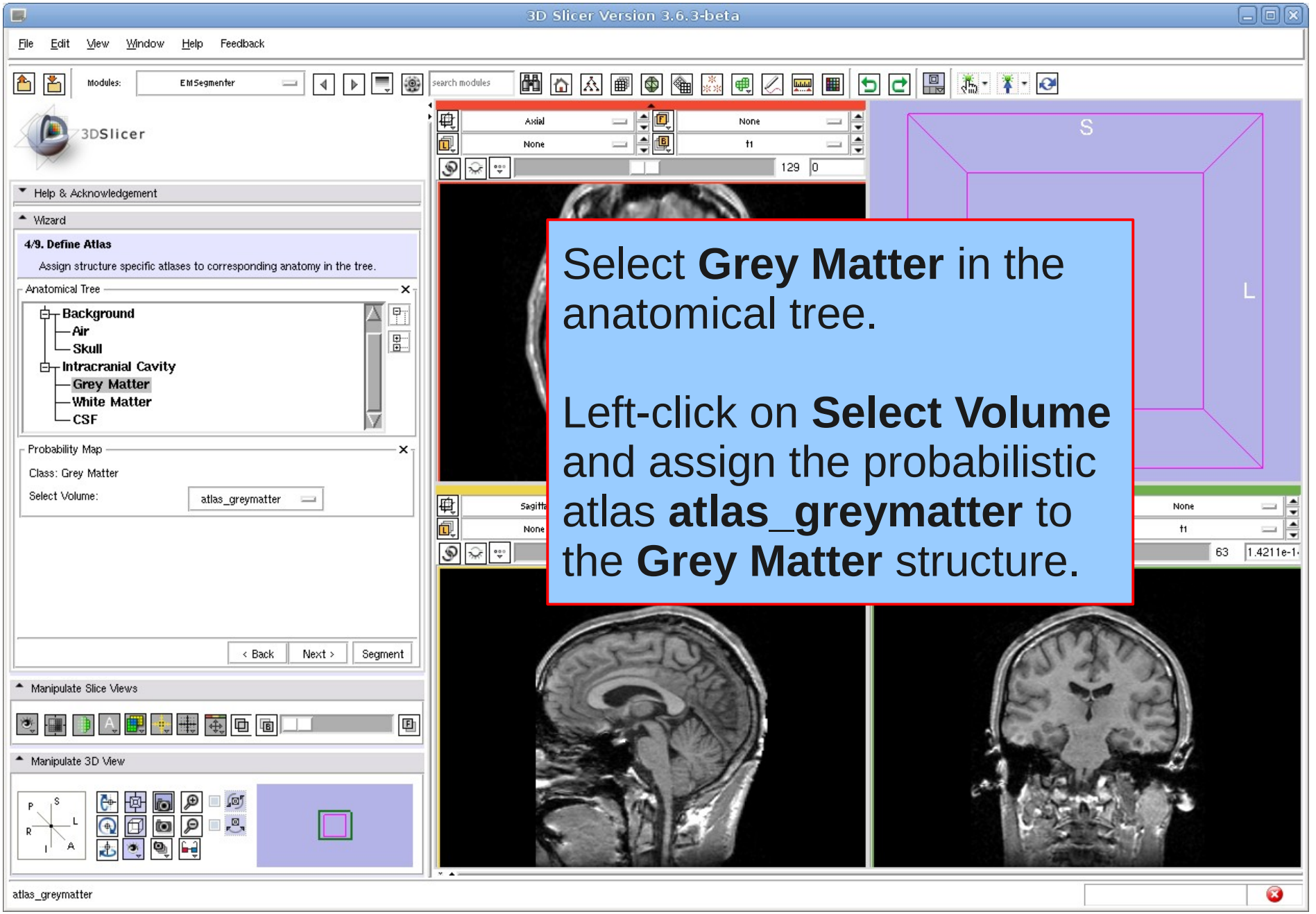
Define Atlas



Select **Skull** in the anatomical tree.

Left-click on **Select Volume** and assign the probabilistic atlas **atlas_skullneck** to the **Skull** structure.

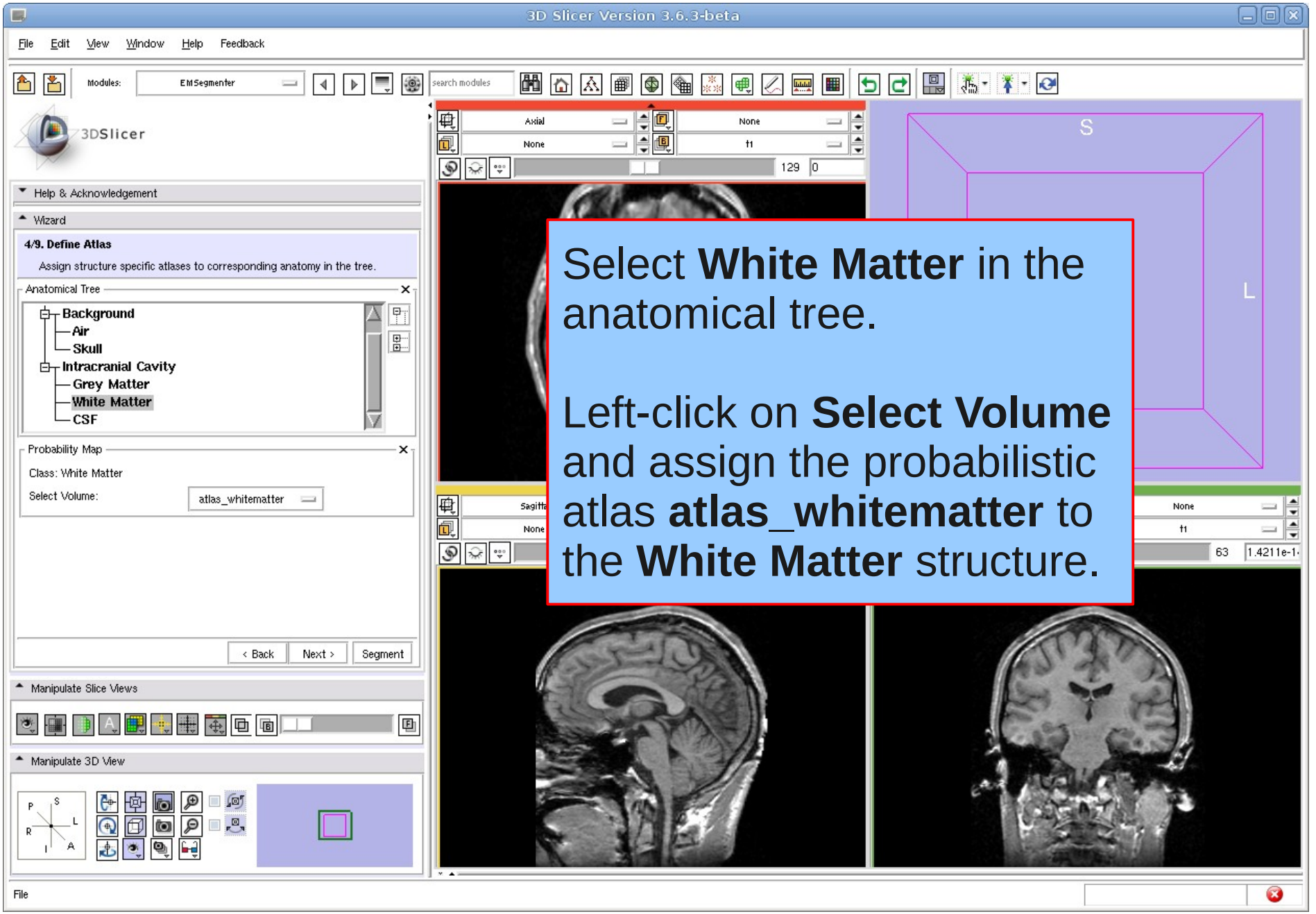
Define Atlas



Select **Grey Matter** in the anatomical tree.

Left-click on **Select Volume** and assign the probabilistic atlas **atlas_greymatter** to the **Grey Matter** structure.

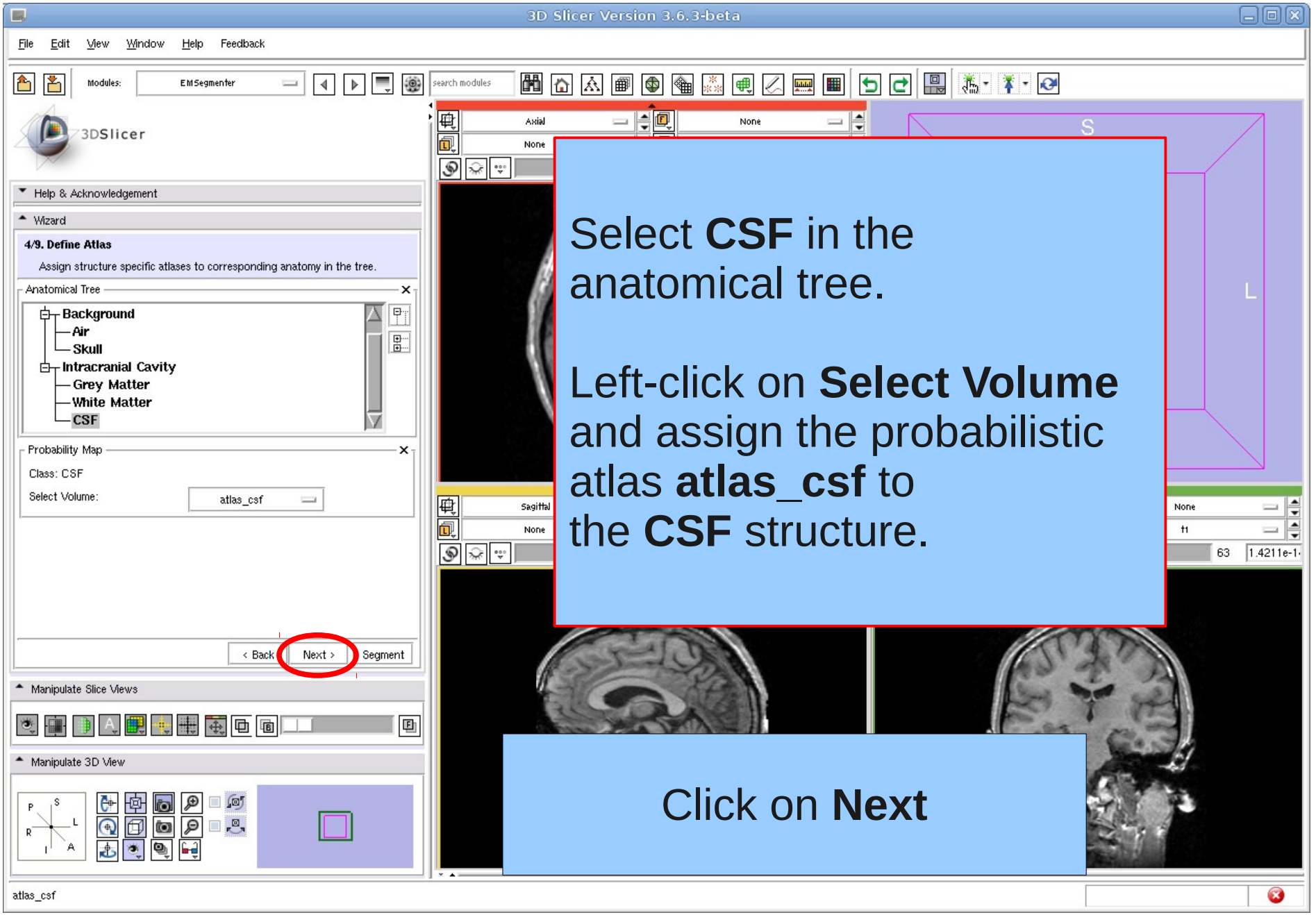
Define Atlas



Select **White Matter** in the anatomical tree.

Left-click on **Select Volume** and assign the probabilistic atlas **atlas_whitematter** to the **White Matter** structure.

Define Atlas



Select **CSF** in the anatomical tree.

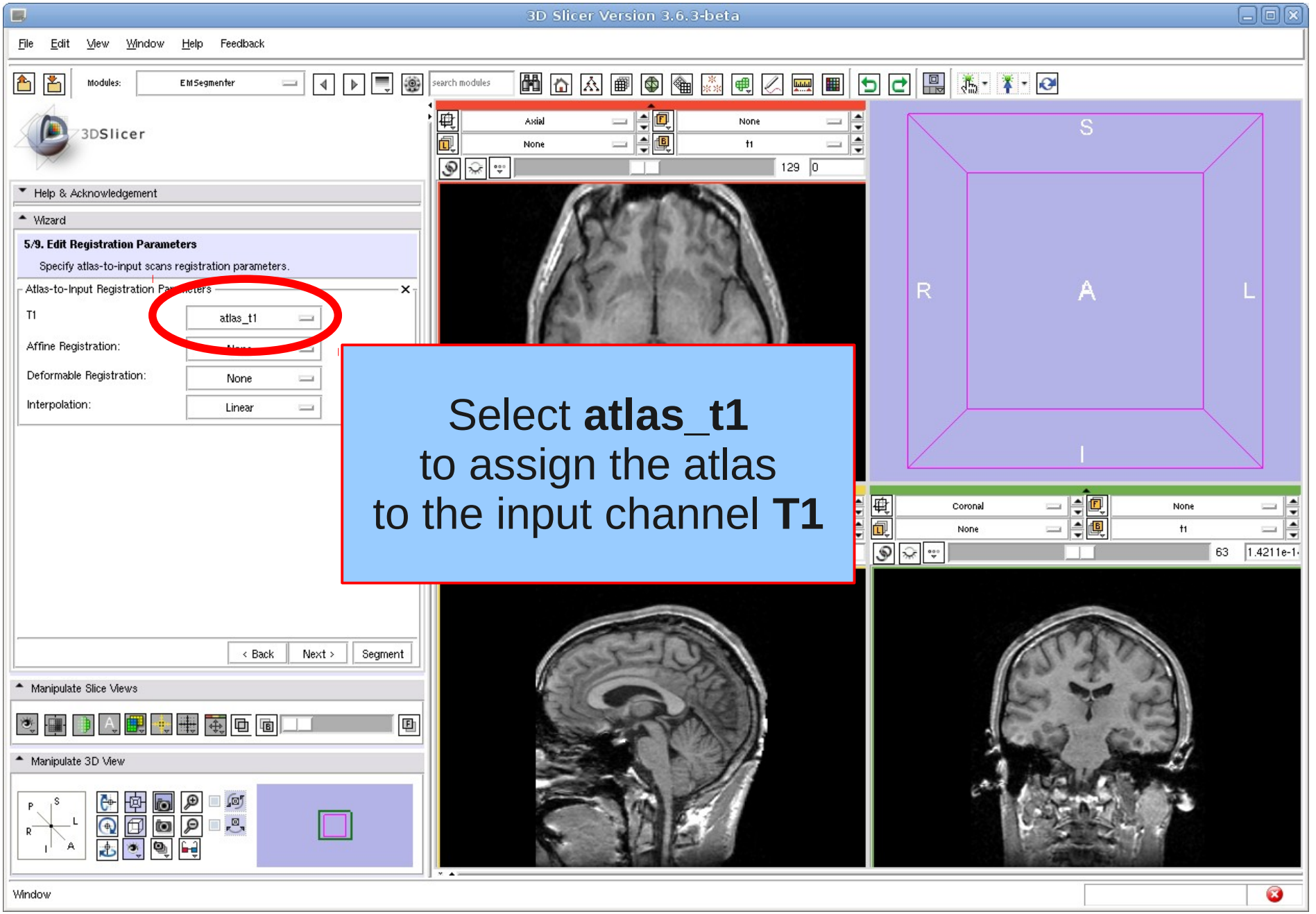
Left-click on **Select Volume** and assign the probabilistic atlas **atlas_csf** to the **CSF** structure.

Click on **Next**

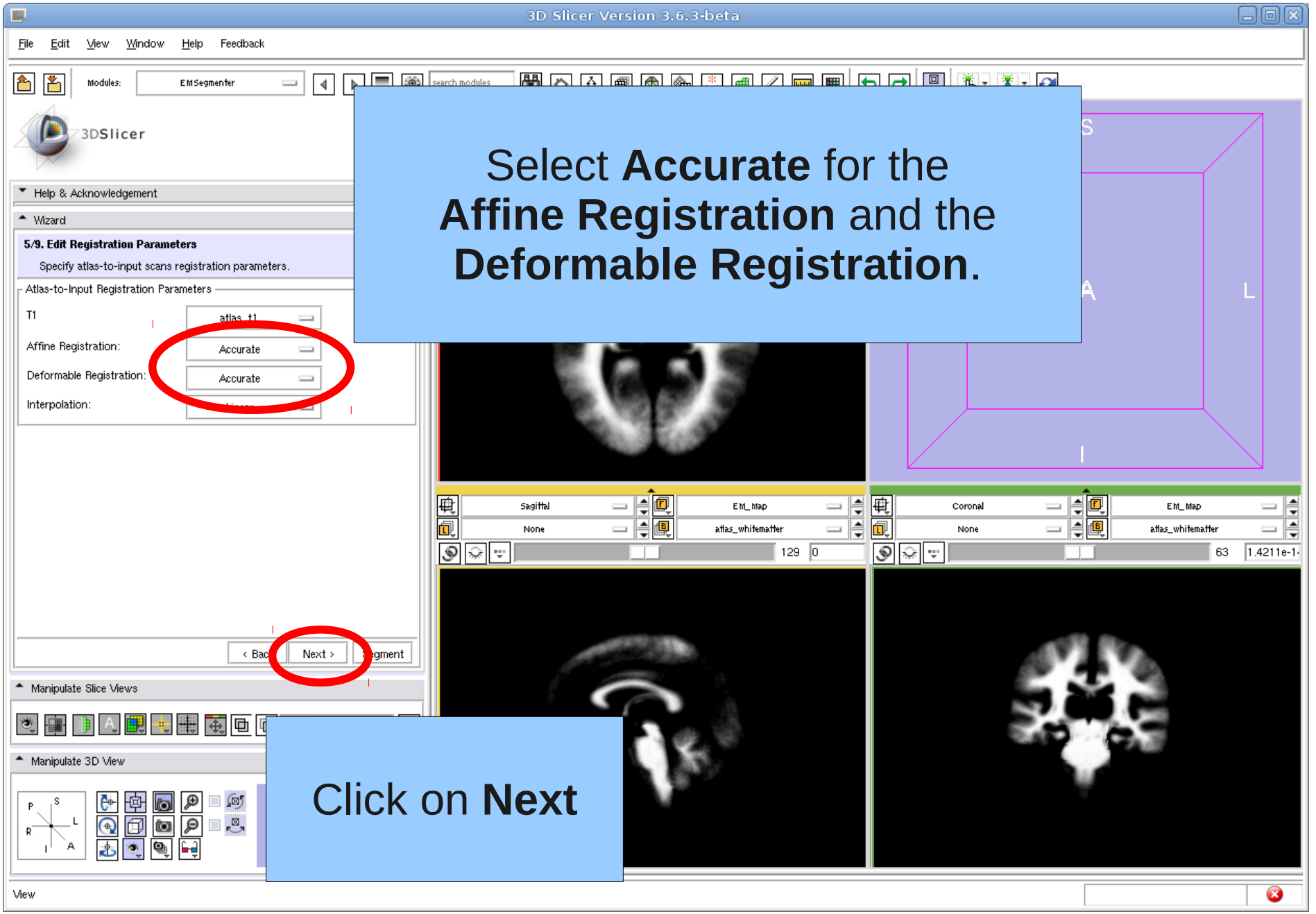
Edit Registration Parameters

Step 5

Edit Registration Parameters



Edit Registration Parameters



Define Preprocessing

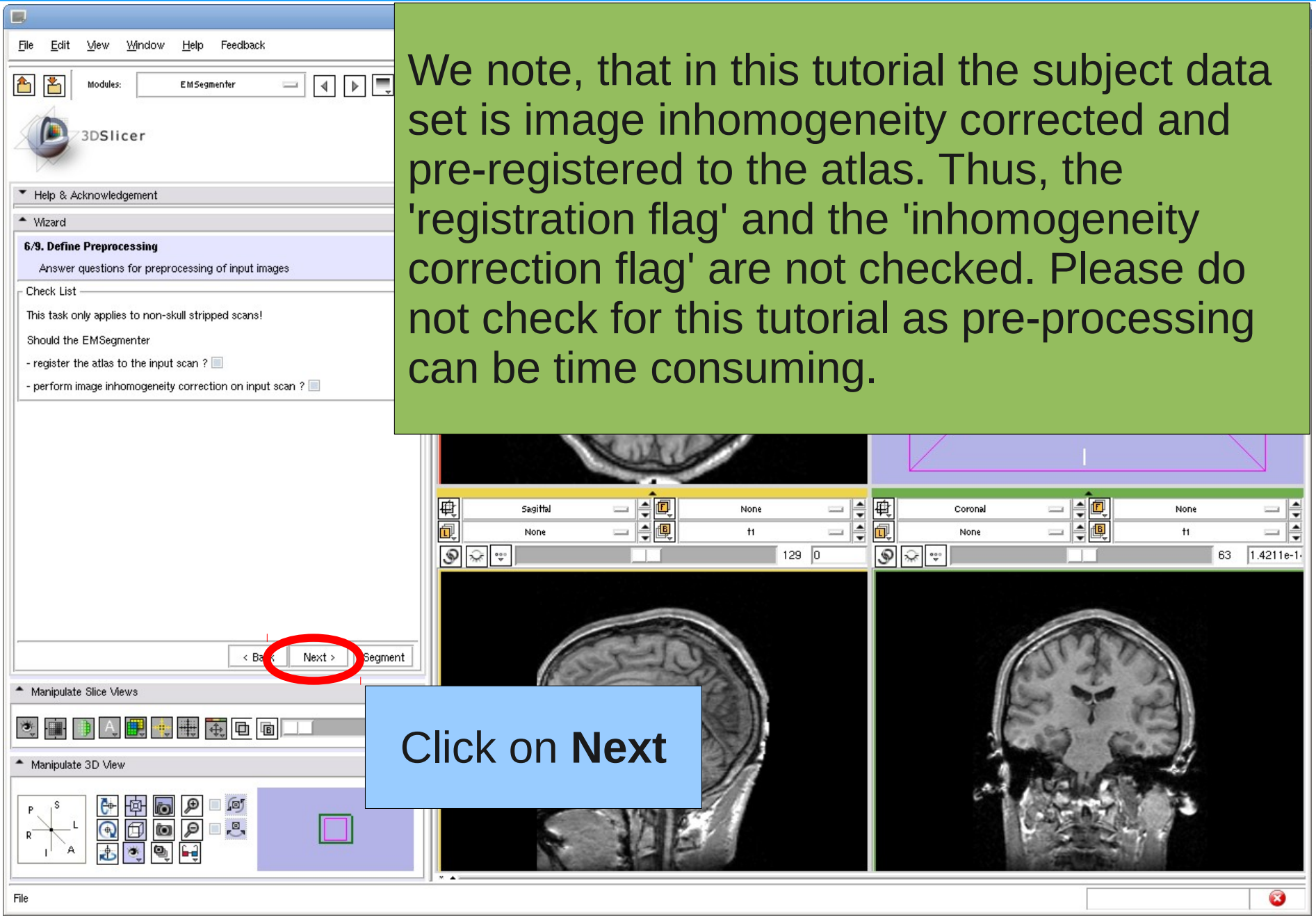
Step 6

In order to get a better segmentation result, the original subject data set can be used to extract additional information and to prepare (e.g. skull stripping, noise correction) the data set for the subsequent application of the segmentation algorithm.

This process is called pre-processing.

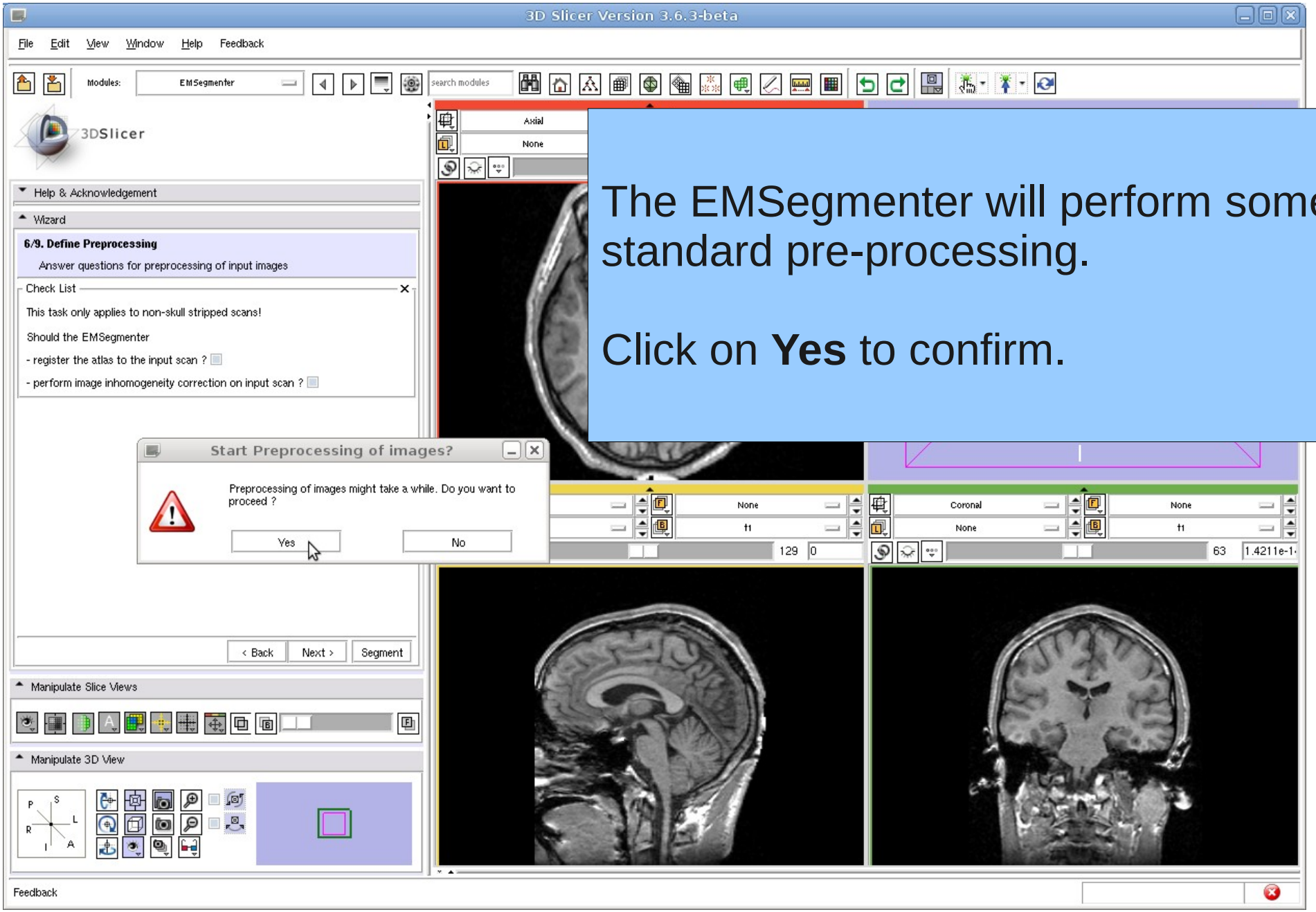
Define Preprocessing

We note, that in this tutorial the subject data set is image inhomogeneity corrected and pre-registered to the atlas. Thus, the 'registration flag' and the 'inhomogeneity correction flag' are not checked. Please do not check for this tutorial as pre-processing can be time consuming.



Click on **Next**

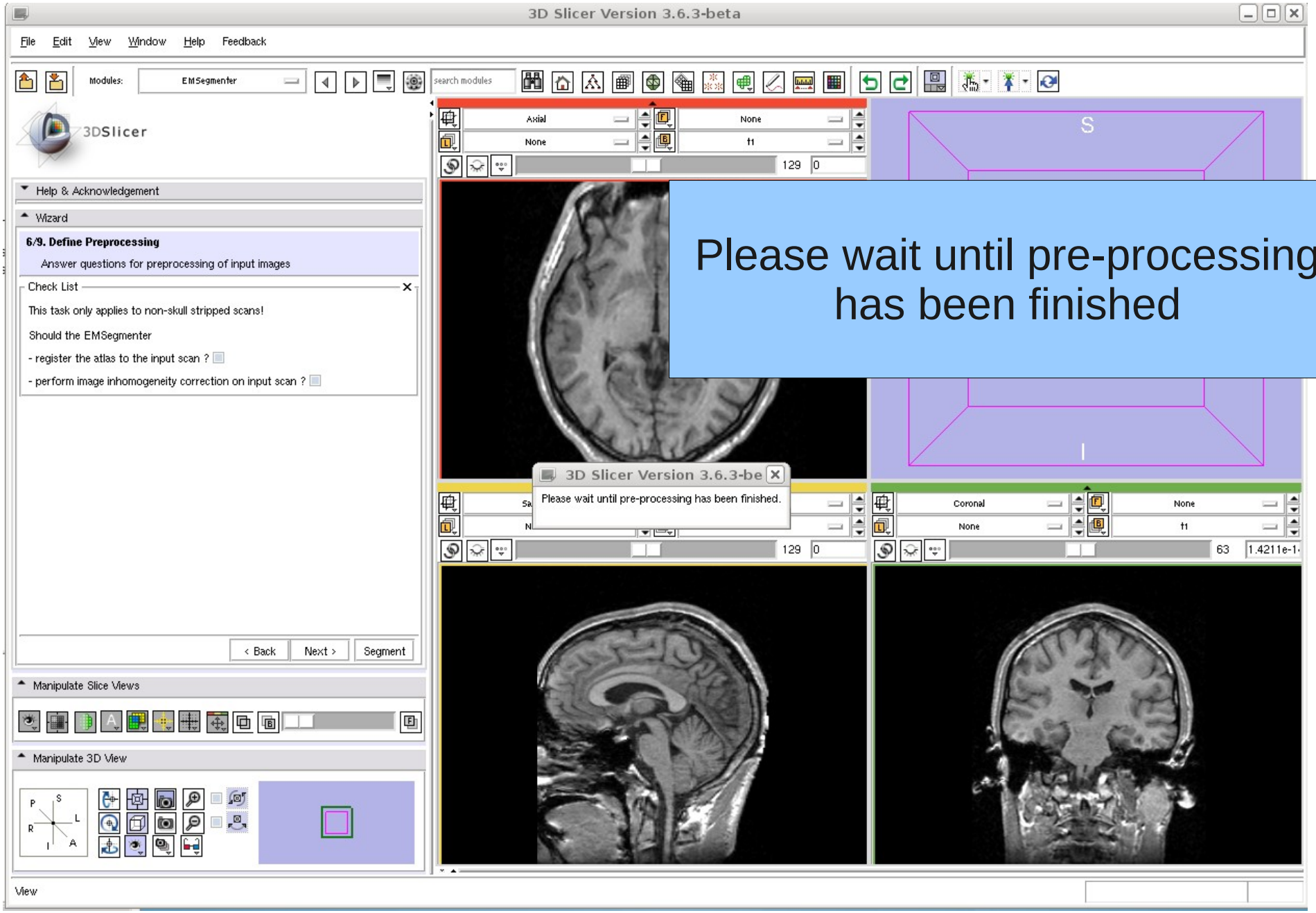
Define Preprocessing



The EMSegmenter will perform some standard pre-processing.

Click on **Yes** to confirm.

Define Preprocessing



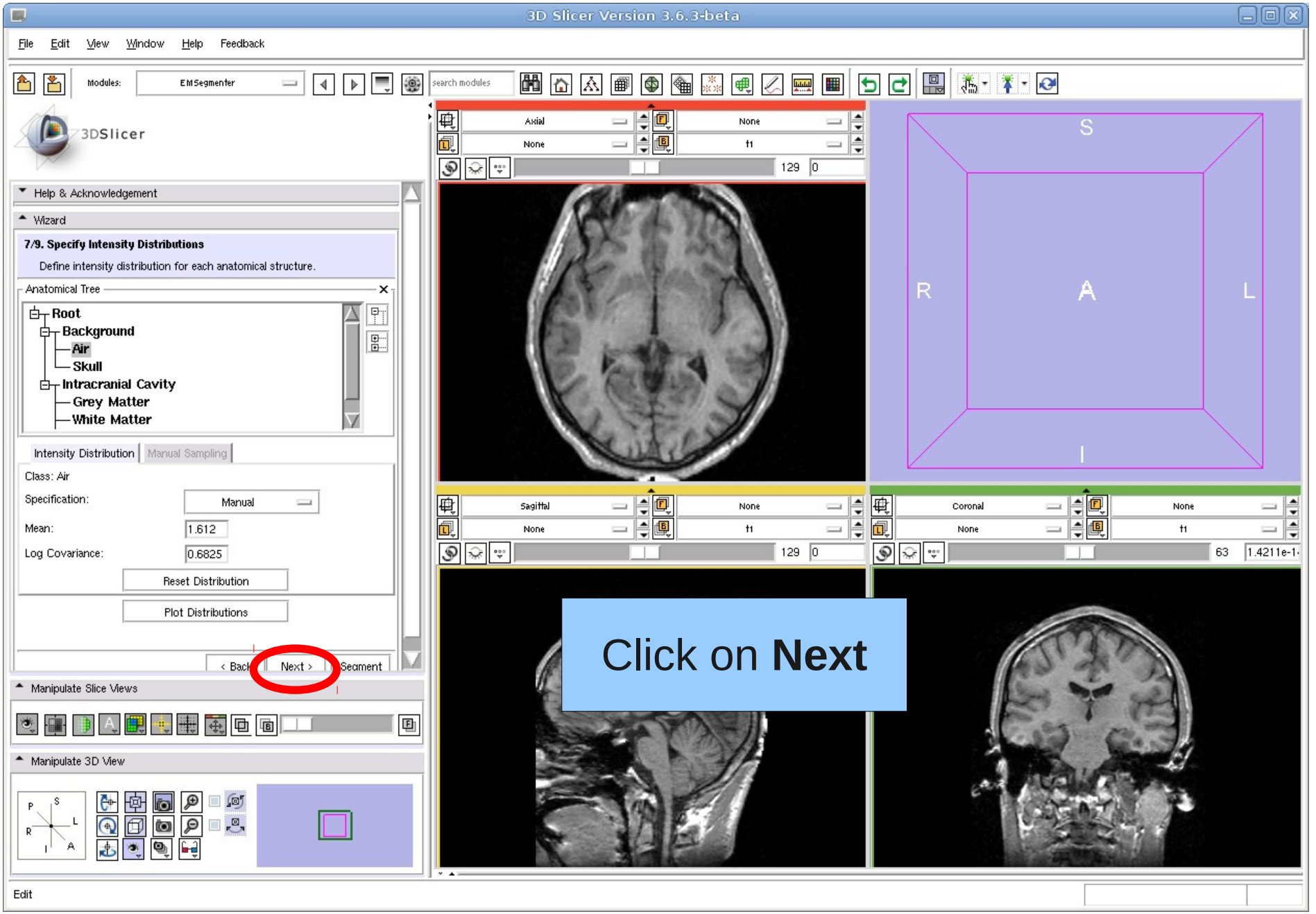
Specify Intensity Distribution

Step 7

In this step the intensity distributions for each class can be refined.

This step can be skipped for the tutorial, because the intensity distributions have been calculated during the pre-processing.

Specify Intensity Distribution

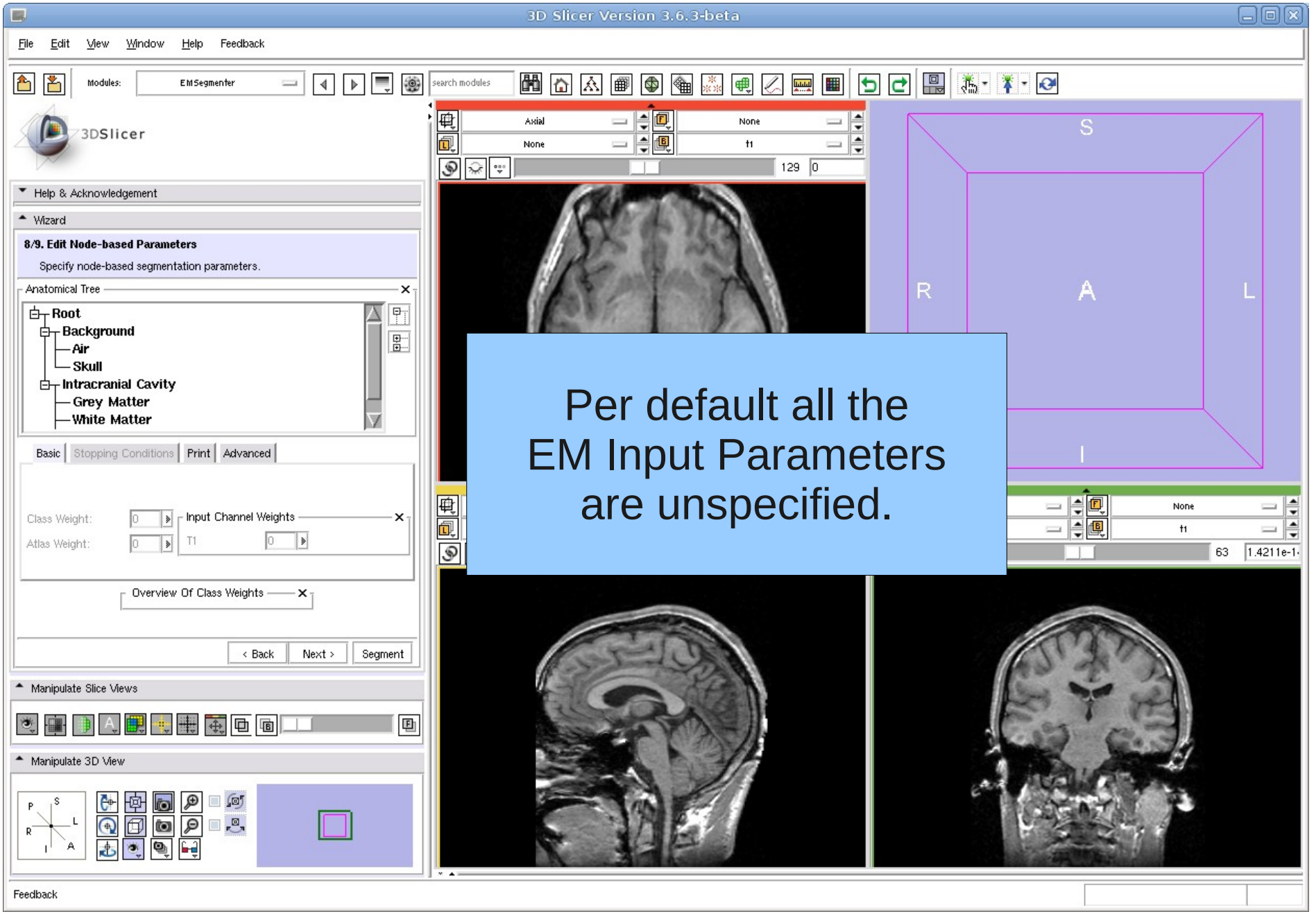


Edit Node-based Parameters

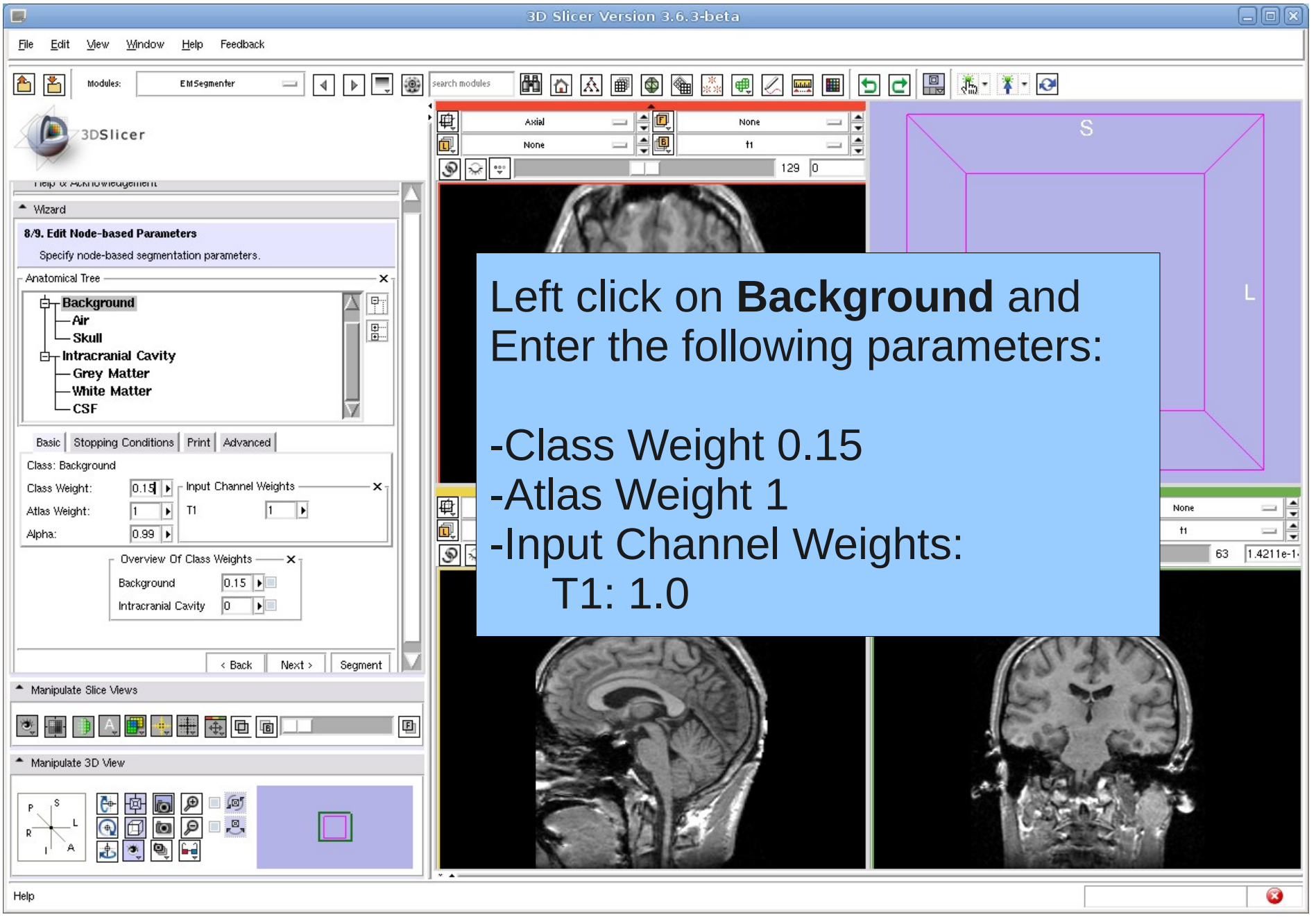
Step 8

Define EM algorithm specific parameters, e.g. class weights, atlas weights, and input channel weights.

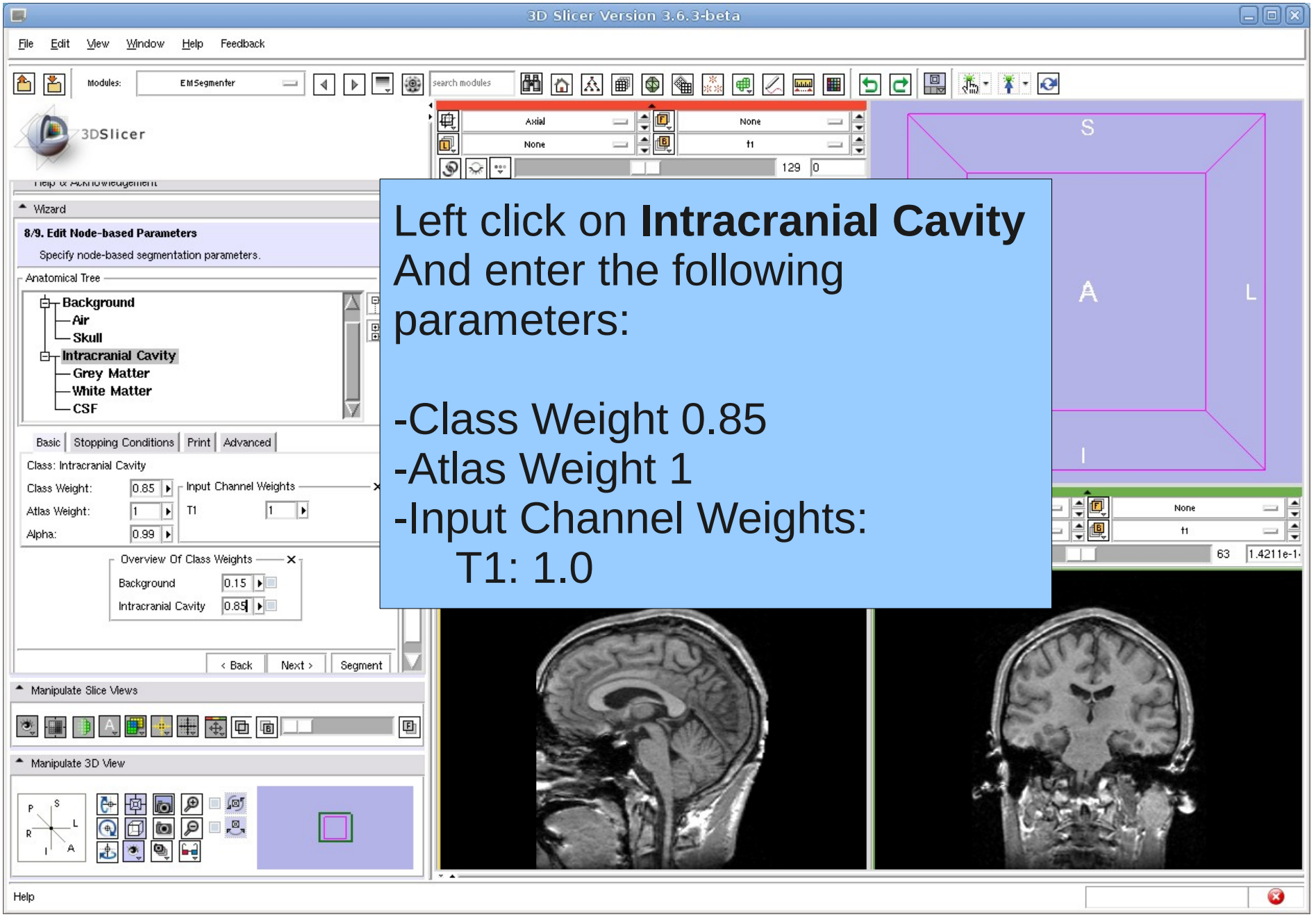
Edit Node-based Parameters



Edit Node-based Parameters



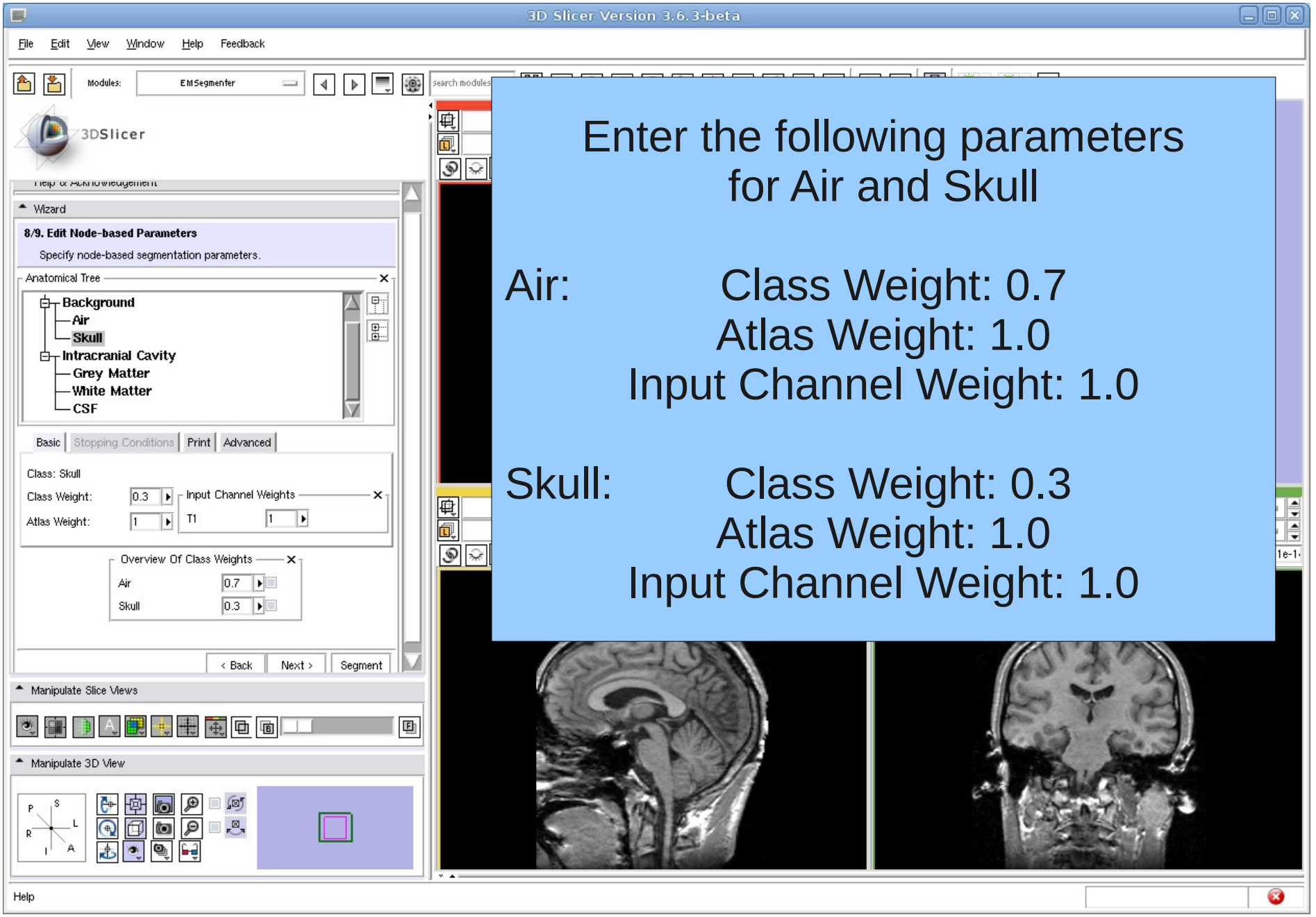
Edit Node-based Parameters



Left click on **Intracranial Cavity**
And enter the following parameters:

-Class Weight 0.85
-Atlas Weight 1
-Input Channel Weights:
T1: 1.0

Edit Node-based Parameters

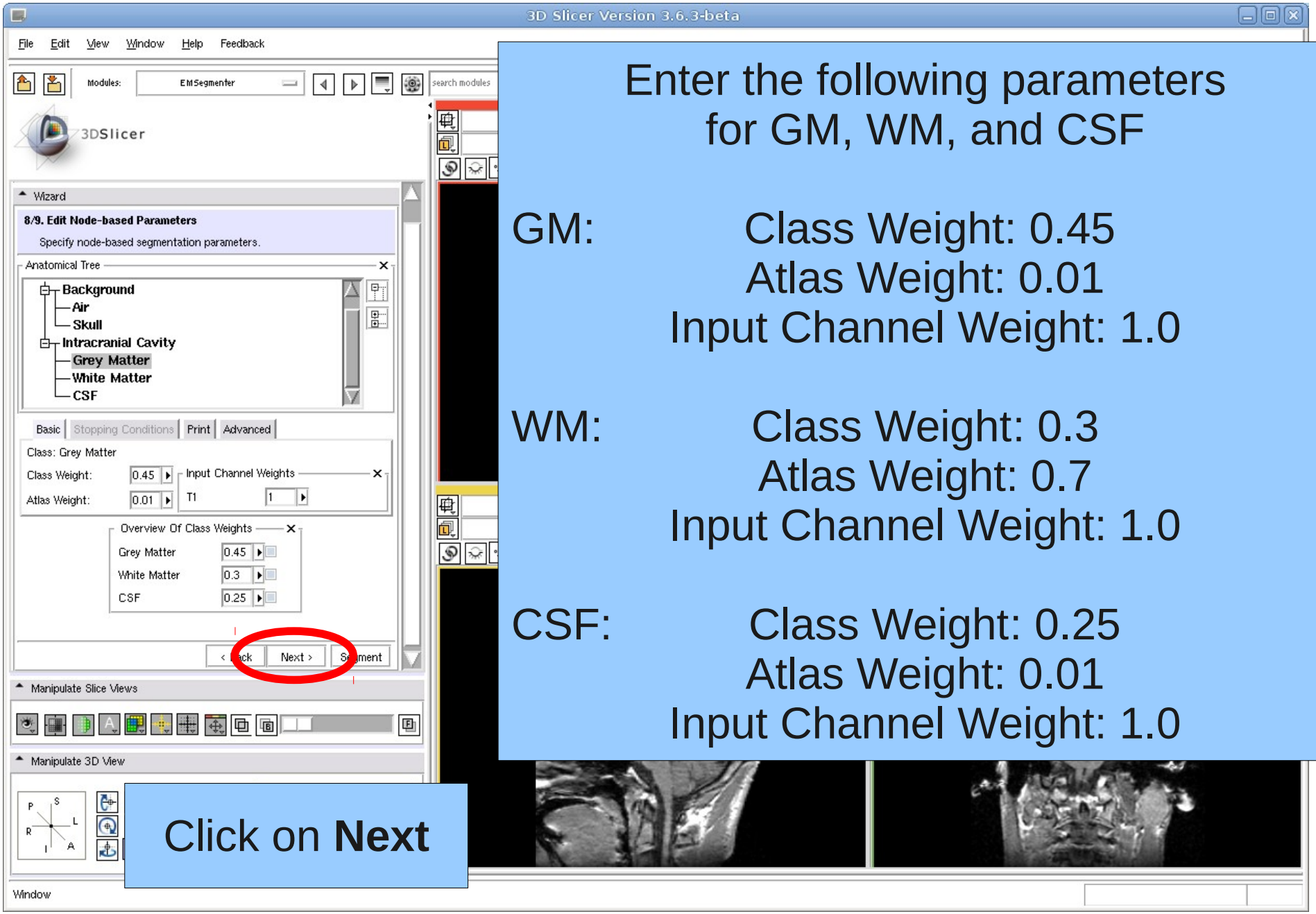


Enter the following parameters for Air and Skull

Air: Class Weight: 0.7
Atlas Weight: 1.0
Input Channel Weight: 1.0

Skull: Class Weight: 0.3
Atlas Weight: 1.0
Input Channel Weight: 1.0

Edit Node-based Parameters



Enter the following parameters for GM, WM, and CSF

GM: Class Weight: 0.45
Atlas Weight: 0.01
Input Channel Weight: 1.0

WM: Class Weight: 0.3
Atlas Weight: 0.7
Input Channel Weight: 1.0

CSF: Class Weight: 0.25
Atlas Weight: 0.01
Input Channel Weight: 1.0

Click on **Next**

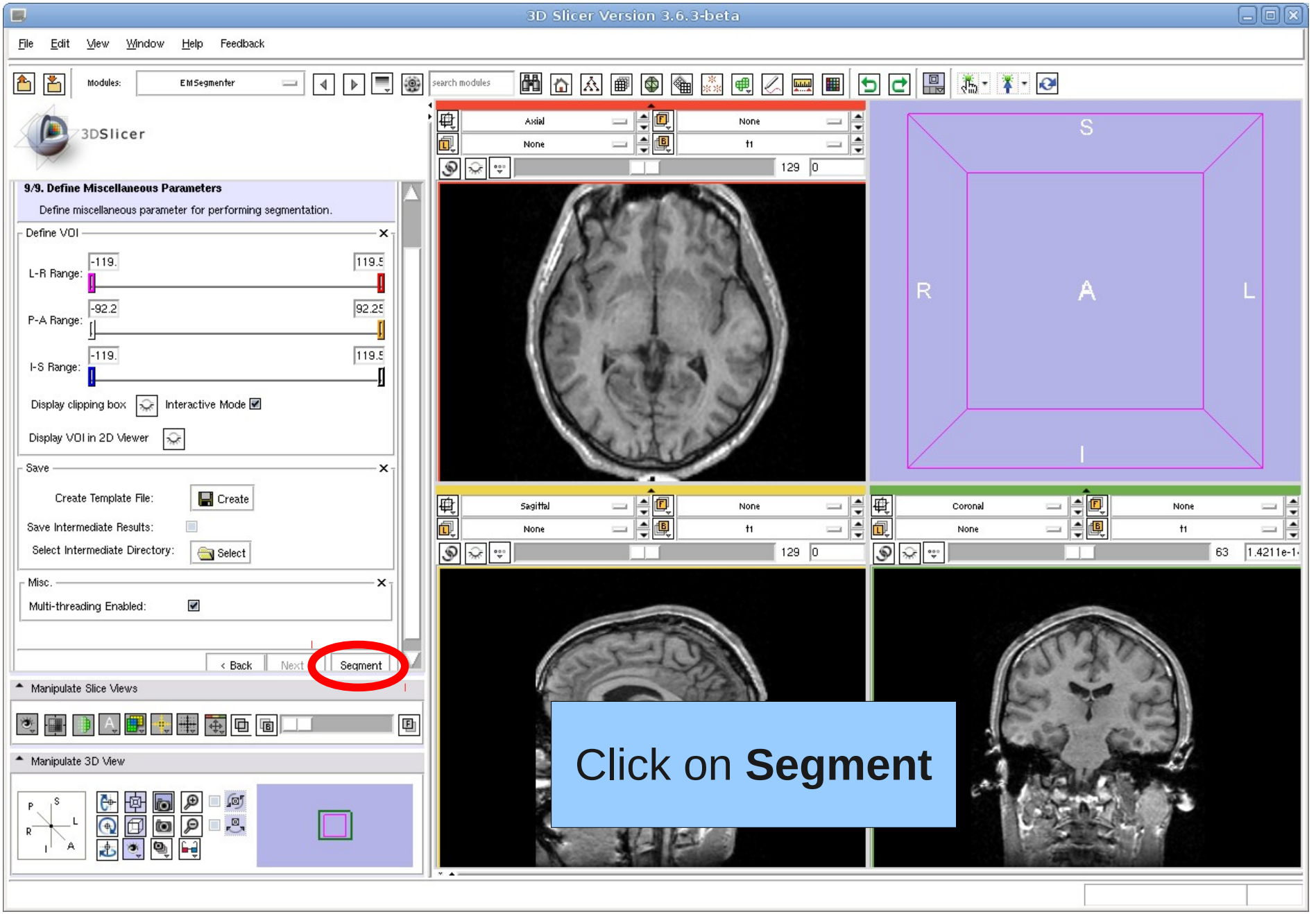
Run Segmentation

Step 9

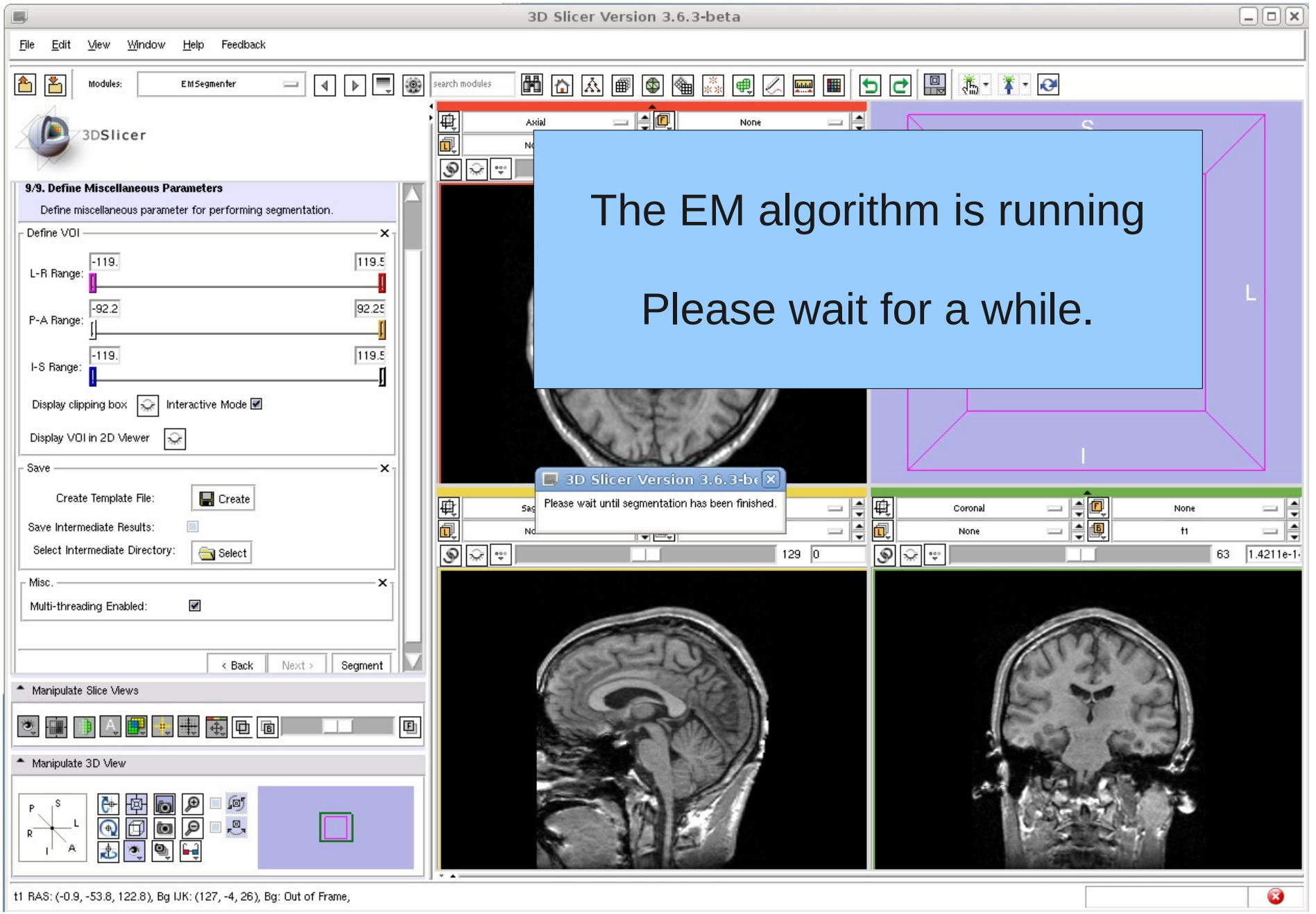
This is the last step of the EMSegmenter wizard.

The Volume Of Interested (VOI) can be specified, and the algorithm can be started.

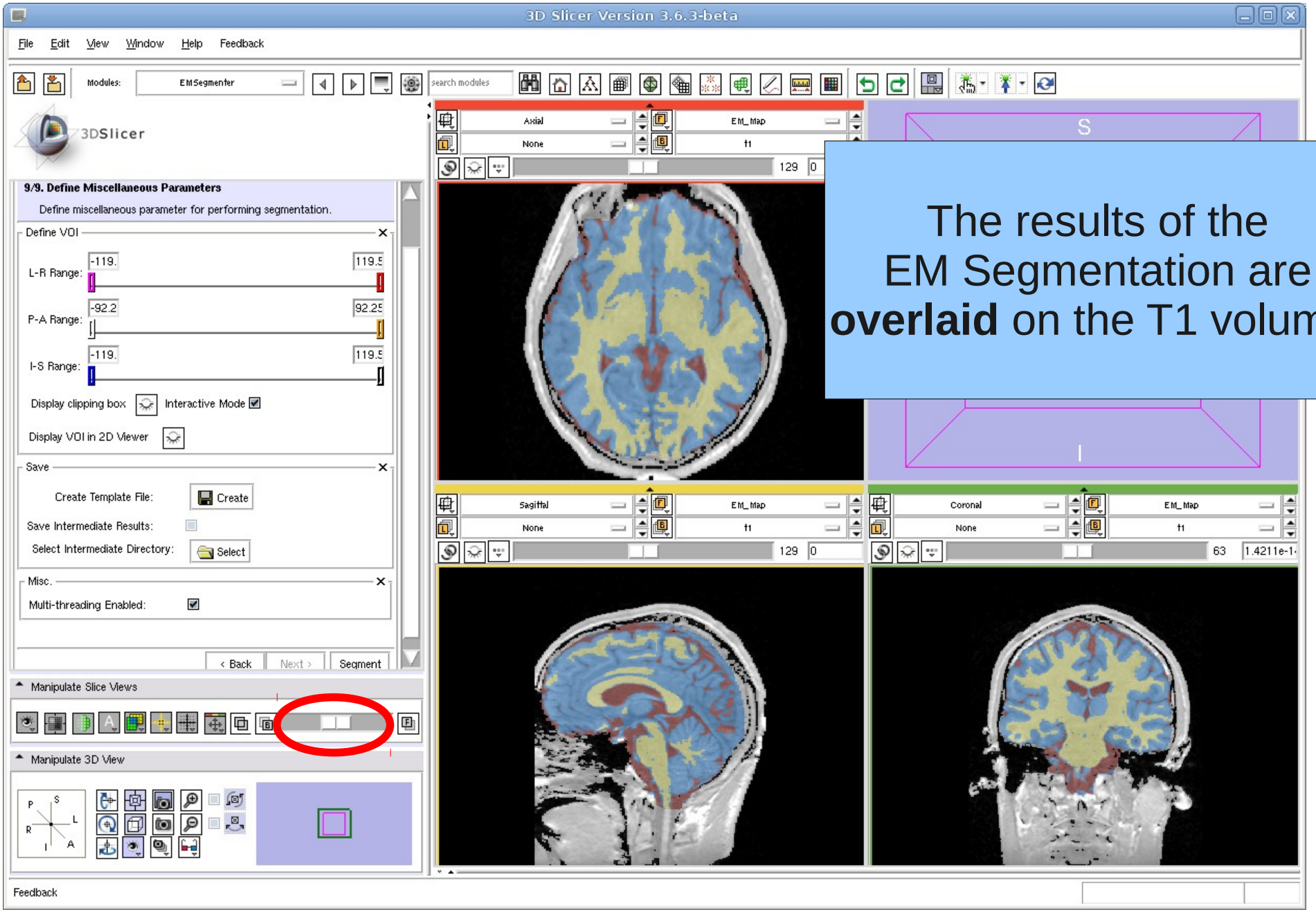
Run Segmentation



Run Segmentation



Results: Run Segmentation

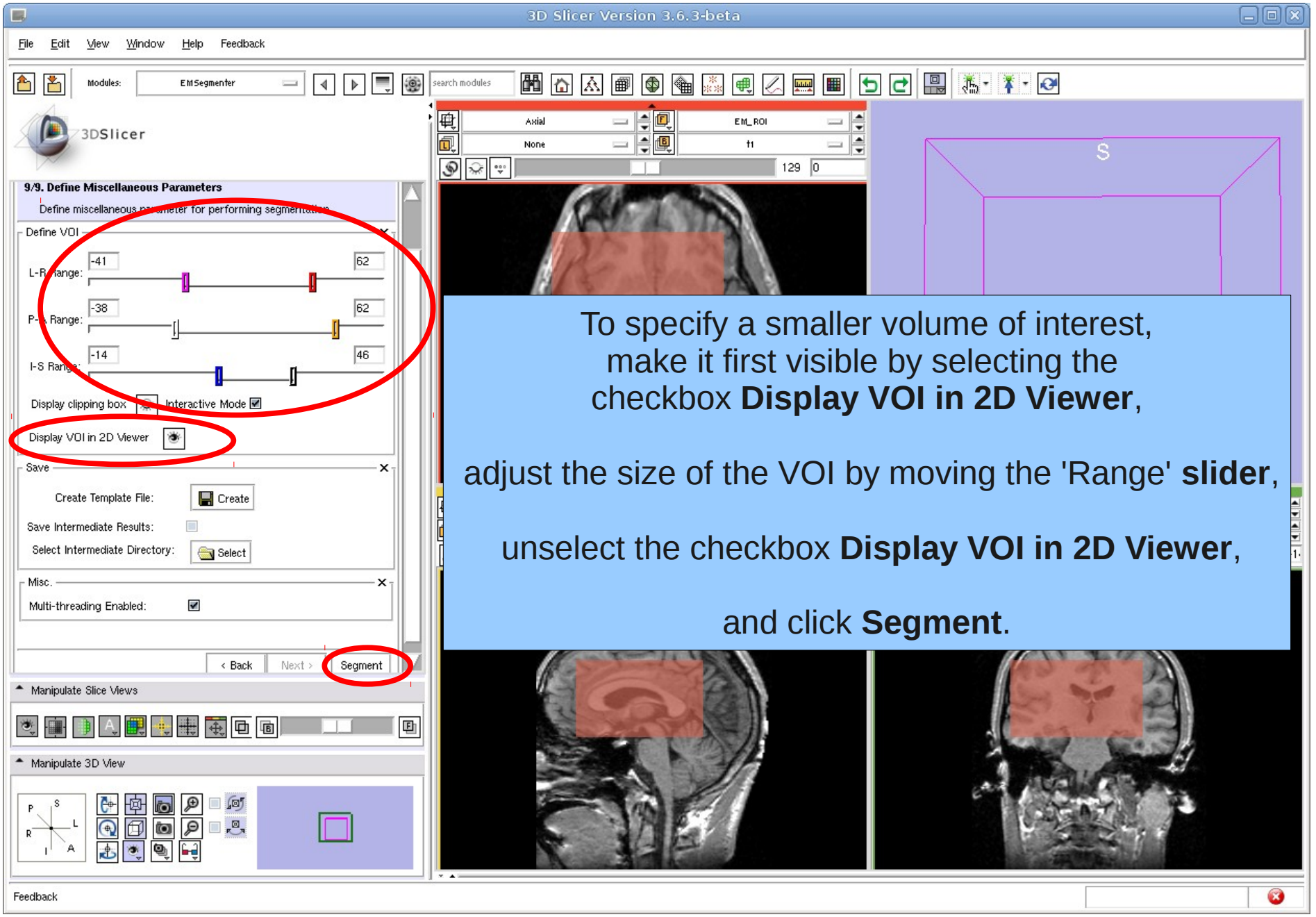


The results of the EM Segmentation are **overlaid** on the T1 volume.

Consecutive adjustment

The following slides illustrate
-how to specify a volume of interest and
-how to adjust segmentation parameters
the refine the segmentation result.

Volume Of Interest (VOI)



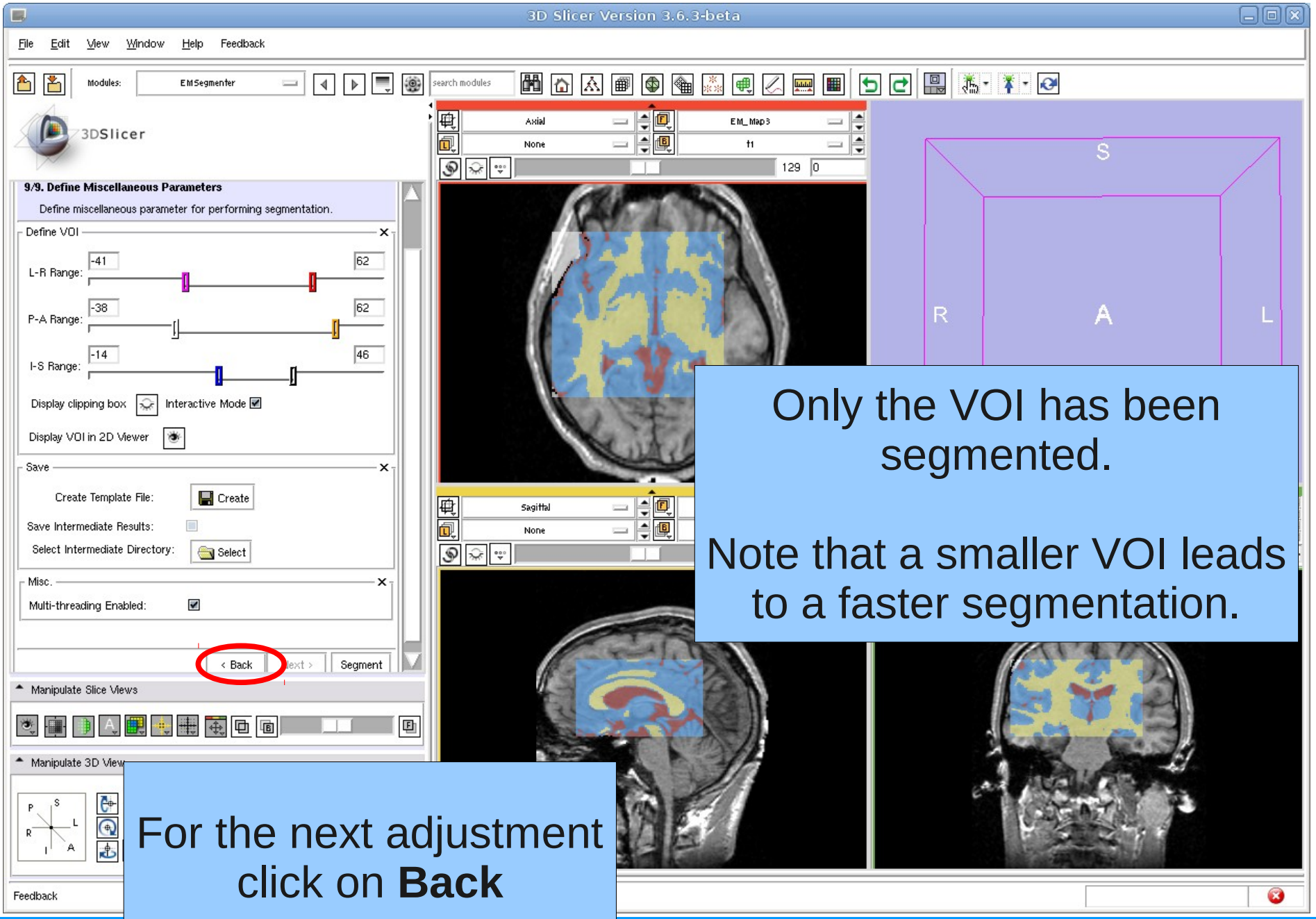
To specify a smaller volume of interest, make it first visible by selecting the checkbox **Display VOI in 2D Viewer**,

adjust the size of the VOI by moving the 'Range' **slider**,

unselect the checkbox **Display VOI in 2D Viewer**,

and click **Segment**.

Result: Volume Of Interest (VOI)

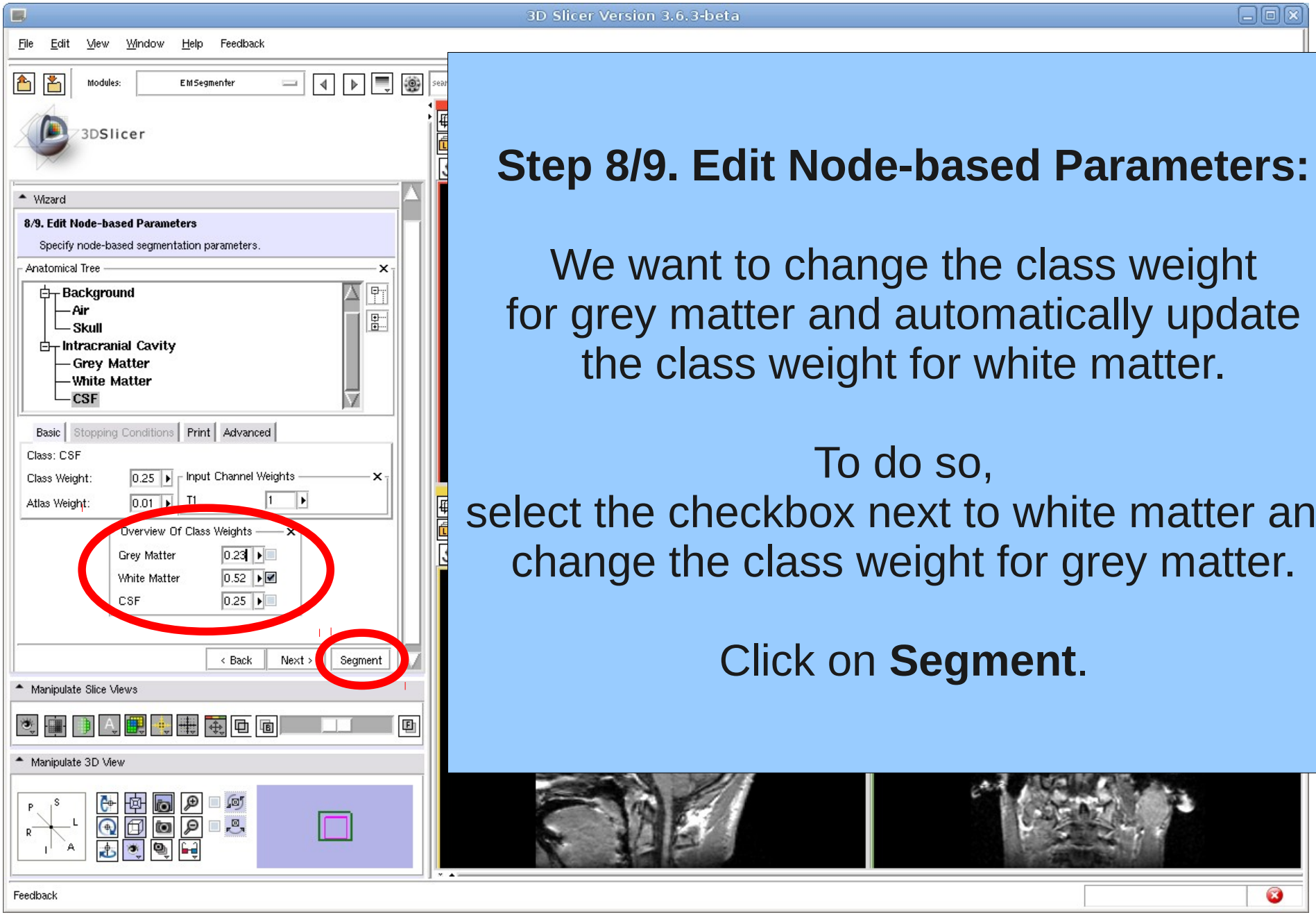


Only the VOI has been segmented.

Note that a smaller VOI leads to a faster segmentation.

For the next adjustment click on **Back**

Adjusting Parameters



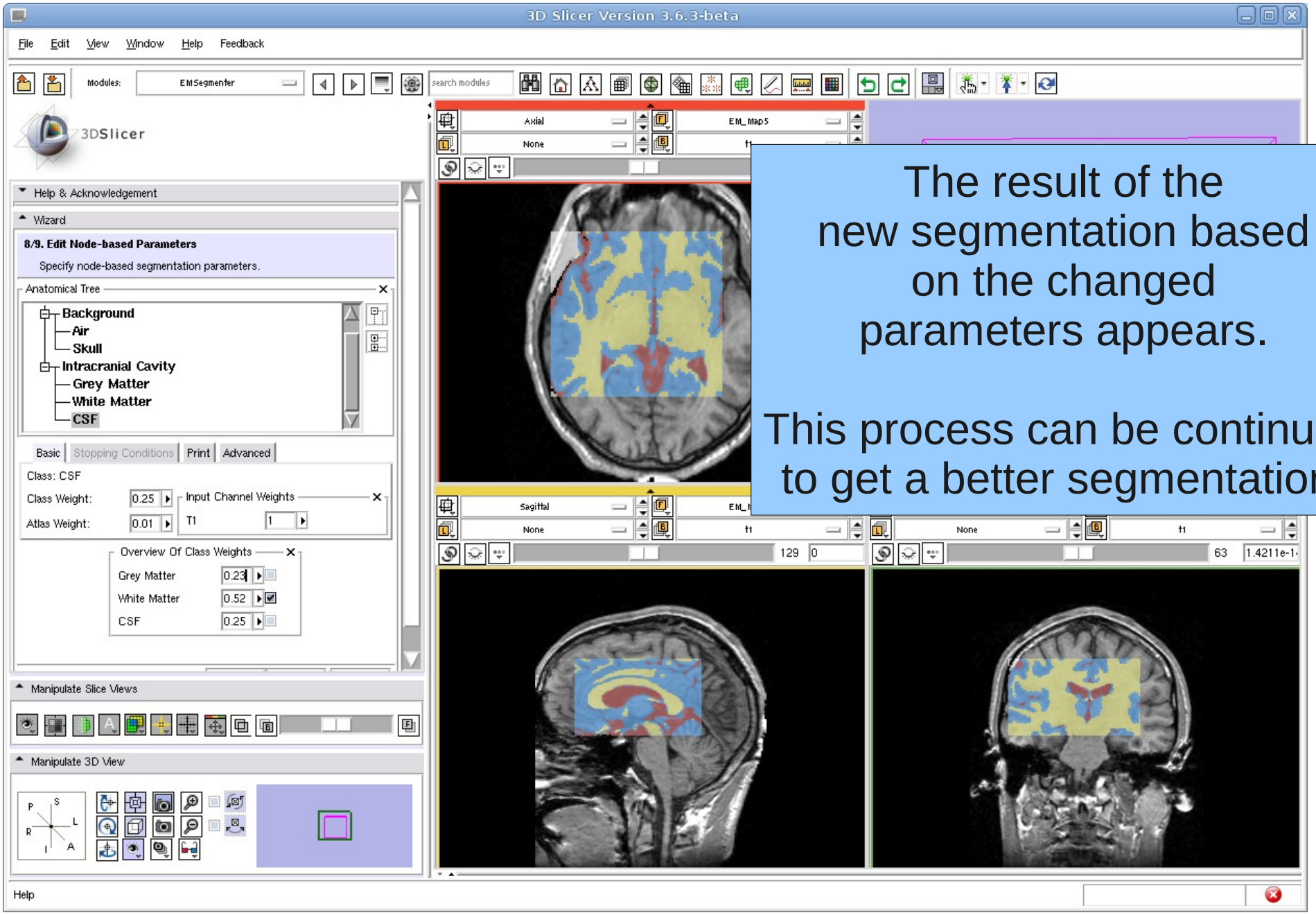
Step 8/9. Edit Node-based Parameters:

We want to change the class weight for grey matter and automatically update the class weight for white matter.

To do so, select the checkbox next to white matter and change the class weight for grey matter.

Click on **Segment**.

Result: Adjusting Parameters



The result of the new segmentation based on the changed parameters appears.

This process can be continued to get a better segmentation.

Further Info & Acknowledgments

EMSegmenter Wiki Page:

http://www.slicer.org/slicerWiki/index.php/EMSegmenter-Overview

The EMSegmenter technology behind was reported in:

K.M. Pohl et. A hierarchical algorithm for MR brain image parcellation. IEEE Transactions on Medical Imaging, 26(9), pp 1201-1212, 2007.

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