Fiber Bundle Selection And Scalar Measurement

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Learning Objectives

Following this tutorial, you'll be able to:

1) select fiber bundles passing through region(s) of interest, and

2) calculate scalar measurements (such as FA and trace) from the fiber bundles.

Tutorial Outline

- Editing multiple labels
- Whole brain tractography
- Fiber bundle selection
- Fiber bundle scalar measurements

Pre-requisite

- This tutorial is a follow-up tutorial of the Diffusion Tensor Imaging Tutorial. Please go through this ahead, which is available at:

https://www.slicer.org/slicerWiki/index.php/Documentation/4.5/Training#Slicer4_Diffusion_Tensor_Imaging_Tutorial

Tutorial Software

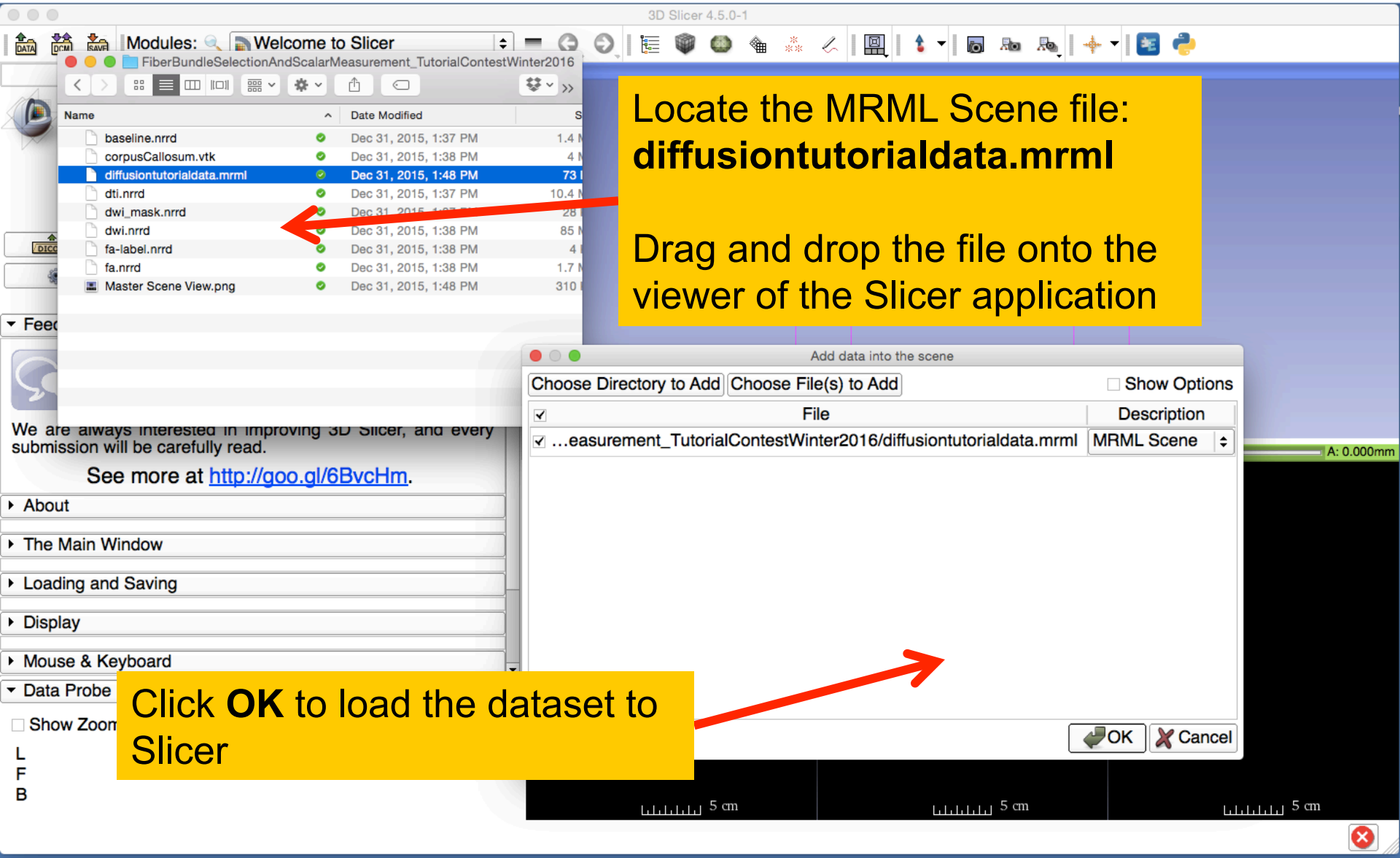
The tutorial uses the 3DSlicer (Version 4.5.0-1 Stable Release) software available at

http://download.slicer.org

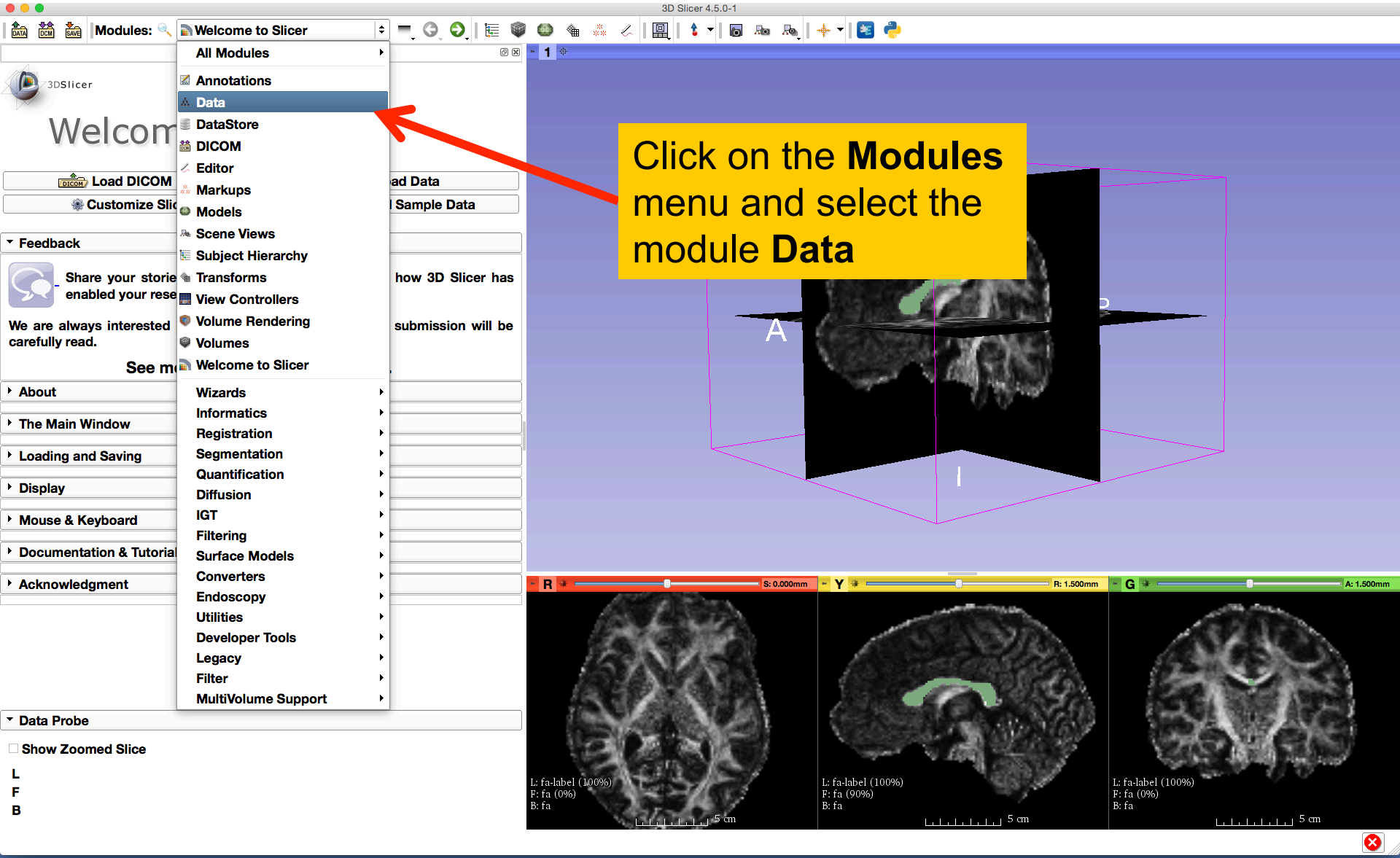
Disclaimer

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. Slicer is a tool for research, and is not FDA approved.

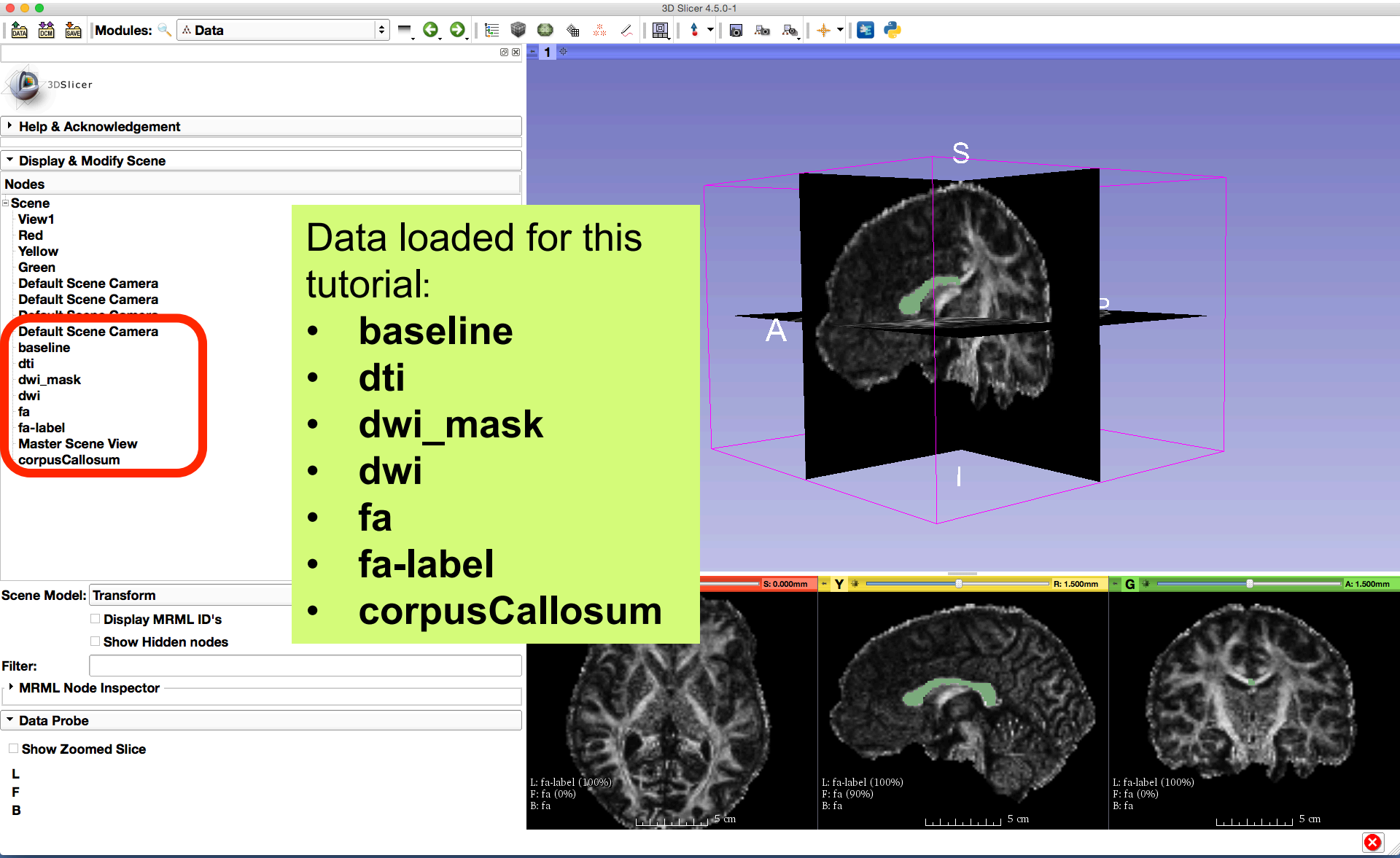
Load MRML Data



Load MRML Data



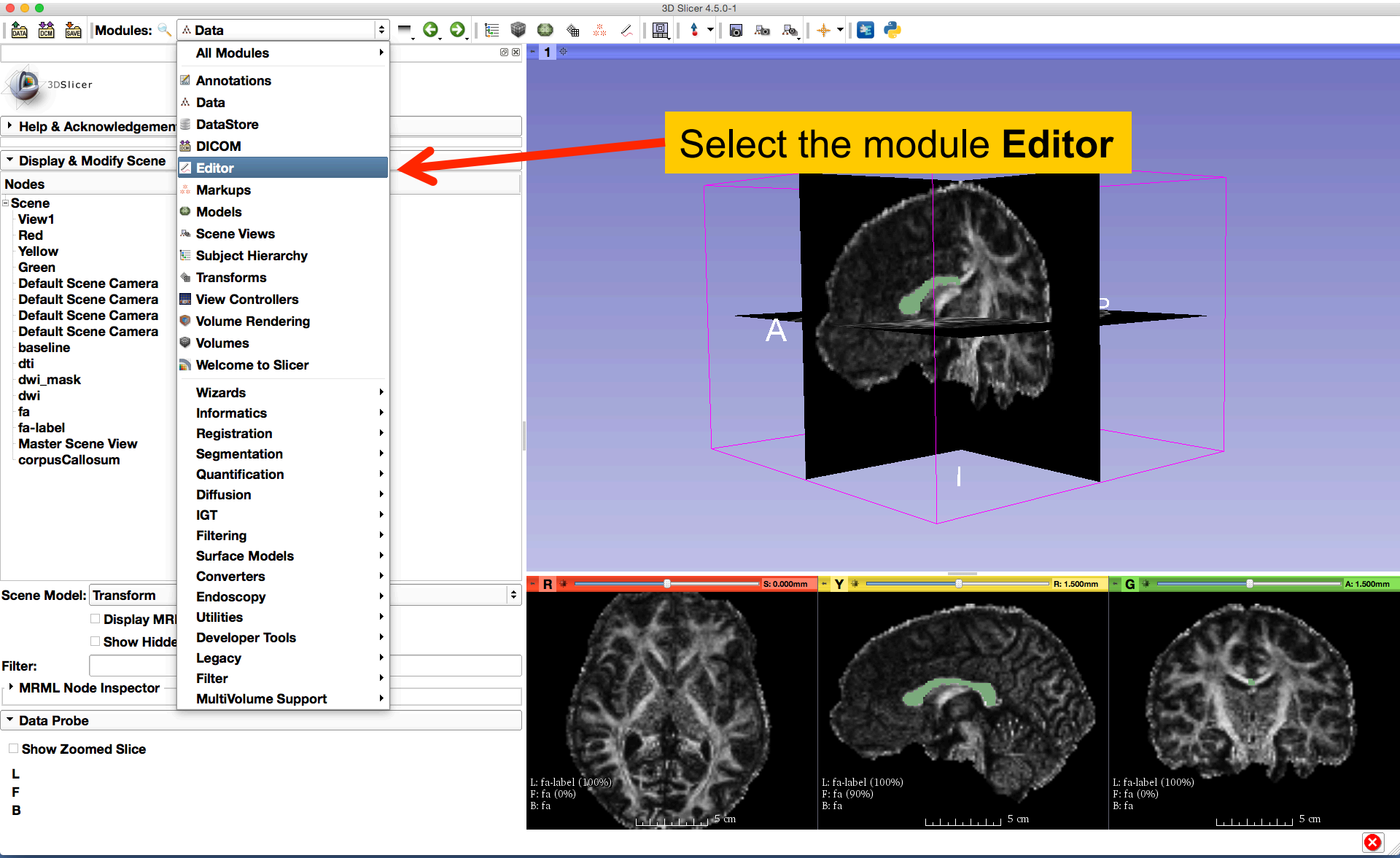
Load MRML Data



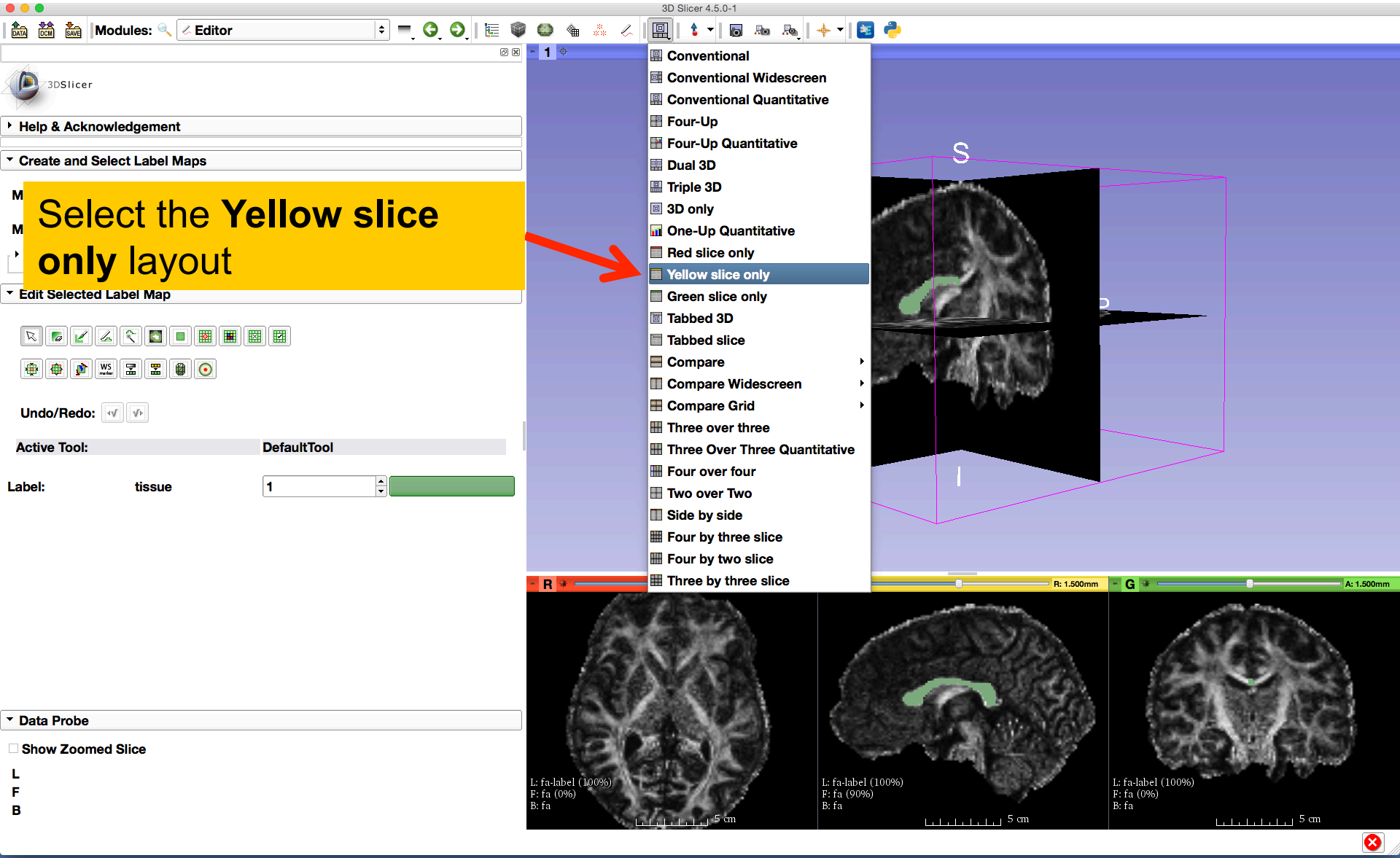
Data loaded for this tutorial:

- **baseline**
- **dti**
- **dwi_mask**
- **dwi**
- **fa**
- **fa-label**
- **corpusCallosum**

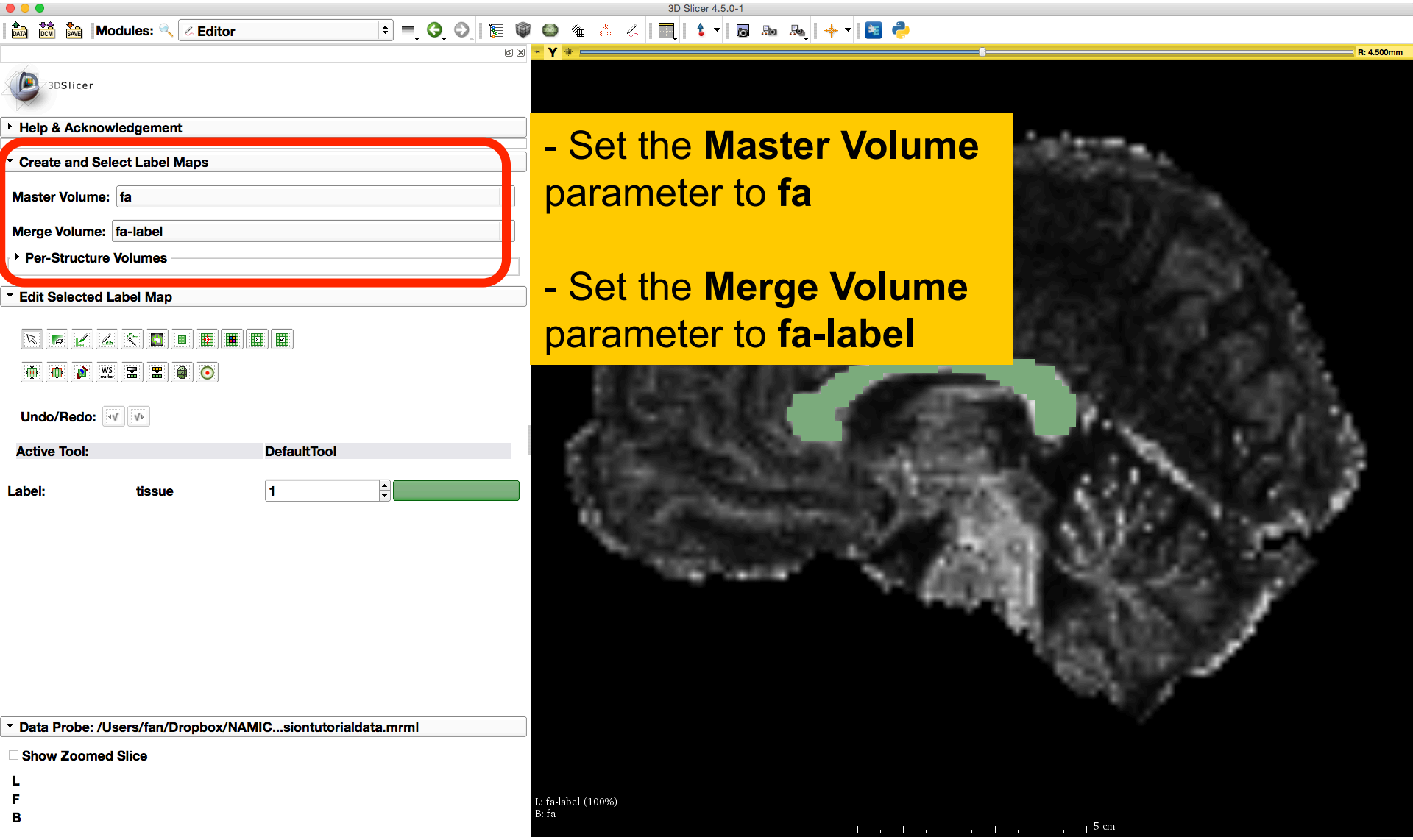
Edit Multiple Labels



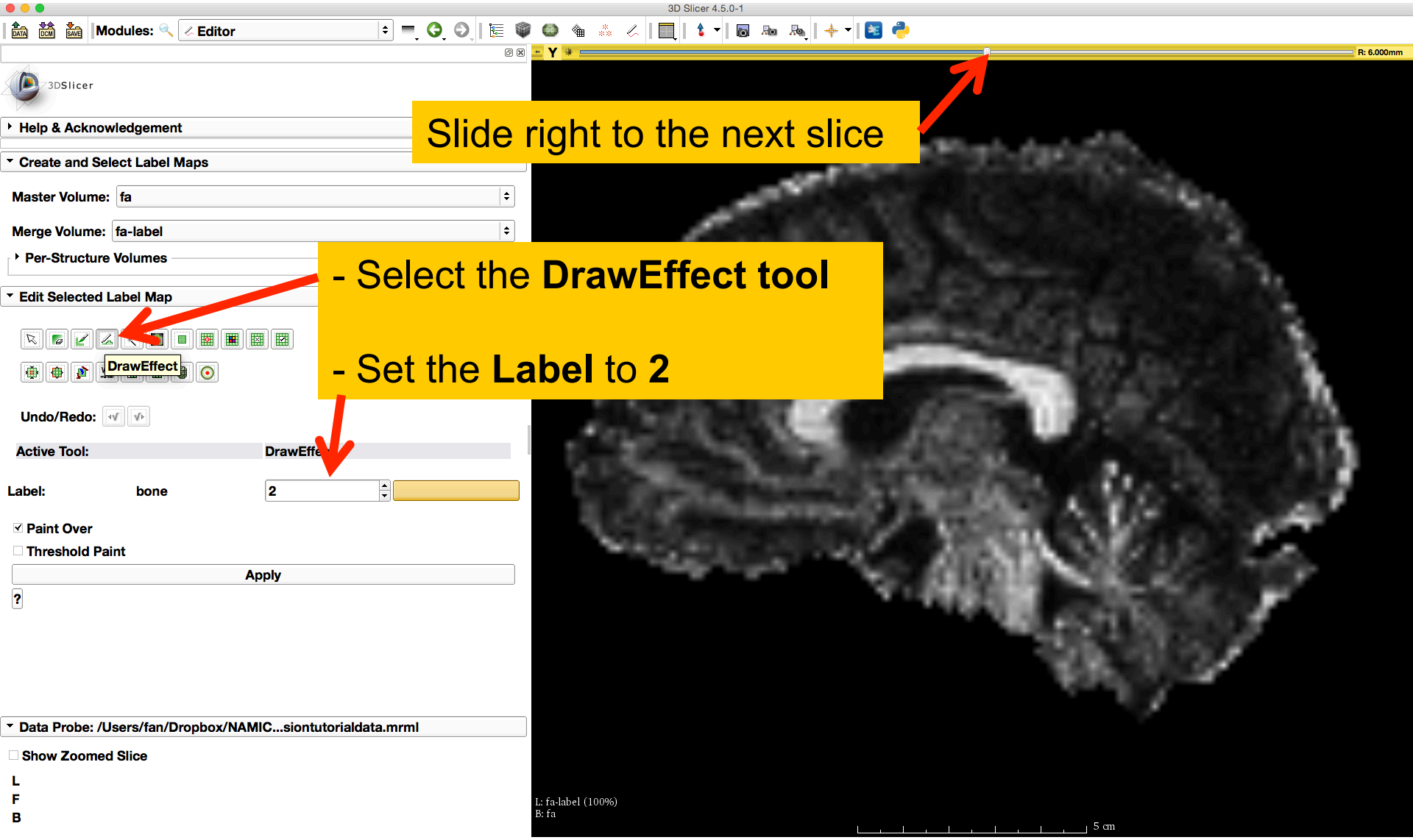
Edit Multiple Labels



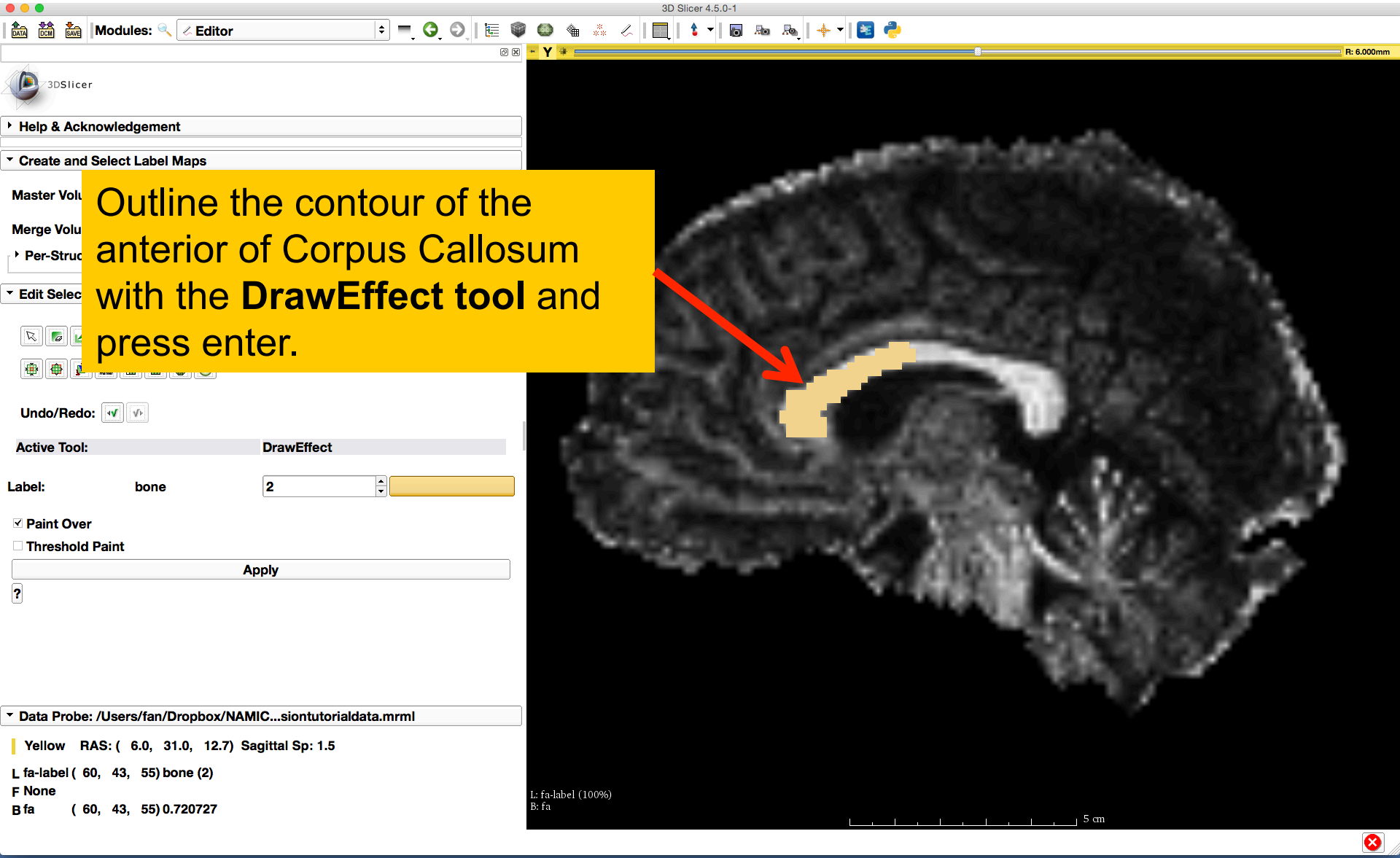
Edit Multiple Labels



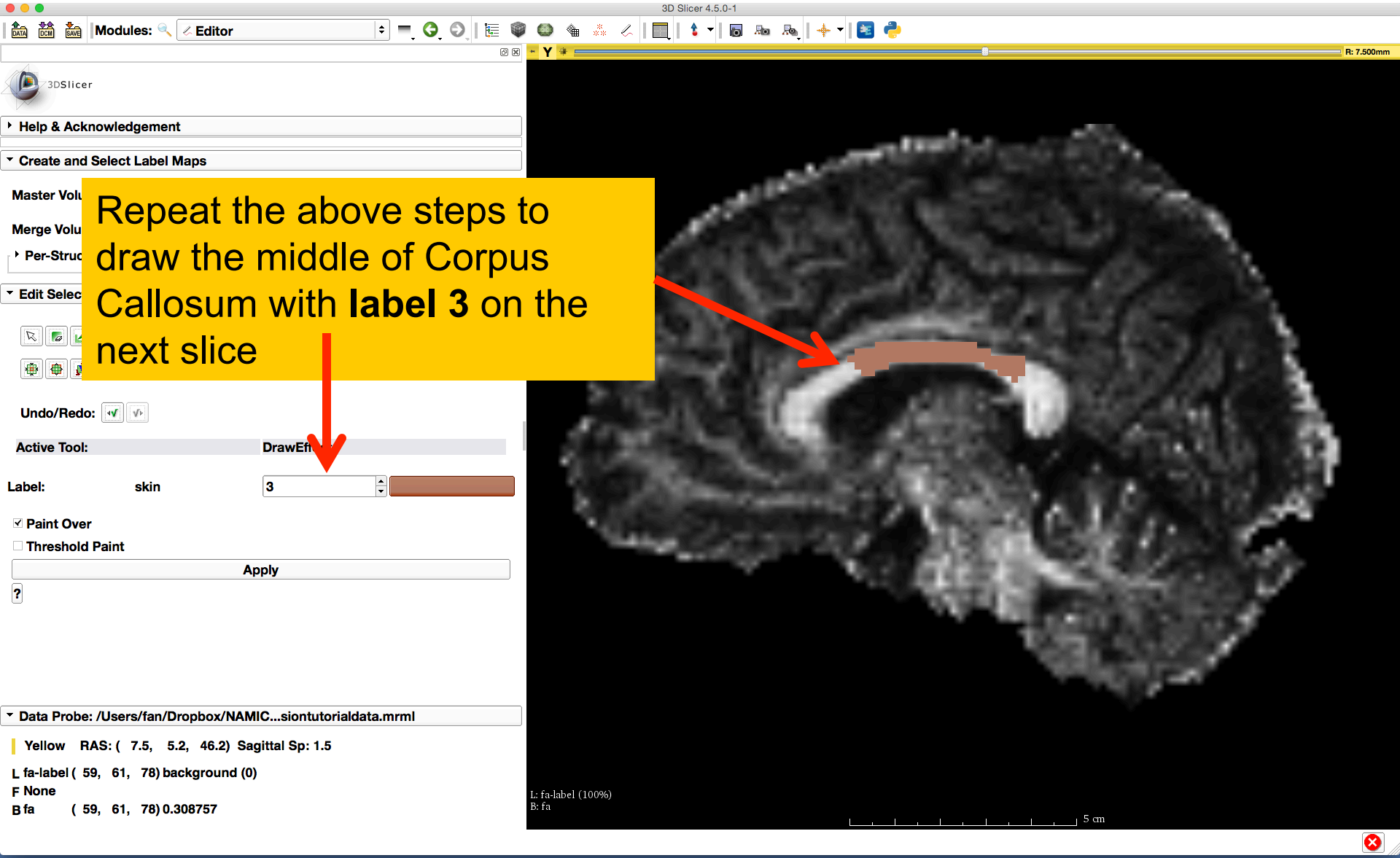
Edit Multiple Labels



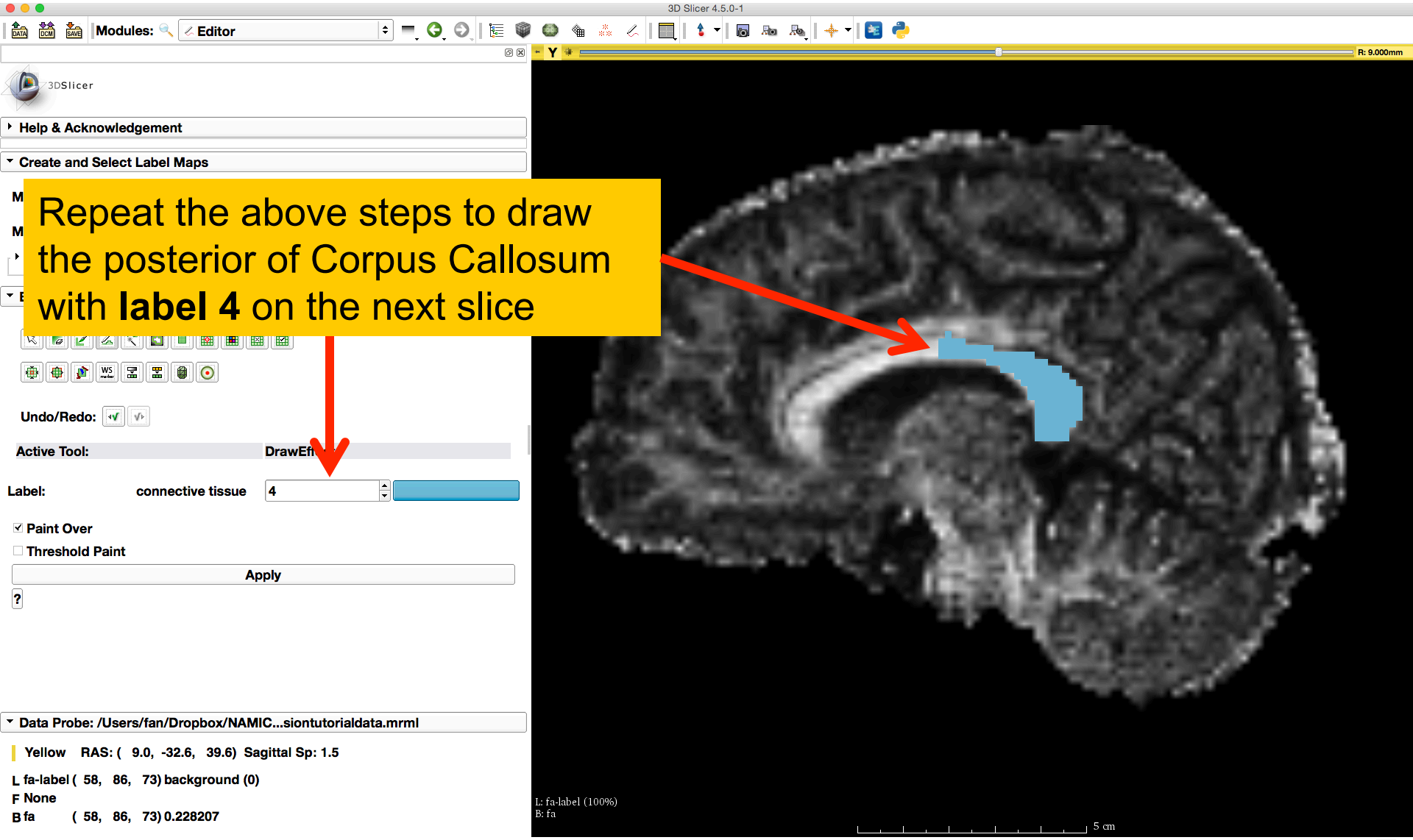
Edit Multiple Labels



Edit Multiple Labels



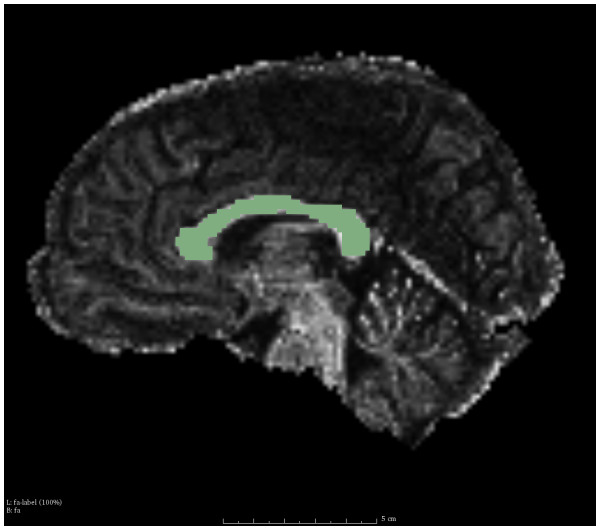
Edit Multiple Labels



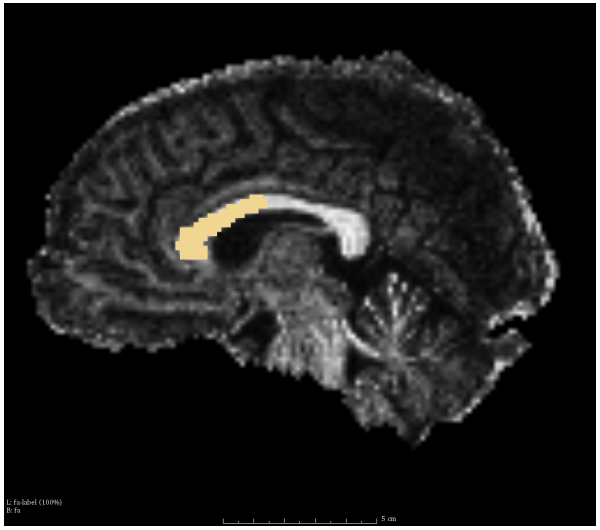
Edit Multiple Labels

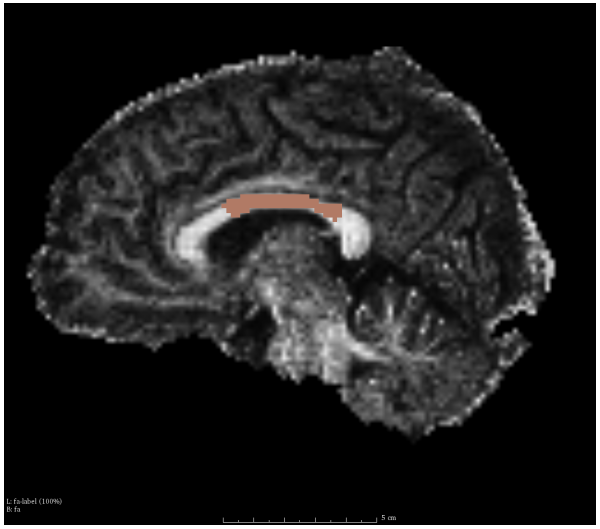
Label map on individual slice, with :

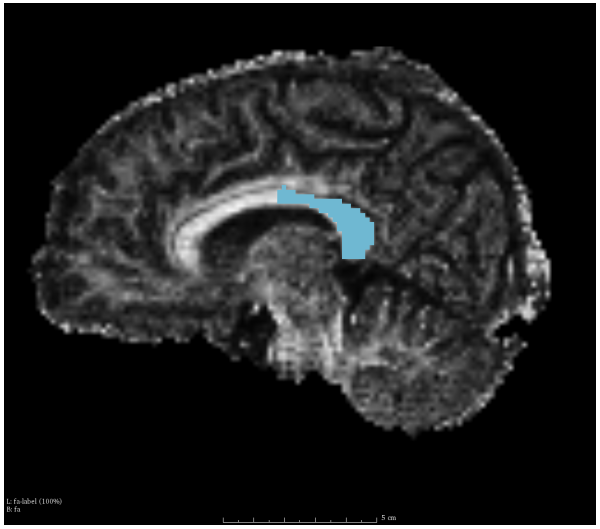
- **1 - entire CC**
- **2 - anterior CC**
- **3 - middle CC**
- **4 - posterior CC**



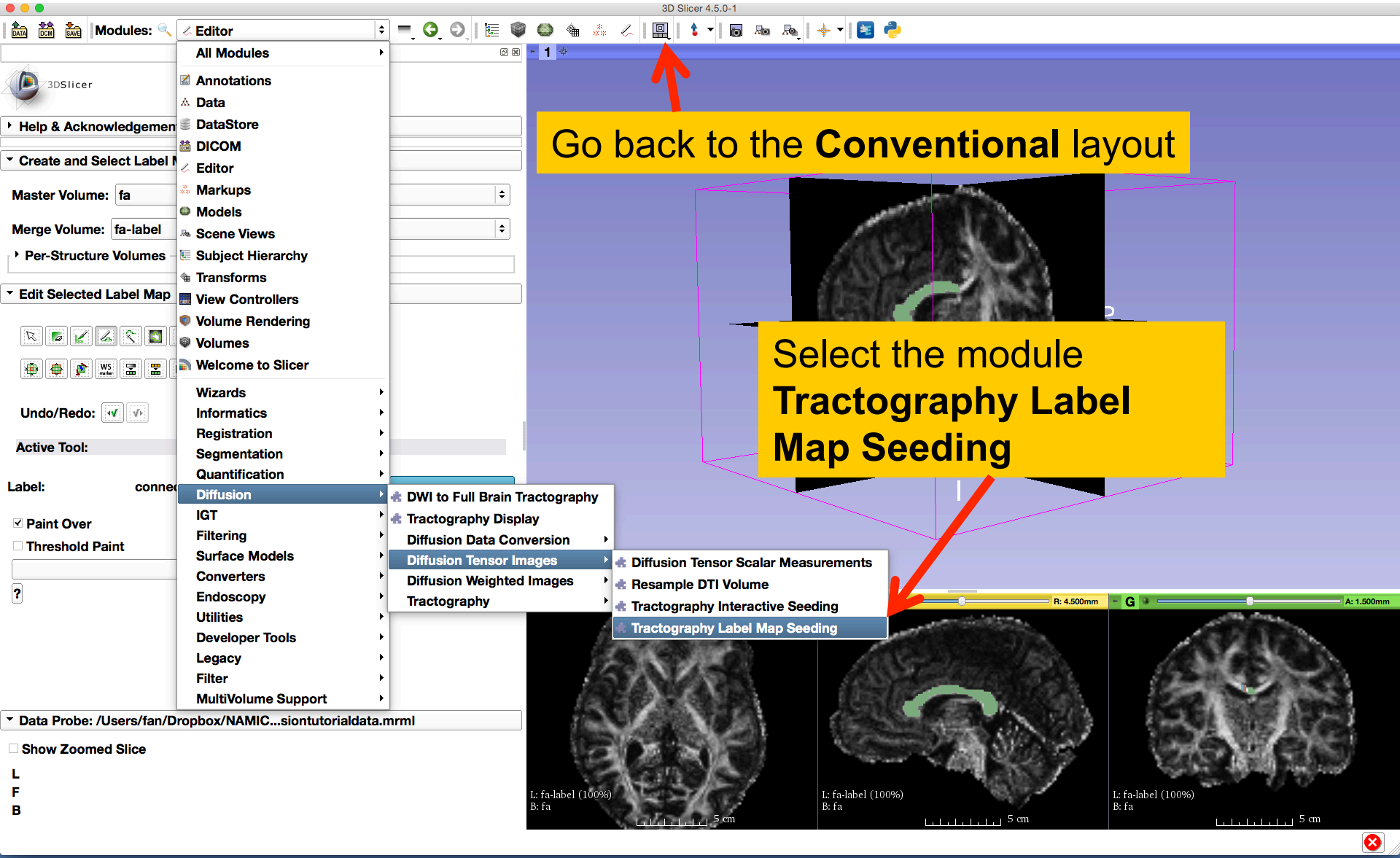
Notice that there are overlaps between different labeled regions, which will be used to investigate the fiber bundle selection.



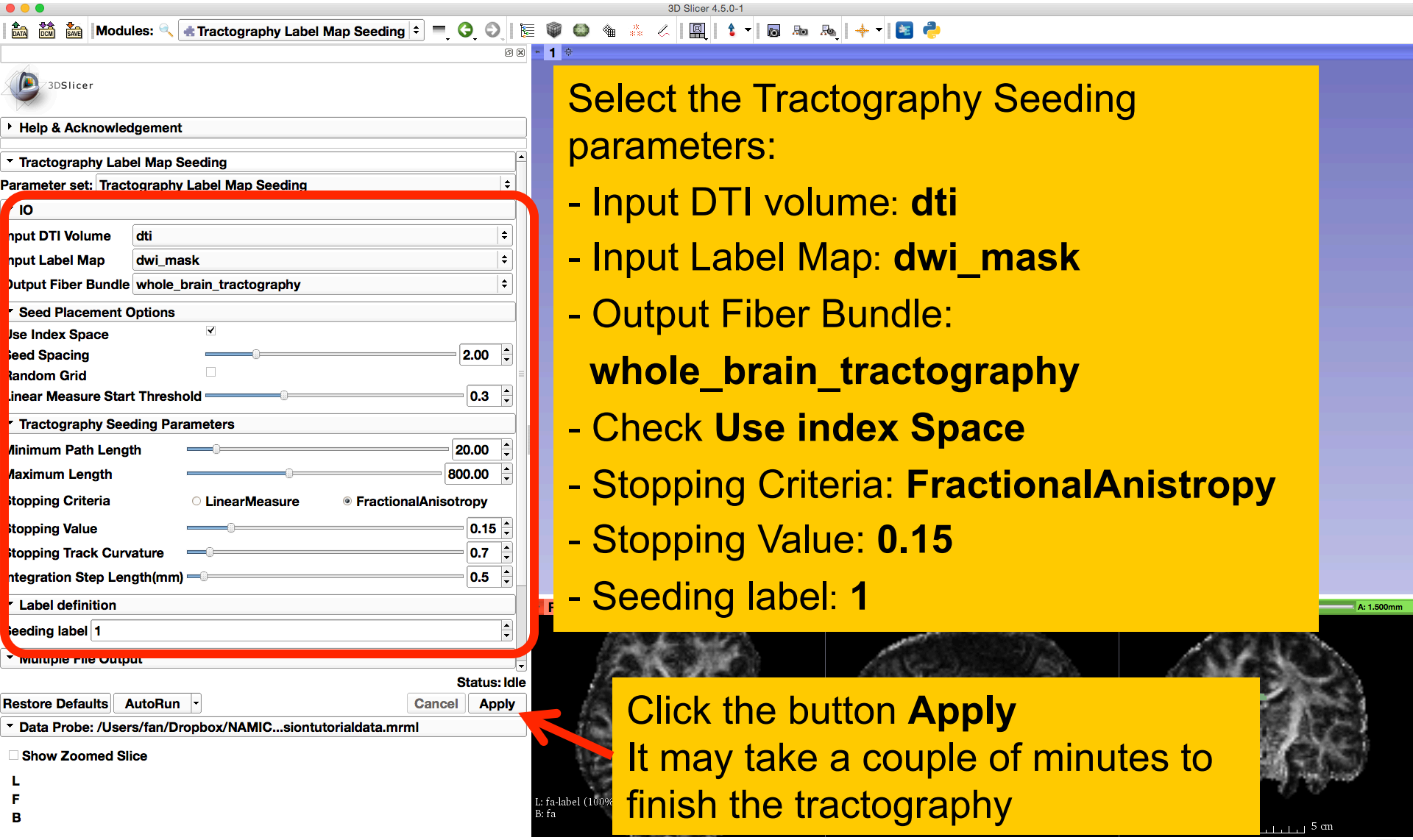




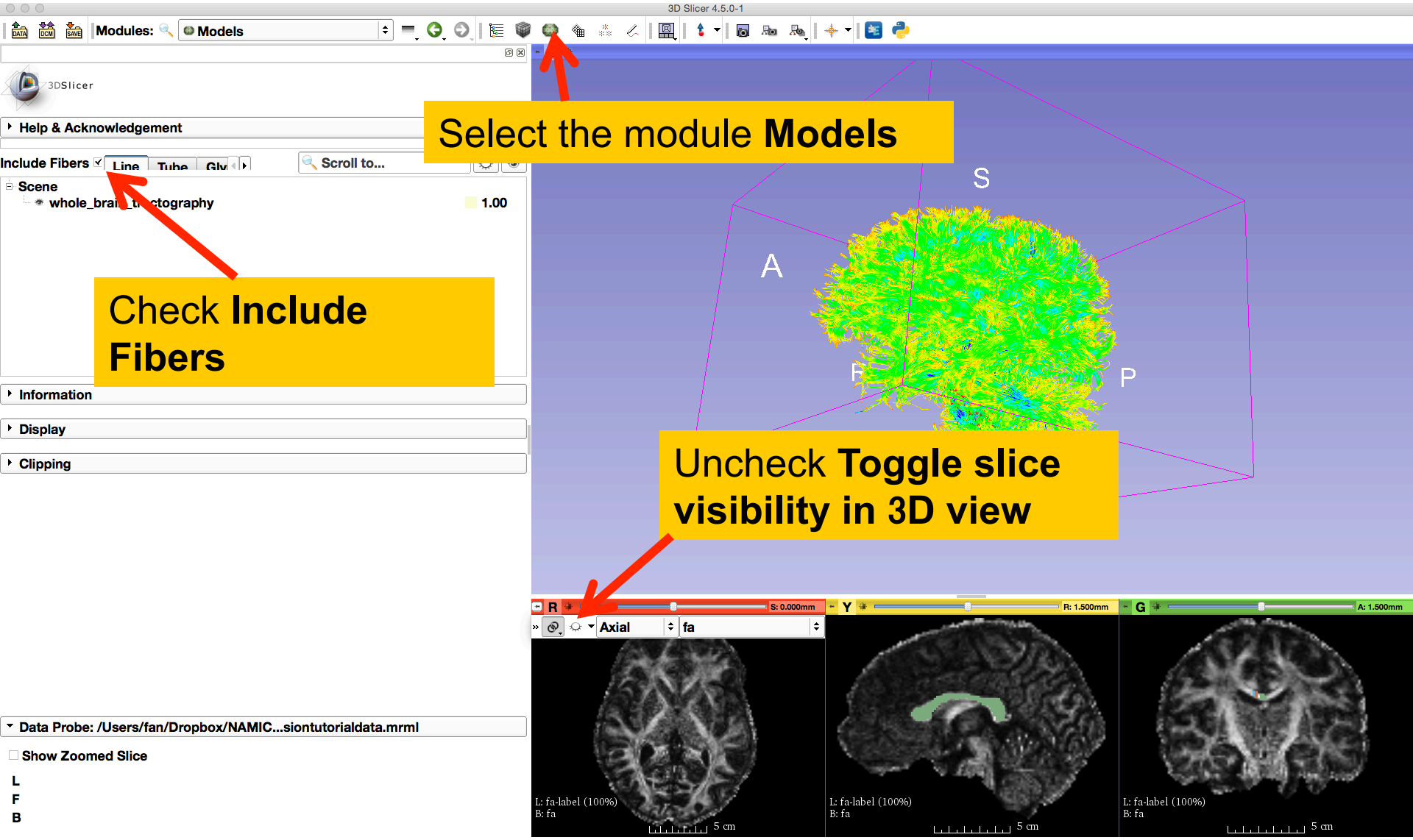
Whole Brain Tractography



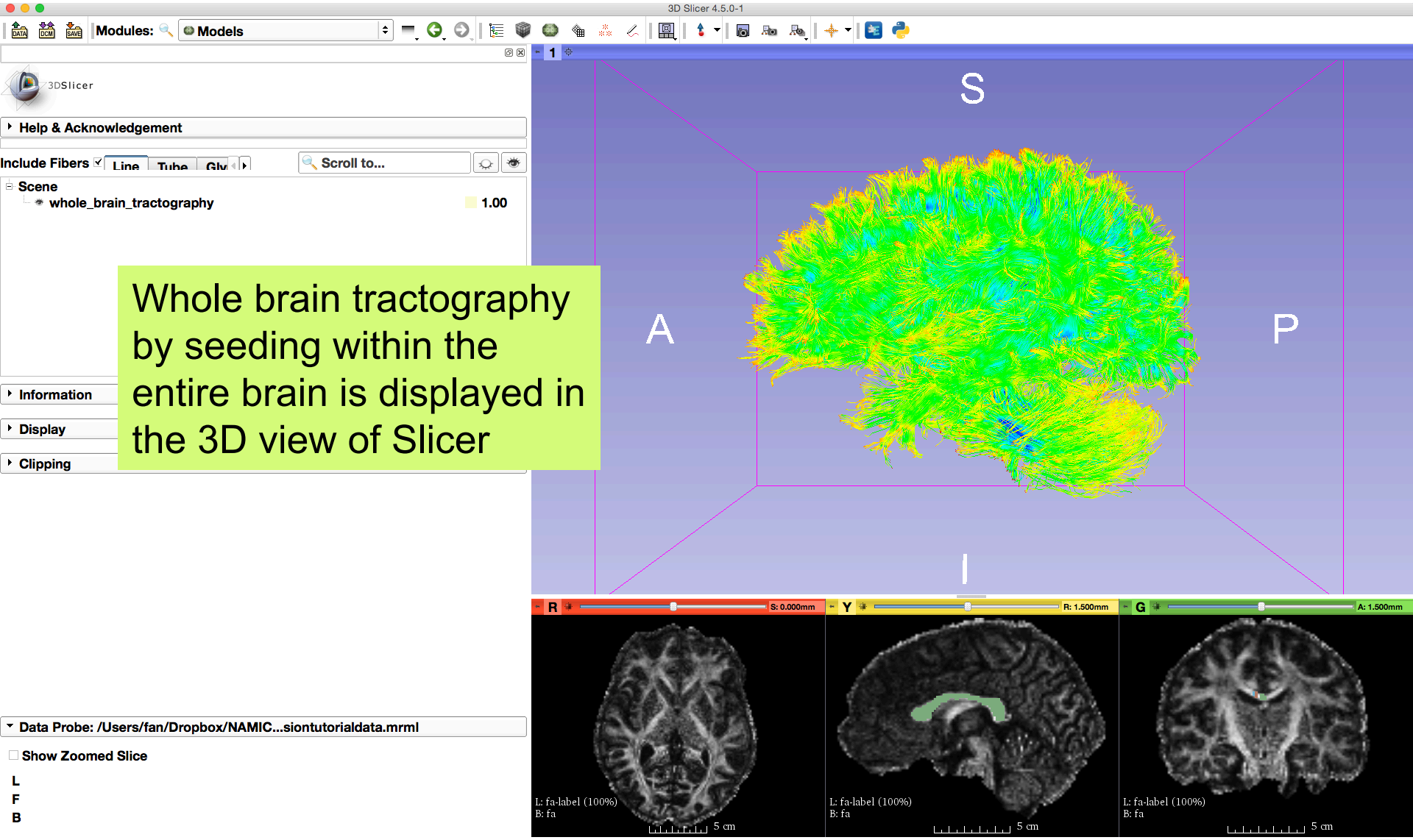
Whole Brain Tractography



Whole Brain Tractography

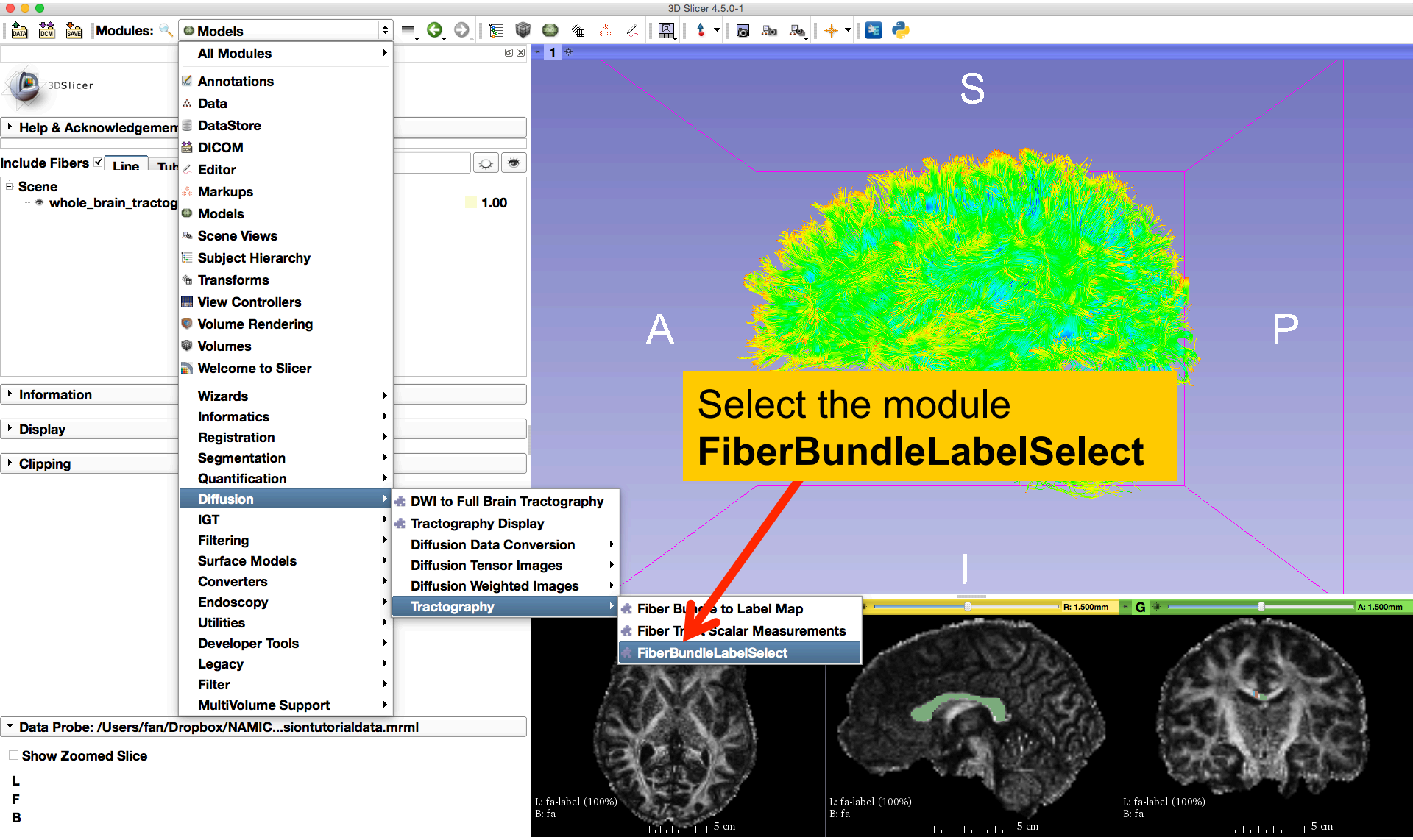


Whole Brain Tractography

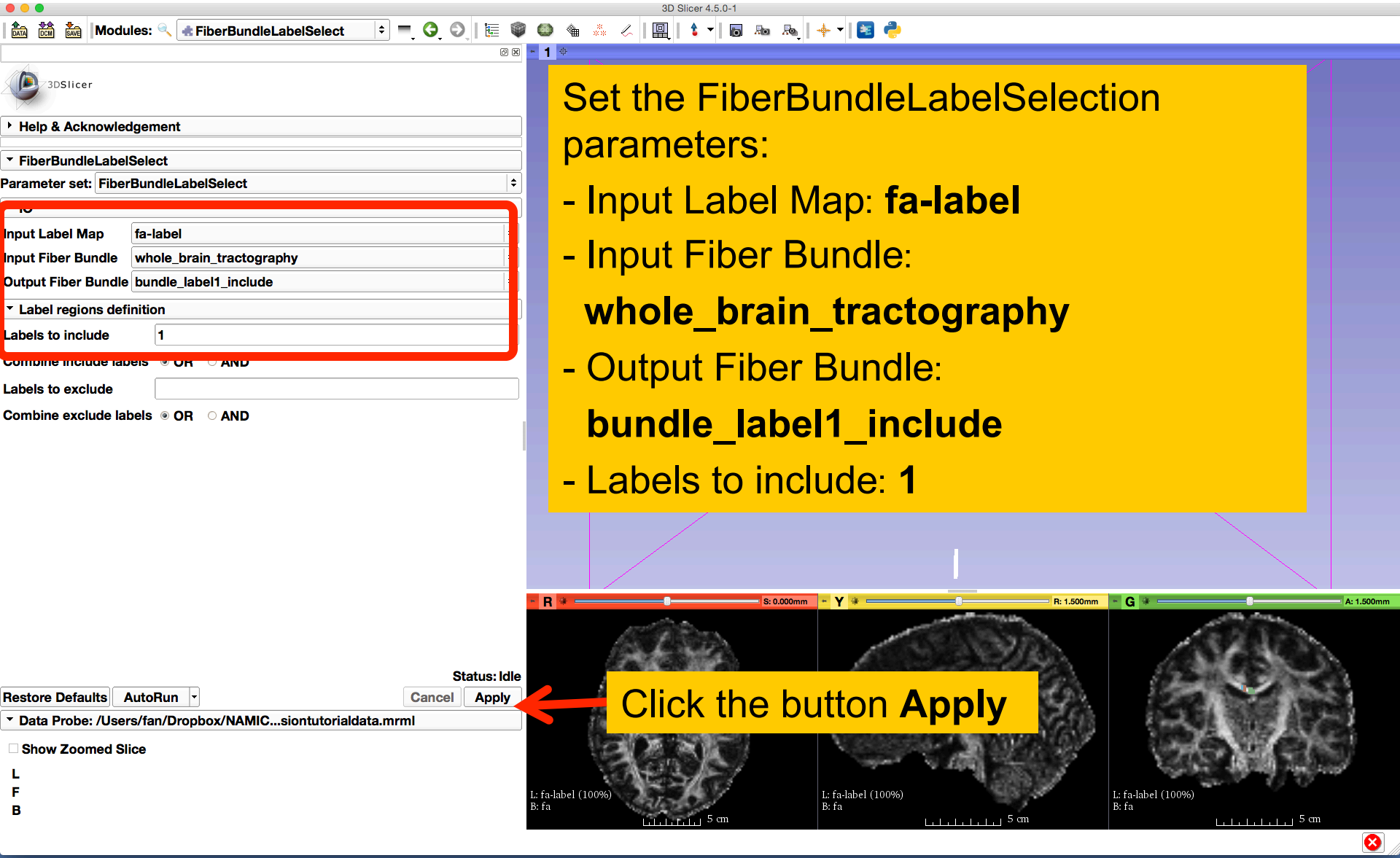


Whole brain tractography by seeding within the entire brain is displayed in the 3D view of Slicer

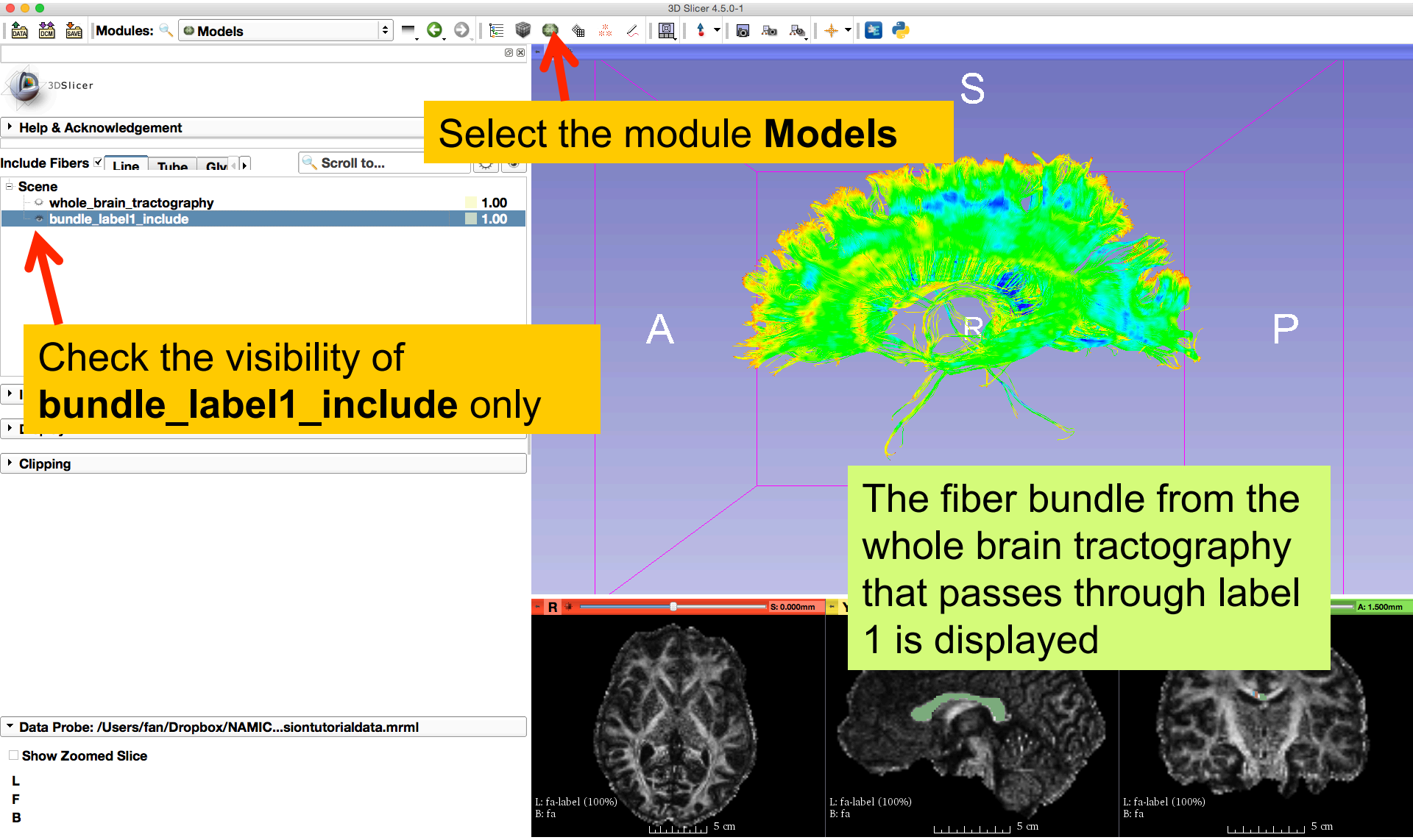
Fiber Bundle Label Selection



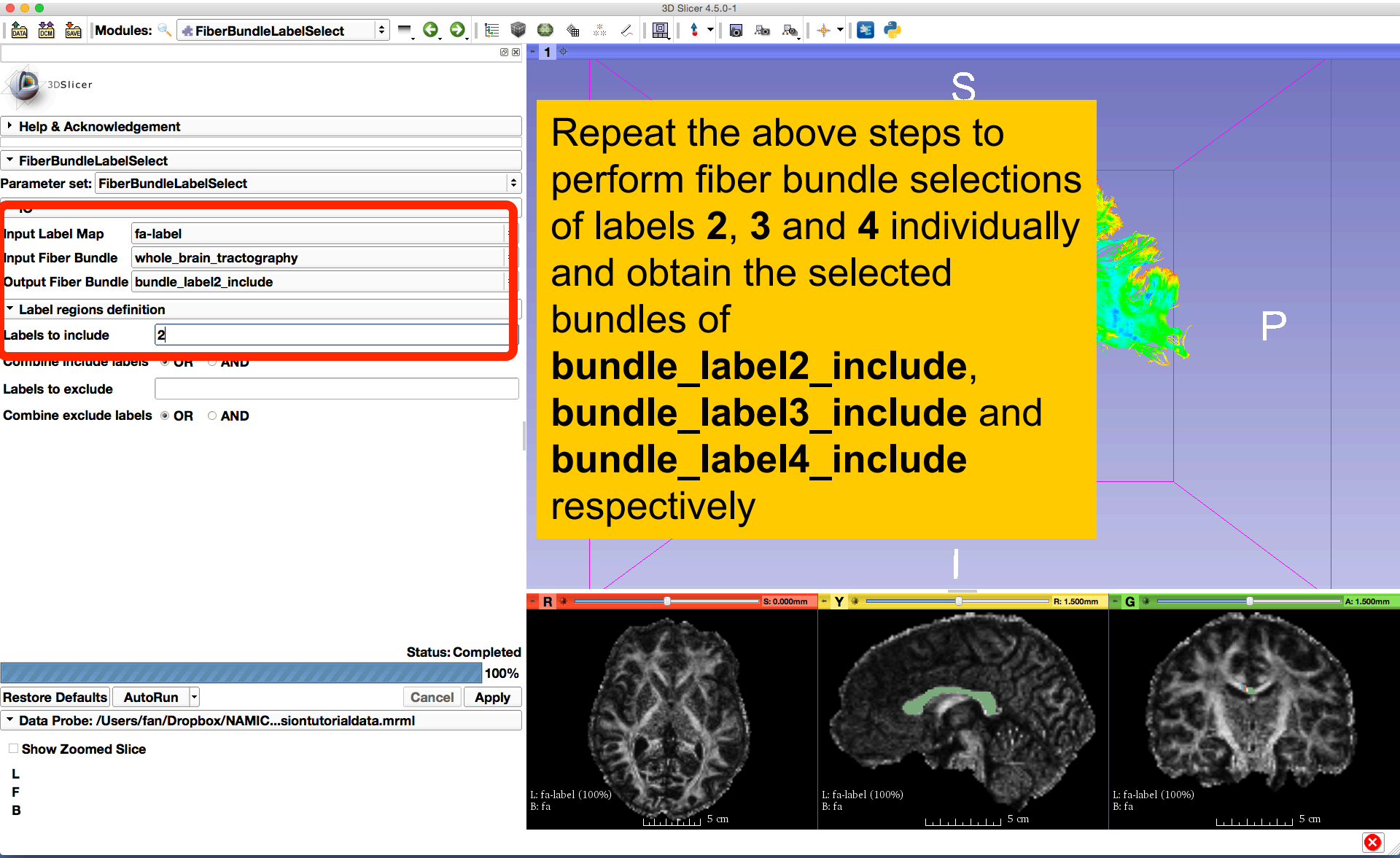
Single Label Selection



Single Label Selection

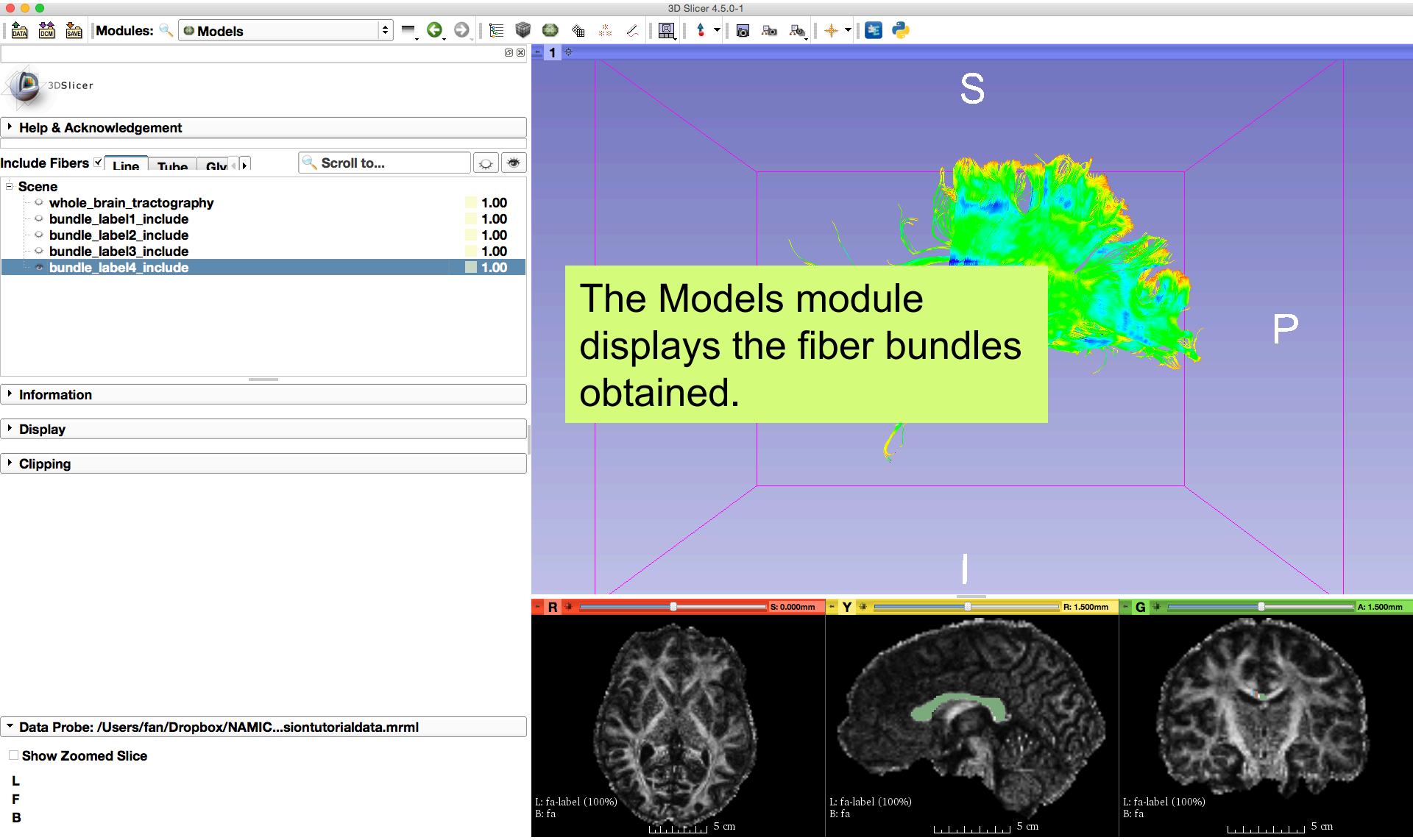


Single Label Selection



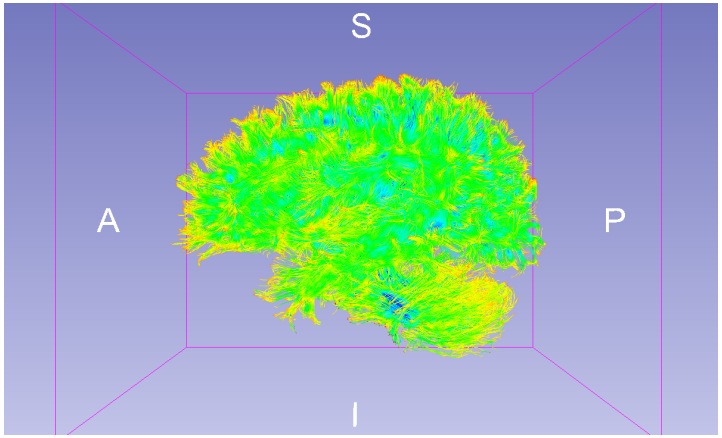
Repeat the above steps to perform fiber bundle selections of labels **2**, **3** and **4** individually and obtain the selected bundles of **bundle_label2_include**, **bundle_label3_include** and **bundle_label4_include** respectively

Single Label Selection

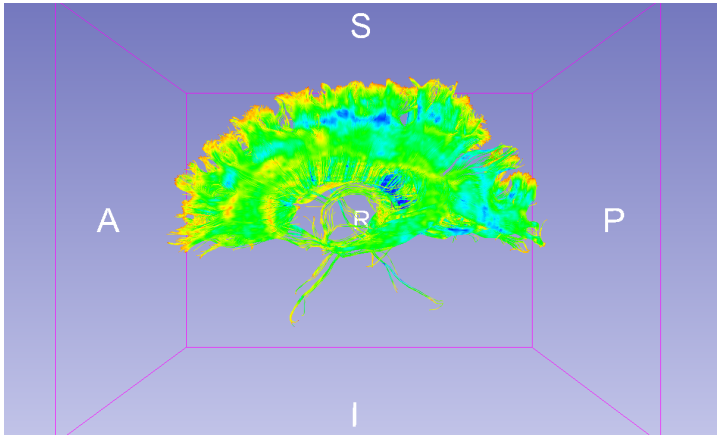


Single Label Selection

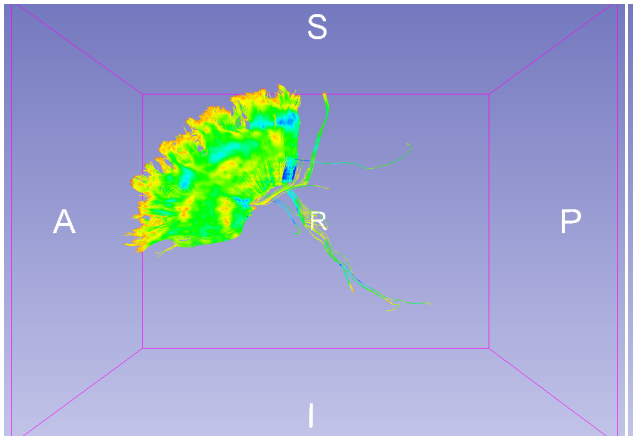
Whole Brain



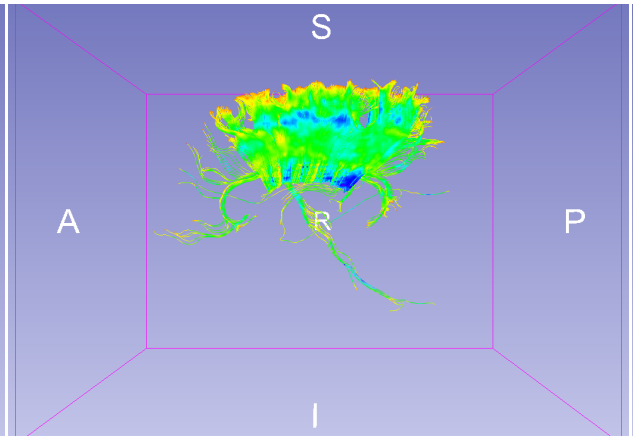
Label 1



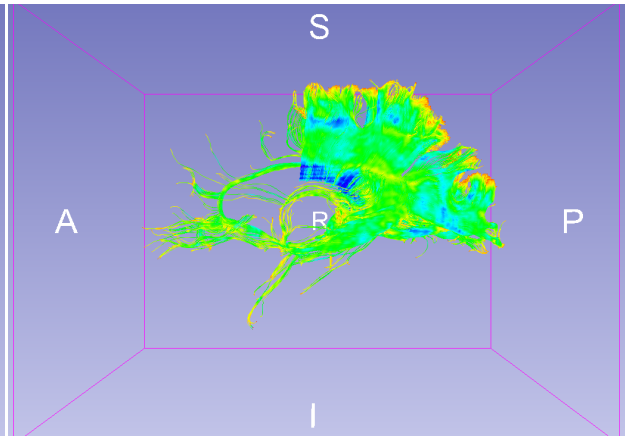
Label 2



Label 3



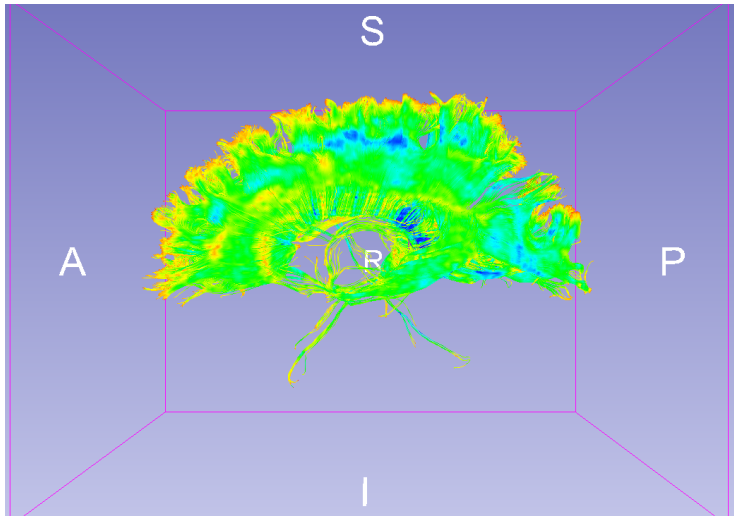
Label 4



Single Label Selection

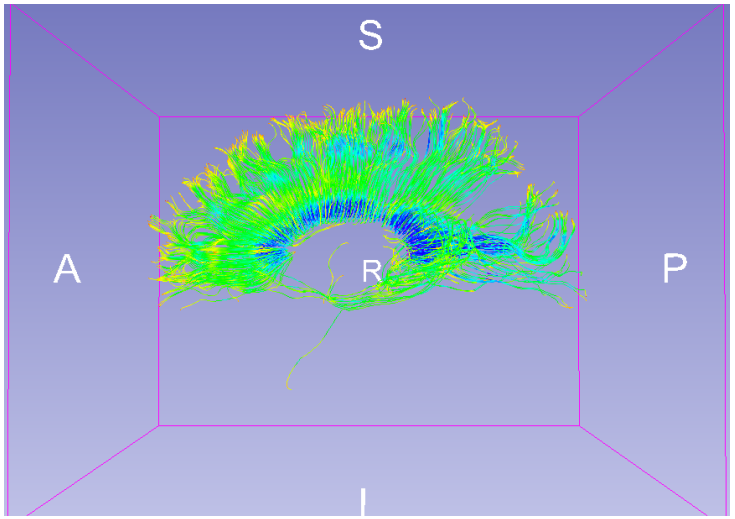
Notice that whole brain seeding creates a denser fiber bundle than seeding from the label 1.

Fiber Bundle Selection of Label 1 from the Whole Brain Tractography



V.S.

Fiber Bundle Obtained by Seeding within Label 1

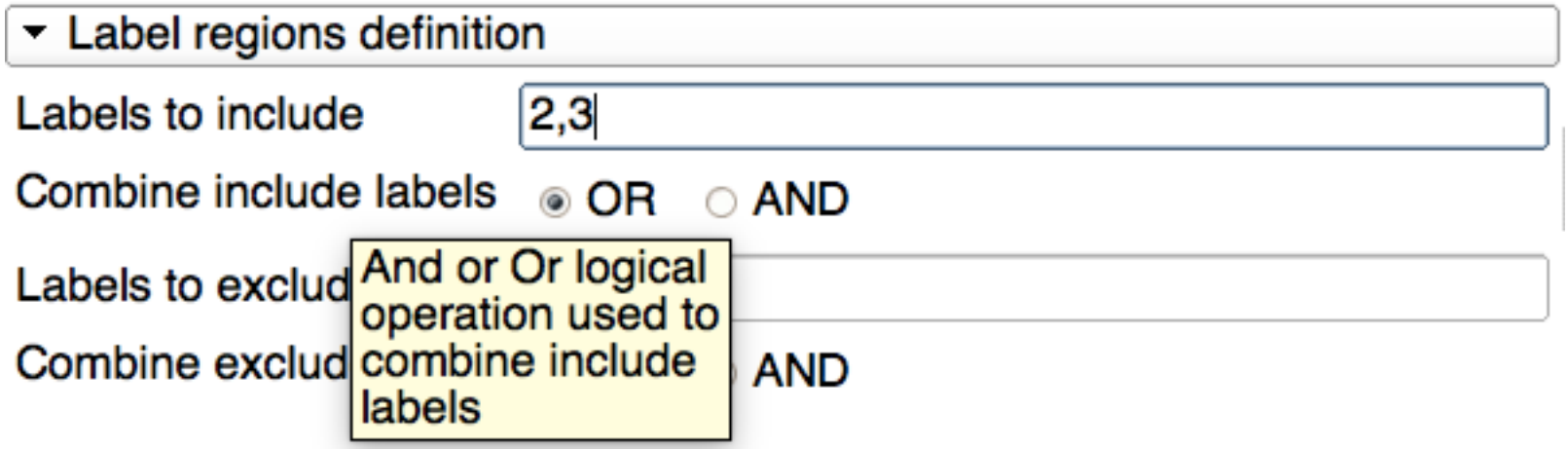


By viewing **corpusCallosum** loaded in the MRML file

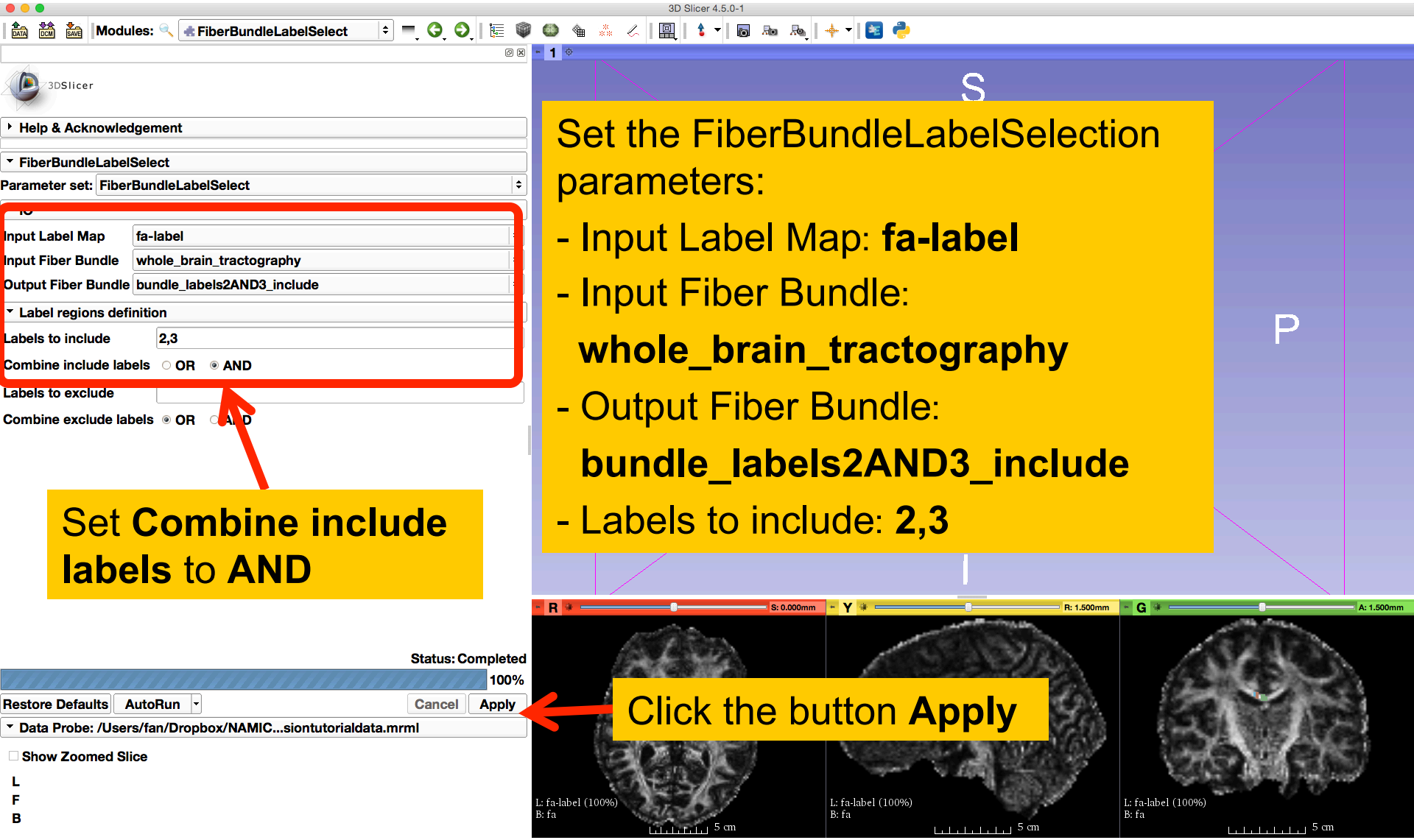
Multiple Labels Selection

FiberBundleLabelSelect allows users to perform multiple labels selection by providing a list of labels and selecting one logical operation:

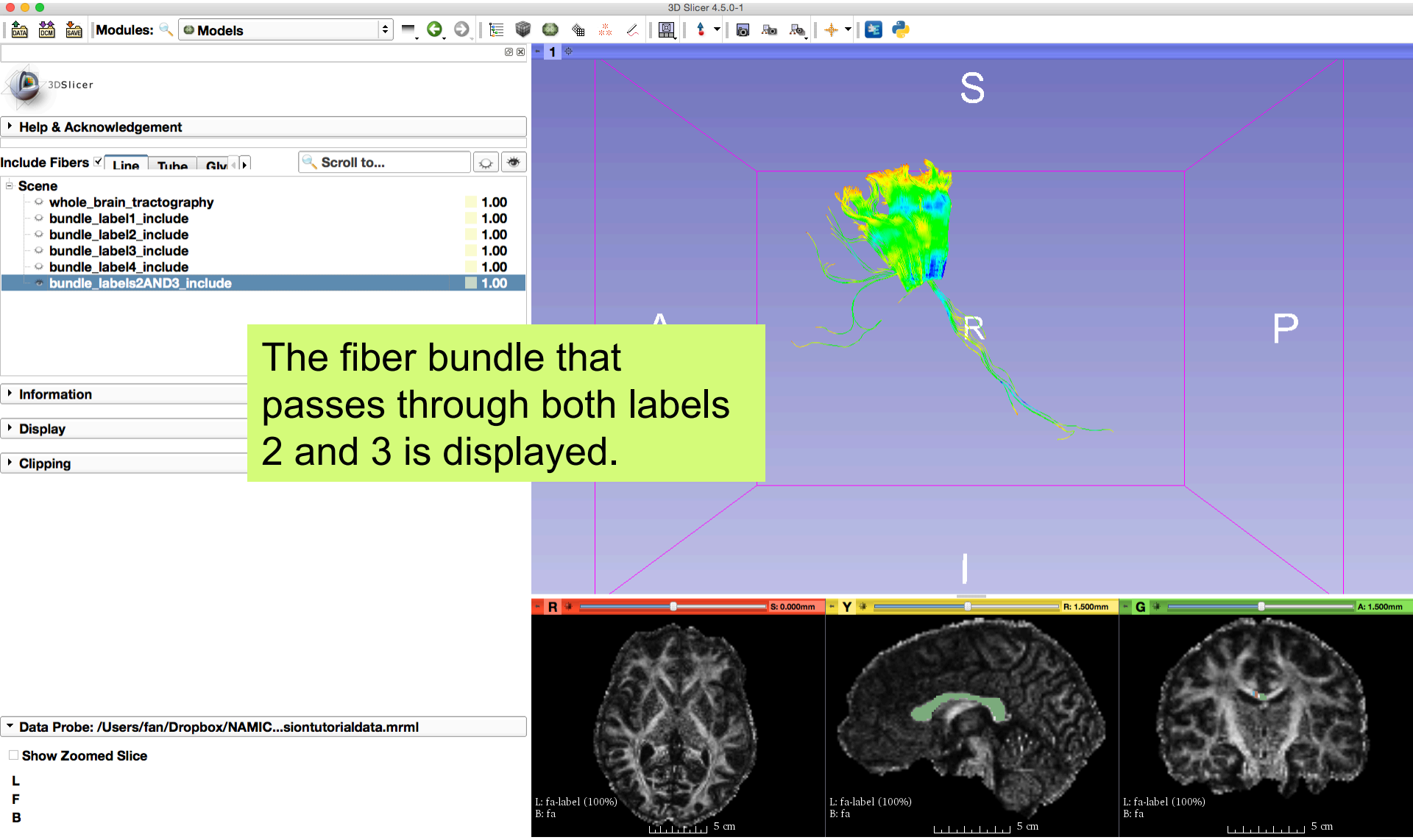
- **OR**: fiber bundles that pass through **any label** in the list
- **AND**: fiber bundles that pass through **all labels** in the list



Multiple Labels Selection (AND)

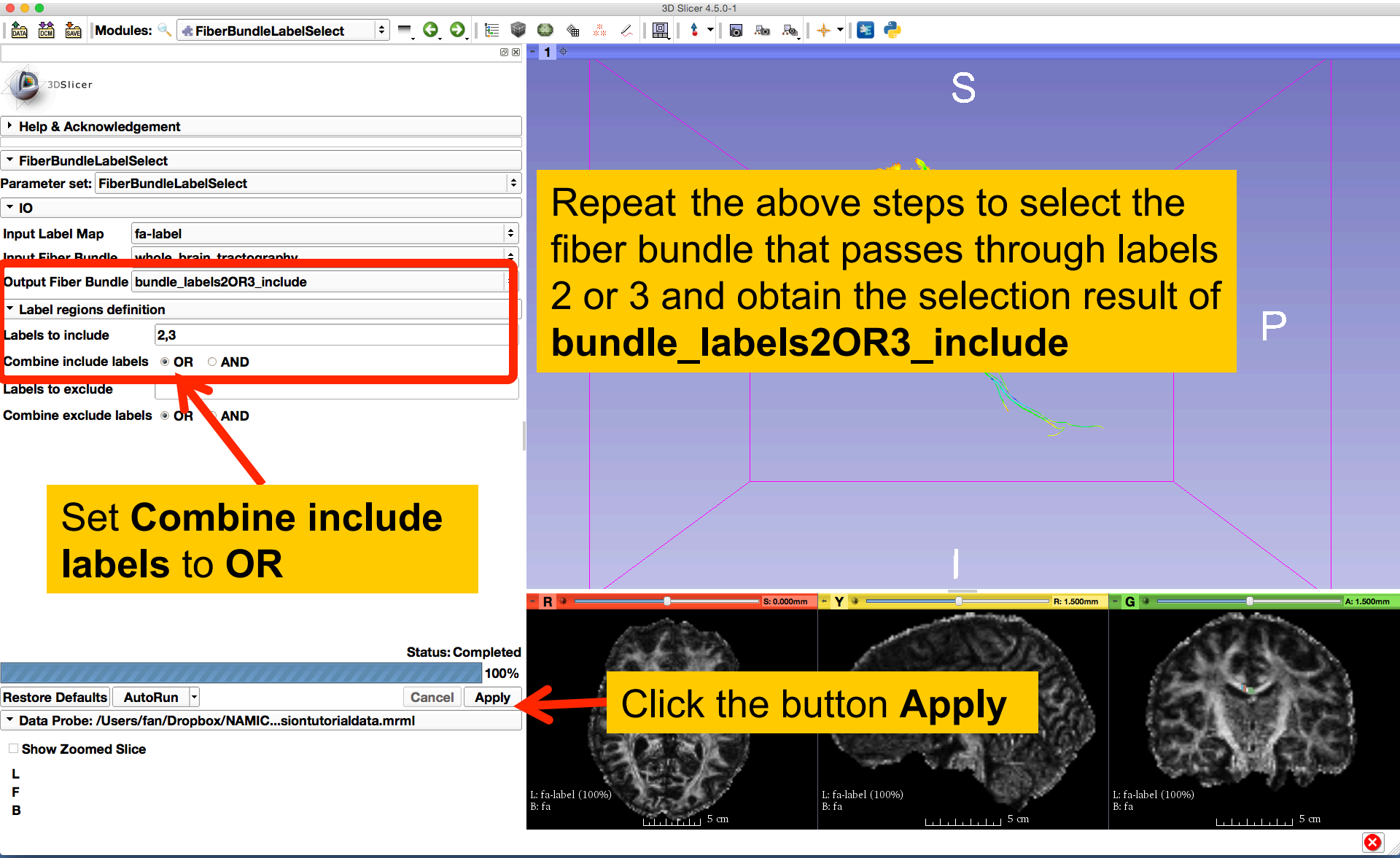


Multiple Labels Selection (AND)

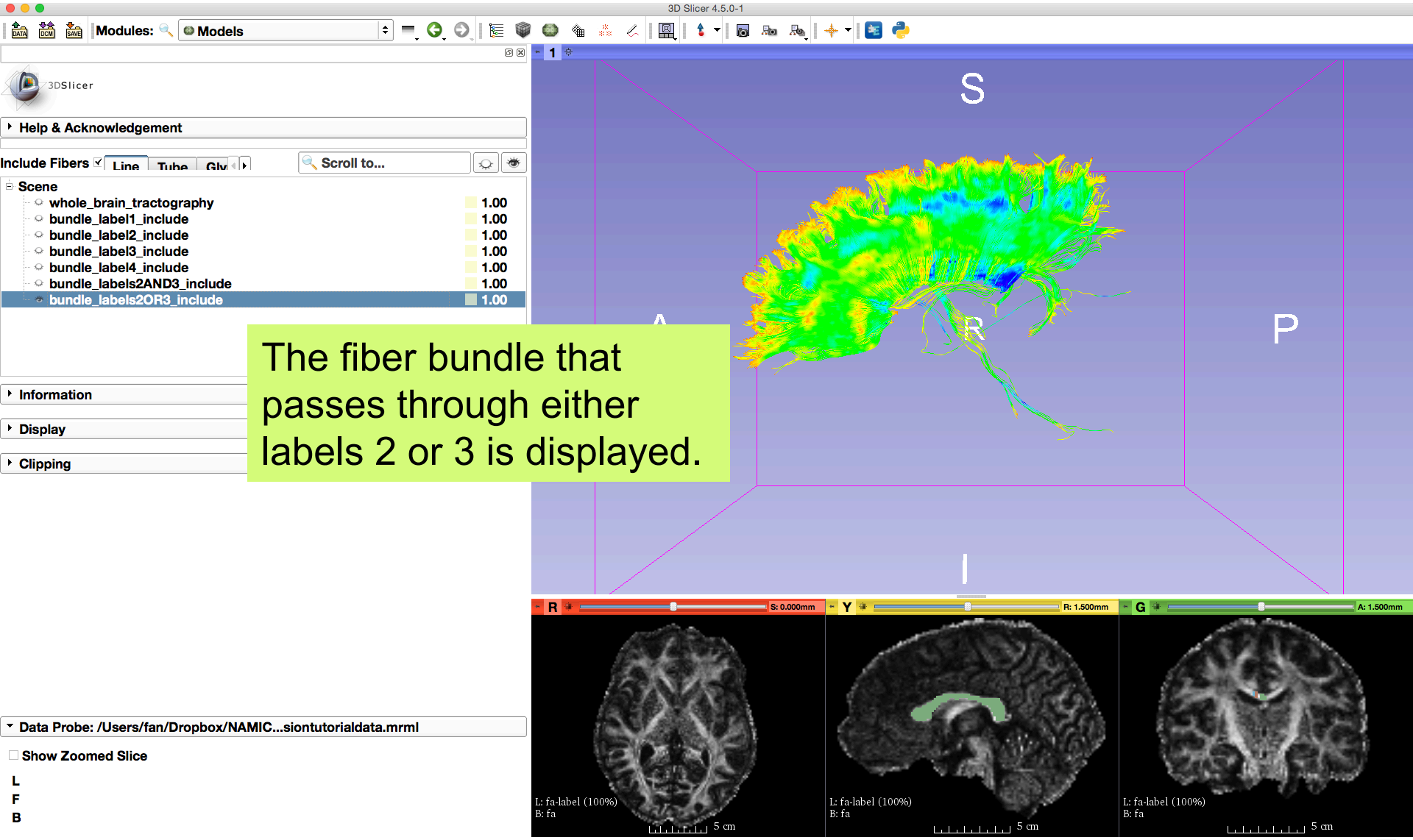


The fiber bundle that passes through both labels 2 and 3 is displayed.

Multiple Labels Selection (OR)



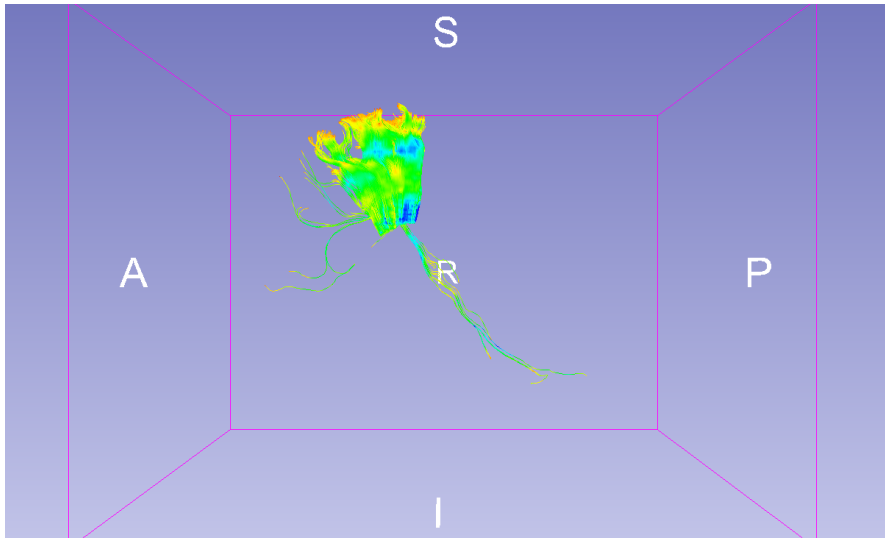
Multiple Labels Selection (OR)



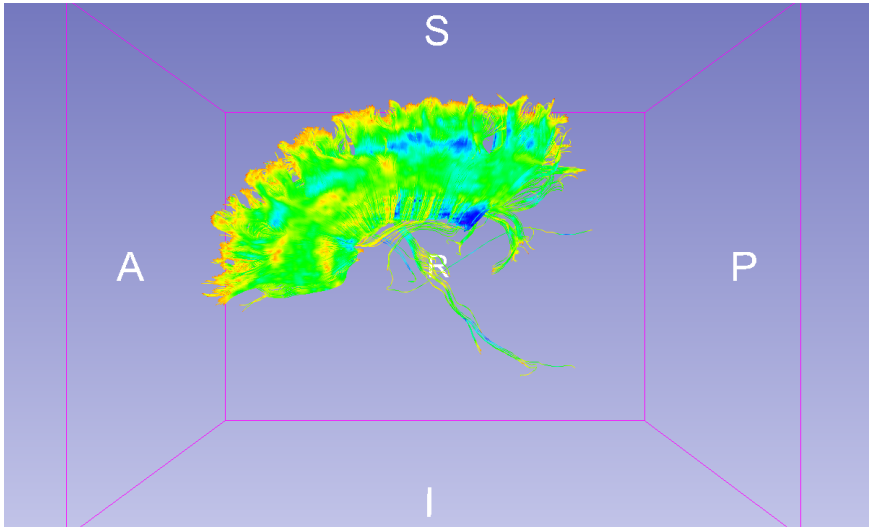
The fiber bundle that passes through either labels 2 or 3 is displayed.

Multiple Labels Selection

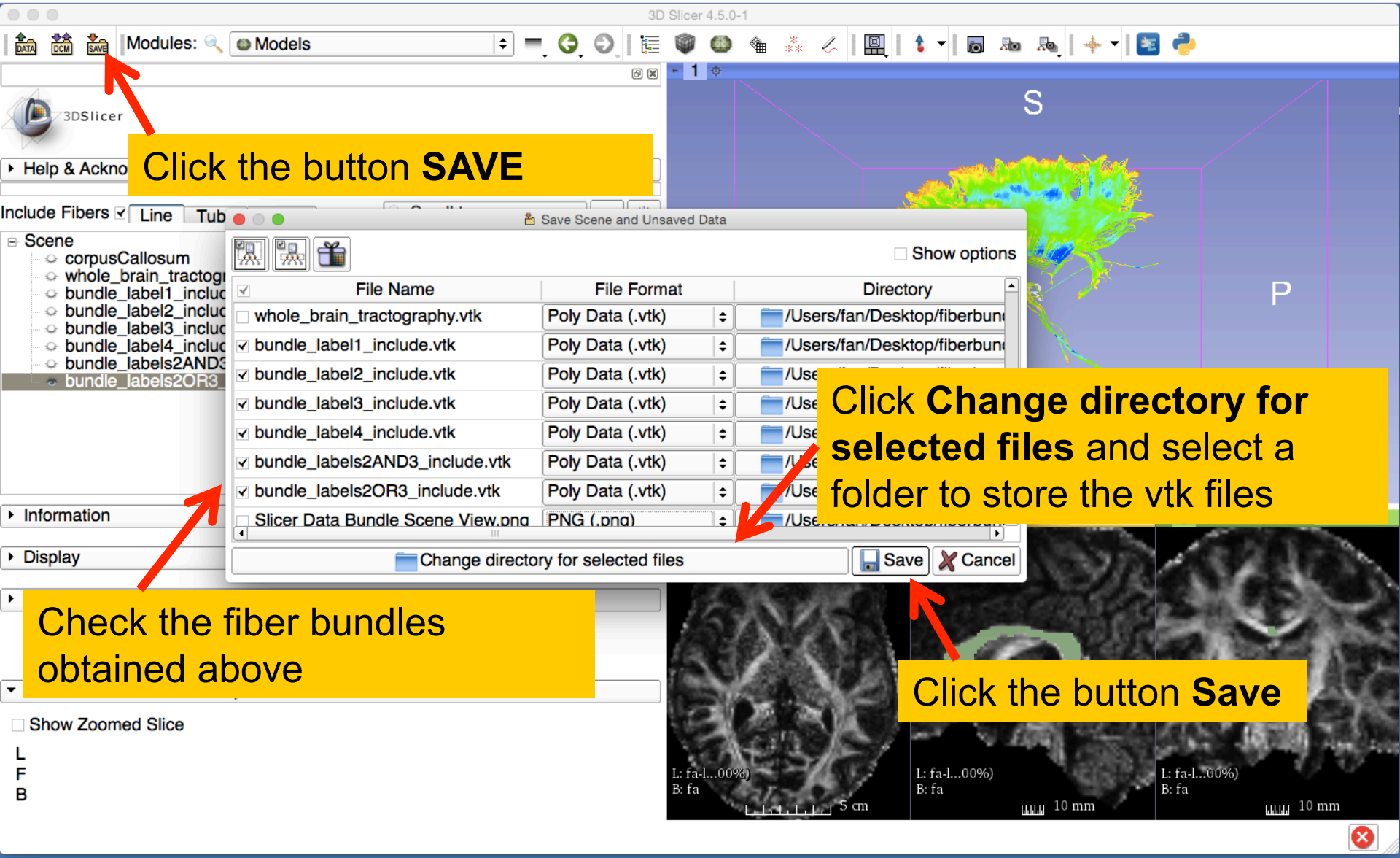
Labels 2 and 3



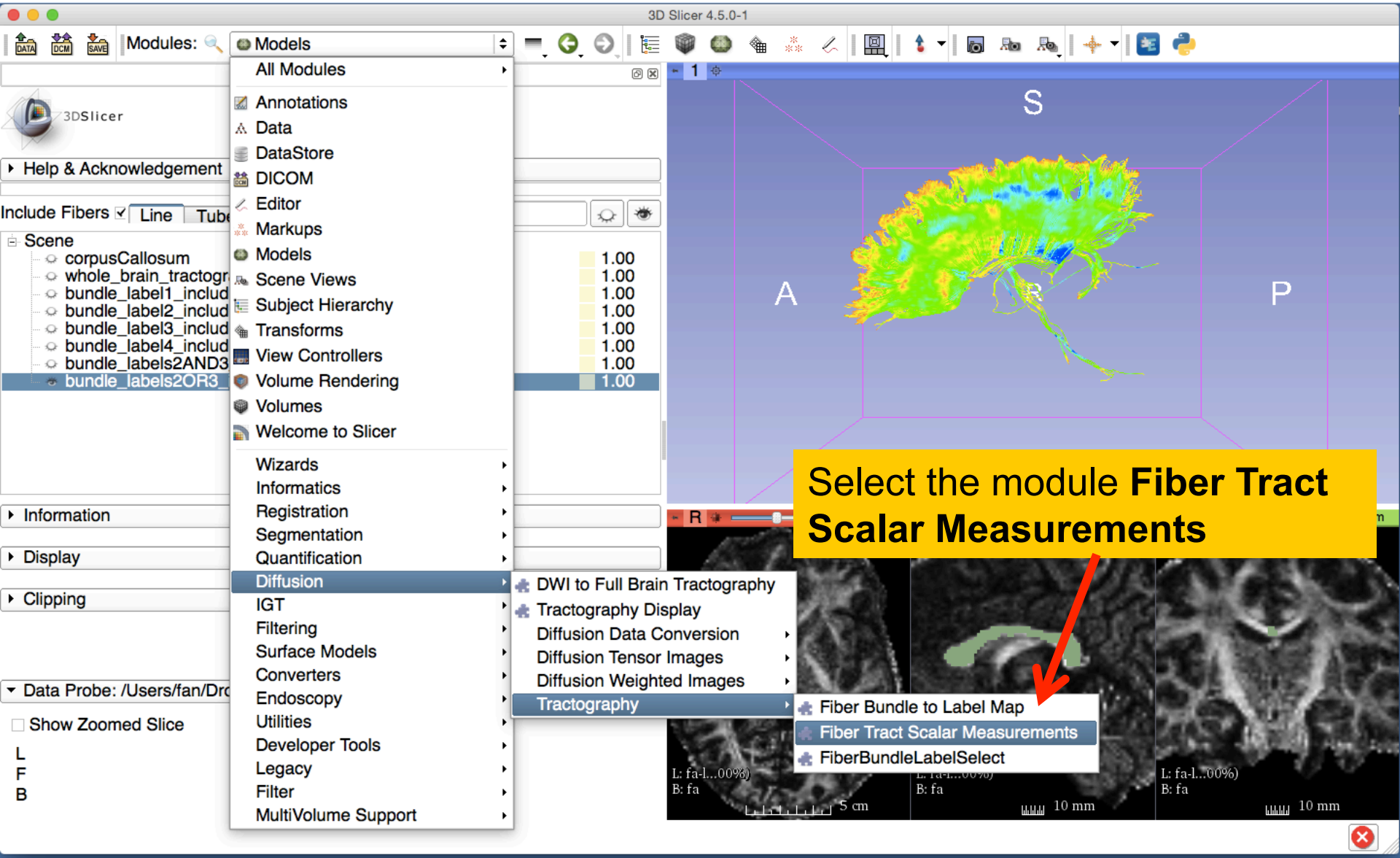
Labels 2 or 3



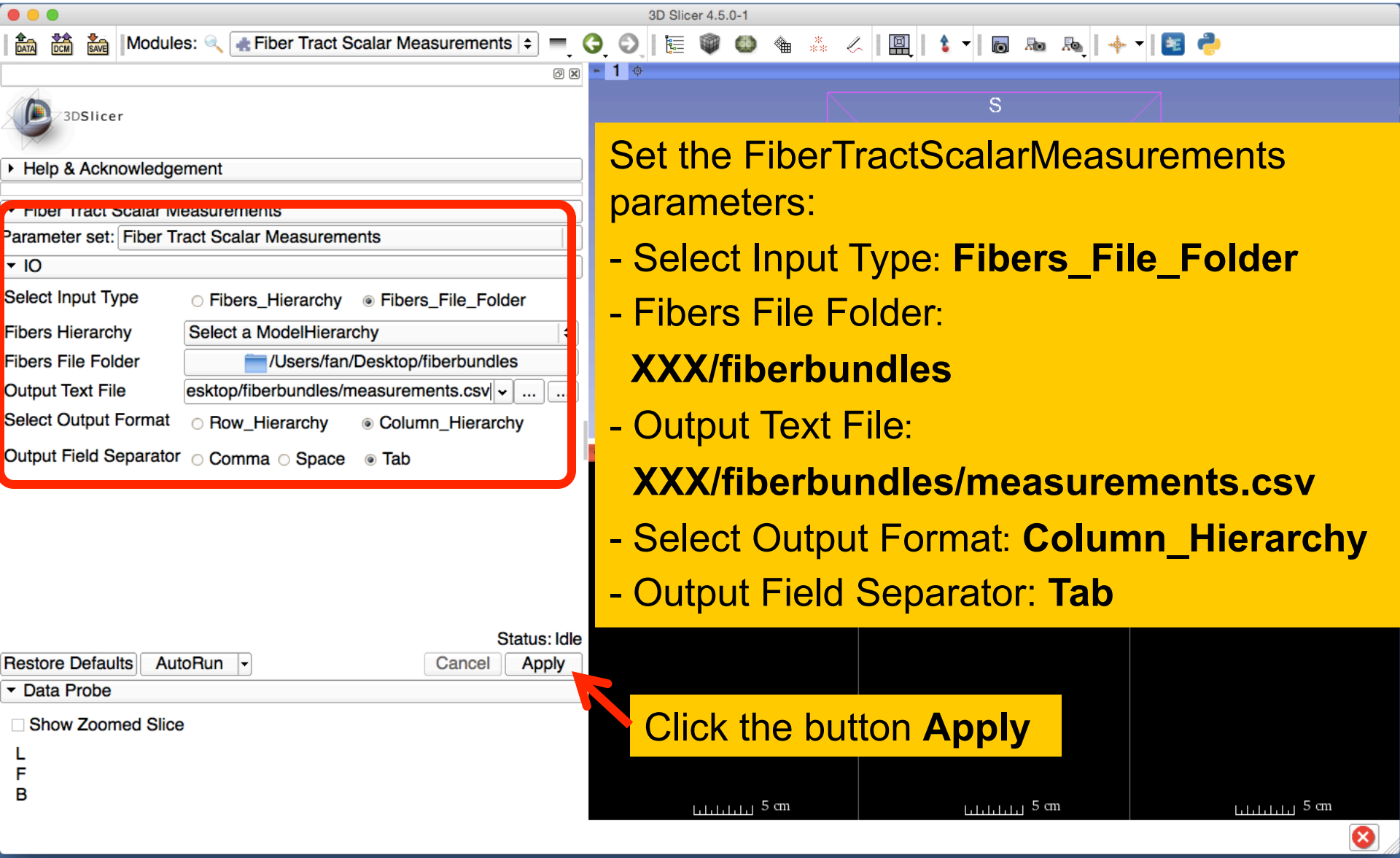
Save Fiber Bundles



Fiber Tract Scalar Measurements



Fiber Tract Scalar Measurements



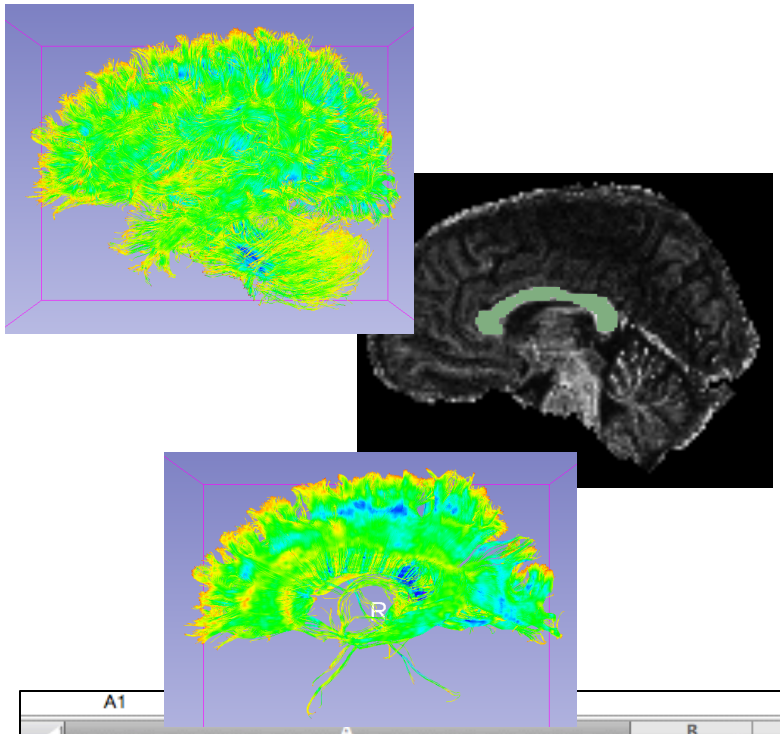
Fiber Tract Scalar Measurements

The module outputted a CSV file listing the mean scalar value (such as FA and Trace) of each fiber bundle in the folder

A1 | Name

	A	B	C	D	E
1	Name	Num_Points	Num_Fibers	Tensors_.FractionalAnisotropy	Tensors_.LinearMeasurement
2	/Users/fan/Desktop/fiberbundles/bundle_label1_include.vtk	2127263	14306	0.525257	0.505662
3	/Users/fan/Desktop/fiberbundles/bundle_label2_include.vtk	708470	5564	0.484828	0.471678
4	/Users/fan/Desktop/fiberbundles/bundle_label3_include.vtk	601023	4428	0.514121	0.490995
5	/Users/fan/Desktop/fiberbundles/bundle_label4_include.vtk	1261823	7485	0.552797	0.528861
6	/Users/fan/Desktop/fiberbundles/bundle_labels2AND3_include.vtk	163814	1360	0.502443	0.490922
7	/Users/fan/Desktop/fiberbundles/bundle_labels2OR3_include.vtk	1145679	8632	0.497677	0.47906

Conclusion



This tutorial guided you through the fiber bundle label selection and fiber tract scalar measurements for conducting further tractography processing.

A1

	A	B	C	D	E
1	Name	Num_Points	Num_Fibers	Tensors_.FractionalAnisotropy	Tensors_.LinearMeasurement
2	/Users/fan/Desktop/fiberbundles/bundle_label1_include.vtk	2127263	14306	0.525257	0.505662
3	/Users/fan/Desktop/fiberbundles/bundle_label2_include.vtk	708470	5564	0.484828	0.471678
4	/Users/fan/Desktop/fiberbundles/bundle_label3_include.vtk	601023	4428	0.514121	0.490995
5	/Users/fan/Desktop/fiberbundles/bundle_label4_include.vtk	1261823	7485	0.552797	0.528861
6	/Users/fan/Desktop/fiberbundles/bundle_labels2AND3_include.vtk	163814	1360	0.502443	0.490922
7	/Users/fan/Desktop/fiberbundles/bundle_labels2OR3_include.vtk	1145679	8632	0.497677	0.47906

Acknowledgments

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Open Source Diffusion MRI Technology For Brain Cancer Research

NIH U01CA199459