Longitudinal Lesion Comparison

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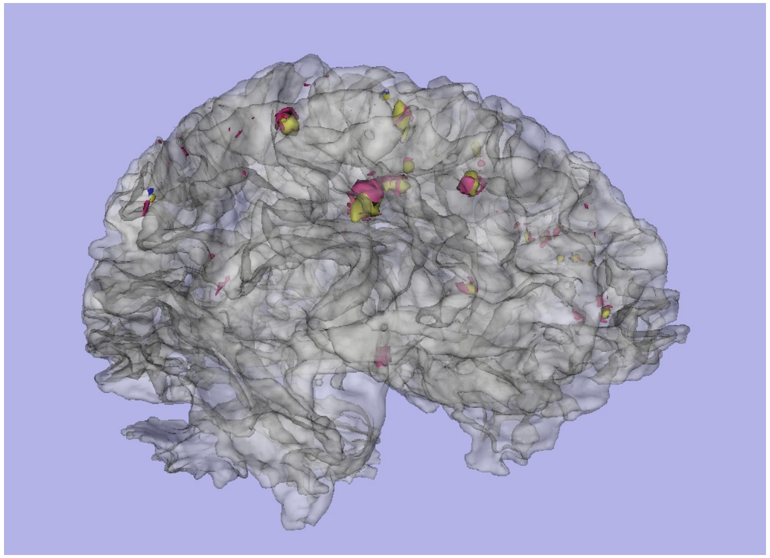
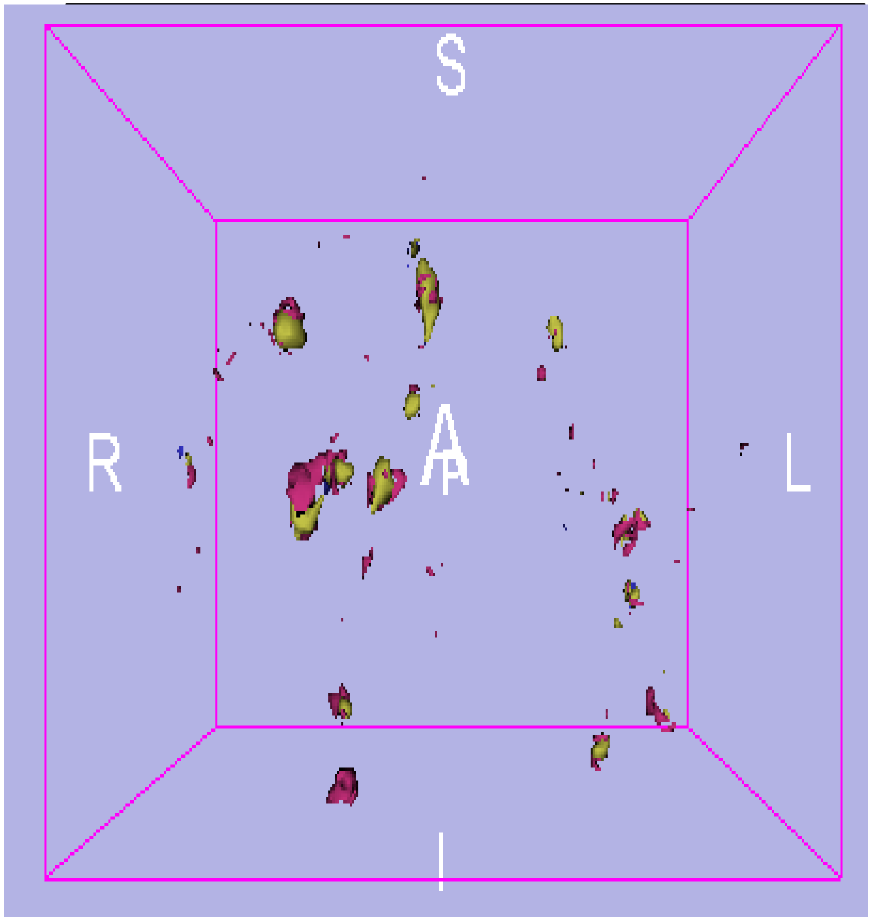


NA-MIC Tutorial Contest:
Summer 2010

Learning Objective

After following this tutorial, you will be able to use Slicer3 to create models that allow you to analyze the changes in white matter lesions between two time points.



Pre-requisite

- This tutorial assumes the user is familiar with loading image datasets and creating basic label maps in Slicer. Please consult the following prerequisite material if you want to brush up on these skills first:
  - Data Loading & Visualization tutorial SoniaPujol,Ph.D.,Harvard/SPL
    - http://www.slicer.org/slicerWiki/images/c/c9/3DDataLoadingAndVisualization_Slicer3.6_SoniaPujol.pdf
  - User documentation for the Slicer3 Editor module StevePieper,Ph.D,Harvard/SPL,Isomics
    - http://www.slicer.org/slicerWiki/index.php/Modules:Editor- Documentation-3.6

About the Tutorial Data

- This tutorial provides data that has had a time1 and time 2 white matter lesion detection and co-registration performed on the raw images on your behalf. Please consult the following prerequisite material if you want to brush up on these steps first; however, these steps are not required in order to perform the steps in this tutorial:
  - White Matter Lesion Segmentation tutorial, H. Jeremy Bockholt:
    - http://www.na-mic.org/Wiki/index.php/File:Slicer3Training_WhiteMatterLesions_v2.2.1.pdf

Material

- This tutorial requires the installation of the Slicer3.6 release and the tutorial dataset.

They are available at the following locations:

  - Slicer3.6 download page

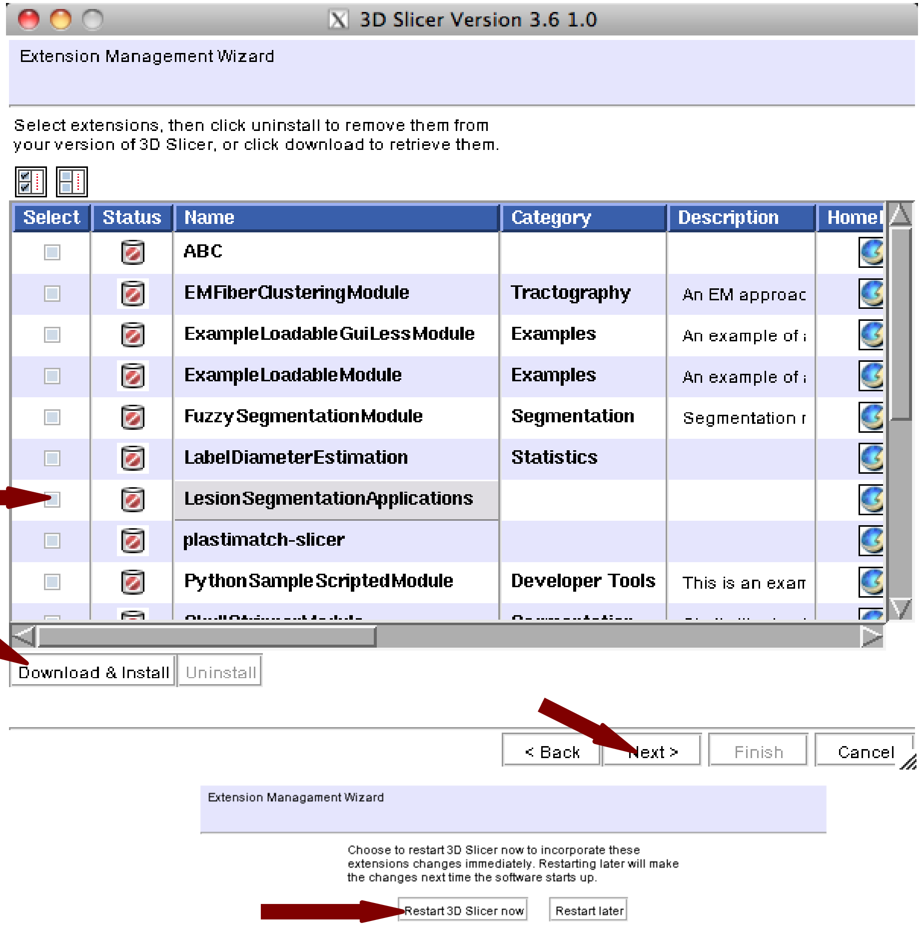
    http://www.slicer.org/pages/Downloads/

  - Tutorial dataset:

Longitudinal_Lesion_Comparison_TutorialContestSummer2010.zip

Material

- Additionally, you need to use the extensions manager to install the Lesion Comparison module to 3D Slicer. To do accomplish this:
  - Select the Extension Manager from the View Menu.
  - Select the LesionSegmentationApplications,
  - Click Download & Install.
  - After the extension downloads, click Next, in the following dialog
  - click Restart 3D Slicer Now button.



3D Slicer Version 3.6 1.0

Extension Management Wizard

Select extensions, then click uninstall to remove them from your version of 3D Slicer, or click download to retrieve them.

Select	Status	Name	Category	Description	Home
☐		ABC			
☐		EMFiberClusteringModule	Tractography	An EM approac	
☐		ExampleLoadableGuiLessModule	Examples	An example of a	
☐		ExampleLoadableModule	Examples	An example of a	
☐		FuzzySegmentationModule	Segmentation	Segmentation r	
☐		LabelDiameterEstimation	Statistics		
☐		LesionSegmentationApplications			
☐		plastimatch-slicer			
☐		PythonSampleScriptedModule	Developer Tools	This is an exam	

Extension Managament Wizard

Choose to restart 3D Slicer now to incorporate these extensions changes immediately. Restarting later will make the changes next time the software starts up.

Platform

- The Longitudinal Lesion Comparison Module was developed using both Linux (32 and 64 bit) and Mac (OS X 10.4 – 10.6)

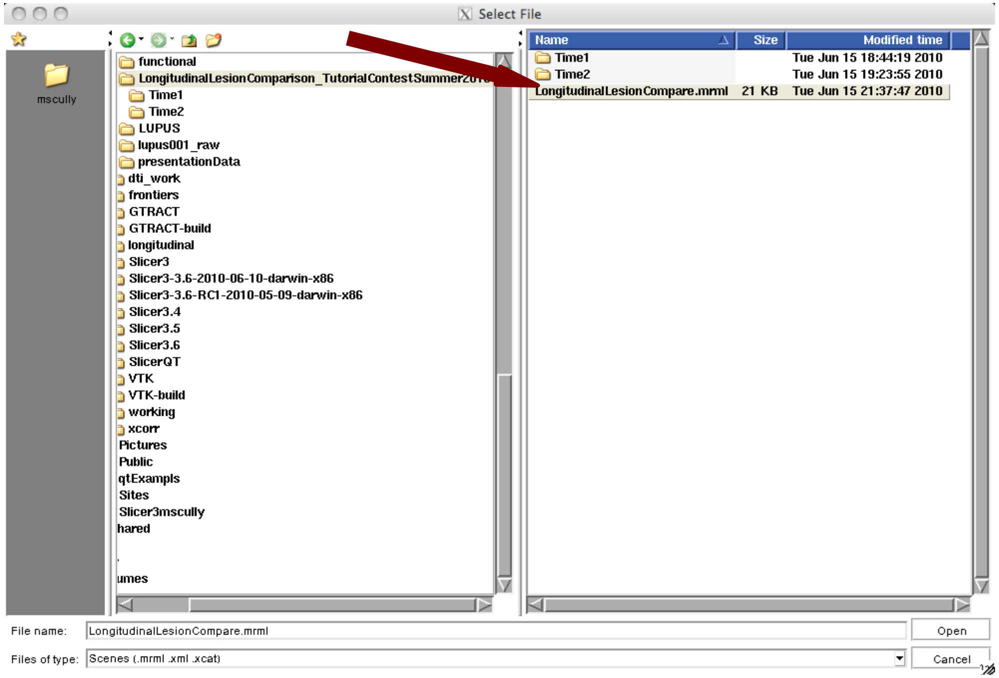
- The module has been tested on both Linux 64-bit and Mac (OS X 10.6)

Overview

- Loading the data.
- Creating the image showing lesion changes
- Creating models of the changed lesions
- Examining lesion changes

Loading The Data - I

- After downloading the tutorial data, unzip it to a local directory on the computer where 3d Slicer has been installed.
- From the 3d Slicer Menu,
  - select File,
  - select Load Scene
  - Open the included mrml scene from the tutorial data set.



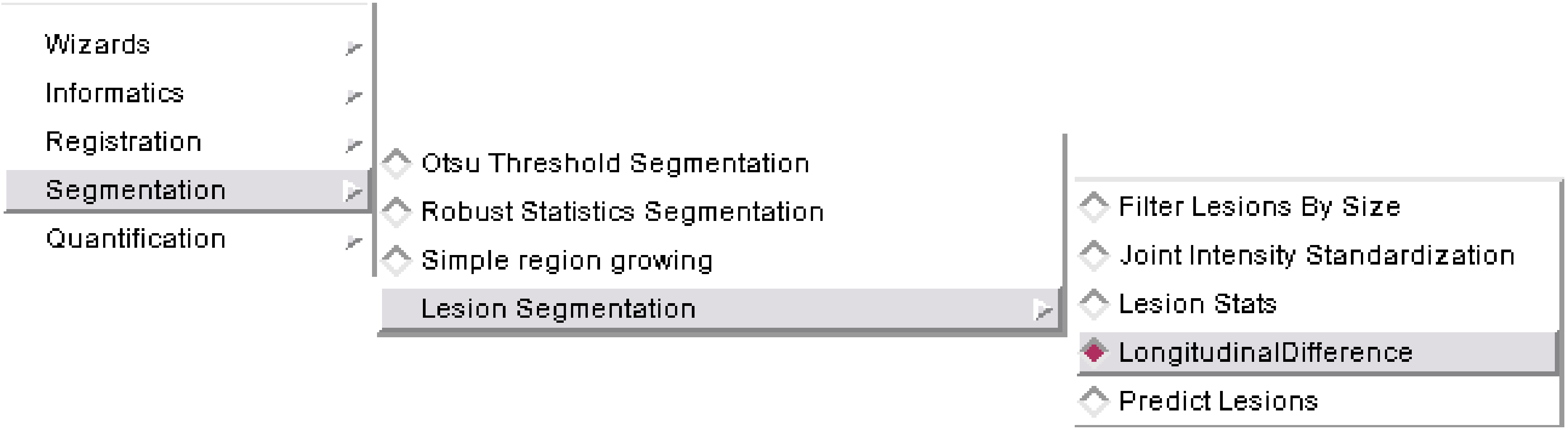
Name	Size	Modified time
Time1		Tue Jun 15 18:44:19 2010
Time2		Tue Jun 15 19:23:55 2010
LongitudinalLesionCompare.mrml	21 KB	Tue Jun 15 21:37:47 2010

File name: LongitudinalLesionCompare.mrml

Files of type: Scenes (.mrml .xml .xcat)

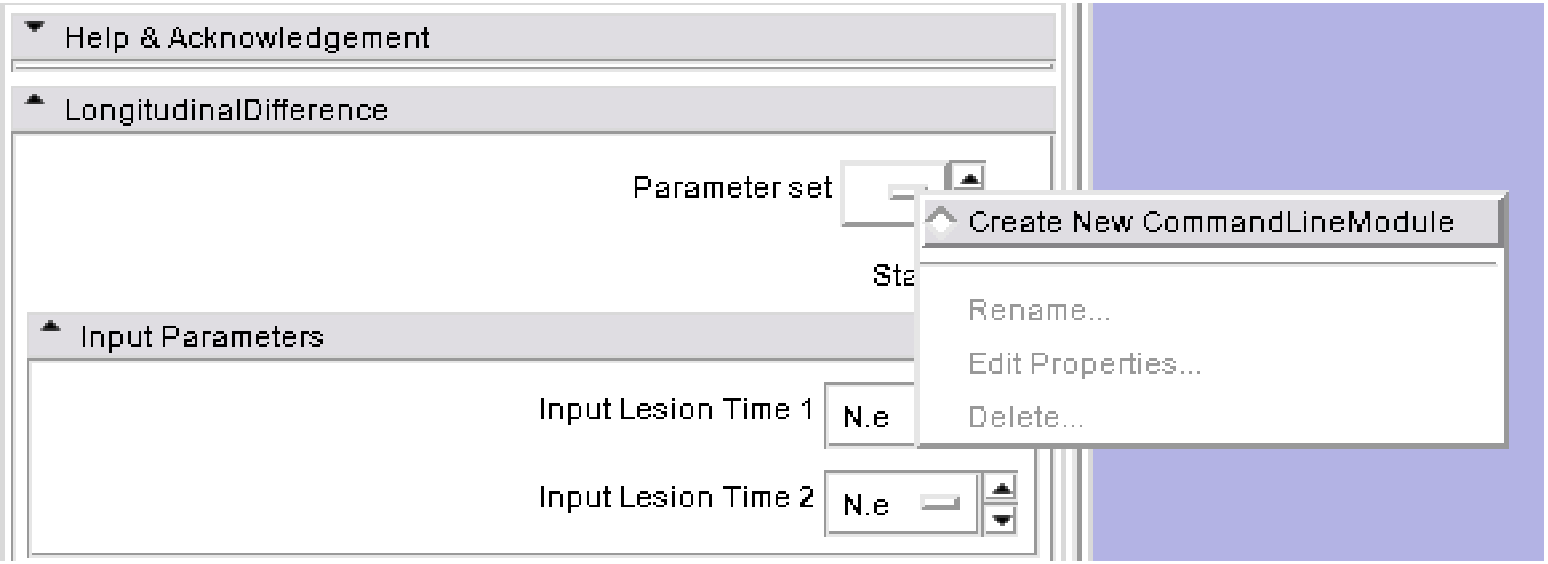
Lesion Changes Image - I

The first step to creating an image showing longitudinal lesion changes is to load the LongitudinalDifference module.



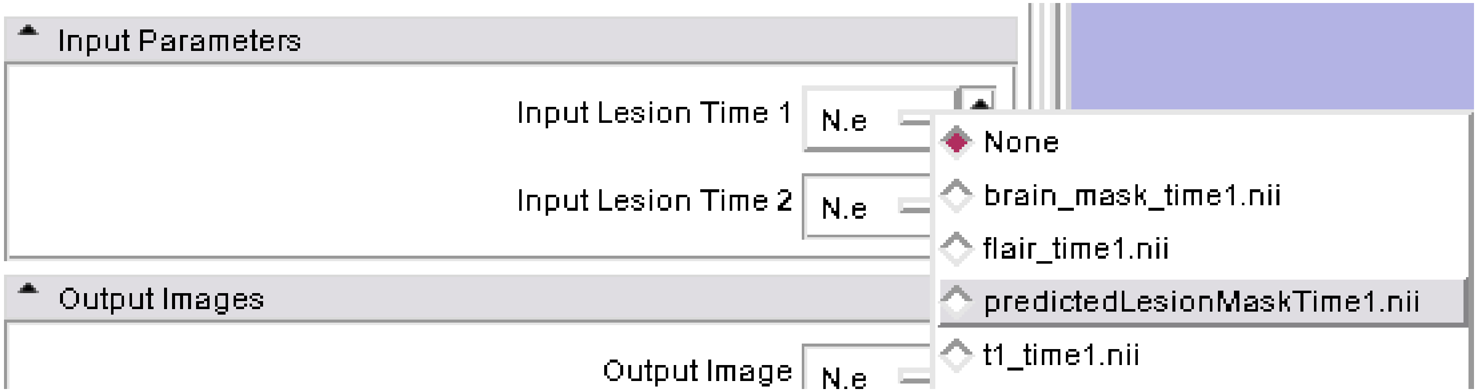
Lesion Changes Image - II

Now choose to Create New Command Line Module option.



Lesion Changes Image - III

Select 'predictedLesionsTime1.nii.gz' for 'Input Lesion Time 1'



Input Parameters

Input Lesion Time 1: N.e

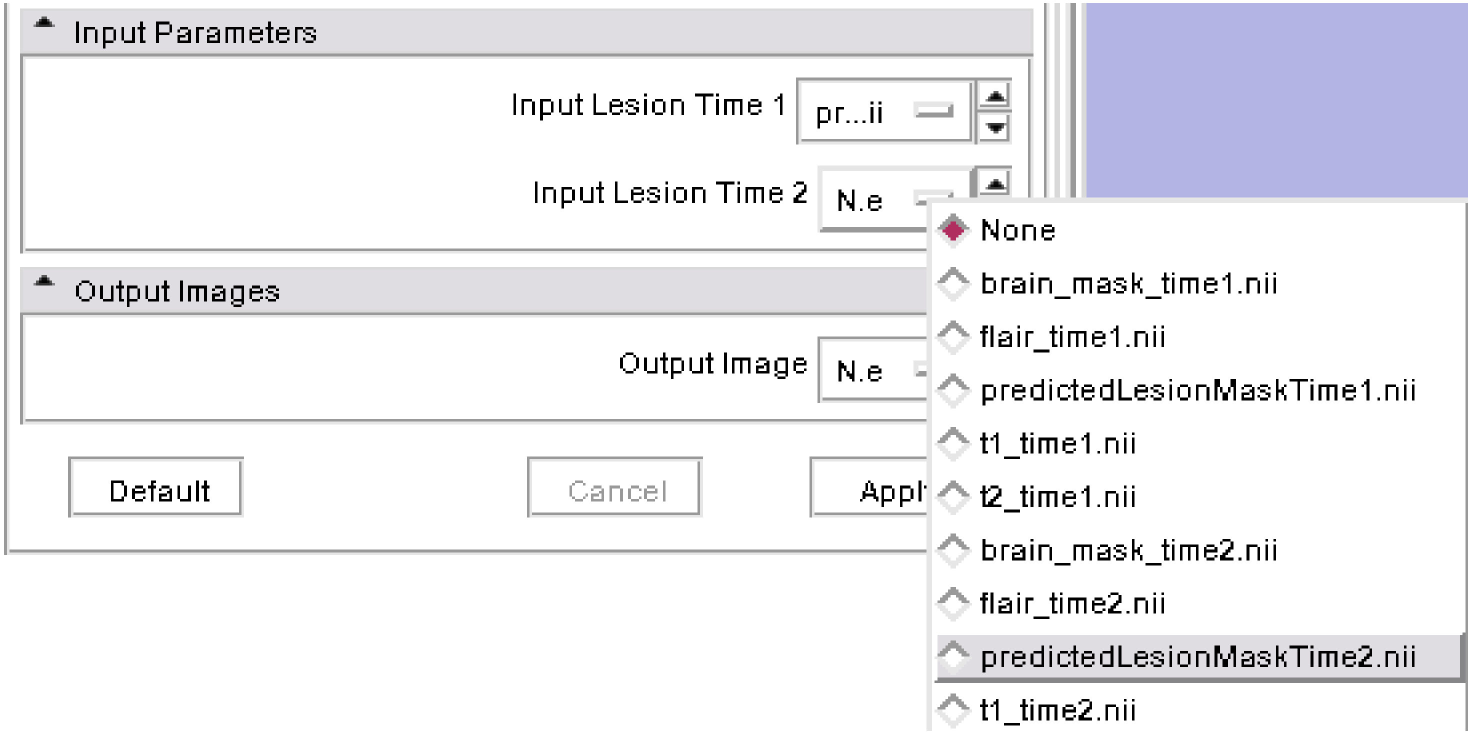
Input Lesion Time 2: N.e

Output Images

Output Image: N.e

Lesion Changes Image - IV

Select 'predictedLesionsTime2.nii.gz' for 'Input Lesion Time 2'



Input Parameters

Input Lesion Time 1: pr...ii

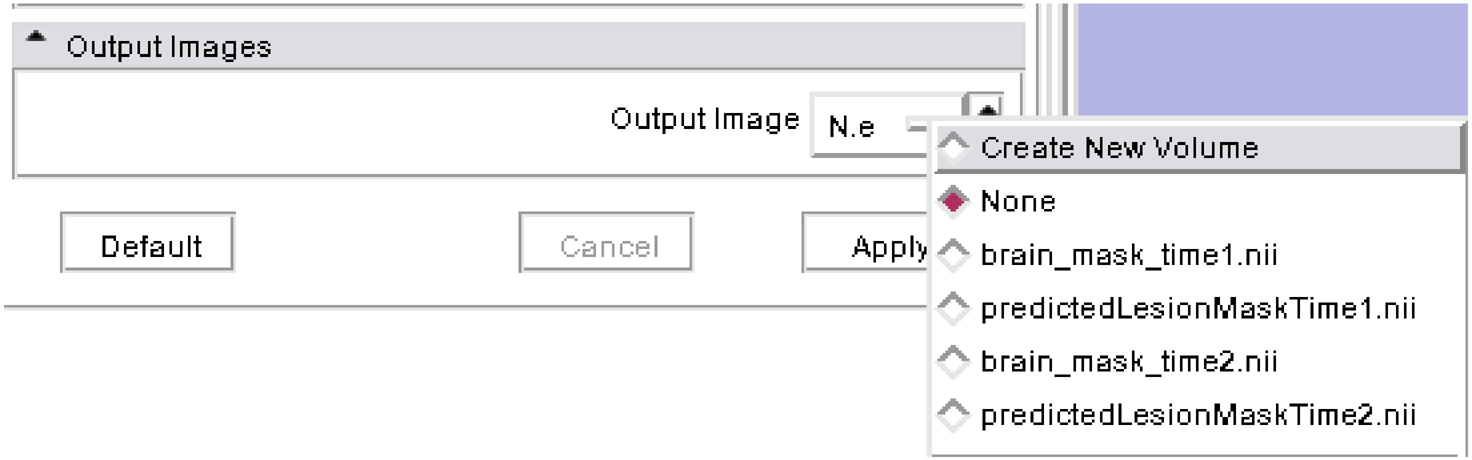
Input Lesion Time 2: N.e

Output Images

Output Image: N.e

Lesion Changes Image - V

Select 'Create New Volume' for 'Output Image'

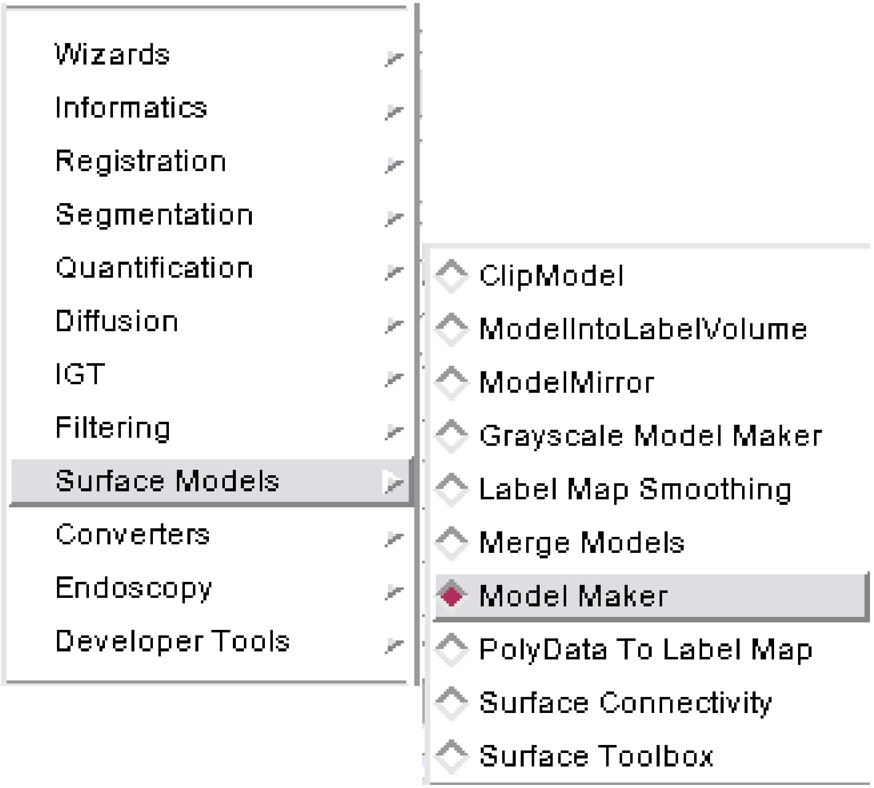


Lesion Changes Image - VI

Click 'Apply' and wait a few seconds for the module to finish running. When it is completed there will be a new image “Output Volume” that represents the changes in lesion between time 1 and time 2. Next we'll generate models from this image.

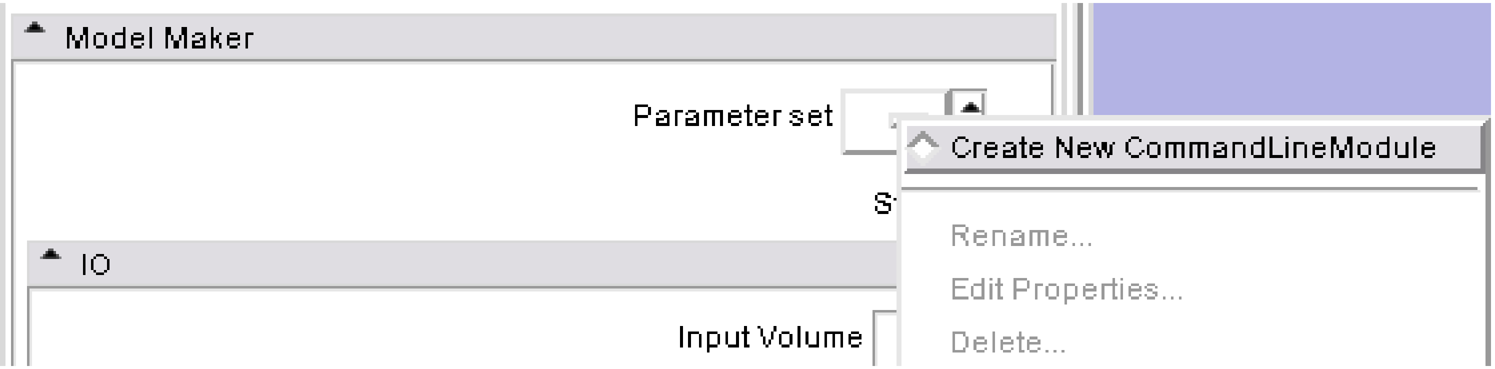
Lesion Models - I

Select the 'Model Maker' module.



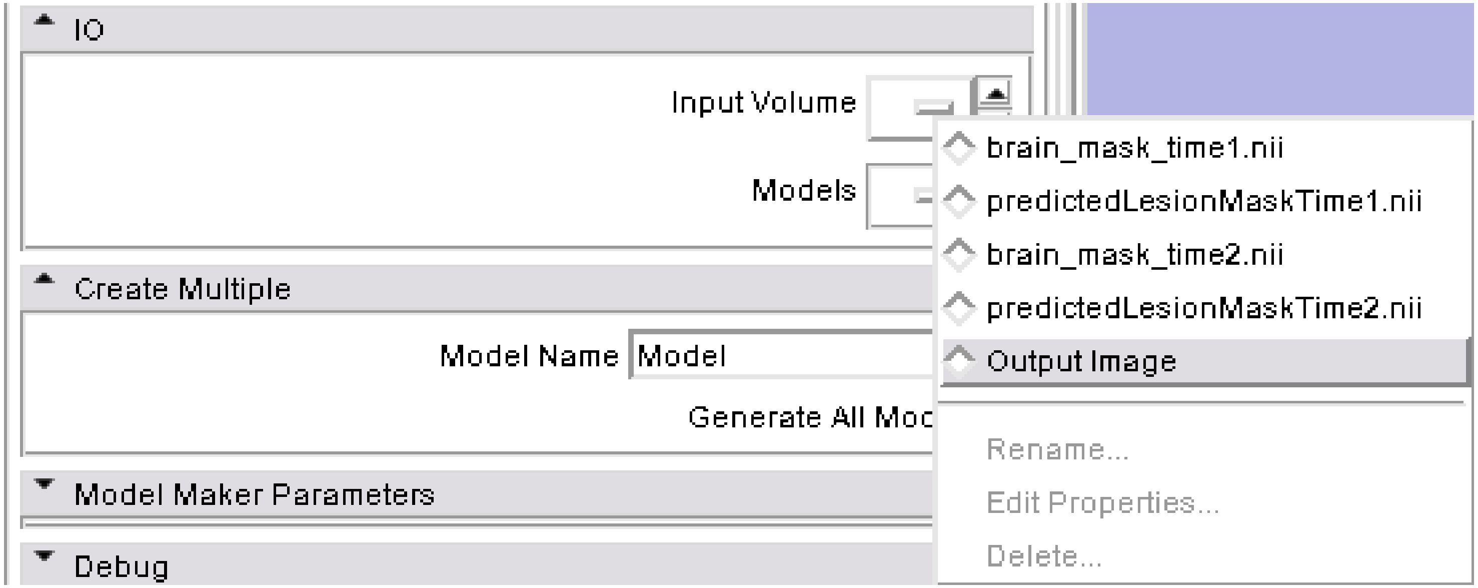
Lesion Models - II

Select 'Create New CommandLineModule' for 'Parameter Set'



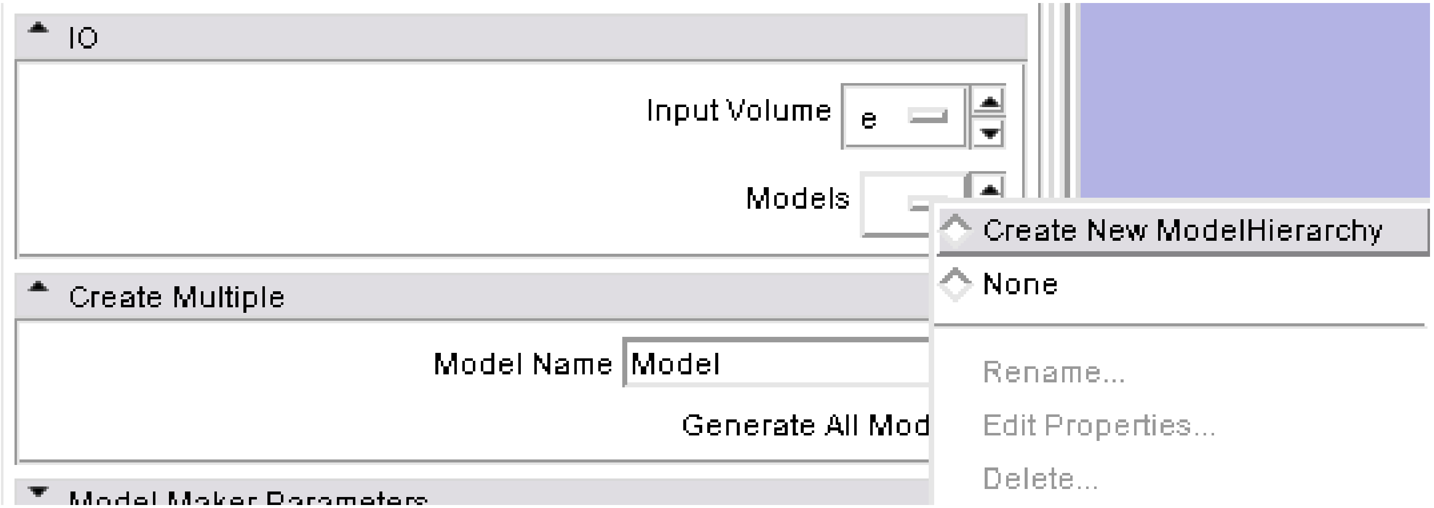
Lesion Models - III

Select 'Ouput Image' as the 'Input Volume'



Lesion Models - IV

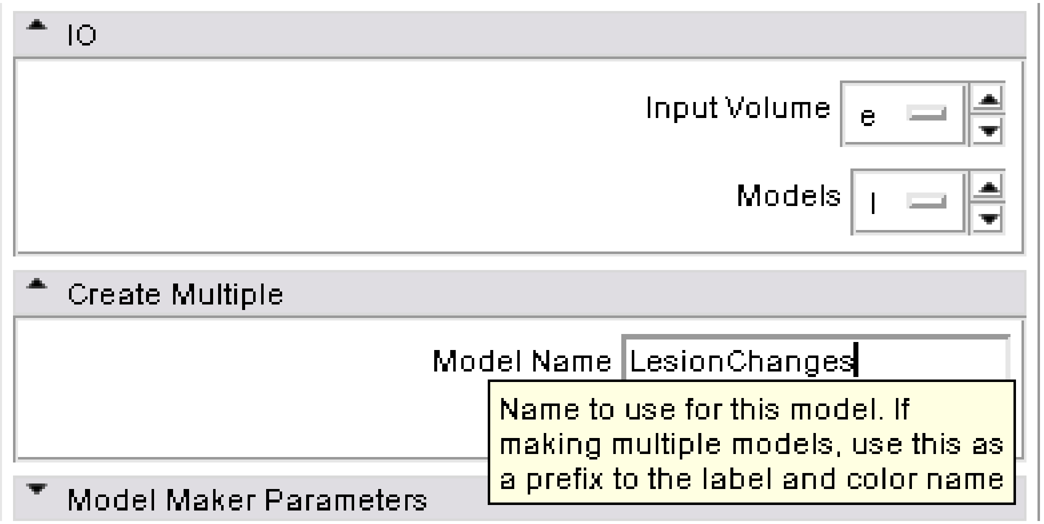
Select 'Create New Model Hierarchy' for 'Models'



Model Name: Model

Lesion Models - V

Change the 'Model Name' to 'LesionChanges'

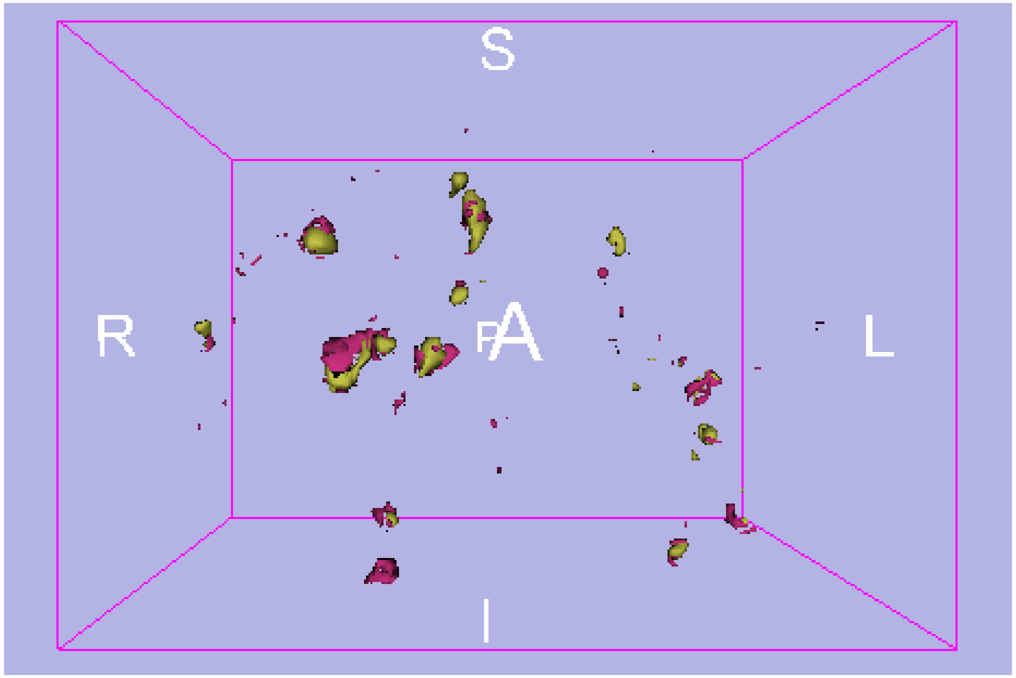


Model Name: LesionChanges

Name to use for this model. If making multiple models, use this as a prefix to the label and color name

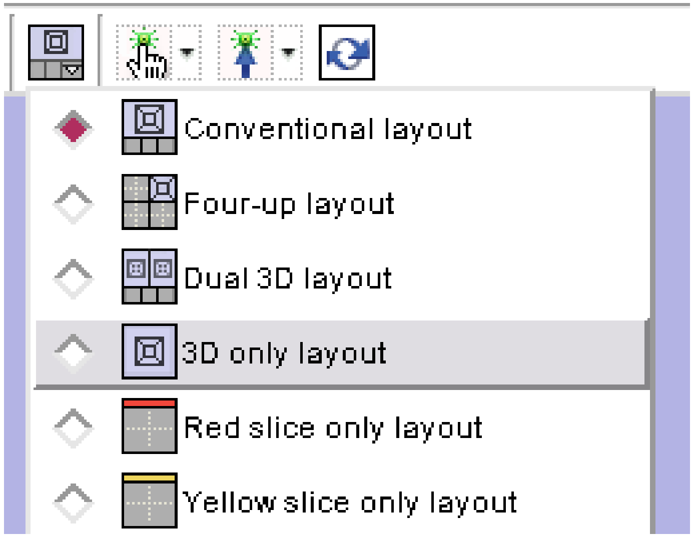
Lesion Models - VI

Click 'Apply' and wait a few seconds for the module to complete.



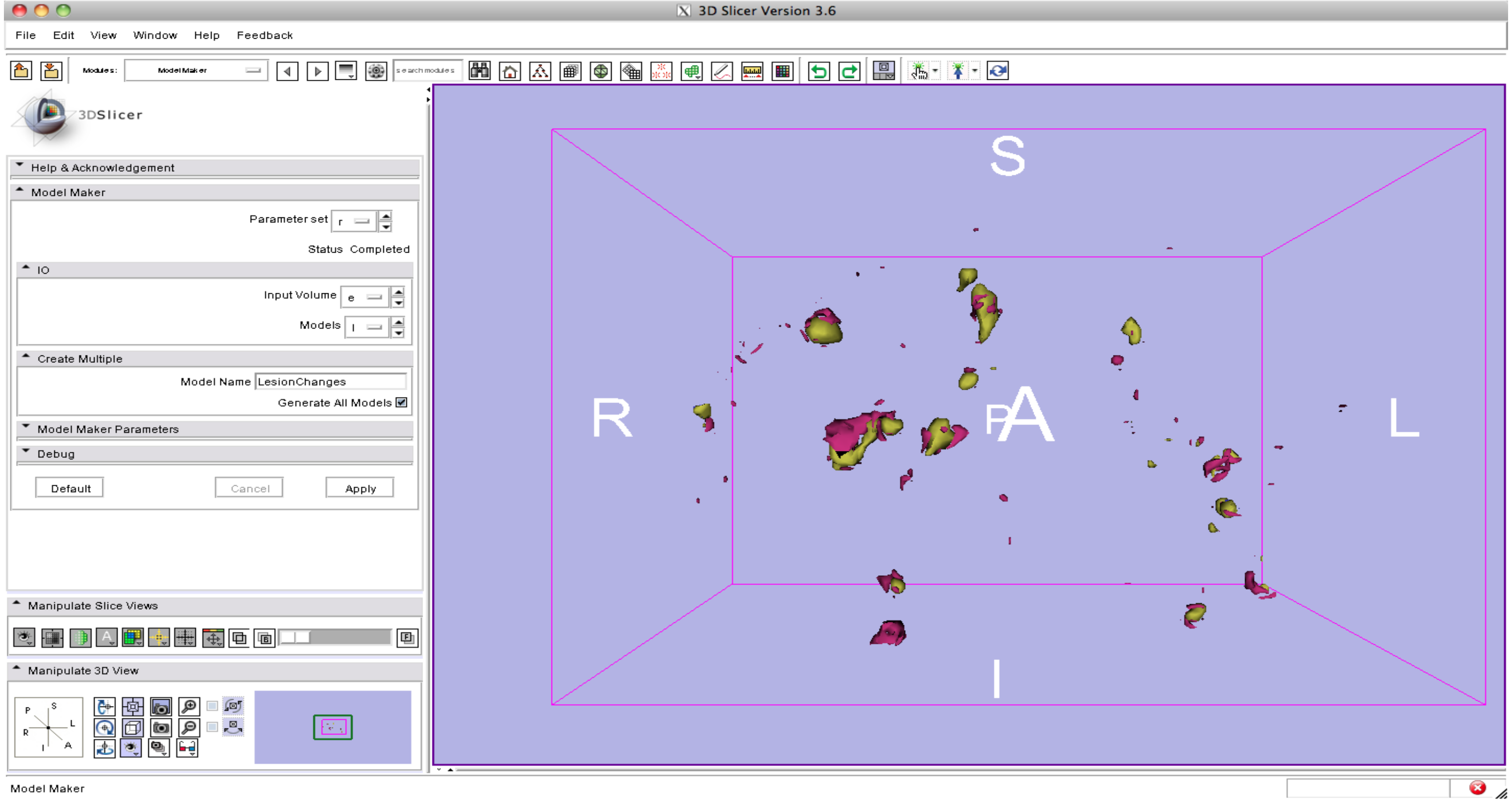
Examining Changes - I

Switch to 3D layout to make visually examining the lesion models easier.



Examining Changes - II

Zoom in



3D Slicer Version 3.6

Modules: Model Maker

Parameter set r

Status Completed

Input Volume e

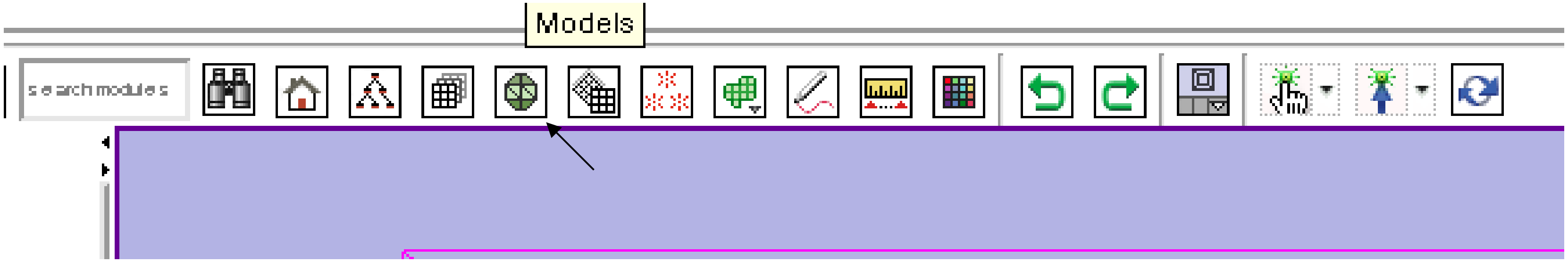
Models l

Model Name LesionChanges

Generate All Models ☑

Examining Changes - III

Bring up the Models module.



Examining Changes - IV

From the models module you can see there are three different model types:

- LesionChanges_247_monk
- LesionChanges_248_forest
- LesionChanges_245_avery

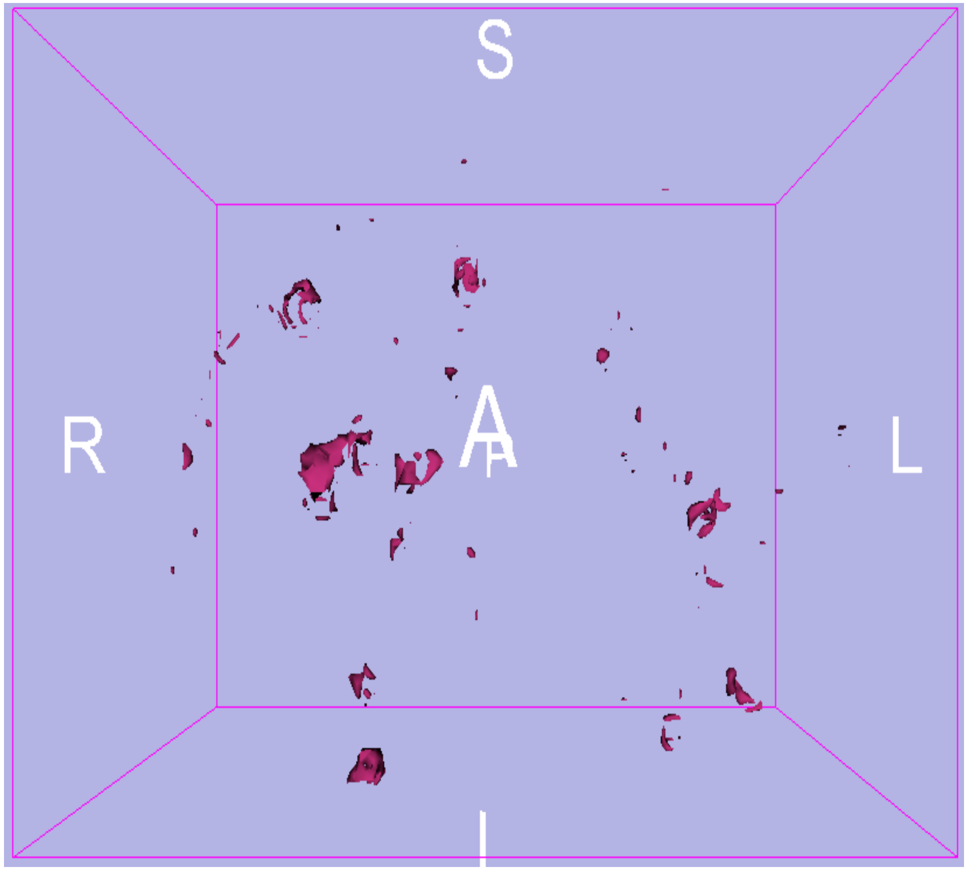
Examining Changes - V

From the Models interface you can adjust the visibility of models.

- Monk is Blue and represents lesion lost between time 1 and 2
- Forest is yellow and represents unchanged lesion
- Avery is red and represents new lesions

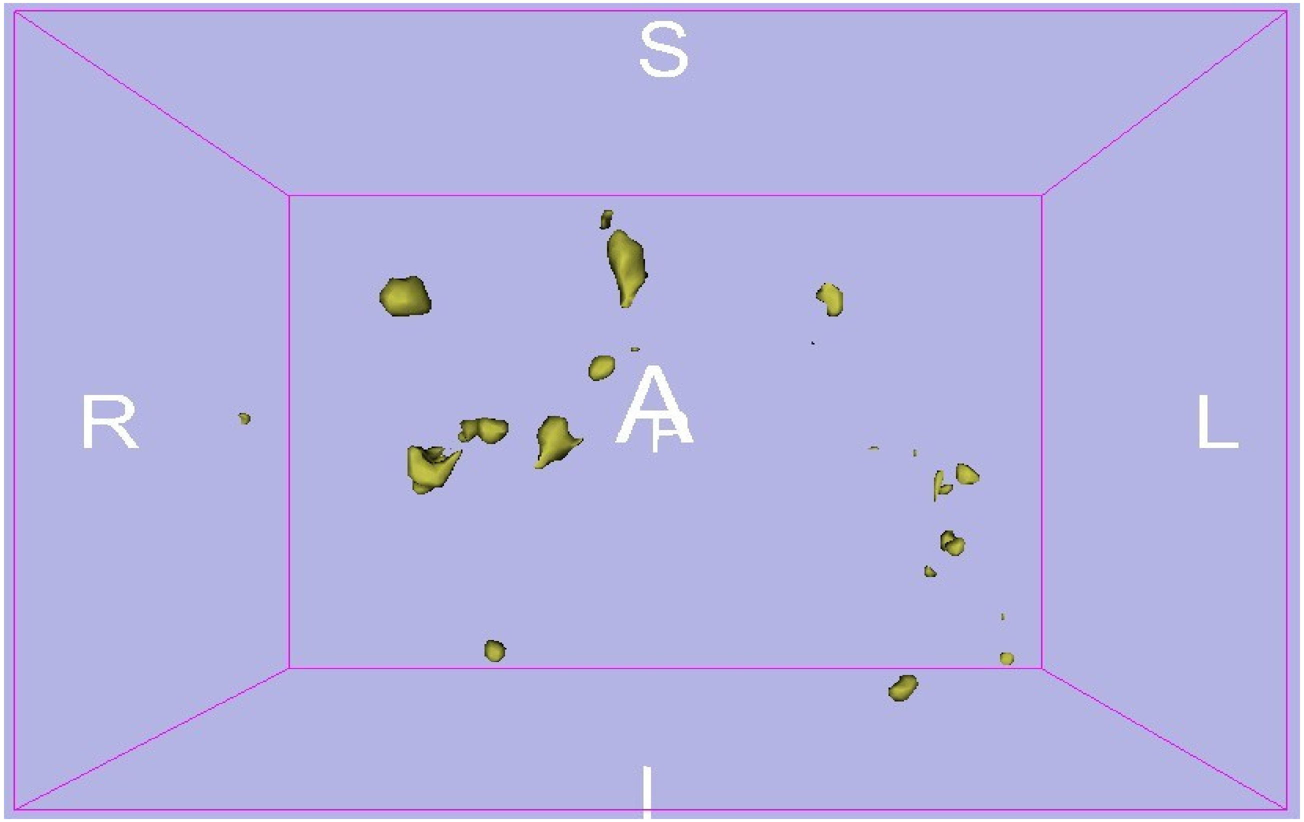
Examining Changes - VI

Each model's visibility can be independently adjusted. Here is just the new lesion (avery) with lost and unchanged lesion's visibility turned off.



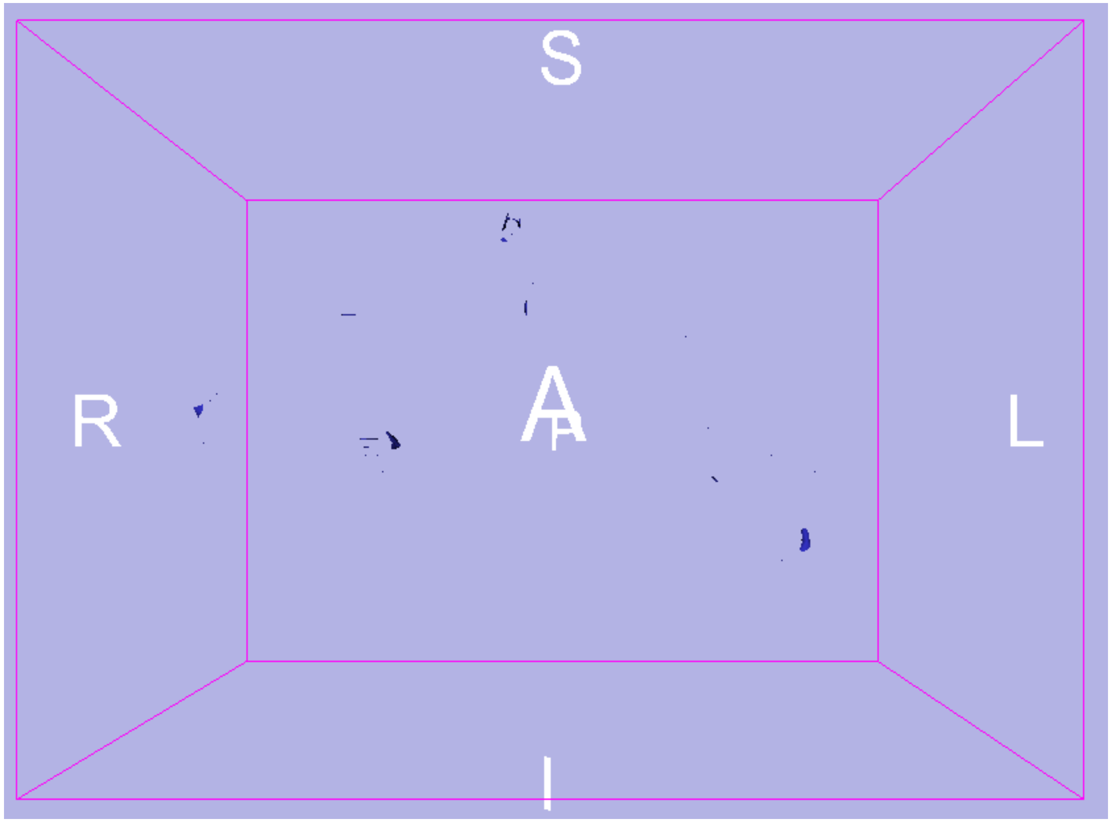
Examining Changes - VII

Here are the unchanged lesions.



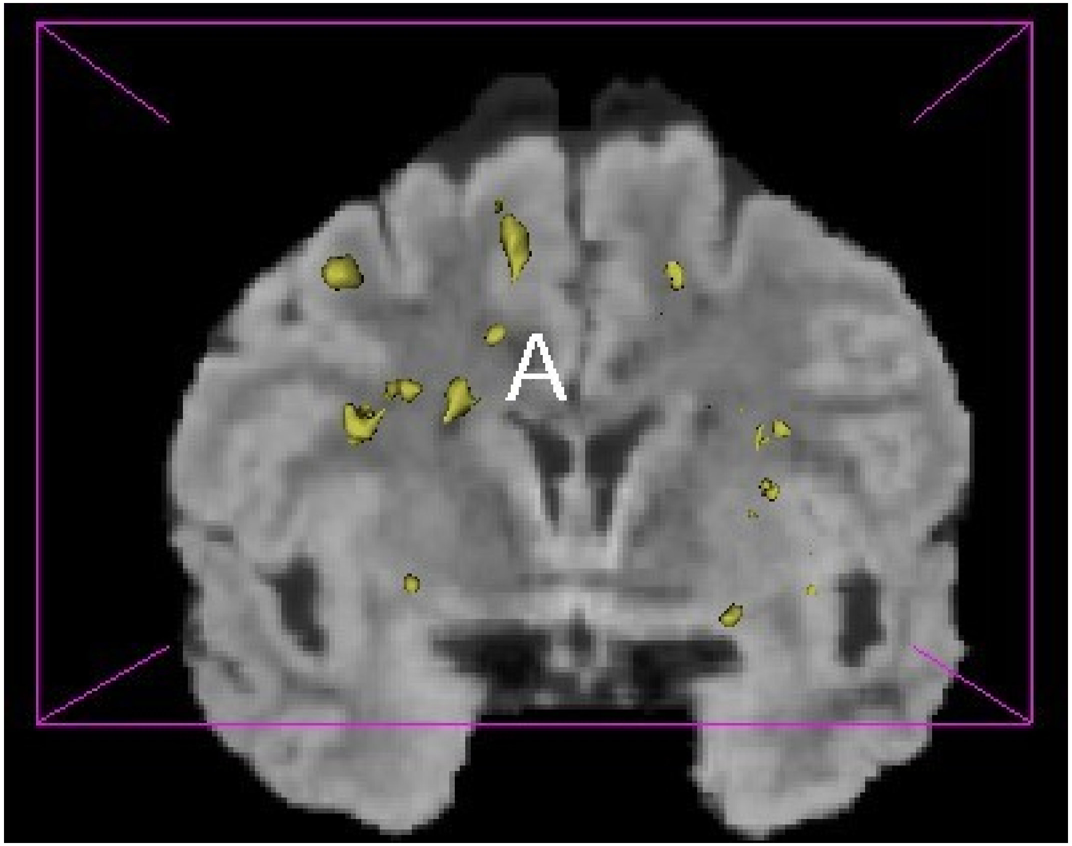
Examining Changes - VIII

Here are the lost lesions.



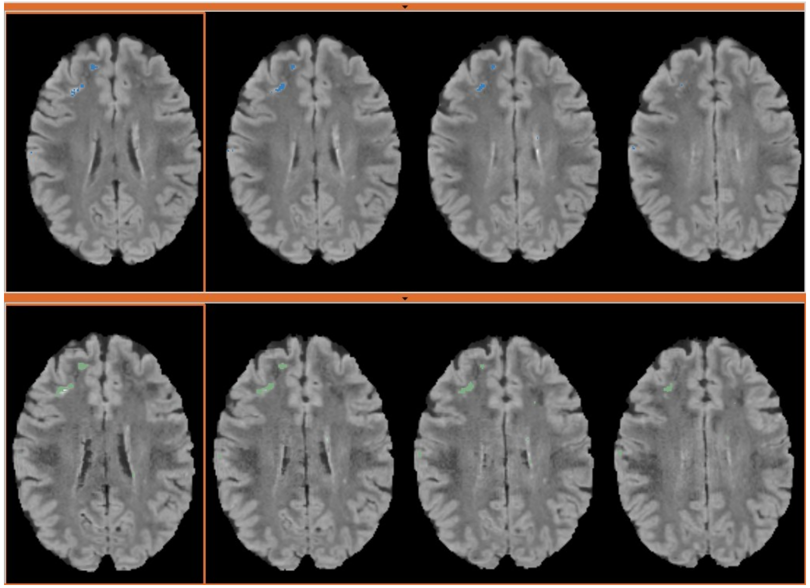
Examining Changes - IX

You can also show models with brain slices. Here is a coronal slice of the time 2 FLAIR along with the unchanged lesions.



Conclusion

You should now be able to generate models that demonstrate the changes in lesions in a single subject. These models can be examined on their own, or combined with other models generated from anatomy in order to better understand lesion changes. Using this approach permits the user to analyze longitudinal changes in white matter lesions.



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