

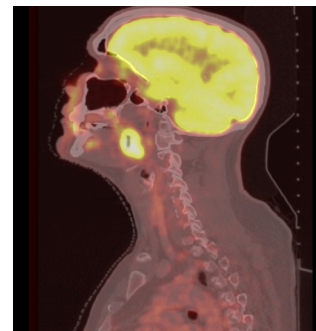
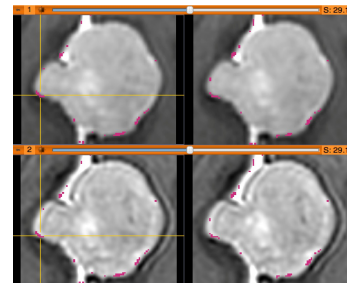


Surgical Planning Laboratory
Brigham and Women's Hospital
Boston, Massachusetts USA

a teaching affiliate of
Harvard Medical School

Quantitative Medical Imaging for Clinical Research and Practice

Sonia Pujol, PhD, Katarzyna Macura MD, PhD,
Kitt Shaffer, MD, PhD, Hatsuho Mamata, MD,
PhD, Andriy Fedorov, PhD, Wendy Plesniak,
PhD, Ron Kikinis, MD



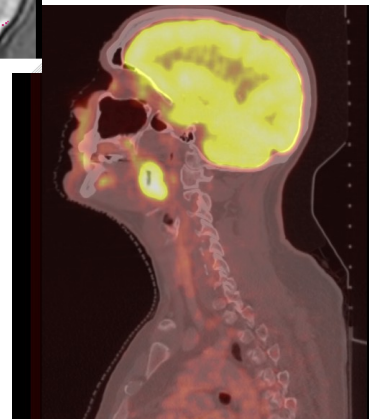
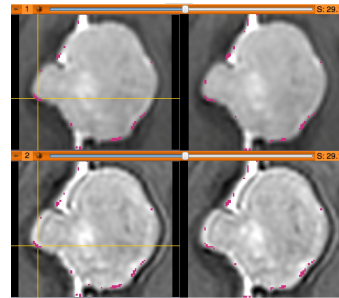


Quantitative Imaging Tutorial

Quantitative imaging is the extraction of quantitative measurements from medical imaging.

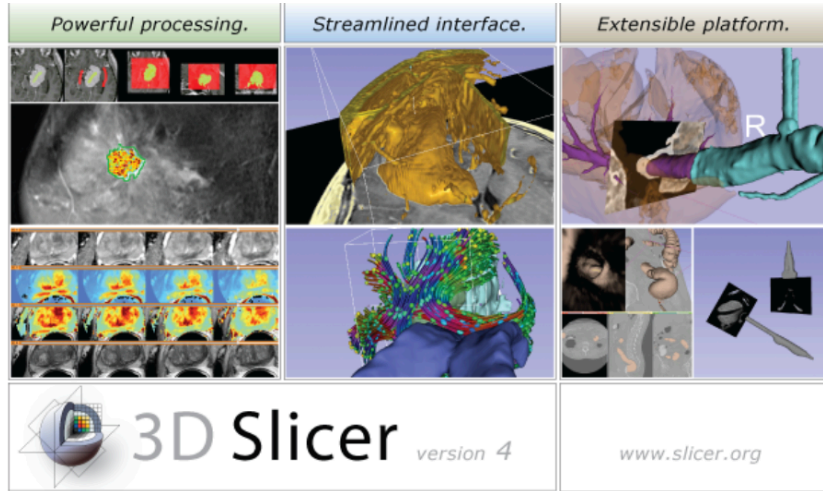
This tutorial is built upon two examples of quantitative imaging:

- **Morphology:** small volumetric changes in slow growing tumors
- **Function:** metabolic activity in squamous cell carcinoma





Quantitative Imaging: Software



www.slicer.org

This hands-on tutorial will guide you step-by-step through the use of quantitative imaging modules of the **3D Slicer software**.

3D Slicer is a freely available open-source platform for medical imaging research **supported by the National Institutes of Health**.



Course Overview

Part 1: Measurement of small Volumetric Changes in meningioma using the Change Tracker module

Part 2: Measurement Metabolic Activity in squamous cell carcinoma using the PET

Standard Uptake Value Computation module



Course Datasets

The course data is located in the directory:

/QuantitativeImaging

- dataset1_MR_Head
- dataset2_ChangeTracker
- dataset3_PETCT

Each dataset is in Slicer **.mrp** file format.



Slicer mrb file format

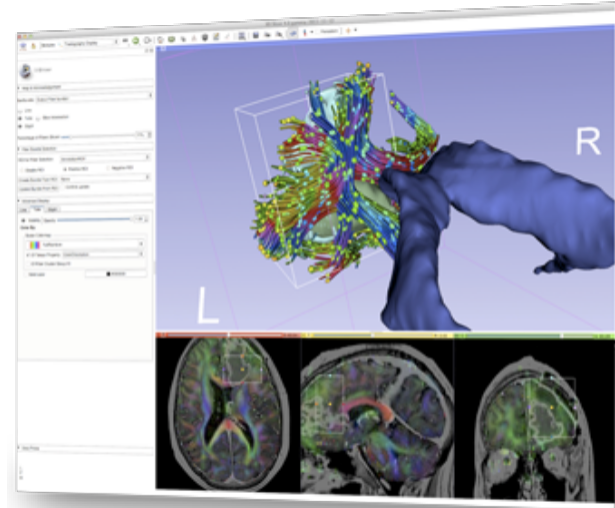
A Slicer mrb file is an archive file that contains all data for loading into Slicer4.

The .mrb file is a .zip file but with a different file extension.



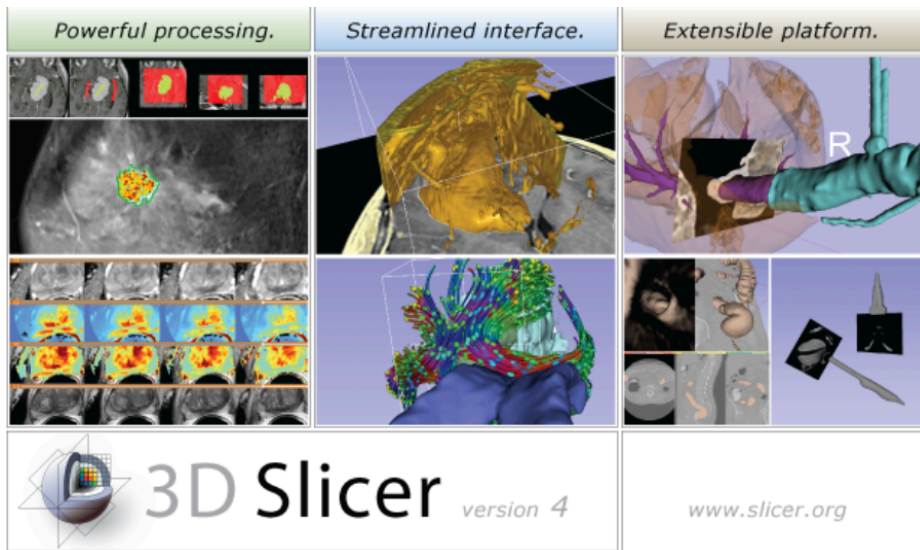
Introduction to the 3D Slicer software

Sonia Pujol, PhD
Director of Training,
Neuroimage Analysis Center
Brigham and Women's Hospital, Boston, MA





3D Slicer

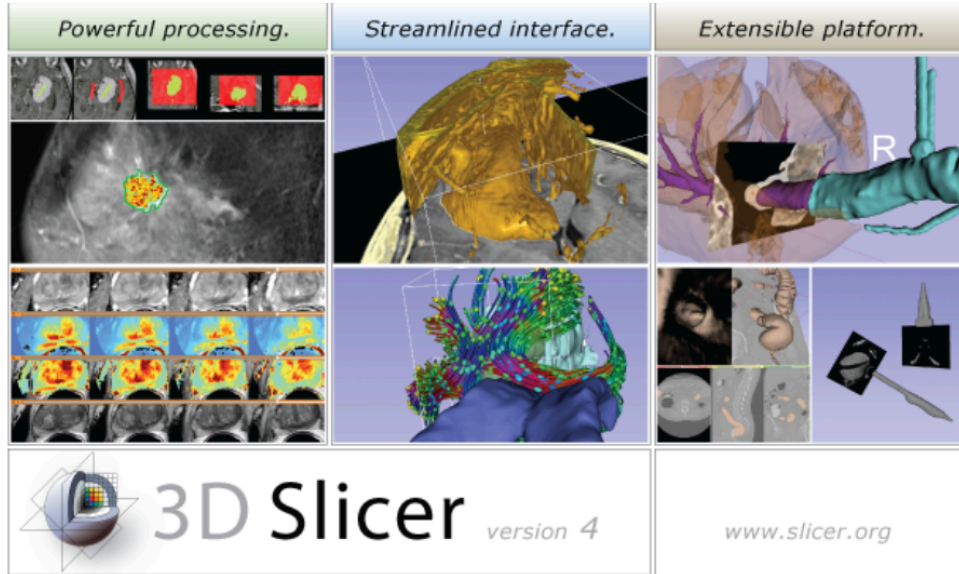


3D Slicer is a freely available **open-source** platform for segmentation, registration and 3D visualization of medical imaging data.

3D Slicer is a **multi-institutional effort** supported by the **National Institutes of Health**.



3D Slicer



- 3D Slicer version 4.5 is a **multi-platform software** running on Windows, Linux, and Mac OSX
- Slicer is distributed under a **BSD license** with no restriction on use
- Slicer is a tool for research, and is **not FDA** approved

Disclaimer

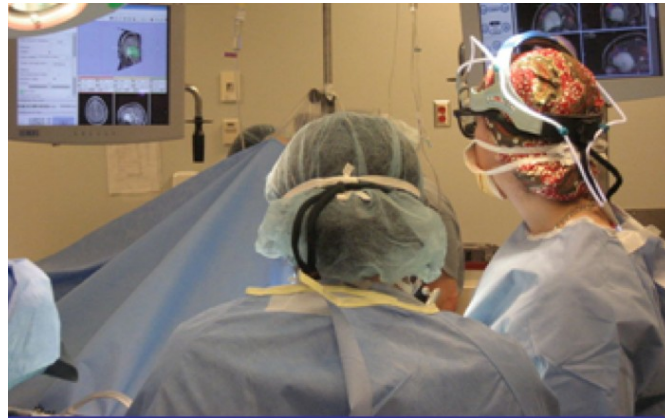
It is the responsibility of the user of 3DSlicer to comply with both the terms of the license and with the applicable laws, regulations and rules.



An interdisciplinary platform



An **open-source environment** for software developers



An **end-user application** for clinical investigators and scientists

A software platform that is both **easy to use** for clinical researchers and **easy to extend** for programmers



3D Slicer History

- 1997: Slicer started as a research project between the Surgical Planning Lab (Harvard) and the CSAIL (MIT)

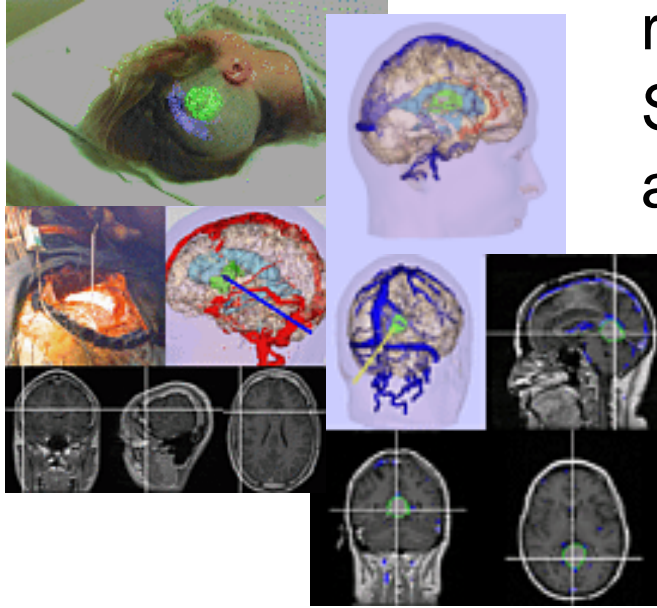
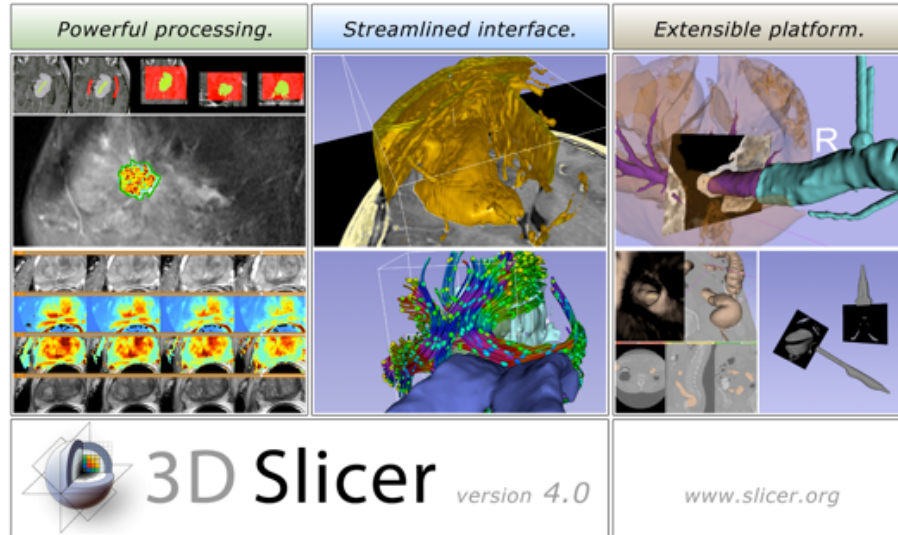


Image Courtesy of the CSAIL, MIT



3D Slicer History




1997: Slicer started as a research project between the Surgical Planning Lab (Harvard) and the CSAIL (MIT)

2015: Multi-institution effort to share the latest advances in image analysis with clinicians and scientists



A multi-institution: NA-MIC, NAC, NCIGT



National Alliance for Medical Image Computing

A National Center for Biomedical Computing
Funded under the NIH Roadmap Initiative

Google Custom Search

NA-MIC Wiki

General

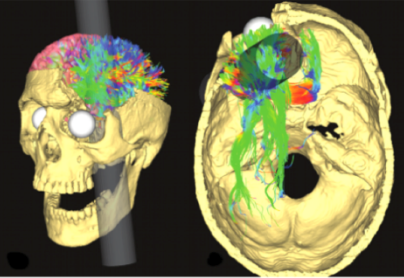
- Overview
- Organization
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Center Components

- Algorithms
- Engineering
- Driving Biological Projects
- Collaboration Grants

Resources

- Publication DB
- Image Gallery
- Downloads
- Service
- Training
- Dissemination
- Events
- Links



The 98th Annual Meeting of the Radiological Society of North America will be held on November 25-30, 2012 at McCormick Place, in Chicago, IL. RSNA is an international society of radiologists, medical physicists and other medical professionals with more than 50,000 members across the globe.

[Read more...](#)

[NEWS ARCHIVE](#)

Modeling the path of the tamping iron through the Gage skull and its effects on white matter structure [Read more...](#)

1 of 24 Photos

The National Alliance for Medical Image Computing (NA-MIC) is a multi-institutional, interdisciplinary team of computer scientists, software engineers, and medical investigators who develop computational tools for the analysis and visualization of medical image data. The purpose of the Center is to provide the infrastructure and environment for the development of computational algorithms and open-source technologies, and then oversee the training and dissemination of these tools to the medical research community.

Supported by the National Institutes of Health

Information about collaborating with

PI: Ron Kikinis, M.D.



Neuroimage Analysis Center

"understanding the human brain through imaging"

Google Custom Search

About the NAC

- Overview
- Organization
- Research Cores
- Collaborations

Resources

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- Image Gallery
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- Web Archive



IMRI-DTI Modeling via Landmark Distance Atlases for Prediction and Detection of Fiber Tracts

Leave-one-out prediction of tract location according to the landmark distance atlas (LDA). Each subject's MRI selection peaks and anatomical landmarks, plus the leave-one-out LDA from the other subjects, were used to predict the location of the AF, left CST, and right CST. The true dissections for each subject are shown in dark blue, and the 80% confidence interval for the predicted trajectory is shown in transparent cyan. These results provide an alternative visualization of the data in the learned landmark distance model and they demonstrate reasonable model generalization to novel subjects.

[More...](#)

[Featured Image Archive](#)

The Neuroimage Analysis Center (NAC) develops image processing and analysis techniques for basic and clinical neurosciences. The NAC research approach emphasizes both specific core technologies and collaborative application projects. The activities of the NAC are centered at the Harvard Medical School and the Surgical Planning Laboratory at the Brigham and Women's Hospital, with collaborators throughout the United States and the rest of the world.

For research center supported by the National Center for Research Resources (NCRR) and the Institute of Biomedical Imaging and Bioengineering (IBIB), see National Institutes of Health.



National Center for Image-Guided Therapy

NCIGT Wiki

About Us

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Advanced Multimodality Image Guided Operating (AMIGO) Suite

The Advanced Multimodality Image Guided Operating (AMIGO) Suite is an innovative surgical and interventional environment that is the clinical translational test bed of the National Center for Image-Guided Therapy (NCIGT) at the Brigham and Women's Hospital (BWH) and Harvard Medical School. The AMIGO is an integrated, 5,700 square foot area divided into three sterile procedure rooms in which a multidisciplinary team will treat patients with the benefit of intra-operative imaging using multiple modalities. [More...](#)

[Featured Image Archive](#)

The National Center for Image Guided Therapy (NCIGT) is a Biomedical Technology Resource Center supported by the NCRR and NIBIB Institutes of the NIH. The NCIGT serves as a national resource for all aspects of

PI: Clare Tempany, M.D.

physicians, scientists, and technical staff members. Download a movie (80MB) [here](#) about the NCIGT team work.



Slicer: Behind the scenes

CDash - Slicer4

http://www.cdash.org/slicer4/index.php?project=Slicer4

RSNA 2011 - NAMIC | CDash - Slicer4

Login | All Dashboards

Slicer4

Dashboard | Calendar | Previous | Current | Project

WARNING: This CDash instance is running the bleeding edge svn trunk CDash code, and is updated frequently. You have 1 file changed by 1 author as of Sunday, November 27 2011 - 22:00 EST

Nightly-Packages

Site	Build Name	Update	Configure			Build	
		Files	Error	Warn		Error	Warn
factory-win7.kitware	Windows7-VS2010-32bits-QT4.7.1-PythonQt-With-Tcl-CLI-Release	0	0	0		2 ⁰ ₀	107 ⁰ ₀
factory-mac-64bits.kitware	SnowLeopard-g++4.2.1-64bits-QT4.7-PythonQt-With-Tcl-CLI-Release	1	0	0		0	14 ⁰ ₀
factory-ubuntu-64bits.kitware	Linux-g++4.4.3-64bits-QT4.7-PythonQt-With-Tcl-CLI-Release	1	0	0		0	13 ⁰ ₀
factory-win7.kitware	Windows7-VS2008-64bits-QT4.7.1-PythonQt-With-Tcl-CLI-Release	0	0	0		0 ⁰ ₀	1000 ⁰ ₀
factory-win7.kitware	Windows7-VS2008-32bits-QT4.7.1-PythonQt-With-Tcl-CLI-Release	1	0	0		0 ⁰ ₀	1000 ⁰ ₀

Nightly

Site	Build Name	Update	Configure			Build		Test			Build Time
		Files	Error	Warn		Error	Warn	Not Run	Fail	Pass	
whitecube.kitware	SnowLeopard-gcc4.2.1-QT4.7.0-PythonQt-With-Tcl-Release	1	0	0		27 ⁰ ₀	190 ⁰ ₀	0	96 ⁰ ₀	391 ⁰ ₀	11 hours ago
youpi.sci.utah.edu	OpenSuse-c++4.5.0-64bits-QT4.6.3-PythonQt-With-Tcl-NoCLI-Release	0	0	0		0	15 ⁰ ₀	0	304 ⁰ ₀	6 ⁰ ₀	11 hours ago
eris.kitware	Linux-g++4.4-QT4.6.3-PythonQt-CLI-Release	1	0	0		15 ⁰ ₀	0	0	36 ⁰ ₀	451 ⁰ ₀	3 hours ago
factory-ubuntu-64bits.kitware	Linux-g++4.4.3-QT4.7-PythonQt-With-Tcl-CLI-Vaigrind-Release	0	0	0		13 ⁰ ₀	0	0	27 ⁰ ₀	460 ⁰ ₀	11 hours ago
factory-ubuntu-64bits.kitware	Linux-g++4.4.3-64bits-QT4.7-PythonQt-With-Tcl-NoCLI-Coverage-Release	0	0	0		12 ⁰ ₀	0	0	23 ⁰ ₀	287 ⁰ ₀	11 hours ago
sagarmatha.kitware	Linux-g++4.3.3-QT4.7-PythonQt-With-Tcl-NoCLI-Release	0	0	0		12 ⁰ ₀	0	0	22 ⁰ ₀	288 ⁰ ₀	12 hours ago

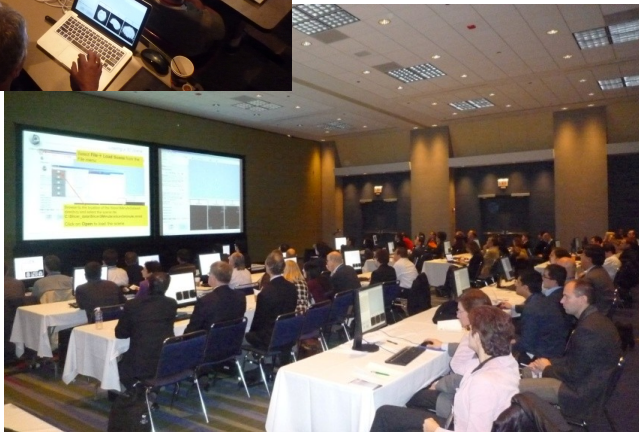
Continuous

Site	Build Name	Update	Configure			Build		Test			Build Time
		Files	Error	Warn		Error	Warn	Not Run	Fail	Pass	
youpi.sci.utah.edu	OpenSuse-c++4.5.0-64bits-QT4.6.3-PythonQt-With-Tcl-NoCLI-Release	2	0	0		0	0 ⁰ ₀	0	304 ⁰ ₀	6 ⁰ ₀	1 hour ago

Slicer is built every night on Windows, Mac and Linux platforms



Slicer Training



RSNA 2015

- Hands-on training workshops at national and international venues
- More than 3,000 clinicians, clinical researchers and scientists trained since 2005



Slicer Downloads



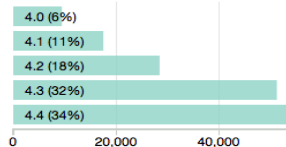
Slicer4 download stats

160,662

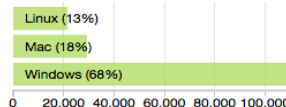
Date range

Nov 28, 2011 - Nov 10, 2015

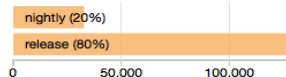
Version



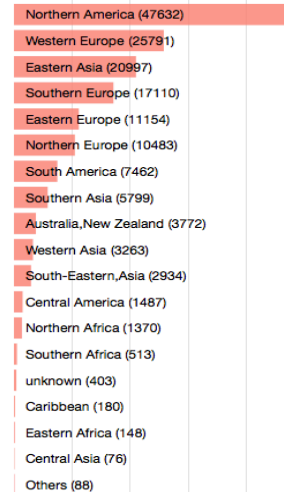
Operating system



Stability



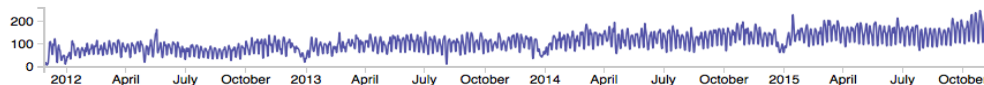
Region

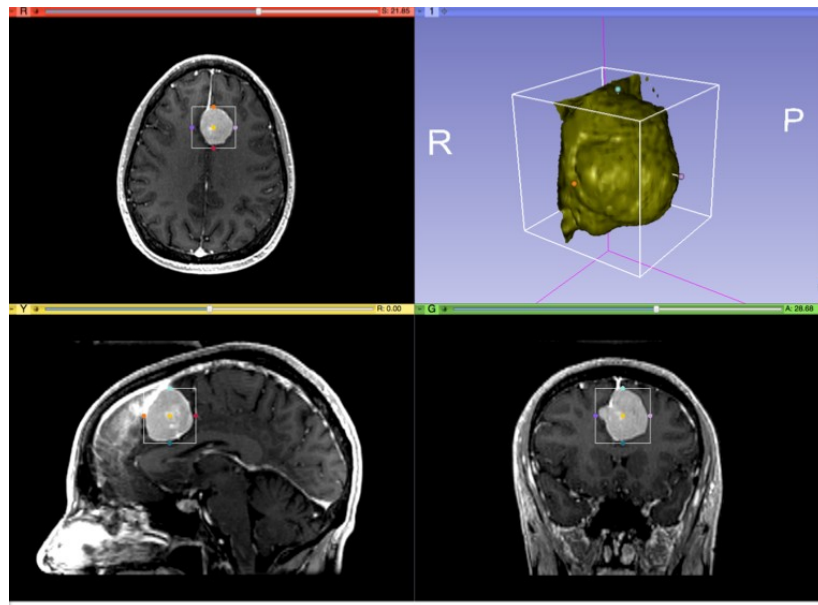


Country



Downloads per day

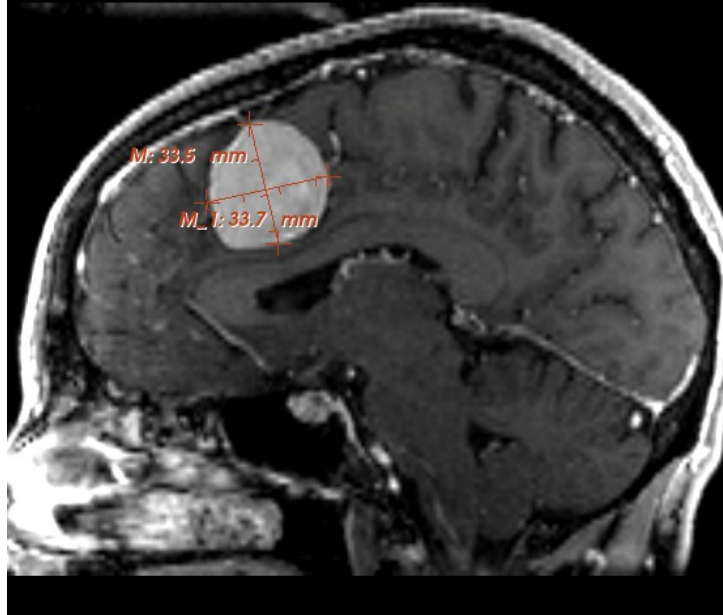




Part I: Analyzing Small Volumetric Changes

Sonia Pujol, PhD
 Kilian M Pohl, PhD
 Andriy Fedorov, PhD
 Ender Konukoglu, PhD
 Ron Kikinis, MD

Conventional measures of tumor response

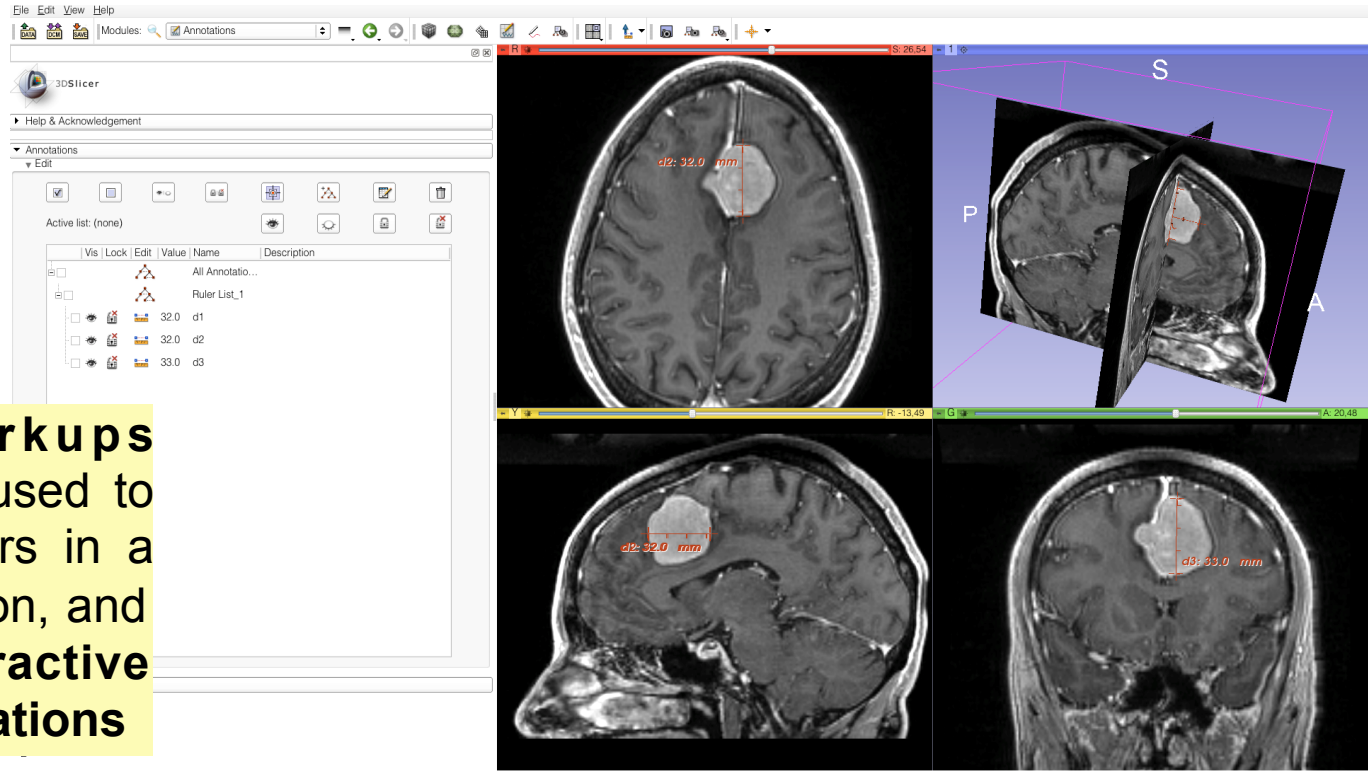


- Conventional anatomic imaging using CT or MRI are often used to evaluate tumor size and shape
- Most clinical trials that evaluate new chemotherapeutic drugs use changes in uni-dimensional or bi-dimensional measurements to assess response (e.g. RECIST)
- Slicer has several tools for applying RECIST methodologies



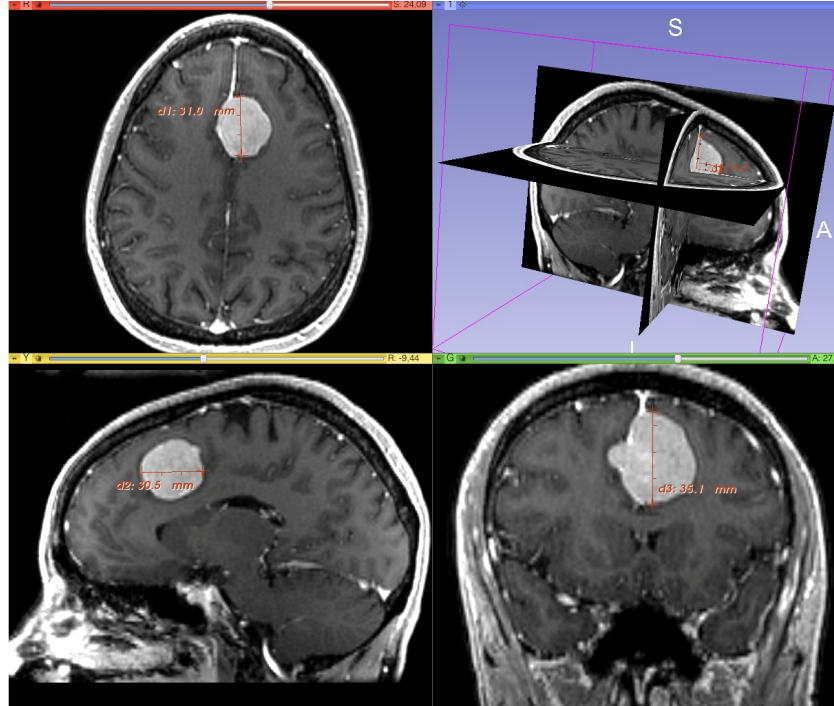
Conventional measures of tumor response

3D Slicer **Markups** module can be used to measure diameters in a tumor cross section, and to provide **interactive numerical annotations**





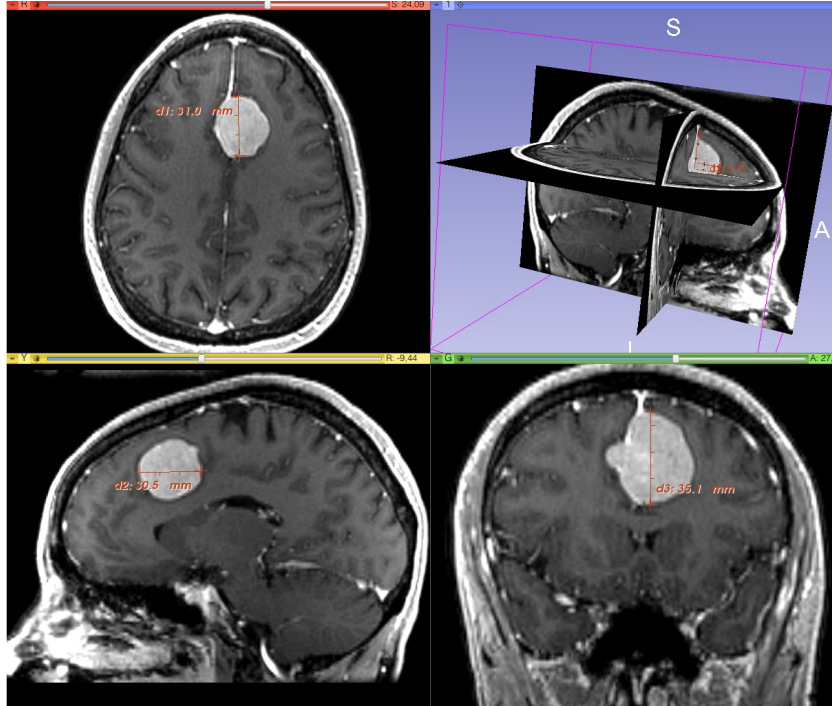
Clinical Case: baseline scan



Baseline radiologist's clinical impression:

- large falcine lesion is identified.
- measures 3.10 cm anteroposteriorly and 3.51 cm in height.
- enhances moderately on post gadolinium imaging.

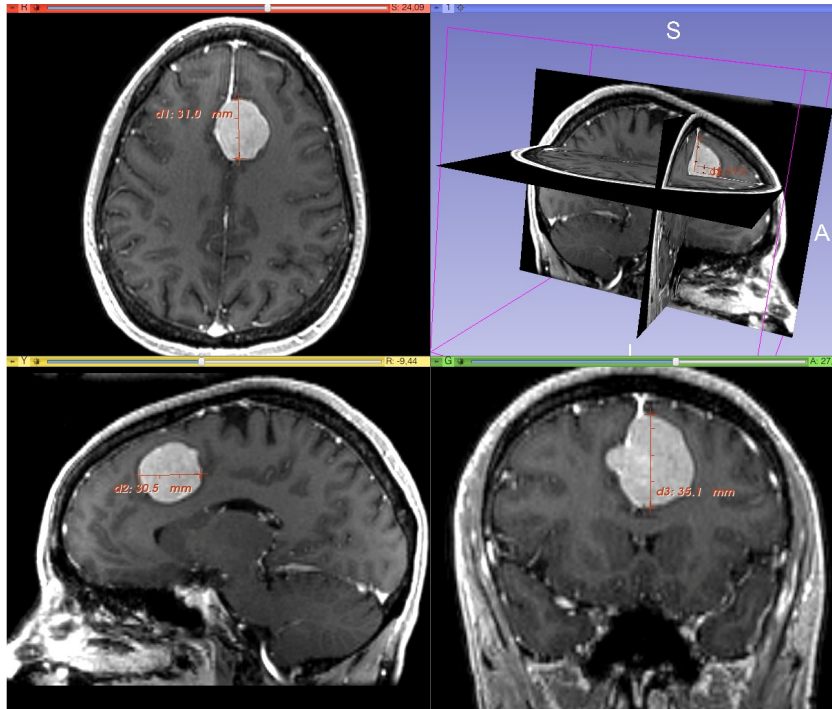
Clinical Case: follow-up scan



Follow-up radiologist's clinical impression:

- left frontal lobe mass appears unchanged on all series.
- measures 3.3 x 3.2 cm in maximum dimension.
- enhances moderately on post gadolinium imaging.

Clinical Case: follow-up scan



Follow-up radiologist's clinical impression:

- left frontal lobe mass appears unchanged on all series.
- measures 3.3 x 3.2 cm in maximum dimension.
- enhances moderately on post gadolinium imaging.

→ How has the tumor changed?



ChangeTracker: rationale for new approaches

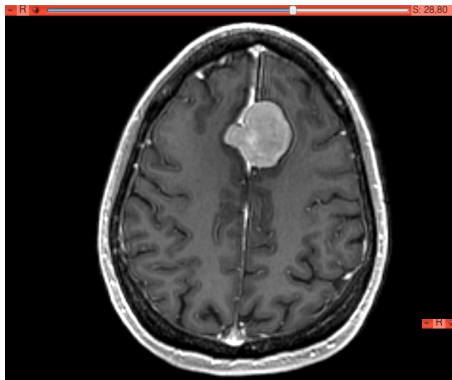
More accurate and precise methods for understanding volume changes may be useful when:

- **benign tumor change** is being monitored, or
- where **small changes may be clinically significant** but difficult to assess with RECIST



Goal of the tutorial

MR Scan1 June 2006



MR Scan2 June 2007



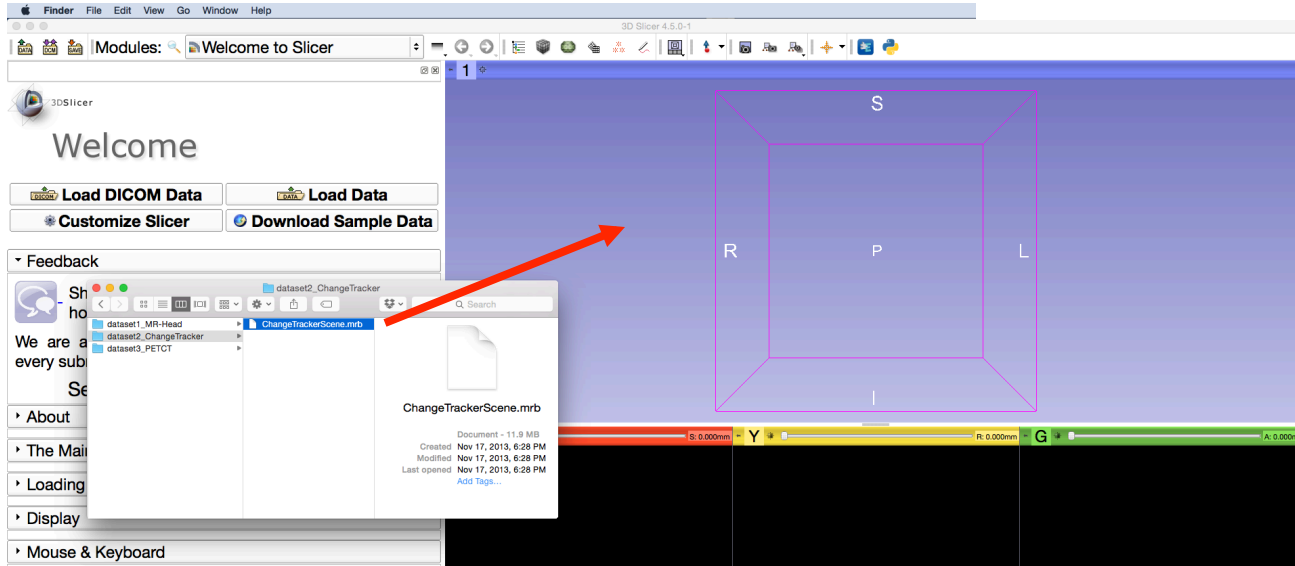
(Voxel dimension: 0.94mm x 0.94mm x 1.20mm, FOV: 240mm, Matrix: 256 x 256)"

The following section will guide you step-by-step through the computation of small volumetric changes in a slow growing tumor.

This tutorial is built upon two scans (Axial 3D SPGR T1 post Gadolinium) of a patient with meningioma, and uses the Change Tracker module of Slicer.



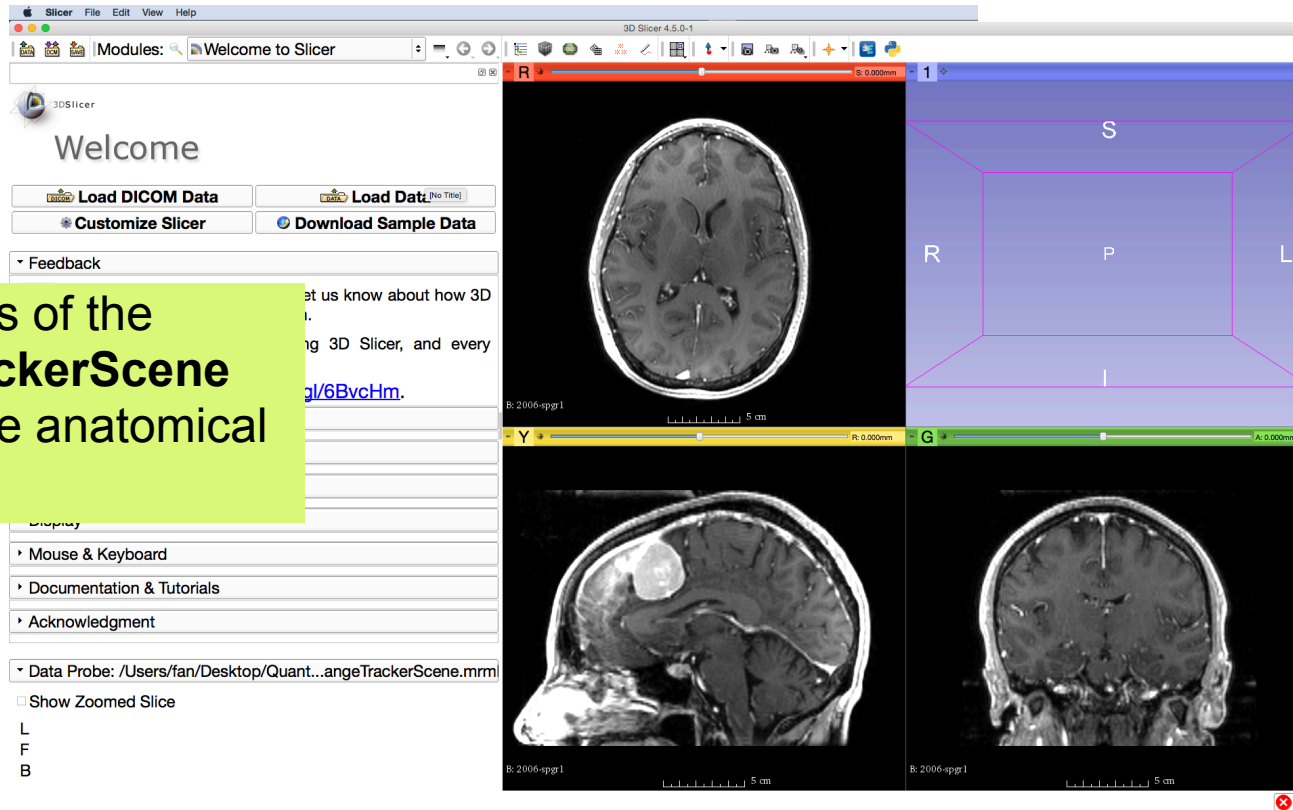
ChangeTracker: Load the dataset



Drag and drop the file **ChangeTrackerScene.mrb** located in **/Users/Desktop/QuantitativeImaging/dataset2_ChangeTracker**, into the 3D Viewer. Then press **OK**



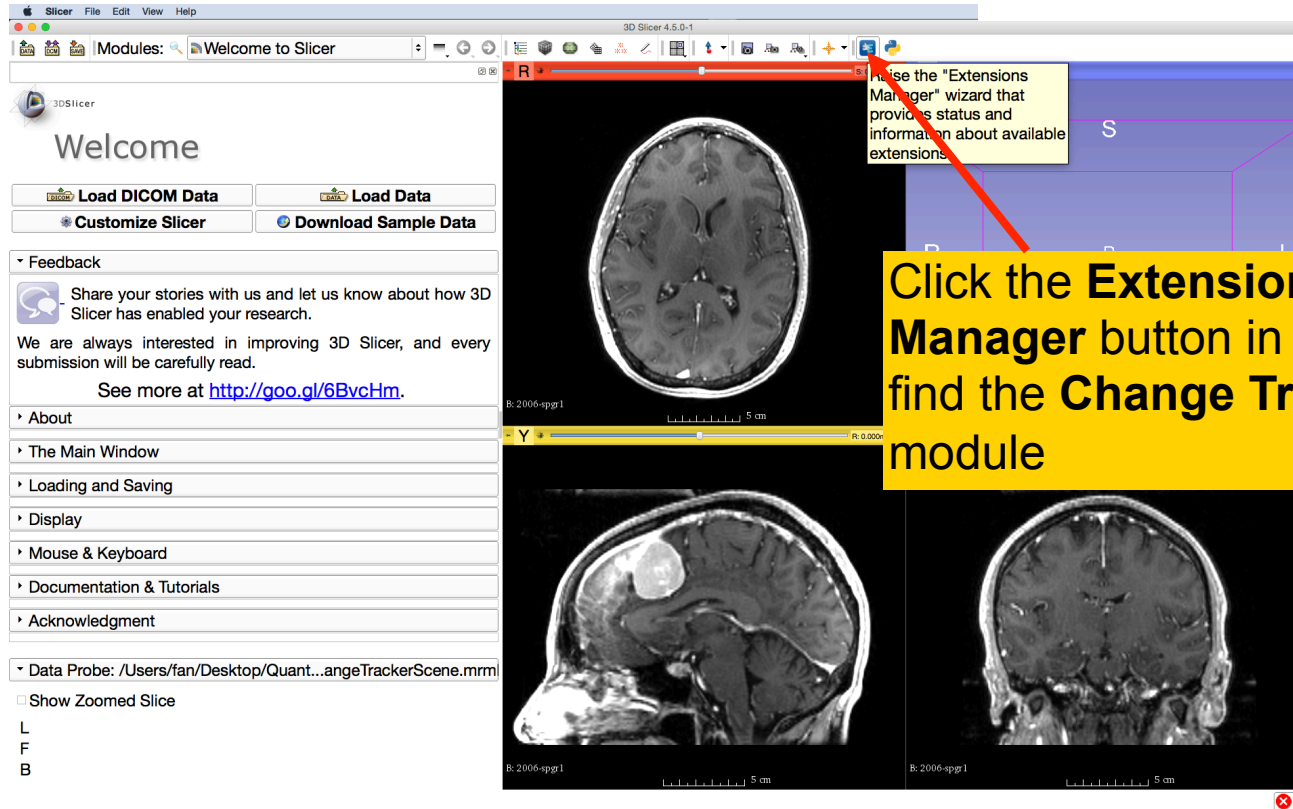
Loading the data



The datasets of the **ChangeTrackerScene** appear in the anatomical viewers.



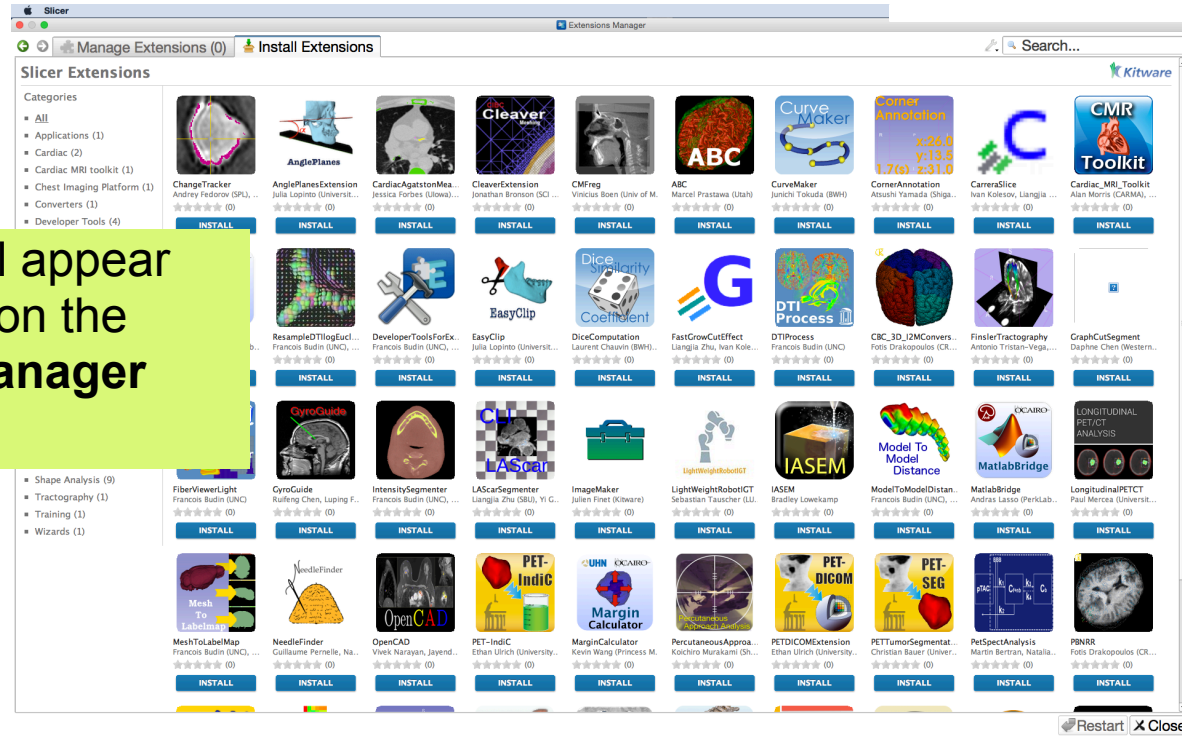
ChangeTracker: exploring small volumetric changes





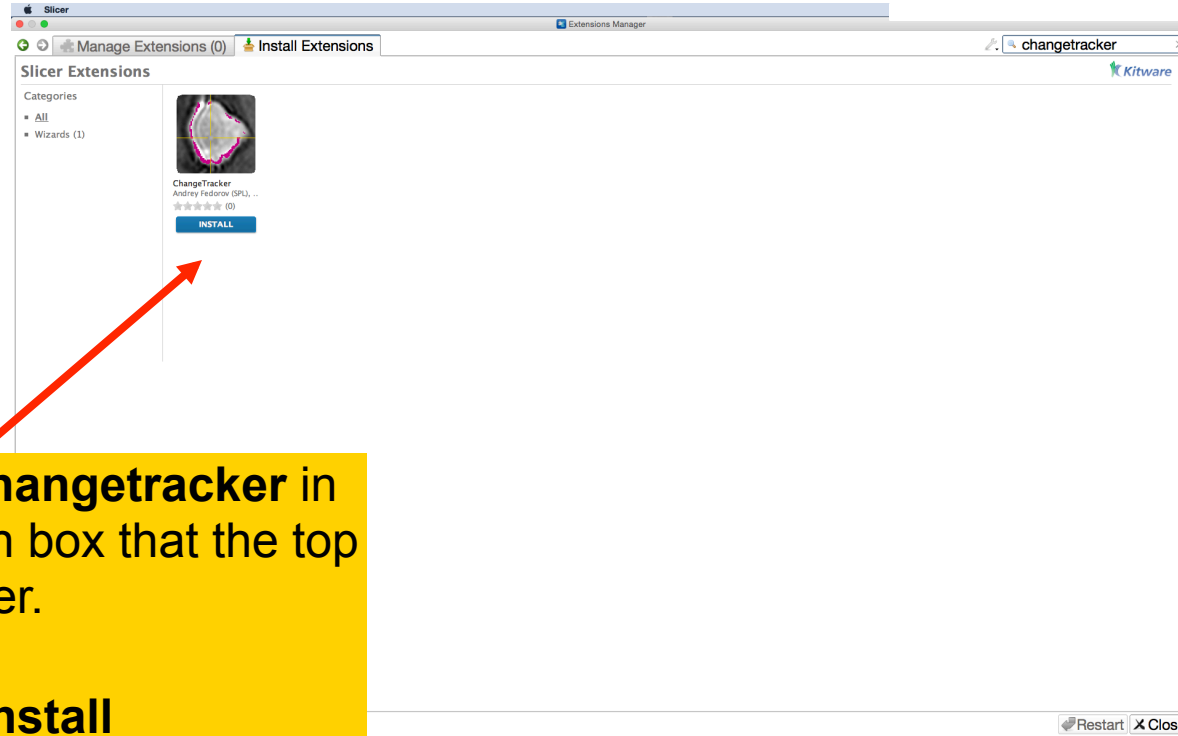
ChangeTracker: exploring small volumetric changes

This screen will appear once you click on the **Extensions Manager** button





ChangeTracker: exploring small volumetric changes

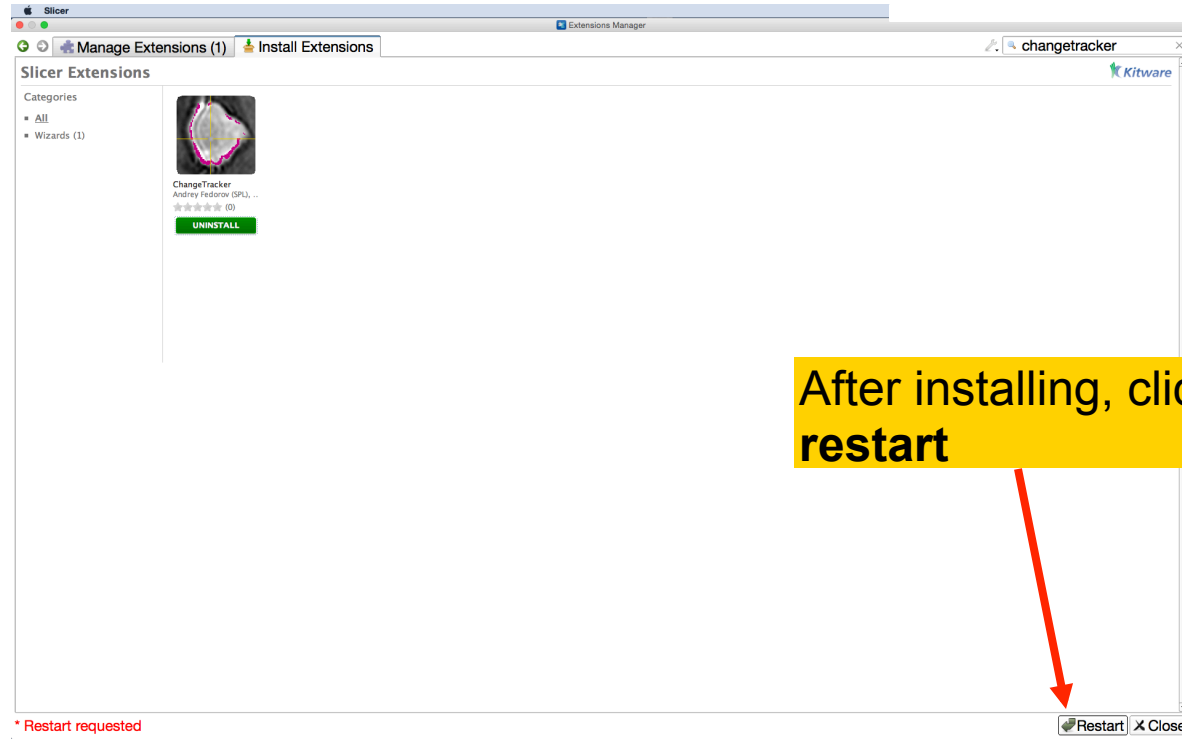


Type in **changetracker** in the search box that the top right corner.

Click on **Install**

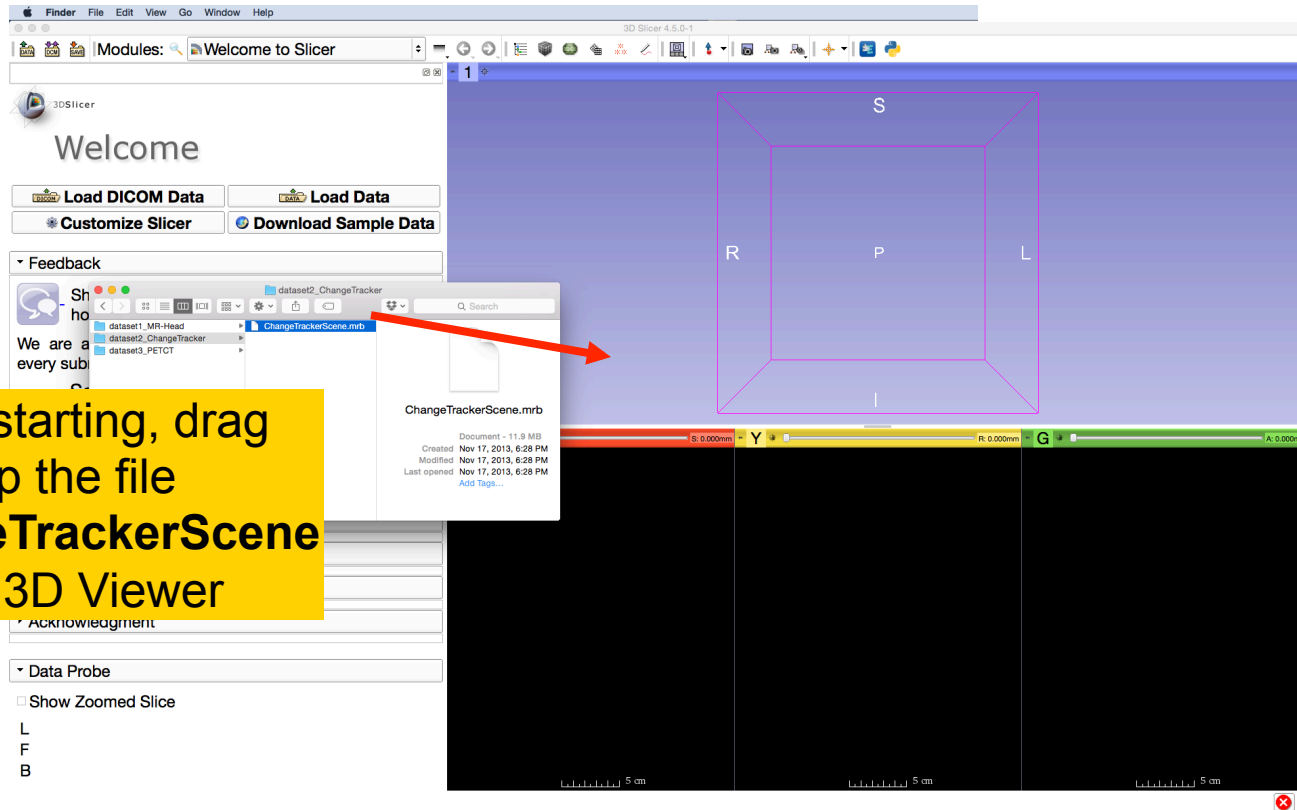


ChangeTracker: exploring small volumetric changes





ChangeTracker: exploring small volumetric changes

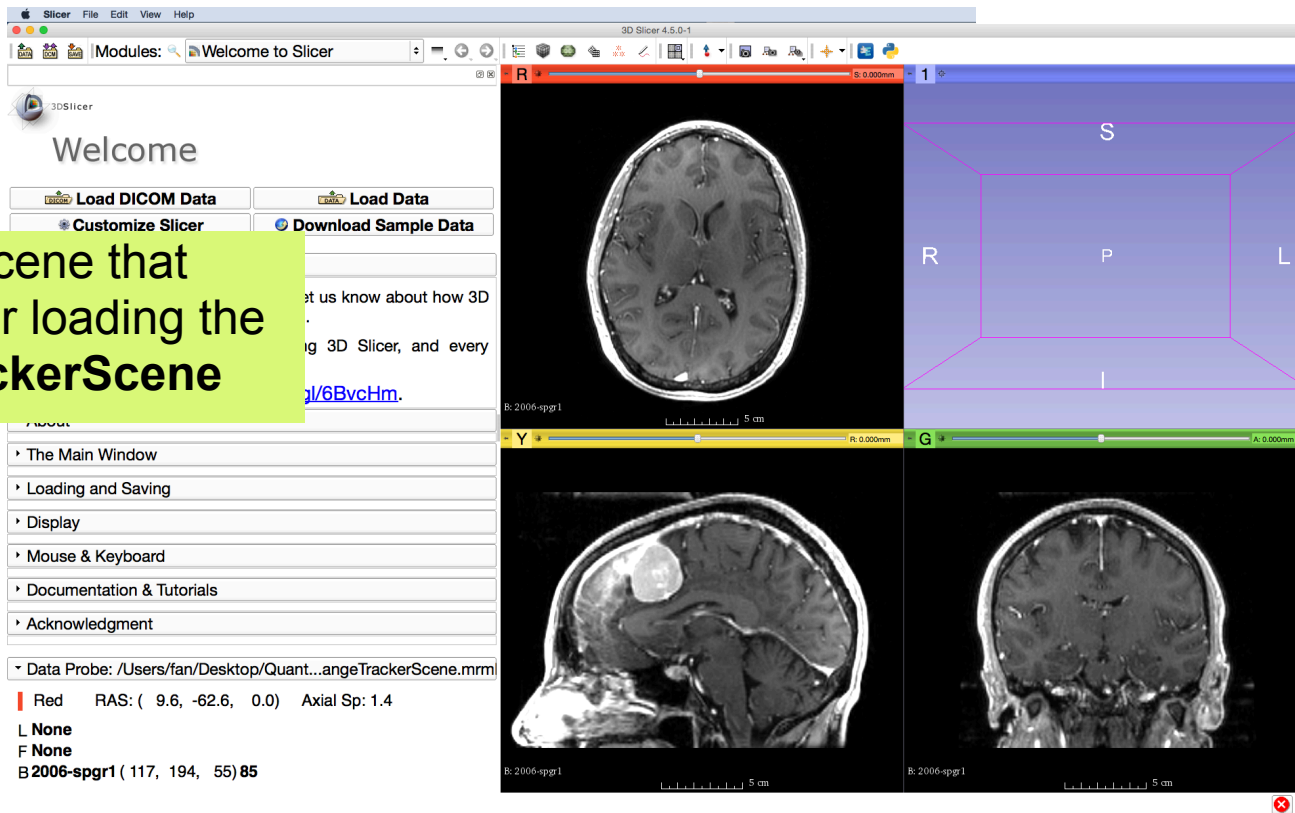


After restarting, drag
and drop the file
ChangeTrackerScene
into the 3D Viewer



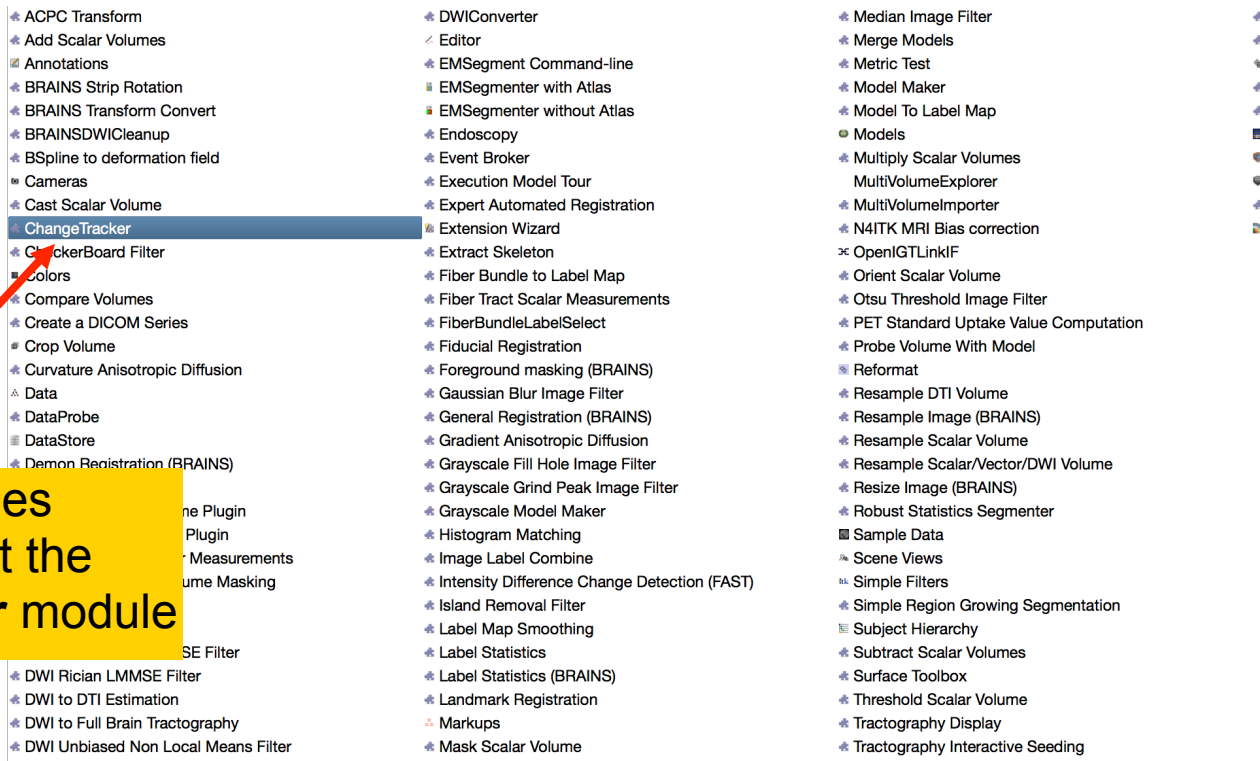
ChangeTracker: exploring small volumetric changes

This is the scene that appears after loading the **ChangeTrackerScene**





ChangeTracker: exploring small volumetric changes



Go to the modules menu and select the **ChangeTracker** module



ChangeTracker: a note about the Workflow wizard

The **Workflow Wizard** guides the user through a sequence of steps and has the following components:

- the Step Panel
- the User Panel
- the Navigation Panel

Step Panel--

User Panel--

"

"

"

Navigation Panel--

3DSlicer

► Help & Acknowledgement

▼ 1. Select input scans

Select the baseline and follow-up scans to be compared.

Load test data

Baseline scan: Select a Volume

Followup scan: Select a Volume

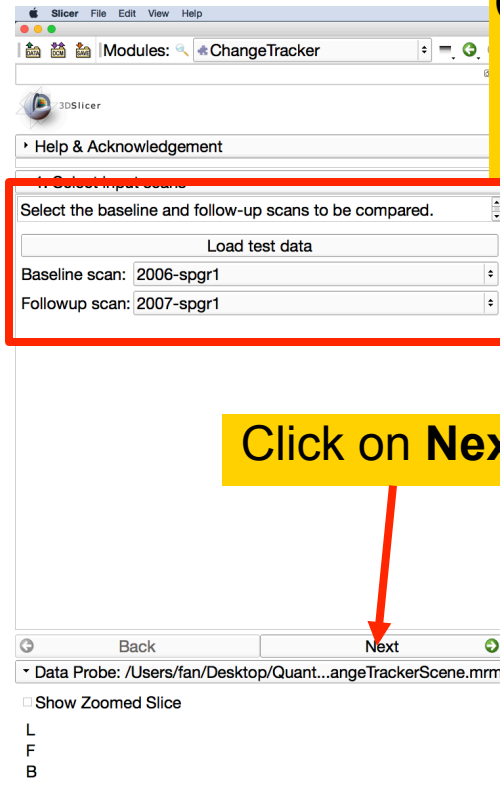
Back Next



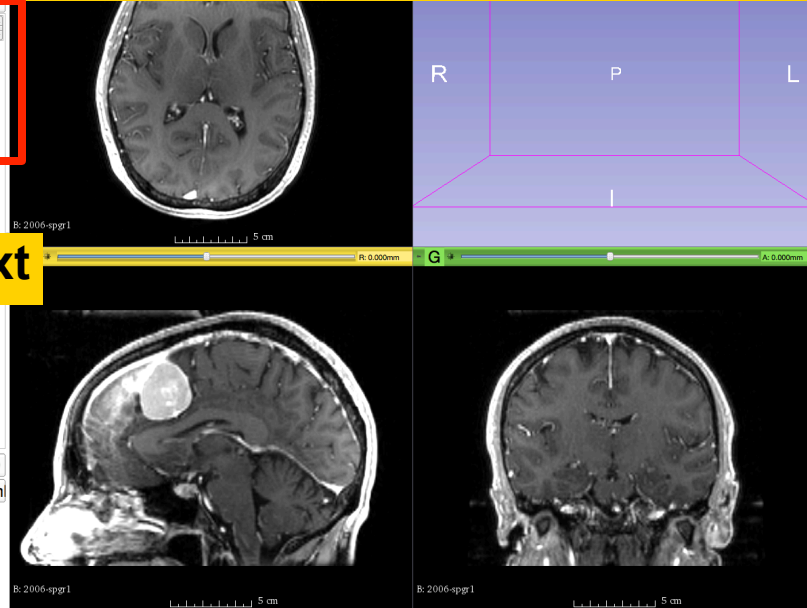
Step1: Select input scans

Click to expand the tab '1.Select input scans'

- Set the **Baseline scan** to 2006-spgr1
- Set the **Follow up scan** to 2007-spgr1



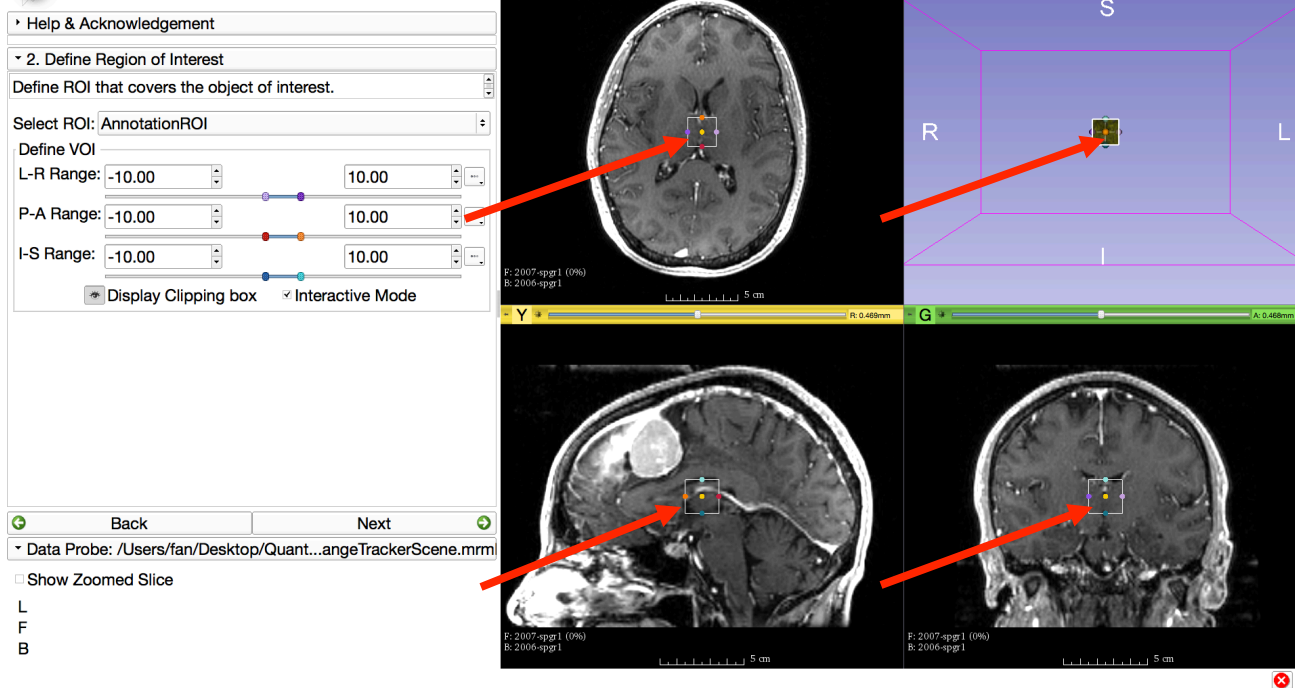
Click on Next





Step2: Define Region of interest

A Volume of Interest (VOI) Box Widget appears in the anatomical viewers, and in the 3D viewer.



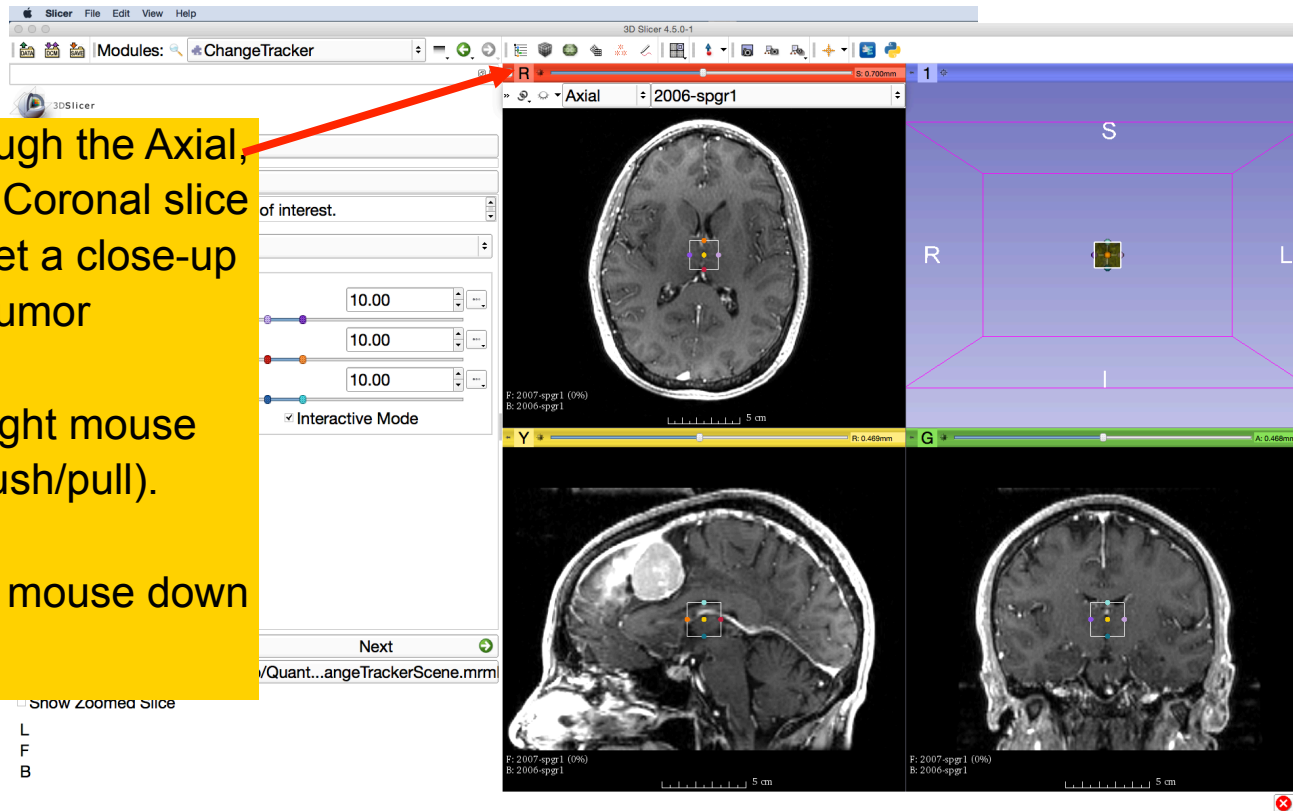


Step2: Define Region of interest

Browse through the Axial, Sagittal and Coronal slice viewers to get a close-up view of the tumor

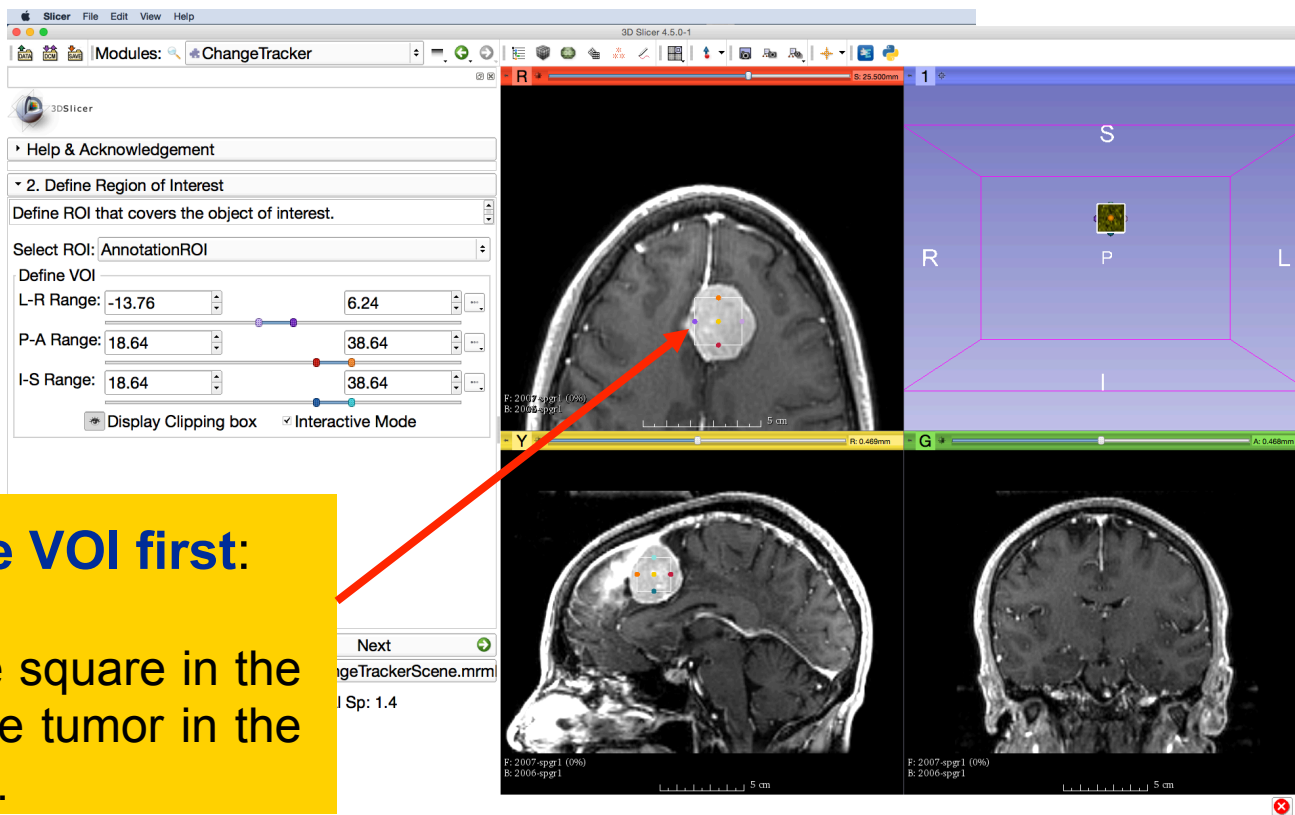
Zoom in (Right mouse down and push/pull).

Pan (Middle mouse down and move)





Step2: Define Region of interest

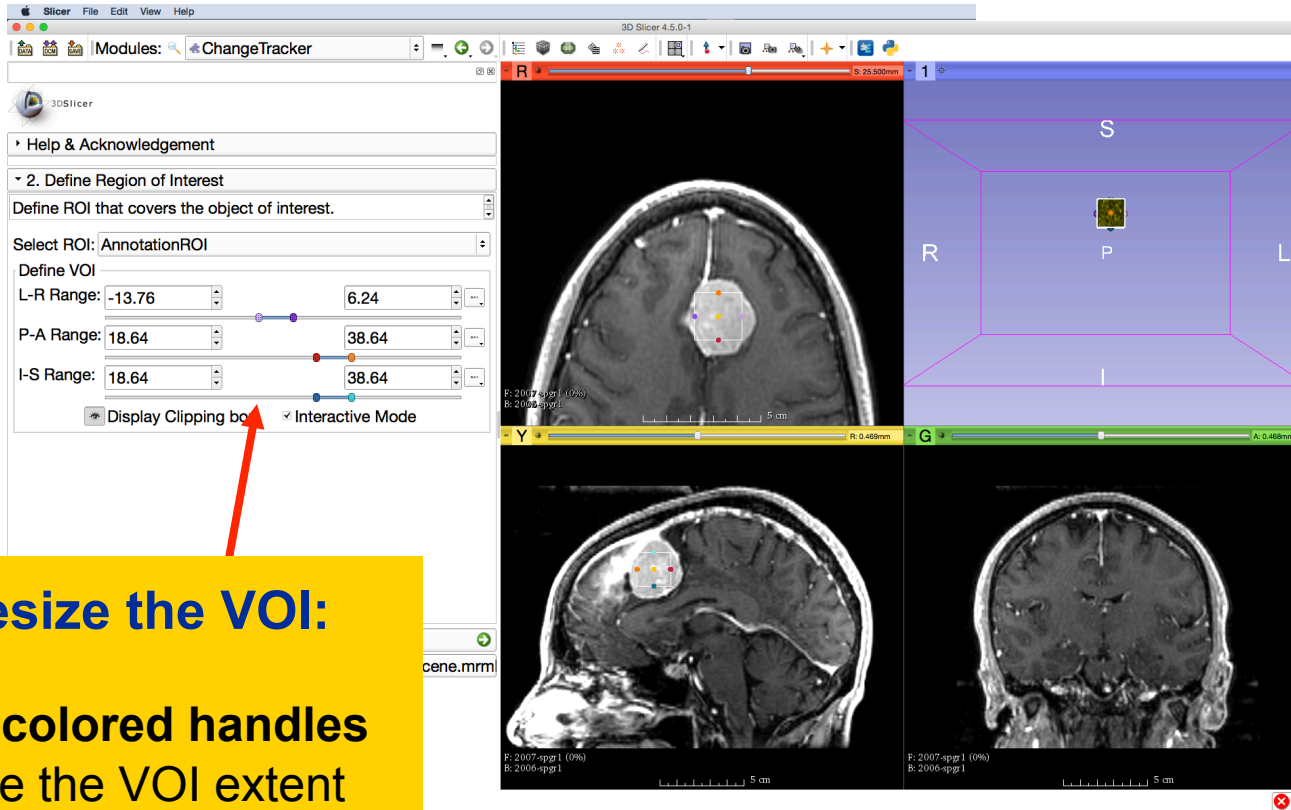


Center the VOI first:

Position the square in the center of the tumor in the slice viewer.



Step2: Define Region of interest



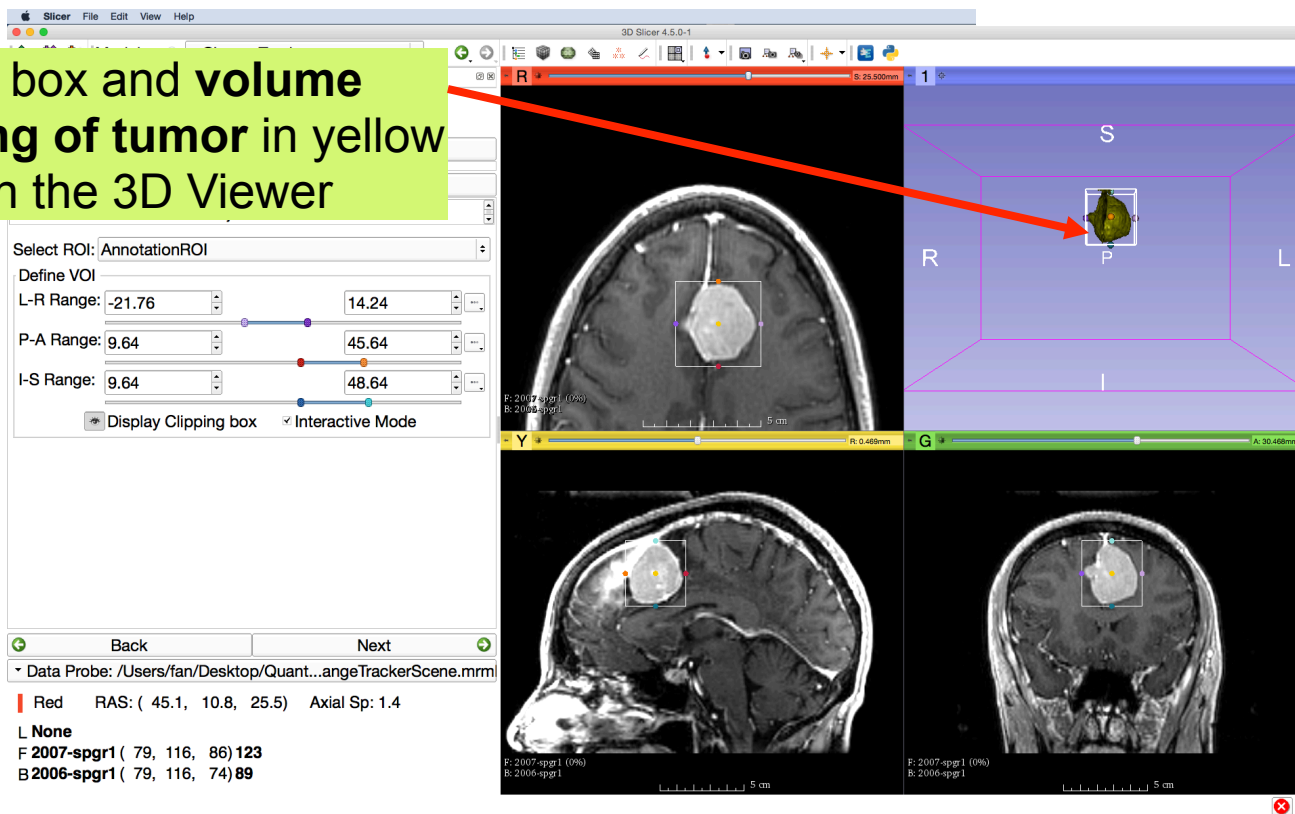
Next, resize the VOI:

**Use the colored handles
to change the VOI extent**



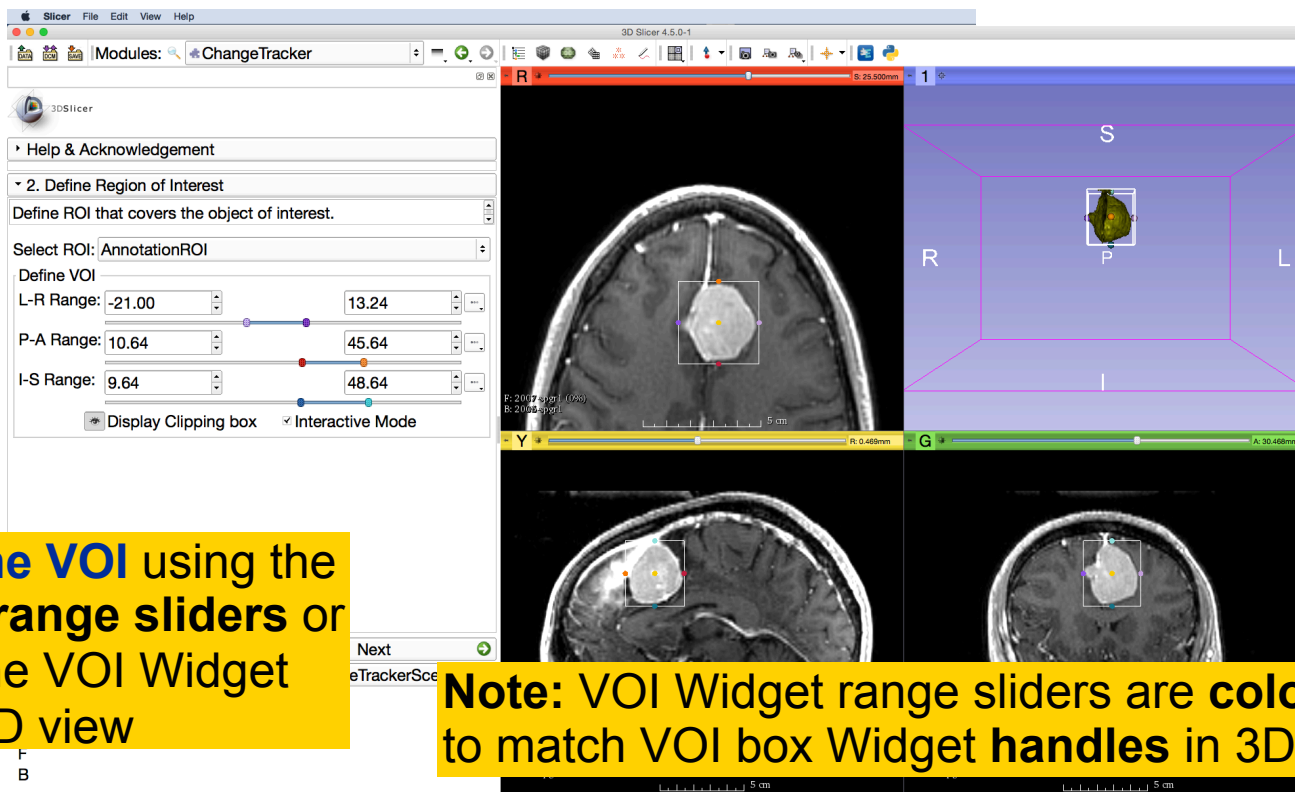
Step2: Define Region of interest

The VOI box and **volume rendering of tumor in yellow** appear in the 3D Viewer





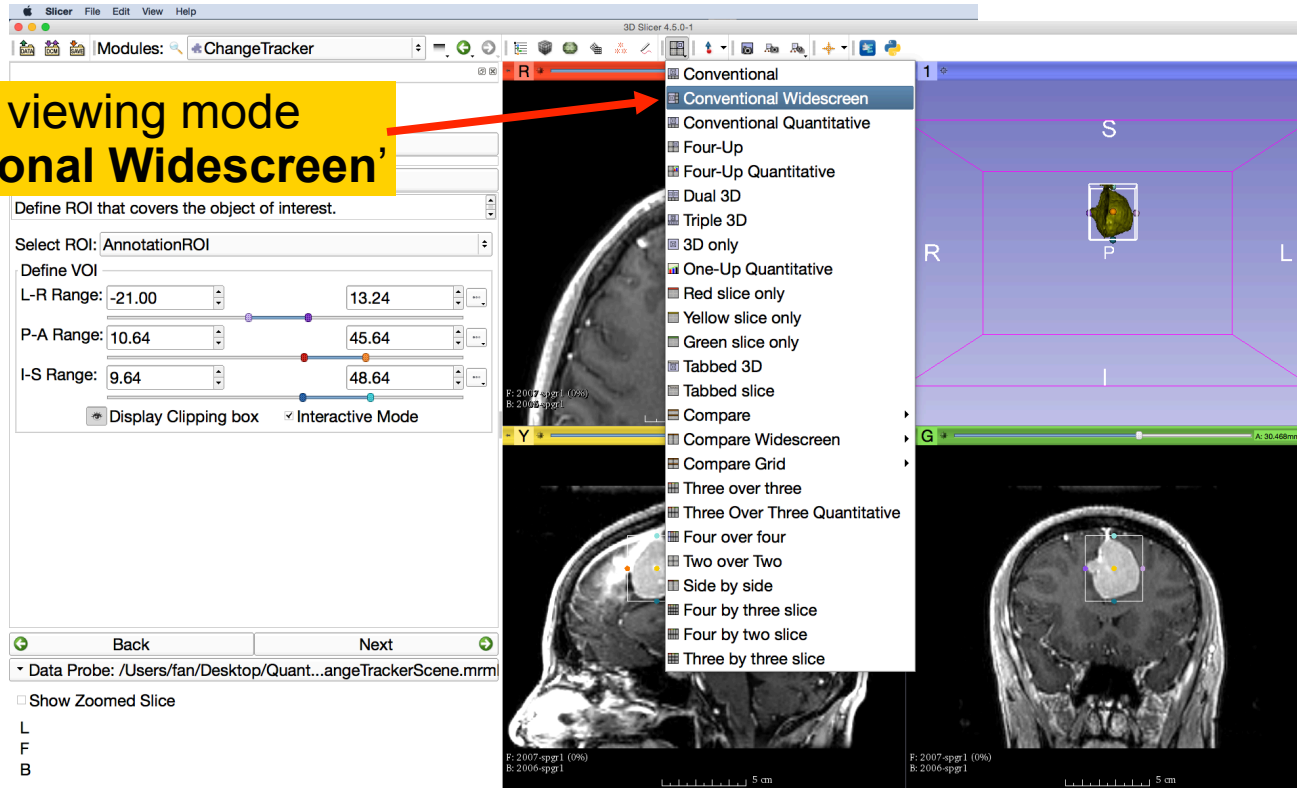
Step2: Define Region of interest





Step2: Define Region of interest

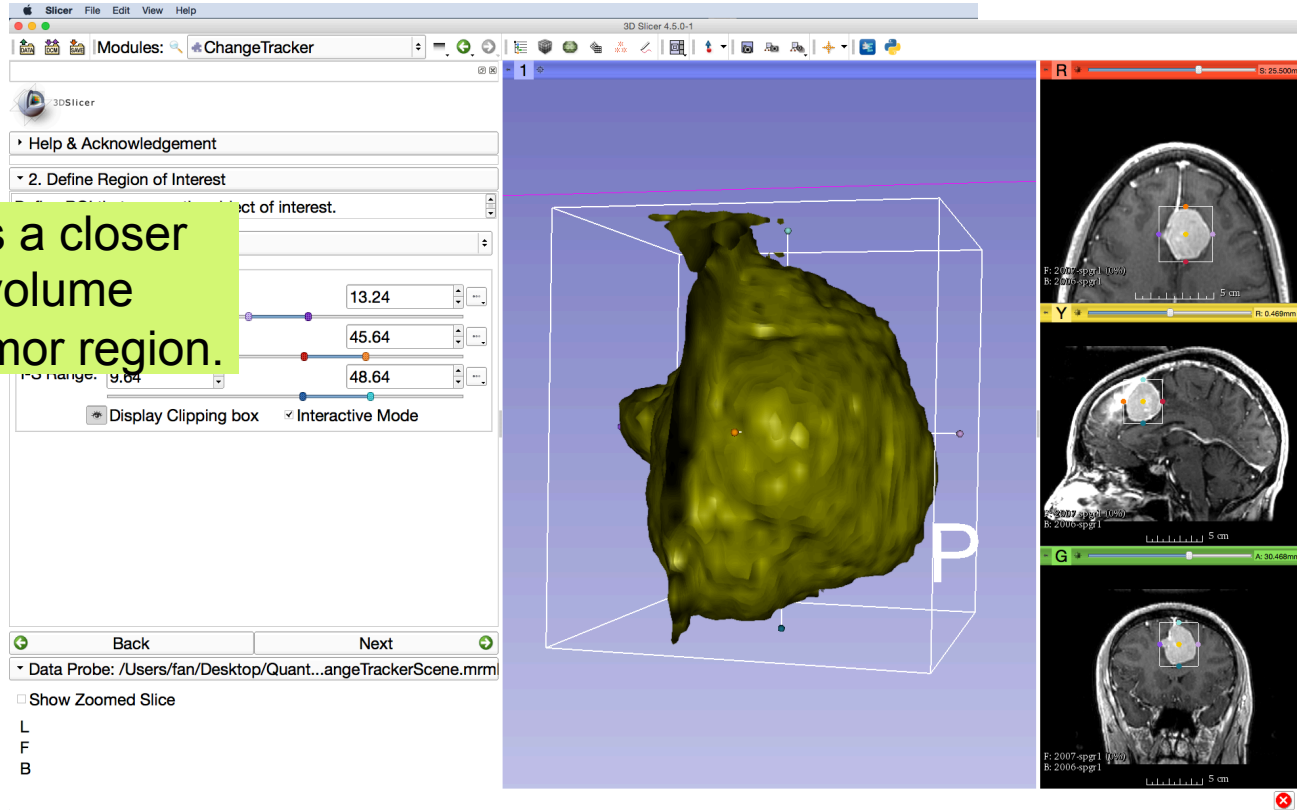
Select the viewing mode
'Conventional Widescreen'





Step2: Define Region of interest

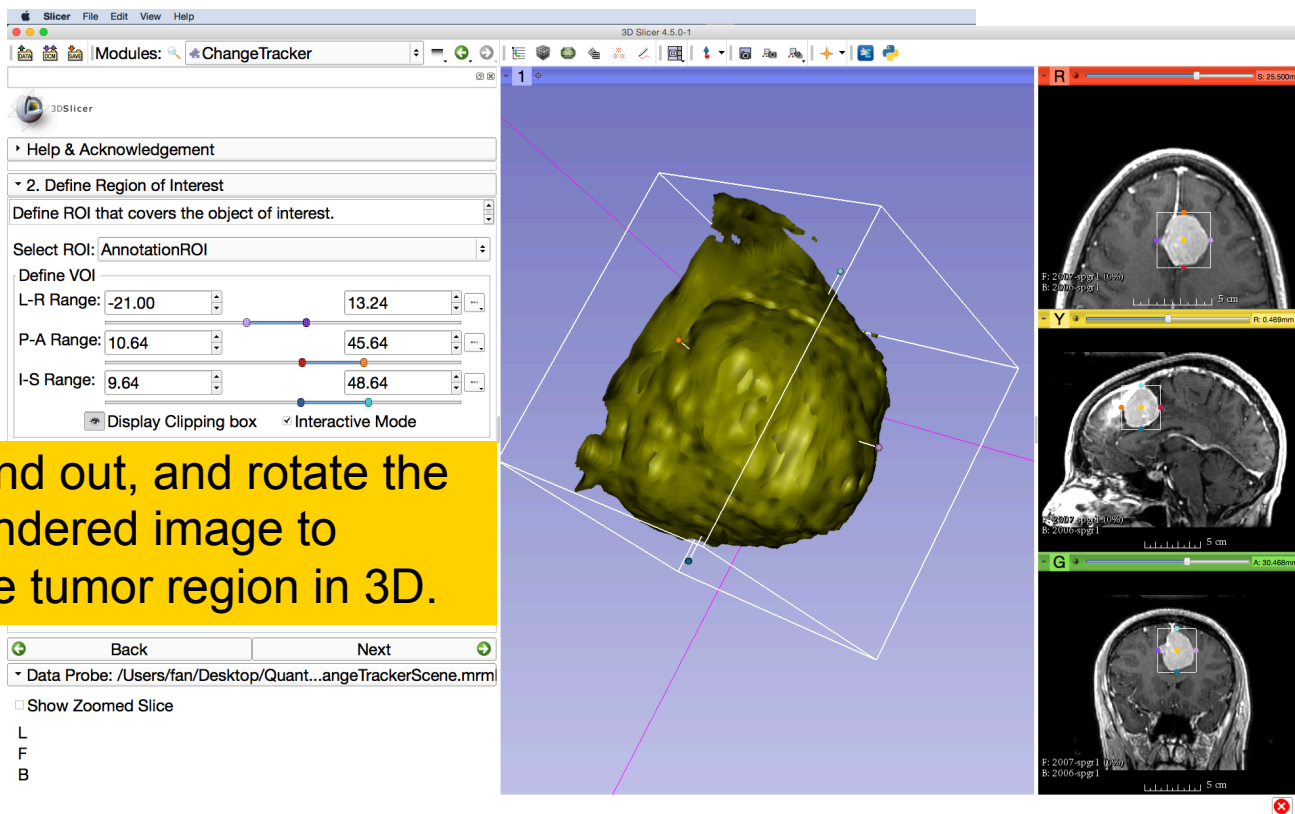
Slicer shows a closer view of the volume rendered tumor region.





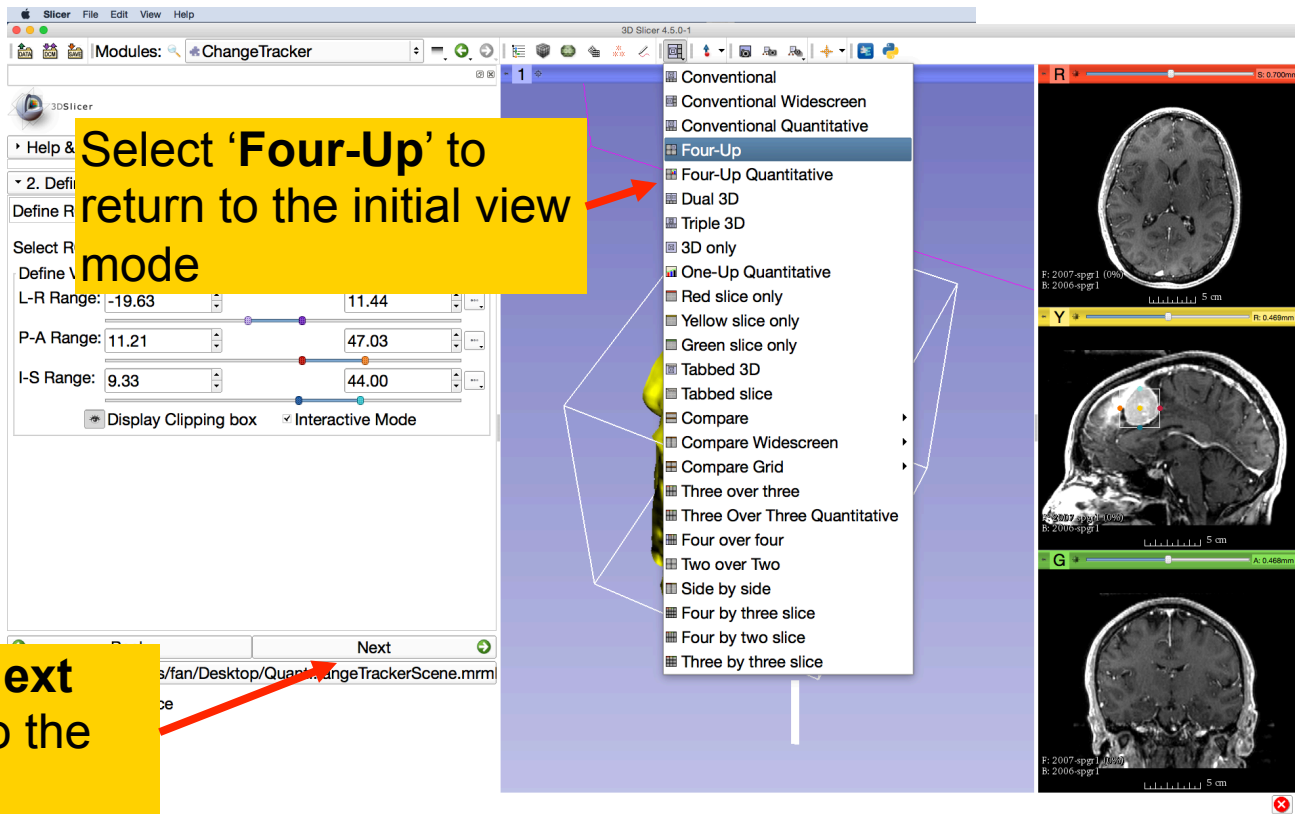
Step2: Define Region of interest

Zoom in and out, and rotate the volume rendered image to explore the tumor region in 3D.





Step2: Define Region of interest





Step3: Segment the tumor

Select the **layout FourUp** in the layout menu to display the volume rendered segmentation

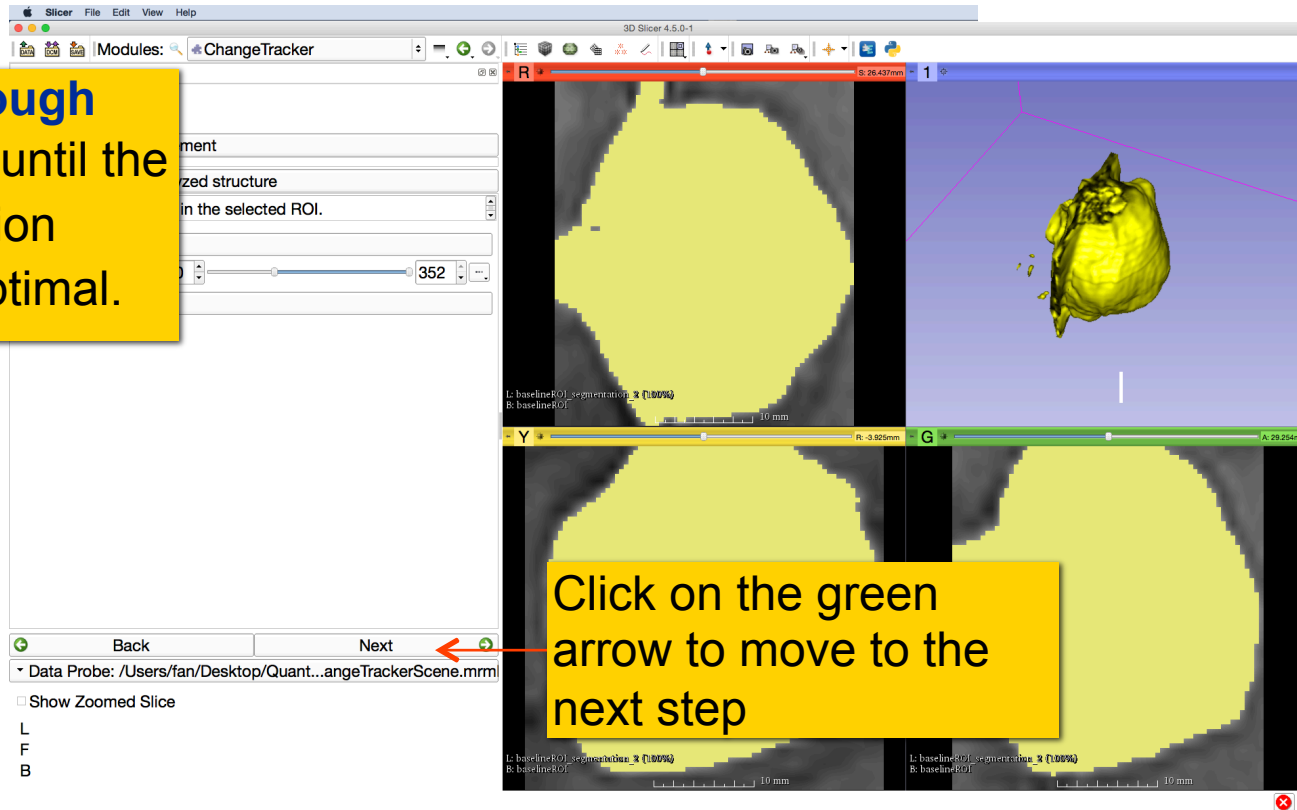
Modify the segmentation of the tumor by moving the **threshold range slider**!

The screenshot shows the 3D Slicer 4.5 interface. The 'ChangeTracker' module is active. The 'Basic settings' section has a 'Choose threshold' slider set to 188, with a red arrow pointing to it. The 'Advanced settings' section is expanded. The 'Data Probe' is set to '/Users/fan/Desktop/Quant...angeTrackerScene.mrm'. The 'Show Zoomed Slice' checkbox is checked. The 'L', 'F', and 'B' checkboxes are also checked. The main view displays a 3D volume rendering of the segmented tumor (yellow) and a 2D slice view of the tumor (yellow) on a grayscale background. A red arrow points to the 'Layout FourUp' option in the layout menu.



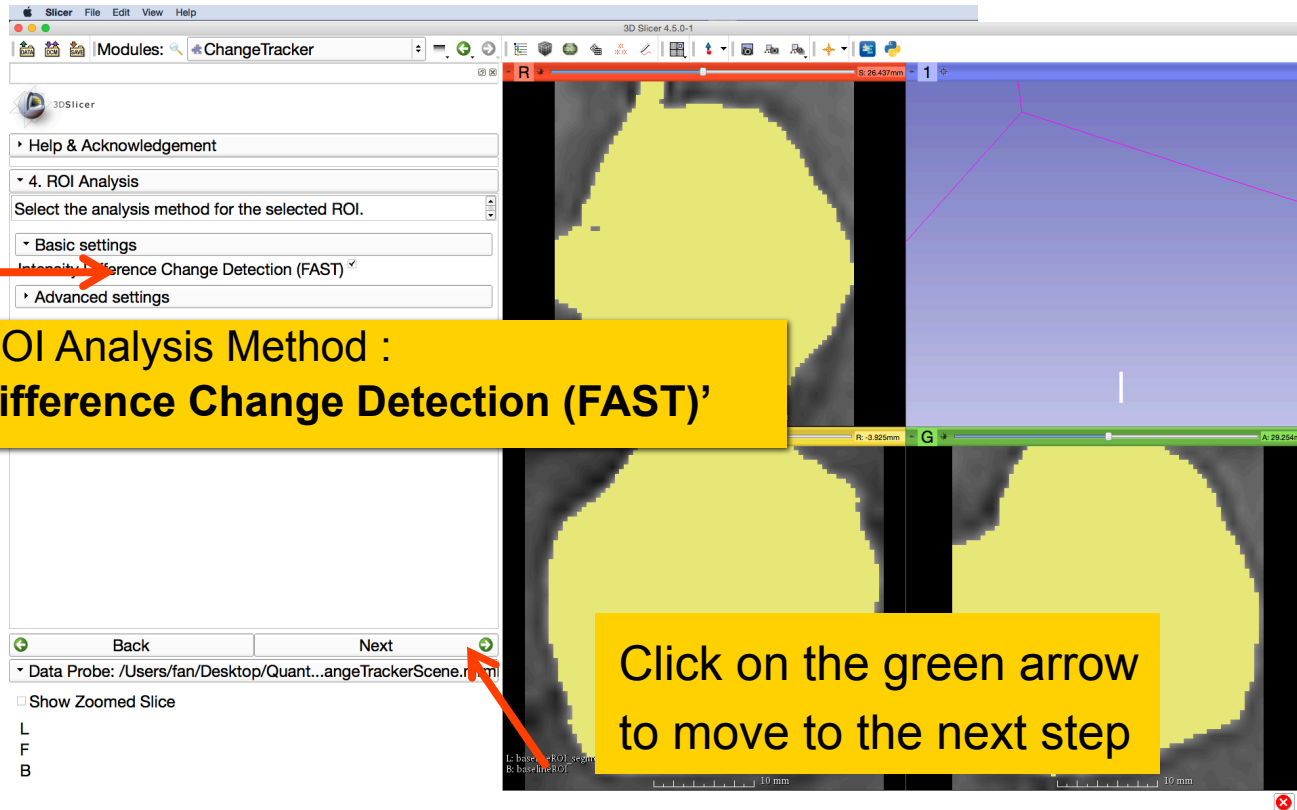
Step3: Segment the tumor

Scroll through the slices until the segmentation appears optimal.



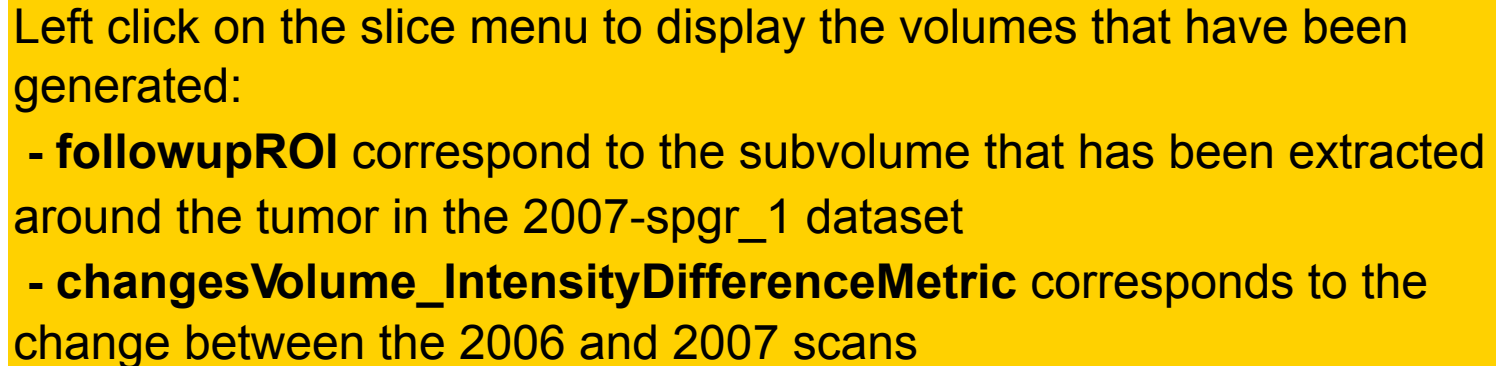


Step4: Select the Analysis Method



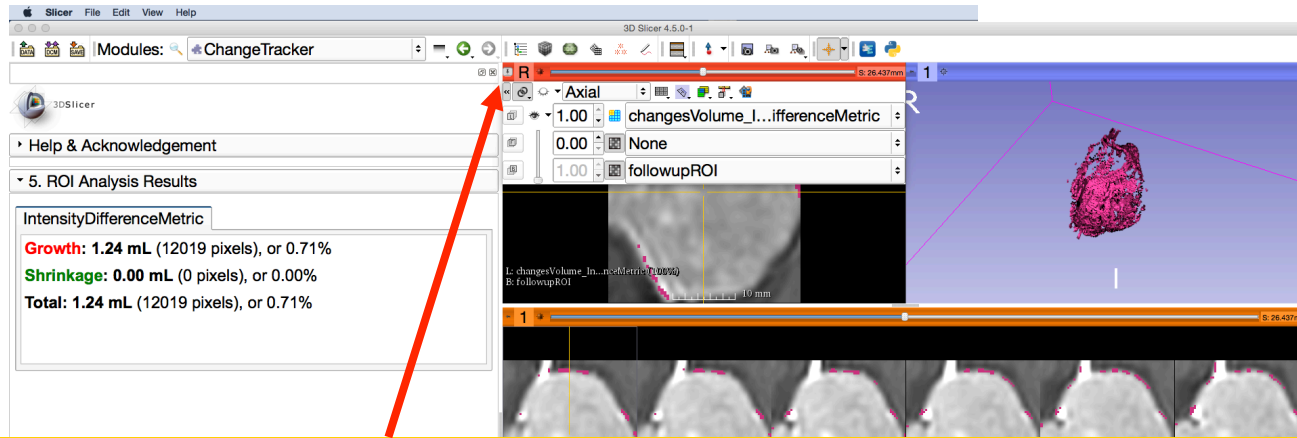
Select the ROI Analysis Method :
'Intensity Difference Change Detection (FAST)'

Click on the green arrow
to move to the next step






Step4: Select the Analysis Method

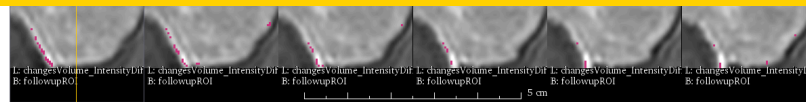


Click on links icon in the Red Slice Viewer menu to link all three viewers.

Click on the  icon to adjust the size of the image to the size of the window, and browse through the slices to display the images

☐ Show Zoomed Slice

L
F
B



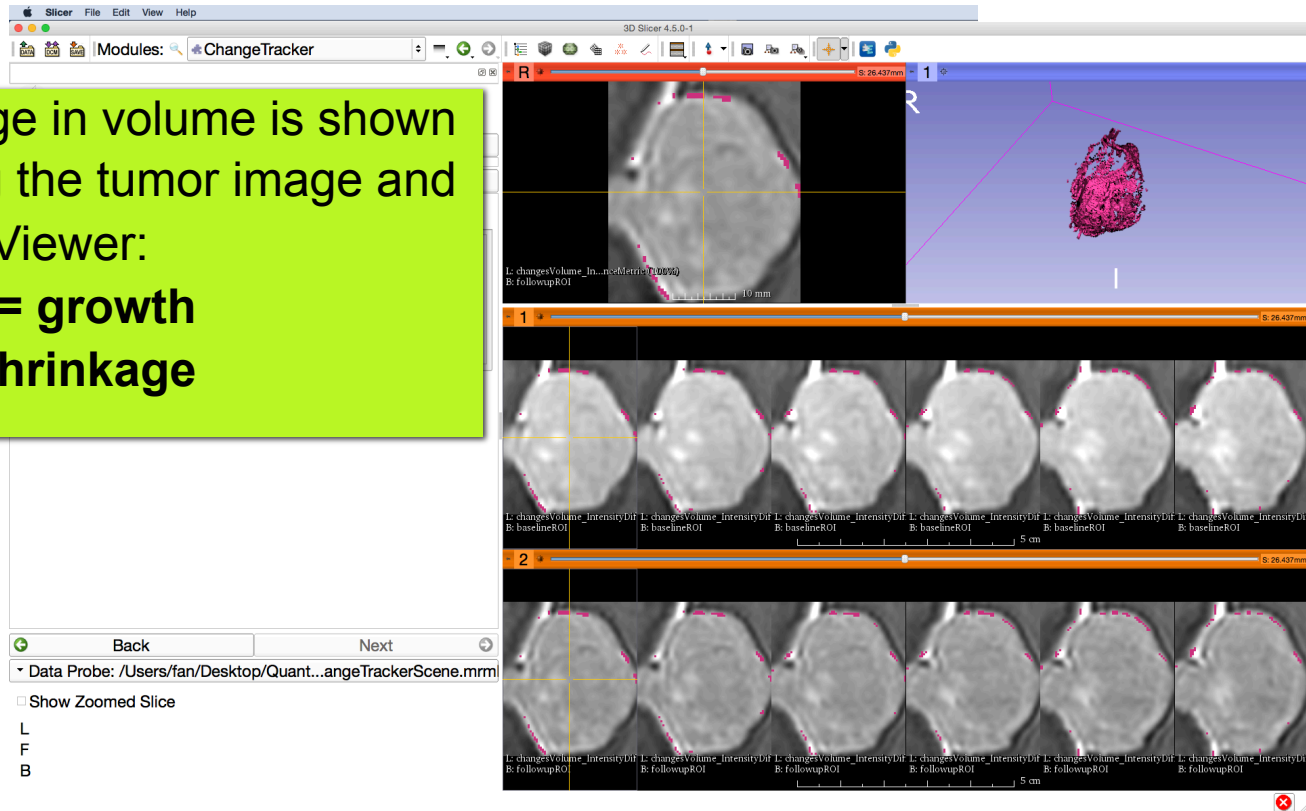


Final Step: Change Tracker Results

The change in volume is shown
overlaying the tumor image and
in the 3D Viewer:

magenta = growth

green = shrinkage

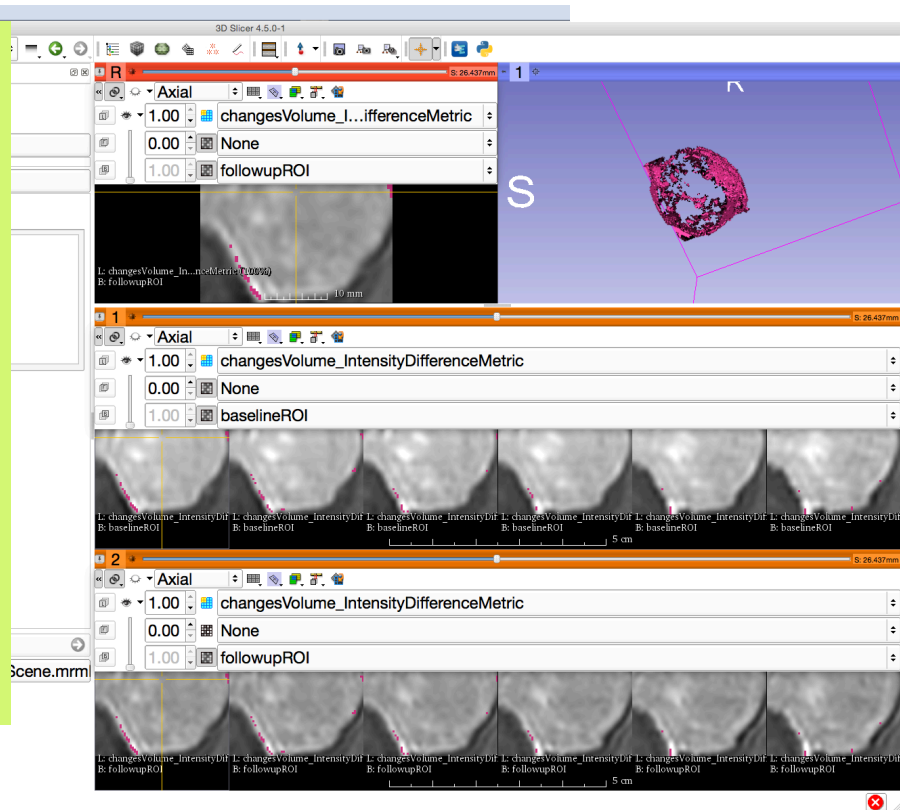




Visualization of the change in pathology

The results of the analysis are displayed in the “**Compare View**” layout

- Six consecutive slices for the VOI in Scan1 (**top row**), and
- Six corresponding consecutive slices for the VOI in Scan2 (**bottom row**).
- A zoomed view of the axial slice in the red slicer viewer





Visualization of the change in pathology

The **Crosshairs** in Compare View show corresponding voxels in **Scan1** and **Scan2** for voxel-wise comparison.

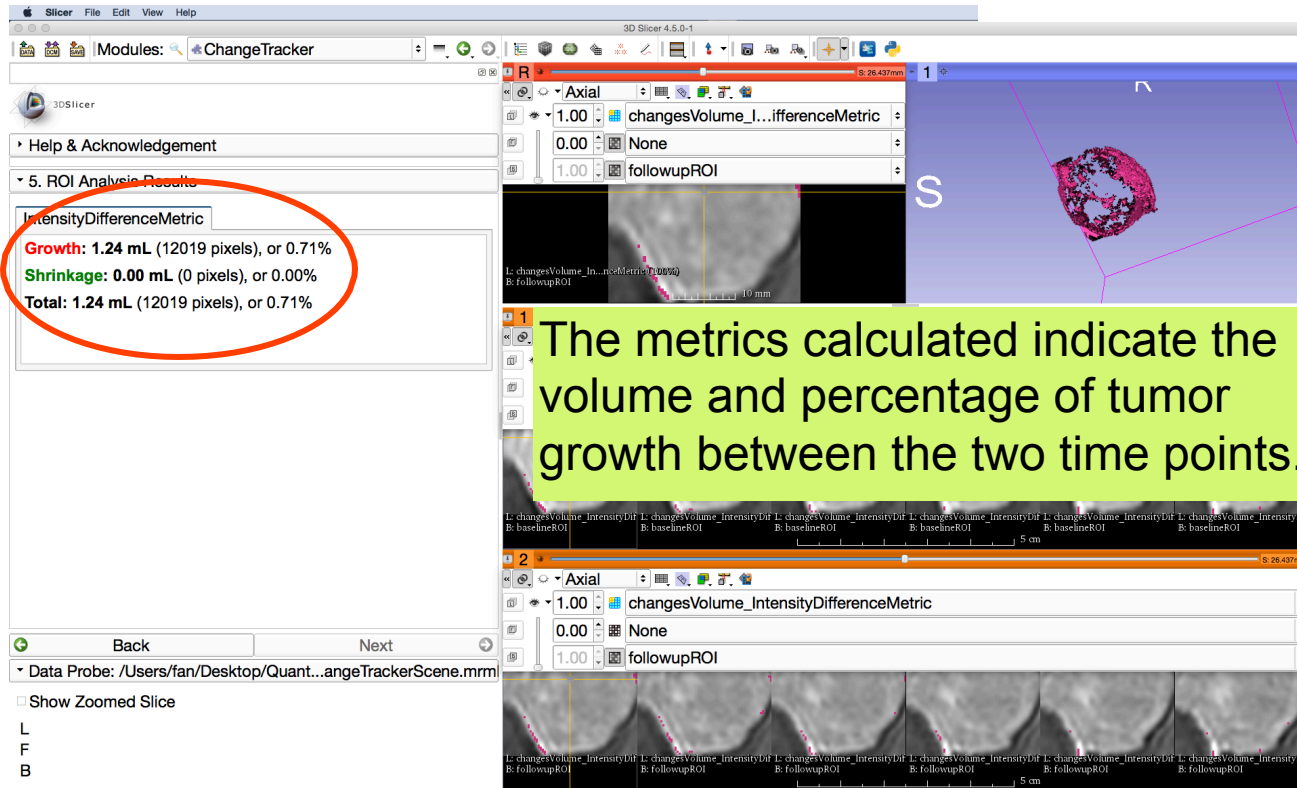
The screenshot displays the 3D Slicer software interface. On the left, the '5. ROI Analysis Results' panel shows the following data for the 'IntensityDifferenceMetric':

- Growth:** 1.24 mL (12019 pixels), or 0.71%
- Shrinkage:** 0.00 mL (0 pixels), or 0.00%
- Total:** 1.24 mL (12019 pixels), or 0.71%

The main window shows the 'Compare View' with two axial slices (1 and 2) of a brain scan. The top slice (1) shows a 3D model of the brain with a red ROI. The bottom slice (2) shows a 3D model of the brain with a red ROI. The crosshairs in the Compare View indicate corresponding voxels in Scan1 and Scan2 for voxel-wise comparison.



Change Tracker Results





Change Tracker module

- This tutorial demonstrated the use of the change tracker module in Slicer on axial 3D SPGR T1 post Gadolinium scans
 - **Tumor boundary should be clear**
 - **Only for contrast enhanced images**
 - **Need homogenous enhancement across timepoints.**
- The Change Tracker module has not been tested for tumors with changing necrosis.



ChangeTracker: Exploring small volumetric changes

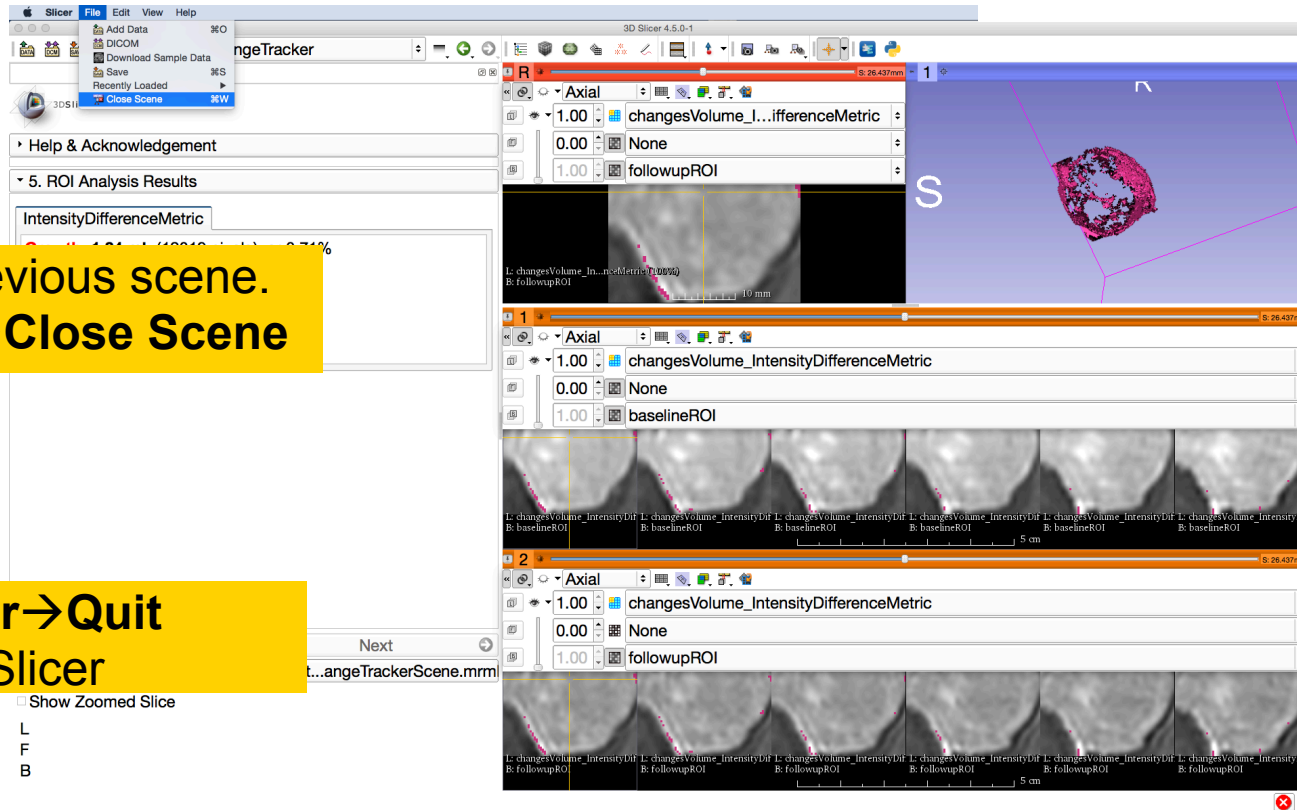
This tutorial demonstrated:

- a method to quantify small volumetric changes in pathology.
- visualization of these changes in the anatomical context
- use of Slicer's “**Compare Viewer**” to simultaneously explore
- baseline and followup studies.

Next, we will demonstrate combined visualization of PET/CT studies and SUV computation.



Clear the scene and its data

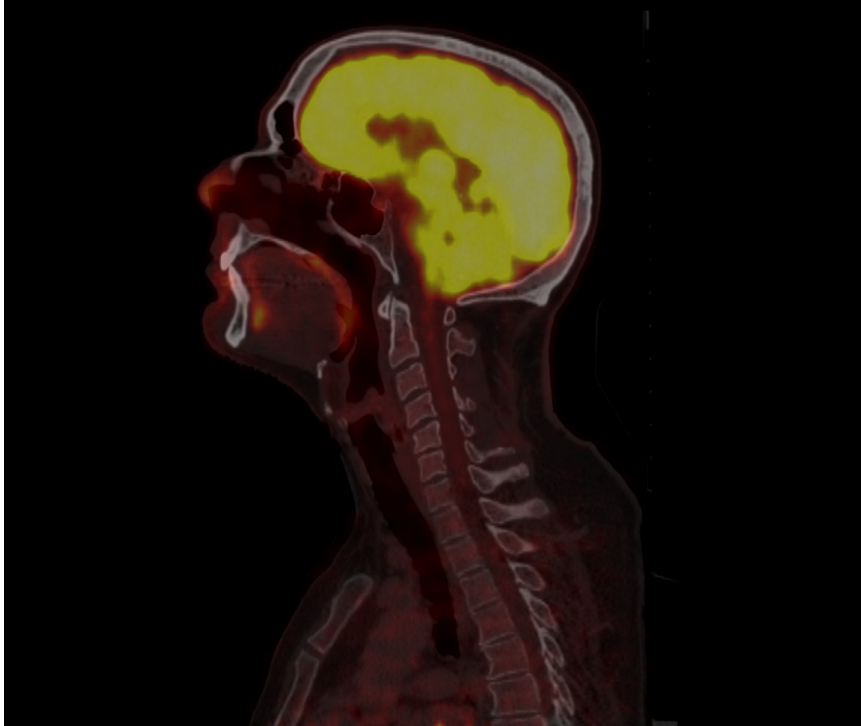


Clear the previous scene.
Select **File**→**Close Scene**

Select **Slicer**→**Quit**
and restart Slicer



PET/CT Visualization and Analysis

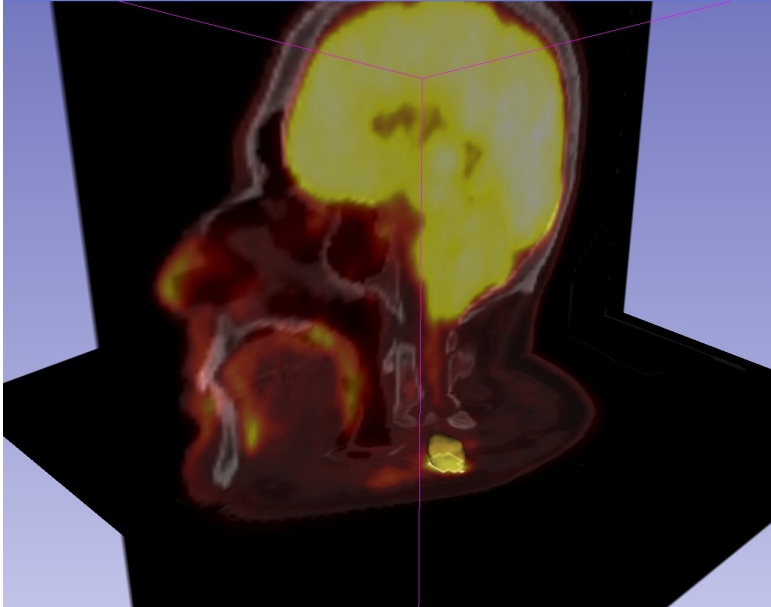


Part II: PET/CT Analysis

Sonia Pujol, PhD
Kitt Shaffer, MD, PhD
Hatsuho Mamata, MD, PhD
Ron Kikinis, MD



Goal of the tutorial



The goal of this tutorial is to guide you step-by-step through the SUV computation of PETCT data of a squamous cell carcinoma case pre- and post-treatment



FDG-PET SUV

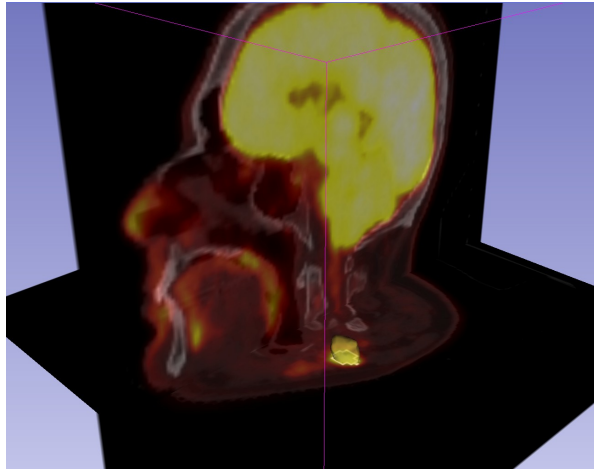
- Standardized Uptake Value (SUV) is a semi-quantitative measure derived from the determination of tissue activity obtained from a clinical PET study

$$\text{SUV} = \frac{\text{Tissue Concentration of Radioactive Tracer} \times \text{Patient Weight}}{\text{Injected Dose}}$$

- Under certain circumstances, 18-F Fluorodeoxyglucose (FDG) SUV correlates with metabolic rate of glucose and/or the number of viable tumor cells



Tutorial Case



- Pathology: poorly differentiated squamous cell carcinoma
- Treatment: radiotherapy and chemotherapy (weekly cis-platin)
- Two ^{18}F -FDG PET and CT scans acquired within a 5-month interval.



PETCT tutorial: Clinical Case and Data

The datasets are located in

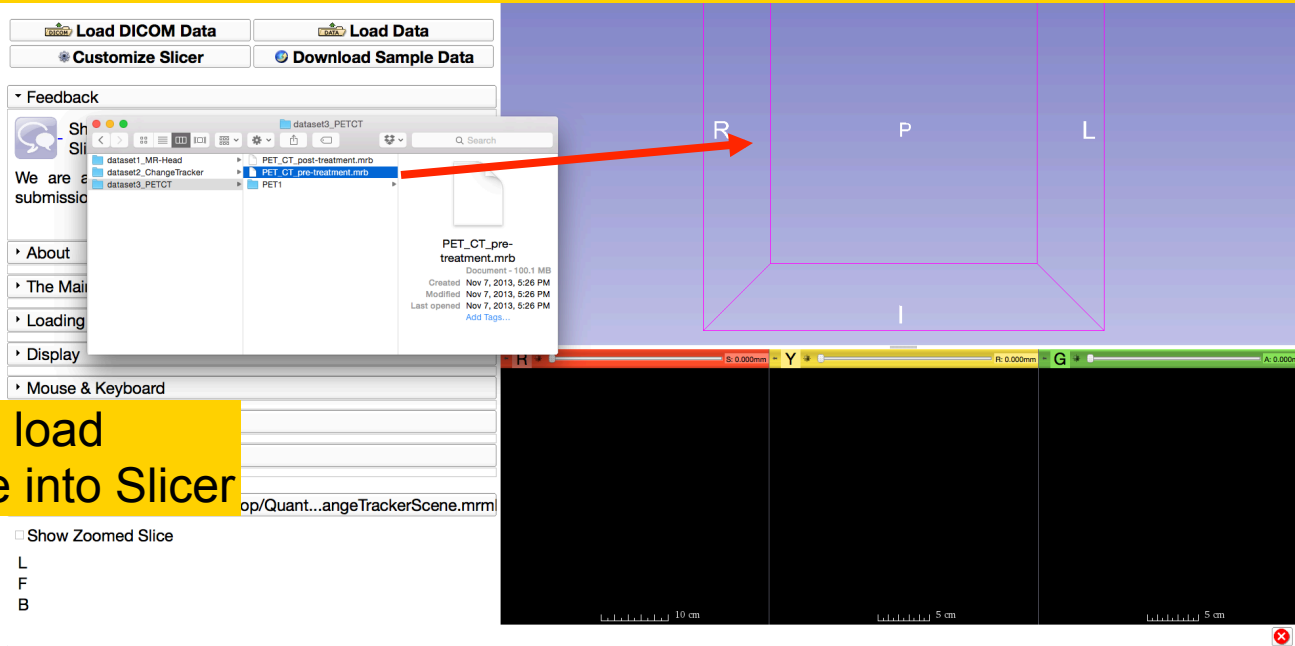
`QuantitativeImaging/dataset3_PETCT`

- **PETCT1 dataset** is located in the **pre-treatment directory** corresponds to the baseline
- **PETCT2 dataset** is located in the **post-treatment directory** corresponds to the follow-up scan.



Loading the PETCT scene

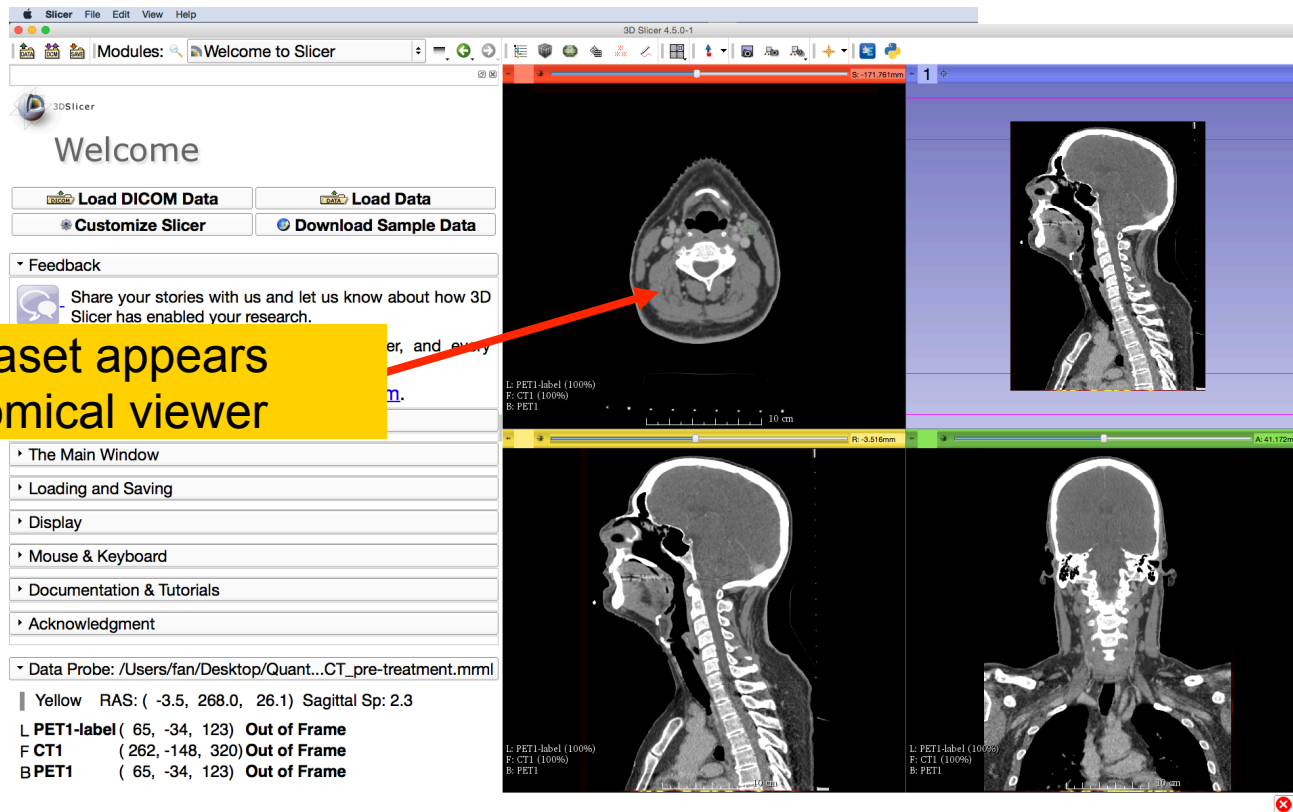
Drag and drop the file **PETCT_pre-treatment.mrb** located in **/Users/Desktop/QuantitativeImaging\dataset3_PETCT**



Click OK to load the .mrb file into Slicer

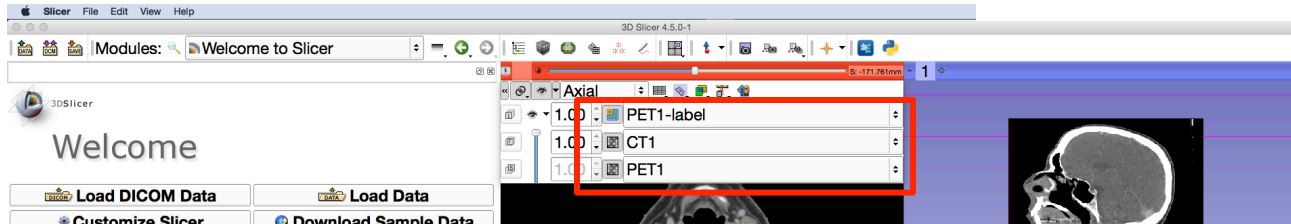


Loading the PETCT scene





Loading a PETCT dataset



Left click on the pin icon in the top left corner to display the red slice viewer menu.

The **CT1** volume is displayed in the Foreground viewer

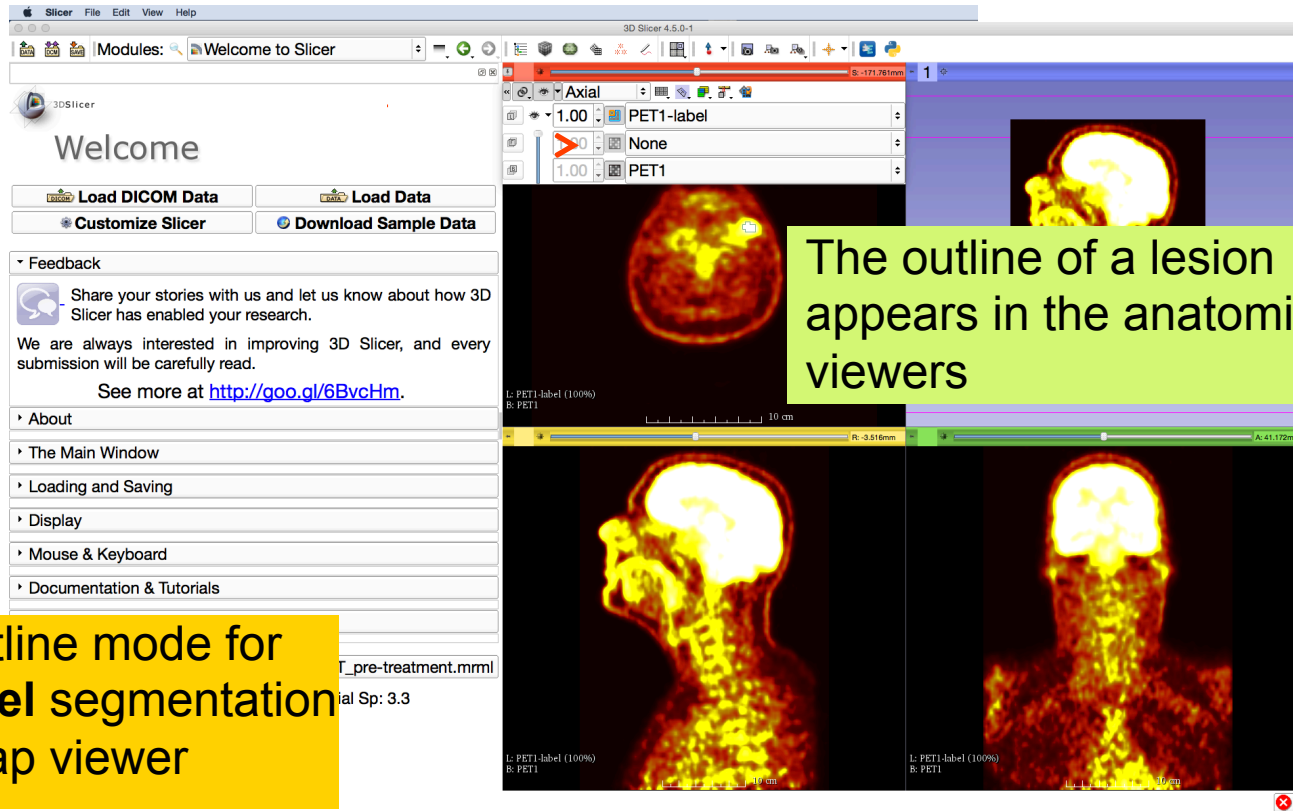
The **PET1** volume is displayed in the Background viewer

The **PET1-Label** is displayed in the Labelmap viewer

Use the slider to fade between the Bg viewer and the Fg viewer to display the PET volume overlaid on the CT volume

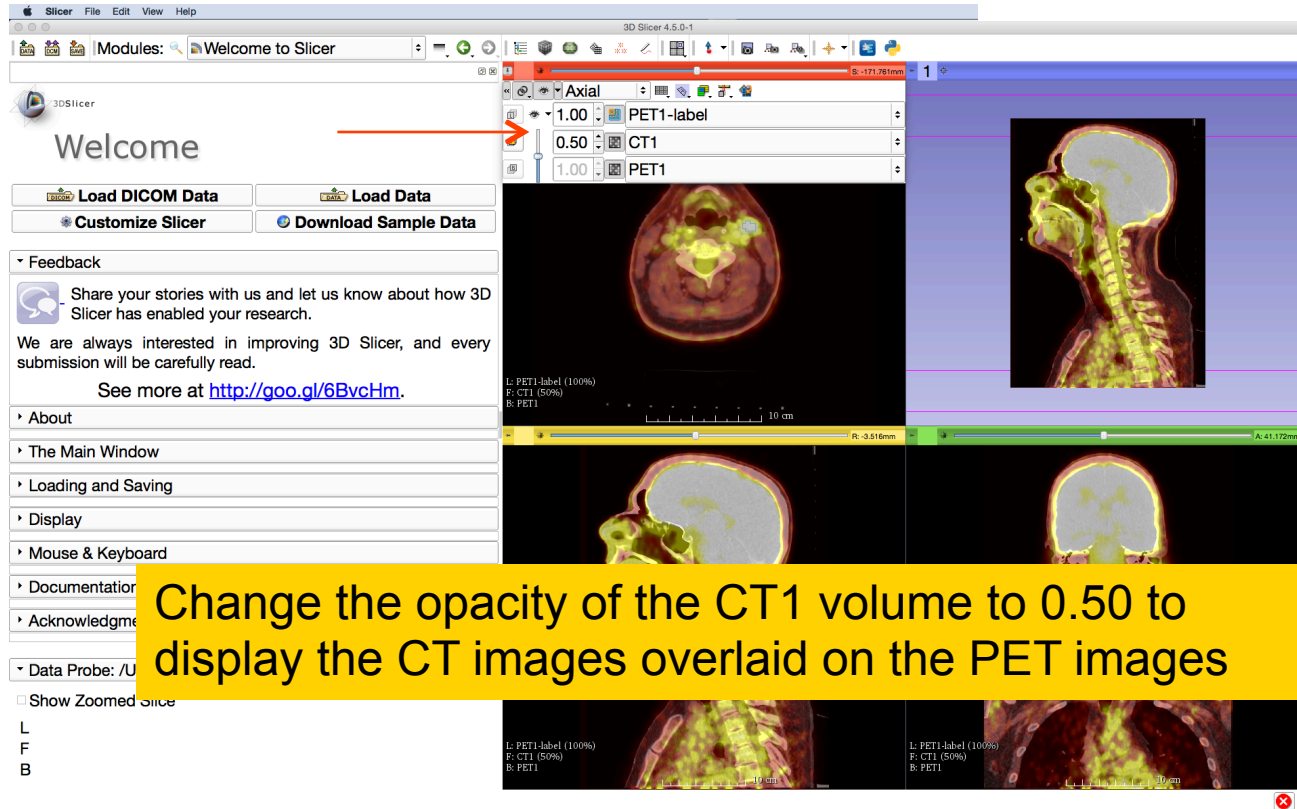


Visualization of PETCT data






Visualization of PETCT data





Visualization of PETCT data

Check on the slice visibility icon  in the red and yellow viewers to display the axial and sagittal slices in the 3D viewer

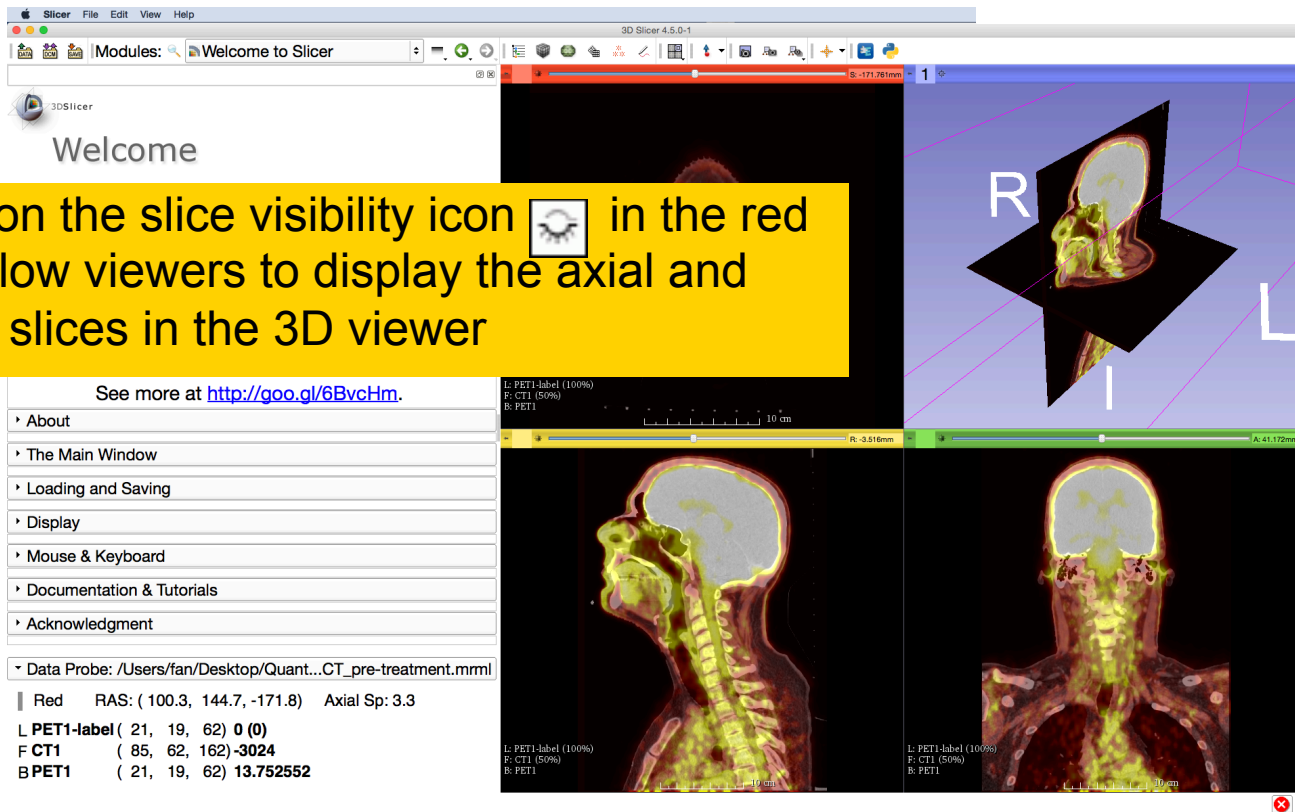
See more at <http://goo.gl/6BvcHm>.

- About
- The Main Window
- Loading and Saving
- Display
- Mouse & Keyboard
- Documentation & Tutorials
- Acknowledgment

▾ Data Probe: /Users/fan/Desktop/Quant...CT_pre-treatment.mrml

|| Red RAS: (100.3, 144.7, -171.8) Axial Sp: 3.3

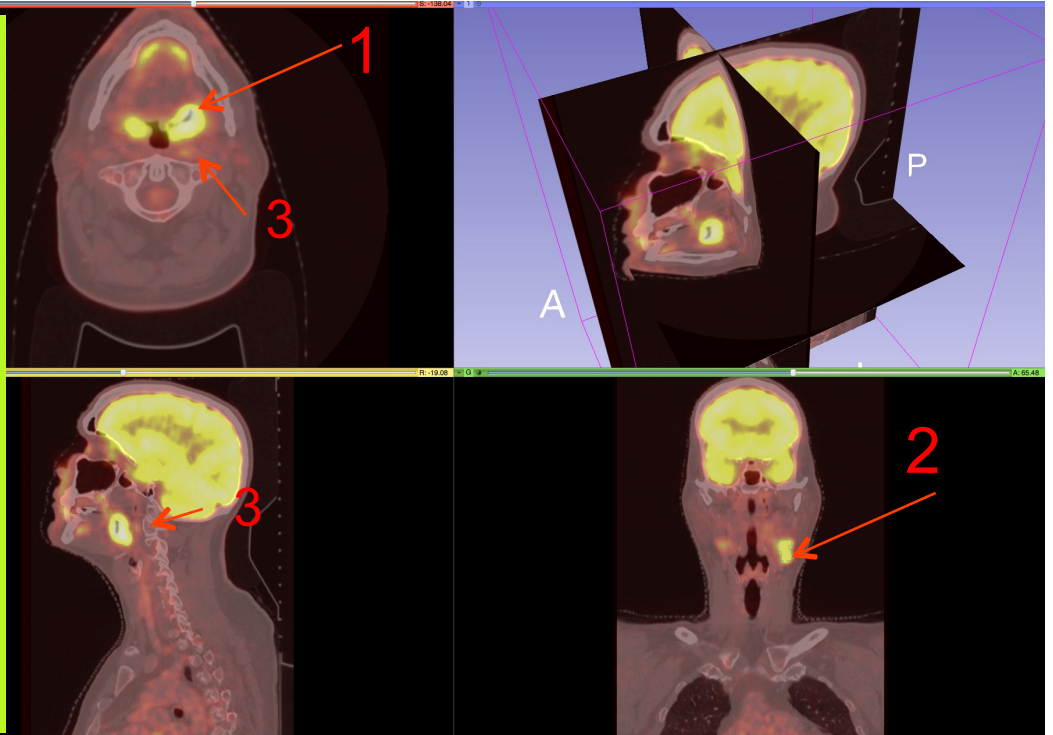
L PET1-label (21, 19, 62) 0 (0)
F CT1 (85, 62, 162) -3024
B PET1 (21, 19, 62) 13.752552





PET uptake findings

Note an intense uptake in
1) left oropharyngeal mass
involving the base of tongue
and left glossotonsillar
fossa and,
2) in left level IIA/III lymph
nodes as well as a small
adjacent left level III node.
3) a possible small
metastasis in the left
retropharyngeal region at
level of C1

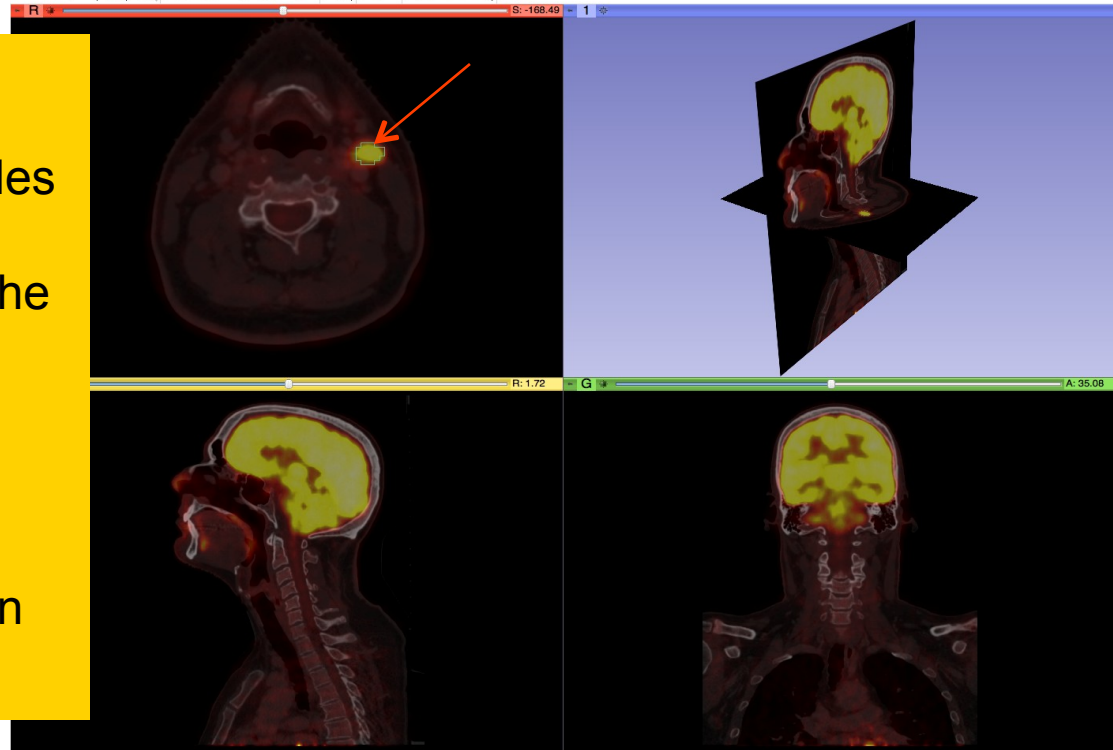




PET SUV Computation

For the purpose of this tutorial, we have pre-segmented the lymph nodes uptake region. In the next section, we will compute the SUV for this area.

Select the module **PET Standard Uptake Value Computation** in the category **Quantification** in the modules' menu





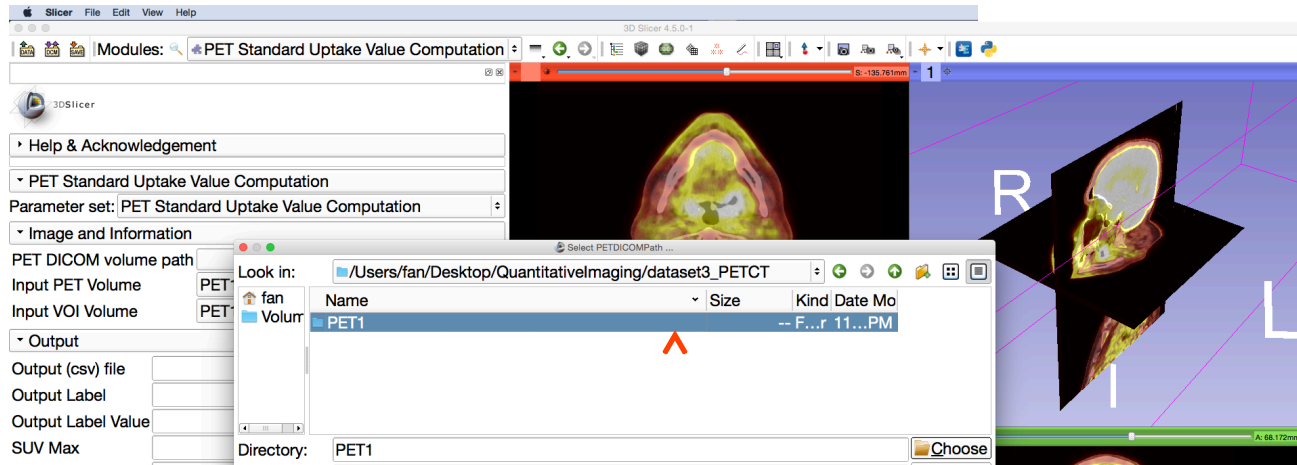
PET SUV Computation

Step1: Input volumes selection
Select Input PET Volume 'PET1'
Select Input VOI Volume 'PET1-label'

3DSlicer
PET Standard Uptake Value Computation
Parameter set: PET Standard Uptake Value Computation
Image and Information
PET DICOM volume path: /Applications
Input PET Volume: PET1
Input VOI Volume: PET1-label
Output
Output (csv) file: ...
Output Label: ...
Output Label Value: ...
SUV Max: ...
SUV Mean: ...
SUV Minimum: ...
Status: Idle
Restore Defaults AutoRun Cancel Apply
Data Probe: /Users/fan/Desktop/Quant...CT_pre-treatment.mrml
Show Zoomed Slice
L
F
B



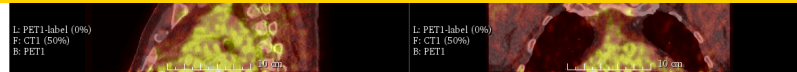
PET SUV Computation



Step2: Path to the DICOM PET header

Click on **/Applications** in the **PET DICOM** volume path, and select the **PET1** subdirectory located under **QuantitativeImaging/dataset3_PETCT/PET1**

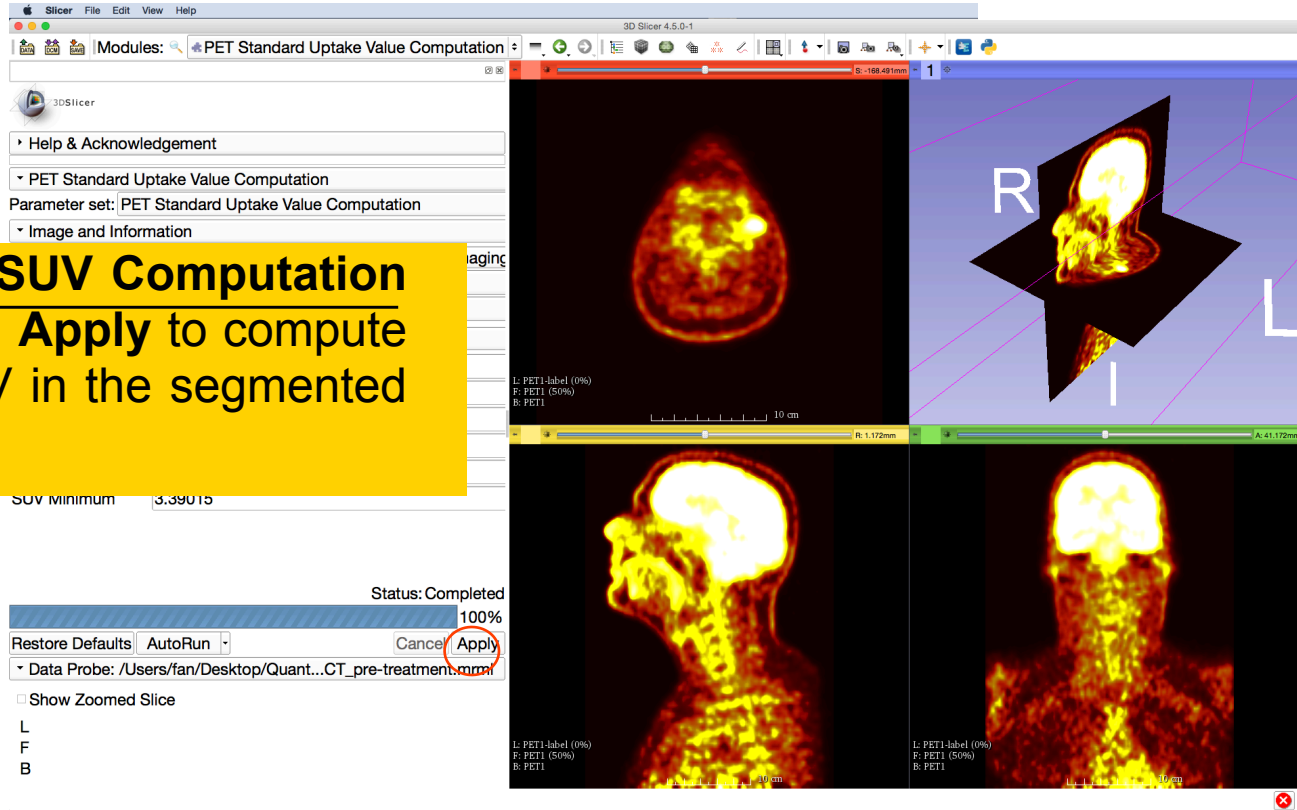
L
F
B





PET SUV Computation

Step3: SUV Computation
Click on **Apply** to compute the SUV in the segmented region





PET SUV Computation

3D Slicer

Modules: **PET Standard Uptake Value Computation**

Parameter set: PET Standard Uptake Value Computation

Image and Information

PET DICOM volume path: /Users/fan/Desktop/QuantitativeImaging

Input PET Volume: PET1

Input VOI Volume: PET1-label

Output

Output (csv) file:

Output Label: 1

Output Label Value: 1

SUV Max: 7.53385

SUV Mean: 5.01805

SUV Minimum: 3.39015

Status: Completed

100%

Restore Defaults AutoRun Cancel Apply

Data Probe: /Users/fan/Desktop/Quant...CT_pre-treatment.mrml

Show Zoomed Slice

L

F

B

SUV Computation Results:

SUVmax = 7.53385 mg/ml

SUVmin = 5.01805 mg/ml

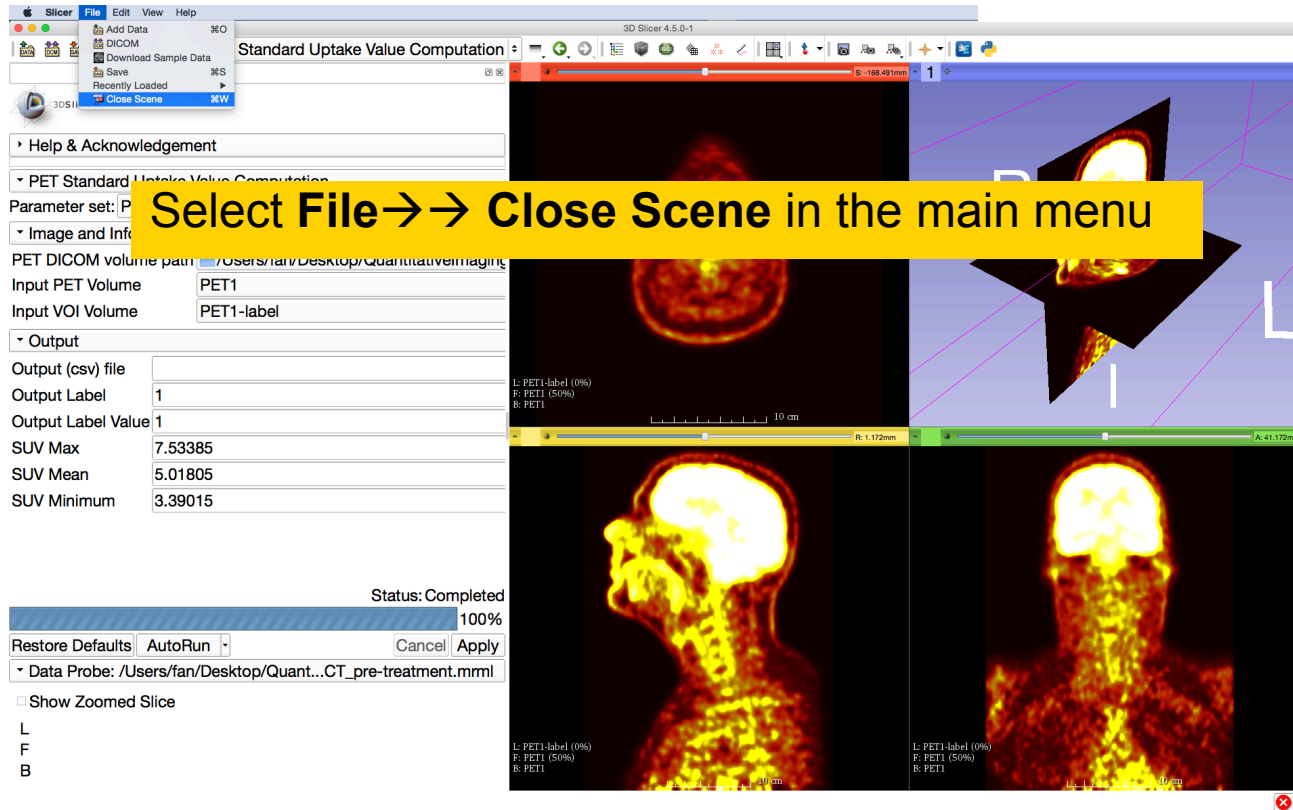
SUVmean = 3.39015 mg/ml

L: PET1-label (0%)
F: PET1 (50%)
R: PET1

L: PET1-label (0%)
F: PET1 (50%)
R: PET1



PET SUV Computation

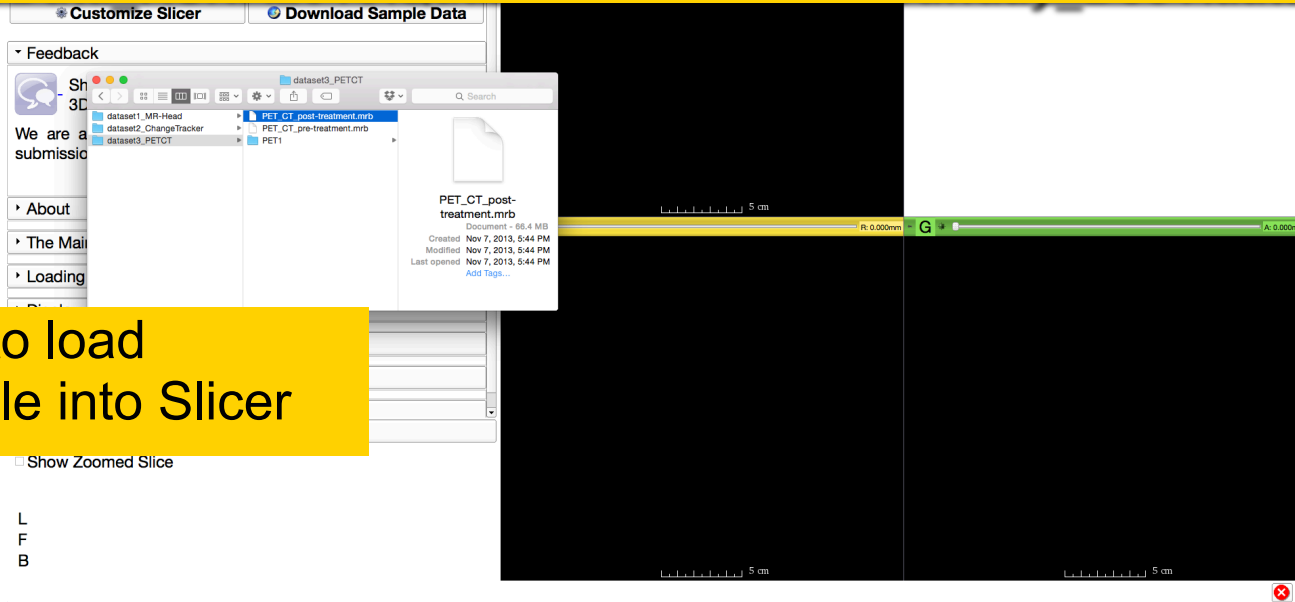




Loading the PETCT scene

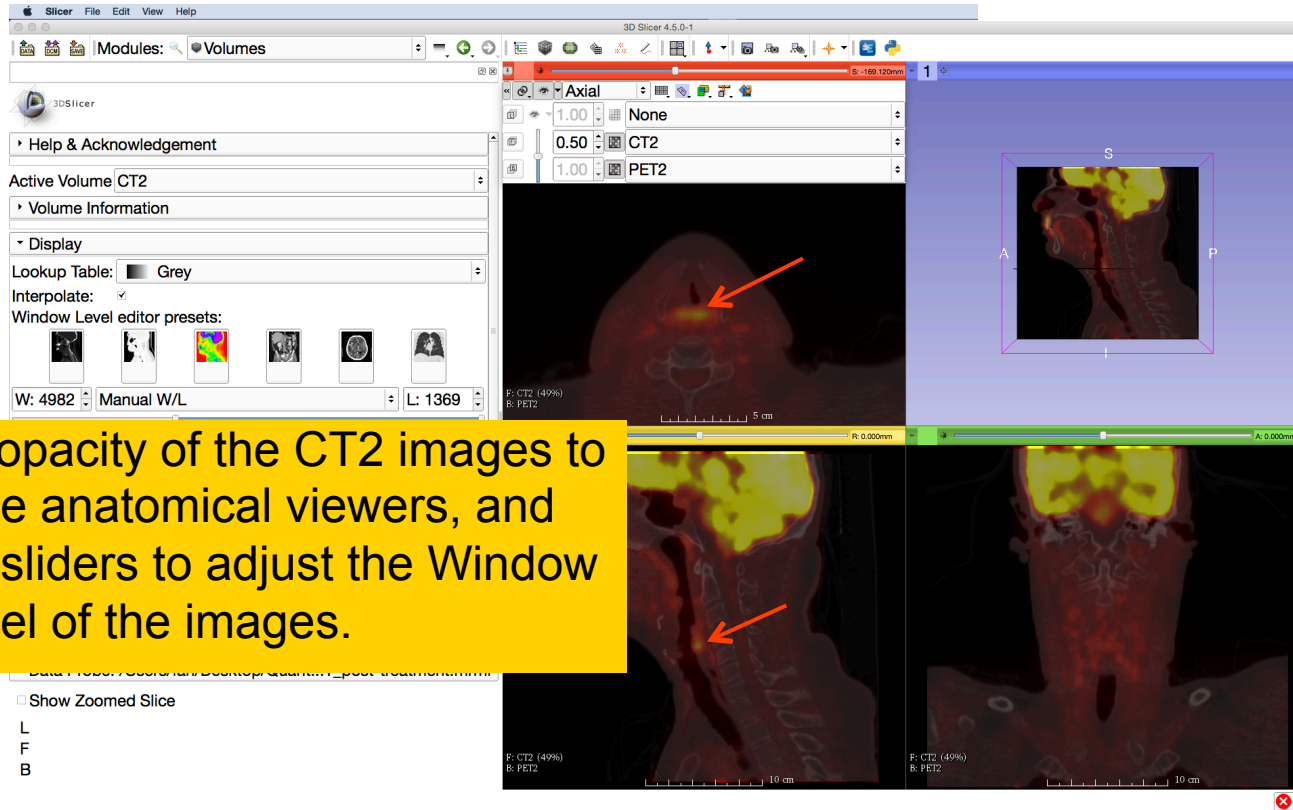
Drag and drop the file **PETCT_post-treatment.mrb** located in

QuantitativeImaging\dataset3_PETCT





PET uptake findings

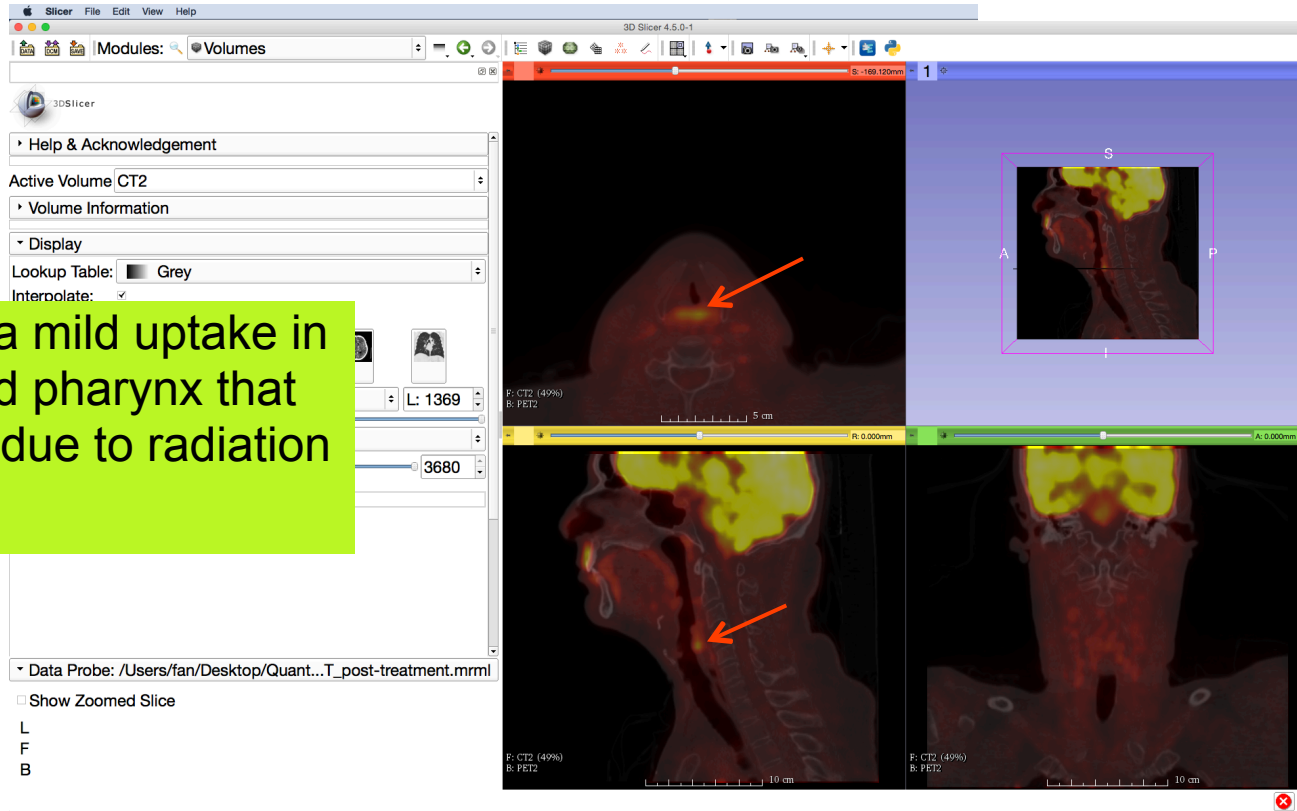


Set the opacity of the CT2 images to 0.5 in the anatomical viewers, and use the sliders to adjust the Window and Level of the images.



PET uptake findings

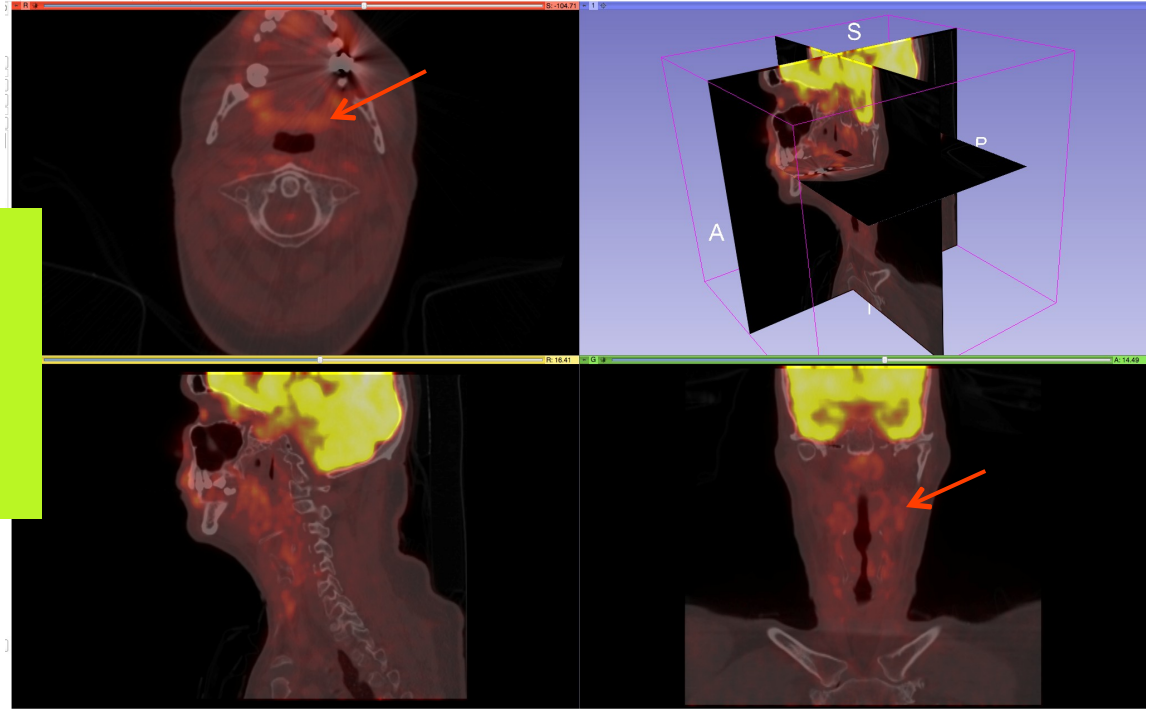
Observe a mild uptake in larynx and pharynx that are likely due to radiation effect.





PET uptake findings

Note that there is no remaining uptake in the area of the primary tumor or nodes after treatment





Conclusion

- This tutorial has demonstrated how to do 3D data visualization, quantitative measurement of small changes in tumor size, and PET/CT SUV computation in Slicer
- 3D Slicer is for research use only, and is not FDA approved
- 3D Slicer is a free open-source software for medical image computing supported by the NIH



Acknowledgments



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- Marianna Jakab, MS, Brigham & Women's Hospital
- Fan Zhang, MSc, University of Sydney



3DSlicer at RSNA 2013

Quantitative Imaging Reading Room Exhibit QIRR 1028

- Sun. Dec.1-Fri. Dec.6, 8:00-6:00
- 3DSlicer: An Open Source Platform for Segmentation, Registration, Quantitative Imaging, and 3D Visualization of Multi-Modal Image Data.
- Sonia Pujol, PhD, Steve Pieper, PhD, Andriy Fedorov, PhD, Ron Kikinis, MD,



Additional Related Hands-on courses

*All courses are in this Advanced Imaging Classroom: S401CD
(except Monday when it is in S401AB)*

Sunday 4:00 pm – Structured Annotation and Image Markup (AIM) Template and Toolsets (ICIW12)

Monday 4:30 pm – Clinical Trials Software for Clinical Trials and Research (ICIW24)

Wed 10:30 am – Open Access Imaging Data Resources: NIH Cancer Imaging Archive (ICIA41)

Wed 12:30 pm – Correlating Imaging with Human Genomics (ICIA42)



3DSlicer at RSNA

Sunday, December 1	Monday, December 2	Tuesday, December 3	Wednesday, December 4	Thursday, December 5	Friday, December 6
<p>8:00am-11:00am: 3D Slicer Exhibit: Quantitative Imaging Reading Room.🔗 Lakeside Learning Center Hall E, Exhibit LL-QRR3007.</p> <p>11:00am-12:30pm: RSNA Refresher Course: "Quantitative Medical Imaging for Clinical Research and Practice: Hands-on Workshop."🔗 Sonia Pujol, Katarzyna Macura, Ron Kikinis Room S401CD.</p> <p>12:30pm-1:30pm: Meet-The-Experts Session 🔗, 3D Slicer Exhibit: Quantitative Imaging Reading Room.🔗 Lakeside Learning Center Hall E, Exhibit LL-QRR3007.</p> <p>1:30pm-6:00pm: 3D Slicer Exhibit: Quantitative Imaging Reading Room.🔗 Lakeside Learning Center Hall E, Exhibit LL-QRR3007.</p>	<p>8:00am-11:00am: 3D Slicer Exhibit: Quantitative Imaging Reading Room.🔗 Lakeside Learning Center Hall E, Exhibit LL-QRR3007.</p> <p>12:30pm-1:30pm: Meet-The-Experts Session 🔗, 3D Slicer Exhibit: Quantitative Imaging Reading Room.🔗 Lakeside Learning Center Hall E, Exhibit LL-QRR3007.</p> <p>1:30pm-6:00pm: 3D Slicer Exhibit: Quantitative Imaging Reading Room.🔗 Lakeside Learning Center Hall E, Exhibit LL-QRR3007.</p>	<p>8:00am-11:00am: 3D Slicer Exhibit: Quantitative Imaging Reading Room.🔗 Lakeside Learning Center Hall E, Exhibit LL-QRR3007.</p> <p>12:30pm-2:00pm: RSNA Refresher Course: "3D Interactive Visualization of DICOM Images for Radiology Applications: Hands-on Workshop." 🔗 Sonia Pujol, Kitt Shaffer, Ron Kikinis Room S401CD.</p> <p>12:30pm-1:30pm: Meet-The-Experts Session 🔗, 3D Slicer Exhibit: Quantitative Imaging Reading Room.🔗 Lakeside Learning Center Hall E, Exhibit LL-QRR3007. ---</p> <p>1:30pm-6:00pm: 3D Slicer Exhibit: Quantitative Imaging Reading Room.🔗 Lakeside Learning Center Hall E, Exhibit LL-QRR3007.</p>	<p>8:00am-12:15pm: 3D Slicer Exhibit: Quantitative Imaging Reading Room.🔗 Lakeside Learning Center Hall E, Exhibit LL-QRR3007.</p> <p>1:30pm-6:00pm: 3D Slicer Exhibit: Quantitative Imaging Reading Room.🔗 Lakeside Learning Center Hall E, Exhibit LL-QRR3007.</p>	<p>8:00am-12:15pm: 3D Slicer Exhibit: Quantitative Imaging Reading Room.🔗 Lakeside Learning Center Hall E, Exhibit LL-QRR3007.</p> <p>12:30pm-1:30pm: 3D Slicer Exhibit: Quantitative Imaging Reading Room.🔗 Lakeside Learning Center Hall E, Exhibit LL-QRR3007.</p> <p>1:30pm-6:00pm: 3D Slicer Exhibit: Quantitative Imaging Reading Room.🔗 Lakeside Learning Center Hall E, Exhibit LL-QRR3007.</p>	<p>8:00am-12:45pm: 3D Slicer Exhibit: Quantitative Imaging Reading Room.🔗 Lakeside Learning Center Hall E, Exhibit LL-QRR3007.</p>

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