Mouse BIRN Atlasing Toolkit
(MBAT v2.0 Beta)

Software User Reference Manual

Mouse BIRN Atlasing Toolkit (MBAT)

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1. ABOUT THE MBAT TOOLKIT

1.1. Overview

The Mouse Biomedical Informatics Research Network (BIRN) testbed's Atlasing Toolkit is designed to view multiple types of multiscale data, access and query databases associated with the Mouse BIRN, and process some of these data types.

1.2. Scope of this Document

This document is a user's manual for researchers. The manual covers an introduction of the application, installation, usage instructions, and appendix.

Report Bugs at the BIRN Help page at http://nbirn.net/help/index.shtm.

Also, visit the MBAT Forum at http://www.loni.ucla.edu/twiki/bin/view/MouseBIRN/MBATForum for answers about some user questions and post a question there yourself (you must have a wiki account for this).

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1.3. Contributors

MBAT is being developed from the activities of six laboratories:

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- The Center for In Vivo Microscopy (CIVM) at Duke University
- The Laboratory of Neuro Imaging (LONI) at the University of California at Los Angeles (UCLA)
- The National Center for Microscopy and Imaging Research (NCMIR) at the University of California at San Diego (UCSD)

- The Informatics Center for Mouse Neurogenetics:
  - GeneNetwork (UTHSC) at University of Tennessee Health Sciences Center
  - Laboratory for Bioimaging and Anatomical Informatics (Drexel) at Drexel College of Medicine, Philadelphia, PA
  - Mouse Brain Library (BIDMC)

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1.4. References

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Bug WJ, Wong W, Badea A, Brandenburg J, Gustafson C, MacKenzie-Graham A, Memon A, Price D, Rosen G, Yuan H, Zaslavsky I, Boline J, Johnson GA, Martone ME, Nissanov J, Toga AW, Williams RW (2007). "The BIRN Atlasing System Interoperability Service: an interface for exchange of registration coordinates, segmentation geometries, and registered images amongst neuroanatomical atlasing systems." Society for Neuroscience, Abstract #100.13.

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Swanson L.W (1998) Brain Maps: Structure of the Rat Brain: A Laboratory Guide with Printed and Electronic Templates for Data, Models, and Schematics, 2nd Revised Edition, pp vii, 267. Elsevier, Amsterdam; New York.

1.5. Acknowledgements

MBAT has the ability to access additional information from web-resources and display it in a user-friendly format. This project is supported by Grant U24 RR021760 to the Mouse Biomedical Informatics Research Network (BIRN, http://www.nbirn.net), that is funded by the National

1.6. Release Version and Date

2.0 Beta version, October 2007

2. APPLICATION INTRODUCTION

2.1. Purpose

The Mouse Biomedical Informatics Research Network (BIRN) testbed's Atlasing Toolkit (MBAT) is a collaborative effort by groups within the Mouse BIRN to create an interoperable tool that offers an intuitive way to access the functionality offered by the individual efforts. Its interface seamlessly enables accessing and viewing multimodal data with emphasis on functionality across distributed locations and diverse databases. This tool allows a user to view microarray gene expression levels visually and offers the ability to interface with data offered by Mouse BIRN. Future plans include the option to incorporate and compare a variety of different data types, regardless of user location or affiliation with the Mouse BIRN.

2.2. Features

Data volumes:

This version includes the option to download several different data volumes created by the Mouse BIRN group for visualization. Most of the data volumes are Analyze image 7.5 format. However, it is possible to load several other types of images into the main viewer. These datasets can be found on the BIRN download site at http://nbirn.net or the MBAT Wiki at http://www.loni.ucla.edu/twiki/bin/view/MouseBIRN/MouseBIRNResources

Atlases:

This version comes stand-alone or packaged with an atlas MR data file, delineation (MDA2006), and 3D surfaces that can be viewed with the 3D Viewer and Surface Manager, and a structural hierarchy that can be viewed and navigated using the BrainGraph tool. Several other atlas delineations are available for download at http://nbirn.net.

Updated Query Features:

One of the main goals of the Mouse BIRN collaboration is to make query and access to multiple data types and sources easy and intuitive within the context of a digital atlas. To meet these needs, there are two new query options that encompass and simplify the previous query options in older versions of MBAT. In addition, these new interfaces will be easier to extend to other data types.

Concept-based query:

This query interface allows the user to search data by specifying data type, subject, and experiment related terms. The query may return multiple types of data within the same interface. Most of the types of data returned within this query will be viewable in MBAT or will link to an external web-site.

Spatial-based query:

This allows the user to search data based on a region of interest selected by the user in the atlas. It has been built using functionality developed for UCSD's SmartAtlas and accesses 2D images that have been registered using tools developed by this group.

The Atlas Interoperability server and API are being developed to expand the ability to cross from 2D and 3D atlases and to add additional types of registered data to the pool of data returned in this manner.

Improved Data Source Access Includes:

- GeneNetwork
- BIRN Microarray Database
- Several Microarray Databases registered through the BIRN Mediator
- The Cell Centered Database (CCDB)

New Data Sources in this Release Include:

- Spatially registered histologic images from SmartAtlas and ArcIMS
- Allen Brain Atlas data with help from NeuroCommons
- GENSAT with help from Stott Parker

Visualization of Data:

The query tools above are tied into MBAT in a manner that will facilitate the ability for the user to download and visualize any publicly available data from the queried data sources.

Access to Additional Information Sources:

MBAT has the ability to access additional information from web-resources and display it in a user-friendly format. These information sources include Bonfire (the BIRN CC ontology tool) and the Brain Architecture Management System (BAMS) at USC.

Upload Your Data:

While MBAT can not be used specifically to upload data, it makes it easy for a user to access multiple data upload resources. Once data is uploaded to one of these resources (and if made publicly accessible by the contributor), it will be available for anyone to discover with the MBAT query tools.

Mouse BIRN Upload Resources:

- The Updated BIRN Microarray Database, which is MAGE compatible.
    - MAGE is the preferred format for data exchange in the Gene Expression community. A BIRN MAGE compatible format facilitates sharing between the BIRN Microarray database and other large microarray databases and other related data types.

- Easy access to UCSD's 2D image warping and registration pipeline through the BIRN portal.
    - This registration upload allows a user to register and upload 2D images to Paxinos plates using the Smart Atlas interface, after which, they are available for query with the Spatial Query Tool. Future plans are to extend these capabilities to 3D atlases.

Additional Features:

MBAT functionality continues to evolve as the potential uses of the software increases and users request features. New this release:

Workspaces:

This version of MBAT has different Workspaces that optimize the configuration of the interface for specific tasks. The MBAT Start up Page points the user to them and they can be accessed through the Workspace pull-down menu.

of moving these windows into a configuration they find most useful. As this is still a fairly new development in

New Docking Framework:

As the functionality of MBAT continues to evolve, access to multiple tools means many more components to organize. A docking framework gives a user the option of moving these windows into a configuration they find most useful. As this is still a fairly new development in JAVA programming, the previous release of MBAT used a docking framework that demonstrated several bugs. This version uses a new docking framework that is meant to address some of the bugs of the older version and aid organization of preferred tools.

Creating BrainGraphs:

This upcoming version of MBAT is capable of opening a hierarchy file created with the BrainGraph editor (to be released November 2007). The BrainGraph Editor allows the user to easily create a hierarchy of any type. There is also the capacity to add metadata to these hierarchies including BIRNLex IDs. The next version of the Brain Graph Editor will have tools that facilitate linking BIRN Lex IDs to hierarchy tags.

2.3. Platform

MBAT is developed in Java in order to be platform independent.

2.4. Compatibility and Requirements

Java

MBAT has been tested on Irix, Linux, Macintosh, and Windows operating systems and requires installation of JRE 1.5. One may also install Java3D 1.3+ (to visualize 3D surfaces). Download and install the appropriate version at http://java.com/en/download/index.jsp. Download and install Java 3D at https://java3d.dev.java.net/binary-builds.html.

3. INSTALLATION

3.1. Installing MBAT

To run MBAT with full functionality, un-tar or unzip the full MBAT folder to the user's hard drive. Other atlases and data may be read from anywhere, but it may be easier to place it in the MBAT folder (see figure below).

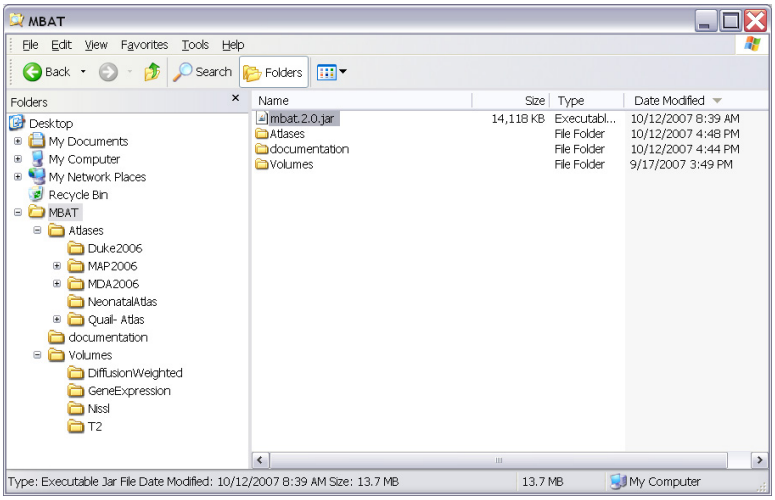

Figure 1: MBAT Installation folders

3.2. Launching MBAT

On most machines, double-clicking on MBAT.jar will launch the program. If that does not work, then execute:

```
java -jar MBAT.jar
```

from the command line interface.

MBAT has command line options and supports loading files at startup. To run MBAT from the command line, go into the MBAT.jar directory and type:

```
java -jar (full MBAT filename).jar Option, i.e., java -jar MBAT.1.2.0.jar -?
```

Upon start up you will see the MBAT launch page, which will take the user to a Workspace that is in the appropriate configuration for a selected task (see Workspaces sections). It also includes links to many relevant external links.

Figure 2: New launch page aids the user in starting a commonly used workflows.

As a default, volumes are loaded with their center of mass at the origin (0,0,0) of MBAT's coordinate frame. However, interoperability with other atlases sometimes requires that the images be tied to a stereotaxic coordinate frame, thus the default atlas packaged with MBAT is placed in these coordinates (MDA2006_STX.atlas).

The origin of the stereotaxic coordinate frame is the bregma point, a landmark visible on the skull of the mouse. The default position of the crosshairs is located at this point so the horizontal (xz) view may appear to be empty, but this is simply because there is no image data at this horizontal plane. Moving the crosshairs down in one of the other views will show the horizontal data in that plane.

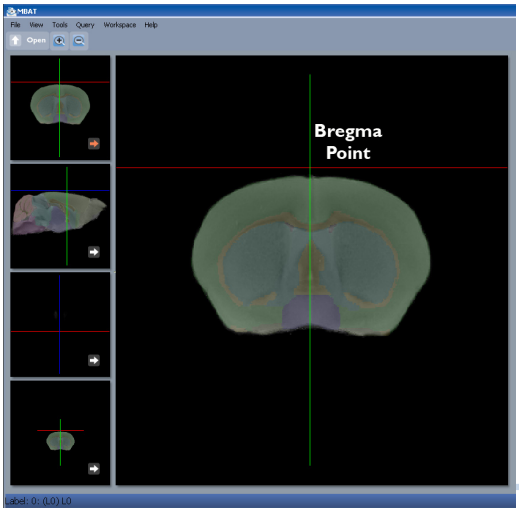

Figure 3: Bregma Point

MBAT needs to know the amount to offset the data files to place them in stereotaxic coordinates. Some atlases come with a corresponding .atlas file which contains the information needed to open that particular atlas in stereotaxic coordinates.

4. FILE INFORMATION

4.1. Download Data and Atlases

Several datasets and atlases are packaged with MBAT or can be downloaded at the BIRN data downloads site, http://nbirn.net. Users may also view their own datasets and create their own atlases.

4.2. File Formats

Image Volumes

An image volume is a file that contains the image data to be displayed. Currently, MBAT can read image files in the following formats:

- Analyze Image 7.5 (.img, .hdr)
- Nifti (.nii)
- Medical Imaging NetCDF (.mnc)
- Bruker format (reco, 2Dseq)
- CIVM format (.headfile) (large volumes)
- Biorad (PIC)
- Tagged Image File Format (TIFF)
    - regular single layer
    - ImageJ image stack

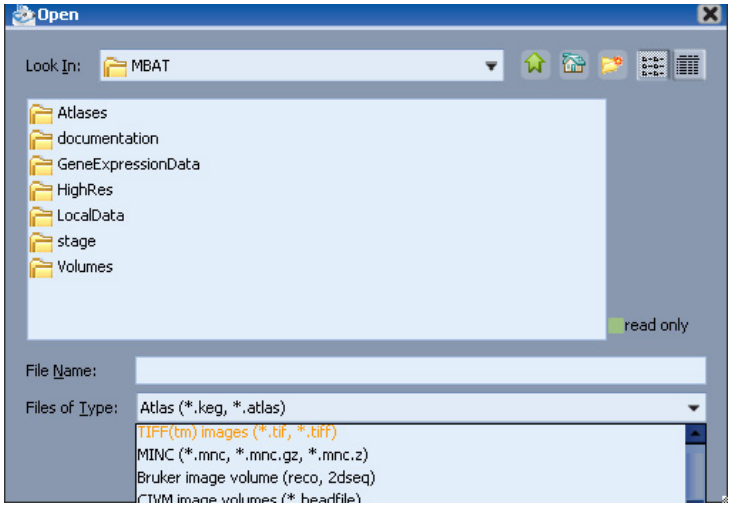

Figure 4: General Open menu illustrating various MBAT file types

MBAT can load and display 8-, 16-, 24- (full color), and 32-bit Analyze Image and MINC volumes. It can also read GZIP compressed Analyze and MINC files. Only TIFF files generated by ImageJ are supported, although MBAT may be able to read some other TIFF file formats. For some Analyze Image files, the image data files may have a different byte order (endianness) than its header. In those cases, check the swap endian box to load them correctly.

Image volumes can be loaded as data volumes, label volumes, or mask volumes. Multiple data and mask volumes can exist simultaneously within MBAT, but only one label volume is permitted at a time. **The order in which volumes are loaded is important. Image volumes loaded later in the sequence will be displayed on top of volumes loaded earlier (see below).**

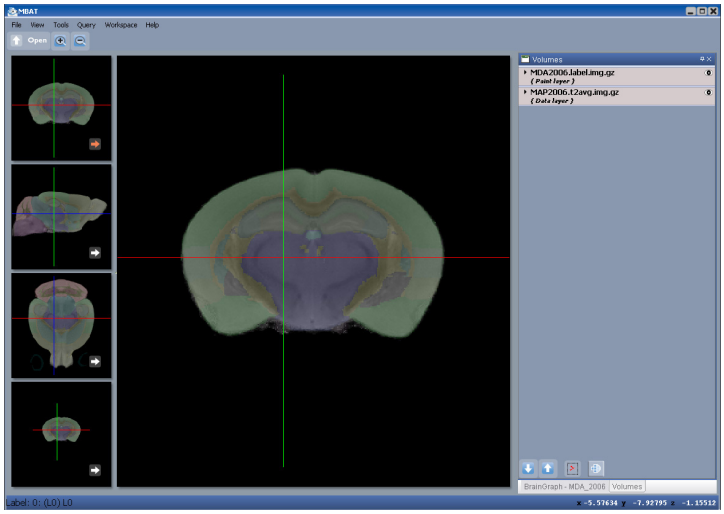

Figure 5: Image volume with overlaying label volume and mask volume

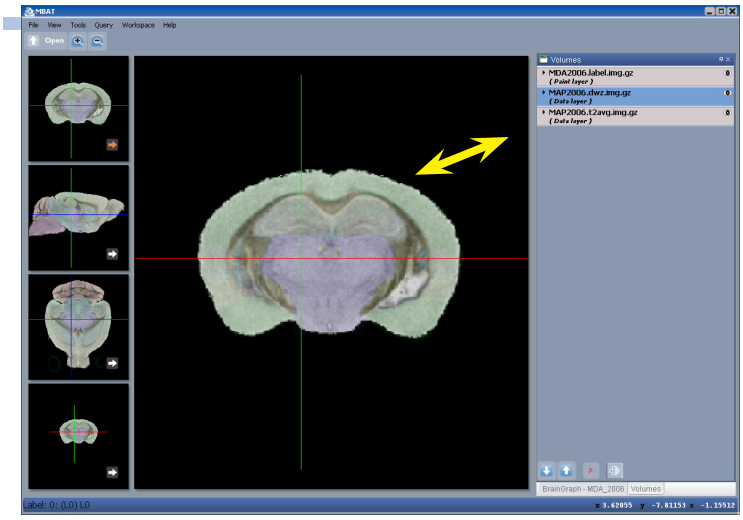

Figure 6: Same set of files open as above with another data volume open (overlays the other data volume)

Once loaded, the order of the volumes can be changed using the Volume Manager, although the default setting is for a data volume to be on the bottom with overlaying label and mask volumes.

Data Volumes

Several whole-brain data volumes are available for visualization in MBAT. Many of these volumes are stored in Analyze Image 7.5 format (.img) or zipped image files (.img.gz), which includes a header file (.hdr) (see Figure below).

The data included with MBAT are:

- One Diffusion-weighted MRI volume
- One T2 MRI volume created from an average of several images

The optional additional data include:

- An additional diffusion-weighted MRI volume
- A reconstructed Nissl volume
- A Gene Expression volume (ubiquitin carboxy-terminal hydrolase L1 courtesy of Gregor Eichele when he was at Baylor working on the GENSAT project).

A volume of this type can be opened within MBAT simply by opening either the .img or the .hdr file. This will load the data with the center aligned to (0, 0, 0) unless specified otherwise.

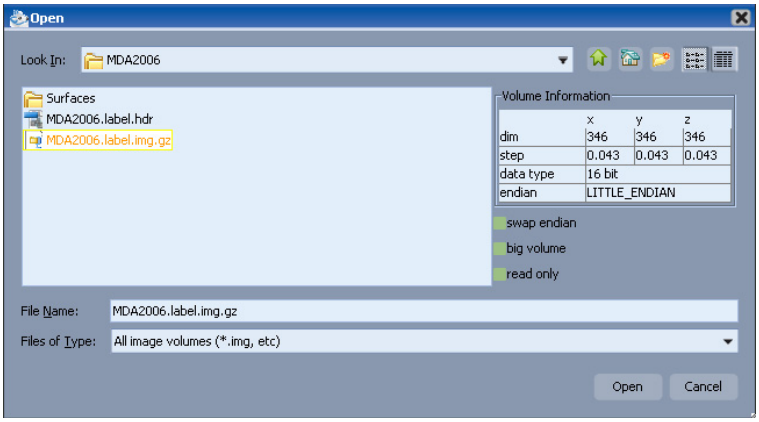

Figure 7: Open interface for image volume showing volume information

It is also possible to load other types of volumes into the main viewer, including multi-layer tiffs. Some of these types of volumes are also available through CCDB and the BIRN infrastructure.

Label Volumes

Several label volumes are also packaged with MBAT. These special volumes contain the delineations that are the foundation of these atlases. However, if these volumes are not opened specifically as label volumes this information will not be recognized (see figure below).

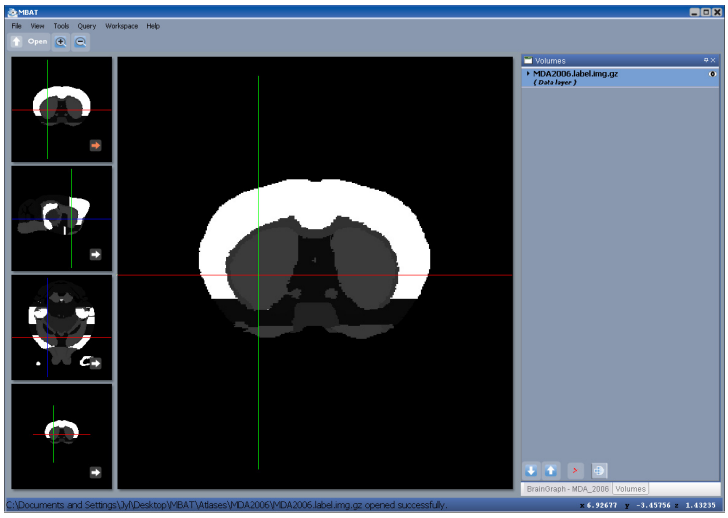

Figure 8: Illustrates label volume opened as data volume rather than label volume

Integrated Label Files (.ilf)

These files associate the delineations in the Label Volumes with the names of the structures, and if it has been created, a structure hierarchy. These files can be opened separately and visualized using BrainGraph, or can be opened in conjunction with a Label Volume to associate the names of the volumes with the delineations.

These files can be created using the tool, The BrainGraph editor. An example file is below:

```
<ilf atlas="example">
  <meta>
        <creator>amg</creator>
        <date>2007-05-130 14:21:53</date>
  </meta>
  <structure>
        <label id="1" color="#ffffff" abbreviation="CNS" name="Central Nervous System">
              <label id="34" color="#330000" abbreviation="SP" name="Spinal Cord">
                    <label id="21" color="#0" abbreviation="C" name="Central Canal,
Spinal Cord/Medulla">
                    </label>
              </label>
              <label id="1000" color="#ffffff" abbreviation="BR" name="Brain">
              </label>
              <label id="1009" color="#ffff" abbreviation="RET" name="Retina">
              </label>
        </label>
  </structure>
</ilf>
```

The integrated label file combines the information contained in BrainGraph (.bgx) and brain label index (.lbl) files, however these file types can still be read in MBAT and are described on the next page.

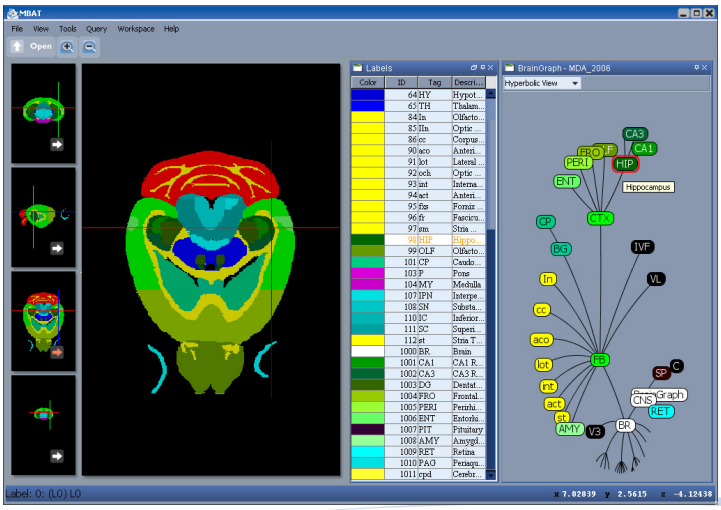

Figure 9: Information in an integrated label file (.ilf) visualized in MBAT

Brain Label Index (.lbl)

A Label Index file contains a list of unique indices for each anatomical structure, its abbreviation, and the complete name of the structure in XML format. If these files are associated with label volumes, they contain information about what the labels represent. MBAT can be used to view label index files using the Label Tool (see figure 9).

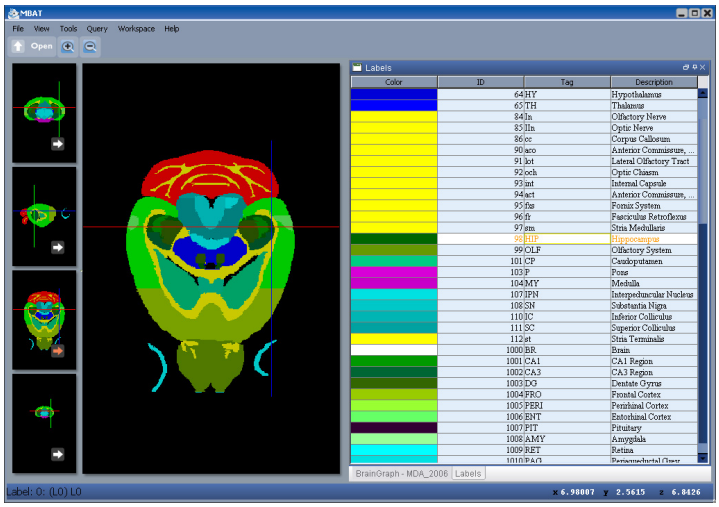

Figure 10: Information in a Label Index file (.lbl) visualized in MBAT

BrainGraph Files (.bgx)

Note *This format is still supported but the Integrated Label Format (.ilf) is the preferred file format for this kind of information*

A BrainGraph file loaded in the BrainGraph tool shows a hierarchical view of brain structures. If matching BrainGraph and Label Index files are open, they are synched to each other.

BrainGraphs can be viewed using either a hyperbolic view (see Figure 11) or a tree view (see Figure 12). As the user navigates by clicking any one structure, all the other structures move in relation to it.

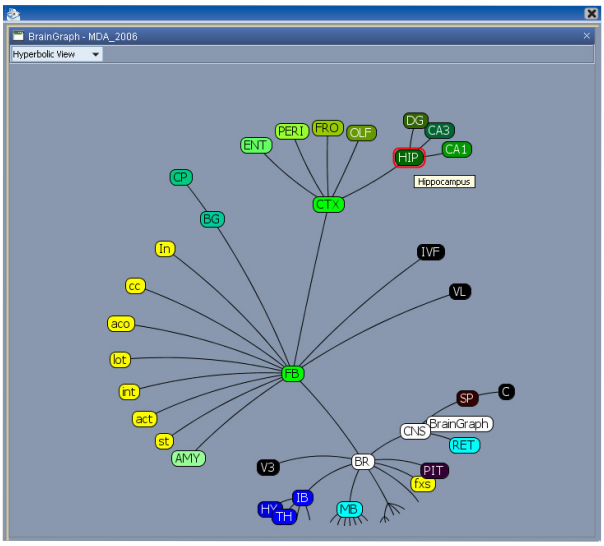

Figure 11: Hyperbolic View

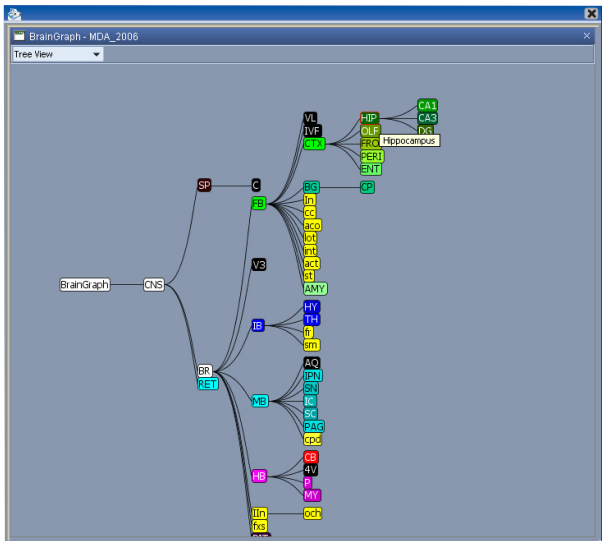

Figure 12: Tree View

Keg and Atlas files

Keg (.keg) and Atlas (.atlas) files contain a list of volume and label index files to be loaded together. These files are in XML format and are a convenient way of loading multiple files simultaneously.

When the user has several files loaded into a configuration setting that the user would like to use again, the user can save these settings as a Keg file.

Below is an example of what sort of content may be held in a Keg or Atlas file:

```
<?xml version='1.0' encoding='utf-8'>
<Atlas>
    <volume src="../../Volumes/DiffusionWeighted/dwz_256.img.gz" />
    <label src="MAP2003S_256.label.img.gz" alpha="0.3" />
    <mask src="mask_256.img.gz" flipY="true"/>
    <labeltext src="MAP2003S_256.ilf"/>
    <BrainGraph src="MAP2003S_256.ilf"/>
</Atlas>
```

The following commands are used within the files to configure the start-up options of the loaded files.

Volume, Label, or Mask

Src	Label volume source file name
Alpha	0-1 color or brightness (intensity values – default = 1)
startX, Y, Z	Start coordinates
flipY	Flag indicates whether to flip the image in Y axis (true or false)
flipX	Flag indicates whether to flip the image in X axis (true or false)

Labeltext

Src	Paint label source file name

BrainGraph

Src	BrainGraph source file name

5. WORKSPACES

5.1. View Atlas Workspace

The MBAT launch page offers workspaces that are configured in a manner to facilitate common user workflows. In addition, these workspaces may be accessed from the Workspace menu. Once the user has begun using MBAT, use the View Atlas Workspace, to open Data or Search by Region.

Figure 13: The Launch Page shows commonly used workflows that may also be accessed from the Workspace menu.

This workspace makes it easy to open and navigate an atlas in MBAT.

- Select View Atlas in the Launch page or the Workspace Menu.
- Open an Atlas (the default is MDA2006_STX.atlas) in the open dialogue.
- This environment has multiple menus and features developed specifically to visualize data. These are discussed in the following section.

5.2. Open Data Workspace

This workspace does not automatically open an atlas file, but it is set up for a user to open their own data without needing to close other files.

- Select Open Data in Launch page
- Open the data type of your choice (see section on opening and viewing files)

- If you wish to switch Workspaces once you have viewed this data, go back to the View Atlas Workspace

5.3. Query Data Workspace

This workspace is designed to search several data types and data sources from different groups.

Search:

- Select Query Data in Launch page
- Set search criteria by selecting search groups with Query Panel and initiate Search

Results:

- Results returned from the query are shown in the Review panel
- For additional information about the dataset, click on the ID and examine the Metadata panel
- Add the results you wish to further examine to the Comparison Cart
- Select Display results when you wish to look at these datasets more carefully

Display Results:

- You will automatically be taken to the Cart
- You may navigate Volumes using the toolbar at the top• Add the results you wish to further examine to the Comparison Cart
- Page Up/Dn will move through a volume quickly
- Once in the display windows, images may be enlarged by clicking the Window icon

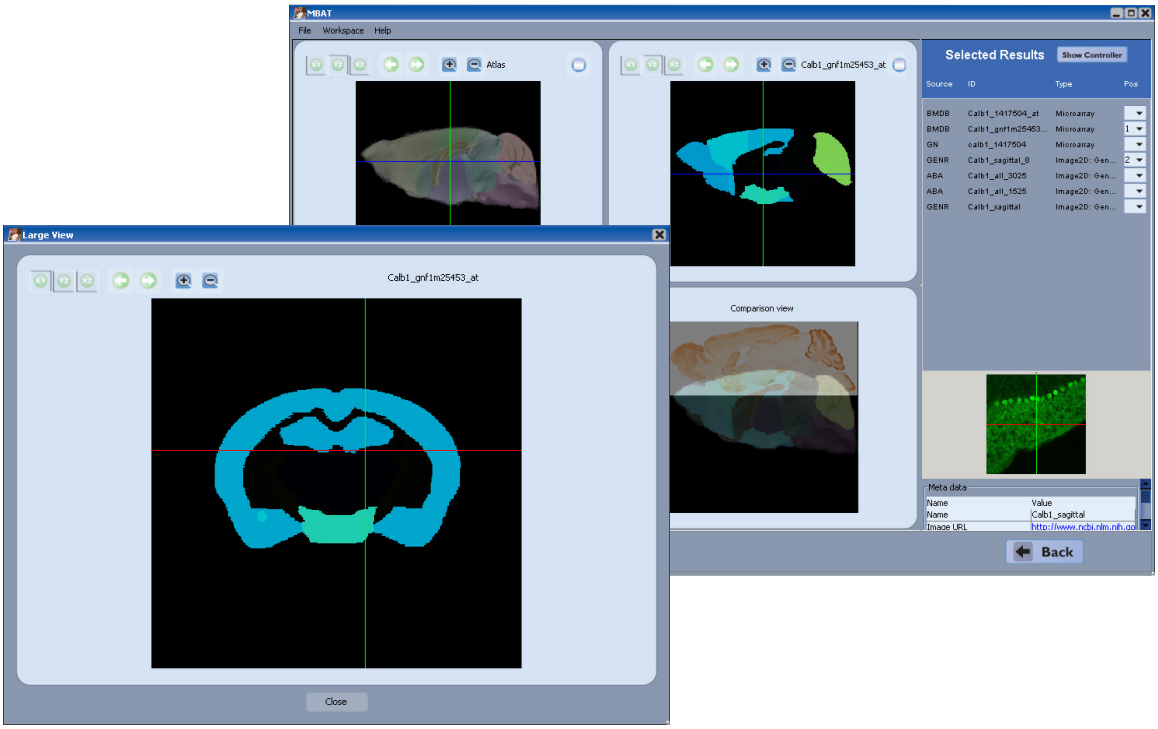

Figure 14: Exploring data in the Display Results panels

Comparing with the Atlas:

If you'd like to do more analysis in relation to the atlas, put images you're interested in window 1 and 2 and click Show Controller. In this window you can manipulate the images to roughly manually align with the atlas, apply, the atlas labels to the images, and run a simple analysis of the level of gene expression.

Align Dataset to Atlas:

In order to align data to the atlas, we recommend hiding one of the windows to make it easy to see the Comparison view (eye icon). Once you have determined which image you will align to the atlas, find an appropriate matching plane in the atlas using either the arrow buttons or the Page Up/Dn buttons to move faster.

- Use the image's Transformation controls to rotate, shift, and scale your image to register it to the the atlas
- Apply the atlas labels to your image
- Estimate gene expression of this image

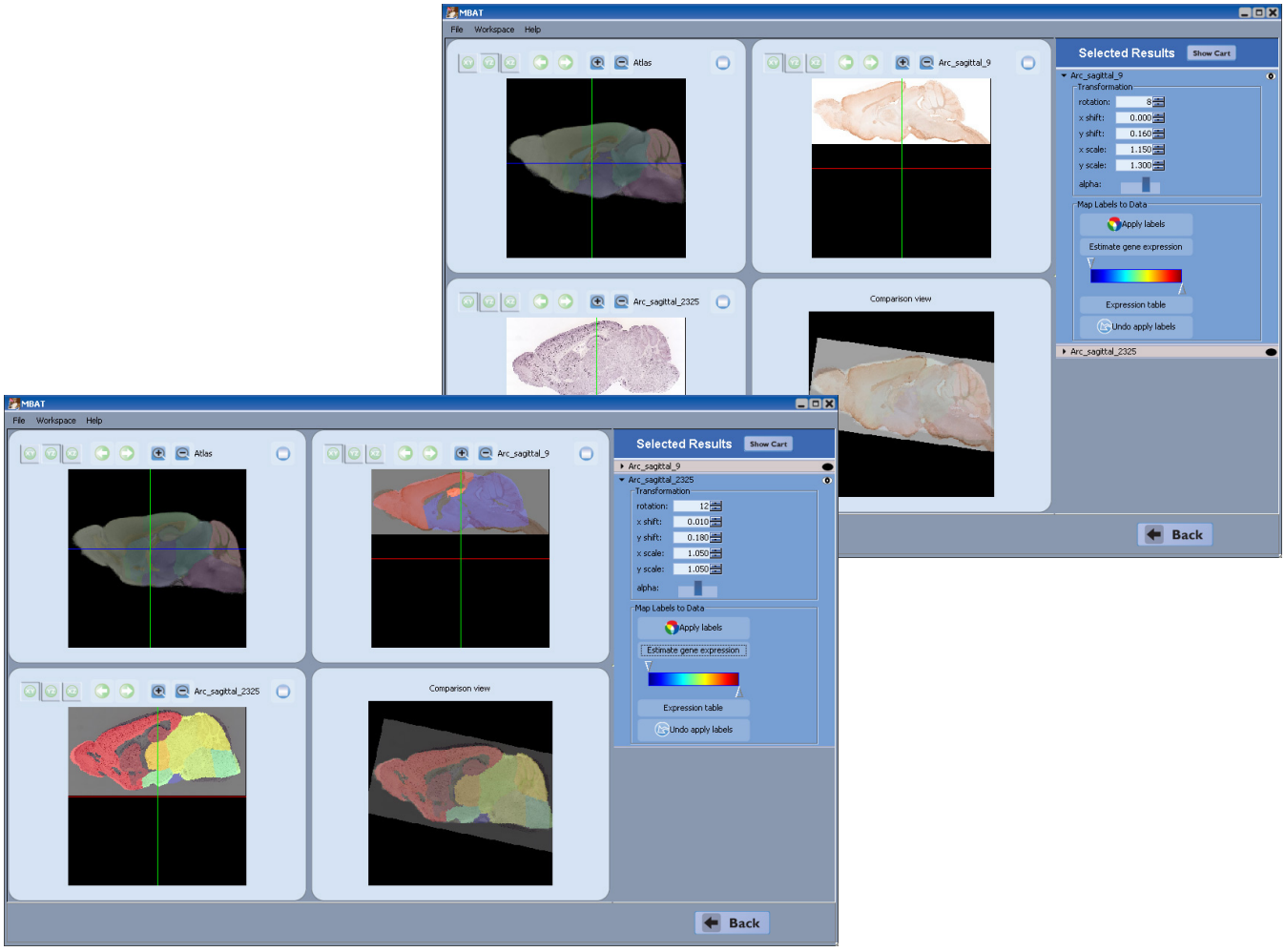

Figure15: Register image to atlas, apply labels and estimate gene expression levels

5.4. Query by Region

This workspace allows you to search for spatially registered datasets

- Select Query Query by Region in Launch page
- Navigate to brain area or interest
- Change to Draw Mode
- Select New to create a new Region.
- Use ctrl + left button drag to delineate a Region
- Any returned data will be placed in the Results Panel

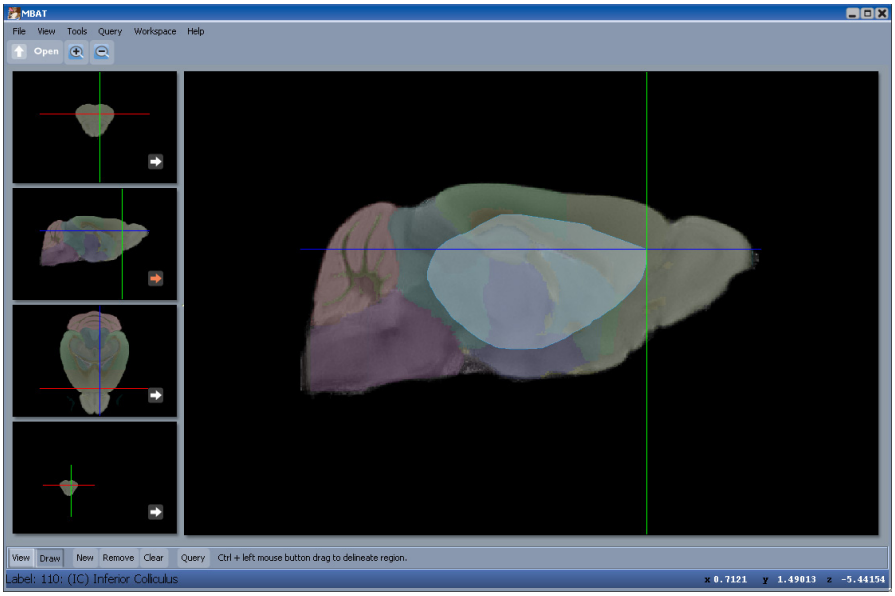

Figure16: Query by Region

5.5. Create Atlas Workspace

This workspace helps users create their own atlas.

- Select Create Atlas in Launch page
- Open data of your choice for delineation
- Create a new Label Volume
- Create a new Label Index and select the Label color
- Select paint brush and brush size in the Drawing Tool
- Drag left mouse button to paint the area
- See Paint volume for additional information on this process

Once you have created and saved a label volume, it can be loaded in the MBAT-associated tool BrainGraph Editor to create a hierarchy with your delineations.

6. USAGE INSTRUCTIONS

6.1. Opening and Viewing Files

File Menu

The File menu contains options to open and close different types of atlases and volumes

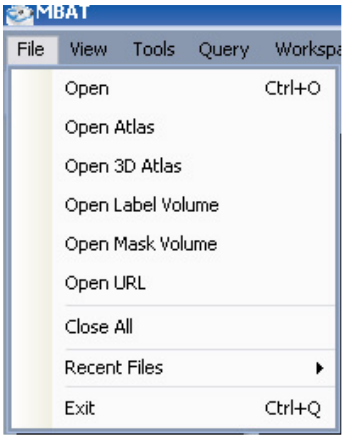

Figure 17:The File Menu

Open

The open menu item allows the user to open any file type that MBAT can load and makes it easier to open specific file types (Open, Open Atlas, Open 3D Atlas, Open Label Volume, Open Mask Volume).

Selecting the specific file type allows MBAT to load that volume appropriately.

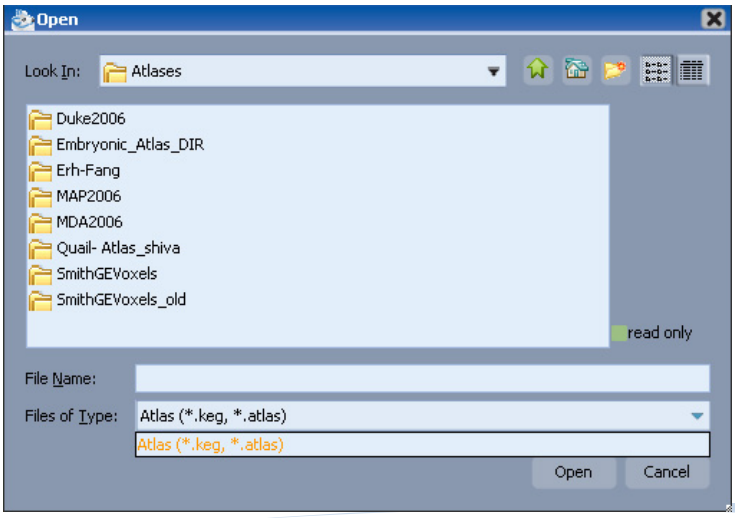

Figure 18:The Open dialogue box offers many different file formats

Files Type supported are as following:

- Atlas (.keg, .atlas)
- 3D Atlas (.atlas3d)
- BrainGraph files (.ilf, .bgx)
- Analyze™ 7.5 (.hdr, .img, .img.gz, .img.z)
- Nifti (.nii, .nii.gz, .nii.z)
- Analyze™ 7.5 big volume (.img)
- TIFF™ Images (.tif, .tiff)
- MINC (.mnc, .mnc.gz, .atlas)
- Bruker image volume (.reco, .2dseq)
- CIVM image volumes (.headfile)
- Bio-Rad PIC (.pic)
- Paint Labels (.lbl, .txt)

Open Atlas

Several atlases are packaged with MBAT or shared at the BIRN data downloads site http://nbirn.net. These full atlases usually contain an integrated label file, a label volume, and the data volume that was used to create the delineations.

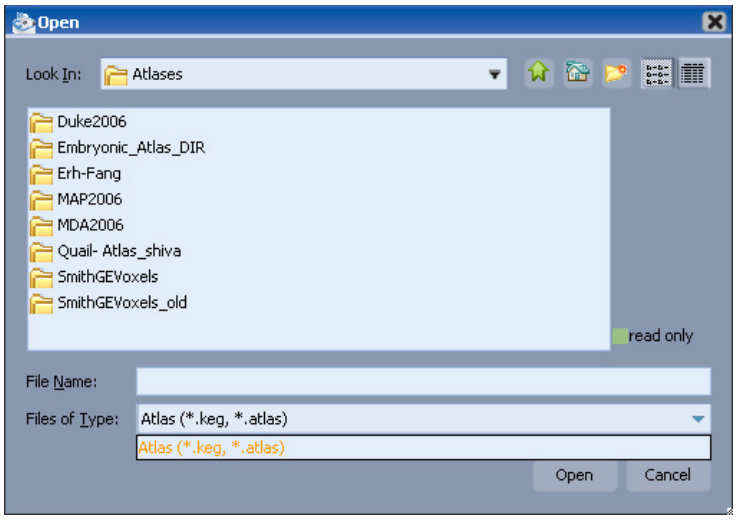

Figure 19:The Open Atlas

Open 3D Atlas

The Atlas3d file is a specialized form of .atlas file used to load surfaces, which are viewed using the 3D Viewer and Surface Manager tools. This file is read by the Surface Manager and displays the names of individual surface files.

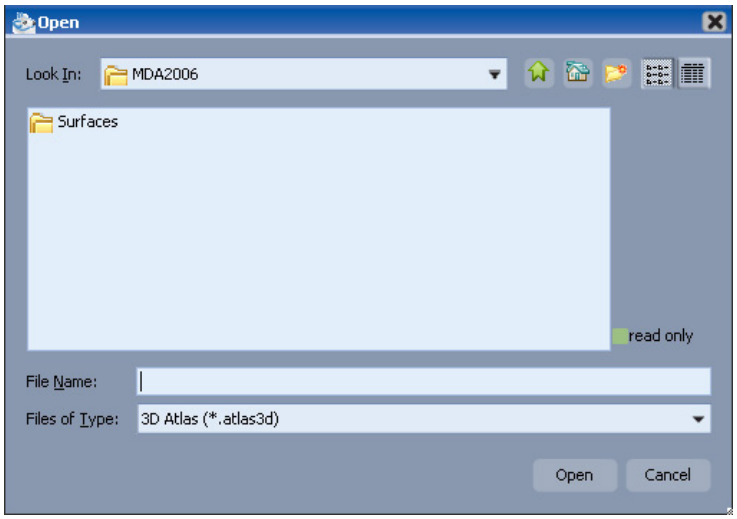

Figure 20: Opening a 3D Atlas

Open Label Volume

Open Label Volume allows user to open a label volume in the special label volume format. If this is not selected, it will be opened as a data volume (see section Label Volumes section). Volume information is displayed when the file is selected.

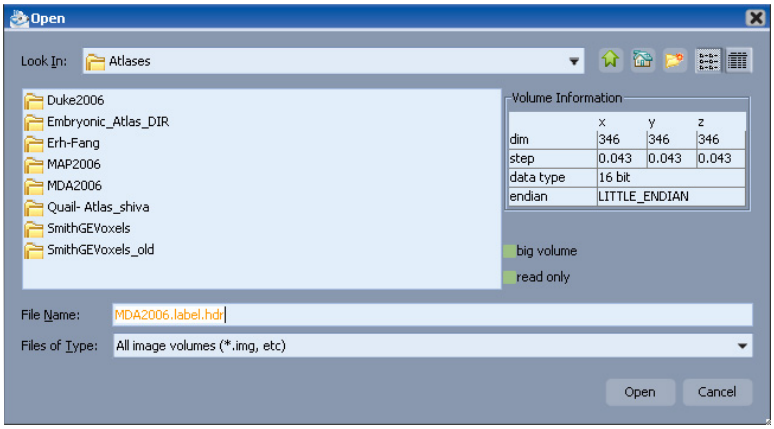

Figure 21: Open Label or Mask Volume Open Dialog

Open Mask Volume

Open Mask Volume allows the user to open a specified mask volume file. Volume information is displayed when the file is selected. (See figure above)

Save The save menu item allows the user to save a file in the current format and file name.

Save As The save as menu item allows the user to save specific files (data volume, keg, label index, label volume, or mask volume) under a different name.

Close All Closes all opened files at once.

Recent Files MBAT keeps a list of the eight most recently opened files.

Exit The exit menu item closes MBAT.

6.2. View Menu

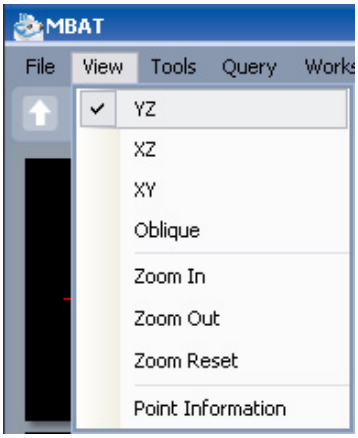

Figure 22: View Menu

View

In MBAT, four thumbnails (XY, YZ, XZ, and oblique) and a single large viewing plane are displayed. The plane selected (XY, YZ, XZ, or oblique) will be displayed in the large viewing plane. Navigation in any view will move the location in all the other views.

XY, YZ, XZ, and Oblique views

The XY, YZ, XZ, and oblique (arbitrary) view options determine the large viewing plane.

The oblique plane allows view of any plane by rotating around the center of the crosshairs

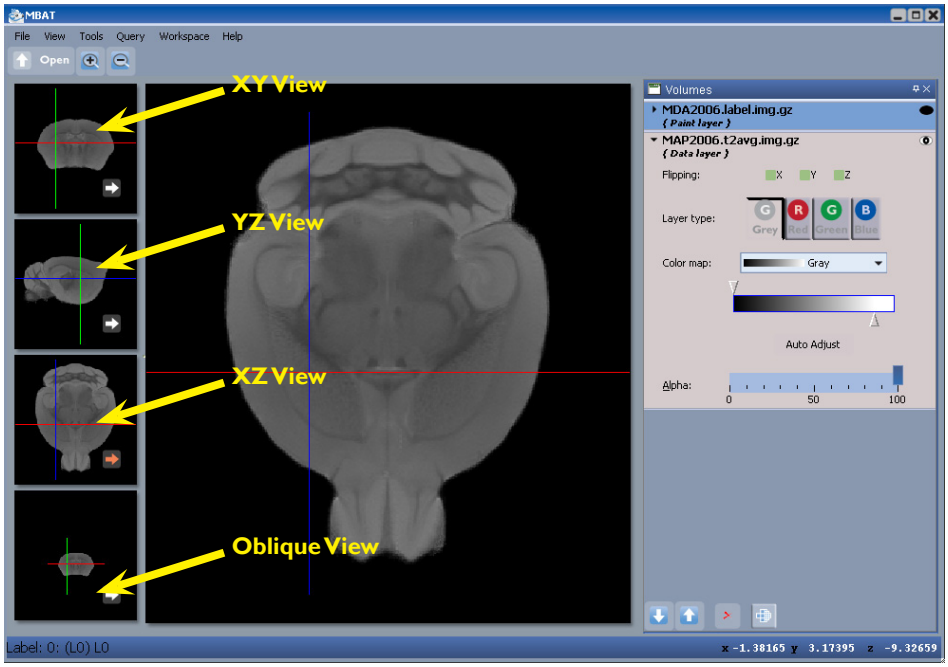

Figure 23: YZ,YZ, XY, and oblique views

Navigating in the active window:

Left click will activate the window (shown by a border around the window) and move the crosshairs to that position.

Control	Description
+/-, up/down arrows	traverse individual slices within the selected View
page up/down	traverse the planes of the selected View faster
left click	set the crosshair position
left click + ctrl	sets crosshair position and syncs Label Tool and BrainGraph to the selected label

In the Oblique View:

Control	Description
arrows keys	rotate around center of volume
page up/down	rotate around center of volume faster
left button drag	rotate freely with mouse
right click	brings up a control dialog box which allows precise rotation and reports the current rotation and rotation matrix. Horizontal rotation is around the Z-axis while vertical rotation is a around the x-axis.

Zooming

In MBAT, four thumbnails (XY, YZ, XZ, and oblique) and a single large viewing plane are displayed. The plane selected (XY, YZ, XZ, or oblique) will be displayed in the large viewing plane. Navigation in any view will move the location in all the other views.

Zooming Controls:

Control	Description
shift + left button drag	select the zoom in area. Be sure to turn off Drag Update option before doing so to clearly see the zoom in box.
A/Z	traverse through the zoom history
S/F/E/D	pan left, right, up and down in the zoomed view

Point Information

This option pops up a small dialog box that displays world coordinate of the crosshair position and actual intensity value of each volume at that position. Anytime the position of the crosshair is changed, this updates the point information.

6.3. Tools Menu

This menu allows the user to check which tools they wish to show in the workspace. Tools include:

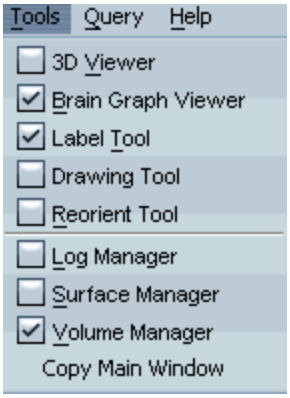

Figure 24: Tools Menu

- 3D view
- BrainGraph Viewer
- Label Tool
- Drawing Tool
- Maximum Intensity Projection
- Reorient Tool
- Log Manager
- Surface Manager
- Volume Manager

You may also make a copy of the Main Window from this menu which creates a window with the main view in it that may be saved to a file.

Label Tool

The Label Tool allows the user to visualize, create, and modify label indices and volumes. The label volumes may be used to describe anatomical structures, lesions, or any other region of interest.

The Label Tool displays labels indices from an integrated label file (.ilf) or label file (.lbl) (see Section 4.2 File Formats). Each label value may have an associated color, ID, tag, description, voxel count, and protected setting.

- Label colors may be changed by double-clicking on the color in the Label Tool window. A dialog box will open that allows a user to choose the label.
- IDs, Tags and Descriptions can be changed by selecting the row, and modifying the tag name and description in the textboxes below.

- Count is the number of voxels in the label volume containing that label value.

- Checking the protected checkbox prevents the label from being overwritten.

All changes must be saved before the update will be reflected on the label view.

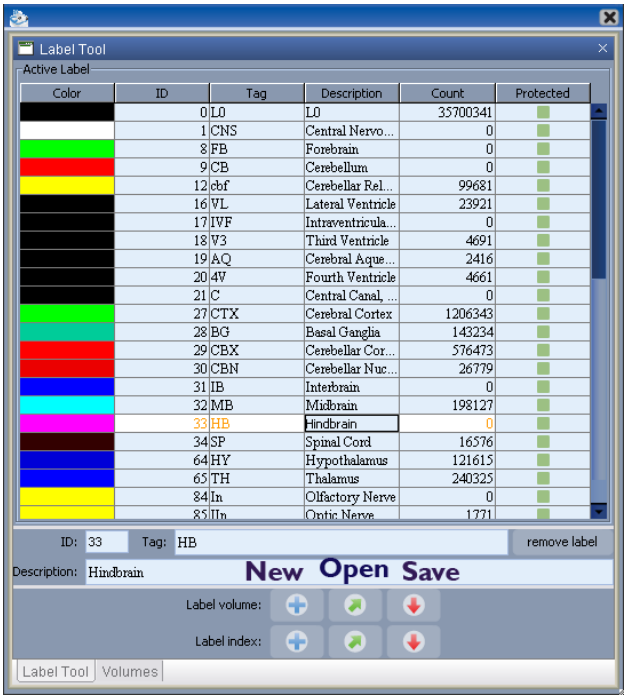

Figure 25: Each label value has an associated color, ID, tag, description, voxel count, protected setting

To create a new Label Index:

- Hit the New button
- Change the ID, Tag, and Description and press Enter in the Tag textbox. If the description is empty, it will be set to the same as the tag. The label ID range is 0-65535.

To create a new Label Volume:

- Click the Icon to create a New volume
- Select 8 or 16 bit. 8 bit can match label id range 0-255 while 16bit can match label ID range 0-65535
- The volume should appear in your Volume Manager as "New Paint Volume"

To save, click the down arrow in the Label Tool to save the label volume in the directory of your choice

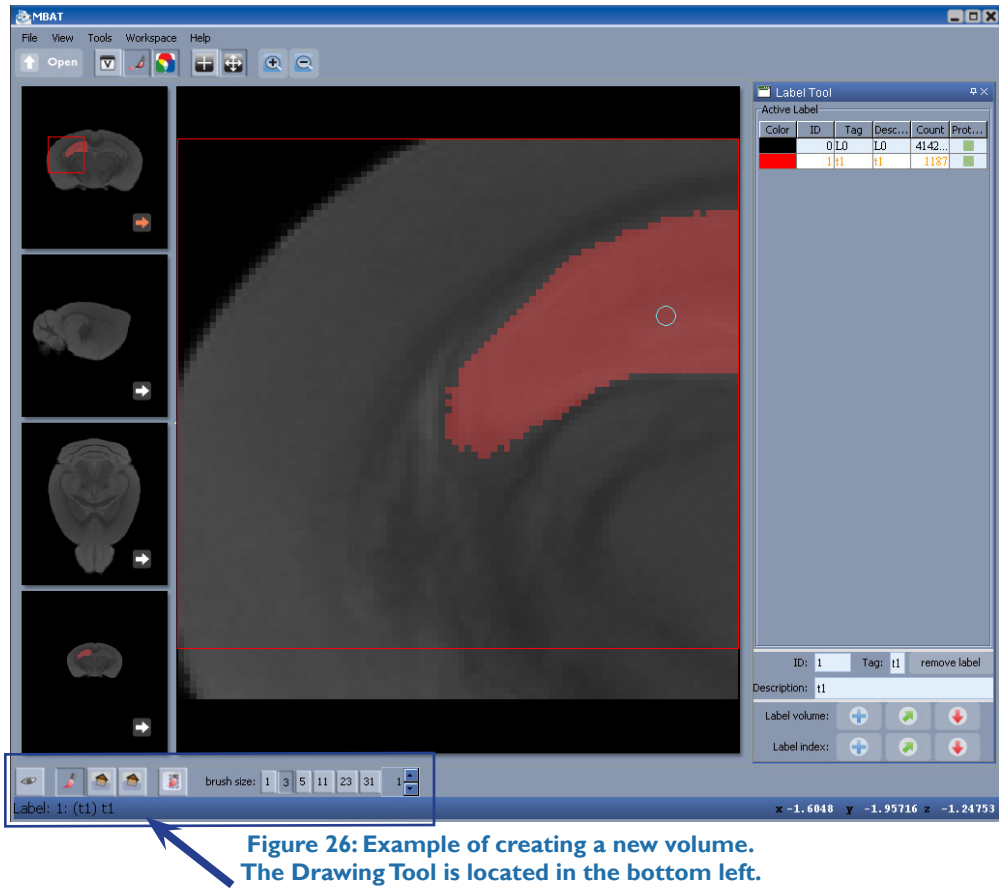

Figure 26: Example of creating a new volume. The Drawing Tool is located in the bottom left.

Paint a Volume:

- Change to the Create Atlas Workspace
- Create a new Label Volume
- Create a new Label Index
- Select the Label Index and change it to the color of your choice
- Select paint brush mode in the Drawing Tool and select a brush size
- Hold down the left mouse button to paint the area
- To fill in a large area, paint an outline and select the fill mode
- If a mask is loaded, all paintings/fills are done within the mask
- A mask may be used in conjunction with the 3D fill mode to fill a 3D volumes

To save:

- Click the down arrow in the Label Tool to save the label volume in the directory of your choice

Volume Manager

The Volume Manager is used to manage, modify the properties, or close loaded volumes. You may hide a volume without closing it, clicking on the eye icon next to the selected volume will alternate between hiding and viewing a volume. By resting your mouse over a volume, information about that layer will show in the tool-tip.

Icons indicate if each layer is being treated as a mask, data, or label volumes. If your file has been opened as the wrong volume type, close the volume, and open it using the appropriate file open category. The order in which the volumes are layered in the view can be adjusted with the up and down arrows.

Each overlay layer is associated with an alpha (transparency) value and a color map. The images of layers are composed together much like laying sheets of transparent paper on top of each other. The colors and brightness of these layers can be controlled in this tool.

For data volumes, the layer type can be adjusted to grayscale overlay layers ("gray"), or red, green and blue channel layers. Grayscale volumes can have a color map applied to them.

For channel layers (image, vs. mask vs. label volume), the image composition is somewhat different. It does color combination for each red, green and blue channel. Although having overlay layers with red, green, and blue color maps also works, the resulting image will be dimmer.

Properties such as volume order, color map, brightness, and contrast can also be adjusted in this window. To modify the properties of a volume, select the volume and open the properties box.

Modifying Volume Properties:

The Volume Manager Property Box will show the available modifications for that data type.

Flipping — selecting an axis will flip that image around that axis

Alpha — the sliding scale adjusts the transparency of that layer

Layer type — select the gray, red, green or blue color channels for that volume

Color map: pull down menu — allows you to change the color map of a data volume

Color map: sliding scale — can be used to adjust the upper and lower bounds of the brightness and contrast of an image volume

Color map: auto adjust — this button will select the appropriate brightness and contrast for that image volume

BrainGraph Viewer

This window holds hierarchical information for structures and MBAT will try to synchronize a BrainGraph file to an open label volume (which will be linked if the default .ilf file is being used). Thus it may be used for navigating through structures.

Note exceptions:

- not all structures in the BrainGraph may be delineated in the label volume
- if not using an .ilf file, the BrainGraph and label volume may be independent and may not sync appropriately

Using the BrainGraph Viewer:

The user may choose the Hyperbolic or the Tree view. Resting the mouse over a node will show the full name in the tooltip.

left button drag	move the BrainGraph view
right button drag	zooms in and out in the Tree view
left click	moves the crosshairs to that structure in the label volume
ctrl + left click in label volume	Move the BrainGraph to that structure
right click	centers that node and brings up a menu or additional functionality (below)
hide this	With the Right click on a BrainGraph node you have the option to show and hide branches from a node, which helps simplify the view of the BrainGraph and the synced Volume Label. You also have the ability to launch a search from that node.
hide children	removes that node and the children of that node
show immediate children	removes the children of that node and all structures under that node inherit the color of that node
show descendents	after hiding children of a node, this may be used to just show the immediate children
search: BonFire	after hiding nodes, this will show all children of that node

Maximum Intensity Projection Tool

This tool was added to make it easier to see difficult to navigate volumes such as cell fills. It creates a 2D image from the maximum intensity values of all the slices in the volume.

To create a maximum intensity projection:

- Open the volume in the MBAT file open menu
- Modify the volume properties as you see fit in the Volume Manager
- Open the Maximum Intensity Projection Tool, select that volume and the desired projection plane

Using Maximum Intensity Projection:

- Select the volume on the left for
- Selecting the XY, YZ, or XZ planes changes to that view
- Zoom in and out using the Zoom, 100%, and Fit to Window key
- Save the projection as a .png file with the red arrow

Log Manager

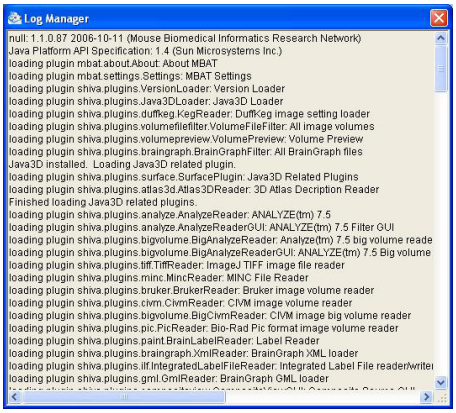

Figure 27: Log Manager Window

If an error has occurred, the status bar of the main window will contain a brief error message. The Log Manager window will contain more detailed information on the error.

Viewing 3D Surfaces

The 3D Viewer and Surface Manager tools are used to view 3D surfaces.

- The 3D Viewer displays a 3D view of any loaded surface and are displayed in relation to the loaded label volume.
- The Surface Manager allows the user to turn views on and off of any loaded surfaces as well as the slice planes.

Open 3D Surfaces

A set of 3D surfaces of several brain areas have been included in the surface folder of some atlases. Load these surfaces using the Oen 3D Atlas (.atlas3d) Fle option.

Open the 3D Viewer and Surface Manager under the Tools menu, the .atlas3D file will will appear in the Surface Manager. Selecting the filename will show all available surfaces. Toggling the eye icon in the surface will alternate between showing and hiding the surface in the 3D surface view. Note that having more surfaces open will start to degrade performance.

Surface Manager:

The surface manager is used to modify your view in the 3D surface viewer.

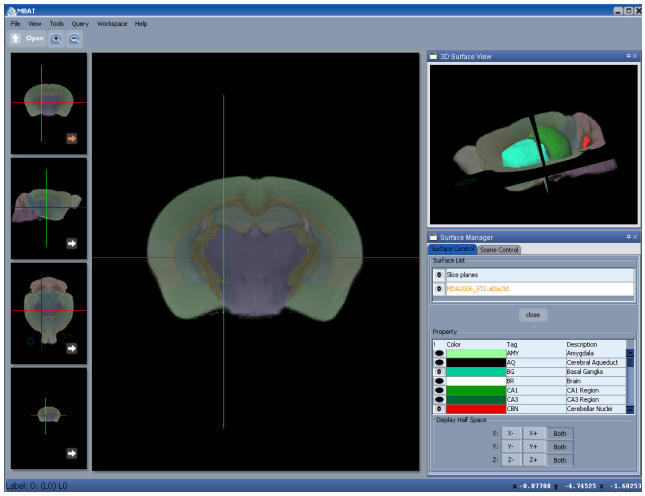

Figure 28: 3D Surface Viewer and Surface Manager with the Basal Ganglia and Caudate Putamen selected for visualization.

- Scene control lets you change the background color. Double click on the background color to modify it.
- Surface control lets you open and close surfaces, or modify the display space.

left click drag	rotate image
right click drag	rotate around center of volume faster
center button/ wheel	zoom in/out image
right click	brings up a control dialog box which allows precise rotation and reports the current rotation and rotation matrix. Horizontal rotation is around the Z-axis while vertical rotation is a around the X-axis.
+/-	traverse planes of the volume

A set of 3D surfaces of various brain areas have been included as an option for viewing in the surface folder of some atlases. Load these surfaces using the open 3D Atlas (.atlas3d) File Toolbar.

Open the 3D Viewer and Surface Manager under the Tools menu, the available surfaces will appear. Select the eye icon in the surface list to visualize the surface.

Check the X, Y, Z property under Surface Control tab to show or hide the X, Y, or Z plane. Change the 3D Surface View background color using the Scene Control tab.

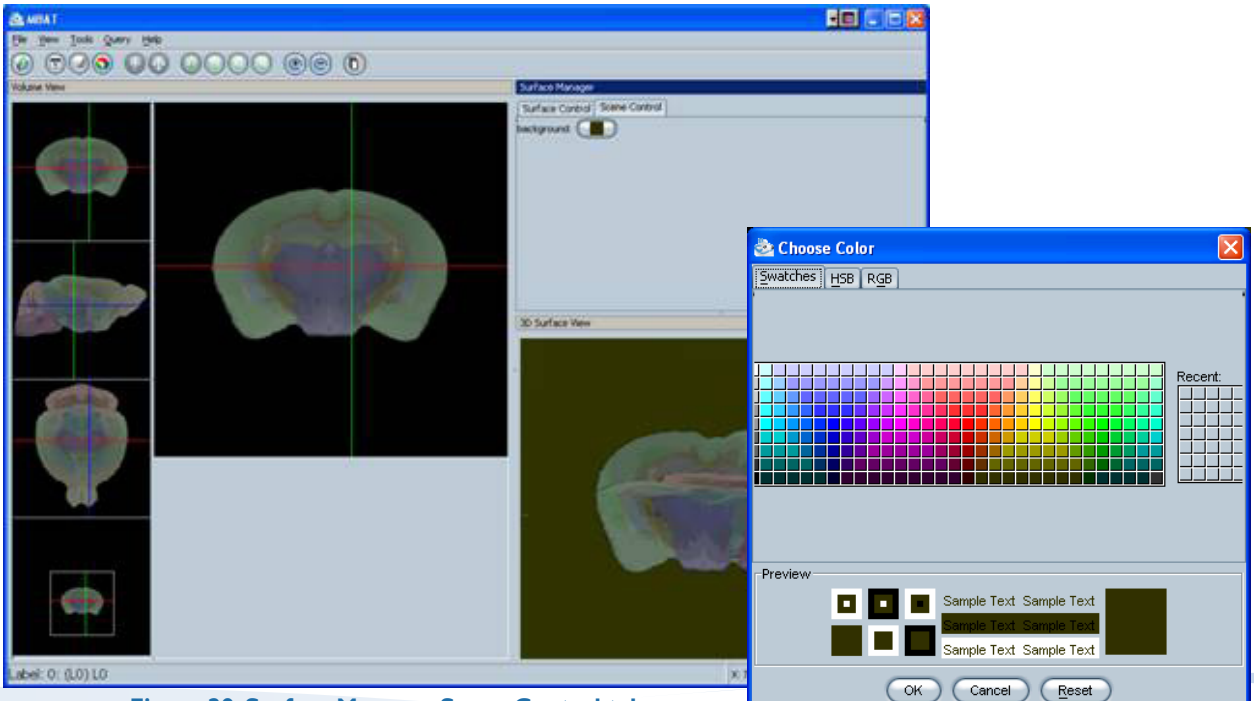

Figure 29: Surface Manager Scene Control tab

6.4. Query Data

One of the goals of the MBAT tool is to act as an easy access tool to remote data. These tools should allow the researcher to compare their own data to multi-scale and multimodal shared data. In the View Atlas space, it's possible to open up various query tools.

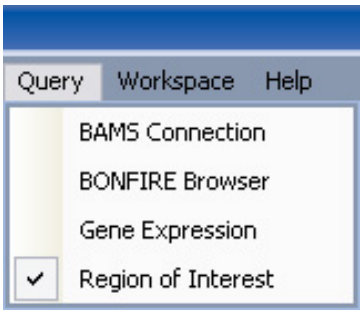

Figure30: Query Menu

Querying BAMS or BONFIRE (the BIRN Ontology System) is similar. Simply open the tool in the View Atlas Workspace and simply type a term into the search box. Currently, BONFIRE contains several experimental and clinical terms and BAMS is specialized for structures.

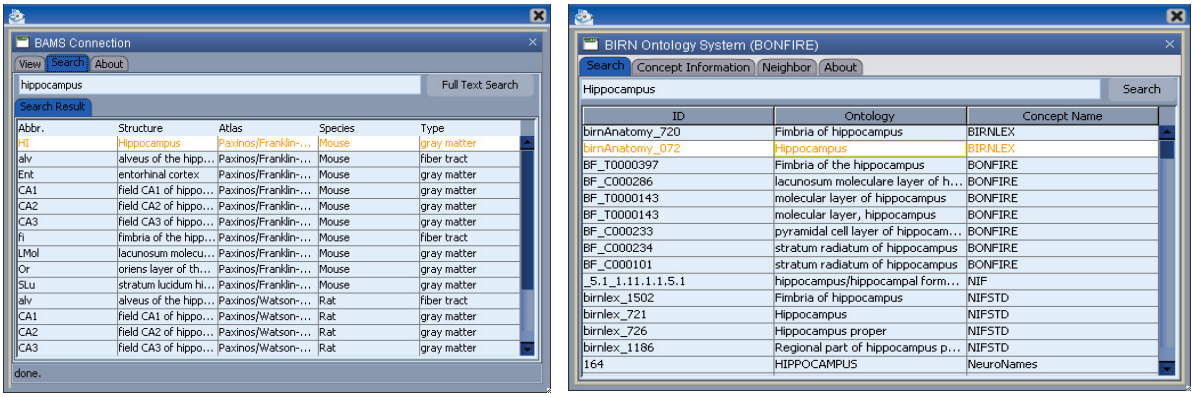

Figure 31: BAMS and BONFIRE query tools

In addition, the older Microarray query tool is included as it allows full exploration of the data in the 3D atlas.

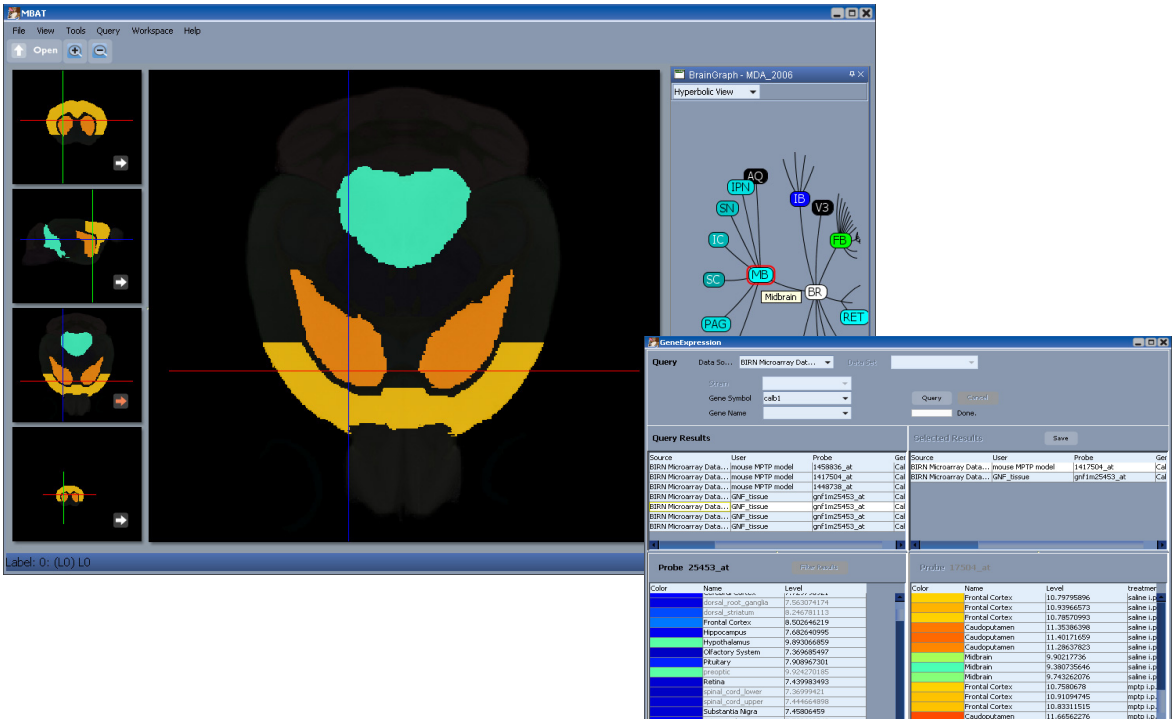

Figure 32: Microarray Gene Expression Query tool and interaction with MBAT atlas space.

6.5. Other Settings in MBAT

Docking

This version of MBAT uses the JIDE docking framework for window and tool management. For more information on these features see http://www.jidesoft.com/products/dock.htm.

1. To drag a panel, drag the title bar at top or the tool tab at the bottom to start the drag-n-drop operation to move the panel to another desired location.

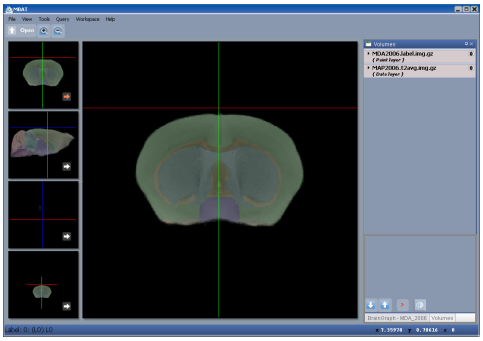

Figure 33: Volume Manager is being dragged to a new position using the bottom tab.

2. For most drop destinations (most panels except volume views), a dashed outline can be seen before drop is finished. For volume or surface views, the dashed outline will not be seen partially due to technical restrictions.

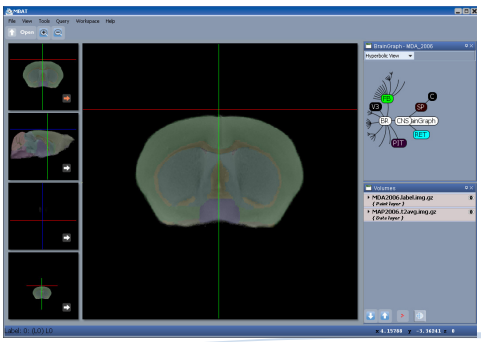

Figure 34: Volume manager has been moved to a separate panel from the BrainGraph

3. To resize a panel or windows within a panel, drag the panels to the desired size.

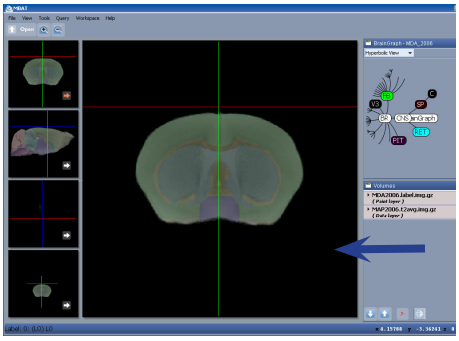

Figure 35: Arrow indicates the frame used to resize a window panel

4. These tools may be hidden by "pinning" or "unpinning" them from the workspace using the Pin icon in the upper right portion of the toolbar.

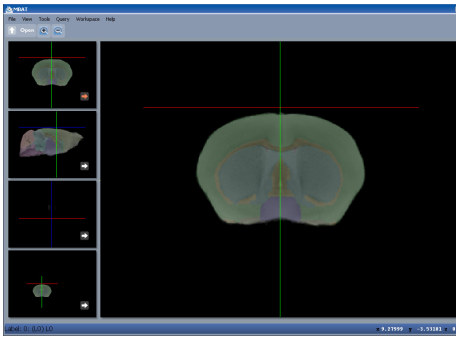

Figure 36: Tools hidden on the side panel

6.6. Help

Homepage

This link will take you to the new Mouse BIRN Atlasing Toolkit homepage that includes help, FAQ, the MBAT Forum, and contact information.

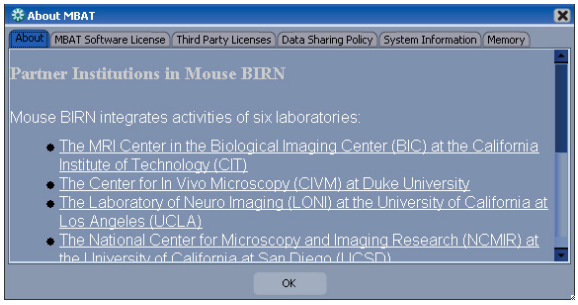

Figure 37: About MBAT Dialog Box

About MBAT

The about menu item calls a dialog box that displays the names of the developers on the MBAT project. The dialog box also includes tabs with system information, memory usage, and specific tool information.

- About
- Software License
- Data Sharing Policy
- System Information
- Memory

MBAT Settings

MBAT Settings allows user to access the Internet through an internal HTTP proxy server if required. Follow the steps below to configure MBAT for use with a proxy server:

1. Open the MBAT Settings Dialog (Help->Settings).
2. Check "Use HTTP Proxy Server" box.
3. Enter the hostname (or IP address) of the proxy server in the Server Name text box, and the port number in the Server Port text box. By default, the server port is 80. You may need to get this information from your network administrator.
4. Click the "Apply" button so that MBAT will begin routing HTTP requests to the server.

Resetting MBAT Layout:

Once tools have been opened in the View Atlas or Create Atlas Workspace, they will open the next time you enter this Workspace. If you wish to return to the original configuration for these spaces, you will need to delete the configuration files and it will reset MBAT to the default layout.

Search for and delete:

- "viewWorkSpace.layout" to reset the View Atlas Work space
- "editWorkSpace.layout" to reset the Create Atlas Work space

7. APPENDIX

7.1. View Controls

In the view window with the XY, YZ, or XZ planes, the controls are:

Control	Description
+/-	traverse the planes of the selected View
up/page down	traverse the planes of the selected View more rapidly
left click	set the cross hair position
left click	moves Label Tool and BrainGraph to the selected label
shift + left button drag	select the zoom in area. Be sure to turn off Drag Update option before doing so to clearly see the zoom in box
A/Z	traverse through the zoom history
S/F/E/D	pan left, right, up and dowsn in the zoomed view

In a view with the oblique plane, the images are generated as if the sliced plane is projected directly on to the screen. The center of rotation is the center of the volume. The controls are:

Control	Description
arrow keys	rotate around the center of the volume
left button drag	rotate freely with mouse drag
right click	brings up a control dialog box which allows precise rotation and reports the current rotation and rotation matrix. Horizontal rotation is a rotation along Z-axis while vertical rotation is a rotation along X-axis
+/-	traverse planes of the volume

In 3D surface view window, the controls are:

Control	Description
left button	rotate image
right button	move image left and right
center button/wheel	zoom in/out image
left click	set the cross hair position
ctrl + left click	set the label index at cursor to be the active label
shift + left button drag	select the zoom in area. Be sure to turn off Drag Update option before doing so to clearly see the zoom in box
A/Z	traverse back and forth in the zoom history
S/F/E/C	pan left, right, up and down in the zoomed view

7.2. Troubleshooting

Known bugs:

With this window docking framework (FlexDock), occasionally, sometimes a window may open in such a narrow space that you may not see it at first. In these cases, the user needs to widen the window with the user's mouse (see above on FlexDock)

If the user has severe problems with the docking framework, close MBAT and delete the docking preferences file, viewWorkSpace.xml under <user home directory>/.mbat/.

Command line:

Options:

-? this help message

-g turn on/off window based logging

-h this help message

-i open a label index file

-l open a label volume

-m open a mask volume

-r turn on/off rgb filter

Extended Options:

--help this help message

--label open a label volume

--labelindex open a label index file

--list-options shiva.plugins.OptionLoader$ListOptions@d83365

--log turn on/off window based logging

--log- turn on/off window based logging

--mask open a mask volume

--rgb turn on/off rgb filter

--rgb- turn on/off rgb filter