Net Station 5

Geodesic EEG Software

version 5.4.2

User manual

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Key changes in this revision (8100050-66 • NS**v5.4.2** • 2018-05-18):

- Preface: Streamlined content for clarity, including the system diagram.
- Section 1.2: Added directions for use.
- Section 1.3: Updated the features list.
- Section 1.4.1: Added EGI system connectivity safety issues.
- Section 1.4.2: Added cybersecurity safety issues.
- Section 2.1: Updated the system requirements.
- Section 6.3.8: Clarified how DC offsets are affected.
- MR Artifact Removal tool in Appendix C: Clarified how DC offsets are affected.

Revision history:

(1) 8100050-65 • NS**v5.4** • 2017-05-15
(2) 8100050-64 • NS**v5.3** • 2016-07-26
(3) 8100050-62 • NS**v5.2** • 2015-09-07
(4) 8100050-60 • NS**v5.1.2** • 2015-07-22
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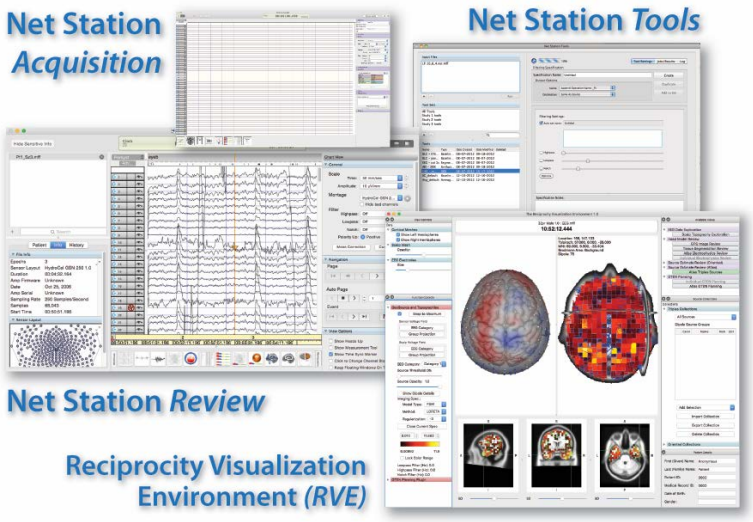
(6) 8100050-52 • NS**v5.0** • 2014-09-15
(7) 8100050-50 • NS**v5.0** • 2014-02-10

Contents

Preface

Welcome to the Net Station™ 5 high density EEG (HD EEG) software from Electrical Geodesics, Inc. (EGI).



Net Station 5 is a complete software package for acquiring, reviewing, visualizing, and analyzing EEG data. It includes the Reciprocity™ Visualization Environment (RVE).

Net Station records EEG from 32 to 256 electrode channels for:

- Routine or short-term (about 2 hours) monitoring
- Extended or long-term monitoring (LTM)
- Simultaneous EEG-PNS data *PNS (peripheral nervous system)*
- Simultaneous EEG-MEG data *MEG (magnetoencephalography)*
- Simultaneous EEG and external signal data

The Net Station 5 software operates within EGI's 400 series Geodesic EEG System™ systems (GES systems) to acquire electroencephalographic (EEG) and peripheral nervous system (PNS) data using:

- Net Amps™ (NA) amplifiers (300 or 400 series)
- *HydroCel* or *MicroCel* Geodesic Sensor Nets™ (HydroCel or MicroCel GSNs)
- Physio16™ polygraphic data acquisition devices

For details about GES 400 series systems, refer to the GES 400 series systems manual (8100400).

The Reciprocity Visualization Environment (RVE) visualizes scalp voltage data on realistic 3D head models. The 3D views are fully synchronized with Net Station Review's chart view to better understand EEG changes.

You will use separate Net Station modules while working with your scalp EEG data:

- **Net Station *Acquisition*.** Acquires scalp EEG data.
- **Net Station *Review*.** Allows you to view scalp EEG data with a variety of views:
  - Standard chart, butterfly, topo plot, topo map, events, and spectral chart, plot, and map
  - Standard 3D atlas head models via the Reciprocity Visualization Environment (RVE)
  - (*optional*) Source localization results as waveforms via:
    - GeoSource **2** (medical device)
    - GeoSource **3 Research** (non-medical product)
  - (*optional*) Source localization results on 2D MRI slices via GeoSource **2** (medical device)
  - (*optional*) Source localization results on head models via one of the three packages of the GeoSource **3 Research** (non-medical product) software (Basic, Intermediate, and Advanced) and the Reciprocity Visualization Environment (RVE):

with **Basic**	*with* **Intermediate**	*with* **Advanced**
Six built-in atlas head models	**Conformal atlas head models (CAHMs)**	**Individual head models (IHMs) and CAHMs**
3D head models	3D head models	3D head models
MRI slices	MRI slices	
Triples dipole sources	**Triples** dipole sources	**Oriented** dipole sources

GeoSource 2 (medical device)	versus	GeoSource 3 Research (non-medical product)
Note that a source montage in GeoSource 2 (medical device) is the same as a source collection in GeoSource 3 Research (non-medical product).		**FOR SCIENTIFIC RESEARCH PURPOSES. Be aware that any source waveforms created using GeoSource 3 Research (non-medical product) are restricted to scientific research purposes only.**

For detailed instructions for using the full-featured version of the GeoSource source localization software, refer to the GeoSource **2** (medical device) manual (8103101-52) or the GeoSource **3 Research** (non-medical product) manual (8103101-54).

- **Net Station *Tools*.** Further explores EEG data with over two dozen specification tools.
- **Utilities.** Utilities are also available for validating files, converting older files, updating your software HASP, and working with an anti-alias filter and event timing.

Typical GES System

As a core component of the GES 400 family of EEG devices, the Net Station software allows you, as a trained clinician or doctor, to:

- Measure and record the electrical activity of the patient's brain, including adults, children, and infants.
- Acquire EEG data from one or more Net Amps amplifiers or to acquire simultaneous data from two different signal sources
- Visualize data that may be used to aid in the diagnosis of epilepsy and other related neurological disorders via the Reciprocity Visualization Environment (RVE).
- *With the exception that the accessory Geodesic Sensor Nets (GSNs) are not recommended for use with non-intact skin.*

See Figure P-1.

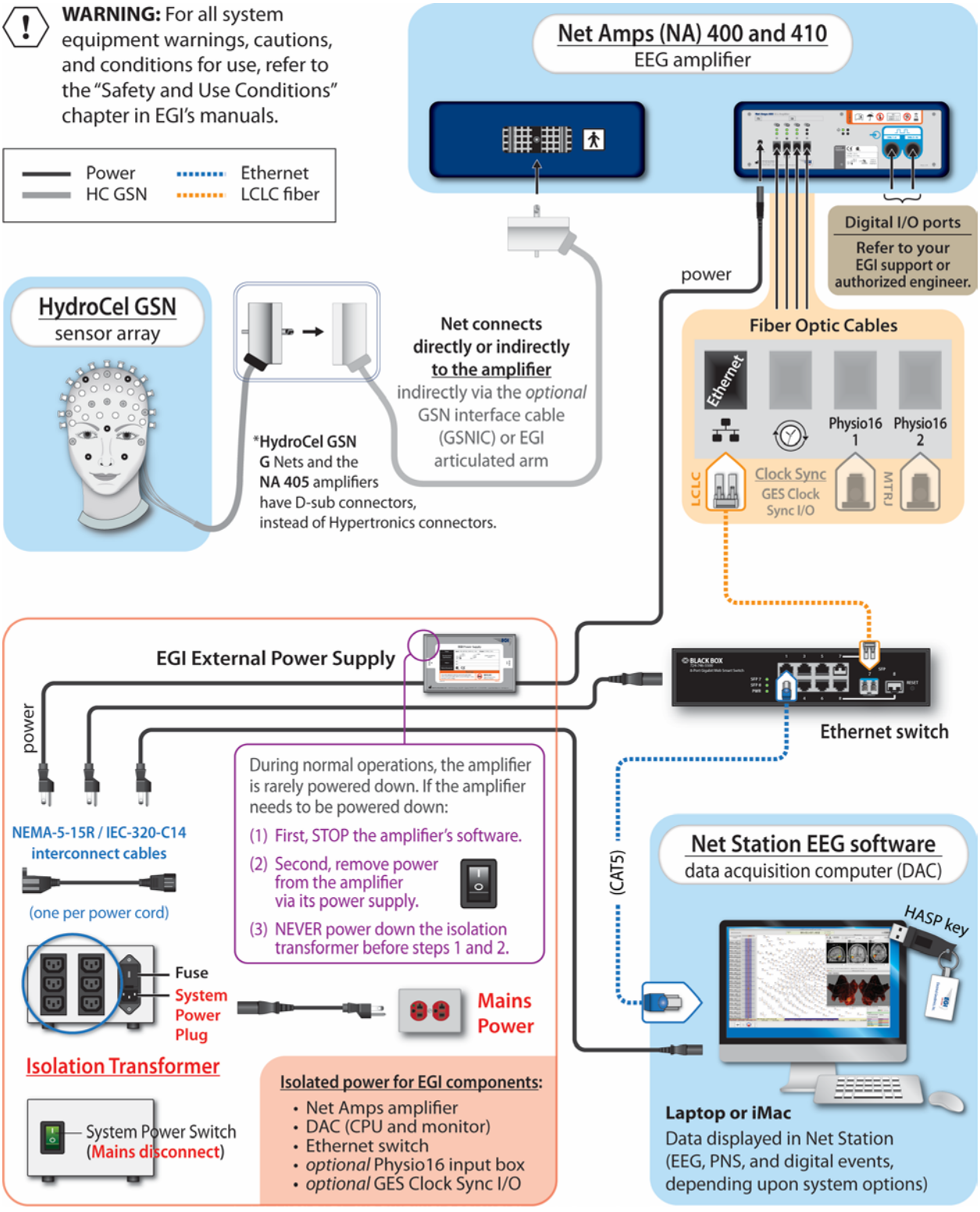


Figure P-1. Core components of a typical EEG-only GES system

Table P-1. Parts list for typical GES 400 series systems, including the Net Station software
GES systems are expandable. Your system components will be specific to your purchased configuration.

Part			Qty	Mfr	Mfr P/N	EGI P/N
For all safety, use conditions, and step-by-step instructions for using the components of your EGI system, refer to the manuals and instructions (including third-party manufacturer documentation) that shipped with your system configuration.						
NOT ALL EGI SYSTEM OR SOFTWARE PRODUCTS OR FEATURES ARE AVAILABLE FOR PURCHASE OR USE IN ALL COUNTRIES OR MARKETS. Refer to www.egi.com/company/certificationscompany.						
Core components—Software Contains the Net Station Acquisition, Net Station Review, and Net Station Tools modules.						
Net Station (NS) 5			1	EGI		variant dependent
HASP key			1	Safenet	YWRGC	variant dependent
Core components—Amplifier Contains Amp Server™, the software that controls, collects, and publishes data from the amplifier to Net Station.						
Net Amps 400 (NA 400)	**Amplifier Sampling Rates** 1 Ksps with Net Station up to 8 Ksps with Net Station *and Amp Server Pro SDK* **Amp Server Pro SDK is for scientific research purposes.**	**32-channel**	1	EGI		4603285
		64-channel				4606358
		128-channel				4606168
		256-channel				4608880
Not available in China **Net Amps 405** (NA 405) *with D-sub connector to connect to the HydroCel GSN* ***G***		**32-channel**	1	EGI		4603293
Net Amps 410 (NA 410)		**32-channel**	1	EGI		4603289
		64-channel				4606362
		128-channel				4606172
		256-channel				4608884
Core components—Misc.						
Articulated Arm for GSNs		**128-channel**	1	EGI		4605128
		256-channel	1	EGI		4605256
Computer, monitor, keyboard, mouse: iMac or laptop			1	Apple	current model	current model
Ethernet switch			1	Black Box	LGB2008A-R2	6156366
Power supply ***availability*** **		**GES External Power Supply**	1	EGI		4603988
		EGI External Power Supply 100				4603990
Isolation transformer			1	Toroid	ISB-060M	6156331
Accessory components—Sensor Array Most Geodesic Sensor Nets (GSNs) have a modular Hypertronics connector. The HydroCel GSN **G**, however, has a D-sub connector and connects only to the Net Amps 405 amplifier.						
HydroCel GSN			1 or more	EGI		variant dependent
MicroCel GSN			1 or more	EGI		variant dependent
Optional components						
Amp Server™ Pro SDK 2 (non-medical product) **FOR SCIENTIFIC RESEARCH PURPOSES**			1	EGI		4602003
AV Device Kit			1	EGI		4601418
AV Device DIN Adapter			1	EGI		4609786

Part			Qty	Mfr	Mfr P/N	EGI P/N
Video camera	Basic PTZ		1	Axis	M1065-L	4600320
	Standard PTZ with IR and microphone		1	Axis	P3364-LV	4600319
	Advanced PTZ with IR, microphone, and remote control		1	Axis	Q6055	4600318
Cart	small		1	EGI		4601100
	large		1	EGI		4607100
EGI External Battery Pack			1	EGI		4605312
Field Isolation Containment System (FICS) *Allowed for non-MRI Uses**	FOR SCIENTIFIC RESEARCH PURPOSES for EEG-MRI in the U.S.	128-channel	1	EGI		4602986
		256-channel	1	EGI		4609069
Clock sync ***availability****	GES Clock Sync I/O		1	EGI		4608295
	GES Clock Sync I/O					4608296
Geodesic Photogrammetry System (GPS)			1	EGI		4601900
GeoScan 1 (non-medical product) FOR SCIENTIFIC RESEARCH PURPOSES			1	EGI		4609761
GeoSource 2 (medical device)			1	EGI		variant dependent
GeoSource 3 Research (non-medical product) FOR SCIENTIFIC RESEARCH PURPOSES			1	EGI		variant dependent
GSN Interface Cable (GSNIC)	128-channel		1	EGI		4606128
	256-channel		1	EGI		4606256
Photic Stimulator			1	EGI		4609125
Physio16			1 or 2	EGI		4609271
Physio16 MR (non-medical product) FOR SCIENTIFIC RESEARCH PURPOSES			1 or 2	EGI		4609272
Response Pad			1	EGI		4608150
Documentation GSN user instructions differ per GSN variant—HydroCel or MicroCel and routine or LTM.						
AV Device Kit manual			1	EGI		S-MAN-200-AV-001
Computer, monitor, keyboard, mouse: iMac or laptop					For all safety and use conditions for using the computer that is shipped with your EGI system, refer to third-party manufacturer manuals at https://support.apple.com/country-selector/manuals.	
GeoScan 1 manual (non-medical product) FOR SCIENTIFIC RESEARCH PURPOSES			1	EGI		8100550
GeoSource 2 (medical device)			1	EGI		8103101-52
GeoSource 3 Research manual (non-medical product) FOR SCIENTIFIC RESEARCH PURPOSES			1	EGI		8103101-53/54
GES 400 manual			1	EGI		8100400
GES 400 MR manual (non-medical product) FOR SCIENTIFIC RESEARCH PURPOSES			1	EGI		8100401
GSN manual			1	EGI		8105171
Net Station manual			1	EGI		8100050
Routine EEG placard			1	EGI		variant dependent
LTM EEG placard			1	EGI		variant dependent
Preterm Infant placard			1	EGI		variant dependent

** For details, refer to the GES 400 series manual (8100400) and/or contact Technical Support (Table P-2).*

*** Changeover between equivalent component model/variants is due to parts availability.*

About This Manual

This manual provides general information for safely and effectively using the Net Station software to acquire, review, visualize, and analyze EEG data.

This manual assumes a working proficiency with EEG and computer systems.

NOT ALL EGI SYSTEM OR SOFTWARE PRODUCTS OR FEATURES ARE AVAILABLE FOR PURCHASE OR USE IN ALL COUNTRIES OR MARKETS. The sale of medical devices is strictly regulated by national laws. This manual is not an offer to sell a medical device in any country where its sale would be prohibited by national law. For the current regulatory clearance status of EGI products in your country, go to www.egi.com/company/certificationscompany.

Typographic Conventions

- *Italics* are used for definitions or newly introduced terms.
- ***Boldface italics*** are used for important concepts or for special emphasis.
- **Boldface** is used for command paths (for example, **File ▶ Open**).

Warnings, Cautions, and Notes

The following are used to convey important information:

WARNING: Warnings provide important information that, if unheeded, could result in serious physical injury, death, or equipment damage.

CAUTION: Cautions provide important information that, if unheeded, could hinder the use of a product, feature, or procedure, or result in physical injury or equipment failure.

Notes provide clarifying information about a product, feature, or procedure.

Support, Repairs, and Documentation

Electronic copies of EGI's user manuals and instructions are available for download at www.egi.com/knowledge-center or from the Training and Technical Support tab at www.egi.com.

Knowledge Center

For articles that address the various procedural and theoretical aspects of EEG acquisition, click the **Training and Technical Support** tab at www.egi.com.

- The **Type** tab provides articles by:
  - application advice (usage, best practices, workflows, etc.)
  - technical/troubleshooting/help advice
  - implementation theory of features and functions
  - theoretical background of dEEG, source localization, etc.
- The **Products** tab provides articles by product group.
- The **Manuals** tab provides product manuals by product group.
- The **Video Tutorials** tab provides product and instruction videos.

If you have a question, please:

- For *urgent issues during acquisition*, contact EGI immediately.
- For *nonurgent issues*, do the following before contacting EGI:
  - **Isolate the problem.** Try to repeat and define the problem.
  - **Document the problem.** Carefully record the sequential details of the problem.
  - **Report the defined problem.** Contact EGI.

Table P-2. EGI contact information

Technical Support web page	www.egi.com/ knowledge-center
Email Technical Support	supportteam@egi.com
Email Sales	orderdesk@egi.com
Telephone	+1.541.687.7962
Fax	+1.541.687.7963
Address	Electrical Geodesics, Inc. (EGI) 500 East 4th Avenue, Suite 200 Eugene, OR 97401 USA

1. Safety and Use Conditions

Before using your GES system, including the Net Station software, ***ensure that you are fully trained, proficient in its use, and understand all warnings, cautions, and conditions for use*** provided in EGI's manuals for the components of your system.

WARNING: All EGI system components must be connected by a qualified service technician and configured according to the instructions in your EGI system manual. Deviating from the supported configuration, running the system with non-EGI-approved components attached, or poorly connected devices may result in:

- hazards or unexpected performance due to additional loading or leakage; or
- poor system timing and/or poor data quality that may not be apparent.

For all safety and use conditions for using your EGI system, refer to the manuals and instructions that shipped with your system.

Note that the information in this manual is subject to change, without notice. The manufacturer declines responsibility for the safety, reliability, and performance of EGI system components if not used in compliance with EGI documentation.

If you have any questions, contact Technical Support (Table P-2).

1.1 Indications for Use—GES 400 series systems with Net Station

The Geodesic EEG System™ 400 Series (GES 400) is intended to measure and record the electrical activity of the brain. It can be used on adults, children, and infants.

1.2 Features

- Complete software package for the acquisition, review, and analysis of EEG data
- Accepts and synchronizes EEG, video, audio, TTL, TCP/IP inputs, up to 32 peripheral nervous system (PNS) signals, and external signals

- Supports multimodal imaging, including EEG-MEG, EEG-NIRS, and EEG-TMS
- Seamless integration with EGI's GeoSource electrical source imaging software with individual head models
- Tools for collaboration, including networking, report writing, and file de-identification
- Acquires and analyzes EEG data from 32 to 256 channels
- Displays EEG scalp data projected on an interactive 3D head and synchronized with chart, topo plot, topo map, butterfly, and video views
- Reciprocity Visualization Environment (RVE) for the visualization of scalp voltage fields on realistic head models
- Optimized for standard workflows
- Customizable workspaces and montages
- Single window dashboard of all controls
- Support for Ethernet-connected digital PTZ cameras
- Metafile Format (MFF) for faster processing, efficient data compression, no file size limit, and expanded interoperability with APIs
- Exports to many file formats, including EDF+, MATLAB, and Persyst

1.3 Safety Warnings

1.3.1 Connectivity

WARNING: Never deviate from the supported configuration of your EGI system. EGI bears no liability whatsoever for any hazards or unexpected performance that may result.

- Never install or operate non-EGI software on EGI systems.
- Never connect (via wired or wireless connection) non-EGI components (external firewalls, routers, etc.) to EGI systems. EGI systems are intended to be stand-alone devices.
- Only trained, skilled, and authorized qualified technicians are allowed to use EGI systems.

1.3.2 Cybersecurity

WARNING: Depending upon customer configuration, EGI systems may contain anti-virus software that has been installed at the factory.

- It is the responsibility of end users to install appropriate anti-virus software on those systems that do not come with it.
- It is the responsibility of end users to maintain the anti-virus software and security patches.
- It is the responsibility of end users to take precautions to mitigate the risks of cybersecurity threats in their use environment, including the use of an internal firewall.
- It is the responsibility of end users to ensure that only virus-free flash drives or memory sticks are used if/when importing/exporting data on EGI systems.

1.3.3 Data Acquisition Computer (DAC)

CAUTION: Before upgrading your EGI system (computer, operating system, or EGI software), confirm compatibility with Technical Support (Table P-2).

1.3.4 Reviewing and Manipulating EEG Data

CAUTION: Vary file names within the first 22 characters. When exporting data to text files, Net Station truncates file names longer than 22 characters. If truncated file names are identical, they may overwrite each other

2. Software

EGI protects its software from unauthorized use by encoding the licensing data in a HASP key (similar to a USB flash drive). All authorized EGI software users have a HASP key that plugs into one of the USB ports of any EGI Mac OS system computer to allow access to the purchased applications licensed to that HASP key.

For all safety, use conditions, and step-by-step instructions for using the components of your EGI system, refer to the manuals and instructions (including third-party manufacturer documentation) that shipped with your system configuration.

2.1 System Requirements
for Net Station 5.4.2

Table 2-1. Software/firmware compatibilities

Net Station	Mac OS	Compatible Amplifier Firmware	
		NA 400s	NA 300s
5.4.2	10.13.4	v2.0.14	
	10.12		v11
5.4*	10.12.4	v1.6.21**	v11
	10.11.6		
5.3.0.1*	10.11.5	v1.6.17**	v11
5.2	10.10.5	v1.6.17**	v11
4.5.7	10.6.8	v1.4.5	v11

*Net Station 5.4.2 requires an Intel Core 2 Duo processor (2 GHz minimum) with a recommended 16 GB RAM.
**If using Amp Server Pro SDK 2.1, you must use amplifier firmware version 1.6.17 or later.

To confirm the system requirements for earlier versions of Net Station, contact Technical Support (Table P-2).

2.2 Installation

The Net Station software comes installed on the EGI system computer. If you need to reinstall or upgrade the software, contact Technical Support (Table P-2).

3. Net Station Interfaces

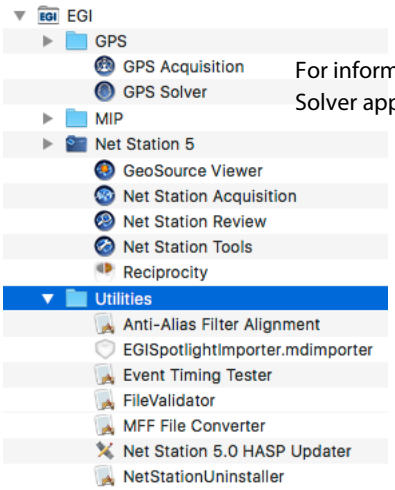
The Net Station *Acquisition*, *Review*, and *Tools* modules have interfaces that feature mostly standard controls. **Standard controls operate as expected.** Nonstandard controls are explained in chapters 6, 7, and 8.

If you desire additional training or support with Net Station, contact Technical Support (Table P-2).

▶ If their icons are not in the Dock  , access Net Station's modules from:

Finder ▶ Applications ▶ EGI ▶ Net Station 5

- ▶ Net Station *Acquisition* (see 3.1)
- ▶ Net Station *Review* (see 3.2)
- ▶ Net Station *Tools* (see 3.3)



For information regarding the GPS Acquisition and GPS Solver applications, refer to the GPS manual (8103002).

Note that any GeoSource **2** (medical device) or GeoSource **3 Research** (non-medical product) functionalities that are available through the Net Station software are described in this manual.

3.1 Acquisition Interface

The Net Station *Acquisition* interface is used for acquiring EEG and PNS data.

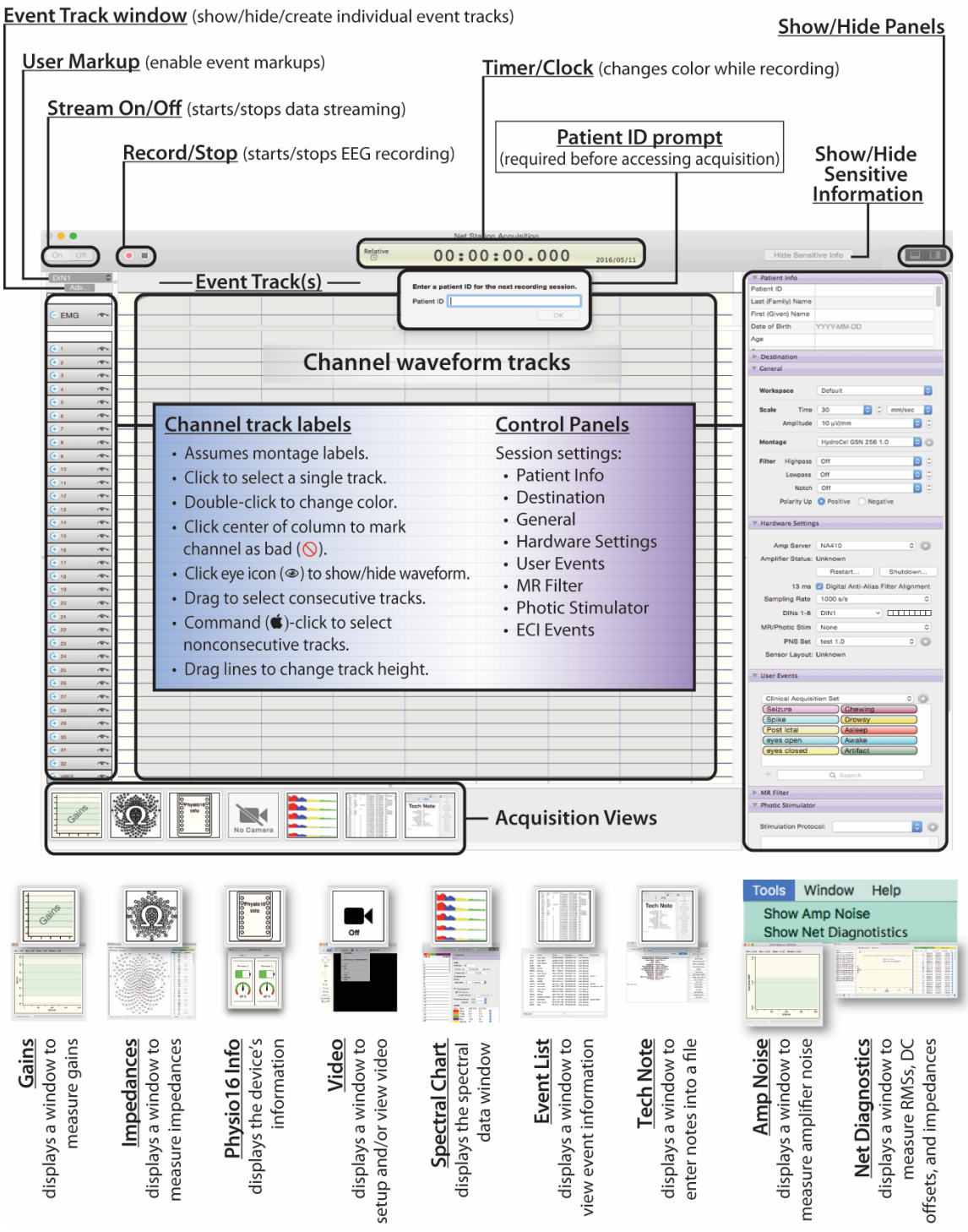
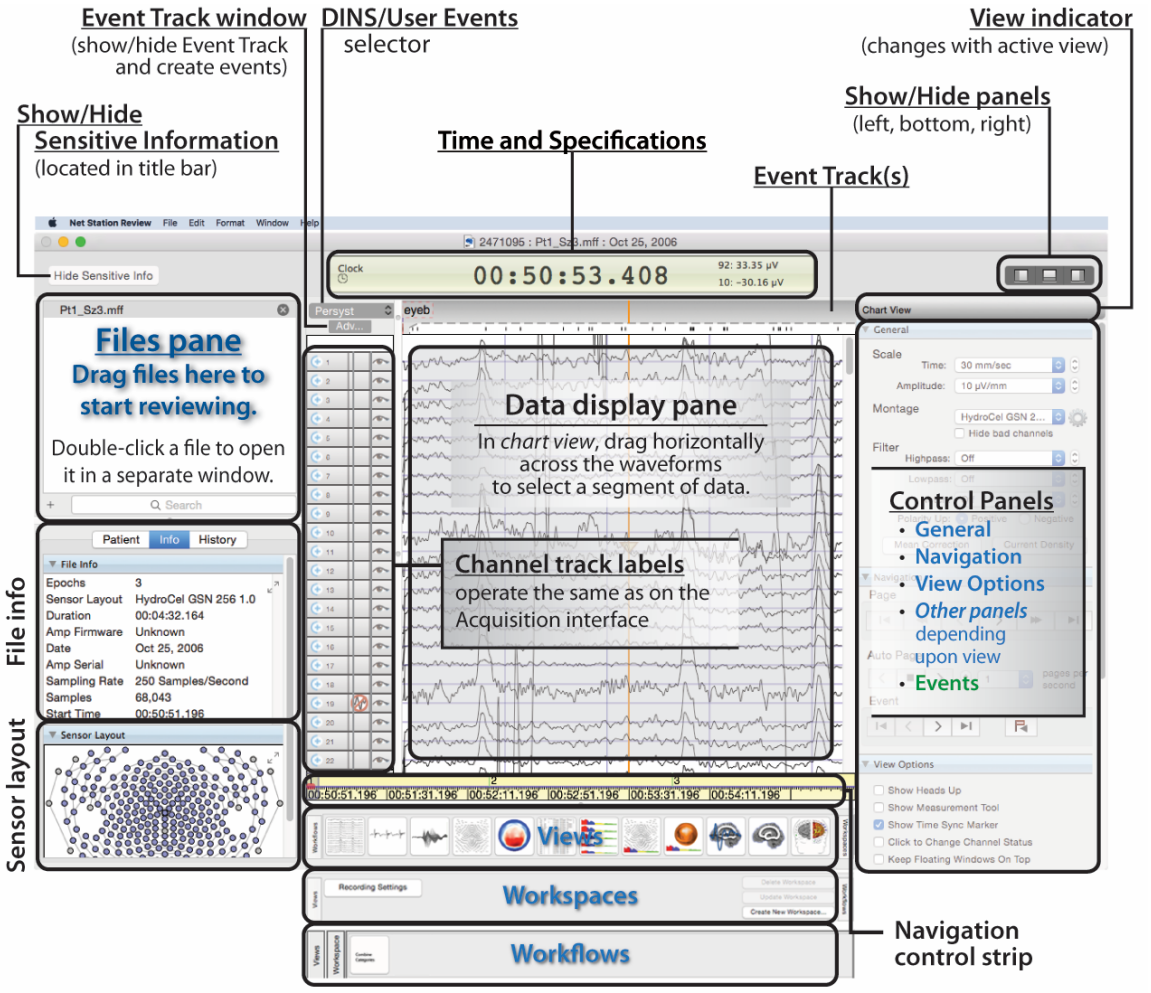


Figure 3-1. Net Station *Acquisition* interface

3.2 Review Interface

The Net Station *Review* interface is used for reviewing EEG data.



Button bars:

Views: Chart, PNS*, Butterfly, Topo Plot, Topo Map, Video*, Events, Spectra Chart, Spectral Plot, and Spectral Map
GeoSource 2 Waveforms** and MRI Slices**
GeoSource 3.0 Research Head Models in RVE***

Workspaces: Recording Settings and user defineable

Workflows: Combine Categories

*Present when data is present. **Present with licensed optional software.
***3D topo maps are standard, but other features require licensed optional software.

How to use the Views:

- Click to open multiple views in the same window.
- Command (⌘)-click to open views in separate windows.
- Multiple views in the same window are linked.
- Views in separate windows are not linked.
- Click the **X** in the upper right corner to close individual views.

Figure 3-2. Net Station *Review* interface

3.3 Tools Interface

The Net Station *Tools* interface is used for analyzing EEG data.

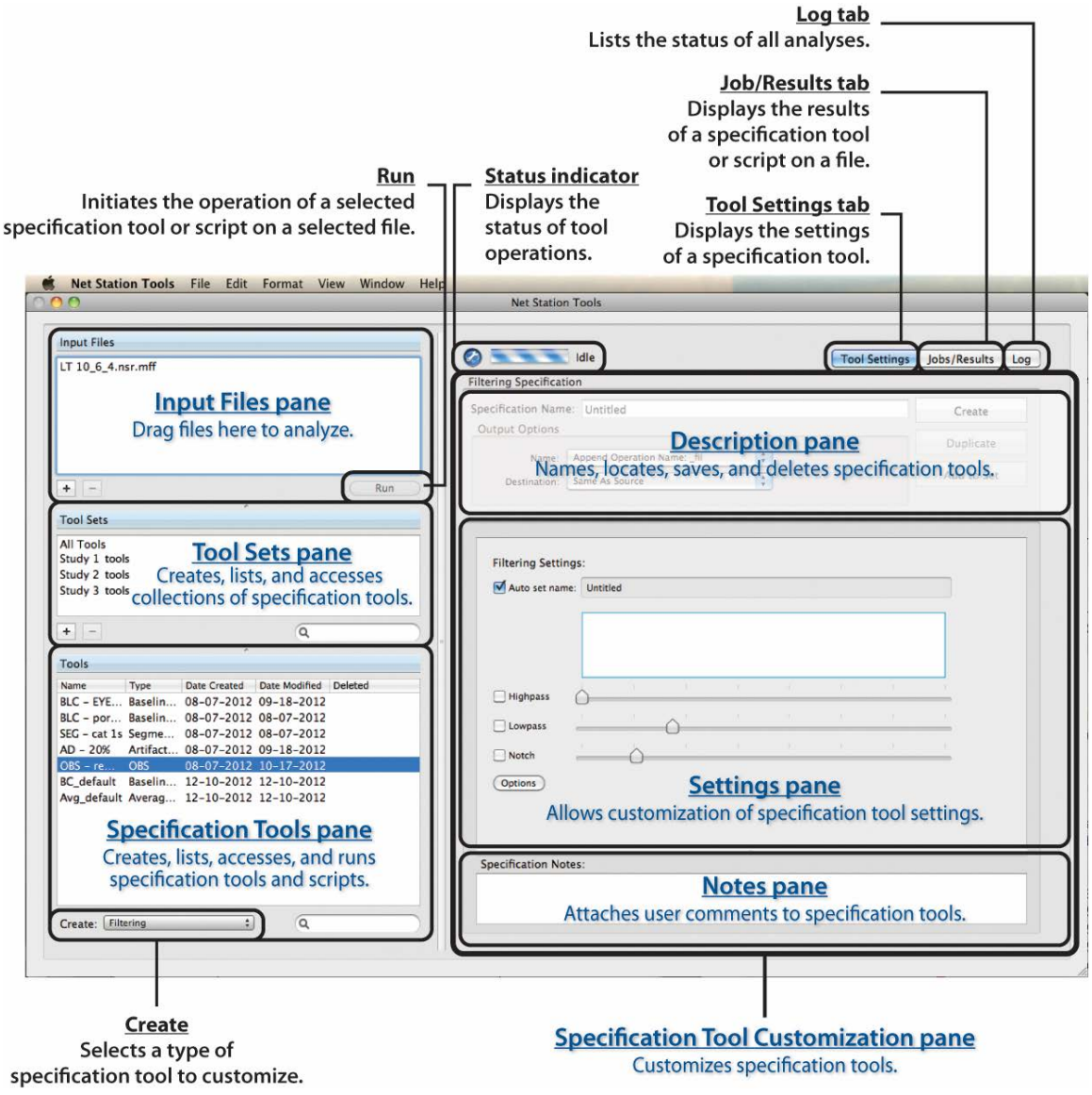


Figure 3-3. Net Station *Tools* interface

3.4 Workspaces

Workspaces are handy collections of windows and view settings to make doing repetitive work quicker and consistently. How you create them, however, is different in *Acquisition* (see section 6.3.5.1) from *Review* (see section 7.2.2.3).

Workspace features:

- Recording settings are saved to a file during recording and become one of the available workspaces that users can choose in Net Station Review.
- Users can create, save, edit, and delete custom workspaces.
- The settings available for workspaces include the locations, sizes, and scroll positions of views; time and amplitude scales; filter, montage, mean correction, current density, and GeoSource settings; active event sets; and event editing mode.
- If selected, workspaces open with files.
- In Net Station Acquisition, the last workspace used will be the one that opens the next time you launch Acquisition.
- When selected, the view attributes of a workspace appear, replacing the view attributes of the previous workspace.
- The active workspace can be updated, while in use, by changing its settings, then selecting Update under the Workspace feature of the General control panel.
- If a workspace contains settings or values that are not found or are in conflict with the file being opened, they will be ignored.
- You can set all files to open with no, a default, or individual workspaces with the Review Preferences dialog. If a default workspace is selected, then all files will open with the same settings, instead of individual files opening with different settings.

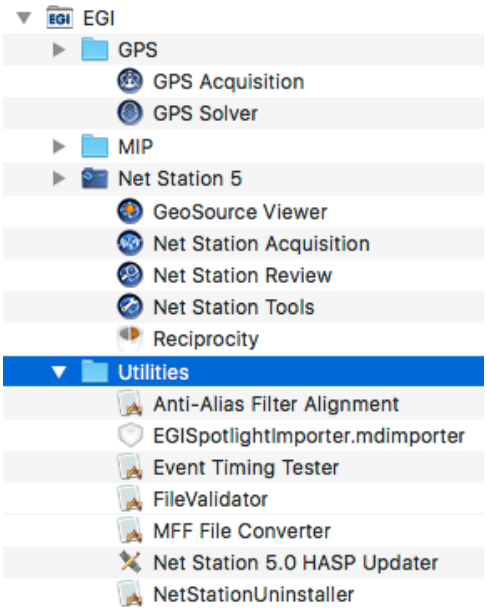
4. Net Station Utilities

Net Station includes a series of utilities to facilitate auxiliary tasks.

Launch them from:

Finder ▶ Applications ▶ EGI ▶ Utilities.

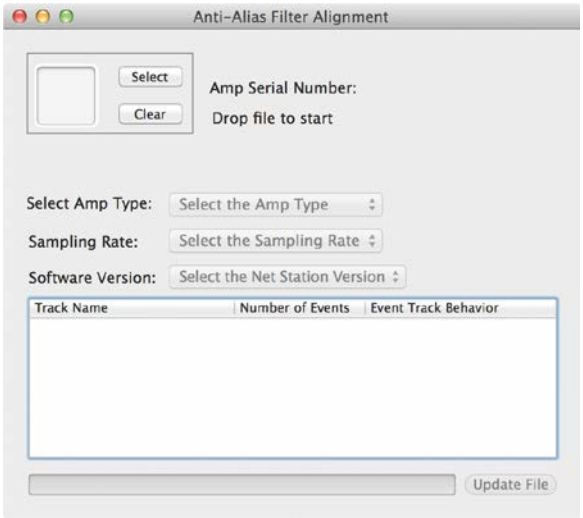
Remember that not all features are available in all versions of software. If you have any questions, contact Technical Support (Table P-2).



4.1 Anti-Alias Filter Alignment

If not adjusted for during acquisition (section 6.3.6.3), use this utility to adjust files for the delay of the recorded EEG relative to the real-time events recorded during EEG acquisition.

MFF files must be version 3.0 or later.



CAUTION: This utility will change the original file—it does not generate a new file. Always make a copy of a file and run this utility on the copy.

Be aware that event tracks differ when considering whether or not to run this utility on a file.

- Manually marked events are already correctly aligned, so you do not need to run the utility for those events.
- DIN and TCP/IP events (for example, ECI events) are delayed, so you might want to apply the utility.

If you are unsure, contact Technical Support (Table P-2).

If you have applied the wrong values to a file, you can use this same utility to undo the adjustment, and then update the file again with the correct values.

To use this utility:

⊇ Drop or select the file to be adjusted.

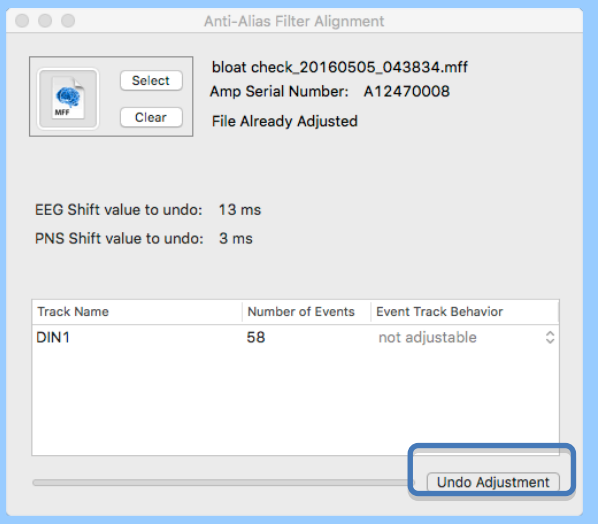
⊄ Select the type of amplifier that was used for the recording.

The sampling rate for the amplifier is automatically populated.

⊂ Select the version of Net Station that recorded the file.

⊆ Click **Update File**.

Note that the utility will not adjust a file more than once. It also will not adjust a file that was automatically adjusted during recording with the Digital Anti-Alias Filter Alignment setting from the Hardware Settings panel.



4.2 Spotlight

The Spotlight utility (showing in the Utilities folder as EGISpotlightImporter) requires you to do nothing to take advantage of it. It is installed when Net Station is installed.

This utility is a plug-in that works locally to let our Mac's OS X understand and index your MFF-based EEG and GPS data files so that you can use Apple's Spotlight feature to search those files using such criteria as Net type or a specific event code.

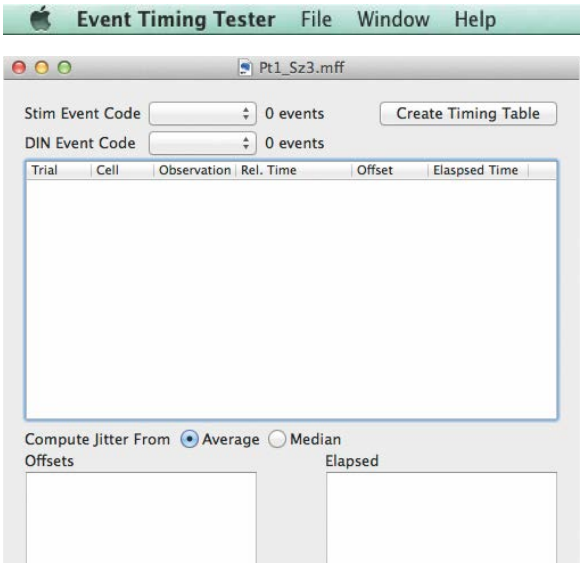
4.3 Event Timing Tester

Use this utility to chart and compare the Stim and DIN event codes found in a recording.

Open the utility with a file by selecting **File ▶ Open** or dragging the file onto the utility's icon in Finder.

Note that the file must be an MFF file, but it can be any version of MFF (v1, v3, etc.).

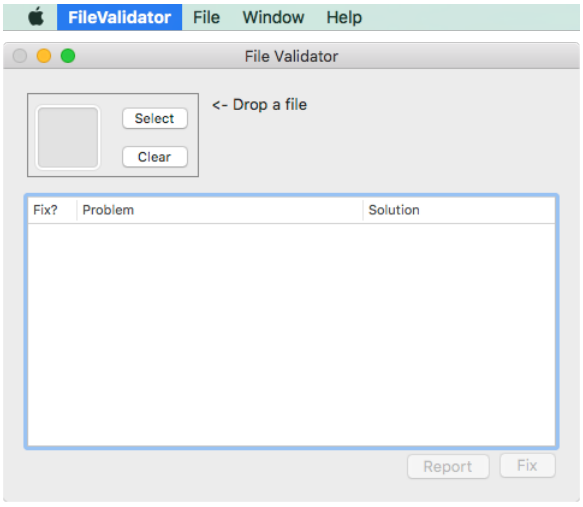
For assistance, contact Technical Support (Table P-2).



4.4 File Validator

The File Validator utility is available to identify issues with problematic files, and then fix those issues that are fixable.

This utility works only on .mff files (any version).



CAUTION: This utility will change the original file—it does not generate a new file. Always make a copy of a file and run this utility on the copy.

To use this utility:

- ⊇ Drop or select a file to be validated.
- ⊄ The File Validator utility then identifies none, one, or more color-coded *fixable* and/or *nonfixable* issues.
- ⊂ To fix an issue: select (check) the **Fix?** checkbox next to it.
- ⊆ Click the **Fix** button.
- ∈ Those issues that were fixed will now display as **purple**.
- ∉ Results are added to the history of files that are validated.

  If desired, click **Report** to save a .txt file of the results.

Table 4-1. Description of the File Validator's color coding

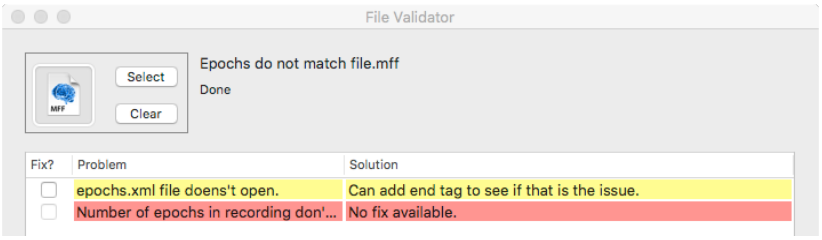
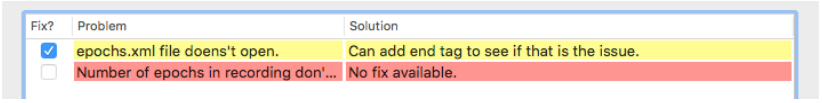
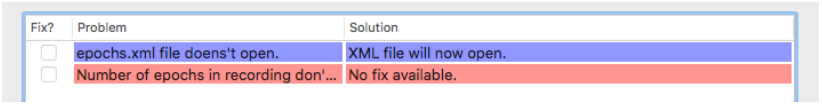
Color	Description
BLANK	The utility has identified no issues in the file.
GREEN	The utility has identified an issue that is fixable with the identified solution.
YELLOW	The utility has identified an issue that might be fixable with the identified solution.
PURPLE	The utility has fixed the issue.
CYAN	The utility has identified an issue that requires the assistance of Technical Support.
RED	The utility has identified an issue that cannot be fixed.

Table 4-2. Sample File Validator identified issues, identified solutions, and fixed issue results

Identified Issue	Identified Solution	Fixed Issue Results
Older MFF file version.	Update recording to the new MFF version.	MFF file updated to the latest MFF version.
Epochs.xml file missing.	Fix to generate epochs file.	Epochs.xml file generated.
Sensorlayout.xml has sensors with identifiers as their numbers.	Will move the identifiers to the correct tag and update their number.	Corrected sensors with bad numbers.
Coordinates.xml has sensors with identifiers as their numbers.	Will move the identifiers to the correct tag and update their number.	Corrected sensors with bad numbers.

Identified Issue	Identified Solution	Fixed Issue Results
Movie sync file found, but no video data.	Will delete erroneous movie sync file.	Erroneous movie sync file removed.
Info.xml file missing.	Fix to generate new info.xml with current clock time as start.	New info.xml created using the current clock time.
Epochs.xml file missing, but event files exist.	We can attempt to generate an epochs file, but if there are multiple epochs in the file, the events won't line up any more.	Epochs.xml file generated.
No signal data for info2.xml.	Can delete erroneous infoN.xml if other signal data exists.	Erroneous info2.xml file removed.
History.xml file doesn't open.	Can add end tag to see if that is the issue.	Xml file will now open.
Epochs.xml file doesn't open.	Can add end tag to see if that is the issue.	Xml file will now open.
lastSettings.xml file doesn't open.	Can add end tag to see if that is the issue.	Xml file will now open.
Missing xml in subject.xml file not found in subjects folder.	Contact EGI Support Team for instructions to fix this file.	
No info1.xml for signal1.bin.	Contact EGI Support Team for instructions to fix this file.	
No signal data at all.	No fix available.	
Unsupported File Type	No fix available.	
No movie sync file found.	EEG and video data will not line up properly.	
Info.xml file missing, but event files exist.	Cannot fix because we don't know the start time to use that would keep the events in the right place.	
Number of epochs in the recording don't match the number of epochs in the file.	No fix available.	
Number of epochs don't match the number of segments.	No fix available.	
Epochs.xml file does not match signal bin based epochs.	No fix available.	

Example

Identified Issue	Identified Solution	Fixed Issue Results
Identified two issues: one fixable and one nonfixable		
Checked one to fix:		
One of two fixed:		

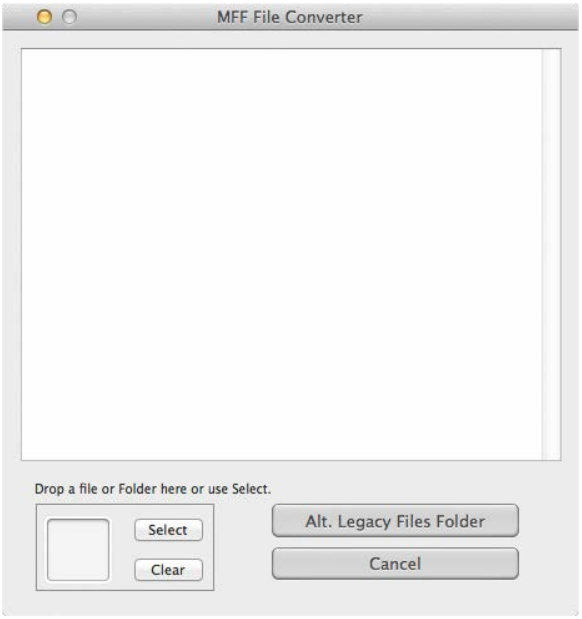
4.5 MFF File Converter

Two MFF File Converter utilities are available to convert older file formats to the latest MFF version 3 format.

CAUTION: Depending upon which converter is used, this utility will change the original file—it does not generate a new file. Always make a copy of a file and run this utility on the copy.

	MFF File Converters	
Mac OS X	10.9.5	10.6.8
Formats converted	MFF v1 – to – MFF v3	NSR – to – MFF v3
How converted	original file changed	new file generated
Will not work on these Net Station export formats	NS Simple Binary, EGIS, Text, Persyst, and MATLAB	

Use the appropriate version of the utility when converting older files to the latest Metafile Format (MFF).



To use this utility:

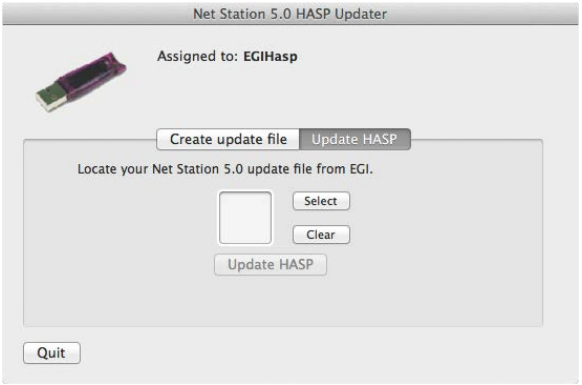
- If desired, save your output files to a location other than where they originated by clicking **Alt Legacy Files Folder**.
- Drop or select the file(s) to be converted. Conversion is automatic. Progress messages will appear in the text pane.

  Note that this utility converts single files, a selection of files, or one folder of files—but not files that are in a folder within a folder.
- Unless canceled, the conversion is complete.

4.6 Net Station 5 HASP Updater

Use this utility when updating your HASP.

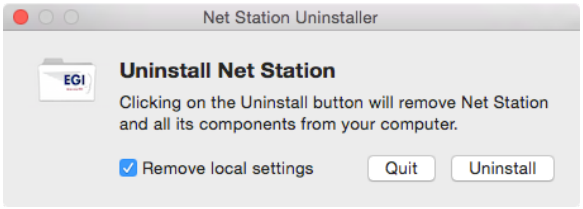
For details, refer to the HASP updating guide (8408078).



4.7 Net Station 5

Uninstaller

Use this utility only at Technical Support's direction.



5. Sample EEG Acquisition and Review Workflow

Workflows are provided for reference only. It is the responsibility of users to follow the laws and regulations of the country in which they are located. EGI does not endorse any "off-label" (that is, unintended or unapproved) use of its products.

The sample workflow in Table 5-1 highlights the typical steps needed to acquire and review EEG data. Your steps may differ.

Contact Technical Support (Table P-2) for:

- specific workflows for routine, LTM, or other recordings, and
- details for using the **tools** of Net Station *Tools*.

Table 5-1. Sample workflow for typical routine EEG

I – Acquire EEG with *Net Station Acquisition* (see Figure 3-1) Set up EEG system ▶ Verify data quality ▶ Record	
⊇	EEG system setup: • Ensure that all GES equipment is set up and operating properly. • According to your GSN's instructions, apply the GSN to the patient.
⊄	Launch **Net Station Acquisition**.
⊂	Enter a **Patient ID**.
⊆	Change any channel and/or session settings desired, including any video or PNS device settings.

∈ Click **Stream On** to start streaming EEG data.

***Optional*—measure gains.** You only need to measure gains upon software installation. However, if you retain a log of gains, measure them now.

Make sure that nothing is plugged into the amplifier—not the Net or the articulated arm.

∉ Plug the Net into the amplifier.

∠ Review the waveforms for data quality and measure impedances.

∇ Click **Record** to start recording EEG. While recording, monitor the patient and data and enter events (if marking events).

® Click **Stop** to stop recording EEG.

© Click one of the **Recording complete** options.

(optional)

Locate sensors with Geodesic Photogrammetry System (GPS)

Acquire images • Model sensors • Solve 3D positions

If you are a licensed GPS user, refer to the GPS manual (8103002) and/or contact Technical Support for details (Table P-2).

II – Review EEG

with *Net Station Review*
(see Figure 3-2)

Open file ▶ Set display parameters ▶ Enter events

⊇ Launch **Net Station Review**.

⊄ Open a file.

⊂ Set the display parameters (for example, time, amplitude, montage, filters, polarity, selection size, categories, etc.).

⊆ Display video, if it exists for the file.

∈ Navigate through the data.

Enter events.

(optional)

Manipulate data with Net Station Tools

Segment • Detect artifacts • Correct bad channels • Average • Remontage • Rereference

Contact Technical Support for details (Table P-2).

(optional)

Localize sources with GeoSource 2 (medical device) or GeoSource 3 Research (non-medical product)

If you are a licensed GeoSource user, refer to the GeoSource manual (8103101) and/or contact Technical Support for details (Table P-2).

6. Using Acquisition

Net Station's *Acquisition* interface allows you to display and record EEG data using default or customized settings. After acquisition, the recording file is immediately available to review.

Remember that not all features are available in all versions of software. If you have any questions, contact Technical Support (Table P-2).

Knowledge Center

For articles that address the various procedural and theoretical aspects of EEG acquisition, click the **Training and Technical Support** tab at www.egi.com.

- The **Type** tab provides articles by:
  - application advice (usage, best practices, workflows, etc.)
  - technical/troubleshooting/help advice
  - implementation theory of features and functions
  - theoretical background of dEEG, source localization, etc.
- The **Products** tab provides articles by product group.
- The **Manuals** tab provides product manuals by product group.
- The **Video Tutorials** tab provides product and instruction videos.

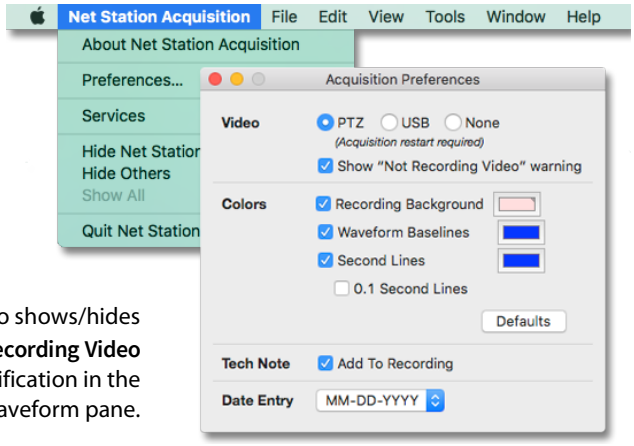
6.1 Acquisition's Menus

Standard menus (File, Edit, View, Window, and Help) operate as expected. Acquisition-specific menus are described here.

6.1.1 Acquisition's Preferences

The Acquisition Preferences dialog is where you:

Video. Ensure that the video source is correctly set in an acquisition setup before you record.



Video also shows/hides the **Not Recording Video** notification in the waveform pane.

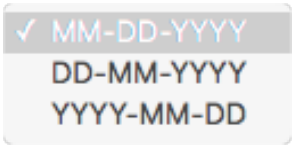
Table 6-1. Video sources

Source	Description
PTZ	Any of several Ethernet cameras If PTZ is selected, you must also use the Video View to select the specific PTZ camera being used. See sections 6.2.2 and 6.2.2.1.
USB	Low-end USB camera
None	No source

Colors. Set the colors and/or the display of *recording background*, *waveform baselines*, and *second lines*.

Tech Note. Enable/disable the ability to add one note during acquisition.

Date Entry. Set the format for the date wherever it appears in a file.



6.1.2 Acquisition's Tools Menu

Most of the tools under the Tools menu are also available as a View button at the bottom of the Acquisition window. For details about these tools, see section 6.2.2.

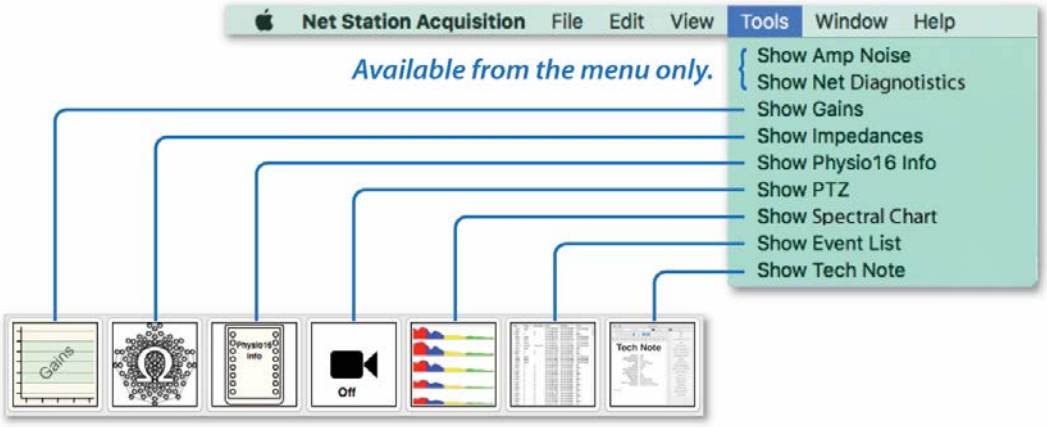


Figure 6-1. Acquisition tools available as View buttons or under the Tools menu

6.2 Acquisition's Commands and Views

Commonly used acquisition commands and views are easily accessible on the Acquisition interface. The right-hand control panels are described in section 6.3.

6.2.1 Acquisition's Commands

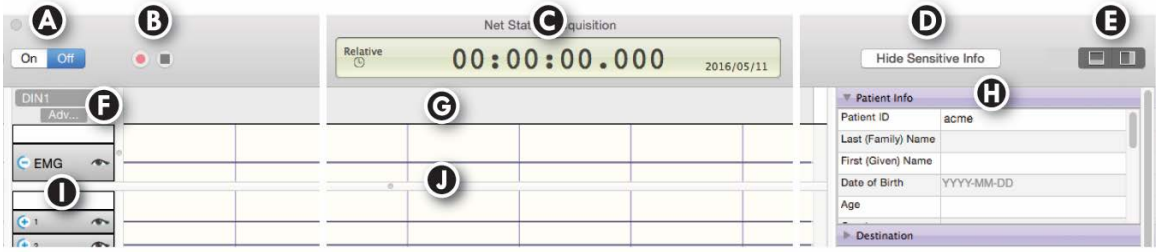


Figure 6-2. Commands of the Acquisition interface

Table 6-2. Acquisition's commands

Callout	Command	Description
A	**Stream On/Off**	Starts/stops data streaming.
B	**Record (λ)** **Pause (II)**	Toggle that starts and pauses the recording of EEG.
	Stop (ν)	Stops the recording of EEG. See section 6.2.1.1.
C	**Time/Clock** Toggle through the time modes by clicking the mode words.	For acquisition and review, displays time as: • **Relative**: **hh:mm:ss.**sss (as time elapsed during an acquisition) • **Epoch**: **000**[epoch number] **hh:mm:ss.**sss • **Clock**: **hh:mm:ss 'TIME ZONE'**
D	**Sensitive Info**	Shows/hides patient's first and last name, age, date of birth, and video (if present).
E	**Panels**	Shows/hides the panels along the bottom and right sides of the interface.
F	**Events Controls**	Enables event entry and shows/hides/creates individual event tracks.
G	**Event Track(s)**	Displays enabled event tracks, which allow: • Editing of events in their tracks, as well as in the events list. • Placement of coincident events into separate event tracks. • Mouseover display of event information. • Moving of events with a click, drag, and confirmation. • Dragging of events to the trash can.
H	**Control Panels**	Provide default or customizable settings for displaying, identifying, and recording EEG data.
I	**Channel Track Labels**	Allows control of corresponding tracks, such as: • Show/hide waveform with eye icon. • Mark individual channels as bad. • Drag lines to change track height. • Click to select a single track. • Drag to select consecutive tracks. • Command+click to select nonconsecutive tracks. • Double-click to change color. • Assumes montage labels. • Double-clicking PNS channels allows control of display, filter, and other PNS settings.
J	**Channel Tracks**	Displays waveforms.

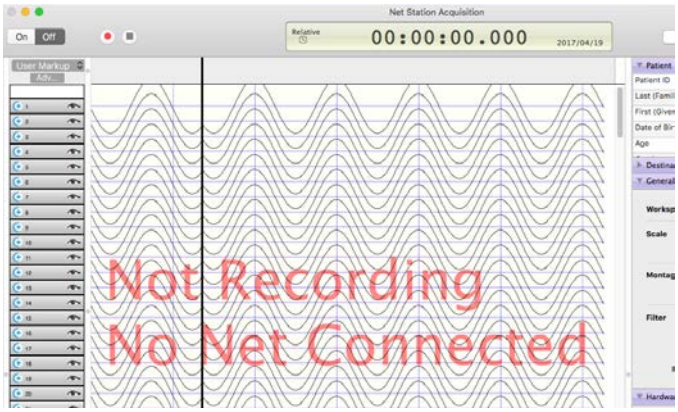
6.2.1.1 Starting, Pausing, and Stopping Acquisition

The following is not a complete workflow. It only demonstrates the key features involved in starting, pausing, and stopping an EEG acquisition session.

Click **Stream On** (On) to start streaming data.

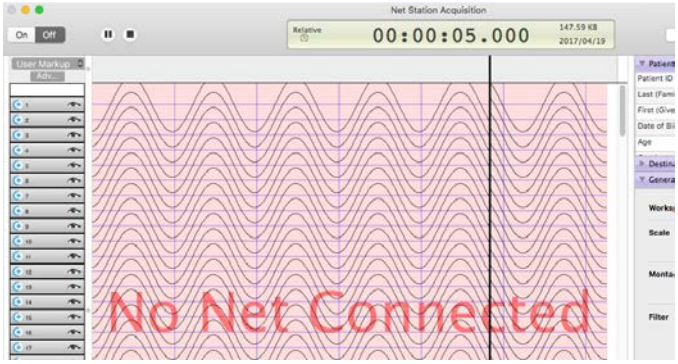
You must stream data before you can start recording EEG data.

Notice that the On button has been activated.



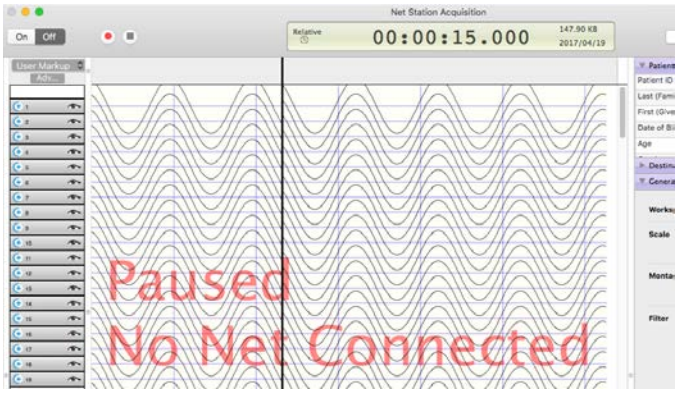
Click **Record** (●) to start recording EEG data.

Notice that the Record button (●) has changed to a Pause button (⏸).



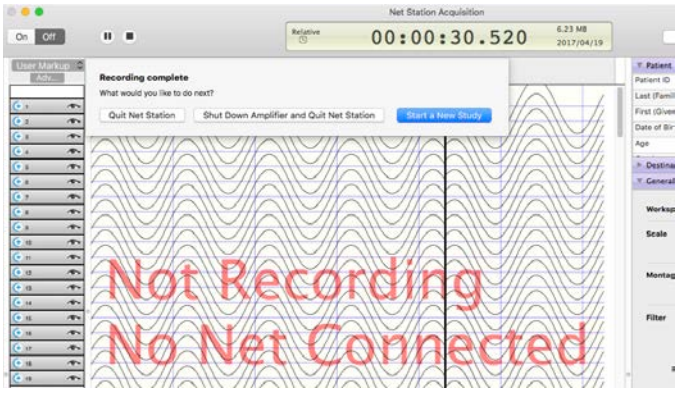
Click **Pause** (⏸) to pause the recording of EEG data.

Notice that the Pause button (⏸) has changed to a Record button (●).

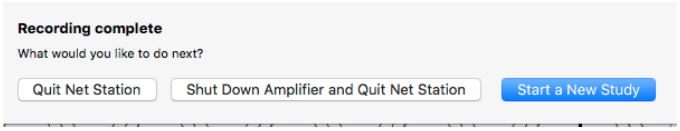


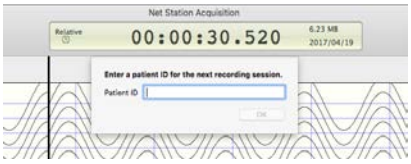
Click **Stop** (■) to stop recording EEG data.

Notice the options of the Recording Complete prompt.



Click one of the **Recording complete** options.



Option	Action
Quit Net Station	Closes Net Station Acquisition, but leaves the amplifier operational.
Shut down Amplifier and Quit Net Station	Closes the amplifier's internal software, powers down the amplifier's hardware, and closes Net Station Acquisition. Use this option when moving the amplifier to another room. For details, see section 6.3.6.2.
Start a New Study	Leaves Net Station Acquisition open and the amplifier operational, and then prompts for a patient ID for a new session. 

6.2.2 Acquisition's Views and Tools Menu

You have two ways to access frequently used acquisition tools—via the view buttons at the bottom of the window or as options under the Tools menu.

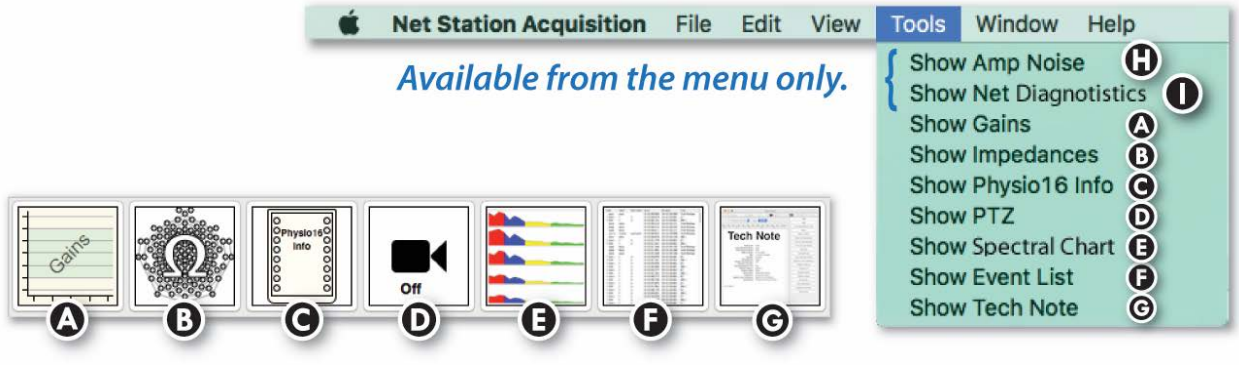
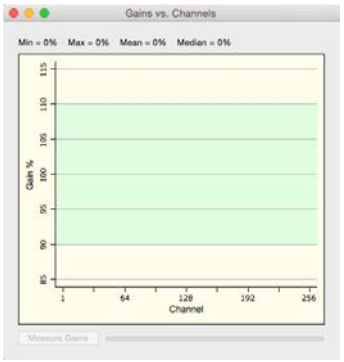
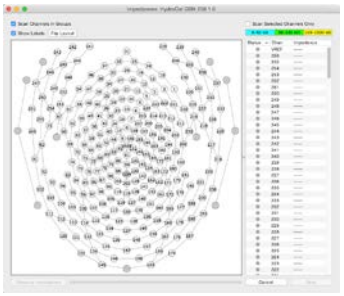
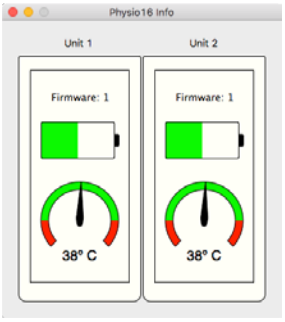
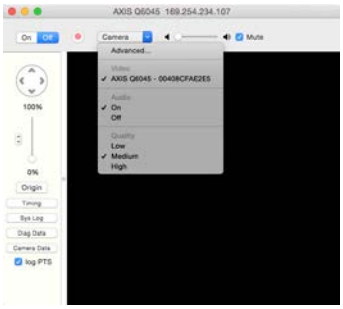
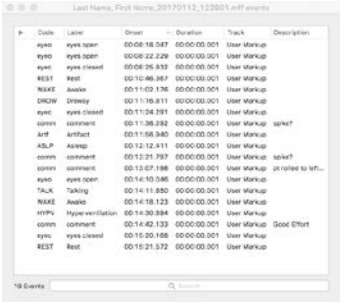
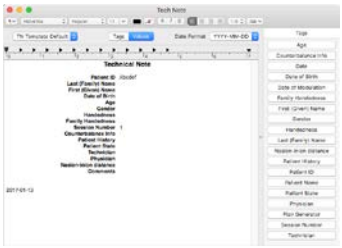
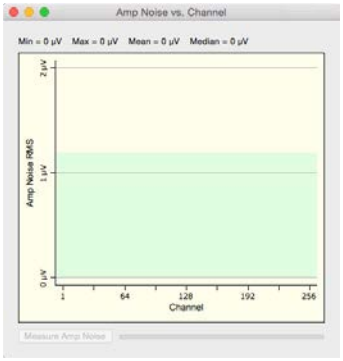


Figure 6-3. View buttons and Tools menu options of the Acquisition interface

Table 6-3. Acquisition's view buttons and corresponding menu options under Tools

Callout	Button / Menu	Description	Display
A	**Gains**	Displays a window to measure gains, which is a diagnostic for amplifier performance.	
B	**Impedances**	Displays a window to measure impedances, which is a diagnostic for the quality of electrode-to-scalp contacts.	

Callout	Button / Menu	Description	Display
C	**Physio16 Info**	Displays a window to show device connectivity, firmware version, battery level, and internal temperature.	
D	**Video**	Displays a window to view video, along with controls for selecting between different cameras and adjusting video settings.	
E	**Spectral Chart**	Displays a window to view data as spectrograms. FFT controls appear to adjust settings. You can edit the bands with the **+ (plus)** and **– (minus)** buttons, and by clicking and changing the numbers, names, and colors.	

Callout	Button / Menu	Description	Display
F	**Event List**	Displays a window to view the events marked during the recording. You can search through events during acquisition in Net Station Acquisition, but you can only edit and delete listed events during review in Net Station Review.	 *The Event List can be searched by code, label, onset, duration, track, or description.*
G	**Tech Note**	Displays a window to add one rich-text-formatted note to a recording file during an acquisition session.	
H	**Amp Noise** *menu only*	Displays a window to measure amplifier noise.	
I	**Net Diagnostics** *menu only*	Displays a window to measure Net RMSs, DC offsets, and impedances.	

6.2.2.1 Video View

If a camera is being used to record video, the system does not automatically detect the specific camera that is attached, only that a camera is attached.

Note that EGI offers a range of pan/tilt/zoom (PTZ) cameras that offer different programmable features within Net Station Acquisition.

To record video, you must:

- Select a **video source** in the Acquisition Preferences dialog. See section 6.1.1.

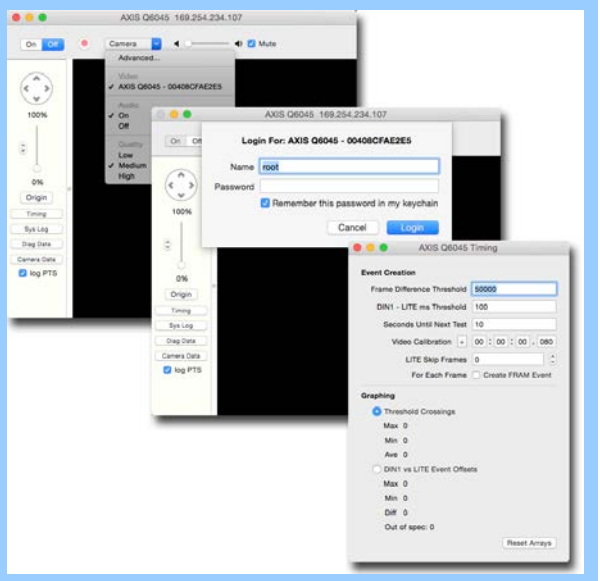
  Note that PTZ is the video source for three Ethernet cameras, USB is the source for a low-end USB camera, and None is no source.

- Select and set up a specific **camera** in the Video View window:

  Axis Q6045 PTZ:
  This camera offers the most programmable features for greater control and automation.

  Axis P3364:
  This fixed dome camera supports digital PTZ.

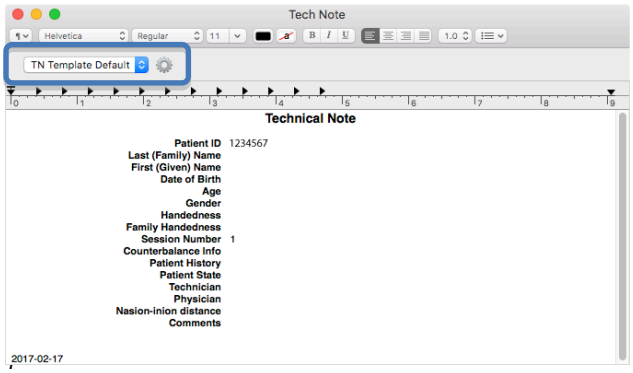
  Axis M1034:
  This camera must be zoomed in on the target location so that the patient stays in the field of view during panning and tilting.



- Select **1000 s/s** as the sampling rate in the Hardware Settings control panel, as is necessary for any DIN device. See section 6.3.6.4.

6.2.2.2 Tech Note

If enabled from the Acquisition Preferences dialog (section 6.1.1), you can add one rich-text-formatted note to a recording file, during acquisition, using the Tech Note feature.



ech Note upon opening the selected template

Information entered into any Patient Info fields (section 6.3.3) that correspond with fields of a selected Tech Note template will autofill those same fields of the Tech Note.

Know, however, that information entered into a Tech Note does not autofill corresponding Patient Info fields.

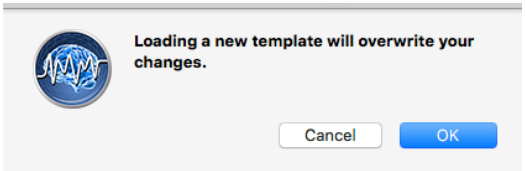
Also note that you can add only one note during an acquisition session. However, you can reopen it to add to it before the session ends.

6.2.2.2.1 Using Provided Templates

The Tech Note dialog allows you to:

Select a template. Select the desired template.

You can open and close the *same* template throughout the recording session. However, be aware that you cannot *change* to a different template without losing your note.



If you must change templates, you can copy and paste your note into a different template, then reformat it.

Add content. Click, tab, or space to place the cursor where you want text to appear, and then type.

Format content. Change the look of text or tags with the font and paragraph formatting options.

Create custom templates. See section 6.2.2.2.2.

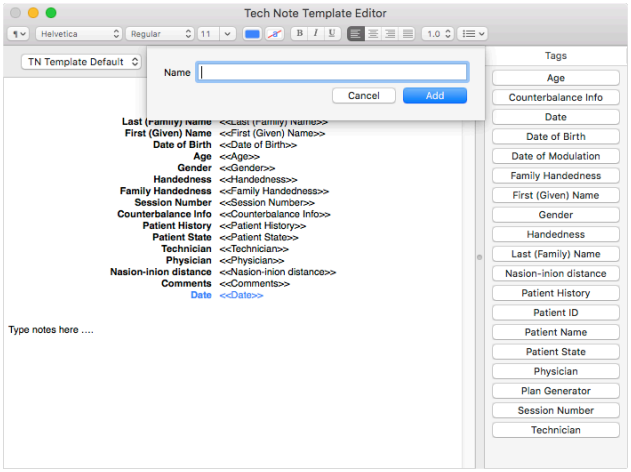
Save the note. To save a Tech Note to a recording file, click the **red close** button.

Delete a note. You cannot delete a Tech Note from a file once one has been added. You can, however, delete the note's content by:

- highlighting and deleting the content
- selecting another template

6.2.2.2.2 Creating Custom Templates

You can create custom templates from any Tech Note dialog by clicking the cog (P) icon next to the template selection field.



Customizing a template with the Tech Note Template Editor

Besides rich text controls, the Tech Note Template Editor dialog allows you to control the:

Type and format. Typing and formatting is similar to most text editors.

- Click, tab, or space to place the cursor where you want text or tags to appear.
- Format text or tags with the font and paragraph formatting options.

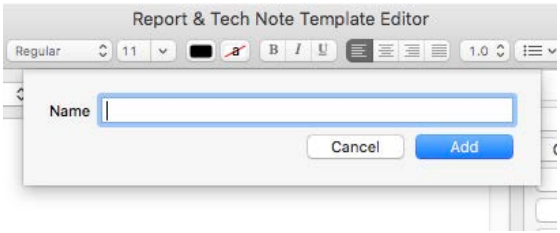
Tags. Provided tags are linked to fields in the Patient Info control panel. If information exists in a Patient Info field, it will autofill the corresponding field of a Tech Note.

To add tags: Click **tag** buttons.

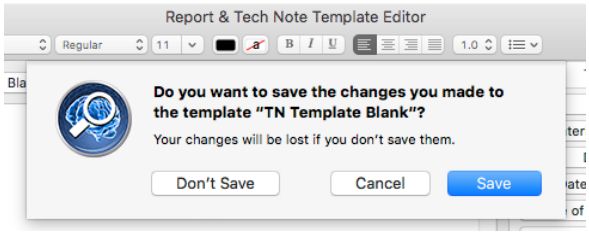
To delete tags: Highlight tags in the template, then click the keyboard **delete** button or **cmd (⌘) + X**.

Save (or not save) the template. To make a custom template available in the template list, save it with a name by selecting or clicking:

File ▶ Save
File ▶ Save As
cmd (⌘) + S



red close button



6.2.2.3 **Net Diagnostics**—Available from the Tools Menu

The optional Net Diagnostics are available to help evaluate the performance of the electrodes in your GSNs. These tests measure the RMSs, DC offsets, and impedances of a *GSN submerged in a bucket of electrolyte*.

You can use the combination of these measures to evaluate the noise, condition, electrical conductivity, and life of the electrodes in your Nets.

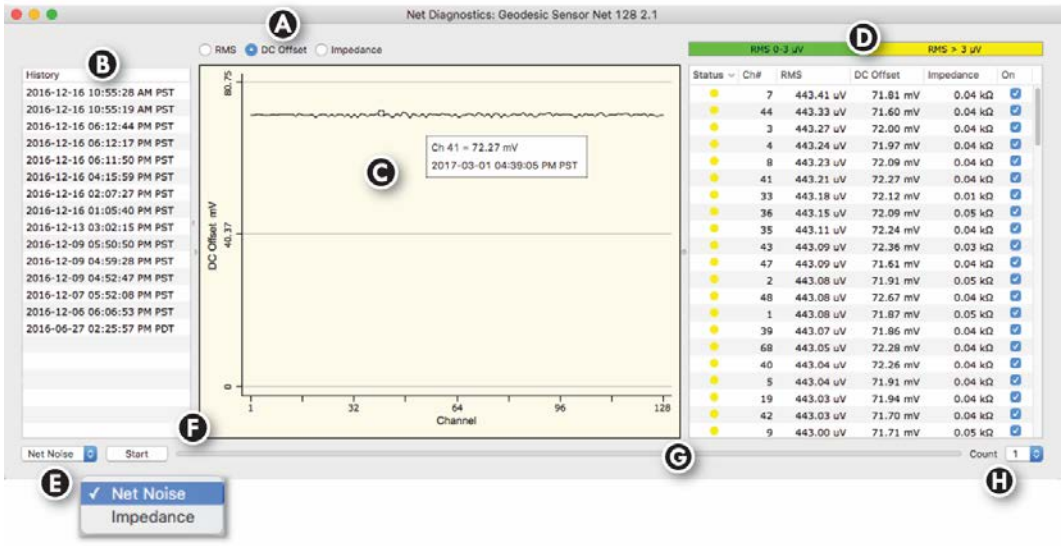
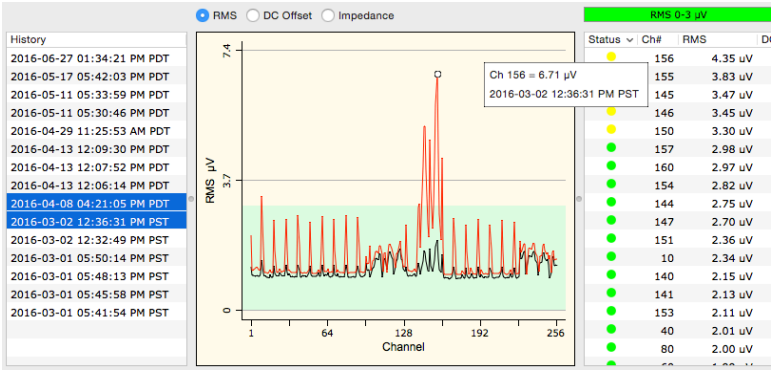


Figure 6-4. Features of the Net Diagnostics dialog

Table 6-4. Features of the Net Diagnostics dialog

Callout	Feature	Description
A	**Graph selector**	Selects the type of measured data to be displayed in the graph pane (C). Click through the buttons. **RMS.** Indicates electrode performance—better when lower noise or poorer when higher noise. **DC Offset.** Indicates electrode performance—better when lower DC galvanic voltage or poorer when higher DC galvanic voltage. **Impedance.** Indicates electrode performance—better when lower impedance values and poorer when higher impedance values.
B	**History**	Logs the results of each measurement. Click log entries to see the data from individual runs.
C	**Graph pane**	Displays the measured data on a grid. Can display histories individually or averaged. When displaying averages of multiple histories: • Mouse over the graph to see the original values. • See the average values of the combined histories in the Value pane. 
D	**Values pane**	Displays the measured data as values in a table. Select a run that is logged in the History, then click through the radial buttons to see the desired measurement values.
E	**Measurement selector**	Selects the type of data to be measured. Note that the Net Noise selection measures both RMSs and DC Offsets.
F	**Start/Stop**	Starts/stops the selected measurement.
G	**Progress bar**	Displays the progress of the current operation.
H	**Count**	Sets the number of times the selected measurement will successively run. Each result will be shown in the History pane and can be selected and displayed separately or as an average of multiple histories.

6.2.2.3.1 Prepare for the Diagnostic Tests

Prepare the electrolyte, GSN, and Net Station Acquisition:

CAUTION:

- Use solution only as directed.
- Do not take internally.
- **Singe-use:** Do not use for more than one test session.

⊇ Check the GSN.

Ensure that no sponges are missing from a routine GSN and that all GSNs have been properly cleaned of residue according to their instructions

⊄ (*optional*) Protect the GSN's cable.

a) Slip a section of *disposable plastic cable cover* over the length of the GSN's cable sleeve.
b) Tape the *disposable plastic cable cover* only to itself to secure it at both ends of the GSN's cable sleeve.

⊂ Thoroughly mix the following in a disinfected **electrolyte/rinse** bucket:

- **1 liter (1 qt)** warm water
  If your facility has hard water, EGI recommends using distilled water.
- **10 ml (2 tsp)** potassium chloride
- **5 ml (1 tsp)** baby shampoo

⊆ Place the bucket of electrolyte on a nonconductive surface, such as a plastic or wood table.

∈ Immerse the sensor end of the GSN in the electrolyte and soak the sensors (*they contain the electrodes*) for **5 minutes**.

Make sure that you protect the connector and cable sleeve from getting wet or dipping into the electrolyte.

The electrodes must soak for at least 5 minutes to become fully charged for testing to avoid false readings.

∉ Set up the software:

a) Launch **Net Station Acquisition**.
b) Enter the GSN's **serial number** as the **Patient ID**.
c) Click **Stream On** in Net Station Acquisition.

Optional—Measure Gains

You only need to measure gains upon software installation.

1) Make sure that nothing is plugged into the amplifier—not the GSN or the articulated arm.
2) Ensure that the sampling rate is set to **1000 s/s**.
3) Click the **Gains** button or select the **Show Gains** menu option.
4) Click the **Measure Gains** button.
5) Ensure that the measurements are in the range of **90–110%.**
6) Close the Gains vs. Channels dialog.

∠ Plug the GSN* into the amplifier.

**Or the GSNIC or articulated arm.*

∇ Click **Record**.

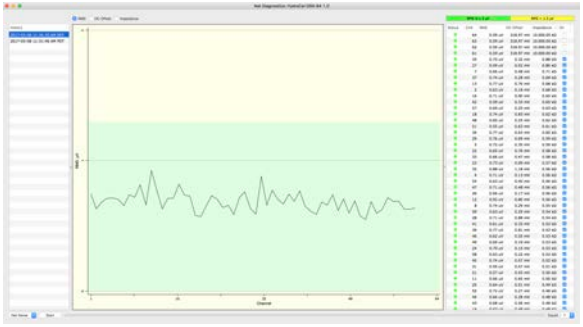
® Select the **Net Diagnostics** menu option and perform your diagnostic tests.

- Notice that the Net Noise test measures both RMSs (µV) and DC Offsets (mV).
- When running multiple tests, you must run the Net Noise test before the Impedance test so that injected current of the Impedance test does not interfere with the Net Noise test.
- Measurements will be saved to the test file.

© Click **Stop** and select one of the **Recording complete** options.

After testing is complete, rinse and disinfect the Net according to its instructions.

6.2.2.3.2 RMS Results



As one of three diagnostic indicators of electrode performance, the RMS test:

- Uses root mean square (RMS) algorithms.

  The RMS algorithms measure the effective differences between individual channels and the channel population.

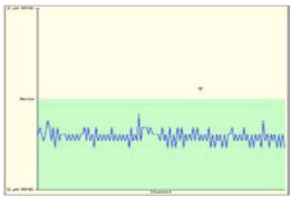
- Can indicate electrode noise relative to the intrinsic noise of the amplifier.

- Can indicate whether electrodes are better performing (those showing lower noise) or poorer performing (those showing higher noise).

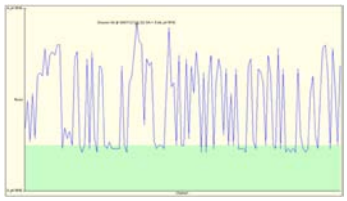
1 µV – 10 µV:	electrodes showing sufficient performance
10 µV – 100 µV:	electrodes showing poor performance
greater than 100 µV:	electrodes possibly needing to be replaced

See how noise values look with the green band of the graph:

Lower noise values
(falling *within* the band)



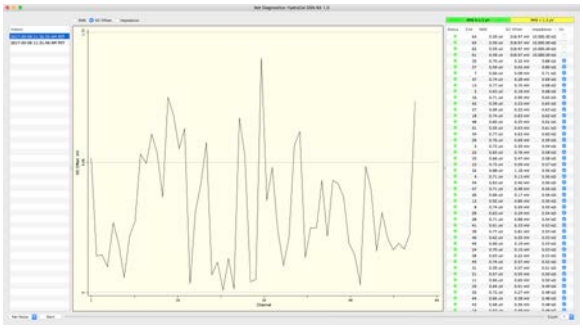
Higher noise values
(falling *outside* of the band)



Use the combined results from the RMS, DC offset, and impedance tests to determine if an electrode may need to be replaced. See section 6.2.2.3.5.

If your results are not clear to you, contact Technical Support (Table P-2).

6.2.2.3.3 DC Offset Results



As one of three diagnostic indicators of electrode performance, the DC Offset test:

- Measures the voltage difference between the channel electrode and the COM electrode.

  EGI's electrodes are uniquely sensitive to amplifying and displaying minute EEG voltage changes, due to their fast electron kinetic quality. This sensitivity also makes EGI's electrodes sensitive to the inherent DC galvanic reaction between the metal of an electrode and the electrolyte. This galvanic reaction results in both wear and the collection of foreign substances over time, which can begin to produce a growing DC voltage.

- Can indicate whether electrodes are better performing (those showing lower DC galvanic voltage) or poorer performing (those showing higher DC galvanic voltage).

  Since the Net Station software filters DC components out of EEG data, the DC offset voltages do not normally affect the measurement of EEG signals. Excessive galvanic voltages, however, can begin to affect the measurement of EEG signals.

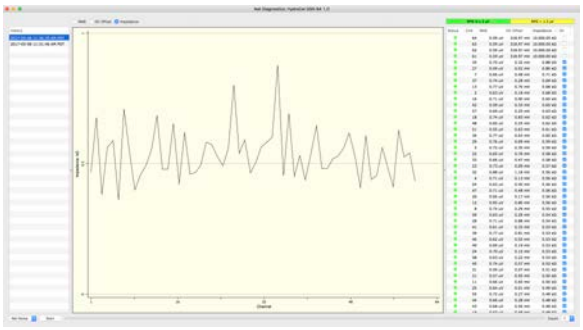
  5 mV – 100 mV: electrodes showing sufficient performance

  greater than 100 mV: electrodes possibly needing to be replaced

Use the combined results from the RMS, DC offset, and impedance tests to determine if an electrode may need to be replaced. See section 6.2.2.3.5.

If your results are not clear to you, contact Technical Support (Table P-2).

6.2.2.3.4 Impedance Results



As one of three diagnostic indicators of electrode performance, the impedance test:

- Measures the effective resistance of an electrode circuit to alternating current (AC).

  Remember that this diagnostic impedance test is completed using a bucket of electrolyte. Therefore, these impedance measurements will differ from the scalp impedance measurements seen during a recording session.

- Besides the effective resistance of an electrode, a higher impedance measurement may indicate an accumulative effect of inductance, capacitance, wear, age, poor connections, etc.

  Note that the diagnostic testing environment is sufficiently different from the recording environment that high diagnostic impedances alone do not normally affect the measurement of EEG signals, unless they are above the recommended thresholds for recording EEG.

  For those recommended thresholds, refer to your Net's instructions.

- Can indicate whether electrodes are better performing (those showing lower impedance values) or poorer performing (those showing higher impedance values).

less than 1 kΩ:	electrodes showing sufficient performance
1 Kohm – 2 kΩ:	electrodes showing poor performance
greater than 2 kΩ:	electrodes possibly needing to be replaced

  Note that for HydroCel GSN MR Nets you need to add 10 kΩ to the above values due to the 10 kΩ resistor value in the Hypertronics connector of those Nets.

Use the combined results from the RMS, DC offset, and impedance tests to determine if an electrode may need to be replaced. See section 6.2.2.3.5.

If your results are not clear to you, contact Technical Support (Table P-2).

6.2.2.3.5 Your RMS, DC Offset, and Impedance Results

Following are the individual values indicating that you should consider replacing an electrode.

RMS values greater than 100 µV

DC offsets greater than 100 mV

Impedance values greater than 2 kΩ

Test values approaching these limits indicate an electrode approaching the need for replacement. These electrodes may still be recording quality EEG. Therefore, you will need to decide whether you replace an electrode now or watch it carefully and replace it when it fails.

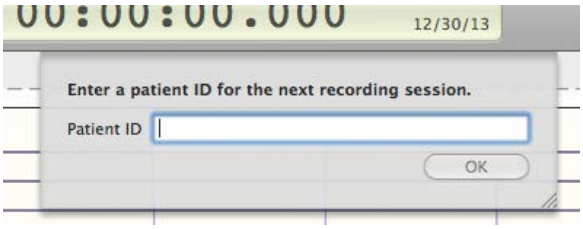
6.3 Acquisition's Control Panels

If desired, you can change the default settings of the control panels' features to customize how EEG data is displayed, named, and where it is recorded.

You can also create workspaces of these custom setups, with some exceptions. See section 6.3.5.1.

6.3.1 Patient ID

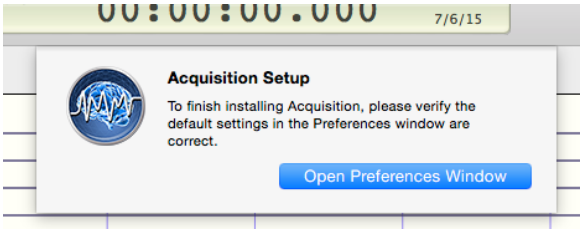
The *Patient ID* prompt is presented before accessing Acquisition. This prompt ensures that a patient ID, which cannot be changed after Record is clicked, is appended to all recordings.



To use GPS and GeoSource data files together, the patient ID must be identical in all files.

6.3.2 Acquisition Preferences

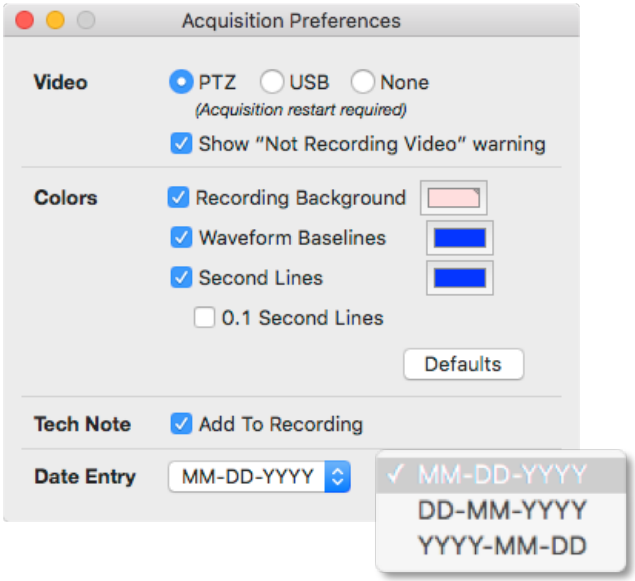
The *Acquisition Preferences* prompt is presented after the Patient ID prompt upon a fresh installation or upgrade.



This prompt ensures that any video source and other preference settings being used are correctly set before a session recording.

To access the Acquisition Preferences dialog at other times, select:

Net Station Acquisition ▶ Preferences from the menu bar.
For details about the settings, see section 6.1.1.



6.3.3 Patient Info

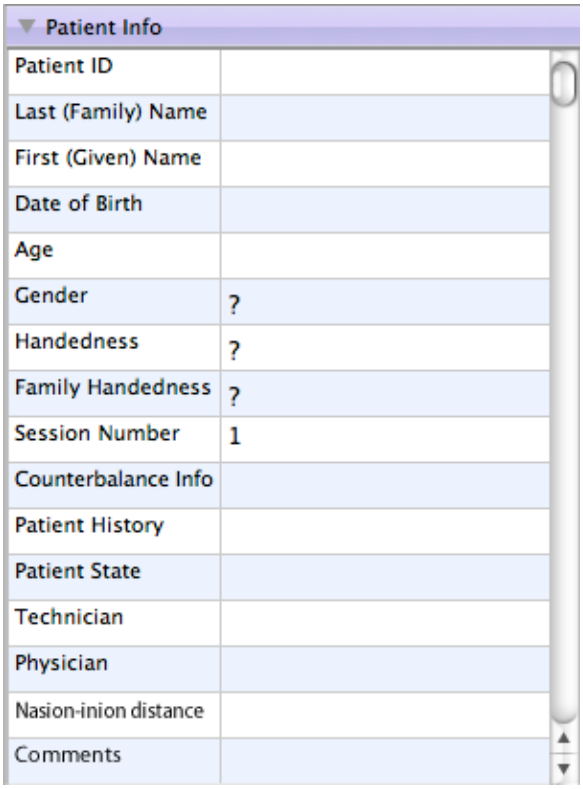
All patient information listed is stored within recordings.

The *Patient ID* is:

- required for a recording file,
- must be entered prior to beginning a recording, and
- cannot be changed after Record is clicked.

All other fields are optional and changeable until the Record button is clicked.

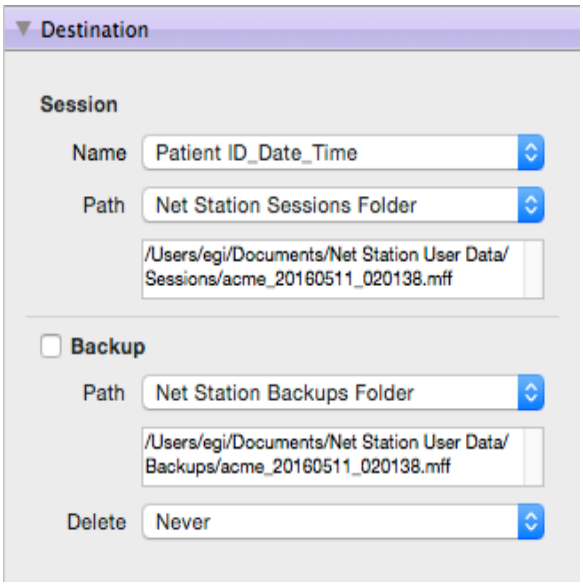
Information entered into any Patient Info fields that correspond with fields of a selected Tech Note template will autofill those same fields of the Tech Note. However, know that information entered into a Tech Note does not autofill corresponding Patient Info fields. See section 6.2.2.2.



6.3.4 Destination

The default file name for an EEG recording is based upon the time of the recording.

You can change both the name and destination of an EEG recording file in the text box of this panel prior to acquisition.



6.3.4.1 Backups

You can also set Net Station to create a backup copy of the session file with a different destination (network or local computer).

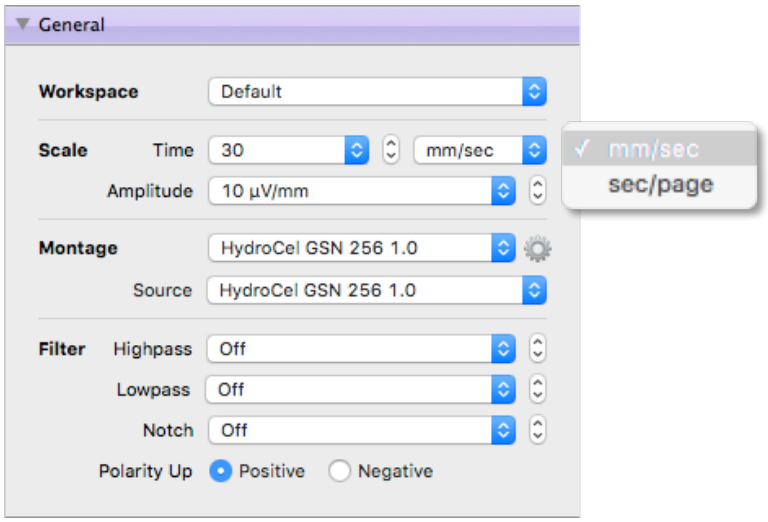
If you are recording video with a USB camera, be aware that the video feed will not be backed up along with the EEG data.

Path. You might find it useful to make the backup destination other than that of the primary destination to ensure uninterrupted access to the file.

Delete. You can set your recording backups to delete when you want, including Never.

6.3.5 General

Besides selecting the time, amplitude, montage, and workspace, use these controls to filter out undesired frequencies from the *onscreen display*.



These settings do not affect how data are recorded or saved.

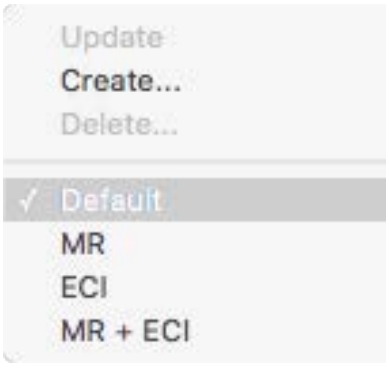
The **sec/page** option is available under the Scale options for Time for such events as sleep scoring. See sections 6.3.7 and 7.3.4.

Note that only those frequencies within the band between the highpass and lowpass filter settings are attenuated, not the frequencies at those settings.

6.3.5.1 Workspaces

Use these controls from the Workspace pull-down menu to:

- Select (click) a workspace to apply to the current recording.
- Update workspaces.
- Create new workspaces.
- Delete workspaces.



Note that Net Station Acquisition opens with the last workspace used.

To create new workspaces in Net Station Acquisition:

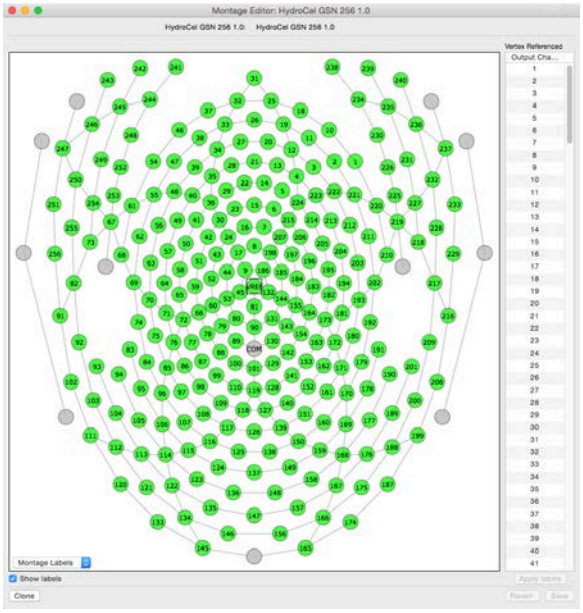
- Set the following available settings as desired: size of windows; location of windows; and display, hardware, montage, PNS, event, photic stimulator, and video settings.

- Select **Create** from the Workspace pull-down menu, name the new workspace, and then click **Create** in the Save dialog.

You can also change the settings of a workspace (before or during a recording), then update the workspace with those settings by selecting **Update**.

6.3.5.2 Montage Editor

Clicking the cog (P) icon next to Montage in the General control panel opens the Montage Editor. With this editor you can select a different montage to view the data with or create a custom montage.



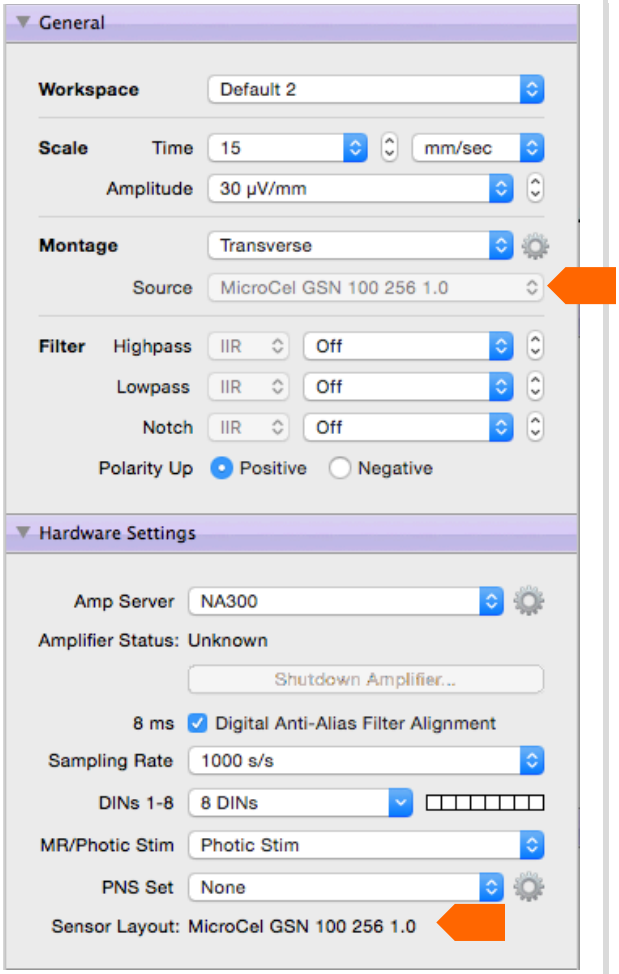
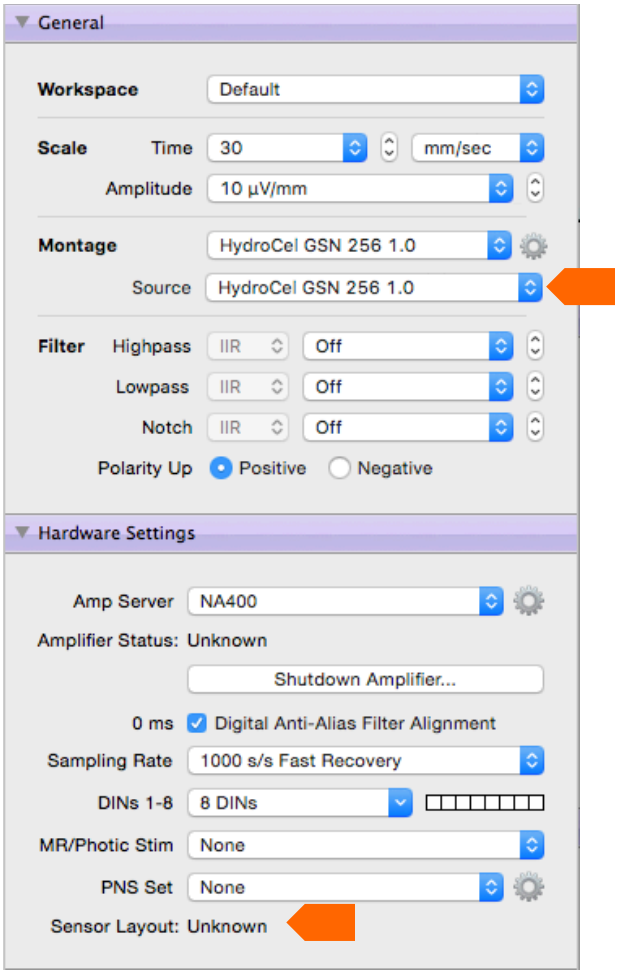
A montage created in either Acquisition or Review is available in both modules, as well as Tools.

With the Montage Editor you can show/hide/select labels, reorder the list of channels, and clone, revert, and save new montages.

6.3.5.3 Montage Source

Use this feature to create custom montages for any GSN without needing to have a GSN plugged into an amplifier or streaming data.

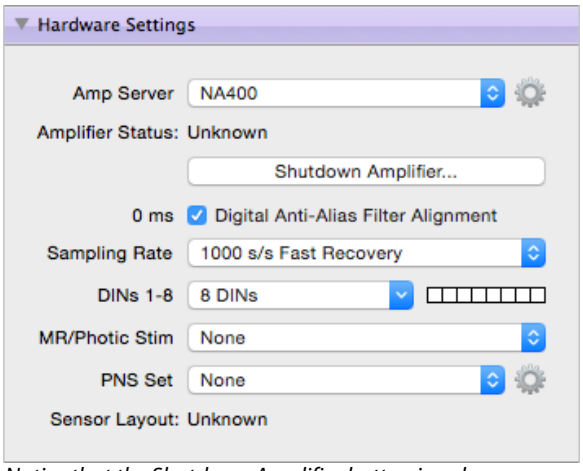
Table 6-5. Conditions of the Montage/Source feature

When streaming data (Stream On is clicked)	**When not streaming data** (Stream On is not clicked)
Montage/Source: **Disabled** (grayed out) Linked with the auto-detected GSN shown in the Hardware Settings panel and is therefore unavailable to change. Can acquire EEG. 	Montage/Source: **Enabled** When no GSN is auto-detected in the Hardware Settings panel, the Montage/Source feature is unlinked and is therefore available to change. Can set up workspaces. 

6.3.6 Hardware Settings

Although attached hardware (such as the amplifier and GSN) is automatically detected by the software, use these hardware controls to select:

- the version of Amp Server that matches the connected amplifier (see section 6.3.6.1) and
- other connected components, such as a Photic Stimulator or video camera.



Notice that the Shutdown Amplifier button is only available before Stream On is clicked.

Be aware that the hardware settings do affect how data are recorded and saved.

Also be aware that *when* you start streaming data or recording EEG affects what hardware settings you can change and when.

Table 6-6. Restrictions on when different Hardware settings can be changed

Setting	Can Change BEFORE	
	Stream On *clicked*	**Record** *clicked*
Amp Server	4	
Shutdown Amplifier	4	
Digital Anti-Alias Filter Alignment		4
Sampling Rate	4	
DINs 1-8		4
MR/Photic Stim		4
PNS Set		4

See sections 6.1.1 and 6.2.2.1 for video camera setup.

6.3.6.1 Amp Server—Amplifier—Digital Anti-alias Filter

While Net Station will automatically detect the connected amplifier, you must ensure that the correct amplifier is selected in the Amp Server field. These two settings, together, ensure that the correct anti-alias filter value gets applied to an EEG recording.

For details, see section 6.3.6.3.

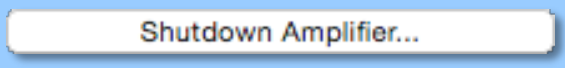
6.3.6.2 Shutdown Amplifier

Use this option when moving the amplifier to another room.

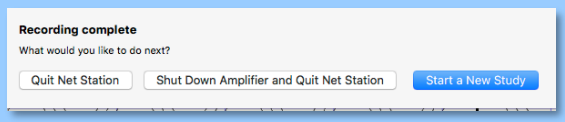
To move the amplifier, you must first safely shutdown the amplifier's software with the Shutdown button **before** removing power from the amplifier.

To shutdown the amplifier:

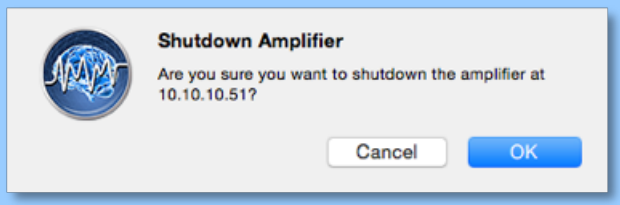
⊇ From the Hardware Settings control panel, click **Shutdown Amplifier**.



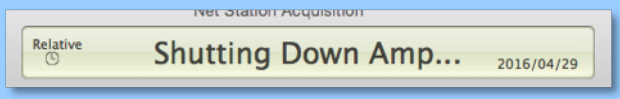
*The process is the same if you clicked **Shut Down Amplifier and Quit Net Station** from the Recording complete options after having stopped the recording of EEG data. See section 6.2.1.1.*



⊄ Click **OK** to continue with the shutdown.



⊂ The Time/Clock bar will give status during shutdown.



⊆ Click **OK**.

∈ Quit **Net Station Acquisition**.

∉ Reset or unplug the amplifier:

Reset Amplifier

When not unplugging the amplifier, you will need to reset it before the next acquisition session.

Do either of the following:

- Turn the amplifier's power supply off and back on.
- Or, at the amplifier, unplug the power cord and replug it.

Unplug Amplifier

When moving the amplifier:

a) Turn off the amplifier's power supply.

b) Unplug the power cable from either the amplifier or the isolation transformer.

If the shutdown fails, contact Technical Support (Table P-2).

6.3.6.3 Digital Anti-Alias Filter Alignment

When checked, the temporal delay of each amplifier's *anti-aliasing filter* is automatically adjusted for during acquisition, which aligns the EEG with the real-time events (that is, those from digital inputs or TCP/IP connection). This setting is checked by default.

For details, see section 4.1 and Appendix A.

6.3.6.4 Sampling Rate for DIN Devices

To ensure millisecond delivery of DIN inputs to the amplifier when using any DIN device, such as a photic stimulator or external signal device, you must set the sampling rate to **1000 s/s**.

6.3.6.5 1000 s/s Fast Recovery Sampling Rate

Only select this option if you understand the relationship between timing and bandwidth.

If you select the 1000 s/s Fast Recovery sampling rate, the hardware anti-aliasing filter of your NA 400 series amplifier will be used rather than the software anti-aliasing filter.

This setting optimizes EEG-TMS acquisition.

For example, knowing that:

1. The amplifier's analog-to-digital converter (ADC) built-in anti-alias filter settles within three samples (3 ms at 1,000 samples/sec) after the TMS pulse.
2. And, the bandwidth of the amplifier's ADC is roughly 1/4 the sampling rate.

Then, the **1000 s/s Fast Recovery** setting sets the analyzable frequency bandwidth to 250 Hz.

This is compared to the non-Fast Recovery options, which set the native sampling rate of the amplifier's ADC to 8,000 Hz, along with the amplifier's field-programmable gate array (FPGA) anti-alias filter pushing the chosen sampling rate, you would get the analyzable frequency bandwidth of 400 Hz with the 1000 s/s option.

For details, contact Technical Support (Table P-2).

6.3.6.6 PNS Set

If you are recording PNS data, click the **cog (P)** icon beside PNS Set, then use the PNS Set Editor to select, edit, or create a PNS setup.

For details, refer to the Physio16 user instructions (8404163).

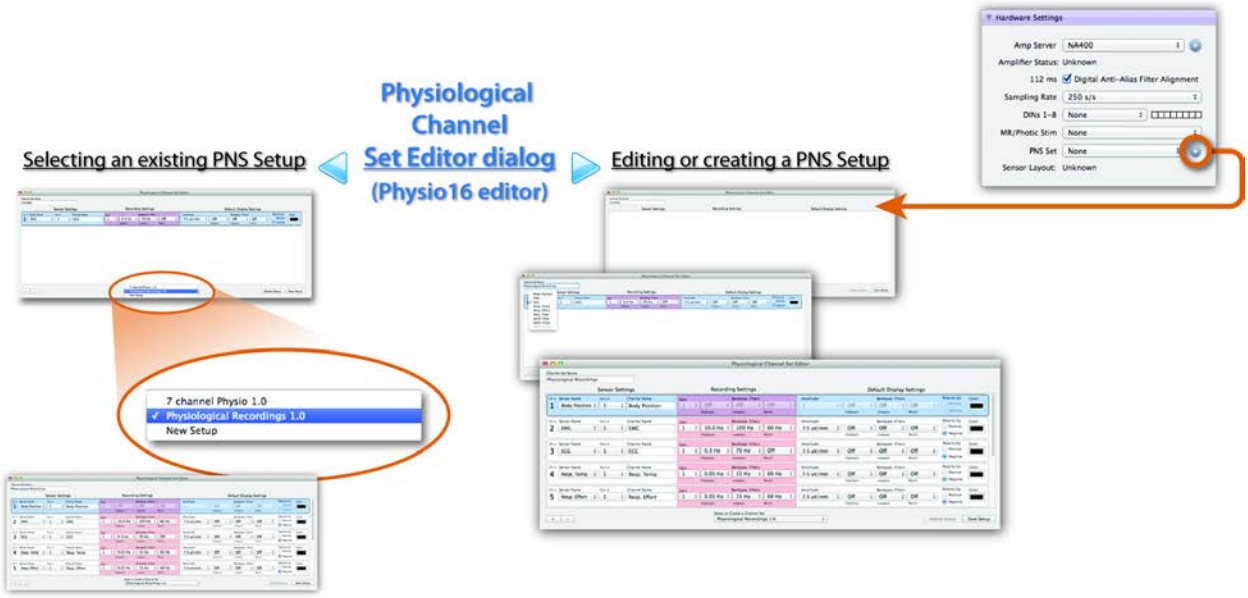
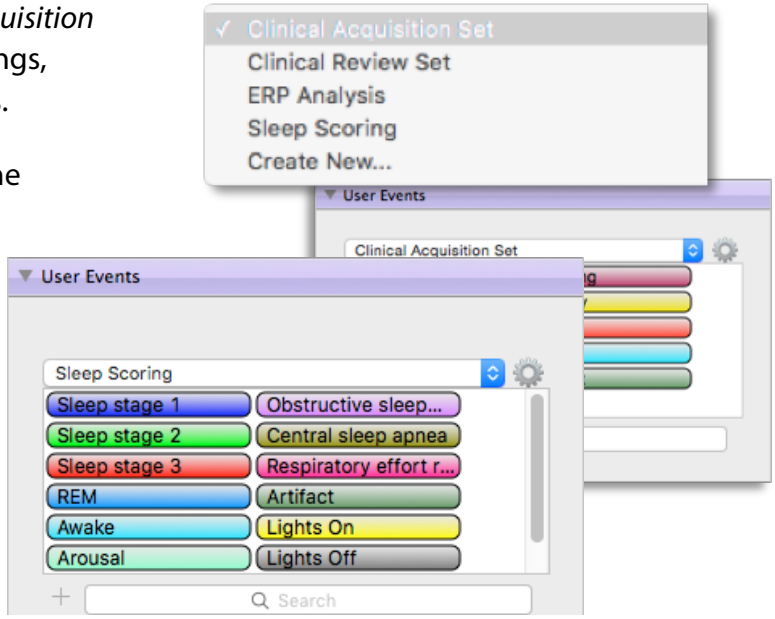


Figure 6-5. Features of the PNS Set Editor

6.3.7 User Events

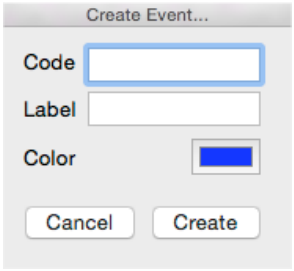
Use these event controls *during acquisition* to place event markers into recordings, create events, and create event sets.



Select an event set by choosing one from the pull-down menu.

Enter event markers into a recording by clicking the event buttons.

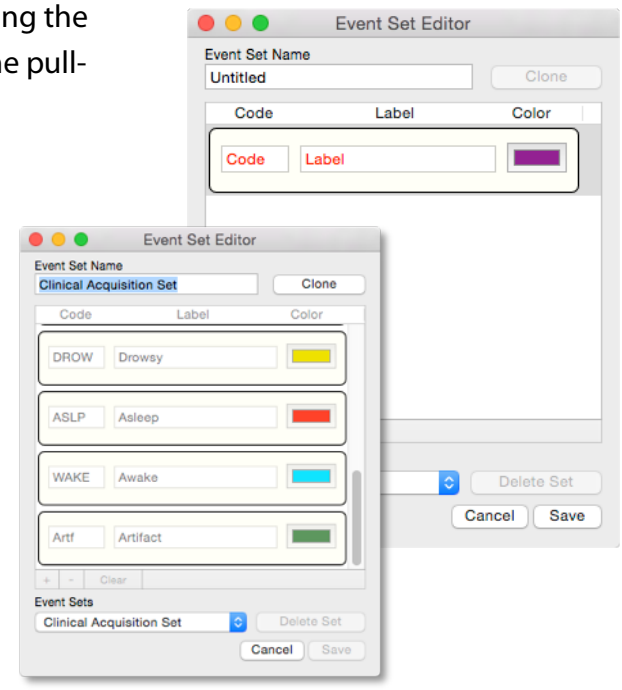
Add event markers to an event set by clicking the **+** button.



Add event sets to the list of event sets by clicking the **cog (P)** icon or by clicking **Create New** in the pull-down list for set selection.

Click **+** and **–** to add or delete single events, and click **Clear** to delete all events at once.

You can edit and delete only created sets, not default sets.



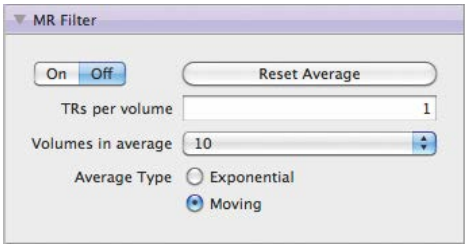
To enter events during acquisition:

- Select an **event set**.
- Click an **event button**.

An event will be inserted at the moment the event button was clicked.

6.3.8 MR Filter

For MR conditional GES MR systems only



When using a GES MR system, click **On** so that Net Station attenuates MR scanner artifacts by using the scanner's test scan TR pulses to build a template.

Note that DC offsets are part of this template and will be removed.

TRs per volume. Sets the number of TR pulses expected per scan. A *volume* is one scan. Be aware that some MRI scanners send one TR pulse at the beginning of each scan whereas others send one TR pulse at the beginning of each slice.

Volumes in average. Sets the number of volumes to be used when averaging.

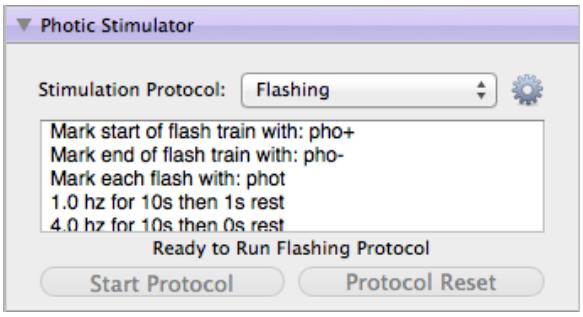
Average type. Sets the type of averaging to be used.

Exponential average. Uses a TR pulse event series (starting with an average of the first 10 TR pulse events) and adds all subsequent TR pulse events at a ratio of 90% of the added TR pulse event series to 10% of the individual subsequent TR pulse events to generate an exponential average for removing MR artifacts.

Moving average. Uses a selected number of TR pulse events to generate a moving average for removing MR artifacts.

6.3.9 Photic Simulator

When using a photic stimulator, use these controls to operate it.

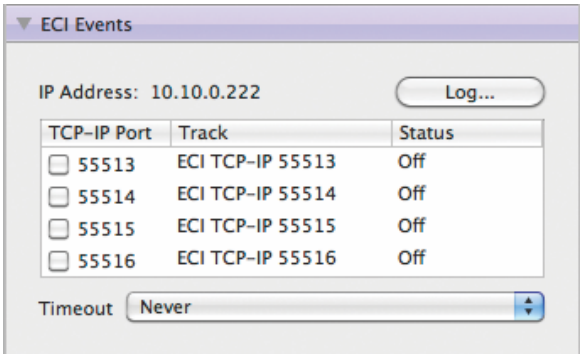


Note that to use the photic stimulator, you must first go to the Hardware Settings pane and set the sampling rate to **1000 s/s** and select the photic stimulator as the MR/Photic Stim device.

For details, refer to the Photic Stimulator user instructions (8405001).

6.3.10 ECI Events

Use these ECI event controls to allow TCP/IP communication between external signal devices and the DAC.



Note that ECI events are events that are generated by external applications that use the Net Station's Experiment Control Interface (ECI).

Also note that when using E-Prime, 55513 is automatically selected.

7. Using Review

Net Station's *Review* interface allows you to review EEG data with flexible view, navigation, and modification controls.

Remember that not all features are available in all versions of software. If you have any questions, contact Technical Support (Table P-2).

Also note that multiple views in the same window are linked. To unlink a view, open it in a separate window (command [□]-click).

Knowledge Center

For articles that address the various procedural and theoretical aspects of EEG acquisition, click the **Training and Technical Support** tab at www.egi.com.

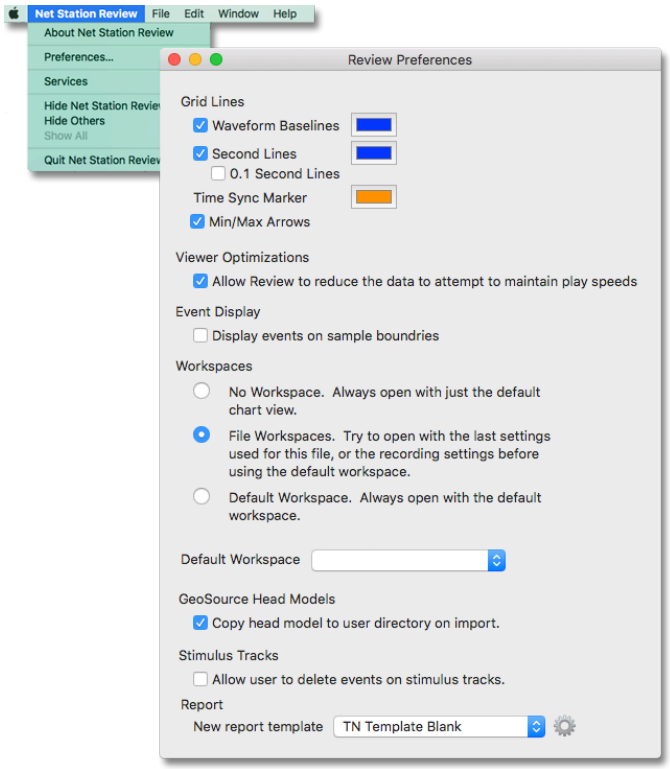
- The **Type** tab provides articles by:
  - application advice (usage, best practices, workflows, etc.)
  - technical/troubleshooting/help advice
  - implementation theory of features and functions
  - theoretical background of dEEG, source localization, etc.
- The **Products** tab provides articles by product group.
- The **Manuals** tab provides product manuals by product group.
- The **Video Tutorials** tab provides product and instruction videos.

7.1 Review's Menus

Standard menus (File, Window, and Help) operate as expected. Review-specific menus are defined here.

7.1.1 Review's Preferences

You access the Review Preferences from the Net Station Review menu.



The Review Preferences dialog is where you adjust:

Grid Lines. Shows/hides and changes the color of grid lines.

Time Sync Marker. Shows/hides the Min/Max arrows of the Time Sync Marker.

Viewer Optimizations. Simplifies the drawing of data playback to reduce the resource load on your computer in order to maintain paging speed.

Data playback is simplified by drawing thinner lines of every other sample. Choose between:

- [unchecked] drawing every sample thicker, but slower, or
- [checked] drawing every other sample thinner, but quicker.

Event Display. Forces events to be aligned with EEG samples, when recording data at less than 1000 s/s.

Note that since events are recorded with millisecond precision, when recording EEG data at less than 1000 s/s, some events will not be aligned with the EEG.

Workspaces. Selects whether to use a default, custom, or no workspaces when opening files.

GeoSource Head Models. When selected, copies head models to the Net Station folder. When unselected, stores shortcuts for head models in the Net Station folder. Regardless, head models are available whenever an EEG file with the same patient ID is present in Net Station Review.

Stimulus Tracks. When selected, allows users to delete events on stimulus tracks.

Report

- Sets the default template that the +Report feature opens with.

- Creates custom templates using the cog (P) icon.

See section 7.2.2.1.1.

7.1.2 Keyboard Shortcut Mapping

Net Station comes with default keyboard shortcuts that are available for custom mapping to the keys of your keyboard.

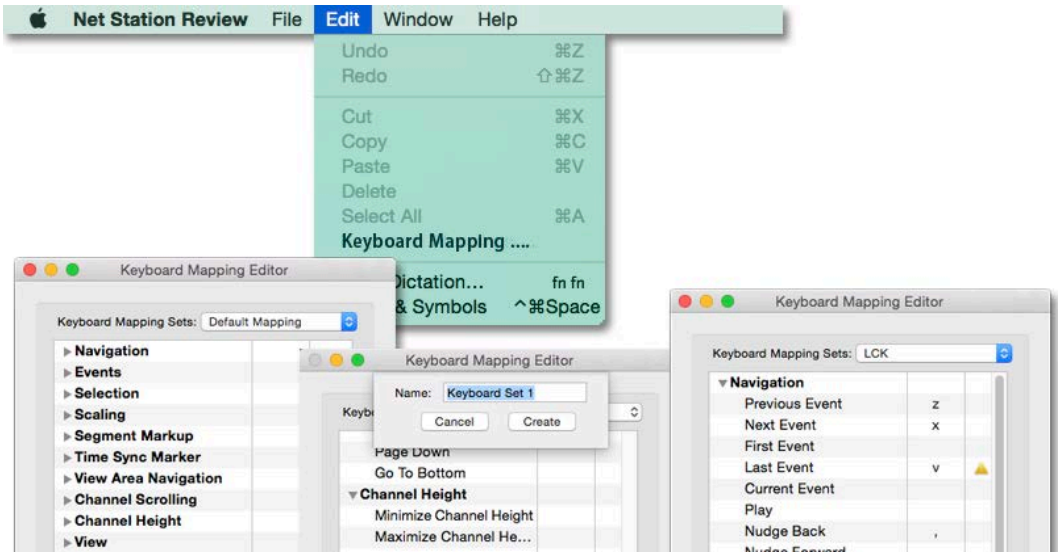


Figure 7-1. Keyboard shortcut mapping

The keyboard shortcut mappings are accessible under the Edit menu.

You can use the defaults or customize them as desired.

You will notice:

Shortcut organization. Keystroke mappings are organized by task, such as navigation, events, segment markup, etc.

Shortcut set creation. You can create new sets with unique mappings by **cloning** the selected set (and changing the set name) or clicking **+ (plus)**.

Shortcut creation or changes. You can enter or change a keystroke mapping in a set by double-clicking a stroke cell (the middle column) associated with a shortcut (like Page Back) and pressing a keyboard key. The stroke is saved upon closing the dialog.

Shortcut duplication. If you attempt to use a key that has been mapped to another shortcut, a caution symbol will appear next to both shortcuts that it is assigned to so that you can set the appropriate keys for each shortcut.

Shortcut defaults. You cannot change the shortcut mappings of the default set.

Table 7-1. Default keyboard mappings of the Keyboard Mapping Editor

Keyboard Mapping Sets	Available Actions	Default and Available Keyboard Mappings
Navigation	Previous Event	z
	Next Event	x
	First Event	
	Last Event	
	Current Event	
	Play	
	Nudge Back	,
	Nudge Forward	.
	Page Back	m
	Page Forward	/
	Got To Beginning	[
	Got To End	]
	Half Page Back	
	Half Page Forward	
	First Segment	
	Previous Segment	
	Next Segment	
	Last Segment	
	First Category	
	Previous Category	
	Next Category	
	Last Category	
	Play .25x	
	Play .5x	
	Play 1x	
	Play 2x	
	Play 3x	
	Play 4x	
	Play 8x	
Events	Insert Comment	c
	Next Event Track	

Keyboard Mapping Sets	Available Actions	Default and Available Keyboard Mappings
	Next Event Set	
	First Event of Active Set	
	Second Event of Active Set	
	Third Event of Active Set	
	Fourth Event of Active Set	
	Fifth Event of Active Set	
	Sixth Event of Active Set	
	Seventh Event of Active Set	
	Eighth Event of Active Set	
	Ninth Event of Active Set	
	Tenth Event of Active Set	
	Eleventh Event of Active Set	
	Twelfth Event of Active Set	
	Insert Events at Marker	
	Insert Events at Selection	
	Insert Events at Start/Stop	
	Insert Events at Page	
Selection	Next Selection Left	i
	Next Selection Right	o
	Move Selection Left	
	Move Selection Center	
	Move Selection Right	
	Nudge Selection Right	
	Nudge Selection Left	
	Clear Selection	
	Extend Selection Right	
	Extend Selection Left	
	Select EEG At Event	
Scaling	Shorten Time	–
	Lengthen Time	=
	Shorten Amplitude	↑
	Lengthen Amplitude	
	Close Channel Zoom	⎋
Segment Markup	Mark Segment Bad	F1
	Mark Segment Good	F2
	Unmark Segment	F3
Time Sync Marker	Nudge Marker Back	←
	Nudge Markere Forward	→

Keyboard Mapping Sets	Available Actions	Default and Available Keyboard Mappings
	Center Marker	
	Snap To Peak	p
	Scroll and Snap To Peak	'
	Scroll to Focal Channel	f
View Area Navigation	Show View Area	v
	Show Workspace Area	s
Channel Scrolling	Got To Top	
	Page Up	
	Half Page Up	
	Channel Up	
	Channel Down	
	Half Page Down	
	Page Down	
	Go To Bottom	
Channel Height	Minimize Channel Height	
	Maximize Channel Height	
	Optimize Channel Height	
View	View as Continuous	
	View as Categories	
	View as Overlaid Segments	
Montage	Previous Montage	
	Next Montage	
	Recording Montage	
Patient Info	Hide Sensitive Info	
Workspaces	Update Workspace	
	Create Workspace	
	Next Workspace	
	Previous Workspace	

Keyboard Mapping Sets	Available Actions	Default and Available Keyboard Mappings
Video	Play Forward	
	Play Backward	
	Stop	
	Increase Speed	
	Decrease Speed	
Channel Markup	Mark Channel Bad	
	Mark Channel Good	

7.2 Review's Commands and Views

Commonly used Review commands and views are easily accessible on the Review interface. The right-hand control panels are described in section 7.3.

7.2.1 Review's Commands and File Information

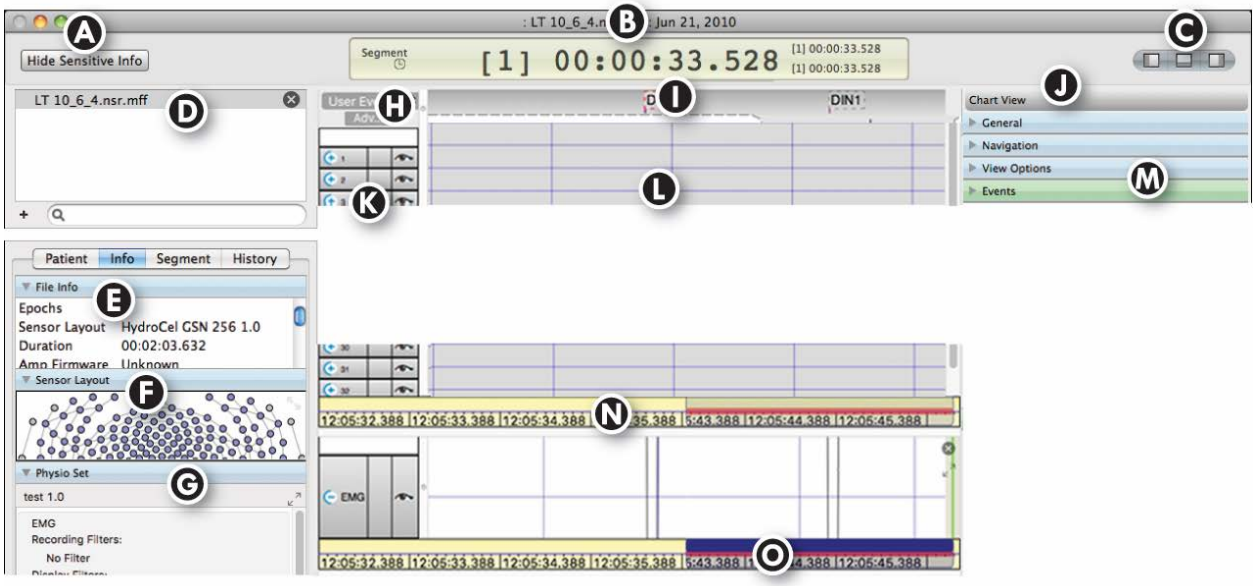


Figure 7-2. Commands of the Review interface

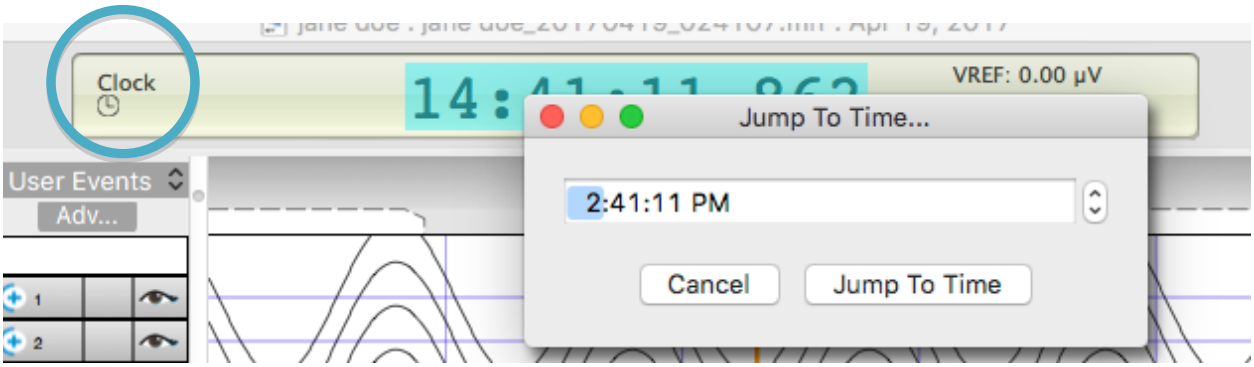
Table 7-2. Review commands

Callout	Command	Description
A	**Sensitive Info**	Shows/hides patient information.
B	**Time/Clock**	Displays the elapsed time and amplitude at points within a recording. For review, time displays as: • **Clock**: **hh:mm:ss.**sss See section 7.2.1.1 for the Jump to Time feature. • **Relative**: **hh:mm:ss.**sss (as time elapsed during an acquisition) • **Epoch**: **[1] hh:mm:ss.**sss (epoch number in brackets) • **Segment**: **[1] hh:mm:ss.**sss (segment number in brackets)
C	**Panels**	Shows/hides the panels along the left, bottom, and right sides of the interface.
D	**File Pane**	Accepts opened or dragged files for review. You can also double-click a file in Finder with the Review module open to automatically open the file in Review. Note that a filename that appears **red** is unavailable. Check settings and compatibilities.
E	**File Info**	Provides patient, segment, and history information for the currently selected file. The Patient tab has a De-identify button. See section 7.2.1.2. The History tab has a Save History button. See section 7.2.1.3.
F	**Sensor Layout**	Displays the sensor layout for the file being reviewed.
G	**Physio Set**	Displays the PNS settings for the file being reviewed.
H	**Event Controls**	Shows/hides/creates individual event tracks and enables event entries.
I	**Event Track(s)**	Displays enabled event tracks, which allow: • Editing of events in their tracks, as well as in the events list. • Placement of coincident events into separate event tracks. • Mouseover display of event information. • Moving of events with a click, drag, and confirmation. • Dragging of events to the trash can.
J	**View indicator**	Shows the view (chart, PNS, butterfly, topo plot, topo map, or event) of the active window.

Callout	Command	Description
K	**Channel Track Labels**	Allows control of corresponding tracks, such as: • Show/hide waveform with eye icon. • Mark individual channels as bad. • Drag lines to change track height. • Click to select a single track. • Drag to select consecutive tracks. • Command+click to select nonconsecutive tracks. • Double-click to change color. • Assumes montage labels. • Double-clicking PNS channels allows control of display, filter, and other PNS settings.
L	**Channel Tracks and Data Display**	Displays data with the chosen view.
M	**Control Panels**	Provides data display controls. See section 7.3.
N	**EEG Navigation Control Strip**	Allows temporal navigation through EEG data with a slider along the time ruler.
O	**PNS Navigation Control Strip**	Allows temporal navigation through PNS data with a slider along the time ruler.

7.2.1.1 Jump to Time

When you are reviewing a continuous (non-segmented) file, you can jump to any time in the file when viewing that file in the Clock time mode. Simply double-click on the **hh:mm:ss:sss** digits.

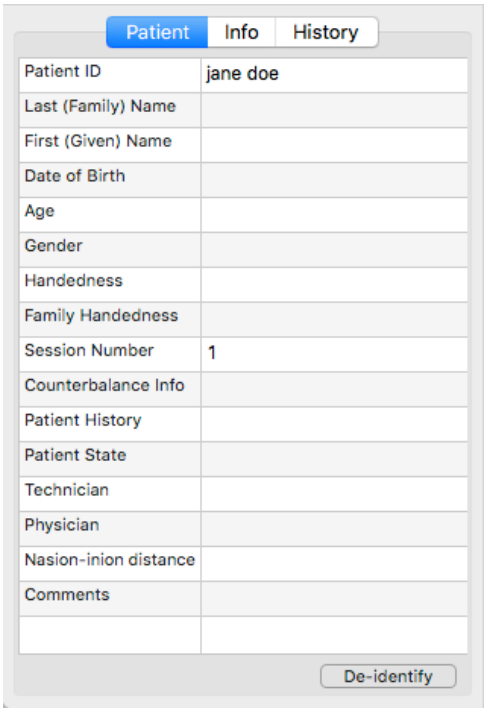


7.2.1.2 File Info—De-identify Patient

Use this feature to automatically and permanently *remove* all sensitive patient-related information (first and last name, age, date of birth, and video, if present) from an .mff recording file.

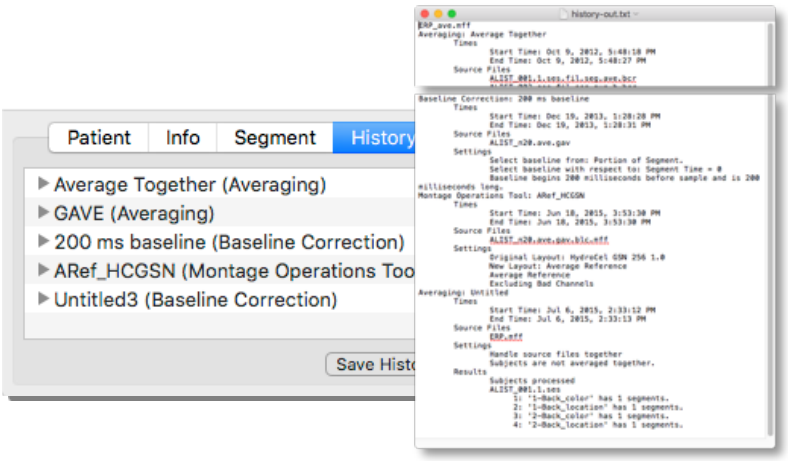
This is useful when sharing files.

This feature actually *removes* that information—it does not just hide it. Therefore, it is recommended that you apply this feature to a copy of a file, if you need to retain the original file intact.



7.2.1.3 File Info—Save History

Use this feature to save a file's history as a separate text file.



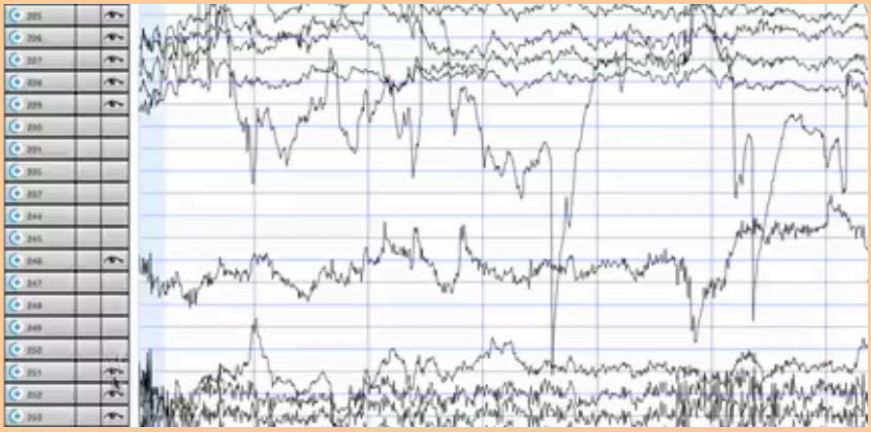
7.2.1.4 Marking Bad Channels

Marking channels as bad is different between:

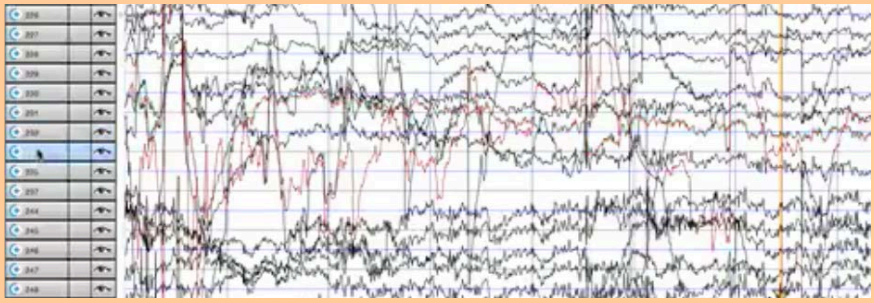
- continuous (non-segmented) files
- segmented files

▶ *For all file types, remember that:*

Show/hide waveforms. You can make specific channels easier to see by clicking the **eye** icon of neighboring channels to hide/show obscuring waveforms. (This does not mark a channel as good or bad.)



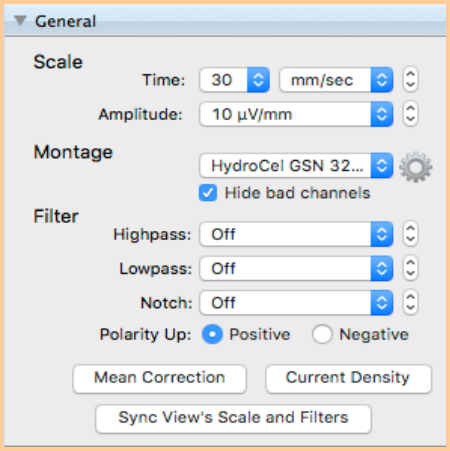
Highlight waveforms with color. You can make a waveform easier to see by clicking that waveform's label, which changes the color of the waveform.



▶ *When marking channels as bad, remember that:*

Hide bad channels in one view.
Use the *Hide bad channels* feature from the General control panel to show/hide channels that are marked as bad:

- Enabled (checked) will hide bad channels.
- Disabled (unchecked) will show bad channels.



Hide bad channels across views.
To hide channels across multiple views that are marked bad (for example, Chart and Topo Plot), you must enable (check) the Hide bad channels feature for *each* view.

The setting from one view has no affect on other views.

If the Hide bad channels feature is enabled (checked) for all views, then when a channel is marked bad in one view it will disappear from all views.

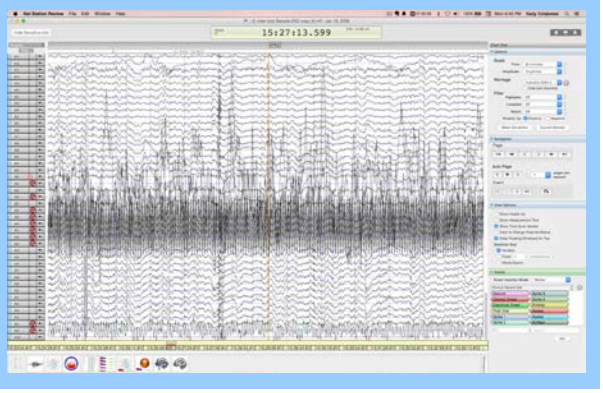
How bad channels appear.
When channels marked as bad are not hidden, the cursor turns into a green dot when over the bad channel mark.

Chart *Topo Plot*

7.2.1.4.1 Continuous (non-segmented) Files

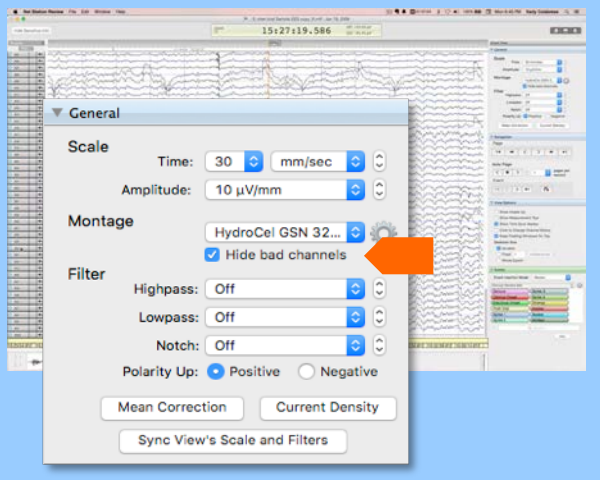
In Chart view:

⊇ Open a continuous (non-segmented) file in Net Station Review.



⊄ If you do not want to see bad channels or if some channels are already marked as bad and obscuring others:

Enable (check) **Hide bad channels** in the General control panel to hide those bad channels.



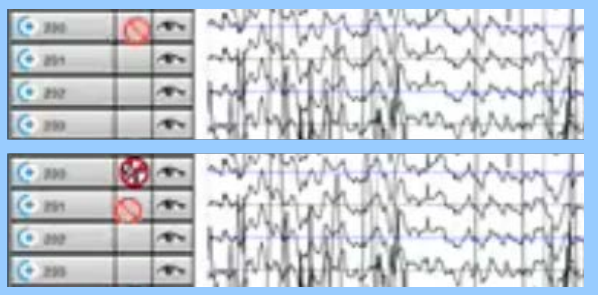
⊂ Scroll through the waveforms to check for bad channels.

⊆ To mark a channel as bad, while in Chart view:

Click the **middle box** of a channel's label.

While hovering over that box, notice that the cursor turns into a Do Not symbol.

After clicking:



Simply click again to unmark the channel.

- *A Bad Channel symbol appears in the box, if the Hide bad channels feature in the General control panel is not checked.*
- *The entire track disappears (waveform and label), if the Hide bad channels feature is checked.*

Know that for continuous files:

- Channels that are marked bad are bad in all views.

  However, while channels are marked bad in all views, they are shown/hidden in each view depending upon each view's Hide bad channels feature setting.

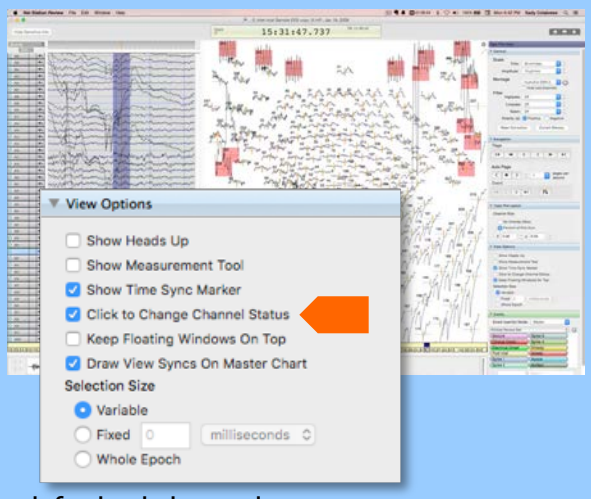
- Channels that are marked bad are bad throughout the entire file.

In Topo Plot view:

∈ To continue marking bad channels in Topo Plot view:

First, you must enable (check) **Change Channel Status** in the View Options control panel.

This enables the ability to mark channels as bad in the Topo Plot view.

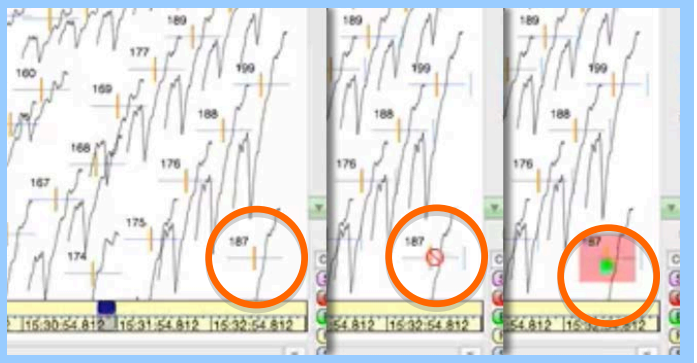


∉ Float the cursor over the topo plot to check for bad channels.

∠ To mark a channel as bad:

Click a **channel's topo plot** when the Do Not symbol appears.

While hovering over that channel's topo plot, notice that the cursor turns into a Do Not symbol.



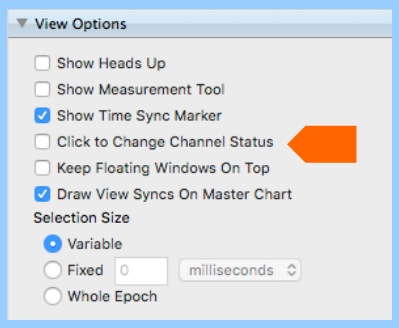
Simply click again to unmark the channel.

After clicking:

- *A red box appears on the channel's topo plot, if the Hide bad channels feature in the General control panel is <u>not</u> checked.*
- *The entire track disappears (topo plot and label), if the Hide bad channels feature is checked.*

∇ When you are done marking bad channels in the Topo Plot view:

You should disable (uncheck) the **Change Channel Status** in the View Options control panel.



This protects you from marking good channels as bad by accident.

7.2.1.4.2 Segmented Files

For files segmented with categories, you can mark:

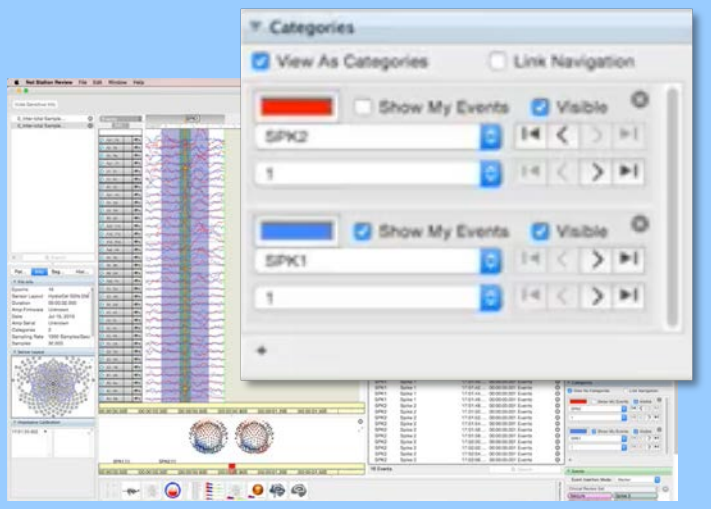
- **Only one segment in a file** by clicking the **middle box** of a channel's label.

  While hovering, you will see  .

- **All segments in a file** by holding command (⌘) + clicking the **middle box** of a channel's label.

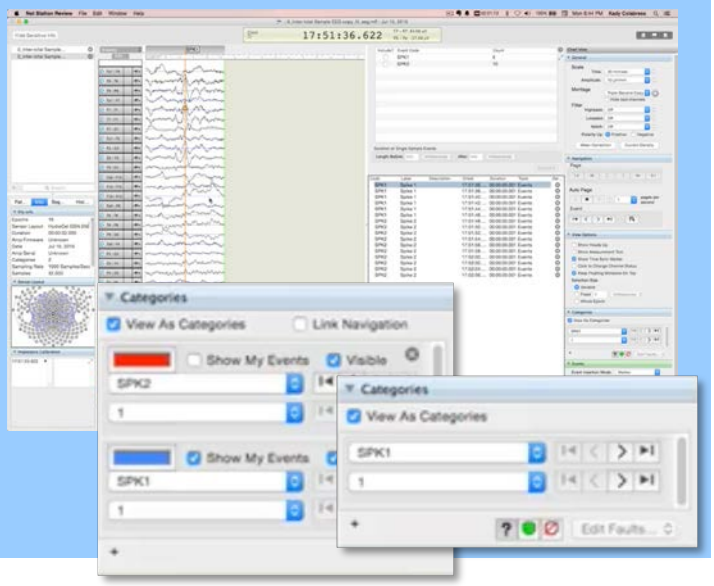
  While hovering, you will see  . *Notice the arrows aside of the Do Not symbol.*

Set up the file for efficiency:



⊇ Open a segmented file in Net Station Review.

Notice that the Categories control panel appears for segmented files.



⊄ To see the waveforms more clearly:

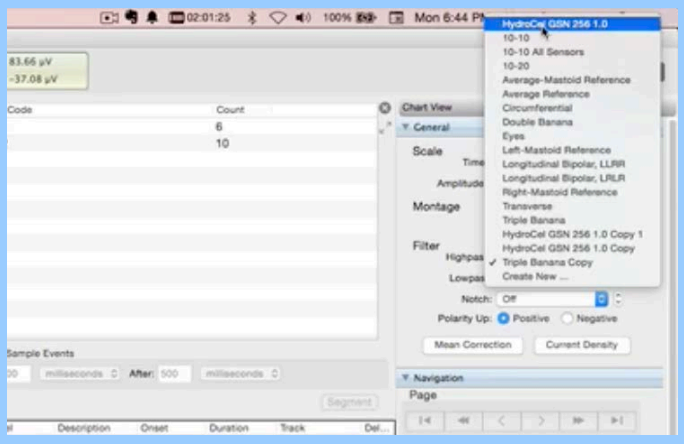
a) Close other views.

b) Close (hide) all but one category using the Categories control panel.

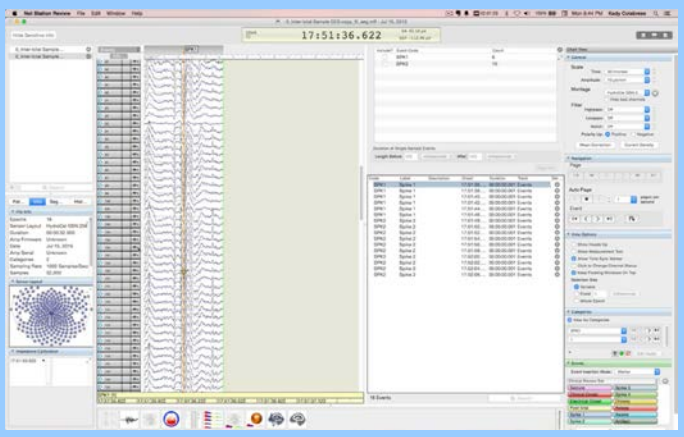
Look at one category at a time.

⊂ If the montage is set to other than the Net's montage:

Change the montage to the Net's montage using the General control panel.



⊆ Notice that you see one tile per channel in files segmented with categories.



∈ Scroll through the waveforms to check for bad channels.

∉ Decide whether you will mark each bad channel as bad in only one segment or in all segments.

∠ To mark channels as bad:

Click only

only one segment

Cmd (⌘) + click

all segments

Notice the arrows aside of the Do Not symbol.

∇ To review marked bad channels across segments and categories:

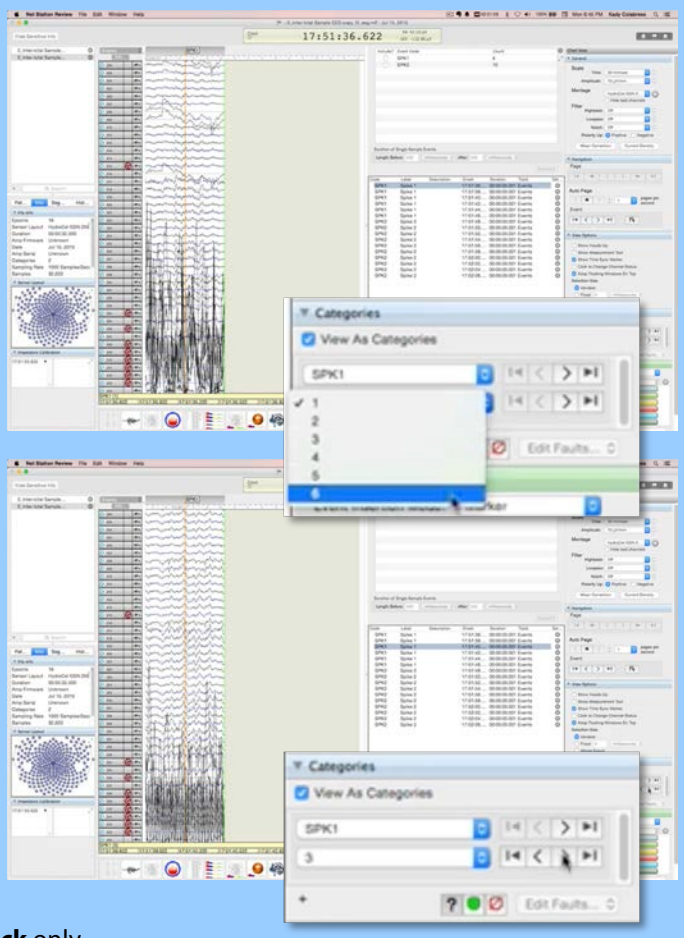
a) Navigate through segments.

In this example, 1 through 6.

b) Navigate through categories.

In this example, SPK1 and SPK2.

c) Review the Event List.



® To undo any marked bad channels:

Click only

only one segment

Cmd (□) + click

all segments

Notice the arrows aside of the Do Not symbol.

7.2.2 Button Bars—Views, Workspaces, and Workflows

7.2.2.1 Review's Views

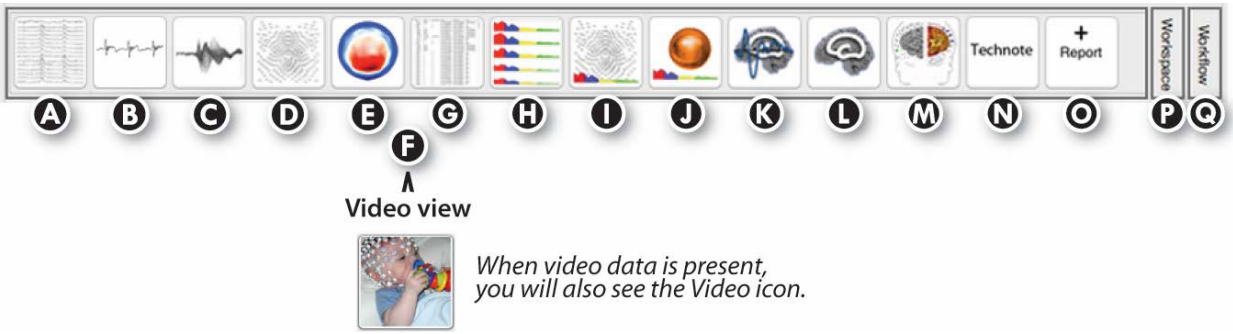
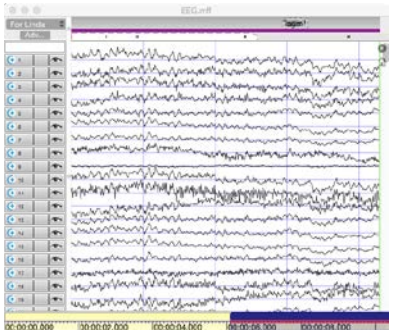
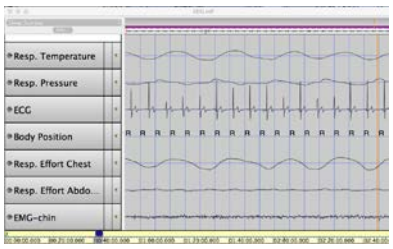
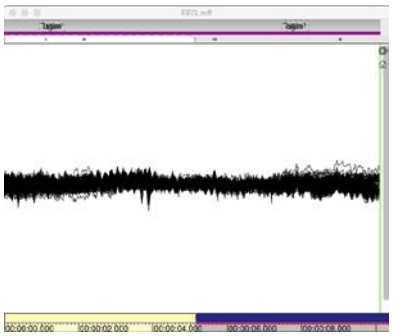
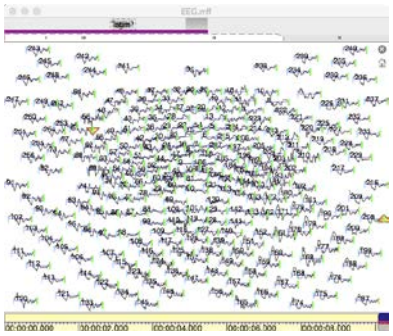
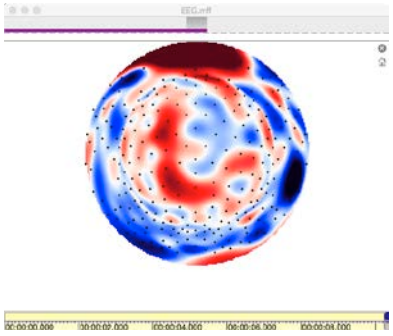
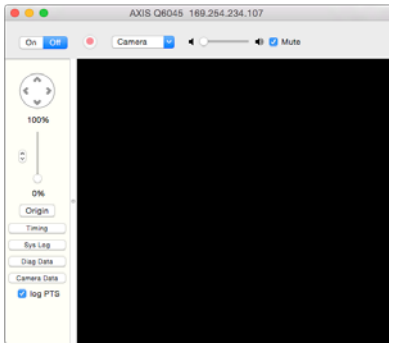
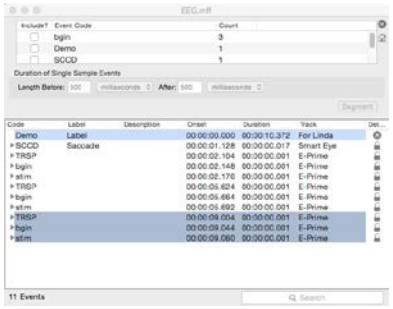
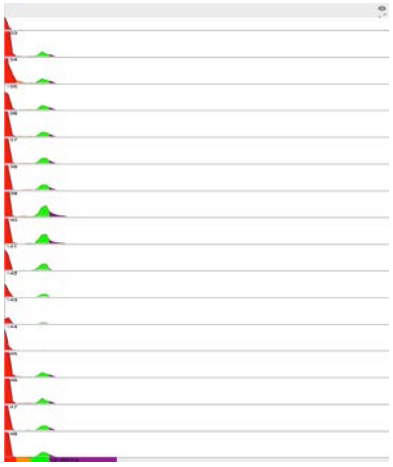
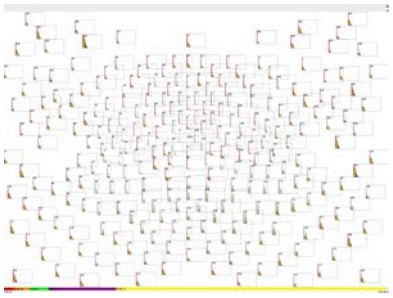
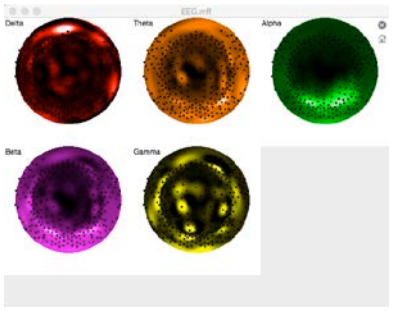


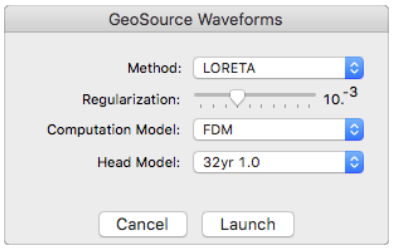
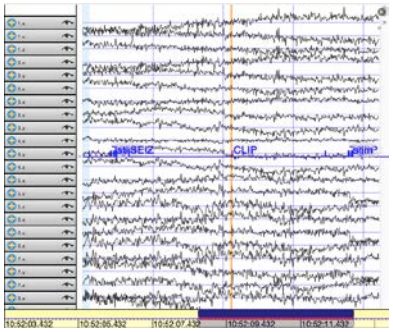
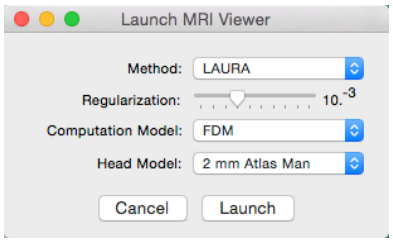
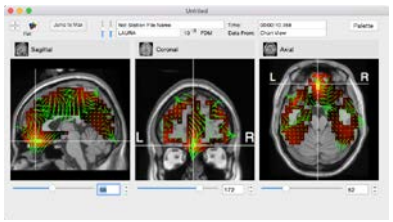
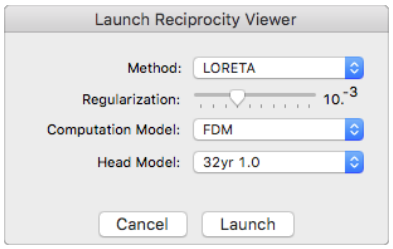
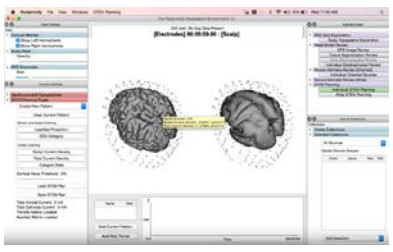
Figure 7-3. View buttons of the Review interface

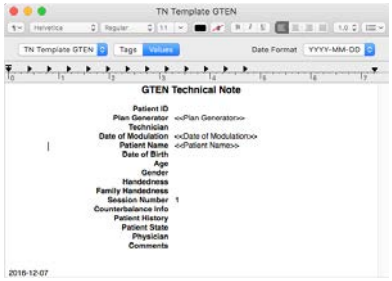
Table 7-3. Review' views

Callout	View / Button	Description	Display
A	**Chart**	Shows EEG data as traditional waveforms.	
B	**PNS**	Shows PNS data, if present, as traditional waveforms below the channels of EEG.	

Callout	View / Button	Description	Display
C	**Butterfly**	Shows all channels of EEG as overlaid waveforms for highlighting bad channels and peaks of activity and for checking baseline correction.	
D	**Topo Plot**	Shows all channels of EEG as spatial and temporal patterns of shorter selections of data organized by location on the head.	
E	**Topo Map**	Shows all channels of EEG as a spatial voltage map with amplitudes represented by color and the amplitudes between sensors being interpolated to depict the entire surface of the head.	
F	**Video**	Shows the video that was recording simultaneously with the EEG.	

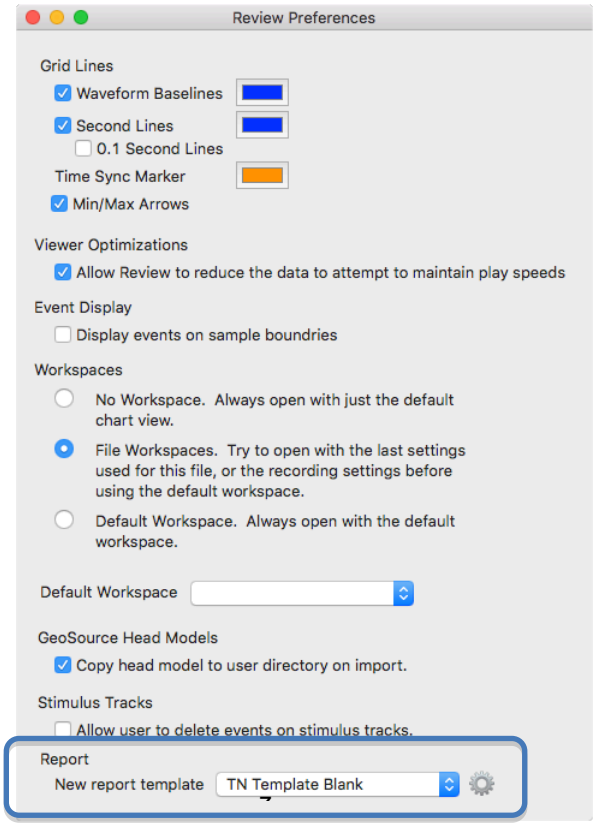
Callout	View / Button	Description	Display
G	**Events**	Lists all events marked in the EEG.	
H	**Spectral Chart**	Shows all channels of EEG as spectrograms.	
I	**Spectral Topo Plot**	Shows all channels of EEG as spectrograms organized by location on the head. See section 7.3.5.3.	
J	**Spectral Topo Map**	Shows all channels of EEG as maps of spectral data by frequency band. See section 7.3.5.4.	

Callout	View / Button	Description	Display
K	**GeoSource Waveform** Available with either GeoSource **2** (medical device) or GeoSource **3 Research** (non-medical product)	Shows all channels of EEG as GeoSource waveforms with associated GeoSource computation, montage, and view controls.	 
L	**GeoSource 2 MRI** Available only with GeoSource **2** (medical device)	Shows all channels of EEG as MRI slices. The Palette button is a toggle button that shows/hides a palette of additional display options for the MRI viewer.	 
M	**RVE's two states*:** ⊇ 3D topo maps ⊄ head models too ***See the rollover text.**	Opens the Reciprocity Visualization Environment (RVE). With Net Station alone, the RVE window shows only 3D topo maps. With Net Station and a license for the optional GeoSource **3 Research** (non-medical product), the RVE window shows head models too.	 

Callout	View / Button	Description	Display
N	**Tech Note**	If a technician's note was entered during acquisition: • It is available in Review via the Tech Note button. • It can be edited in Review. • It cannot be deleted from the file from Review.	
O	**+ Report**	Opens the default template (from among the options of a blank, predefined, and any custom templates created) as set by the Review Preferences dialog. See sections 7.1.1 and 7.2.2.1.1.	
P	**Workspaces**	Toggles between the Views, Workspaces, and Workflows button bars. A *workspace* is a collection of view settings to view files with, including window sizes, window locations, views (topo map, spectral topo plot, etc.), montages (for each data window), filters (for each data window), and event set (also event track, if needed). See section 7.2.2.3.	**Workspaces** *button bar*  **Views** *button bar*  **Workflows** *button bar* 
Q	**Workflows**	Toggles between the Views, Workspaces, and Workflows button bars. Net Station is optimized for standard *workflows*, which makes it easy for you to create custom workflows for the analyses you most commonly perform. The Combine Categories workflow is provided as one standard workflow. See section 7.2.2.2.	**Workspaces** *button bar*  **Views** *button bar*  **Workflows** *button bar* 

7.2.2.1.1 +Report

With the +Report feature, you can:



Select your default report template: You can set the template that reports open with from the Review Preferences dialog (section 7.1.1).

Add four reports: You can add up to four rich-text-formatted reports to a recording file, if a technician's note was *not* added during acquisition.

Add three reports: You can add only three reports to a recording file, if a technician's note *was* added during acquisition.

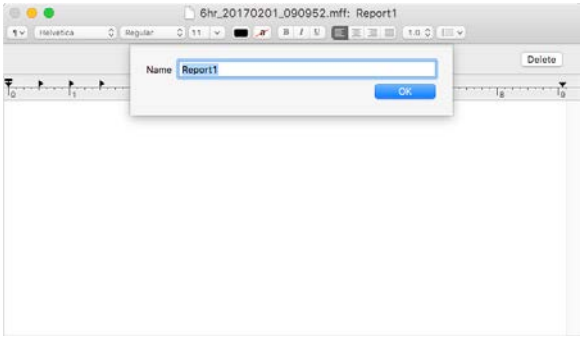
Not delete technician's note: You cannot delete a technician's note, if present.

Delete any reports: You can delete any report.

Create custom templates: You can create customized report templates using the cog (P) icon.

7.2.2.1.2 Using Provided Reports

Upon opening a report window, you can:



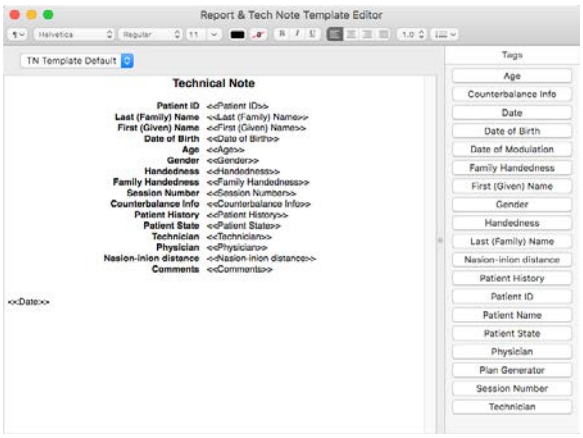
Add content: Click, tab, or space to place the cursor where you want text to appear, and then type.

Format content: Change the look of text or tags with the font and paragraph formatting options.

Save a report: Save and name a report by clicking the **red close** button.

7.2.2.1.3 Creating Custom Templates

You can create custom report templates from the Review Preferences dialog by clicking the cog (P) icon next to the template selection field.



Besides rich text controls, the Report & Tech Note Template Editor dialog allows you to control the:

Type and format: Typing and formatting is similar to most text editors.

- Click, tab, or space to place the cursor where you want text or tags to appear.
- Format text or tags with the font and paragraph formatting options.

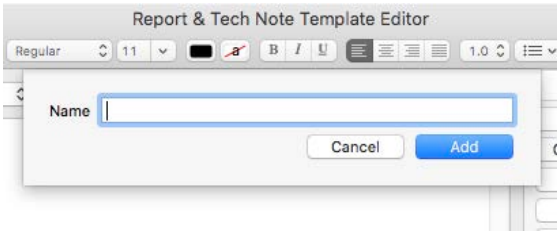
Tags. Provided tags are linked to fields in the Patient Info control panel. If information exists in a Patient Info field, it will autofill the corresponding field of a report.

To add tags: Click **tag** buttons.

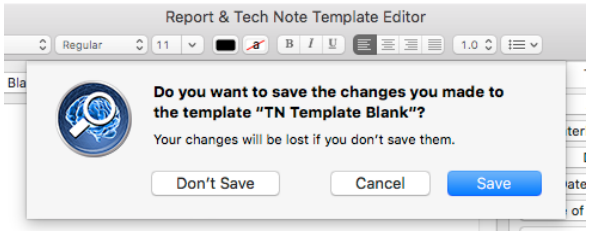
To delete tags: Highlight tags in the template, then click the keyboard **delete** button or cmd (⌘) + X buttons.

Save (or not save) the template. To make a custom template available in the template list, save it with a name by selecting or clicking:

File ▶ Save
File ▶ Save As
cmd (⌘) + S



red close button



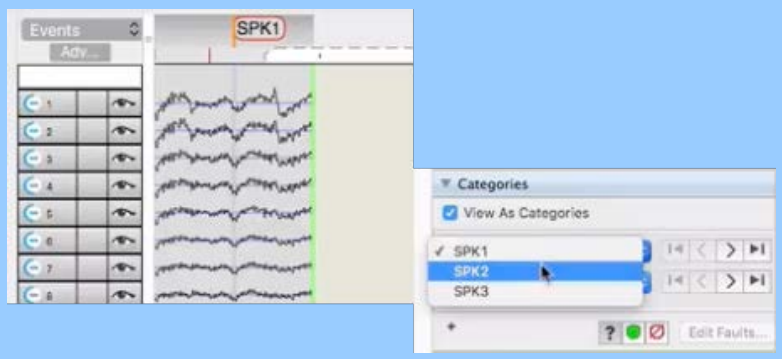
7.2.2.2 Review's Workflows—Combine Categories

The *Combine Categories* default workflow is useful for reassigning the segments and categories of segmented files.

One example of using the Combine Categories workflow:

⊇ Open any *segmented* file in Net Station Review.

⊄ Review the file's segments and categories.

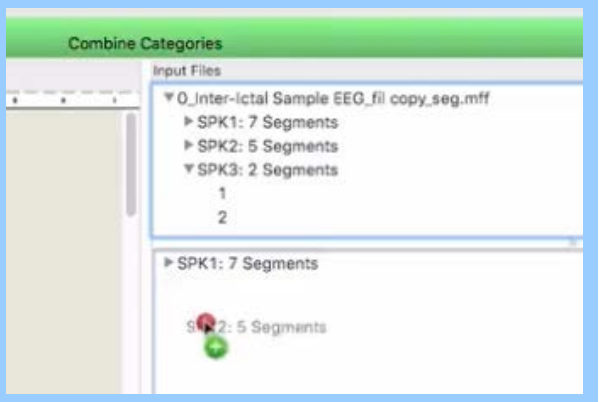


⊂ Click **Workflows** on the button bar.

⊆ Click **Combine Categories** on the Workflows button bar.

Notice that the same file is listed in both the upper-left pane and the Input Files pane.

∈ Expand the file's folder in the Input Files pane to see the file's categories and segments.



∉ Drag and drop the categories you want to keep to the Segment's pane.

∠ Select a segment in the remaining category, then:

a) If necessary, review it in Net Station Review.

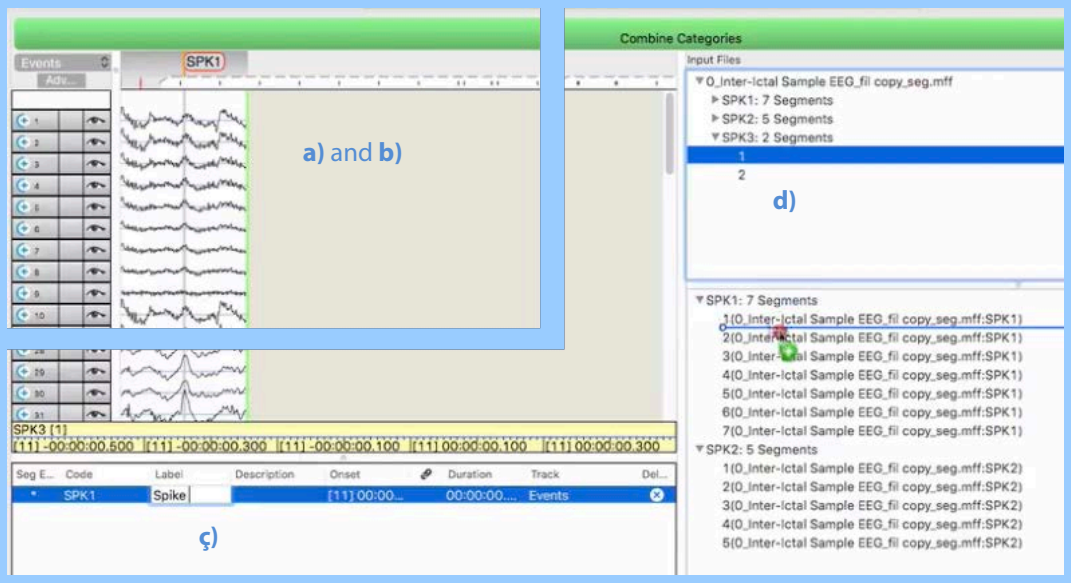
b) Decide which category to move the segment to.

c) If desired, edit the segment's code and/or label.

Notice that changing the category of a segment does not change the codes of the events contained within the segment.

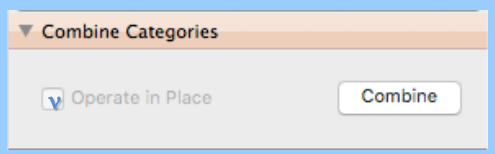
d) Drag and drop the segment to the desired category.

If you need a new category, drop the segment to the empty area in the Segment's pane below all segments.

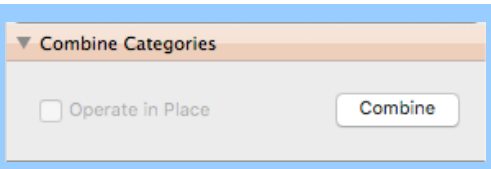


∇ Apply the changes with one of two choices:

- **Save changes to the original file:** Check **Operate in Place**, then click **Combine**.



- **Save changes to a copy of the original file:**
  Leave the Operate in Place option *unchecked*, and click **Combine**.



  The copy with the changed segments/categories will be saved to the same location as the original file, with *_cmb* appended to the filename.

If you explore the Categories control panel and the Events list for the new file, you will now see only the categories and segments you reassigned to it.

7.2.2.3 Review's Workspaces

Use the controls from the Workspaces bar to select, create, update, or delete workspaces in Review.

Notice that files recorded with Net Station 5.2 or later contain an initial default workspace named "Recording Settings."

- Make a selection of an existing workspace to apply to your file by clicking **one from the list**. (A checkmark appears beside the active workspace.)
- A workspace must be active to be updated or deleted.

To create new workspaces in Net Station Review:

⊇ Open a file in Net Station Review.

⊄ Set the available workspace settings as desired:
window sizes, window locations, views (topo map, spectral topo plot, etc.), montages (for each data window), filters (for each data window), and event set (also event track, if needed).

⊂ Click **Create New Workspace**, name the new workspace, and then click **OK**.

To set how Net Station Review displays workspaces:

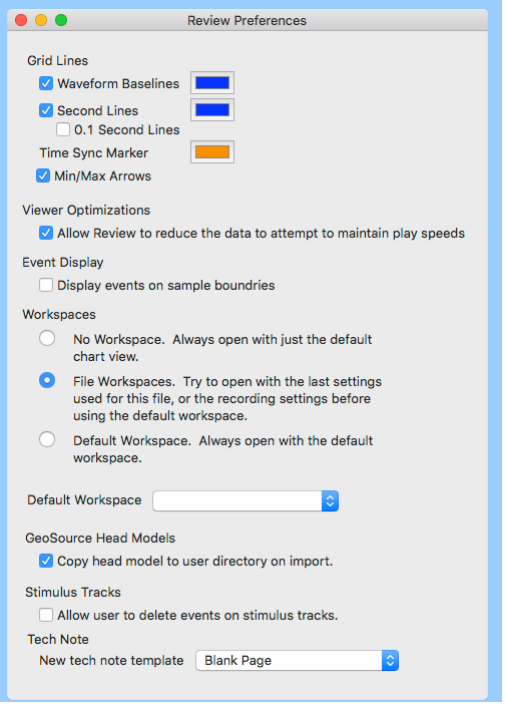
⊇ Open **Review Preferences**.

⊄ Select:

No Workspace to always open files using the default chart view.

File Workspaces to open files in the order of:
(a) last settings used for this file;
(b) Recording Settings; or
(c) Default Workspace.

Default Workspace to always open files using the Default Workspace, which is set by the pull-down list below these Workspace settings.



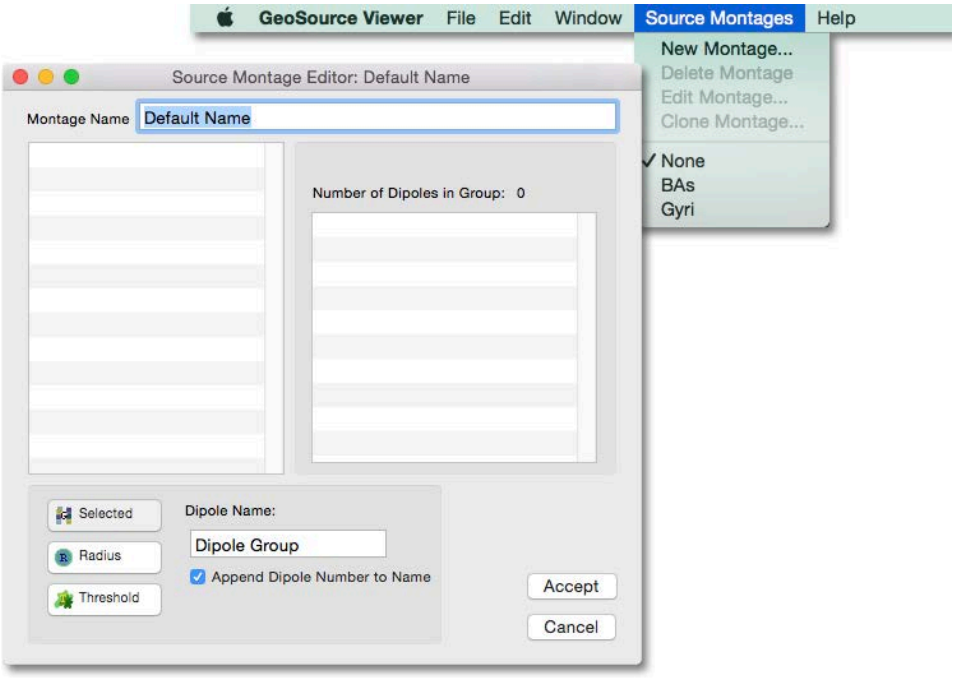
7.2.2.4 GeoSource 2 Source Montages

After launching the GeoSource **2** MRI view from Net Station Review, the menu bar for the GeoSource **2** (medical device) software is available and is where you can create *source montages*.

GeoSource 2 (medical device)	versus	GeoSource 3 Research (non-medical product)
Note that a source montage in GeoSource 2 (medical device) is the same as a source collection in GeoSource 3 Research (non-medical product).		**FOR SCIENTIFIC RESEARCH PURPOSES. Be aware that any source waveforms created using GeoSource 3 Research (non-medical product) are restricted to scientific research purposes only.**

For detailed instructions for using the full-featured version of the GeoSource source localization software, refer to the GeoSource **2** (medical device) manual (8103101-52) or the GeoSource **3 Research** (non-medical product) manual (8103101-54).

A source montage allows you to highlight only the source data that is of interest. You can then export this subset of data to another file.



If you save out individual participant average files as source waveform files using a source montage, you can then use these files with the Statistics Extraction *tool* to extract values for statistical analyses in time windows and brain regions of interest across conditions or participant groups.

OBSERVATIONS: Notice that each dipole group of a source montage is displayed as a composite dipole with three vectors. Also notice that the length of each vector indicates the intensity of the corresponding dipole's orientation in the X, Y, and Z planes. The vectors point in the positive direction of the dipolar activity. In orthogonal slice views, only two of the three vectors are visible. For example, the coronal slice view shows vector orientation strengths in the X and Z directions.

To view the vectors more clearly, you may need to toggle off the crosshairs.

Remembering that a *source montage* in the GeoSource **2** (medical device) software is the same as a *source collection* in the GeoSource **3 Research** (non-medical product) software:

- source *montages* are created using the GeoSource **2** MRI slice viewer in Net Station Review and

- source *collections* are created using the Source Collections pane of the Reciprocity Visualization Environment (RVE).

The dipoles in the MRI slice viewer of the GeoSource **2** MRI viewer or the RVE are approximately represented by *voxels*, which are colored 3D volume pixels. A dipole group represents one compound dipole in a source montage/collection (computed as the mean intensity of the dipoles included in the group). Once created, source montages/collections are available in either the GeoSource **2** MRI slice viewer or the Net Station Review viewer for any source data file.

To create a source montage:

⊇ View the source data at the time point of interest.

⊄ To make the spatially discrete areas of the MRI slices more obvious, you can reduce the number of low-intensity voxels that are showing. A good starting point is to reduce the palette maximum by approximately 20% to highlight the higher intensity voxels. To reduce the number of low-intensity voxels, raise the palette-minimum slider.

⊂ Click **Source Montages ▶ New Montage**.

⊆ After the Source Montage Editor window opens, notice that the voxels in the MRI panes of the GeoSource Viewer are now empty so that they may be easily selected for a new source montage.

∈ In the Source Montage Editor window, type in a name for this source montage and type in a name for the first (or only) dipole group to be included in the montage.

When naming dipole groups, consider names that are meaningful, such as amygdala, OFC, or P300.

∉ Create the first dipole group for the source montage with the *selected*, *radius*, or *threshold* dipole-group method.

Selected method:

a) Click **Selected**.

b) Manually select voxels to populate the dipole group. Do so by clicking or shift-clicking voxels in the MRI panes.

Clicking starts a new group and shift-clicking adds voxels to the current group.

c) Watch the dipole-group table for updates of the chosen method, name,

dipole ID numbers, and the number of dipoles that are included.

Radius method:

a) Click **Radius**.

b) In the Radius text box, specify a distance from the selected voxel to be included in the group.

c) Click a **voxel** in the MRI panes. All voxels that fall within the specified radius of the voxel clicked will be added to the group.

Threshold method:

a) Click **Threshold**.

b) In the Percent of Peak text box, specify a percentage of intensity voxels adjacent to the selected voxel to be included in the group.

c) Click a **voxel** in the MRI panes. All adjacent voxels with intensities that fall within the specified percent-age of the voxel clicked will be added to the group.

∠ If adding additional dipole groups, repeat step ∉.

∇ Click **Accept**.

® Upon creation, the new source montage will be displayed. To change between montages or no montage, choose **Source Montages ▶ {montage name}**.

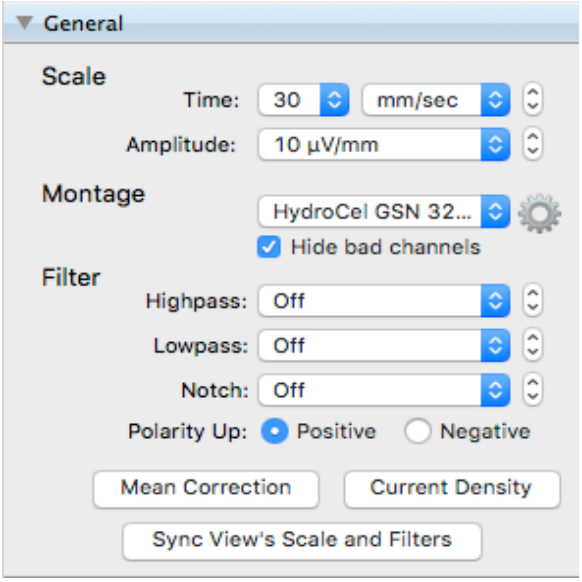
7.3 Review's Control Panels

Following are the standard Review control panels.

Notice that some controls change according to the selected view (topo plot, etc.).

7.3.1 General

Use these general controls to filter out undesired frequencies from the *onscreen display*.



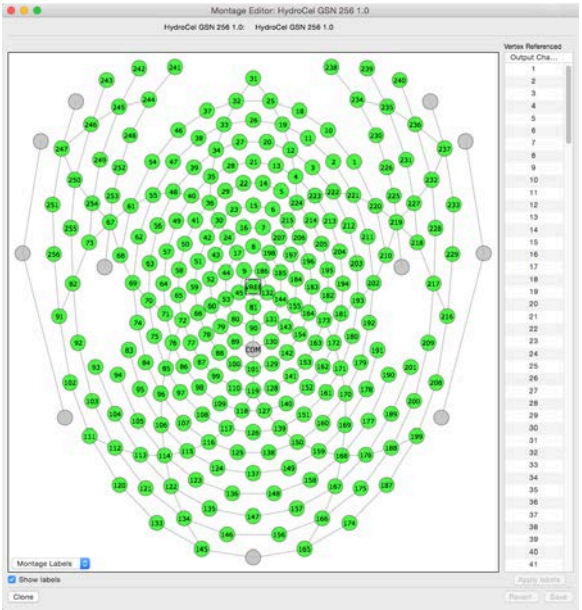
These settings do not affect how data are recorded or saved.

The **sec/page** option is available under the Scale options for Time for such events as sleep scoring. See sections 6.3.7 and 7.3.4.

Note that only those frequencies within the band between the highpass and lowpass filter settings are attenuated, not the frequencies at those settings.

7.3.1.1 Montage Editor

Clicking the cog (P) icon next to Montage in the General control panel opens the Montage Editor. With this editor you can select a different montage to view the data with or create a custom montage.



A montage created in either Acquisition or Review is available in both modules.

With the Montage Editor you can show/hide/select labels, reorder the list of channels, and clone, revert, and save new montages.

7.3.1.2 Sync View's Scale and Filters

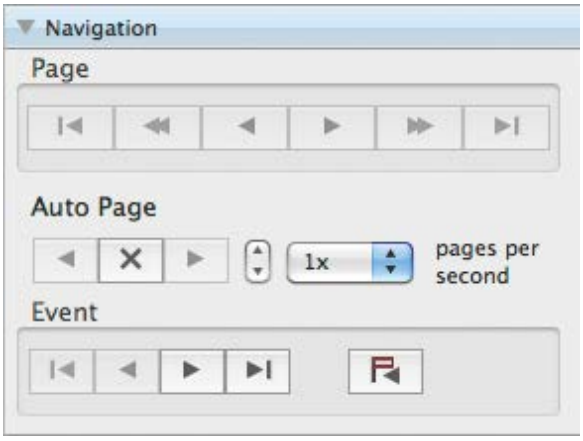
Use this button to synchronize the scale and filter settings that have been applied to the active view to all other open views.

Note that the settings are synchronized only once, upon clicking the button. If you change additional scale and/or filter settings that you wish all views to reflect, you must click the button again.

Also notice that the views are *not linked* but that only the current scale and filter settings of the active view have been applied to all other views.

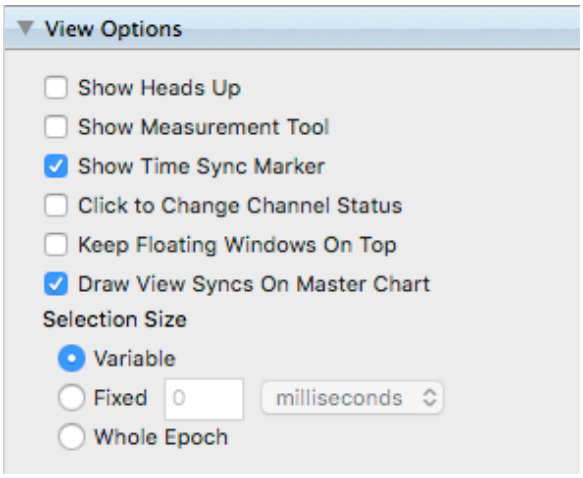
7.3.2 Navigation

Use these navigation controls to move through the data by page, automatic scrolling, or event (sequential or flagged).



7.3.3 View Options

Use these view controls to change the appearance of the data display pane.



Heads Up. Shows/hides mouseover information for data points.

Measurement Tool. Shows/hides the amplitude and time scale ruler that is used for measuring waveforms.

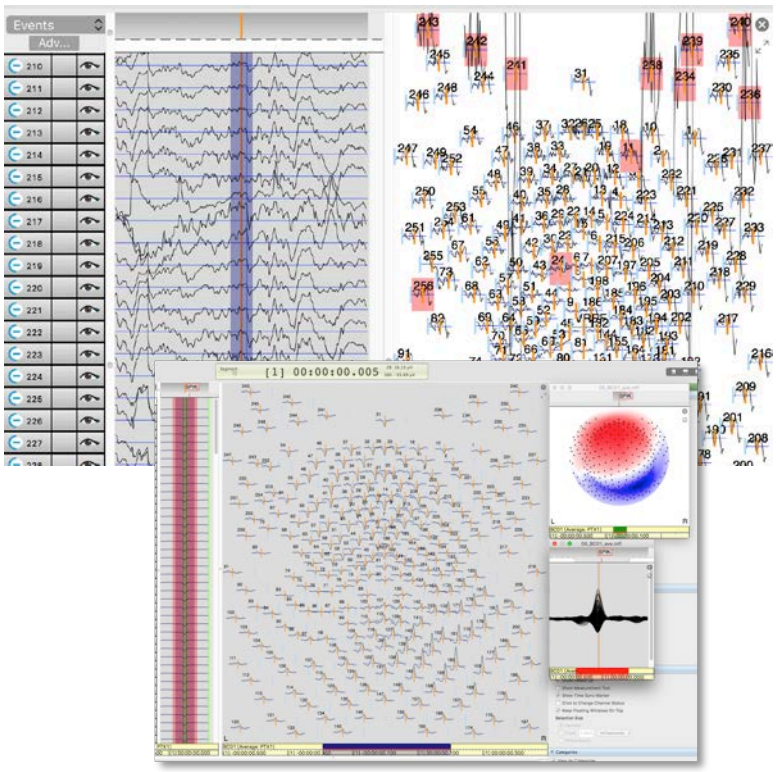
Time Sync Marker. Shows/hides the time sync marker.

Channel Status. Enables/disables the ability to change the status of individual channels.

Floating Windows. Enables/disables the keeping of unlinked windows in front of all other windows.

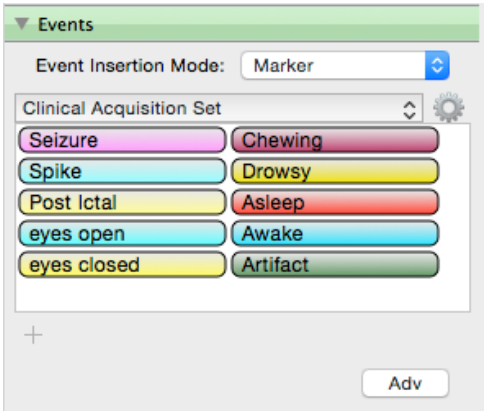
Sync Bar on Master Chart. Shows/hides a colored bar (purple, red, green, etc.) on the EEG waveforms (Chart view) that coincides with the time being viewed in other views (like Topo Plot, Topo Map, Butterfly, etc.).

Selection Size. Changes the preset selection size between variable (how wide you drag), a fixed quantity of time, or an entire epoch.



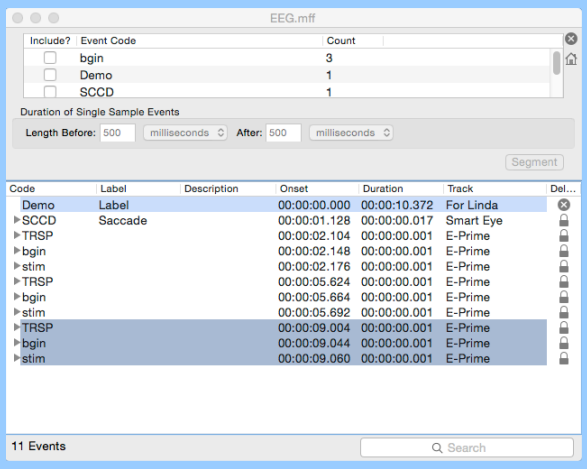
7.3.4 Events

Use these event controls *during review* to choose your insertion mode, choose your event set, place event markers into recordings, create events, and create event sets.



Use the **Event View** to:

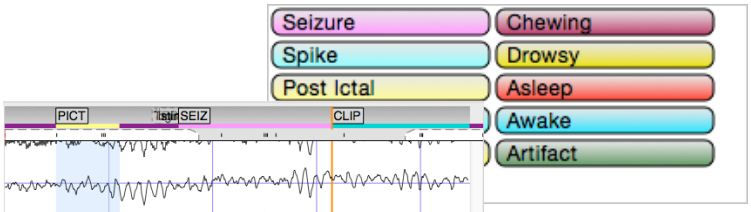
- edit the attributes of events in recordings:
  - code
  - label
  - description
  - onset
  - duration
  - track
- delete events from recordings

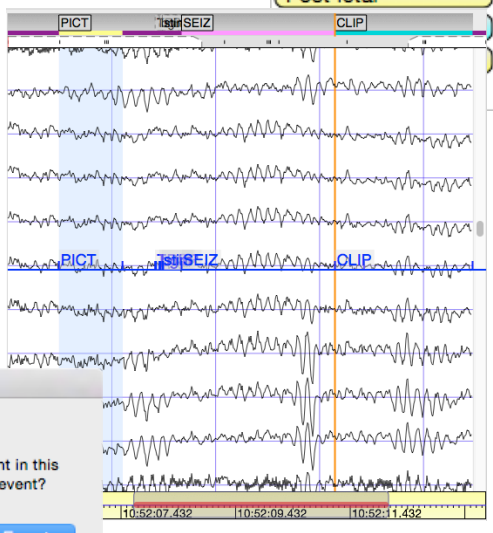


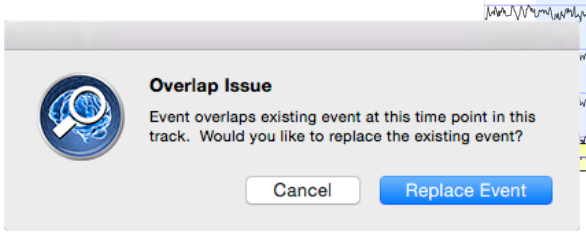
7.3.4.1 Enter Events

Use the following controls to enter event markers and control how they will be displayed.

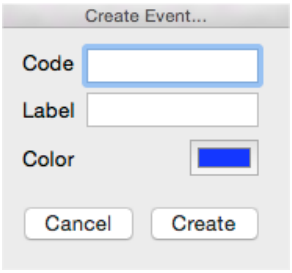
Event buttons. Click these buttons to enter events into recordings. If an event entry overlaps an existing event marker, you will get a message to choose which to retain.







+(plus). To add event markers to an event set, click **+** and make choices in the Create Event dialog.



Adv button. To change how events will be displayed, click **Adv** and make choices in the Advanced Events Controls dialog.

To enter events during review:

- ⊇ Select an **insertion mode**.
- ⊄ Select an **event set**.
- ⊂ Click a **point** or drag a **selection of time** in the time ruler or data display pane.
- ⊆ Click an **event button**.
- ∈ If the Overlap Issue message appears, choose which event to retain (the previous or the new).

7.3.4.2 Event Insertion Mode

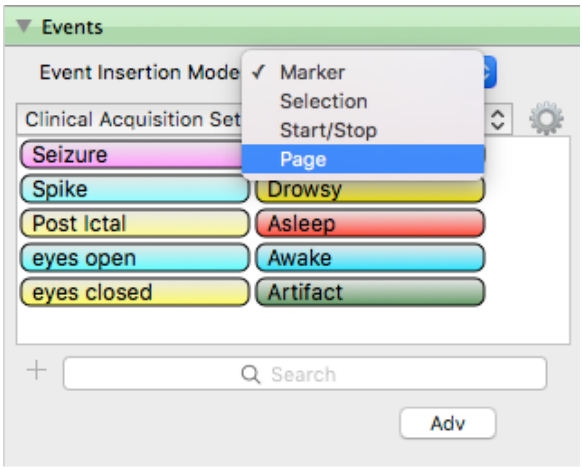
Insert events into a recording using one of these modes.

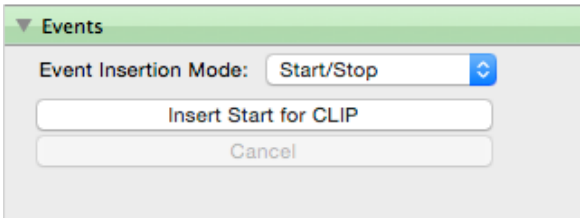
Marker: a point in time

Selection: a dragged span of time

Start/Stop: a *CLIP* of time (longer than can be dragged) with start and stop points

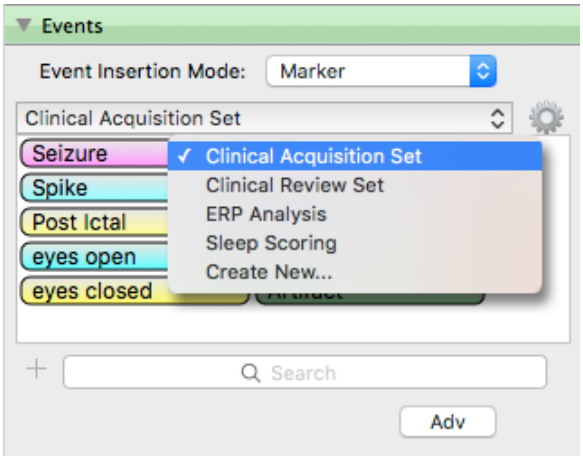
Page: the data visible in the width of the data display pane (section 3.2)





7.3.4.3 Event Set Selection

You have sets of event markers in a pull-down list to choose from—both default and custom sets.



7.3.4.4 Create Events and Event Sets

You can create custom event markers and sets of event markers.

To create a new event set:

1) Either click the **cog** (P) icon next to the event set field or select **Create New** from the event set pull-down list.

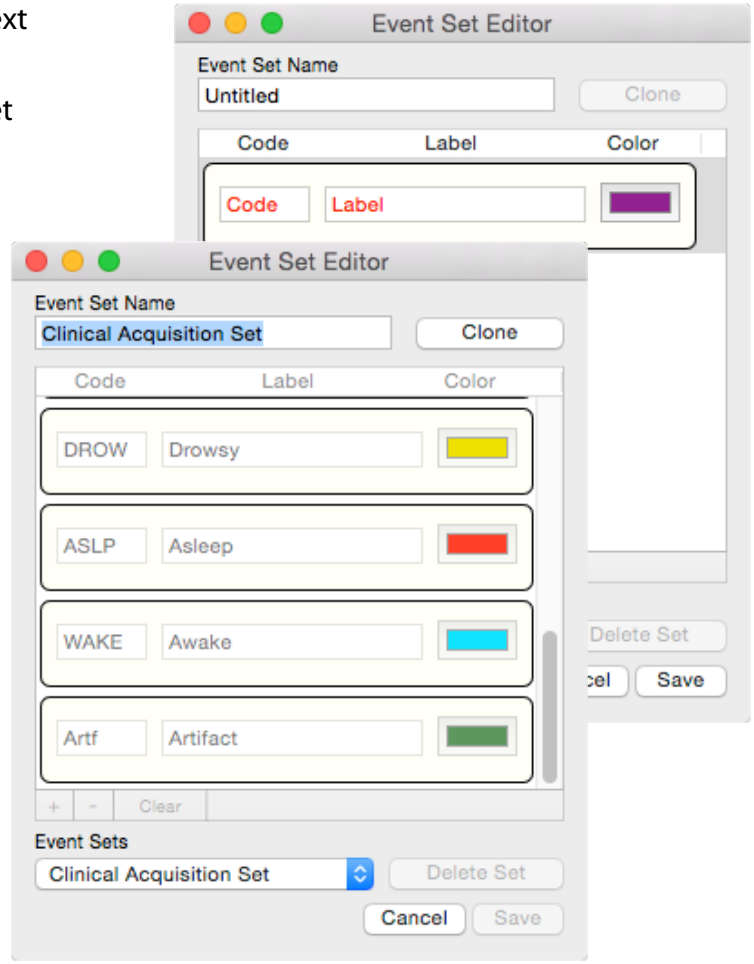
   Either will open the Event Set Editor so that you can add a new event set to the list of sets or change the events included in an existing set.

2) Add single events by clicking the **+** icon.

3) Delete single events by clicking the **–** icon.

4) Delete all events by clicking **Clear**.

You can edit and delete only created sets, not default sets.

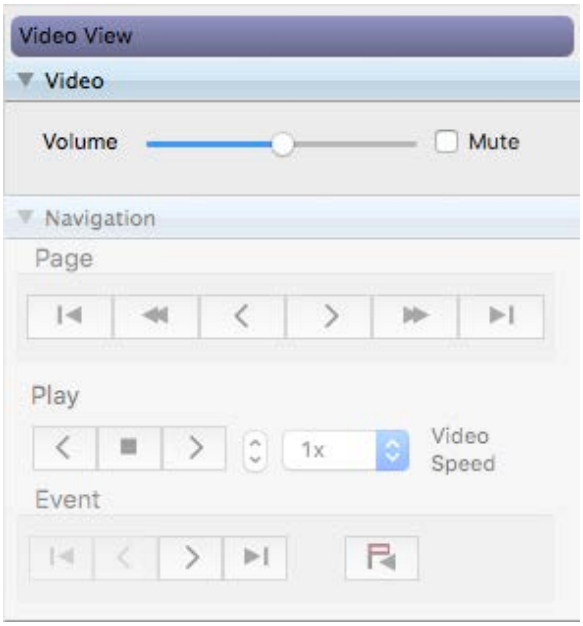


7.3.5 Additional Control Panels

Additional control panels will appear to support selected views.

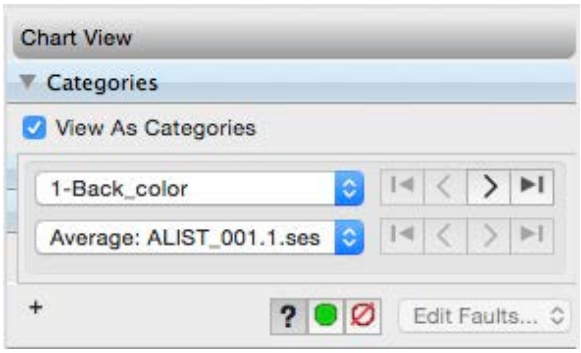
7.3.5.1 **Video**—for the Video View

Video volume controls will appear when viewing video.



7.3.5.2 **Categories**—for the Chart View

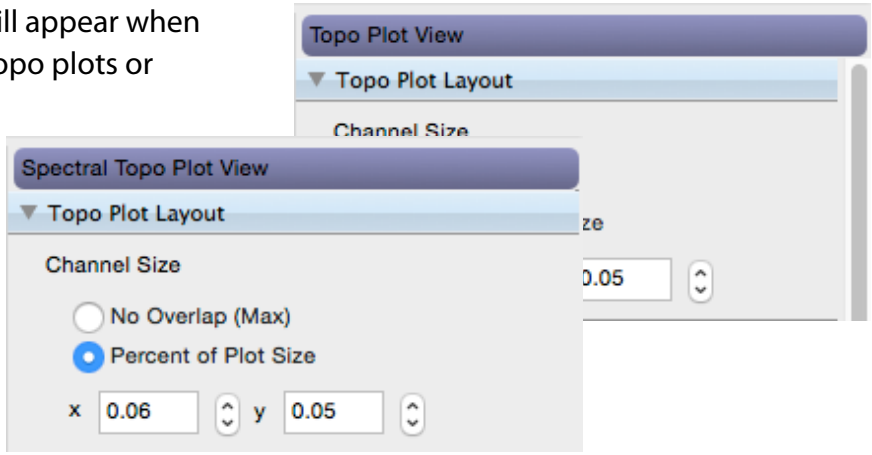
Category controls will appear when viewing segmented EEG data in Chart or GeoSource Waveform views. When enabled, use these controls to view and navigate data one segment at a time (within the selected category) or to change the status of segments.



Use the **+(plus)** to add (overlay) waveforms from different categories within an averaged file containing external events.

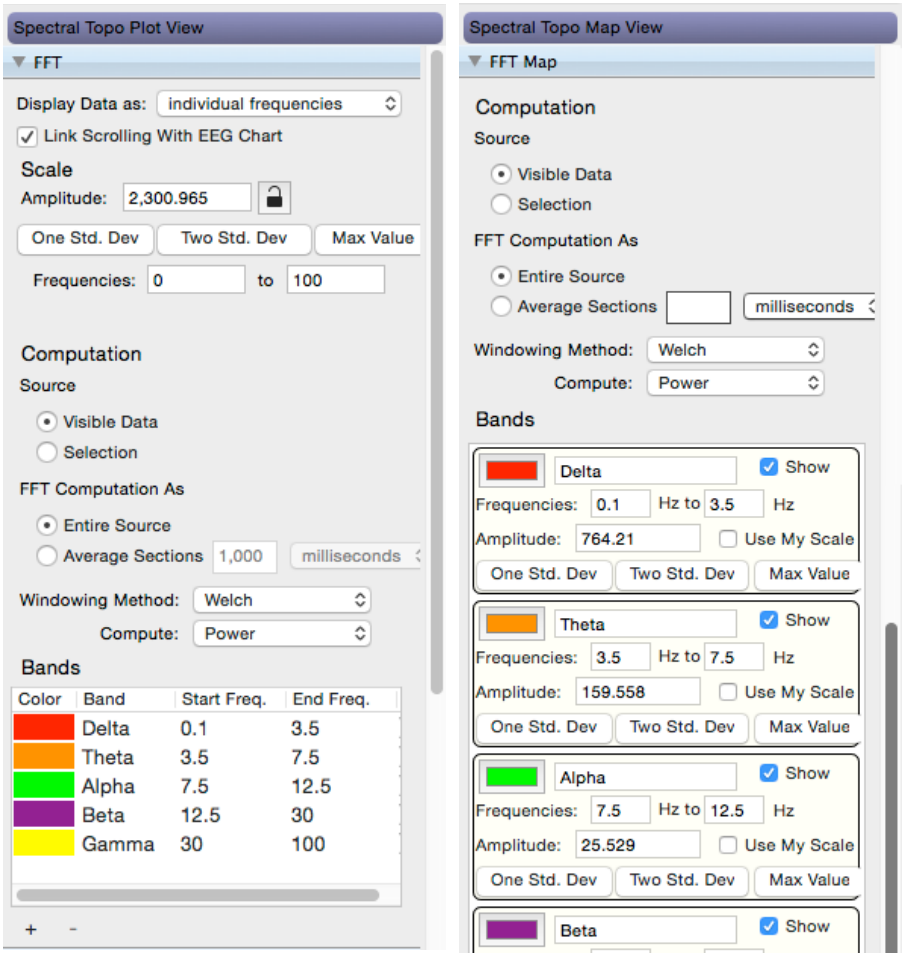
7.3.5.3 **Topo Plot Layout**—for the Topo Plot and Spectral Topo Plot Views

Topo Plot Layout controls will appear when viewing EEG data as either topo plots or spectral topo plots.



7.3.5.4 **FFT**—for the Spectral Topo Plot or Spectral Topo Map Views

FFT controls will appear when viewing EEG data as spectral topo plots or spectral topo maps.



7.3.5.5 GeoSource Computation Settings—for the GeoSource 2 (medical device) or the GeoSource 3 Research (non-medical product) Waveform Views

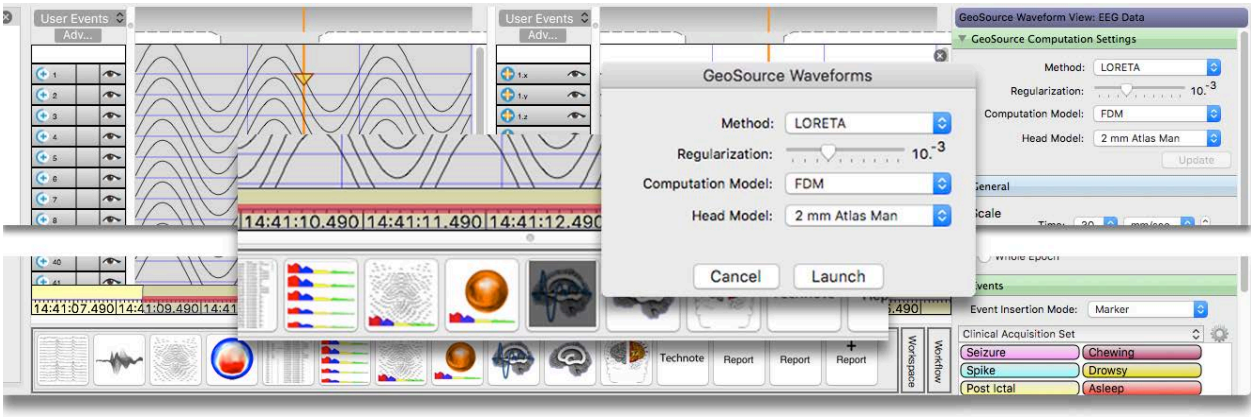


Figure 7-4. GeoSource Computation Settings after GeoSource Waveform button clicked

When viewing GeoSource waveforms, use these controls to select the:

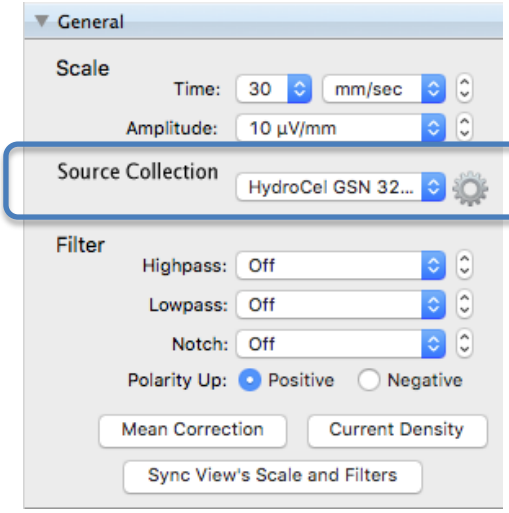
Method = the source-imaging specification for solving the inverse problem

Regularization = the method that adds information to stabilize an ill-posed problem

Computation model = the finite difference method (FDM) that defines the geometry of the head tissues

Head model = a defined dipole set for the GeoSource waveforms

Several things to note:



- The Montage field in the General control panel changes to the Source Collection field.
- Specifications created in the GeoSource Waveform view do not propagate to the GeoSource **2** MRI view or the RVE.
- You must carefully create specifications in each view (GeoSource waveform, GeoSource **2** MRI, and RVE) in order to compare results between the three views.
- The source collections that appear in the General control panel are based on those created in the RVE; therefore, those results in Net Station Review would propagate to the RVE.

GeoSource 2 (medical device)	versus	GeoSource 3 Research (non-medical product)
Note that a source montage in GeoSource 2 (medical device) is the same as a source collection in GeoSource 3 Research (non-medical product).		**FOR SCIENTIFIC RESEARCH PURPOSES. Be aware that any source waveforms created using GeoSource 3 Research (non-medical product) are restricted to scientific research purposes only.**

7.3.5.5.1 GeoSource Data as Numbers versus Visualizations

The following will help you understand the difference between the GeoSource specification tool that is available in Net Station Tools and the GeoSource views that are available in Net Station Review.

Primarily, the GeoSource views in Net Station Review allow you to **see** your source localizations, while the GeoSource tool from Net Station Tools allows you **access** the numbers behind what you are seeing.

Secondly, understand that source localization with GeoSource is different from visualizing the energy of voxels with fMRI. With GeoSource, *unlike fMRI*, when you see a voxel due to its energy, that doesn't mean that that voxel has statistically more energy than surrounding voxels. With fMRI, the statistical computations are part of the fMRI data, but, with GeoSource source localization, you still need to explore the data, based on your goals.

For example, if you were interested in visualizing source localizations, you might:

1. Review your data in Net Station Review to understand how to best explore it.
2. To visualize certain aspects more closely or in isolation, select the RVE icon in Net Station Review.
3. The results of the specification can be examined in either or both Net Station Review (when in Chart view) and the RVE, because they are linked in time. The visualizations in the RVE would show you such aspects of your data as the orientation of dipoles and the composition of the cortex.

If you wanted to go further, to find the numbers behind the visualizations, you might:

1. If doing a classic ERP workflow with visual target detection, again, first, review your data in Net Station Review to understand how to best explore it.
2. Look for something significant that represents a common occurrence, such as a specific activation at say 300-400 m/s, that might indicate an active/inactive condition to examine further across the subject group.

3. To visualize certain aspects more closely or in isolation, select the RVE icon in Net Station Review.
4. After exploring the data thoroughly, pick the best source specification that matches the source montages (also known as *source collections* in RVE).
5. Take that specification into the GeoSource specification tool of Net Station Tools and run it on your data to extract the numbers behind it.
6. You can then run a Statistics Extraction tool from Net Station Tools to go further with statistical analysis.

8. Using Tools

Net Station's *Tools* interface allows you to create and run specified waveform tools and scripts on your files to manipulate EEG data.

After you have run a tool or tools on a file, you will open it in Review for evaluation.

Remember that not all features are available in all versions of software. If you have any questions, contact Technical Support (Table P-2).

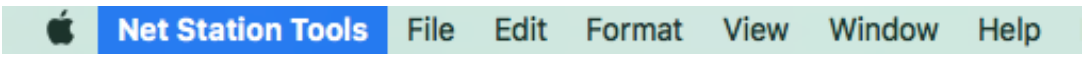
Knowledge Center

For articles that address the various procedural and theoretical aspects of EEG acquisition, click the **Training and Technical Support** tab at www.egi.com.

- The **Type** tab provides articles by:
  - application advice (usage, best practices, workflows, etc.)
  - technical/troubleshooting/help advice
  - implementation theory of features and functions
  - theoretical background of dEEG, source localization, etc.
- The **Products** tab provides articles by product group.
- The **Manuals** tab provides product manuals by product group.
- The **Video Tutorials** tab provides product and instruction videos.

8.1 Tools' Menus

All menus on the Tools menubar are standard and operate as expected.

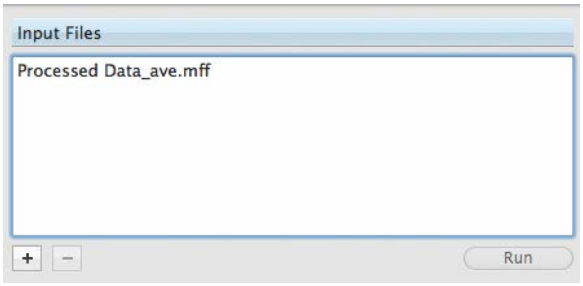


8.2 Tools' Control Panels

Following are the standard Tools control panels.

8.2.1 Input Files

Use these controls to add (**+**) and remove (**–**) files to be run with selected tools or scripts.



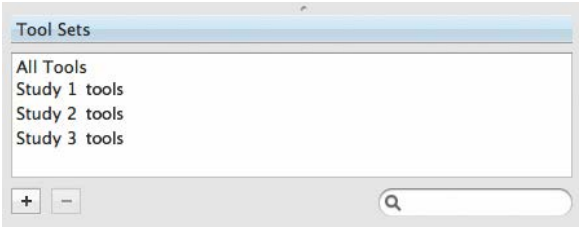
Note that a filename that appears **red** is incompatible
with the selected tool. One that appears **blue** is open in Review.

8.2.2 Run Button

Use the Run button to initiate the operation of a selected tool or script on a selected file.

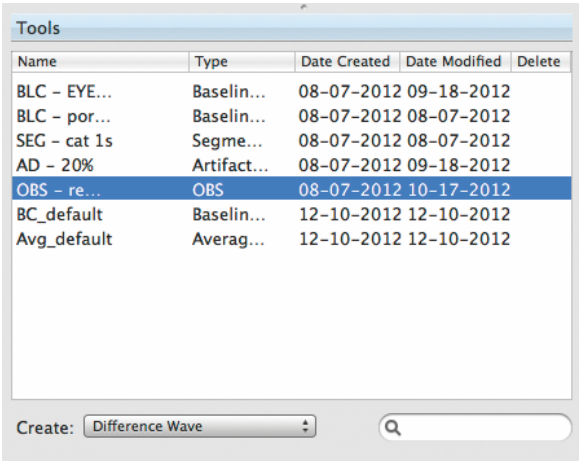
8.2.3 Tool Sets

If desired, use these controls to create unique collections of tools.



8.2.4 Tools

Use these controls to create, view the settings of, or select tools and scripts.

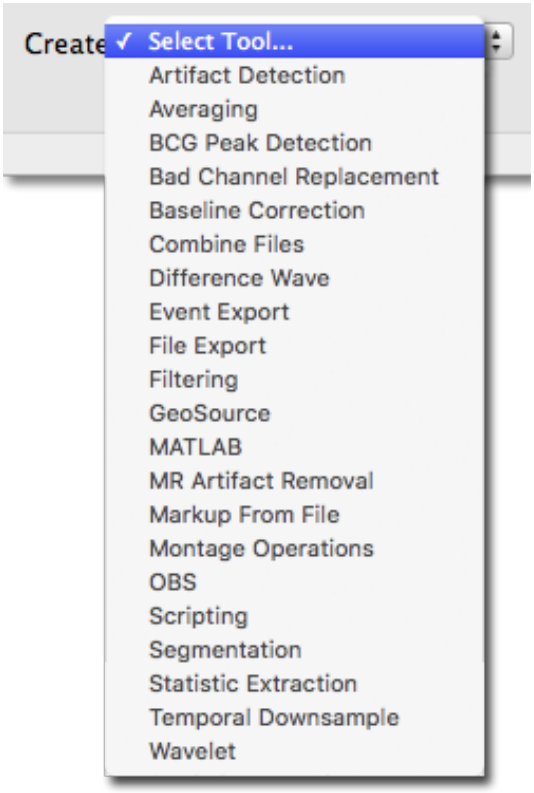


8.2.5 Create Tools

Use this control to select individual tools to create.

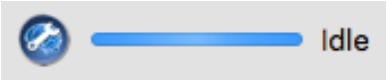
A *Scripting* tool runs a *specified series* of tools in a defined order. All other tools run individually.

See Appendix C, "Net Station's Tools," for details about individual tools.



8.2.6 Operation Status Indicator

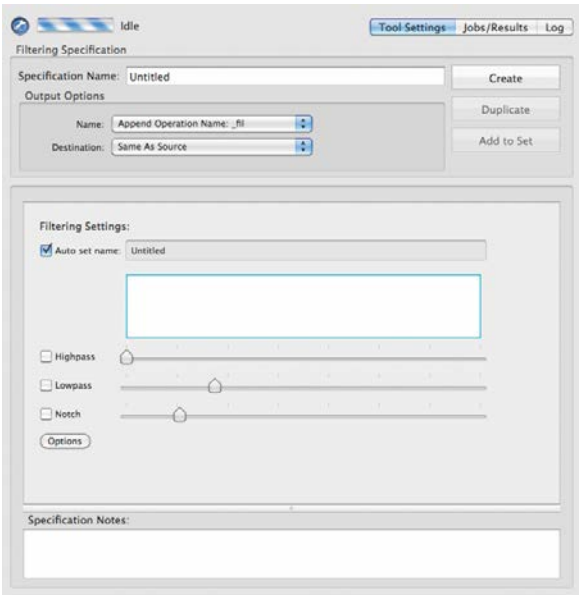
Displays the status of tool or script operations.



8.2.7 Settings, Results, and Log Tabs

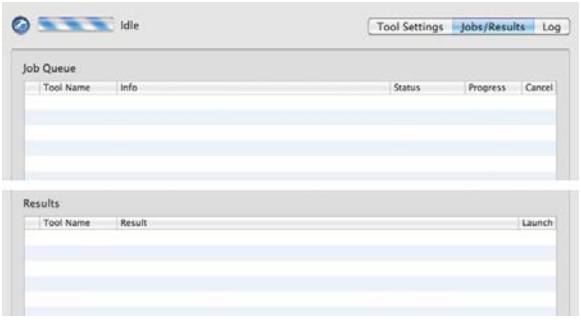
Tool Settings

Displays the settings for a tool.



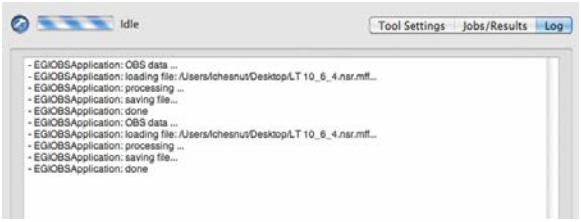
Jobs/Results

Displays the files waiting to be run and/or the results of running a tool or script on a file.



Log

Lists the pending, completed, or failed status of all jobs.



8.3 Creating Tools

This section gives you an example of how to use the controls of Net Stations Tools to specify a particular tool.

The same tool may be specified differently for different evaluations, such as clinical interictal. Even for the same evaluation, the same tool may be specified with different parameters to better explore the data.

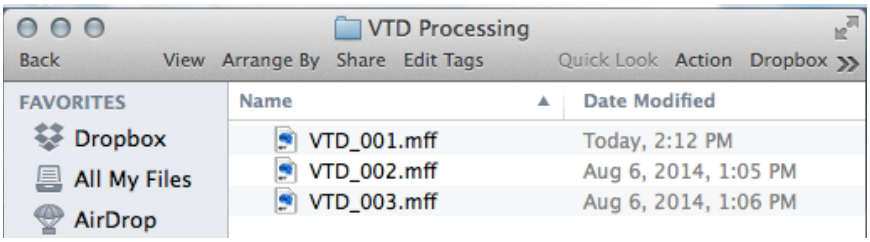
Common workflows containing different tools and settings are available from Technical Support (Table P-2).

8.3.1 Creating a GeoSource Specification Tool

To specify a tool, in this case a GeoSource specification tool, do the following:

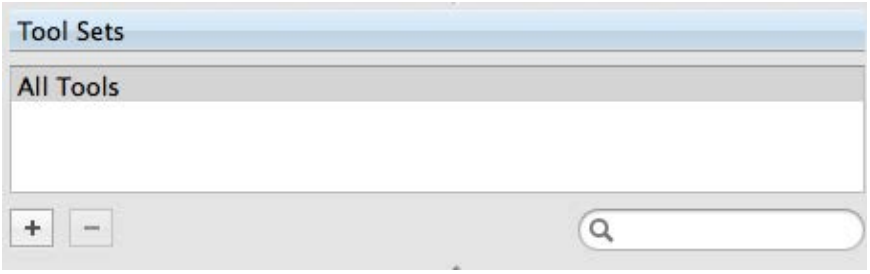
1. Know where your session data files are.

   In this example, the three session data files are titled VTD_00X and the folder they are in is titled VTD Processing.



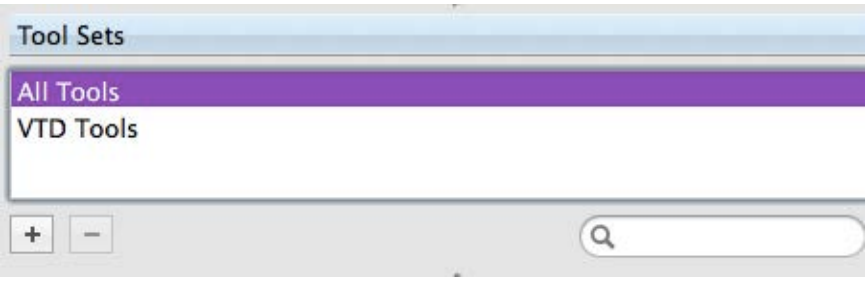
2. Open the **Net Station Tools** module of Net Station 5.

3. Tool sets are option but, if desired, click **+(plus)** to make a new tool set.

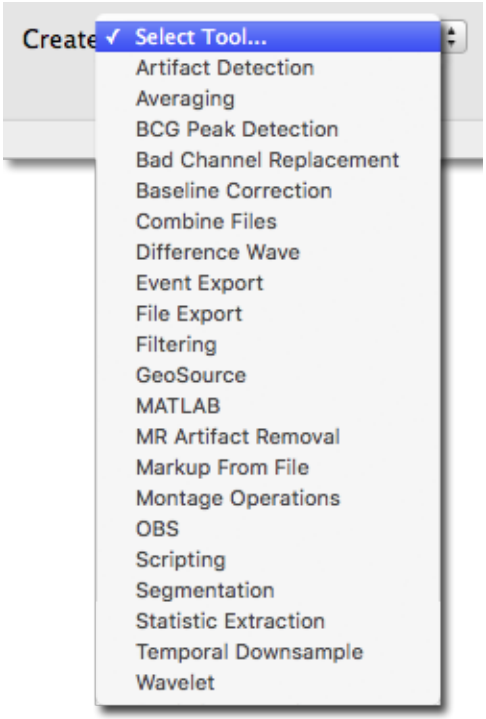


4. If you created a new tool set, name it.

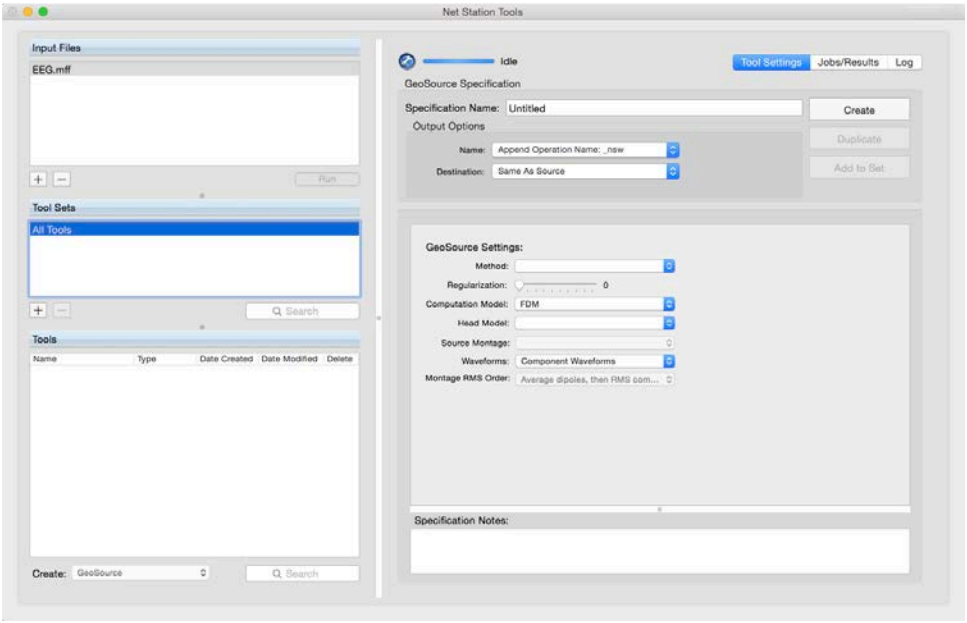
   In this example, change the untitled tool set to VTD Tools.



5. Beside Create, select **GeoSource** as the tool to be specified.

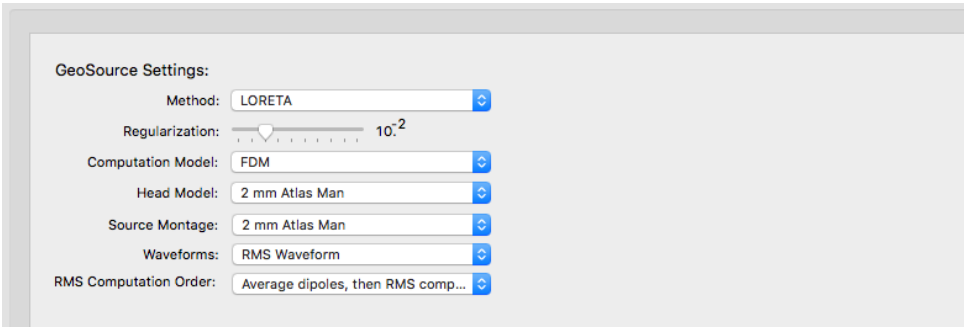


6. A new GeoSource specification with default settings appears on the right. Type a **name** for this new specification (that is, this new tool) into the Specification Name field.



7. Under GeoSource Settings, set the fields as follows:

- **Method**: LORETA
- **Regularization**: 10^{-2}
- **Computation Model**: FDM
- **Head Model**: 2 mm Atlas Man
- **Source Montage**: 2 mm Atlas Man
- **Waveforms**: RMS Waveform
- **RMS Computation Order**: Average dipoles, then RMS components



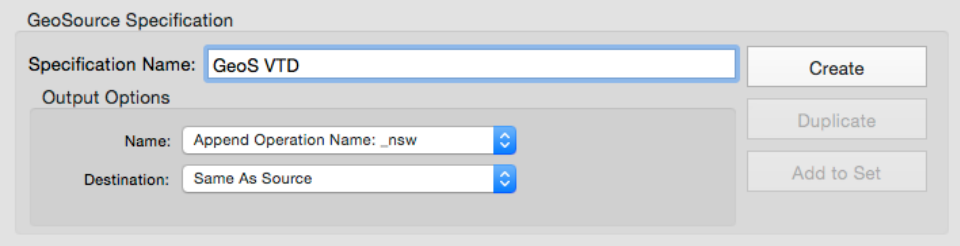
RMS Computation Order—*atlases only*

GeoSource provides the following options for the RMS Computation Order setting, when the Waveforms setting is set to RMS Waveform.

Average dipoles, then RMS components. To take orientation into account, this option takes the mean of each vector orientation (that is, the mean of all Xs, the mean of all Ys, and the mean of all Zs), and then takes the RMS at the end.

RMS components, then average dipoles. To take the magnitude of each dipole triple into account, this option takes the RMS of the vector strengths of each dipole triple first, and then takes the average across the group.

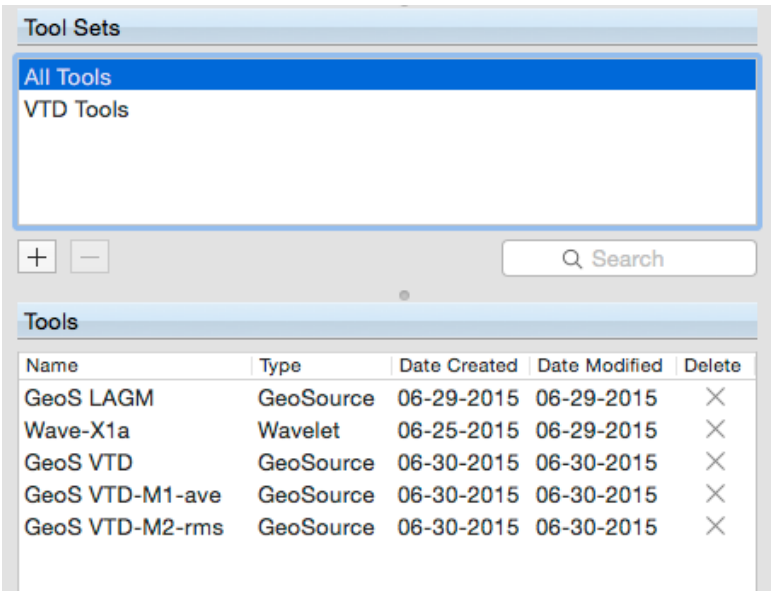
8. For this example, leave the Destination output **Same As Source** and click **Create**. This creates a tool that outputs files with automatically appended names (for GeoSource specification tools, "_nsw"), saved to the source file's location.



The GeoSource *tool* outputs source waveform files.

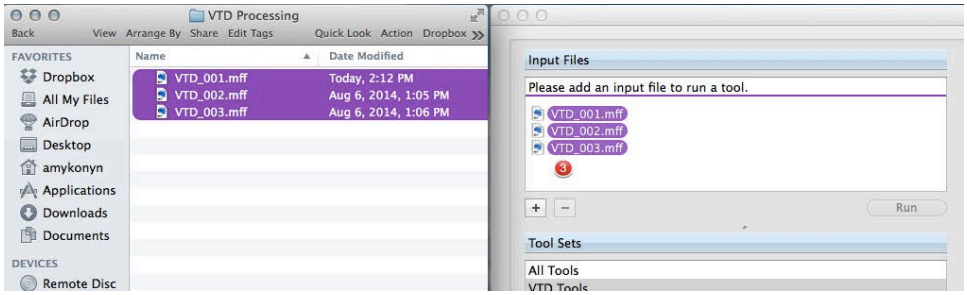
9. Notice that your new GeoSource tool appears in the Tools pane below the Tool Sets pane.

   As shown in the image below, when estimating sources, you would normally explore your data with various versions of the GeoSource Tool to verify results.



10. Drag your **session files** to the Input Files pane.

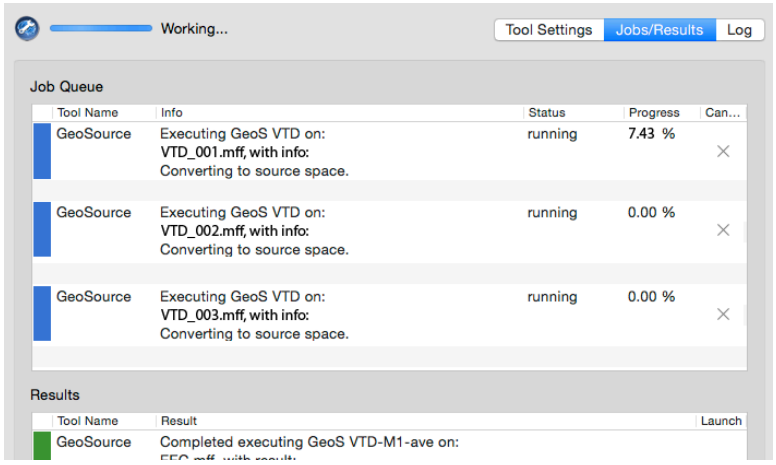
    Note that tools have been run successfully on up to 30 input files.



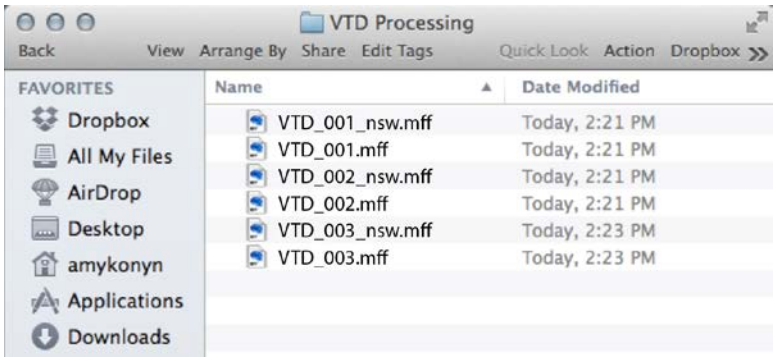
11. If not done already, select (highlight) your **new GeoSource tool** in the Tools pane.

    Confirm you have selected the correct tool and that the specification settings are correct.

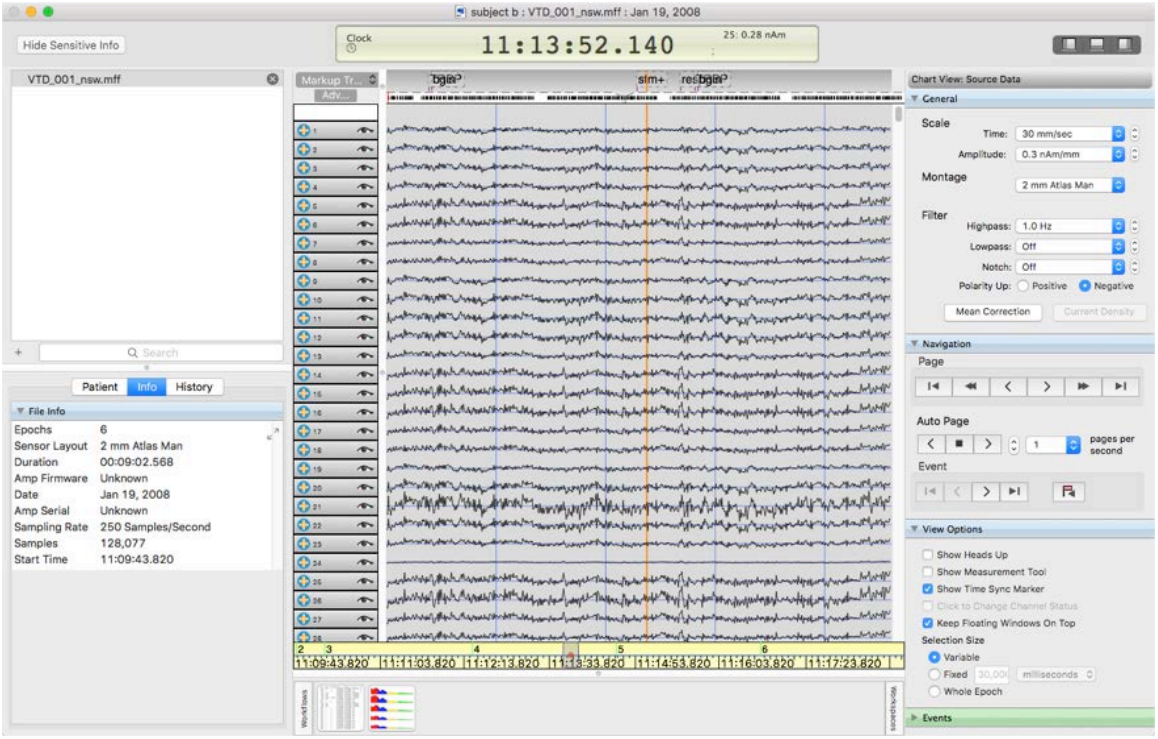
12. Click **Run** to process the files. Net Station will display the Job Queue and begin executing the selected tool.



13. New _nsw.mff source data files will appear in the processing folder, which, in this case, also contains the .mff EEG data files.



14. Double-click your **new source data files** to open them in Net Station Review. Confirm the quality of the source results.



9. 3D Visualization

NOT ALL EGI SYSTEM OR SOFTWARE PRODUCTS OR FEATURES ARE AVAILABLE FOR PURCHASE OR USE IN ALL COUNTRIES OR MARKETS. Refer to www.egi.com/company/certificationscompany.

The RVE provides different features depending upon what optional software has been purchased.

- **The RVE provides only 3D topo maps for review when no version of GeoSource is licensed.**
- **The RVE is not available when using the GeoSource 2 (medical device) software.**
- **The RVE provides access to different head models depending upon which package of GeoSource 3 Research (non-medical product) is licensed (Basic, Intermediate, or Advanced).**

See Table 9-2.

While working with Net Station, you can work seamlessly between the Reciprocity Visualization Environment (RVE) and the optional GeoSource 3 Research (non-medical product) software (Basic, Intermediate, or Advanced). The RVE provides you with vivid visualizations and 3D source localizations of your EEG scalp data. See Table 9-1.

GeoSource 2 (medical device)	versus	GeoSource 3 Research (non-medical product)
Note that a source montage in GeoSource 2 (medical device) is the same as a source collection in GeoSource 3 Research (non-medical product).		**FOR SCIENTIFIC RESEARCH PURPOSES. Be aware that any source waveforms created using GeoSource 3 Research (non-medical product) are restricted to scientific research purposes only.**

Table 9-1. General functionalities of EGI's interoperable software products

EGI Software	Function
Net Station *Acquisition*, *Review*, and *Tools*	• Acquires, reviews, and exports EEG data. • Saves EEG data to MFF files. • Net Station (5.3 or later) provides the link between EEG data and 3D head models in the RVE.
GeoSource 3 Research (non-medical product) *Basic*, *Intermediate*, or *Advanced*	• Localizes electrical sources. • Displays source localizations in the RVE.
Reciprocity Visualization Environment (RVE) 	• Shows 3D topo maps, with or without GeoSource **3 Research** (non-medical product). • Shows 3D advanced visualization of your EEG data, with any package of GeoSource **3 Research** (non-medical product). • Displays 2D MRI slices of the corresponding cortical source localizations, with *Basic* or *Intermediate* GeoSource **3 Research** (non-medical product). • Displays source intensities with 3D topo maps and 3D head models of your EEG data generated from a variety of views, including: – scalp topography, with any package of GeoSource **3 Research** (non-medical product) – atlas triples dipoles, with *Basic* or *Intermediate* GeoSource **3 Research** (non-medical product) – individual oriented dipoles, with *Advanced* GeoSource **3 Research** (non-medical product)
Modal Image Pipeline (MIP) *used only with* GeoSource **3 Research** (non-medical product) *Intermediate or Advanced*	• Creates conformal atlas head models (CAHMs). • Creates individual head models (IHMs). Refer to the GeoSource **3 Research** (non-medical product) manual (8103101).

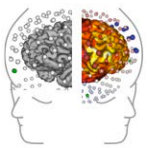
What you see in the RVE depends upon what type of data you are viewing. See Table 9-2.

Table 9-2. RVE functionality, depending upon other licensed software

Net Station *Review* *(5.3 or later)*, **GeoSource 2** (medical device), **GeoSource 3 Research** (non-medical product), and **MIP**	**Reciprocity Visualization Environment (RVE)**
Net Station *Review* The RVE is not available when using **GeoSource 2**. However: • The GeoSource Waveforms button () displays **GeoSource 2** source waveforms. • The GeoSource 2 MRI button () opens **GeoSource 2** files, which provides access to: – 2 mm Atlas Man head model – 2D MR slice view with highlighted sources – all **GeoSource 2** features	
Net Station *Review* *Review* provides minimal access to the RVE (), even when no version of GeoSource is licensed.	With no licensed version of GeoSource, the RVE provides only 3D topo maps for review.
Net Station *Review* *Review* provides access to the RVE (), while ***Basic*** **GeoSource 3 Research** (non-medical product) provides access to the following in the RVE: • Three views: – EEG Data Exploration – Head Model Review – Source Estimate Review (Triples) • Six atlas head models: – Three adult atlases – Three adolescent atlases • MRI slices • *Cannot use MIP outputs.*	With ***Basic*** **GeoSource 3 Research** (non-medical product), the RVE provides: • 3D topo maps • Triples dipole sources • Custom source collections • Custom dipole source groups

Net Station *Review* *(5.3 or later)*, **GeoSource 2** (medical device), **GeoSource 3 Research** (non-medical product), and **MIP**	**Reciprocity Visualization Environment (RVE)**
Modal Image Pipeline (MIP) For ***Intermediate*** **GeoSource 3 Research** (non-medical product), the MIP creates Conformal Atlas Head Models (CAHMs).	
Net Station *Review* *Review* provides access to the RVE (), while ***Intermediate*** **GeoSource 3 Research** (non-medical product) provides access to the following in the RVE: • Includes all of Basic's features, plus: • Uses the MIP's Conformal Atlas Head Model (CAHM) outputs	With ***Intermediate*** **GeoSource 3 Research** (non-medical product), the RVE provides: • 3D topo maps • Triples dipole sources • Custom source collections • Custom dipole source groups
Modal Image Pipeline (MIP) For ***Advanced*** **GeoSource 3 Research** (non-medical product), the MIP creates Conformal Atlas Head Models (CAHMs) and Individual Head Models (IHMs).	
Net Station *Review* *Review* provides access to the RVE (), while ***Advanced*** **GeoSource 3 Research** (non-medical product) provides access to the following in the RVE: • Includes all of *Intermediate's* features, plus: • Provides one additional view – Source Estimate Review (Oriented) • Uses both of the MIP's outputs: – Conformal Atlas Head Models (CAHMs) – Individual Head Models (IHM)	With ***Advanced*** **GeoSource 3 Research** (non-medical product), the RVE provides: • 3D topo maps • Oriented dipole sources • Custom source collections • Custom dipole source groups

9.1 RVE Viewer

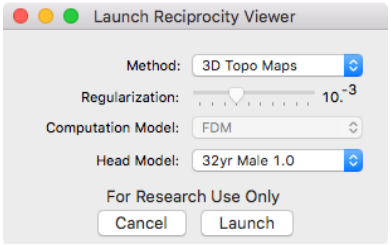
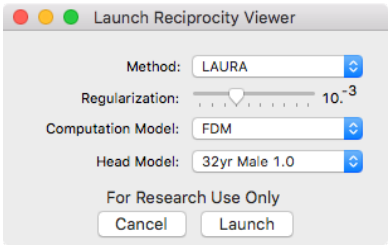
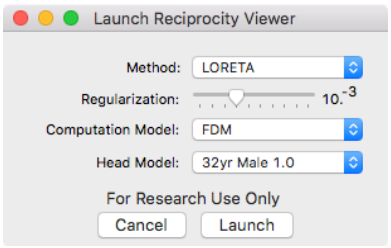
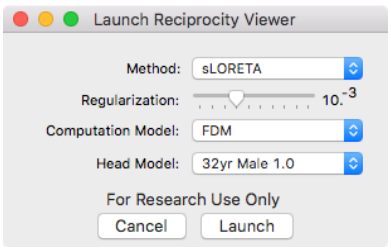


Depending upon what you want to do with your data, you will launch the RVE Viewer either from inside **Net Station Review** or from **Finder ▶ Applications ▶ EGI ▶ Net Station 5**. Select the RVE icon either place.

Opening the RVE from Finder ▶ Applications allows you to open any head model directly into the RVE. See tables 9-1 and 9-2.

9.1.1 Launched from Net Station Review

Table 9-3. Reciprocity's available launching options from Net Station Review

Methods	Regularization Values	Computational Models	Head Models
3D Topo Maps 	*Not applicable*	*Not applicable*	Built-in atlases • three adult • three adolescent
LAURA* 	10 – 10^{-9} (10^{-3} is the default.)	Spherical / FDM (FDM is the default.)	Built-in atlases • three adult • three adolescent
LORETA* 	10 – 10^{-9} (10^{-3} is the default.)	Spherical / FDM (FDM is the default.)	Built-in atlases • three adult • three adolescent
sLORETA** 	10 – 10^{-9} (10^{-2} is the default.)	Spherical / FDM (FDM is the default.)	Built-in atlases • three adult • three adolescent

*Also appropriate for conformal atlas head models (CAHMs).
**Also appropriate for individual head models (IHMs).

9.1.1.1 Chart View as Display Controller of the RVE

While you are exploring your source EEG data, be aware that the display of EEG data in the RVE is controlled by the settings made in the Chart view of Net Station Review.

If, however, you switch views between montages that use different references (for example, HydroCel GSN 256 1.0 to an Average Reference), the RVE will re-reference the scalp (electrode) EEG data.

If, however, you switch between montages that do not include the same number of channels (for example, a 10-10 montage to a 10-20 montage), the RVE will display the maximum number of sensors in the Net and EEG data (that is, 256, 128, 64, or 32) on the 3D head model.

9.1.2 Launched From Finder ▶ Applications

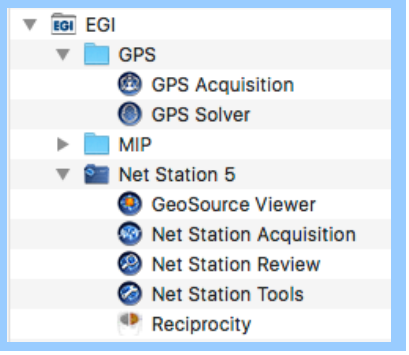
Accessing the RVE as a standalone application provides the features for visualizing CAHMs and IHMs in GeoSource **3 Research** (non-medical product) *Intermediate* or *Advanced*.

When launched as a standalone application, the RVE provides most of the features as when launched from Net Station Review, except source localization—there are no GeoSource settings for method, regularization, computation model, or head model when launched from Finder.

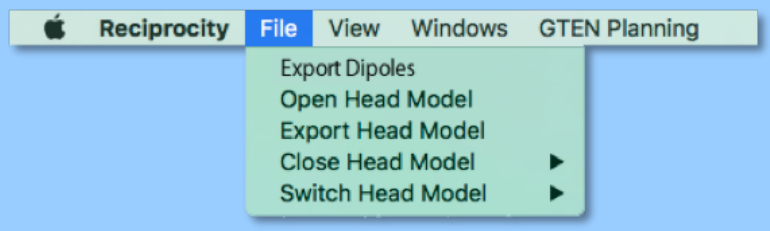
Note that source localization with all of Reciprocity's 3D source localization and visualization features requires that you access your EEG data from Net Station Review.

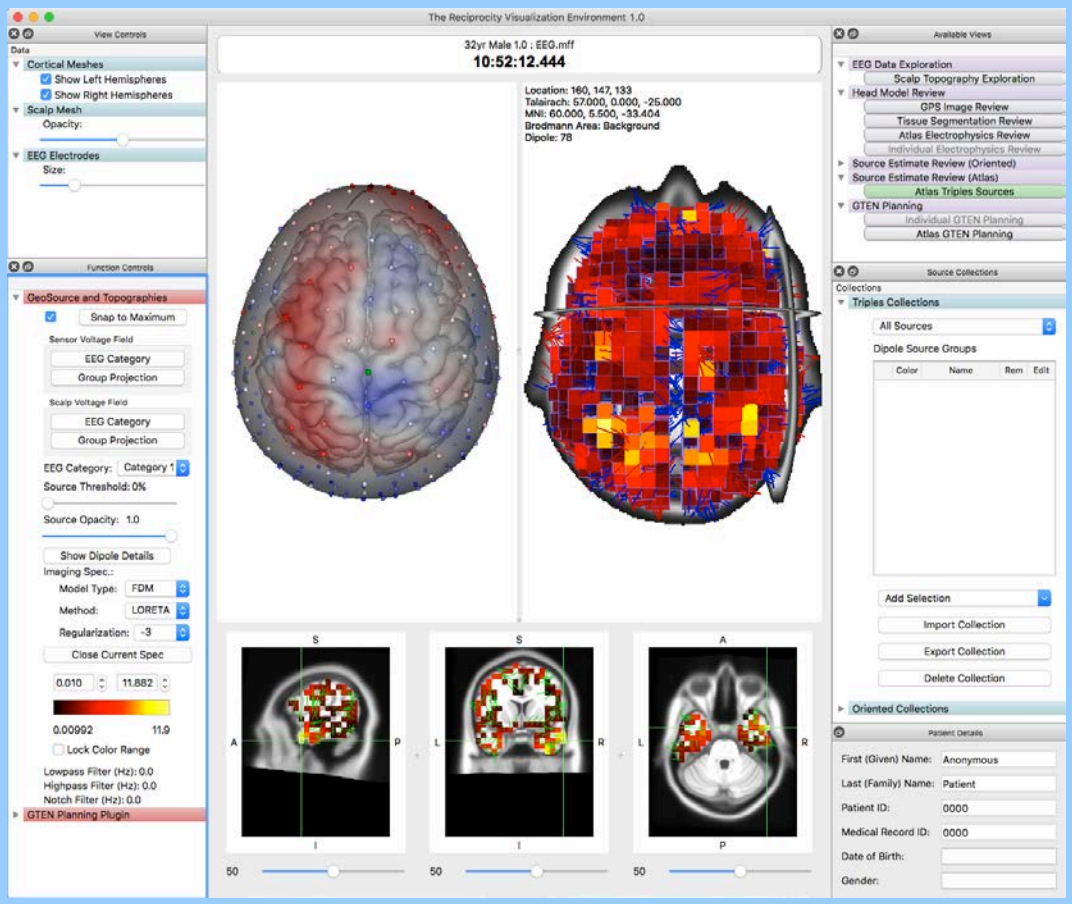
To launch the RVE and visualize a head model:

⊇ Launch the RVE from **Applications ▶ EGI ▶ Net Station 5 ▶ Reciprocity**.



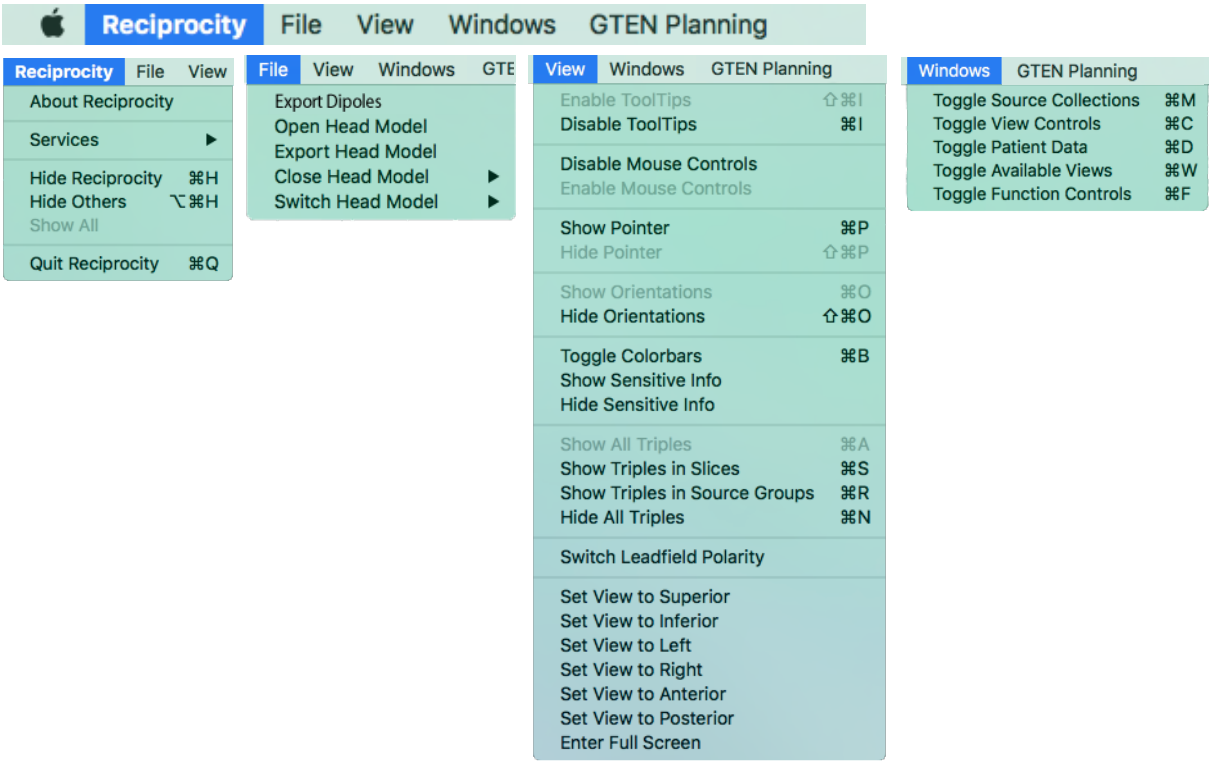
⊄ Open a head model by clicking **File ▶ Open Head Model**.





9.2 RVE's Menus

Standard menus operate as expected. Reciprocity-specific menus are described here.



Reciprocity. *About* gives you the version number of your copy of the RVE and *Quit* allows you to quit the application (or, you can click the red close button).

File. Use these menu options to open, export, close, or switch between opened head models. Also export dipoles.

When the RVE is launched from the Finder, remember that you have no source localization features for a file in the RVE. If you need to use the source localization features, you must launch the RVE from within Net Station Review. See section 9.1.

View. Use these menu options to set views to a particular angle of the head, toggle color bars, etc.

For additional controls that create source collections, view GeoSource and topographic data, and increase the visibility of areas of interest in head models, see sections 9.3.2, 9.3.4, 9.3.5, and 9.3.6.

Windows. Use these menu options to show/hide the five panes of the RVE window.

GTEN Planning. Not active.

9.3 RVE's Window, Features, and Controls

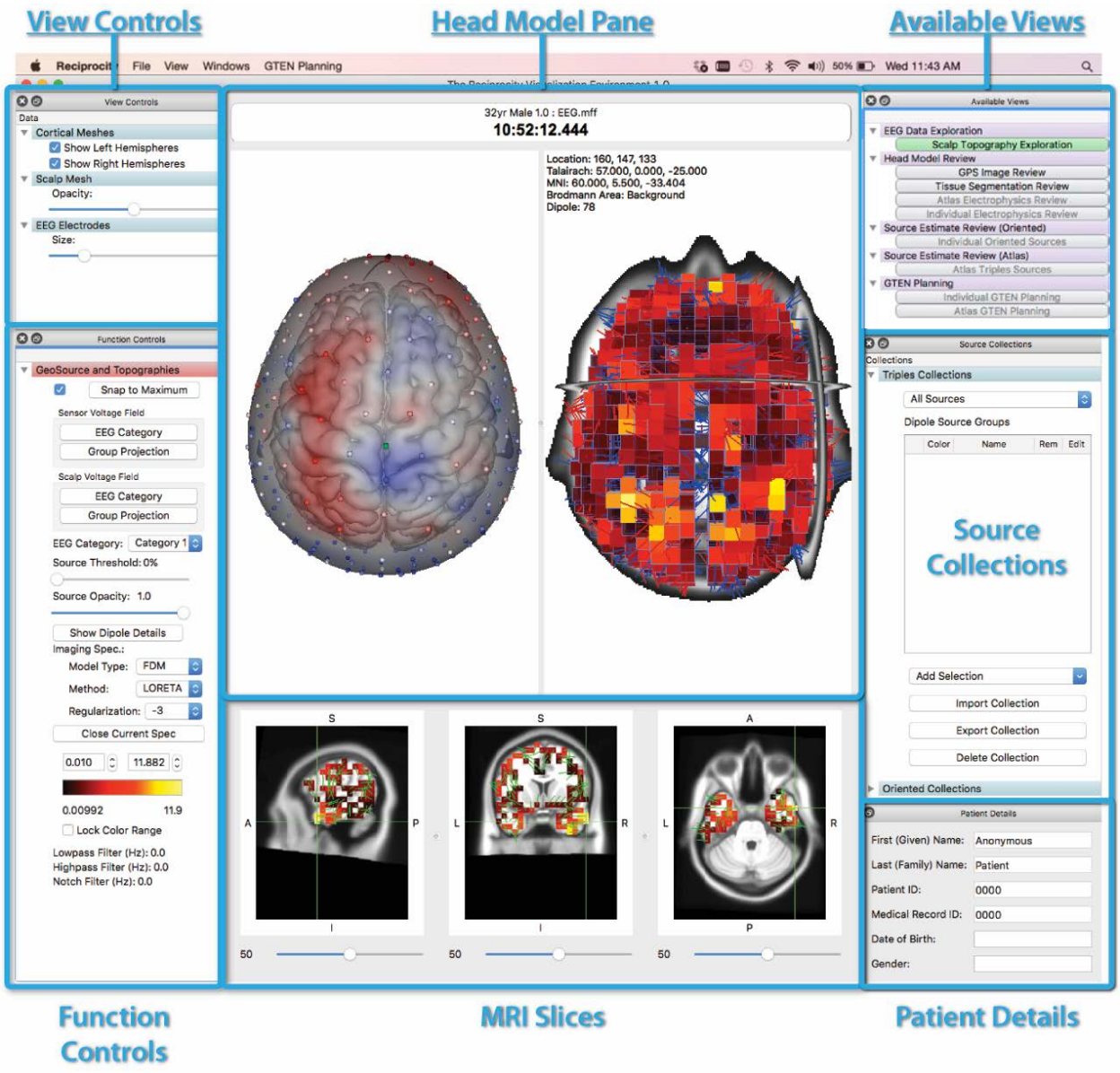


Figure 9-1. Features and controls of the RVE window

9.3.1 Available Views

Depending upon which level of GeoSource **3 Research** (non-medical product) you have a license for (*Basic*, *Intermediate*, or *Advanced*), different views will be available to you in the RVE.

After the RVE opens, either from Net Station Review or Finder ▶ Applications, the RVE provides a selection of views to facilitate your further research or clinical research work.

Remember that EEG data displayed in the RVE is controlled by the settings made in Chart view in Net Station Review. See section 9.1.1.1.

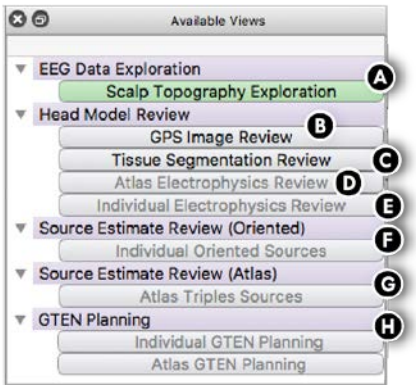


Table 9-4. Available views

Callout	View	Description
A	**EEG Data Exploration**	*Scalp Topography Exploration*. This is the 3D topo map view that is selected as a Method from Net Station Review.
B	**Head Model Review** Aside from any GeoSource **3 Research** (non-medical product) uses, these views are useful for verifying electrical head models.	*GPS Image Review*. This view shows how well EEG sensor positions are registered to CAHMs and IHMs.
C		*Tissue Segmentation Review*. This view shows how well tissue classifications are characterized.
D		*Atlas Electrophysics Review*. This view shows the forward leadfield projections of triples dipoles for built-in atlases and CAHMs.
E		*Individual Electrophysics Review*. This view shows the forward leadfield projections of oriented dipoles for IHMs.
F	**Source Estimate Review (Oriented)**	*Individual Oriented Sources*. This is a view for IHMs, when using ***Advanced*** GeoSource **3 Research** (non-medical product).
G	**Source Estimate Review (Atlas)**	*Atlas Triples Sources*. This is a view for any atlas-based head model, including CAHMs, when using ***Basic*** or ***Intermediate*** GeoSource **3 Research** (non-medical product).
H	**GTEN Planning**	Not active.

9.3.1.1 Default Settings for Available Views

The Available View buttons work as follows for all atlas and individual head models:

- Click a view button *once* to display data in that view, starting with that view's default settings.
- Click the same view button *again* to reset that view to its default settings, at any time during your exploration.
- Click another view's button, and that view will display the data with its default settings.
- **Zoom exception.** All view settings reset to default, except for the zoom setting. Even if you are changing from one view to another, the zoom setting will remain as it was set in the previous view.

9.3.2 Source Collections

You can create customized triples or oriented source collections within the RVE to display specific dipoles or dipole groups.

Remember that:

GeoSource **2** (medical device)	=	GeoSource **3 Research** (non-medical product)
source montage	=	source collections
ROIs	=	dipole source groups

In addition to creating dipole source groups from the Source Collections pane, you can select dipoles (voxels) manually.

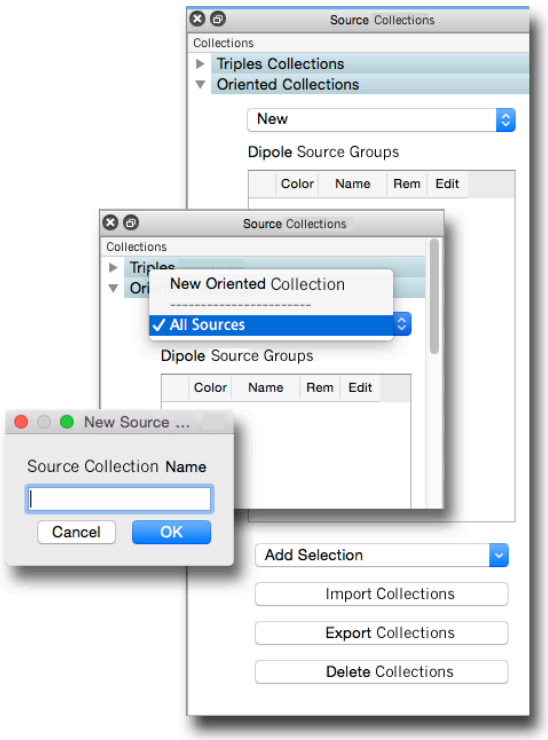


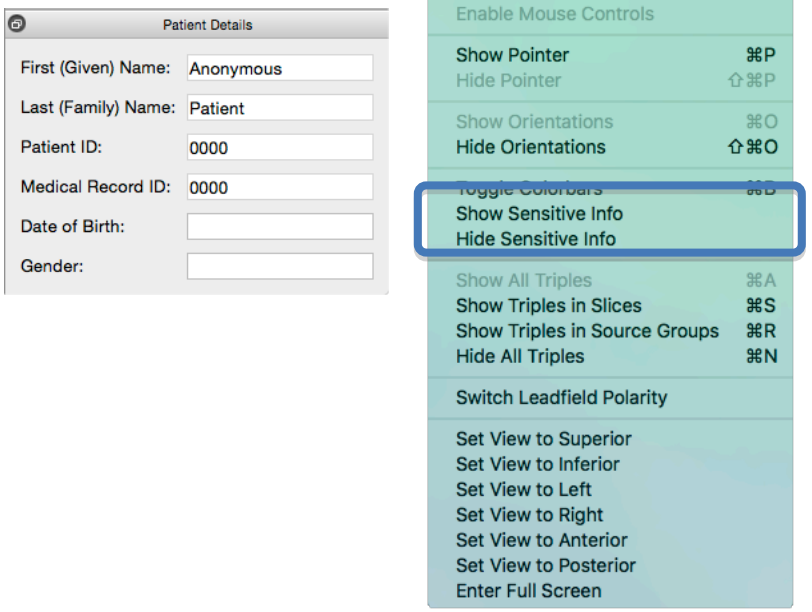
Table 9-5. Selecting dipoles (voxels)

Method	Keystrokes	Descriptions
2D MRI Slices — *Basic* and *Intermediate*		
Individual	**Shift + click**	Selects individual dipoles to populate a dipole source group.
Radius	**Shift + click + drag**	Selects a group of dipoles within a drawn radius.
Threshold	**Cmd (⌘) + click**	Selects the first dipole and then displays a dialog box to enter a threshold value for the automatic selection of additional dipoles that are connected to the first dipole. For example, a threshold of 50 entered for a dipole of 10 µA fills the dipole source group with dipoles that are within ± 50% (5-15 µA).
Dynamic Threshold	**Cmd (⌘) + click + drag**	Selects the first dipole and then displays mouseover text of the threshold percentage value based upon the additional dipoles you select by dragging.
3D Head Models — *Advanced*		
Patch	**Cmd (⌘) + click**	Selects patches of dipoles to populate a dipole source group.

9.3.3 Patient Details

The Patient Details pane in Reciprocity is linked to the Show/Hide Sensitive Info button in Net Station Review.

You can change the display (show or hide) from Review or from Reciprocity by clicking **View ▶ Show [or Hide] Sensitive Info**.



9.3.4 **Function Controls**—GeoSource and Topographies

Following are the function controls that appear when viewing GeoSource and topographic data.

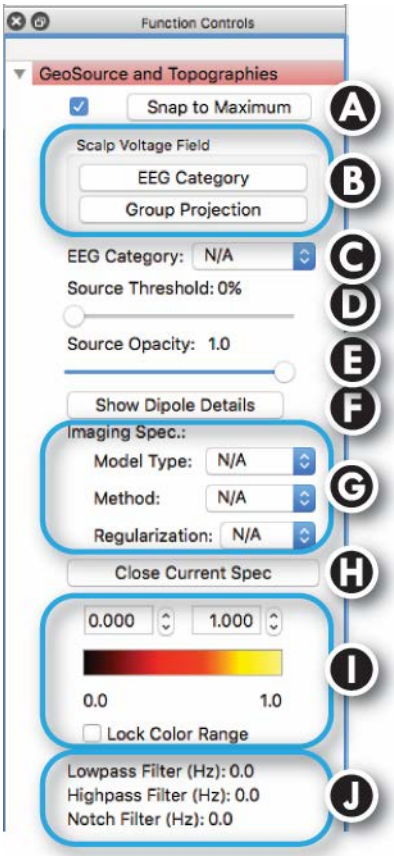
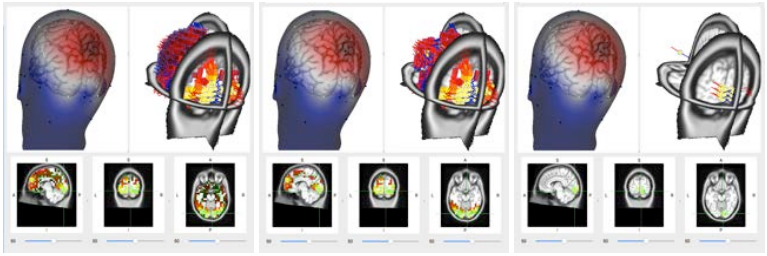
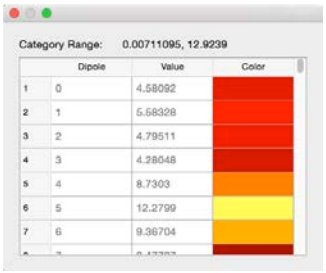
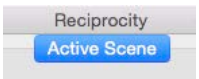


Table 9-6. Function controls for GeoSource and Topography views

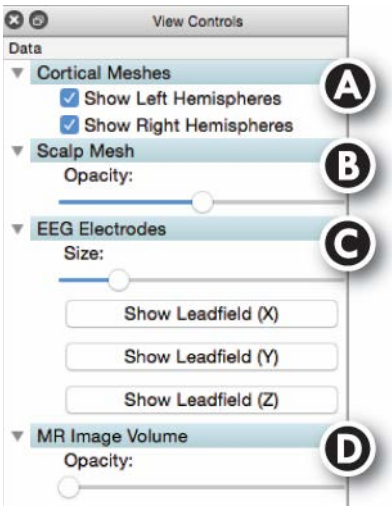
Callout	Control	Description
A	**Snap to Maximum**	Centers the crosshairs to the location of the maximum (or highest) dipole intensity. **Checkbox**. When checked, the crosshairs will automatically snap to the location with the highest dipole intensity as you continue to move through the data. **Button**. When the checkbox is unchecked, the button is still available to selectively snap the crosshairs to the highest dipole intensity.
B	**Scalp Voltage Field**	Provides buttons to view scalp voltage data as *scalp EEG categories* or *dipole source group projections*.
C	**EEG Category**	Shows the category currently being displayed, which is the category selected in Net Station Review and linked to RVE. If multiple categories (as with overlaid segments) are being displayed in Net Station Review, use this selector to choose which category is displayed in the RVE.

Callout	Control	Description
D	**Source Threshold**	Displays more or fewer of the source results based on a percentage of threshold values for dipole intensity. Depending upon the selected threshold: • A **higher** percentage displays a wider range of dipole intensities, including all of the highest values (and colors) and gradually fewer of the lower values (and colors). • A **lower** percentage displays a narrower range of dipole intensities, including far fewer or none of the lower value intensities, but still showing most or all the highest valued dipole intensities.  threshold 0% threshold 16% threshold 68%
E	**Source Opacity**	Adjusts the transparency of the displayed source data.
F	**Show Dipole Details**	For a category range, lists all dipoles and their values and colors. This dialog can be sorted and used to navigate (jump) to specific locations. Any view, except 3D topo maps, will show dipole details.  Category Range: 0.00711095, 12.9239 Dipole / Value / Color 1 0 4.58092 2 1 5.58328 3 2 4.79511 4 3 4.28048 5 4 8.7303 6 5 12.2799 7 6 9.36704
G	**Imaging Spec**	Shows the *Model Type*, *Method*, and *Regularization* a file was launched with. To see a head model with other imaging specifications, go back into Net Station Review, click the **RVE** button again, and launch another RVE window for the same head model with different parameters that are linked to the same EEG data in Review. With multiple RVE windows open for the same head model (with different parameters), the Imaging Spec fields become active so that you can change the parameters for the *active head model* (that is, the *Active Scene*).  Reciprocity Active Scene Note that only two head models can be open at the same time and only four windows associated with each head model can be open.

Callout	Control	Description
H	**Close Current Spec**	When multiple RVE windows are open, this button closes the active window. When only one window is open, it closes the RVE completely. Note that up to four windows can be open for the same head model and up to two head models can be open at a time.
I	**Intensity color controls**	**Minimum and Maximum pickers**. Upon first displaying a file, these pickers display the default minimum (right picker) and default maximum (left picker) intensities. You can adjust these as desired. **Intensities color bar**. Graphically shows the intensities shown by the pickers. **Lock Color Range**. When checked, the minimum and maximum, as well as the spectrum palette, are locked, regardless of the time point changing. When unchecked, the minimum and maximum values will update as the current time point changes in the data. You can use these controls to make spatially discrete areas more obvious: • Reduce the maximum picker value by 20% to highlight the higher intensity voxels. • Reduce the number of low-intensity voxels that are showing by raising the minimum picker value.
J	**Filters**	Shows the values of the lowpass, highpass, and notch filters as set in the file.

9.3.5 View Controls

The View controls increase the visibility of areas of interest in head models.



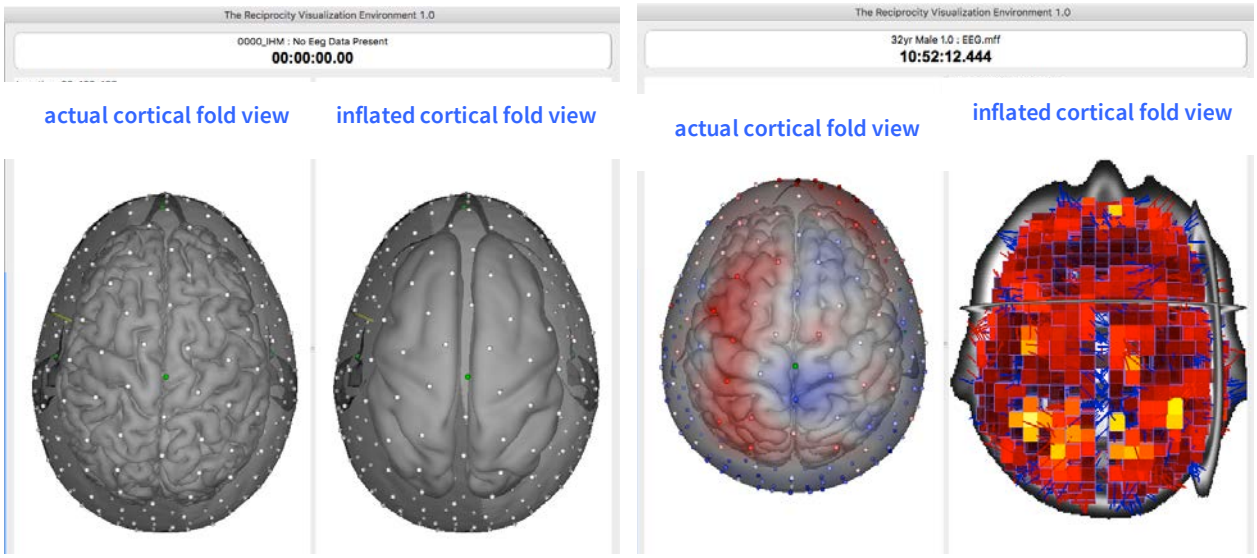
Not all view controls appear for all types of head models.

Table 9-7. View controls (*some are not available for all views*)

Callout	Control	Description
A	**Cortical Meshes**	Shows/hides the left and/or right hemispheres.
B	**Scalp Mesh**	Indicates the head surface. **Opacity slider**. Adjusts the transparency of the scalp mesh.
C	**EEG Electrodes**	Indicates the location of the EEG sensors across the head surface. **Size slider**. Adjusts the size of the displayed EEG sensors. **Show Leadfields (X, Y, and Z)**. These buttons represent the three vectors (X, Y, and Z) of a triples dipole. They are used to change the leadfield projection to the stated direction (X, Y, or Z). Only this projection is displayed.
D	**MR Image Volume**	Indicates dipole intensities. **Opacity slider**. Adjusts the transparency of the MR slices.

9.3.6 Head Model Pane

Aside from creating source data files with GeoSource **3 Research** (non-medical product), the 3D head model pane is used to display EEG data and source results or to create dipole source groups and source collections.

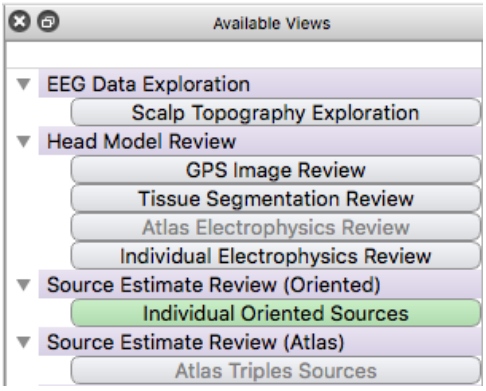


Source Estimate Review (Oriented) view
Individual Oriented Sources

Source Estimate Review (Atlas) view
Atlas Triples Sources

Figure 9-2. Head model pane of the RVE window

Depending upon the RVE view being used, the 3D head model pane displays:



- **small dots** (of any color), which indicate sensors
- **directional arrows**, which indicate orientation (triples or oriented)
- **colored squares**, which indicate voxels (3D volume pixels)

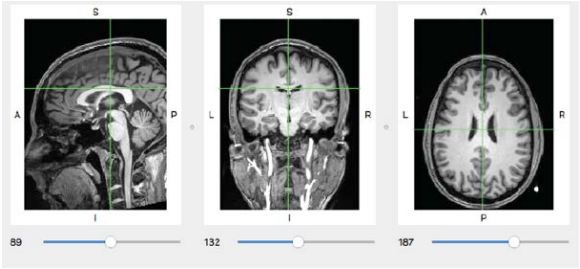
9.3.7 MR Slices

The MRI slices of the RVE visualize the brain in one of two ways:

- **MRI brain**, when viewing individual head models (IHMs) with oriented dipoles, or
- **voxelated brain**, when viewing atlas head models, including conformal atlas head models (CAHMs) with triples dipoles.

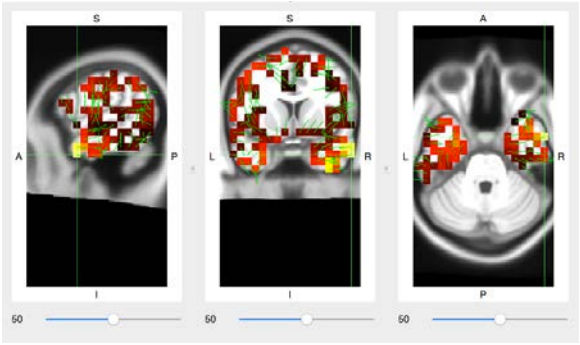
For details about voxels and dipoles, refer to the **GeoSource 3 Research (non-medical product)** manual (8103101).

For **individual head models** (IHMs), the MRI slice panes display individual head geometry, such as tissue segmentation and cortical surface.



For IHMs, dipoles are oriented, which means they are one-directional and oriented perpendicular to the cortical surface.

For **atlas head models**, including CAHMs, the MRI slice panes display dipole intensities overlaid onto sagittal, coronal, and axial MRI slices.



For atlases, dipoles are approximately represented by voxels, which are colored 3D volume pixels. Specifically, a single, colored dipole cube represents 7 voxels cubed. As a basic volume unit in the MRI slices, a dipole of 7 voxels x 7 voxels x 7 voxels is resampled in .egia files as 1 mm x 1 mm x 1 mm.

The **slice sliders** navigate to a specific slice in the corresponding pane (sagittal, coronal, or axial). As they do, the other two slice panes will update accordingly.

The grid numbers used in GeoSource do not correspond to Talairach Daemon or MNI coordinates.

9.4 3D Image and 2D Slice Shortcuts

The keyboard shortcut mappings available for GeoSource **3 Research** (non-medical product) in the RVE allow you to easily rotate, zoom, move, and navigate 3D images and 2D MRI slices.

Table 9-8. 3D image and 2D slice keyboard shortcuts for GeoSource 3 Research in the RVE

Mode	Function	Keys
2D slice	**Zoom**	Right-click + drag
	Move	Shift + right-click + drag
	MRI slice navigation	Left-click + drag
	Brightness	Cmd (⌘) + right-click + drag ⇔
	Contrast	Cmd (⌘) + right-click + drag ⇳
3D image	**Zoom**	Right-click + drag
	Move	Shift + right-click + drag
	Rotate	Left-click + drag

Appendix A:

Filter Basics

Anti-aliasing Filter

Effects on EEG Timing

The anti-aliasing filters of the Net Amps amplifiers introduce a temporal delay in the EEG. Whether EEG is steaming, displaying, or recording, there is a temporal delay from *real time* and any event aligned with real time.

Without adjustment, this delay affects the alignment of EEG with the real-time events (as from digital inputs or TCP/IP connection) recorded during EEG acquisition.

This delay does not affect the alignment of events manually entered during EEG acquisition. It also does not affect the alignment of events entered during review or from the operation of tools after data acquisition.

For the automatic adjustment of this delay during acquisition, see sections 4.1 and 6.3.6.3.

If you are segmenting data, you can adjust the delay between EEG and real-time events by adding a positive value (a stimulus presentation offset) in the Offset Segment field of the *Segmentation* tool, in addition to adjusting for external event or digital input (DIN) offsets.

For details, refer to the GES 400 Series manual (8100400) or contact Technical Support (Table P-2).

CAUTION: The anti-aliasing filters of the Net Amps amplifiers introduce a temporal delay in the EEG. To adjust for the delay between recorded EEG and the real-time events recorded during EEG acquisition, use the following known delays for each sampling rate and amplifier model:

Sampling Rate	NA 300	NA 400	NA 405	NA 410
1,000 s/s	8 ms	36 ms	36 ms	13 ms
500 s/s	18 ms	66 ms	66 ms	34 ms
250 s/s	36 ms	112 ms	112 ms	76 ms
125 s/s	72 ms			

Effects on EEG Averaging

You will want to be careful when averaging files.

- Only average adjusted files with adjusted files and unadjusted files with unadjusted files.
- Only average unadjusted files that have the same temporal delay. For example, the NA 300 at 250 s/s with the NA 400 at 1,000 s/s, because both have a 36 ms delay adjustment.

Appendix B:

Net Station Reminders

Following is a collection of reminders for effectively using your Net Station software.

Anti-alias Filter Alignment. You can adjust for the amplifier's anti-alias filter delay *during* or *after* the acquisition of your EEG data.

- Section 4.1 describes the Anti-Alias Filter Alignment utility that can be used after the acquisition of EEG data.
- Section 6.3.6 describes the Digital Anti-Alias Filter Alignment option that can be used during the acquisition of EEG data. It is checked by default.
- Appendix A explains this filter's effects on EEG timing and EEG averaging.

MFF Conversion. When converting older files to the latest .mff file format (version 3), save a backup of the original file and convert the copy. See section 4.5.

Sampling Rate. To ensure millisecond delivery of DIN inputs to the amplifier when using any DIN device, such as a photic stimulator or external signal device, you must set the sampling rate to **1000 s/s**. See section 6.3.6.4.

CAUTION: Do not change the sampling rate after streaming is on; otherwise, drift errors will occur.

Video Cameras. When recording video, the system does not automatically detect the specific camera that is attached, only that a camera is attached. Before a recording session, you must select the camera and video source. You select the video source (Ethernet, USB, or none) with the Acquisition Preferences dialog and the specific camera with the Video viewer. See sections 6.1.1 and 6.2.2.1.

Appendix C:

Net Station's Tools

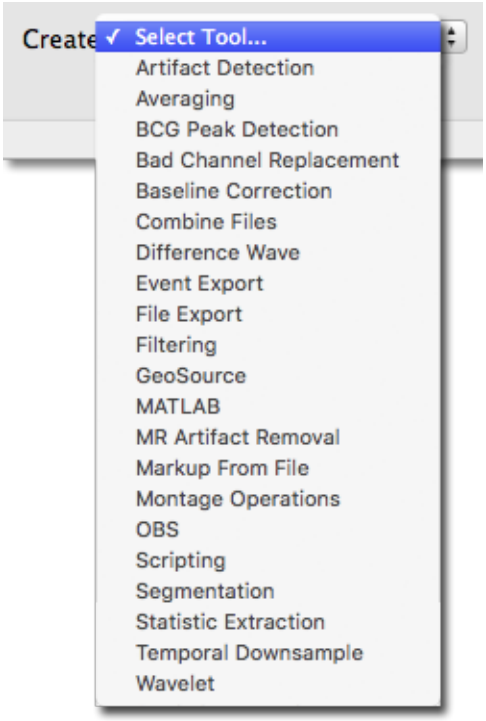
Net Station's tools allow you to run various signal-processing operations on your EEG data.

Note that EEG data must be in the latest .mff file format.

Tools can be run singly or in series. When run in series, many tools output a form of the data that is used as the input of a next tool.

Most of the tools provide default parameters that you will want to change for your specific purposes.

All tools work only on data from good channels.



To specify new tools, in general:

1. Open **Net Station Tools**.
2. Select a **tool**.
3. Name the new tool and set the output options.
4. Accept the tool's defaults or customize the tool's settings.
5. Click **Create**.

Tools vs File Types

All tools run on files that are in the .mff file format and all tools only work on data from good channels.

Some tools, however, only run on specific EEG file types:

- continuous recording
- segmented
- averaged
- bad channels marked

Table C-1. Available tools for different EEG file types

File Type	Available Tools
continuous recording .mff (not segmented or averaged)	Filtering Montage Segmentation Temporal Downsample
segmented .mff (via Segmentation tool)	Artifact Detection Averaging Baseline Correction Difference Wave Montage |Segmentation Statistical Extraction Wavelet
averaged .mff (via Averaging tool)	Artifact Detection Averaging Difference Wave Montage Segmentation Statistical Extraction Wavelet
.mff containing marked bad channels (via Artifact Detection tool or manually in Review)	Bad Channel Replacement

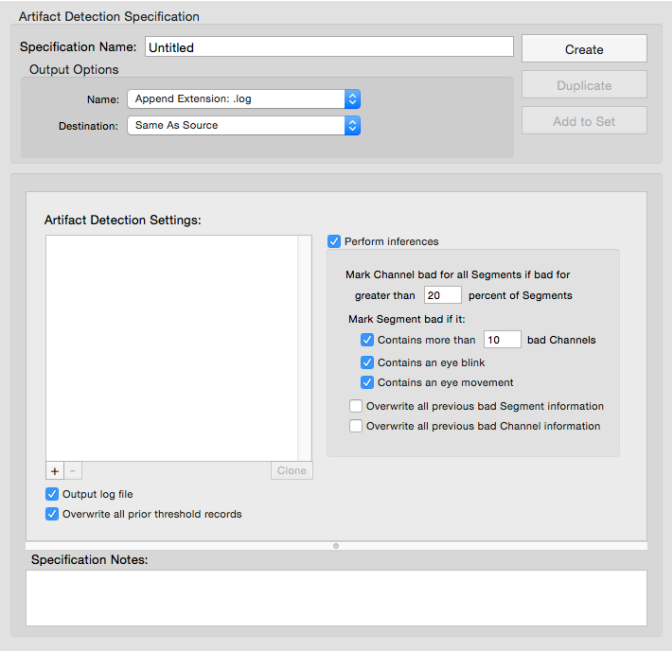
Common Tools

The following tools are useful for various signal-processing operations on your EEG data. For research-only tools, see section "RESEARCH ONLY fMRI Tools" later in this appendix.

For additional details or white papers related to any of the tools, contact Technical Support (Table P-2).

Artifact Detection

The Artifact Detection tool automatically detects and marks *bad channels* and *bad segments* in a file.



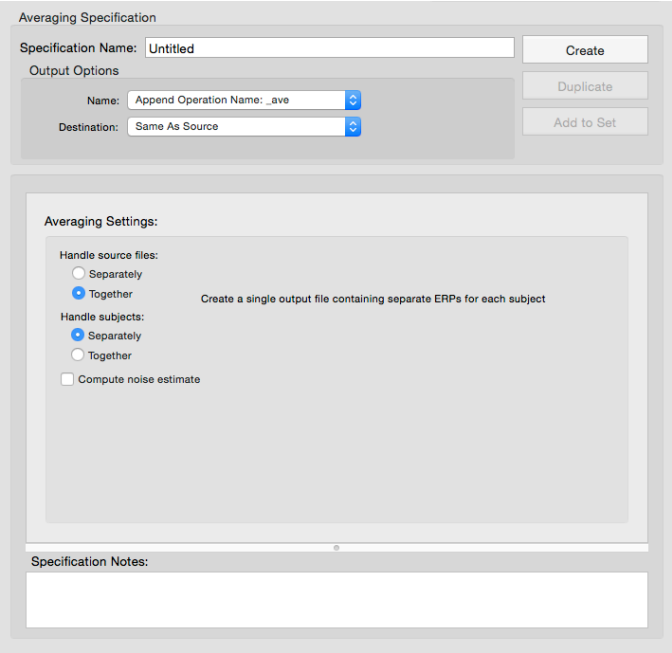
Additionally:

- This tool can be run on any Net Station .mff segmented or averaged file.
- This tool does not produce an output file.
- Bad channels in good segments are replaced when you run the Bad Channel Replacement tool.
- Bad channels in bad segments are not replaced but rather are automatically excluded when you run other tools.

Averaging

The Averaging tool performs both *averaging* and *grand averaging*.

- **Averaging**. When averaging, the tool calculates a single, average segment from all of the segments that were *not marked as bad*, for each category created during segmentation. Depending upon your selections, you will output a single or multiple files.



- **Grand Averaging**. When grand averaging (selecting *Together* for handling both source files and subjects), the tool averages all of the individual participant ERPs to create a cross-participant ERP. All of the files in this case must then have the same sampling rate.
- **How Different**. Grand averaging emphasizes the ERP patterns shared by all of the participants and deemphasizes individual differences. You should use non-baseline-corrected data for grand averaging so that you can understand the effects of baseline correction on your grand-average ERPs.
- **Different Settings**. In the settings, the *Separately* setting creates an averaged file that allows you to view individual participant data. The *Together* setting creates a grand average file. The pane to the right of the settings tells you what type of files you are creating based on your mix of *Separately* and *Together* settings.

Additionally:

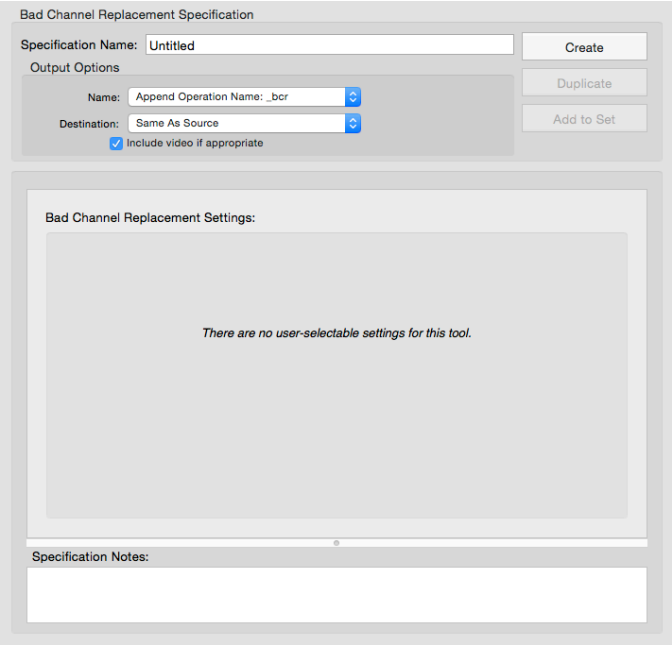
- This tool can be run on any Net Station .mff segmented or averaged file.
- This tool outputs to a Net Station .mff averaged file.
- This tool copies events from the first segment in the first file in the source list. Be aware that the list is reordered alphabetically each time a new file is added.

Bad Channel Replacement

The Bad Channel Replacement tool replaces the bad channels (in good segments only) detected manually or by the Artifact Detection tool with data interpolated from the remaining channels and deactivates the bad channel status.

Note that bad channels in bad segments are not fixed by this tool.

The Bad Channel Replacement tool never perfectly re-creates a channel. The resulting waveform is only an ***approximation*** of the signal that was present at that location on the scalp during recording. Because reconstructing a bad channel is an approximation of the actual missing data, it is limited by the spatial frequency of the electrode system and the spatial frequency of the underlying signal. A channel reconstructed from 64-channel data will be less accurate than one reconstructed from 128-channel data, if sufficiently high spatial frequencies are present.



Additionally:

- There are no customizable parameters for this tool, other than its name, appended filename, and file destination.
- This tool can be run on any Net Station .mff file containing marked bad channels (marked either by the Artifact Detection tool or manually in Review).
- This tool outputs to the same format as the input file.
- The bad channel replacement algorithm operates on good segments only. For each good segment, it replaces every sample of every channel that is bad for that segment with data interpolated from the remaining channels. It uses spherical splines as the interpolation method.

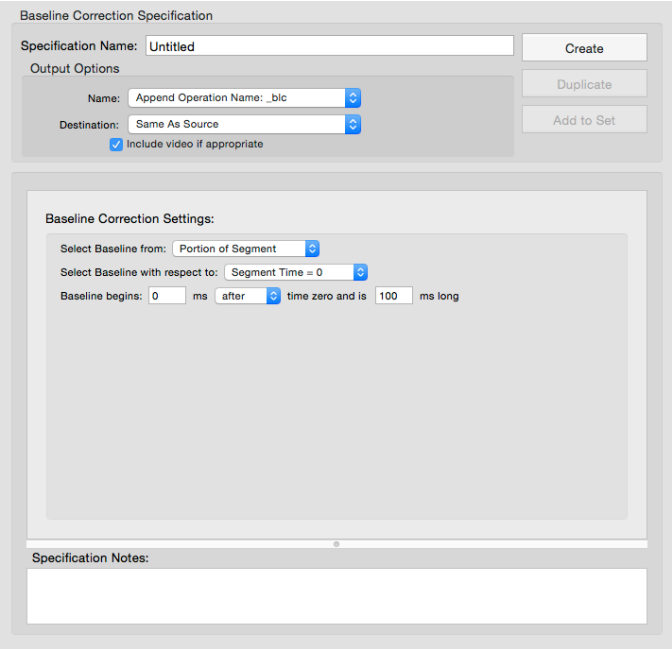
Baseline Correction

The Baseline Correction tool establishes a new zero-voltage value based on a *baseline interval* that you select within the segment. The baseline interval could be a portion of the segment or the entire segment.

- For stimulus events, the baseline interval normally precedes the stimulus.
- For each channel, the average of all the samples within the baseline interval is subtracted from every sample in the segment.

Additionally:

- This tool can be run on any Net Station .mff segmented file.
- This tool outputs to a Net Station .mff segmented or average file.

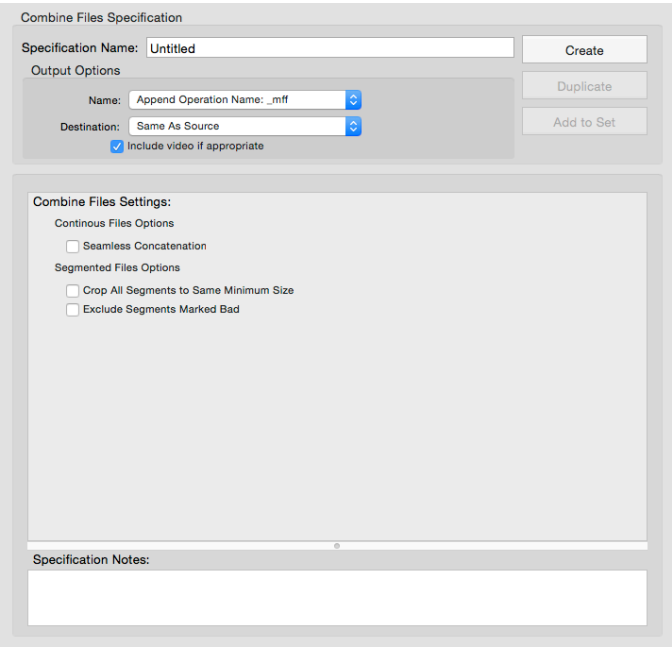


Combine Files

The Combine Files tool organizes the segments in a data file.

Options:

- Preserves/removes segment breaks
- Crops all segments to the same size
- Excludes bad segments



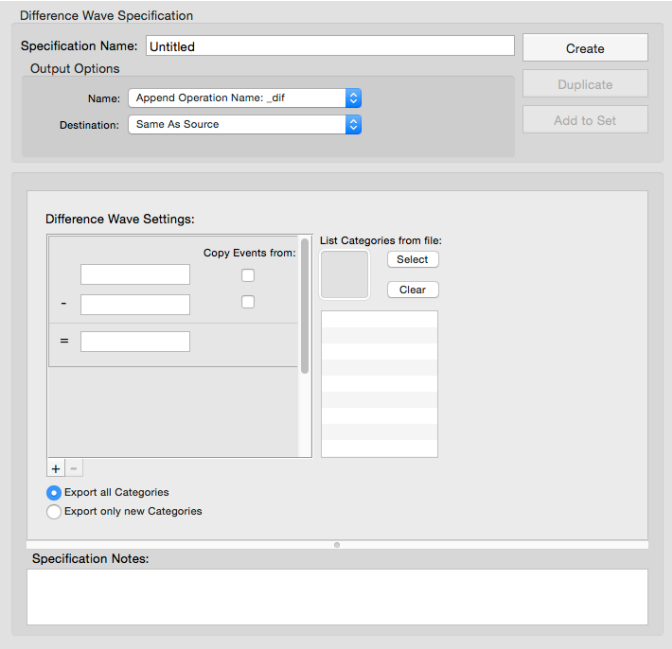
Seamless Concatenation. When selected, this feature removes segment breaks from the output file. When unselected, this feature preserves segment breaks in the output file.

Crop All Segments to Same Minimum Size. When selected, all segments and epochs are cropped from the end until they are the same length as the shortest segment or epoch.

Exclude Segments Marked Bad. When selected, all segments and epochs that are marked as bad will be excluded.

Difference Wave

The Difference Wave tool, based on the *subtractive method*, creates new output categories that are the difference between the input categories you specify.

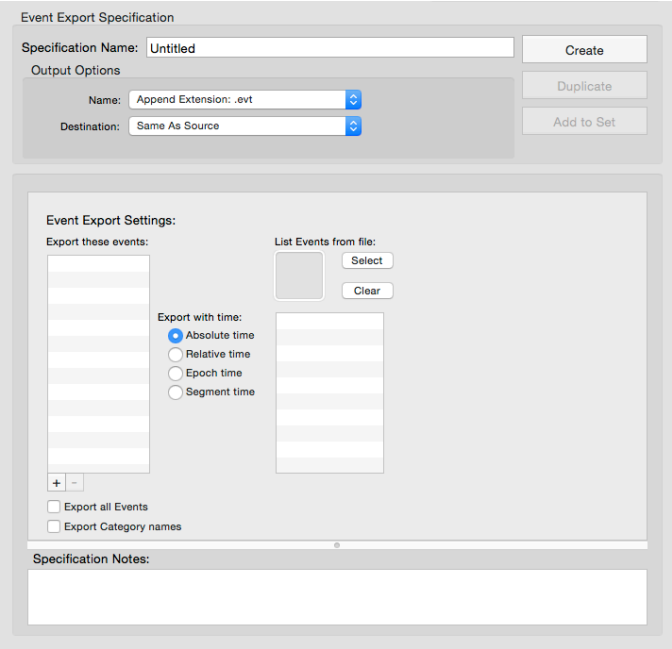


- If there is more than one segment in each category, then each segment is subtracted.
- If categories are of different lengths (for example, segment number and size), then the tool skips that category and issues a warning that a problem has occurred.

Additionally:

- This tool can be run on any Net Station .mff segmented or averaged file.
- This tool outputs to the same format as the input file.
- The subtractive method is a common psychological research technique based on the assumption that:
  If two experimental conditions differ in only one psychological process, and the difference between these two conditions is taken, then common processes will be eliminated and the unique process will be preserved.
- Neuroimaging researchers use the subtractive method to reveal the brain area(s) involved in an isolated psychological process. However, designing experimental conditions that differ in only one process is not entirely easy. You should always inspect the original waveforms to understand the difference waveform. The experimental conditions can differ in just one psychological process, and this difference may be associated with one or more unique ERP components. However, this psychological difference may also lead to latency differences in shared ERP components. The latency differences will distort the difference waves and may lead to spurious ERP components.

Event Export



The Event Export tool creates an ASCII file of all the events from the source data. Event information is displayed in a spreadsheet that is similar to the Net Station Event List.

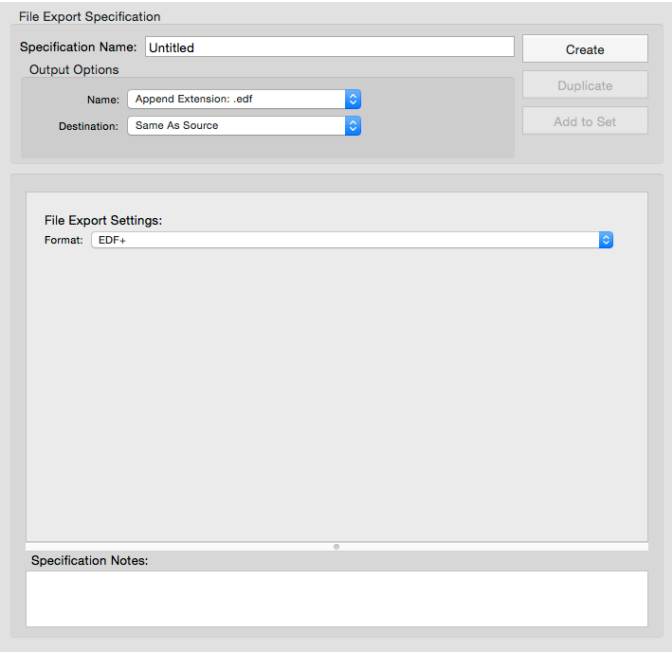
Remember that there can be any number of event tracks in an EEG file:

- First, those entered via TCP/IP.
- Second, those entered via the Markup From File tool.
- Third, those entered manually via Net Station Review.
- And so on … like those entered by the Segmentation Markup tool (under the Segmentation tool), when another form of the event code names is needed by another program.

Additionally:

- This tool can be run on any Net Station .mff file.
- You can use this event file with custom programs or other applications.
- You export your EEG data file to a Microsoft Excel spreadsheet that itemizes your events; you manipulate the events as needed; and, then you add those changes back into your EEG data file using the Markup From File tool.

File Export



The File Export tool creates tools to export data to a variety of formats. There are different parameters to set for the different export formats.

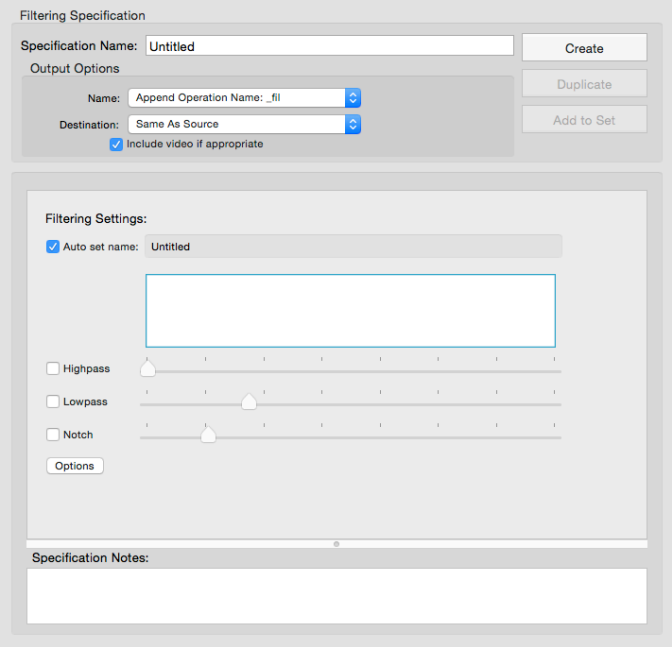
Additionally:

- This tool can be run on any Net Station .mff file.

- You can export to a variety of formats, including: EDF+ (.edf), MATLAB (.mat), metadata (.txt), Net Station Simple Binary (.raw), Persyst (.lay), and tab-delimited text (.txt).

Filtering

The Filtering tool lets you filter out activity in frequencies that are not of interest.



- **Highpass**. Attenuates frequencies below the specified frequency, while passing frequencies above the specified frequency.

  Note that frequencies at or below 1 Hz are IIR filters, while frequencies above 1 Hz are FIR filters.

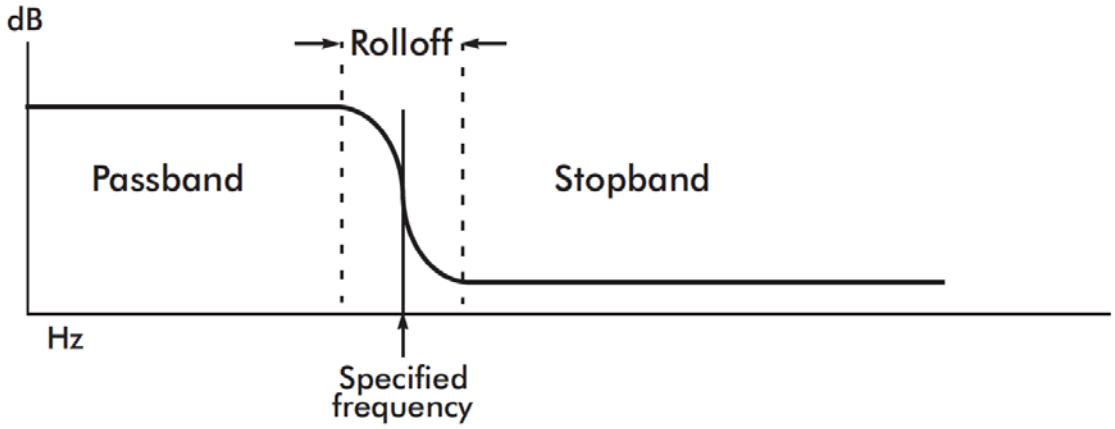
- **Lowpass**. Attenuates frequencies above the specified frequency, while passing frequencies below the specified frequency.

- **Notch**. Attenuates frequencies in a narrow band around the specified frequency, while passing frequencies outside the band. The notch filter is primarily used to filter out 50 Hz (most countries) or 60 Hz (United States and some regions) line noise.

To further refine the settings of the highpass, lowpass, and notch filters, there are optional passband gain, stopband gain, and rolloff settings. Click **Options** to access them.

- **Passband gain**. Controls the amount of the signal that the filter retains in the passband (that is, the frequency range in which the signal is to be retained). For example, a passband gain of 0.1 dB results in approximately 98.86% of the signal being retained, whereas a passband gain of 1.0 dB results in approximately 89.13% of the signal being retained.

- **Stopband gain**. Controls the amount of the signal that the filter attenuates in the stopband (that is, the frequency range in which the signal is to be attenuated). For example, a stopband gain of 40 dB results in 99% of the signal being attenuated, whereas a stopband gain of 20 dB results in 90% of the signal being attenuated.
- **Rolloff**. Controls the frequency range of the transition band (that is, the frequency range in which the filter transitions from retaining the signal to attenuating it). Rolloff is typically measured in Hertz (for example, from 10 to 11 Hz).

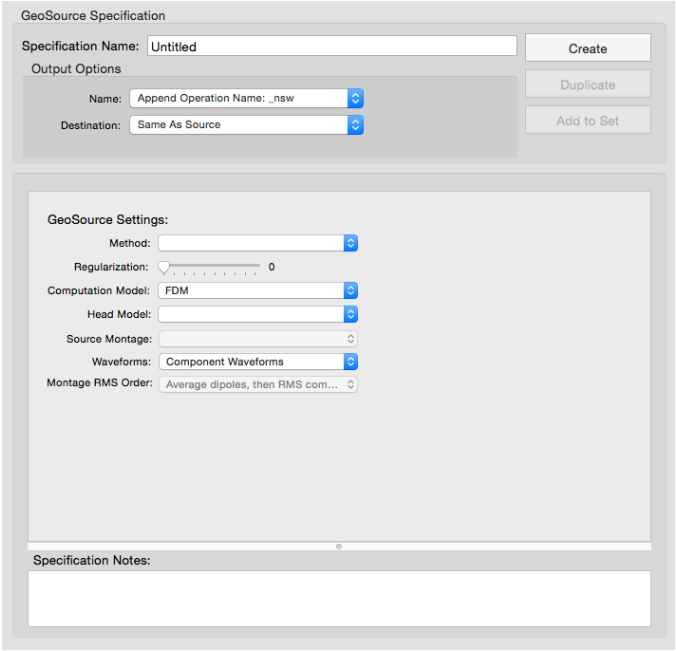


Additionally:

- This tool can be run on any Net Station .mff continuous file.
- This tool outputs to the same format as the input file.

GeoSource

The GeoSource tool allows you to easily visualize and explore source activations represented in MRI and waveform views. These comparative source localizations allow you to draw educated conclusions.



For details, refer to the GeoSource manual (8103101).

Additionally:

- This tool can be run on any Net Station .mff file.
- This tool outputs to a Net Station _nsw.mff file, which is a different form of the data.

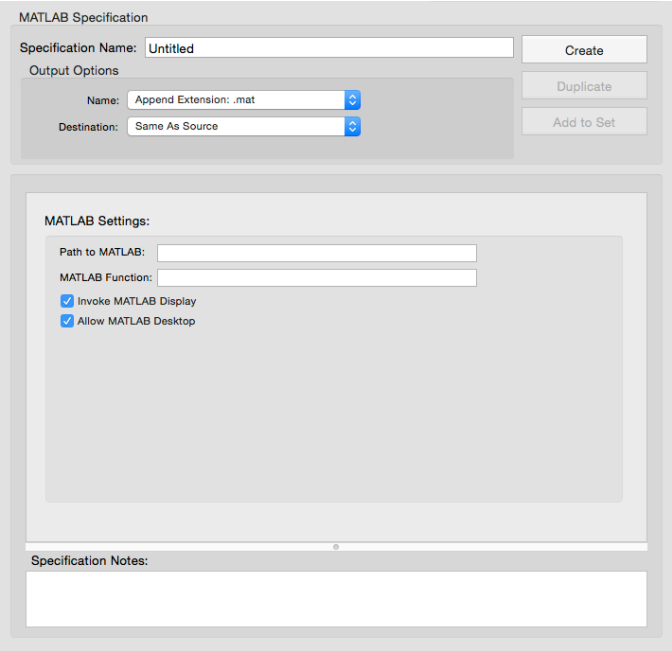
  Note that the .mff file is the scalp potential EEG form of the data, while the _nsw.mff file is the current source results form of the data.

The solutions provided by GeoSource are approximations of the locations of sources that are responsible for generating the EEG that is recorded at the scalp. It is a good idea to use GeoSource solutions from different source-imaging specifications in conjunction with other EEG tools and the results from other imaging modalities to determine if the solutions are consistent with the recorded data.

WARNING: Source localization refers to methods that are employed for estimating the current sources of scalp recorded EEG. There are two classes of methods: linear and nonlinear. Each class employs different approaches to source localization, which is an ill-posed problem. In the nonlinear class are methods that employ equivalent dipoles, and in the linear class are methods that employ different constraints applied to a minimum norm solution. Because source localization is an ill-posed problem, there are no unique answers. Therefore, estimates of current sources from scalp recorded EEG data, whether they are derived from linear or nonlinear techniques, are approximate, and should always be viewed in the context of the scalp data by a trained reviewer.

MATLAB

The MATLAB tool allows you to run MATLAB functions on your EEG data from out of Net Station one of two ways. Either way, the results will come out of MATLAB.



The Path to MATLAB field is where you type the actual path to MATLAB on your computer.

The MATLAB function entered must be one of MATLAB's recognized functions.

- **With the EGI MATLAB MFF API**:
  For example, after filtering and segmenting the data, you input the .mff file into the MATLAB tool, and then Net Station calls up MATLAB and MATLAB runs the set function on the file via the API.

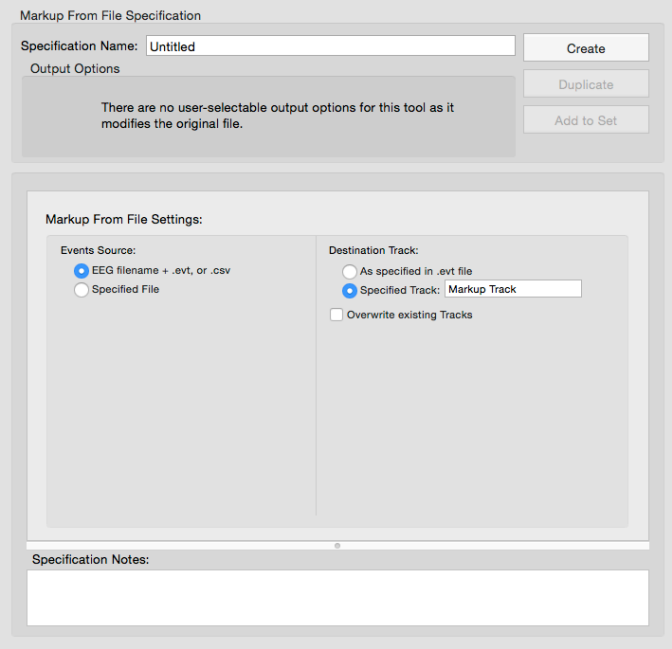
- **Without the EGI MATLAB MFF API**:
  For example, after filtering and segmenting the data, you export your file (using the File Export tool) as a .mat file, input that .mat file into the MATLAB tool, and then Net Station calls up MATLAB and MATLAB runs the set function on the file.

Additionally:

- This tool can be run on any Net Station .mff or .mat file, depending upon whether or not you are using EGI's MATLAB MFF API.
- This tool outputs to a MATLAB readable format.

Markup From File

CAUTION: This tool will change the original file—it does not generate a new file. Always make a copy of a file and run this utility on the copy.



The Markup From File tool uses an ASCII text file (created by the Events Export tool) to add events to a Net Station file.

Additionally:

- This tool can be run on any Net Station .mff file.
- This tool does not produce an output file—it modifies the current input file.

Required Mark-up Event Formats

To add mark-up events to a Net Station EEG file using the Markup From File tool, the mark-up events must be in one of three formats:

Note that the time formats of data and mark-up events must be the same in order to apply the Markup From File tool. If they are not, you may get an error message in the Results pane.

- **Event Export file**. This is an ASCII text file of all events from your data—it is created by using the Event Export tool.

  Note that events include all those manually marked during acquisition and review as well as those marked via TCP/IP, DINs, Segmentation Markup, and Markup From File.

  For Markup From File, the events must be exported in either Relative or Epoch Time timing.

- **Persyst CSV file**. This is a comma-separated value format. The general CSV file format is used to exchange data between disparate applications. Each record is a line and each field is separated by a comma.

  For details, refer to third-party Persyst documentation.

  For Markup From File, the time format for the mark-up events must be in milliseconds from the beginning of the recording.

- **Markup From File format**. This is a tab-delimited format, which requires that you create an ASCII text file and write your own code to add mark-up events to a Net

Station file based on the results of a separate event-generating program, such as an eye tracker.

For Markup From File, the time format for the mark-up events must be in milliseconds from the beginning of the recording.

Required Coding Conventions

When adding events, marking channels good or bad, or marking segments good or bad, adhere to these conventions:

- Angle brackets **<**xxx**>** are used to indicate user-entered information.
- The angle brackets are not part of the code. So, do not include them.
- Any item not enclosed by angle brackets is mandatory.

Adding Events

To add a mark-up event, your code should contain a line that includes:

- the time of the event (in milliseconds from the beginning of the recording)
- a tab space
- the four-character code of the event

Task	Code	Example
Add a mark-up event at a specific time point in milliseconds from the start of the recording.	**<**time**><**tab**><**4-char. code**>**	60000 eyeb Marks an eye blink 1 minute from the start of the recording.

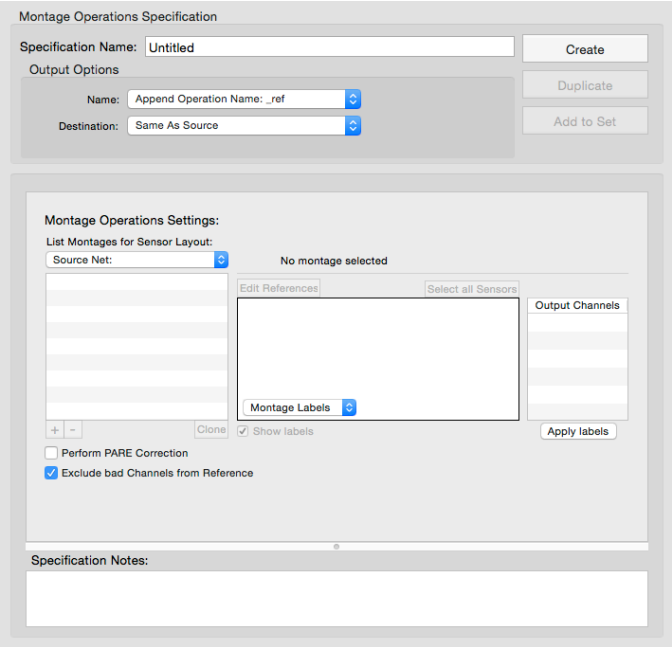
Montage Operations

The Montage Operations tool creates a montage containing a specified reference and a subset of channels. Montages modify files as follows:

- If set, data can be rereferenced.
- Spatial downsampling of the data can result. If the tool's number of channels is fewer than the number of channels in the input file, the output file will contain only those channels specified by the tool.

Additionally:

- This tool can be run on any Net Station .mff continuous, segmented, or averaged file.
- This tool outputs the same format as the input file.
- This tool rereferences your data. You can rereference your data to any channel or to the average of any set of channels. Average referencing means rereferencing your data to the average of all the channels. When you average reference your data using the Montage Operations tool, you have the option of using a PARE-corrected average reference.



- In general, EGI recommends doing an average reference or a PARE-corrected average reference.
- When comparing your data with another's data, you should use the same reference for the purpose of comparison.

Rereferencing

EEG is a measure of voltage, and voltage measurements are inherently differential. In other words, any voltage measurement is really a measurement of the difference in potential between the site being measured and a reference site that is assumed to have a value of zero. In actuality, any choice of reference is arbitrary. There is no site that can be assumed to have a value of zero, and, to make matters worse, there is no site that can even be assumed to have a constant value from one timepoint to the next.

The objective of rereferencing EEG data is to estimate a true, *nonarbitrary zero value* to which to reference the voltage measurements.

Polar Average Reference Effect (PARE)

There are several reasons to believe that, at any given time, the average over every point on the surface of the body (the surface integral) would represent such an ideal reference value:

- If you assume, as many researchers do, that neural sources are dipolar (at practical distances from the sources), then positive and negative fields will sum to zero.

Regardless of how many sources are active, if the entire surface of the volume is measured, assuming homogeneous conductivity, the surface integral will therefore be zero.

- Even if you don't make the preceding assumption, the surface integral will be zero because of the conservation of charge inside an electrically neutral body.

As channel counts increase, the average of all the channels better approximates the surface integral and, therefore, the ideal zero reference value. To eliminate the influence of the arbitrary recording reference channel and use instead a reference that approximates the ideal zero reference, many researchers prefer to rereference their data to the average reference.

However, if the head surface is unevenly sampled, then the average reference is biased toward the region that is sampled. This is known as the polar average reference effect (PARE). For example, if the electrodes are concentrated on the top of the head, and inadequately sampled on the undersurface, then the average reference is biased toward the top of the head. Even with EGI's dense array Geodesic Sensor Nets, the entire head surface cannot be adequately sampled (the underside is still not sampled). Therefore, there will always be a PARE when using the average reference.

One solution to this problem is to use a PARE-corrected average reference. The PARE-corrected average reference is computed from the entire surface of the head, including the surface not covered by electrodes. Spherical spline interpolation is used to estimate the voltages of the surface that is not covered. For more information on PARE, see the following:

Junghoefer, M., Elbert, T., Tucker, D.M., & Braun, C. (1999). The polar average referenced effect: A bias in estimating the head surface integral in EEG recording. *Electroencephalography and Clinical Neurophysiology*, 110, 1149–1155.

Scripting

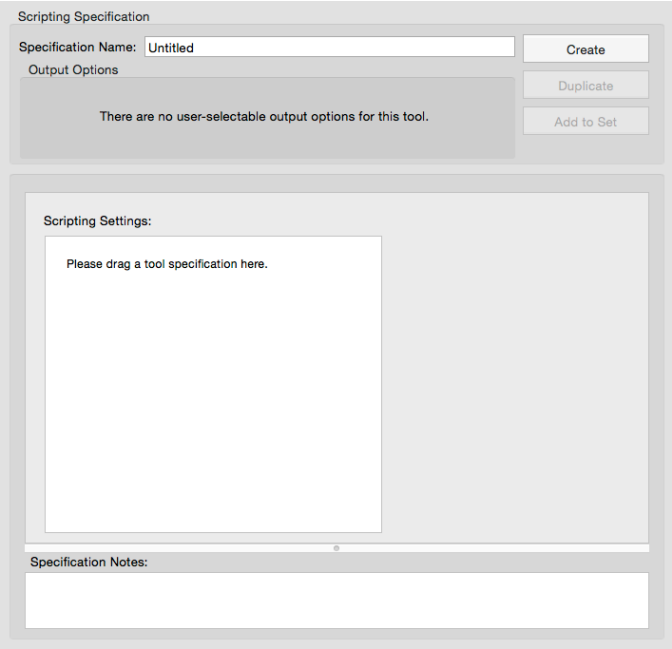
The Scripting tool chains the operations of other tools together in order to automate data analysis.

The Scripting tool has been run successfully on up to 30 input files.

After specifying individual tools and ordering them according to your data analysis path, the Scripting tool can run them in order.

The output of most tools becomes the input for the next tool specified in the script.

The Averaging tool can process multiple input files to generate a single output file. In a script, the Averaging tool will accumulate all of the input files first, before generating the output file.



Additionally:

- This tool does not operate directly on a Net Station .mff file.
- This tool does not produce an output file.

Incorrect Scripting Specifications

It is possible to incorrectly specify Scripting tools. The Scripting Specification editor will notify you of some errors during setup, but some specification errors are only revealed when you attempt to run a tool.

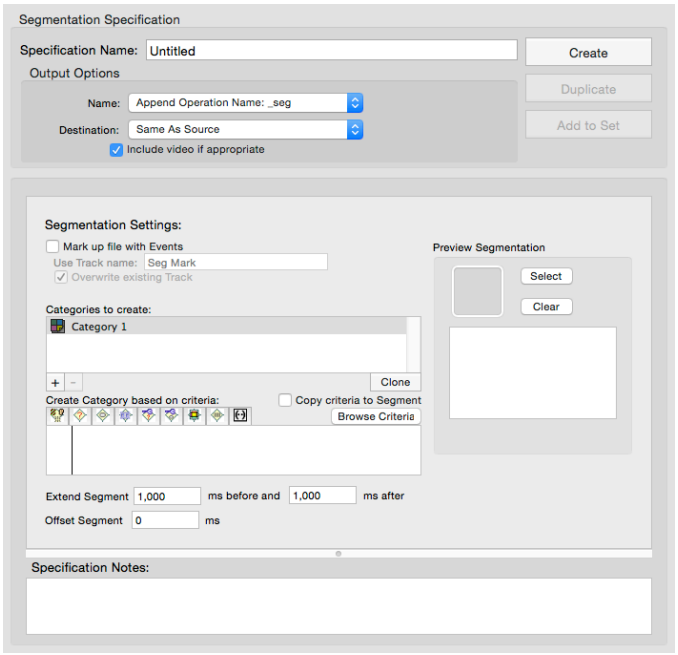
- If you set up a script to export a file to a format that is not supported for import by another tool and then try to perform another operation on the file, the Scripting Specification editor generates an error message during the scripting session.
- If a Scripting tool is set up to run a Segmentation tool followed by an Averaging tool, and the Segmentation tool's output happens to contain no segments, averaging cannot be done. In this case, Net Station generates an error when you run the script.
- If a Scripting tool is set up to run a Filtering tool followed by an Averaging tool, and continuous data are supplied to the Filtering tool, the Averaging tool will fail because it requires segmented data. This error can be detected only at run time because the Scripting Specification editor cannot know ahead of time what type of data will be supplied.

Segmentation

The Segmentation tool specifies parameters for segmentation and segmentation markup.

- **Segmentation**. Breaks a continuous recording into event-locked epochs (called *segments*) based on a set of selection rules and user-defined criteria. The purpose of segmentation is to organize your data into categories so that you can average them or perform other operations on them.

- **Segmentation Markup**. Places event markers into EEG data to locate segments, but unlike segmentation, you do not segment the data or generate an output file. Segmentation markup allows you to extract data from the Net Station key lists to a form suitable for export into other applications that do not support key lists. In most applications, events have only names—they contain no key lists. After segmentation markup, you can perform segmentation in these other applications. Also see the Event Export and Markup From File tools.



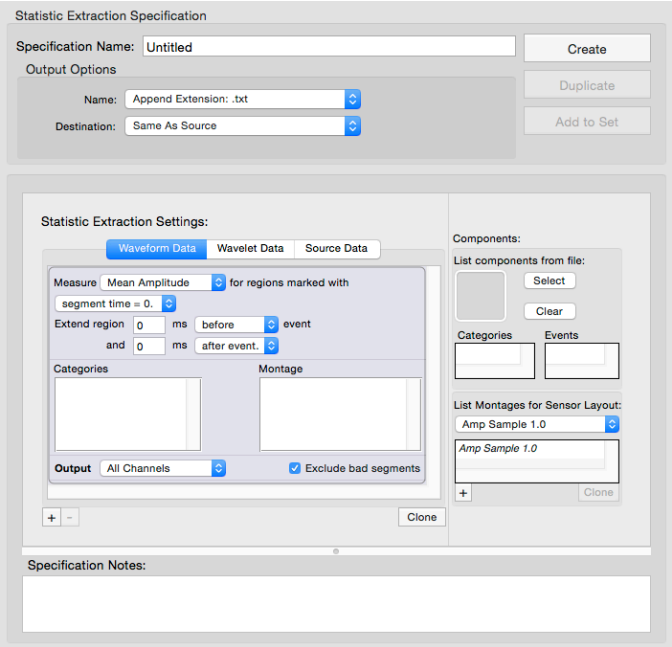
Additionally:

- This tool can be run on any Net Station .mff continuous, segmented, or averaged files.
- For segmentation, this tool outputs to a segmented Net Station file.
- For segmentation markup, this tool outputs an edited input file.

Markup Example

In Net Station, all the stimulus events might be named ***stim***. The distinction between *standard* and *target* stimuli cannot be determined from the event name—it can be determined only from the key lists. Segmentation markup allows you to create new events, at the appropriate locations, called *targ* and *stnd*. You can segment on these events in other applications.

Statistic Extraction



The Statistic Extraction tool extracts data to a text file to be used in external statistical applications.

To do this, you run the Statistic Extraction tool on a multiparticipant averaged file, and then import the output into a statistical software package (such as SPSS or JMP) for analysis.

Additionally:

- This tool can be run on any Net Station .mff segmented or averaged file.
- Before extracting data from a file, make sure that a participant has been assigned.

Data Types

The Statistic Extraction tool operates on the following data types:

- **Waveform data**. This is the scalp data (in microvolts) that was acquired by your Geodesic EEG System.
- **Source data**. This is the cortex data (in nano-amp meters) derived by using the GeoSource software.
- **Wavelet data**. This is the joint time-frequency information produced when you run a Wavelet tool on your data.

Parameters Needed

The Statistic Extraction tool needs you to specify the following parameters:

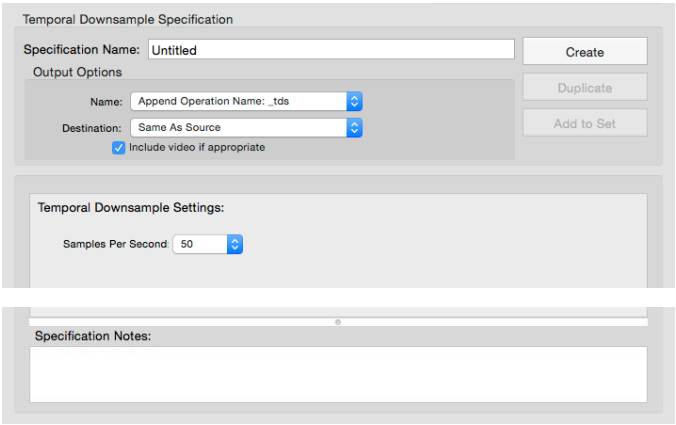
- a time window
- a measure (mean amplitude, adaptive mean, minimum amplitude, maximum amplitude, or latency)
- how the measure is to be reported for each channel group
- one or more categories

- one or more channel groups

  Specify a channel group using montages, which have to be using the same sensor layouts as the input file.

Temporal Downsample

The Temporal Downsample tool lowers the sampling rate of data in a file.

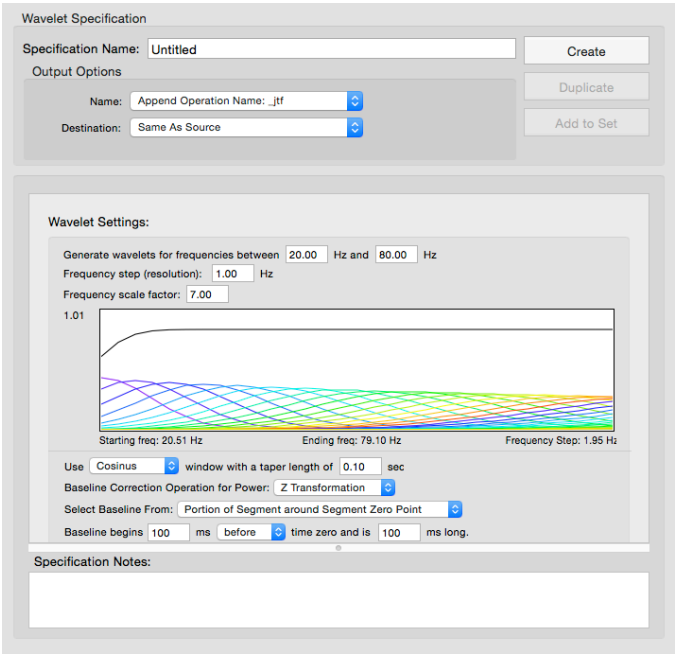


This tool allows you to oversample EEG data during a recording, and then later lower the sampling rate to reduce file size. It also allows you to process files with different sampling rates by resampling them to the same rate prior to analysis.

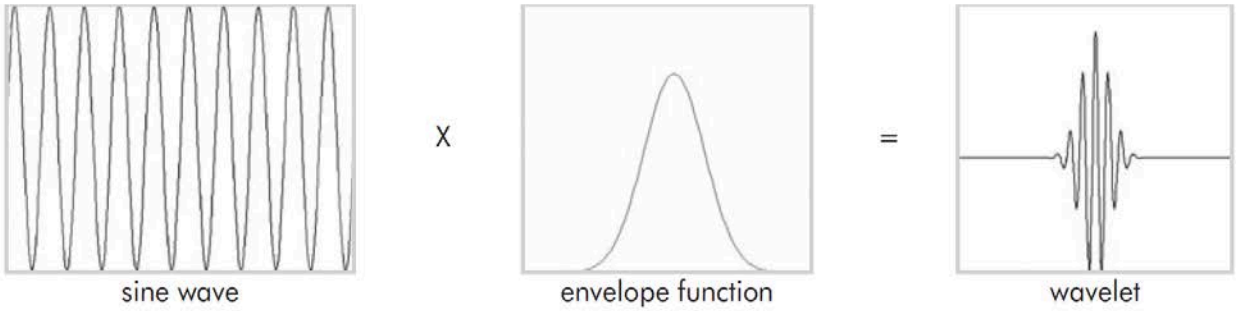
The process of downsampling involves filtering the data to remove frequencies above the nyquist to avoid aliasing the data. Due to this filtering, this tool cannot be used on files containing segmented or averaged data.

Wavelet

The Wavelet tool decomposes the EEG signal into its temporal and frequency components, using a scale-varying basis function—the wavelet.



Net Station uses the Morlet wavelet, which is created by multiplying a sinusoidal wave by a Gaussian envelope, resulting in a small wave that oscillates with varying amplitude within a finite period, concentrating its energy around a point in time.



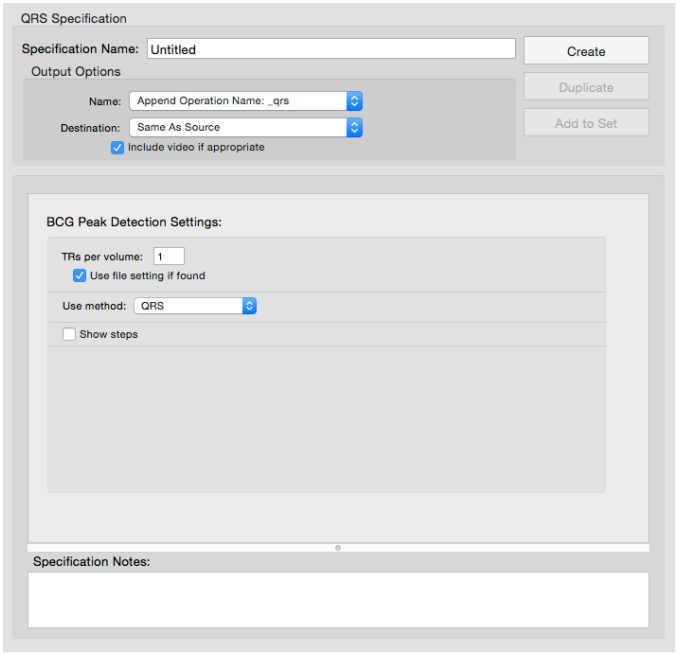
Additionally:

- This tool can be run on any Net Station .mff segmented or averaged file.
- This tool outputs to a Net Station _jtf.mff file.

RESEARCH ONLY fMRI Tools

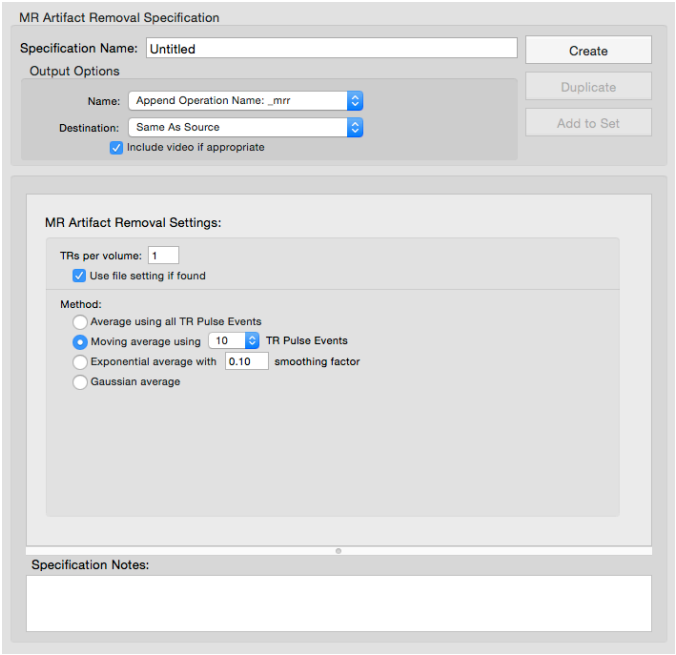
BCG Peak Detection

The BCG Peak Detection tool detects and marks the R peaks of the QRS compounds in an ECG signal (from QRS, Niazy et al. 2005) or the onset of the BCG artifacts (from EEG, Iannotti et al. 2014). These makers are time locked to the BCG artifacts and will be used for removing the BCG artifacts in the OBS tool.



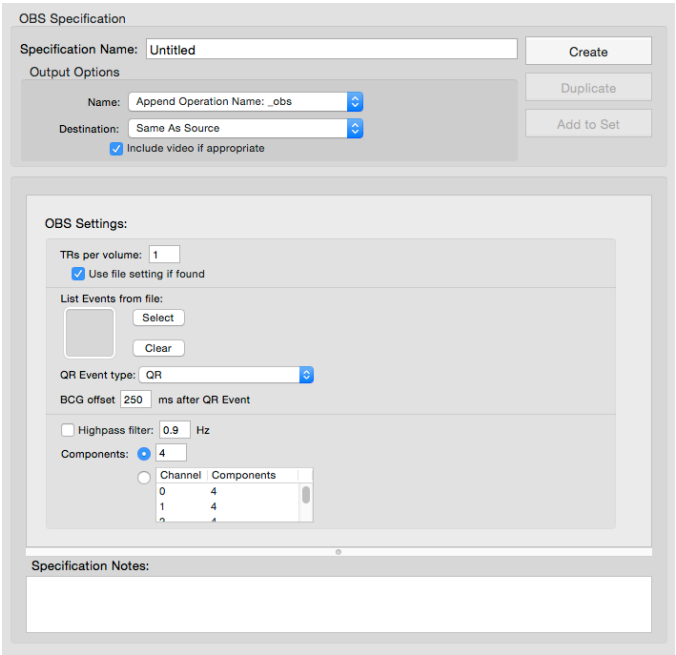
MR Artifact Removal

The MR Artifact Removal tool removes the gradient artifacts in the EEG data that are collected from the MRI scanner. It also removes DC offsets from the data. This tool is based on the template subtraction method.



OBS

The OBS tool is based on the optimal basis sets (OBS) algorithm developed by Niazy et al. (2005) for removing BCG artifacts. It is mainly a principal component analysis (PCA) followed by the creation of a set of basis functions that describe the temporal variation of the artifacts, and then removes these artifacts.



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