SEISMOLOGY
RESEARCH
CENTRE

Streams

GECKO & SEEDLINK DATA ACQUISITION AND DISPLAY SOFTWARE

PRODUCT USER MANUAL

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Installing Streams

System Requirements

Streams version 3.0 is for Windows, macOS, Ubuntu, Raspberry Pi OS.

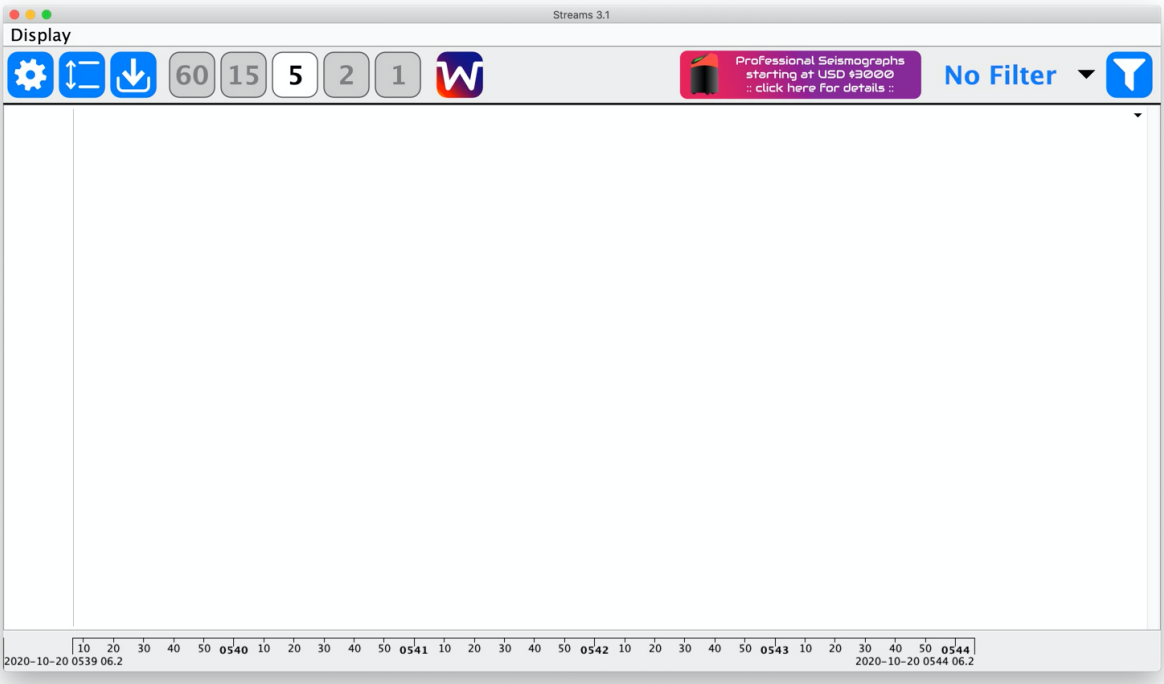
Streams is a Java application with a built-in Java Runtime Environment (JRE), so there is no longer a requirement to install Java separately (as required for Live Stream and Waves 3).

Application Installer

When you run the Windows installer, a copy of the application will be installed on your computer under **Program Files > src** and a shortcut is created on your desktop. The other versions contain the software package that you can place in your applications folder.

When you run the program for the first time, a folder called "**eqsuitefiles**" in will be created in your User folder. It contains the relevant program resources files in the "streams" folder, and a folder called "**Data Archive**" which is where all data received data by Streams is stored. Files relevant to Waves also reside in the eqsuitefiles folder.

When Streams starts up, you will be presented with the window below. The number buttons at the top of the screen indicate the number of minutes of data displayed on screen.



Functionality

Streams is an application that receives real time data from Kelunji Gecko seismic recorders, SeedLink servers, and MiniSEED or PC-SUDS data files sent to it via FTP (e.g. from Kelunji Echo and EchoPro recorders). Streams will display the data on screen and store it in an archive, which can be accessed using the computer's file browser.

Streams has a colour coded amplitude display mode which will change from green to yellow to red based on user-defined levels of velocity of acceleration.

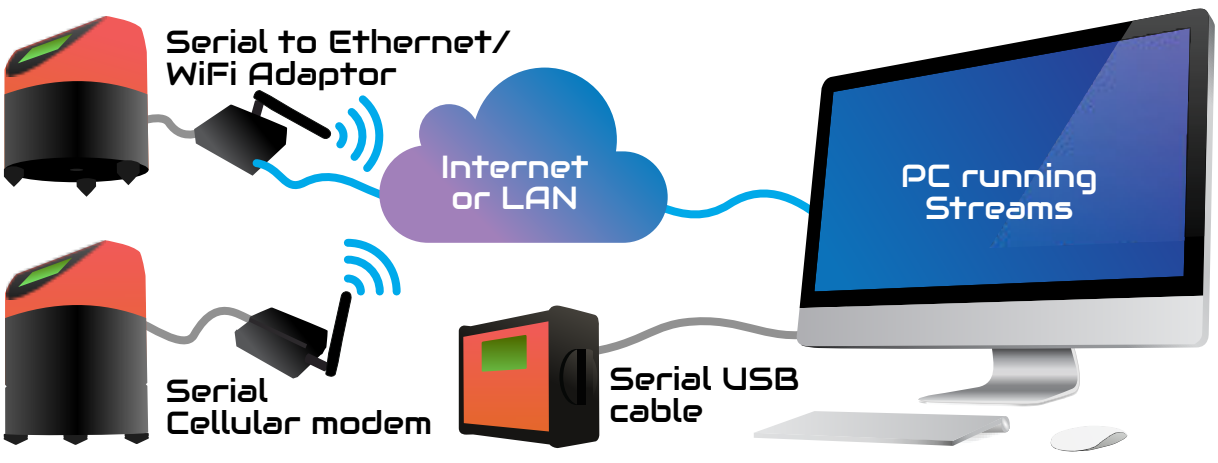
Streams can also analyse the incoming data in real time and generate alerts based on user-defined parameters, which appear on screen and can optionally be sent as email messages. Streams also gives you the ability to remotely configure and control any connected Gecko recorders, as well as upgrade their firmware.

Gecko Telemetry to Streams

To stream data from a Gecko you need to use a device that has an RS232 serial port and the ability to route that port to a TCP/IP port on a remote computer. Most cellular modems that have this feature refer to it as "TCP Client" or "PADD" mode. Within the modem you set the serial port to connect to the IP address or domain name of your Streams computer, and as long as the nominated port is open (default is 58772) the data will start to flow.

Serial-to-Ethernet/WiFi adaptor setup is along the same lines, and the setup procedure for the models we support are documented in the Gecko user manual.

A Gecko-to-USB cable is available for direct connection between the recorder and the Streams computer. Streams will scan all connected USB serial devices every 30 seconds and if it detects that the device is a Gecko, a connection will be established automatically.



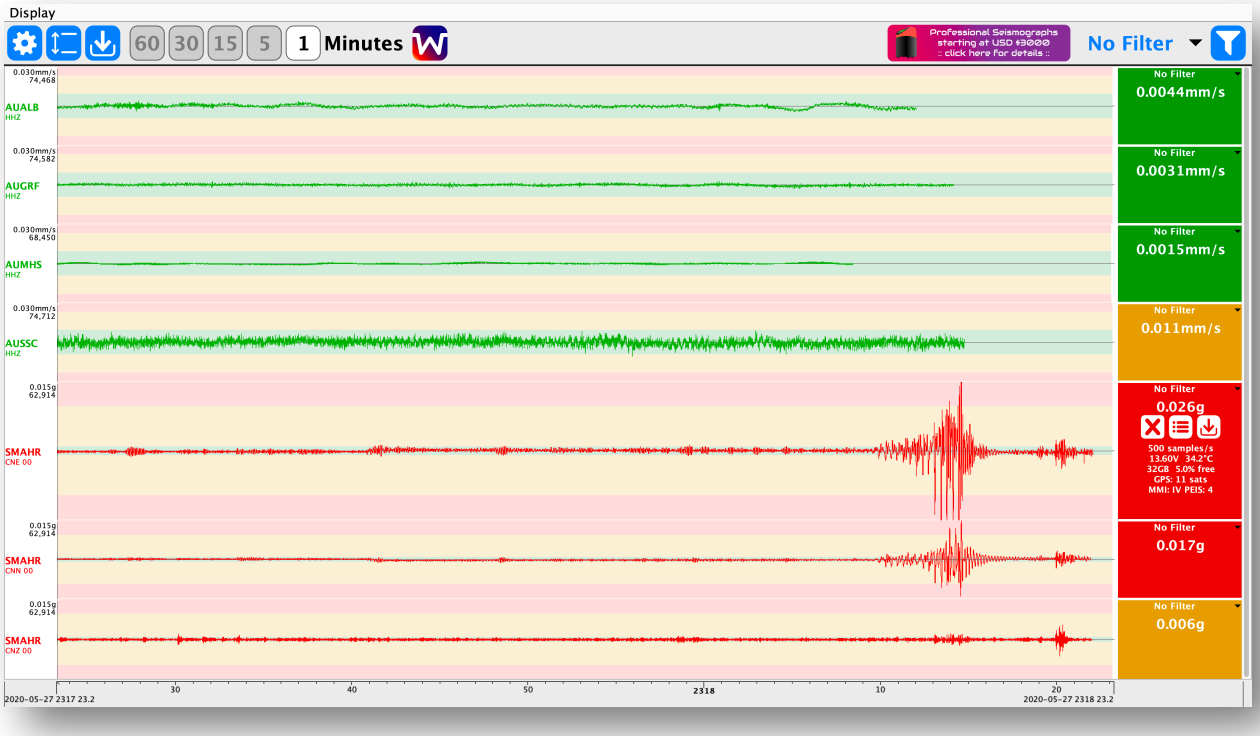
Gecko Telemetry Protocol

Without going into too much technical detail, a Gecko streams data out through an RS-232 serial port using a custom communication protocol. Data is bundled into 512-byte MiniSEED data format packets and sent to a program called Kelunji Hub which is built into Streams.

When a connection is established by a Gecko, Streams treats this socket connection as a virtual serial port and starts two-way communication with the Gecko. Any number of Geckos can concurrently connect to Streams on the same port as the computer treats each connection separately.

Kelunji Hub also operates on eqServer (a cloud-based service) and on GeckoLink (a Raspberry Pi-based accessory), but instead of feeding data to the Streams application user interface, it feeds the data into a processing system which allows remote data display and Gecko configuration using your web browser.

The amount of data that can be streamed continuously from a Gecko (without data gaps) depends on a number of factors including the telemetry link speed, the number of channels being sent, the sample rate, and the load on the data reception computer. With a decent data connection to a modern PC, a Gecko can stream multiple channels of data continuously at 500sps. Sending 1 channel continuously at 4000sps is possible over a local network.



Tool Bar

The tool bar buttons are used to access settings and control the display of data.

	**Streams Settings**	Modify settings controlling archive location, email and more. Also accessible with shortcut Ctrl-period (⌘**.** on macOS)
	**Amplitude Scaling**	Toggle amplitude display from auto-scaling to fixed amplitude scale, as defined in Streams Settings
	**Download from Gecko**	Send a request to all connected Gecko recorders to send in all stored data from a specific time period
	**Display Window Size**	Choose the size of your display window in minutes
	**Open with Waves**	Opens the currently visible data in a Waves window for quick data analysis
	**Filter**	Toggle the user-defined band pass filter on or off for all channels (whether visible or not)

Display Menu

Show Alerts

Opens a window showing a log of alerts that were previously displayed in the pop-up window. Only events that meet the Event or Station alert criteria (not individual station triggers) will be displayed here and on screen. Also accessible with shortcut Ctrl-A (⌘**A** on macOS).

All Channels

Select this to display all channels that have been active the last hour. Depending on the resolution of your display, the window size, and the number of incoming channels, you may need to scroll down to see all channels. Stations are displayed in alphabetical order.

Vertical Channels

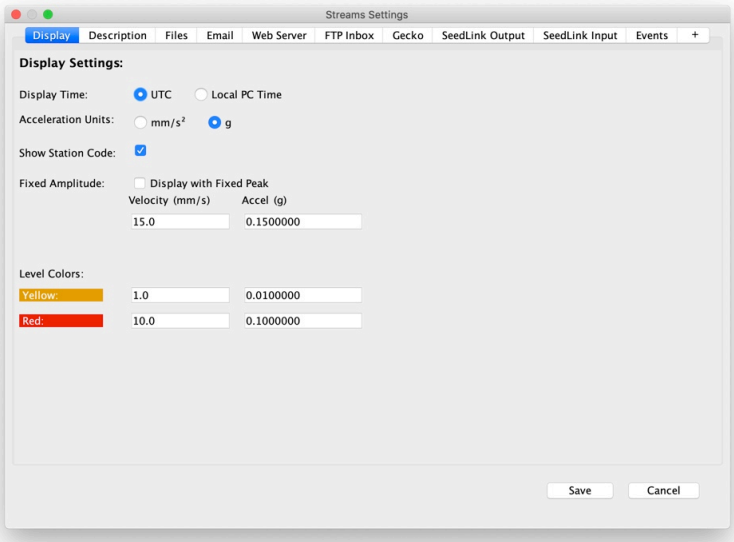
Select this to only display the vertical (Z) channels from all stations.

Station CODE

Select a station CODE to only display channels from that station.

Settings

Display



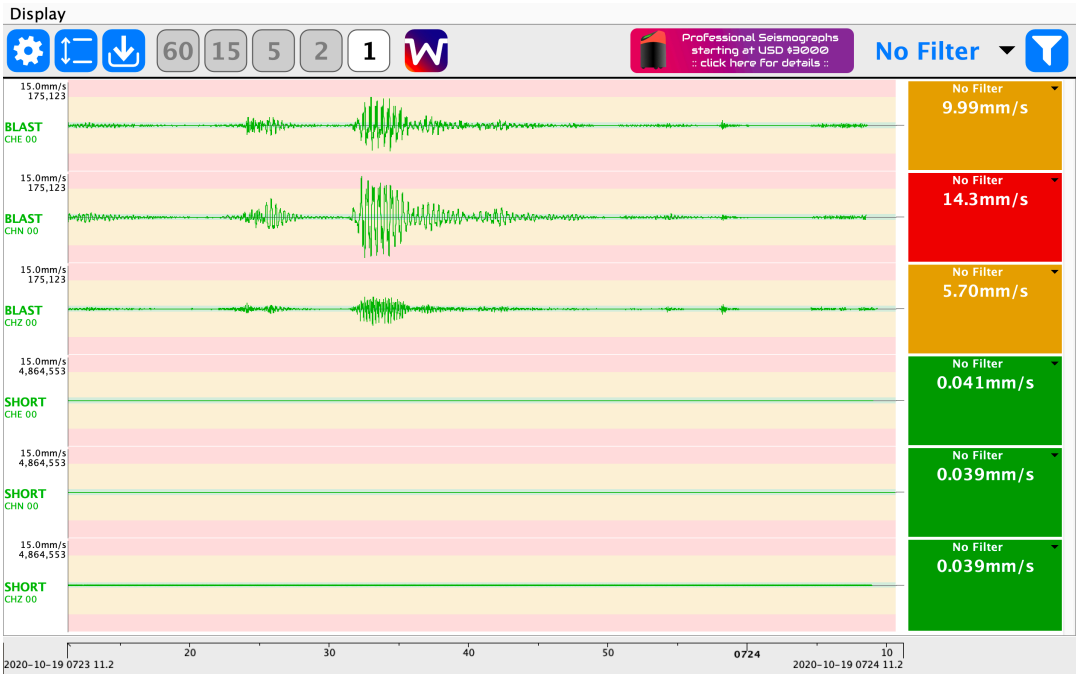
The first parameter in the Display settings allows you to choose to display data in UTC (Universal Time Coordinated, as used by seismologists worldwide) or in Local time according to your computer's clock.

Acceleration data can be displayed in mm/s or in *g* (gravity) according to your preference.

The amplitude scale in Streams is toggled by a toolbar control, but can also be enabled in this window, where the value of the fixed amplitude is defined for Velocity (in mm/s) and Acceleration (in mm/s or *g*) signals.

The coloured boxes at the right-hand end of each channel can be colour-coded according to the currently displayed peak signal level. Streams has two levels, yellow and red, which could be used to display a visual warning level or alarm level. These levels can be defined in velocity or acceleration and can only be used for stations where station sensitivity is known.

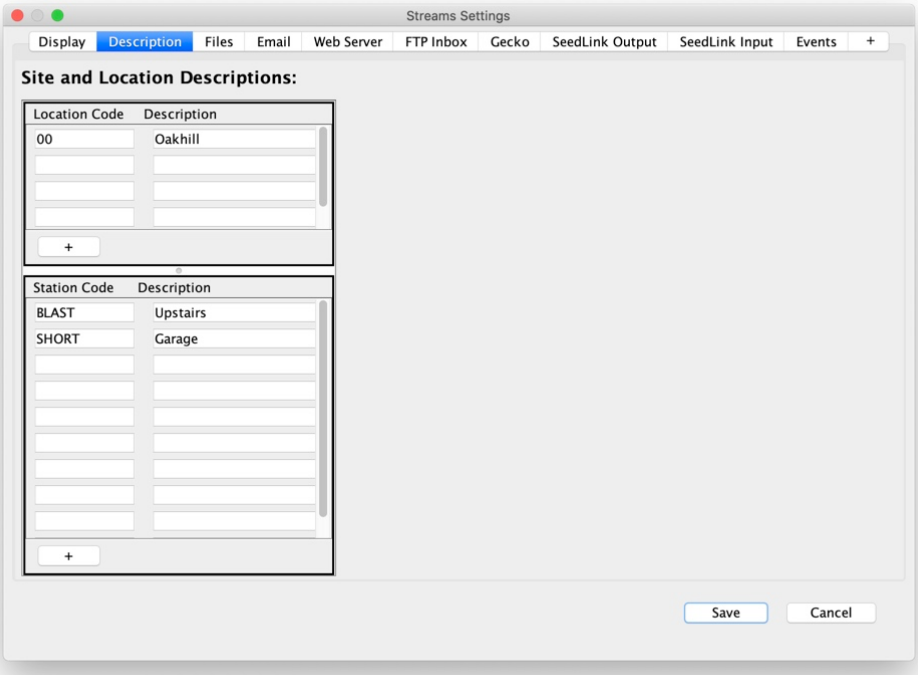
If you do not want to show the green/yellow/red amplitude colouring on your display, set all of the Level Colours to zero.



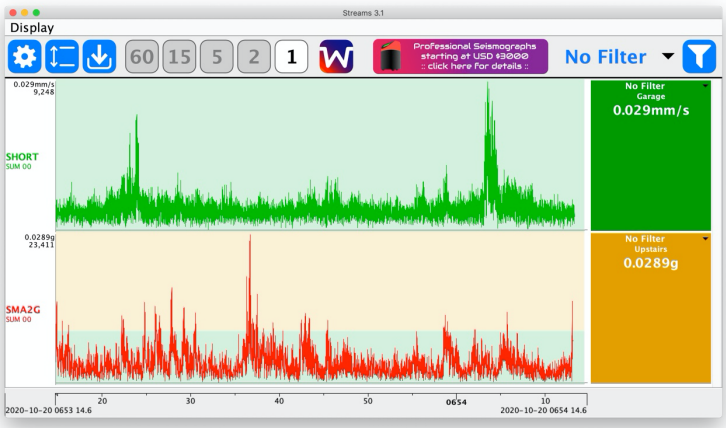
Description

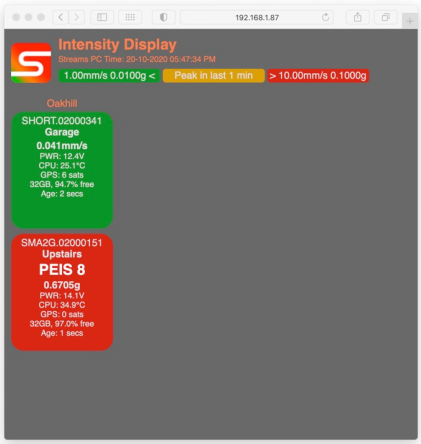
New to version 3.1 of Streams is the addition of descriptive names for FDSN Location and Station Codes.

As stations send in their MiniSEED data, a list of these unique station and location codes will populate the lists in the "Description" settings tab, where you can enter up to 16 characters per code to better describe the location group of the individual station.



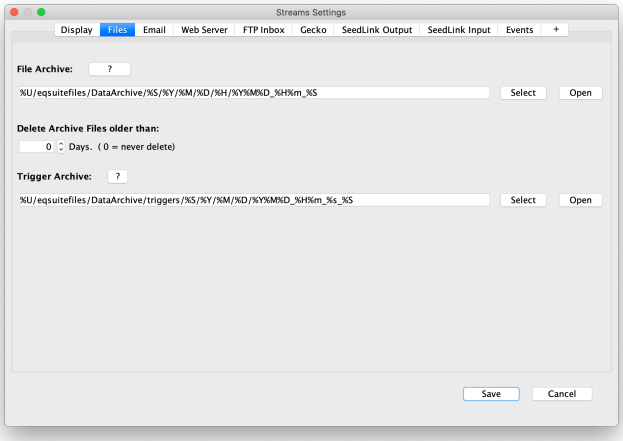
The station name will appear in coloured station information box in the main display (below, left) and on the Intensity Display web page (below, right). Stations with a common Location ID are grouped into columns on the Intensity Display web page, listed in alphabetical order by Station Code. This is a useful way to group structural monitoring accelerographs located in a building on different floors. See later section for more about Web Server settings.





Files

The Files tab allows you to define the location of the Continuous File Archive on your computer. By default the data is stored in your User directory in the **eqsuitefiles** folder under **DataArchive/STATION/YEAR/MONTH/DAY/HOUR** in files that are named by date, time, and station code in the format YYYY-MM-DD_HHMM_STATION.ms.zip.



You can Select the archive location, and modify the save path and file names using wildcards. The word "archive" must appear somewhere in the path.

Do not include the file extension in the filename wildcard definition. Available wildcard values are as follows:

- **%U** - User home directory as defined by your operating system. %U will return the path from the root directory. Alternatively you can start the archive location at a fully qualified path, e.g. "/archive/" or "C:/Users/me/seismic-archive"
- **%N** – Network Code
- **%S** – Station Code
- **%I** – Gecko ID / Serial No. 8 chars hex, e.g. 02000374
- **%Y** – Year. Always displays as four characters, e.g. 2019
- **%M** – Month. January = 1. Displays as two characters, e.g. 05
- **%D** – Day of month. Displays as two characters, e.g. 09
- **%d** – Day of year. Jan 1 = 1, Feb 1 = 32. Displays as three characters, e.g. 034
- **%H** – Hour. Displays as two characters, e.g. 23
- **%m** – Minute. Displays as two characters, e.g. 59
- **%s** – Seconds. Displays as two characters, e.g. 00
- **%u** – Microseconds. Displays as six characters, e.g. 123456

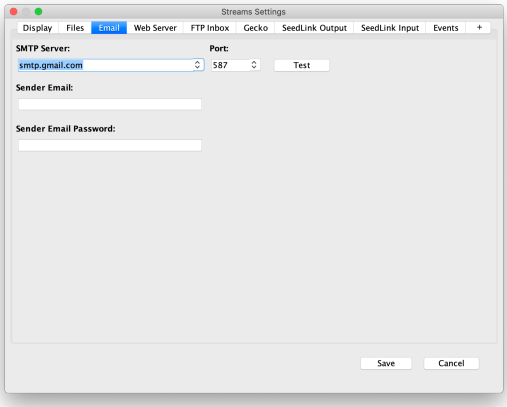
At the bottom of this tab is a section that defines the location and file name format of the Trigger Archive, which by default follows a similar location/naming convention.

The 

button will bring up a help information text box, and the **Open** button at the end of the line will open the folder in your operating system's file browser.

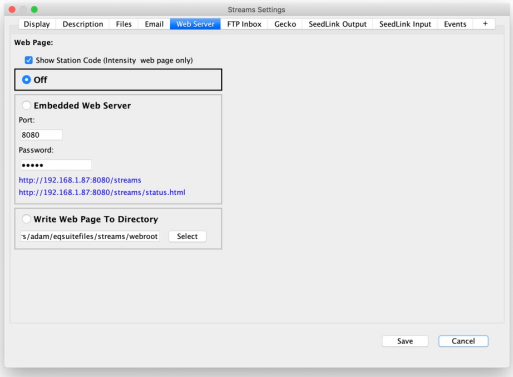
To avoid filling up your hard drive with data, you can choose to only keep a certain amount of time in the archive. Under the "Delete Archive Files older than:" heading, type in a number of days of data to keep on your computer, or set it to zero to never delete old files.

Email



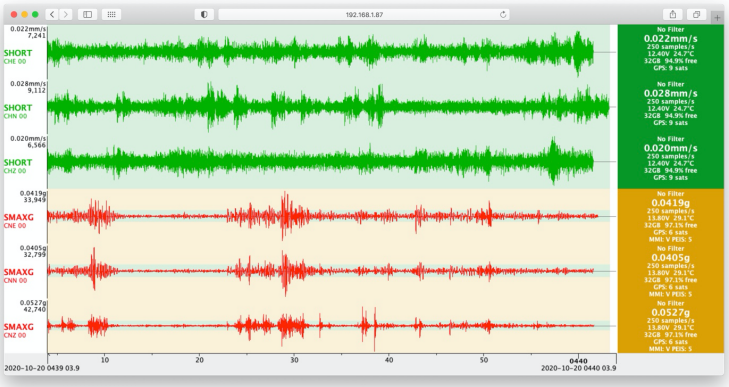
To send emails from Streams you need to define a mail server and account. Contact your mail host for SMTP server details such as the SMTP address, port and credentials. If you are using a Gmail account, you will need to log in to Gmail using a web browser on the Streams computer once for Google to authorise that PC as a valid sender. Streams uses a basic email protocol, so your account will to need to "allow less secure apps" to send emails.

Web Server

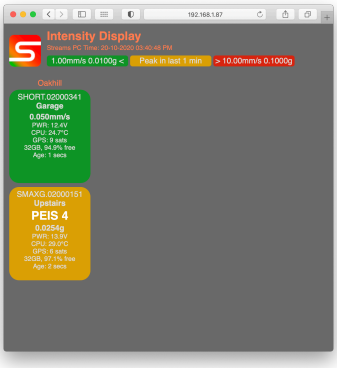


If you enable the web server, you can view an Streams from a remote computer using a web browser. Windows and Linux users can use the built-in basic web server (minimal security) but may need to set a custom port (port 80 by default, 8080 a common alternative), then define a password to restrict access to the page (default is **gecko**). macOS users can download Personal Web Server from the App Store.

A more secure alternative is to set up a third-party web server and direct it to the folder containing the Streams web pages, as defined in the bottom dialogue box.

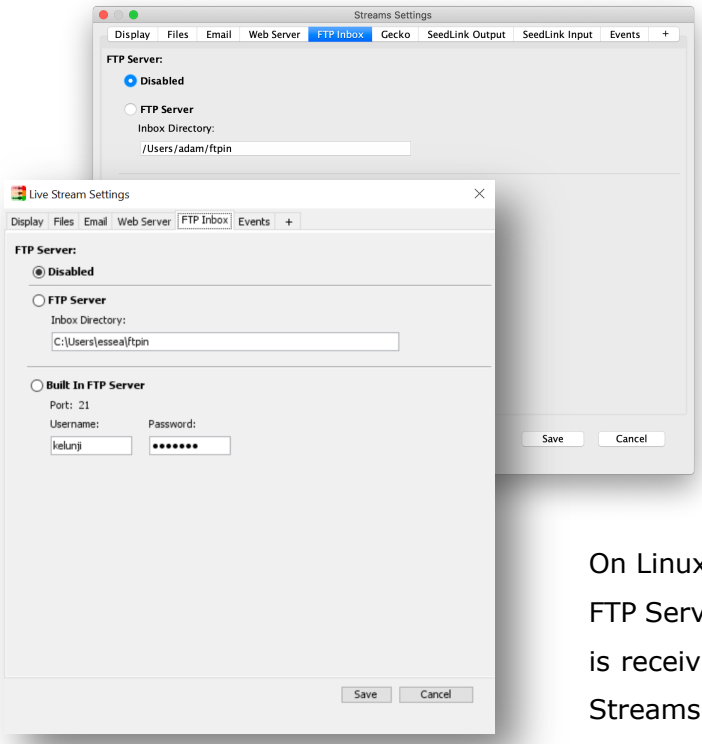


When you browse to the server, the page will show a screenshot of the Streams data window, or click on the image to swap to the Intensity Display page. Both web pages are updated every few seconds. Click on the Streams icon to go back to the live data.



The blocks show the peak value being displayed for each station, coloured according to the Display settings. Accelerographs will show intensity in PEIS, and the tick box at the top of the settings window will hide or show the station code and serial number.

FTP Inbox



You can send files from other sources into Streams via FTP. If Waves can open the file, Streams can process it. FTP data reception is disabled by default.

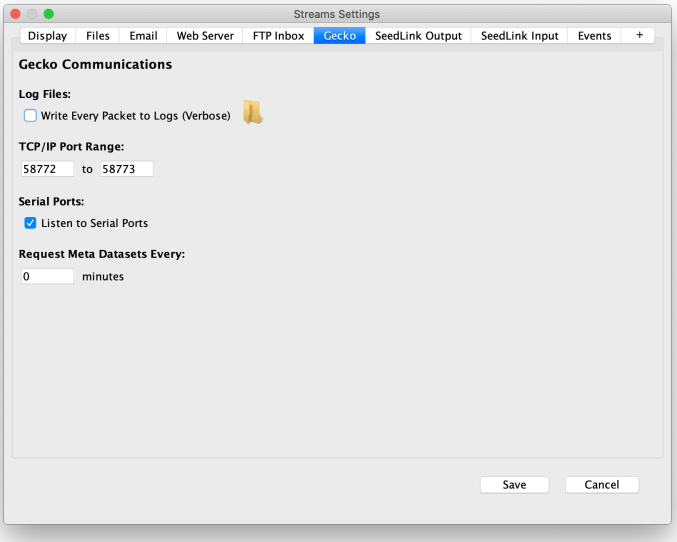
Windows users can use Streams' in-built FTP Server or a 3rd party FTP Server. When your remote data source connects to the FTP server with the user-defined login and password, it will ignore sub directory destinations defined by the sender and process all incoming files.

On Linux and macOS you will need to run a 3rd party FTP Server program. Enter the path to the folder that is receiving the FTP files, which will be stored in the Streams archive, renamed according to the "Files" rules, but otherwise unmodified.

Gecko

By default both the Gecko and Streams use port number 58772 for communication. Your firewall or IT administration may require you to use an alternative port number, which would need to be changed in the Gecko's communication adaptor. If you have two or more Gecko recorders on a multi-serial-port-to-network adaptor you will need to give each of them unique port connection numbers. In this case Streams allows you to set a range of ports to which it will listen for connections.

You can also enable local serial port monitoring. If your Gecko is connected to a serial port on your Streams computer (either RS232-to-USB or a direct RS-232 port), Streams will scan all serial ports every 30 seconds to check for data. Note that this may interfere with other RS-232 devices connected to your computer, so we recommend that this mode is only used for testing or on a dedicated Streams computer.

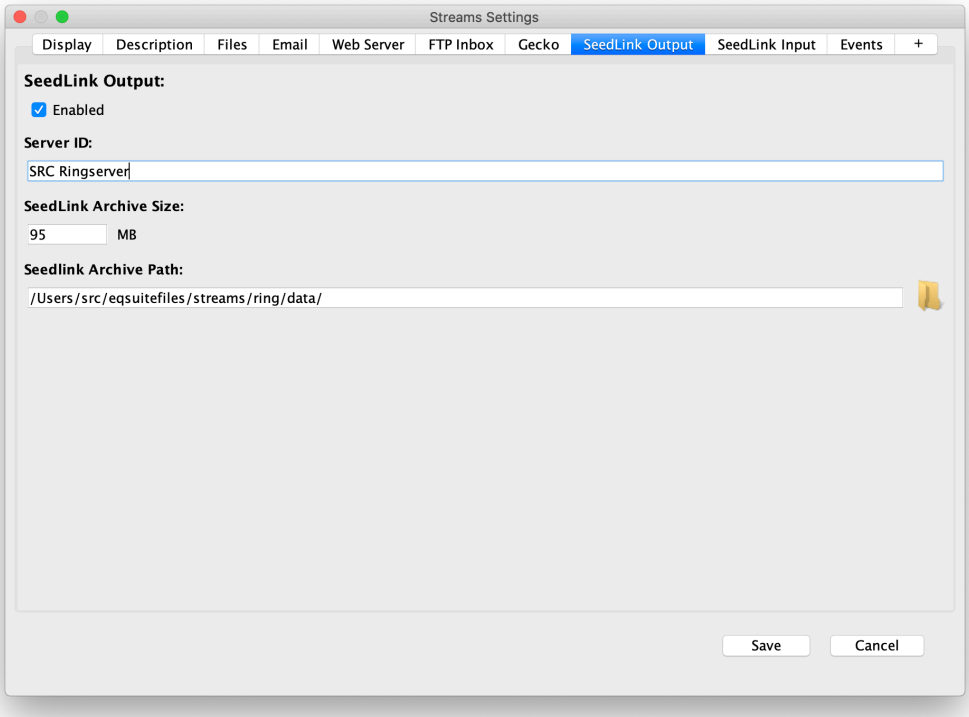


Streams ask a connected Gecko for a setting or status parameter every few seconds. It takes about 2 minutes to get a full set of this meta data. If the request frequency setting is Zero, Streams will start the meta data request loop again immediately. If you wish to limit the frequency of these updates (if you have limited bandwidth or data allowance on your Gecko connections) you can increase the request interval to multiple minutes (e.g. 60 for once an hour, 1440 for once a day, etc).

Note that your communications device may use additional bandwidth that may contribute to data usage beyond that required by the Gecko and Streams.

SeedLink Output (Linux & macOS only)

Streams for Linux and macOS can act as a SeedLink server, which means that other seismic software systems can subscribe to a feed of any incoming data.

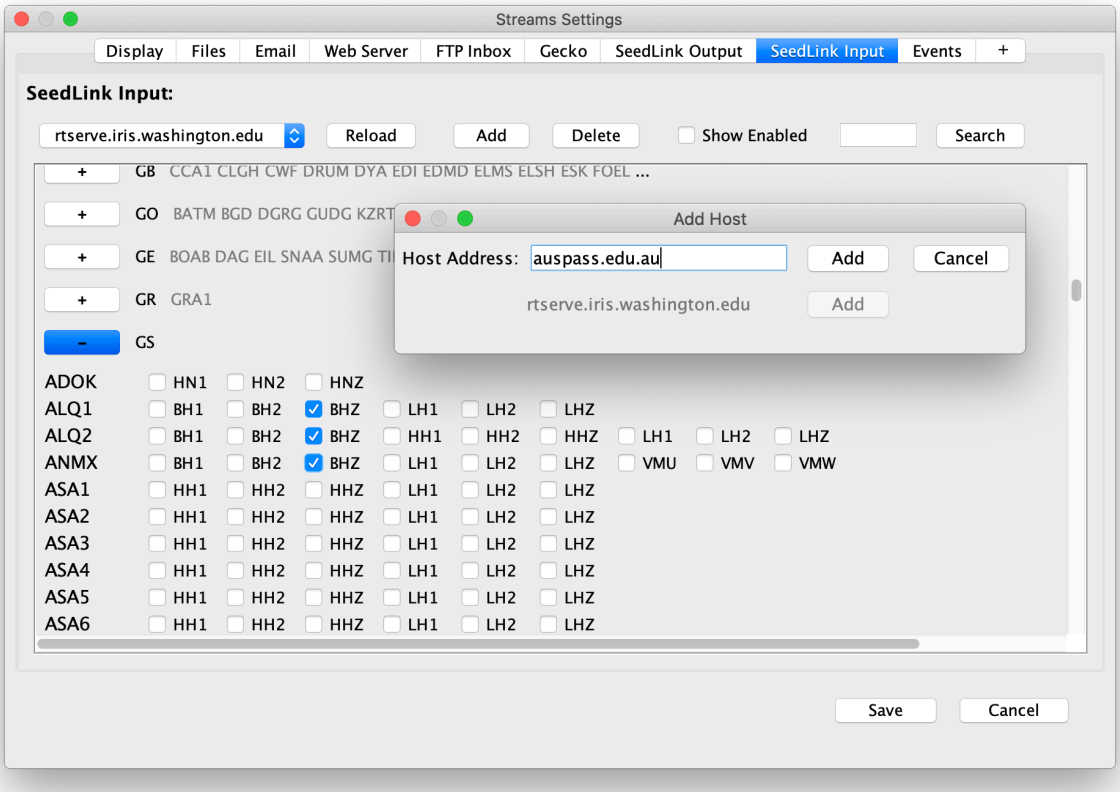


You can set a Server ID (name) and define the amount of space on your hard drive that you wish to allocate for this ring buffer. When the buffer is full, the oldest data will be overwritten. Note that this does not affect the data stored in the Streams data archive (as defined under the Files tab).

You can also define location of the SeedLink ring buffer on your computer's storage drive, which by default is: **user/eqsuitefiles/streams/ring/data**

SeedLink Input

In addition to acting as the interface to your Gecko recorder network, Streams has a handy feature that allows you to subscribe to real time data feeds from other SeedLink servers. Many seismographs have SeedLink servers built-in to their communication links (such as the optional GeckoLink adaptor for our Gecko recorders). You can use Streams to pull data from your remote stations this way, or to pull data from other network operators who have publicly accessible SeedLink servers.



Click on the **[Add]** button to add a SeedLink server address to your list. We have built in a shortcut to add the IRIS SeedLink data server, or you can type in the IP address or domain name of another SeedLink server.

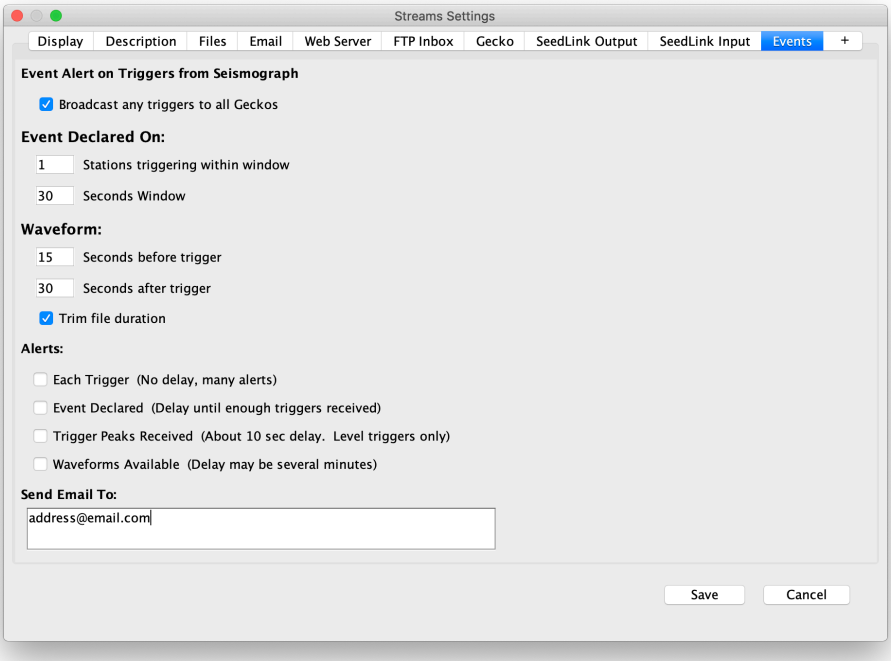
After adding the server, Streams will gather a list of available networks (a two-letter code) hosted on this server. Expand each network by clicking on the **[+]** button to see the available stations and channels, then tick the box next to the data channels that you wish to receive in near real time. Click **Save** to send the channel feed requests to the server. It may take a minute or two for the data feed to start.

To see just the stations that you have previously selected, tick the **Show Enabled** box, which allows you to quickly manage your existing subscriptions. To find a particular network or station code, use the Search box to filter the display window.

Event Triggering

Because Streams can receive data from multiple Gecko stations, if those stations have a Level trigger or STA/LTA trigger process enabled, a trigger notification is immediately sent to Streams, so it is then possible to declare an "Event" based on some simple rules.

An **Event** is declared when a certain number of stations trigger within a certain time period. Let's say you have a network of 5 stations spread over a 100km^2 area. You may want to be alerted when 3 of those stations trigger within a 5 second window as it is likely to be an earthquake. This avoids false alarms if there is concurrent noise at up to two stations.



When a trigger notification is received by Streams, if the Broadcast box is ticked, all Gecko stations will send in as much pre-trigger data as they have immediately available, and stream data after the trigger time for at least the number of seconds defined by the **Waveform** time settings. You can optionally trim the resultant trigger file to this time span, or leave the box uncheck for all the data sent by the recorders. Very high sample rate data may be delayed.

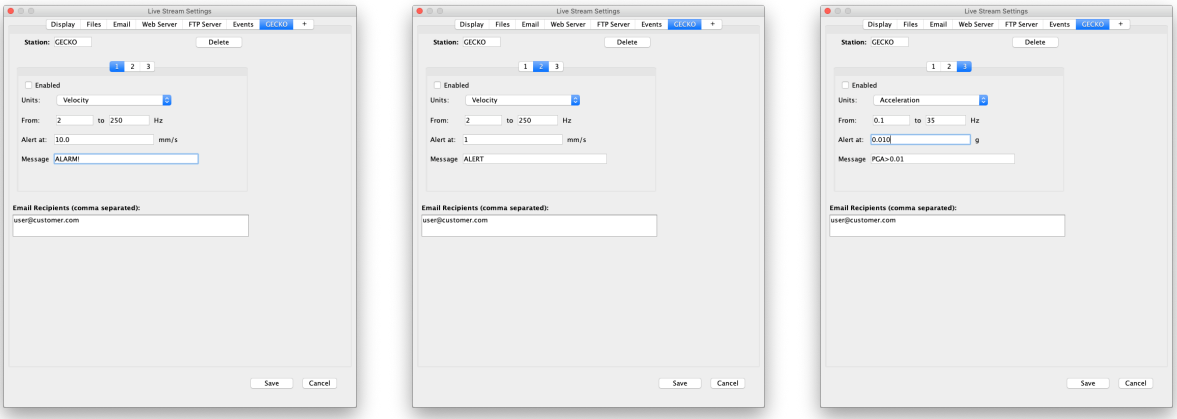
An email can be sent at some or all stages of the triggering process. You can define the recipient email address (or addresses, separated by a comma and/or a space) in the text box at the bottom. An email will be sent when any of the enabled **Alerts** are true:

- every time a trigger is received from a station (no delay, many alerts)
- when an event is declared (when the Event declaration conditions become true)
- 10 seconds after a Gecko trigger, showing the peak motion in that period
- when the event waveforms are available for attachment to the email

Station Triggering

By clicking on the **[+]** button tab, a new tab will be added and automatically named as one of the incoming stations. You can edit the station code if Streams has not correctly predicted the code of the station that you want to add. Continuous data streaming from this station will be analysed by Streams so that you can customise trigger parameters.

This "station" trigger allows you to define up to three Level-trigger rules for a station that is sending in a continuous stream of data. Streams will analyse the incoming real time continuous data, and then generate a message when the conditions of the rule are true. The connected recorder does not need to have triggering enabled, but it needs to be streaming at least one channel of continuous data.



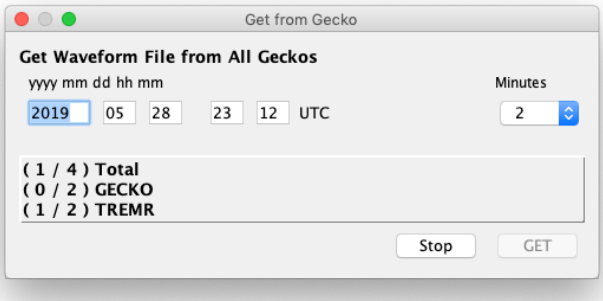
Each of the three rules can be enabled or disabled, and the data can be processed as acceleration, velocity, or displacement, regardless of the original ground motion units of your sensor. You will define a trigger level in m/s^2 or *g* (for acceleration, according to your "units" preference), in mm/s for velocity, and in mm for displacement. You can also define the trigger frequency band. For example, you may be receiving velocity data but wish to trigger if signal exceeds an acceleration of 0.01g between 0.1Hz and 35Hz (e.g. for structural monitoring).

You can add a short message to prefix the email before it displays the trigger level. For example, you may write "ALERT" for 0.01g on one rule and "ALARM!" for 0.1g on another. These messages will be sent to the recipient's email address (or addresses, separated by a comma and/or a space) in the text box at the bottom.

Amplitude

This button toggles the amplitude scaling of the channels between Dynamic and Fixed. The fixed amplitude is defined under Streams > Settings > Display. By default a channel will dynamically scale to the maximum signal in the display window.

Download



Clicking this button brings up a window that allows you to request data from all connected Gecko recorders from a certain time for up to 3 minutes. In the Gecko, data is stored in files that are 1-minute long, so each file is requested and queued in the progress bar.

When the data download is complete, the requested data is displayed in a Waves window.

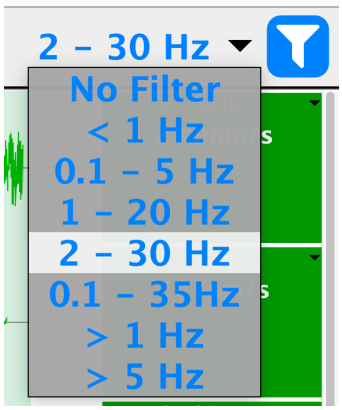
The "Close" button changes to a "Stop" button during the download process. If you press "Stop" before the download is complete, any data that has been downloaded is displayed in a Waves window. This window must remain open during the download process.

Waves

We have built a copy of Waves into Streams to allow you to quickly bring up the currently displayed data for data analysis using the tools available in Waves. Please refer to the Waves user manual for a full description of the data analysis features. You must save this waveform to a new file if you wish to retain any changes that you make during data analysis.

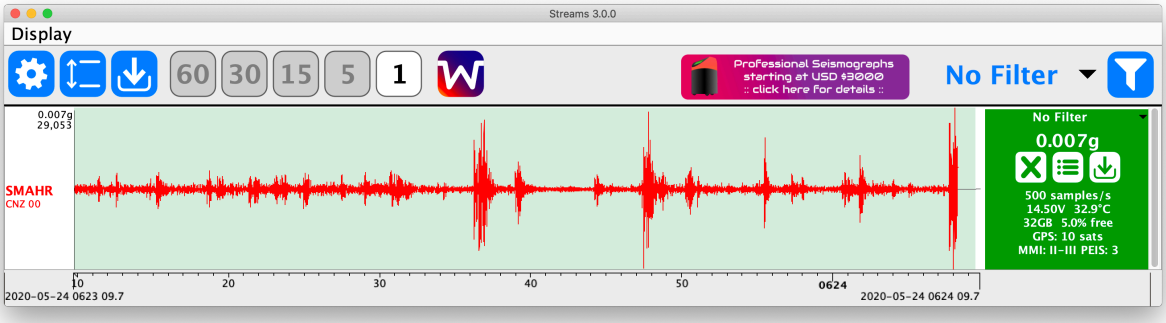
Filter

This button applied the selected frequency filter to all channels. Select pass band from the list and the data will be filtered for display. Data is stored to the archive in its original form, unfiltered. To remove the filters from all channels, select "No Filter" and then click the button.



Channel Information Box

At the right-hand end of the channel display you will see a coloured box, normally green, that displays the current peak value of the displayed data, along with the filter status. If you place your pointer over the box, additional controls and information will appear.



Controls & Information

At the top of each box is the individual channel's filter control. Below this, the peak ground motion value for the displayed period is displayed in large text. If the sensor is an accelerometer, the estimated equivalent Intensity in MMI and PEIS is displayed at the bottom of the information block.

Clicking the button will hide that channel from the live data display.

Clicking the button will bring up data download request for this Gecko.

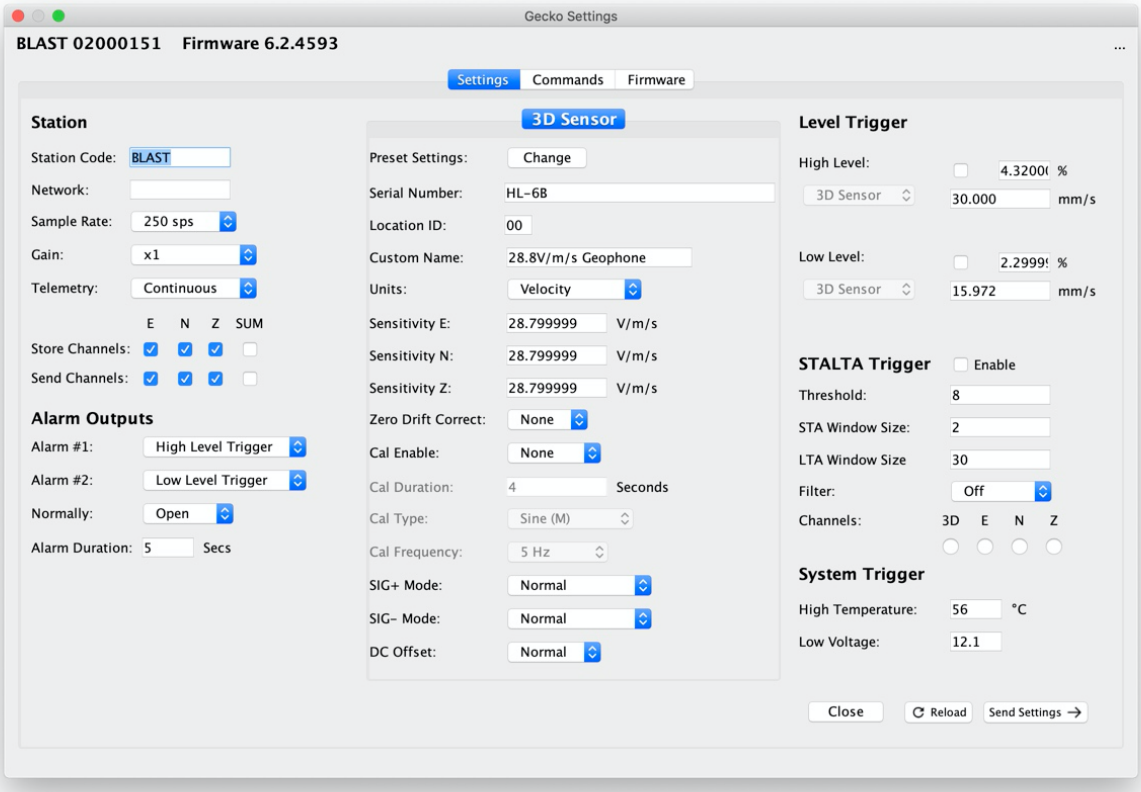
If a control button is greyed out, it means that it does not apply to this channel or station.

Below the control buttons, some Gecko state-of-health information will be displayed, including the data sample rate, supply voltage, CPU temperature, SD card storage size and free space available, and the number of GPS satellites visible.

Gecko Settings

Click on the  button to show all settings that you can remotely edit in the Gecko recorder.

By default, these settings are updated every few seconds by the Gecko, so you can use the Reload button to see any settings that have not yet been updated.



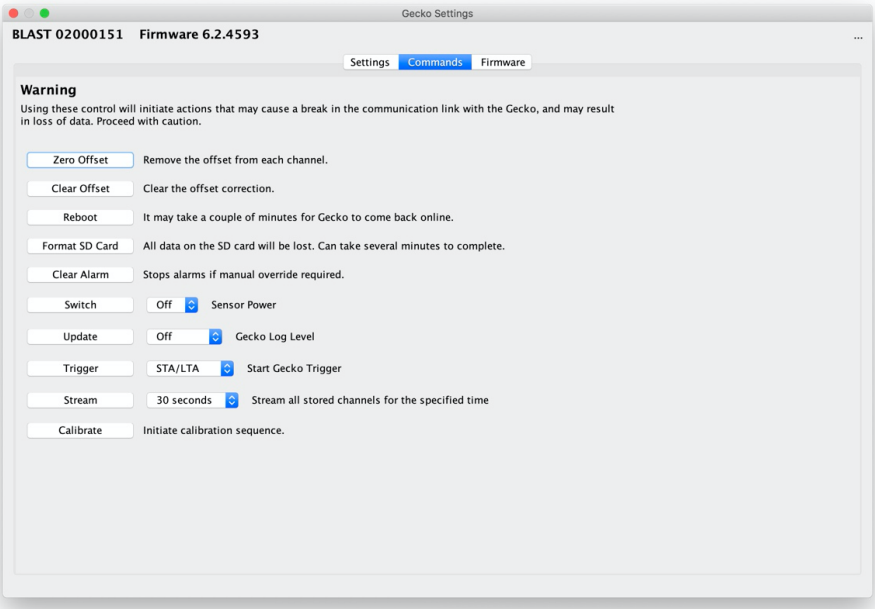
You can change any setting (please refer to the Gecko user manual to understand the functions) and then click on the "Send Settings" button to send the commands to the Gecko. It may take a few seconds for the setting change to take effect in the Gecko.

If you would like to select a sensor from a list of popular sensors, click on the **Change** button to reveal a drop-down menu. Selecting a sensor will fill all of the sensor settings with the default values for that model. You can then edit the fields to customise the sensor, e.g. enter the calibrated channel sensitivities. If you have a Gecko with an internal 3D sensor you will not be able to edit the 3D sensor settings remotely as these have been set at the factory.

Note that you cannot edit the data telemetry settings as this could potentially break the connectivity between the Gecko and the Streams computer. These changes can only be made through the Gecko LCD-keypad user interface.

Gecko Commands

There are a number of actions that you can initiate remotely in a connected Gecko. These functions are described in the Gecko user manual. Some actions can result in a loss of data or connectivity with your Gecko, so proceed with caution, particularly when using the **Reboot** and **Format SD Card** options as both actions will cause a temporary break in communications with the Gecko.



Firmware

You can upload a "Rasbora.bin" firmware upgrade file to a Gecko remotely. All settings will be retained after the update. Data recording will be suspended during the upload process. The link to the Gecko will be lost temporarily as it restarts to upgrade the firmware.

SRC Research & Development

Streams is free for anyone to download and use with any compatible seismic data source, of which there are thousands freely available. You can support the SRC by considering purchasing our recorders, seismographs, and accelerographs which offer observatory-grade signal digitisation and continuous recording, with a simple built-in user interface, at an affordable price. Go to https://www.src.com.au/promotion/ for more information.

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