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

Live Stream

REALTIME DATA ACQUISITION AND DISPLAY SOFTWARE

PRODUCT USER MANUAL



Table of Contents

Installing Live Stream.....	1
System Requirements.....	1
Application Installer.....	1
Live Stream Display Window.....	1
Features	2
Gecko to Live Stream	2
Gecko Telemetry Protocol	3
Tool Bar	4
Display Menu	4
Show Alerts.....	4
All Channels	4
Vertical Channels	4
STATION.....	4
 Settings	5
Display	5
Files	6
Email	7
Web Server	7
FTP Inbox.....	7
Gecko	8
SeedLink Server	8
Events	9
Station Triggering	10
 Amplitude	11
 Download.....	11
 Waves	11
 Filter	11
Channel Information Box	12
Control Buttons	12
Gecko Settings	13
Firmware	13

Installing Live Stream

System Requirements

Live Stream version 2.2 is for Windows, Linux (Ubuntu, CentOS, and Raspian) and macOS.

Live Stream is a Java application, which means that the Java Runtime Environment (JRE) needs to be running on your computer. You can install Java for free by web browsing to www.java.com and following the download prompts.

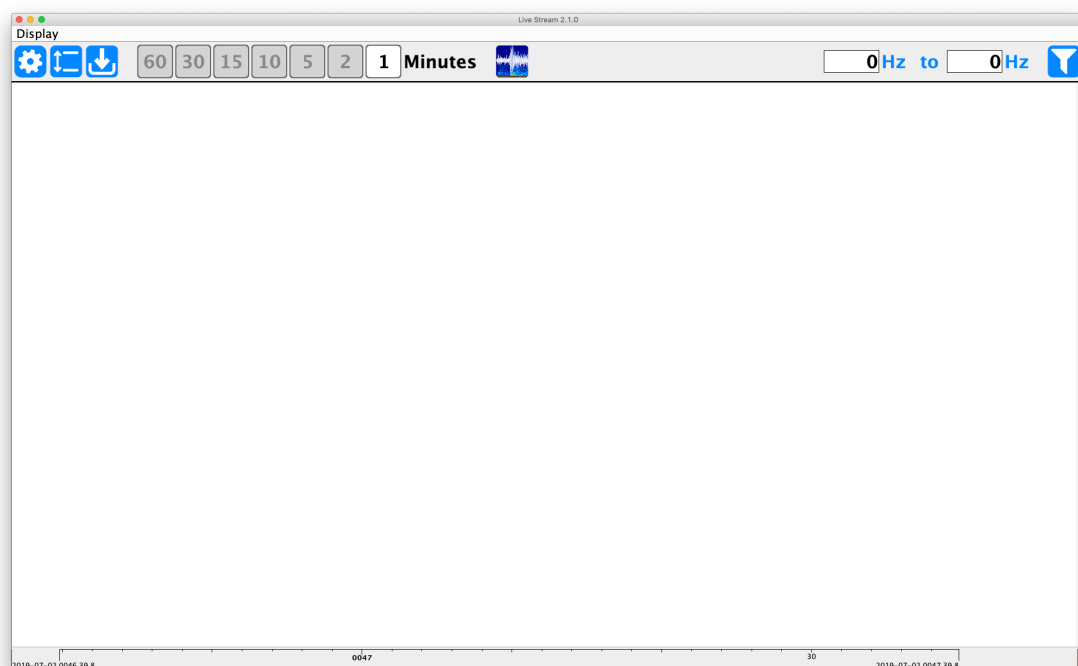
Application Installer

When you run the Windows installer, a copy of the application will be installed on your computer under **Program Files > src > livestream** and a shortcut is created on your desktop. The macOS and Linux version contains 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 "livestream" folder, and a folder called "**Data Archive**" ("lsarchive" in earlier versions) which is where all data received data by Live Stream is stored. Files relevant to Waves also reside in eqsuitefiles.

Live Stream Display Window

When Live Stream starts up, you will be presented with the window below. For users of our Waves waveform viewer, the layout should seem familiar, except with a live moving timeline.



Features

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

Live Stream 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.

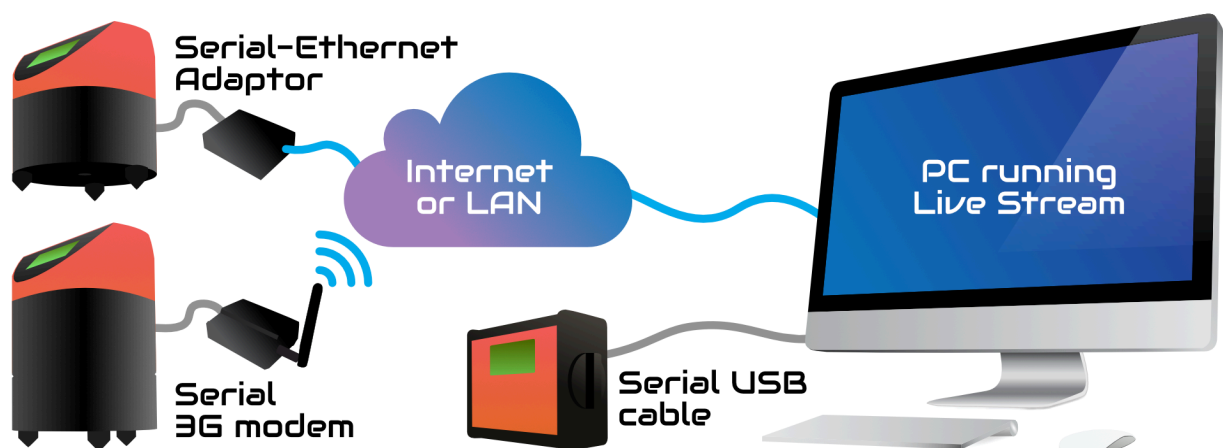
Live Stream can also analyse the incoming data in real time and generate alerts based on user-defined parameters, which appear on screen and can optionally be sent as email messages. Live Stream also gives you the ability to remotely configure any connected Gecko recorders, as well as upgrade their firmware.

Gecko to Live Stream

We've designed the Gecko to be as simple as possible to set up for data telemetry. If you're using a 3G modem, all you need to do is set up the IP address or domain name of the computer that Live Stream is running on, along with your 3G carrier access point name (APN). The Gecko will open a connection to Live Stream using the standard port (58772) and data will start to flow.

Streaming data using a Perle or Netcomm serial-to-Ethernet adaptor requires a laptop and web browser to configure the Live Stream server address and port number. The setup procedure for these devices is relatively simple and is documented in the Gecko user manual.

A Gecko-to-USB cable is available for direct connection between the recorder and the Live Stream computer. Live Stream 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.



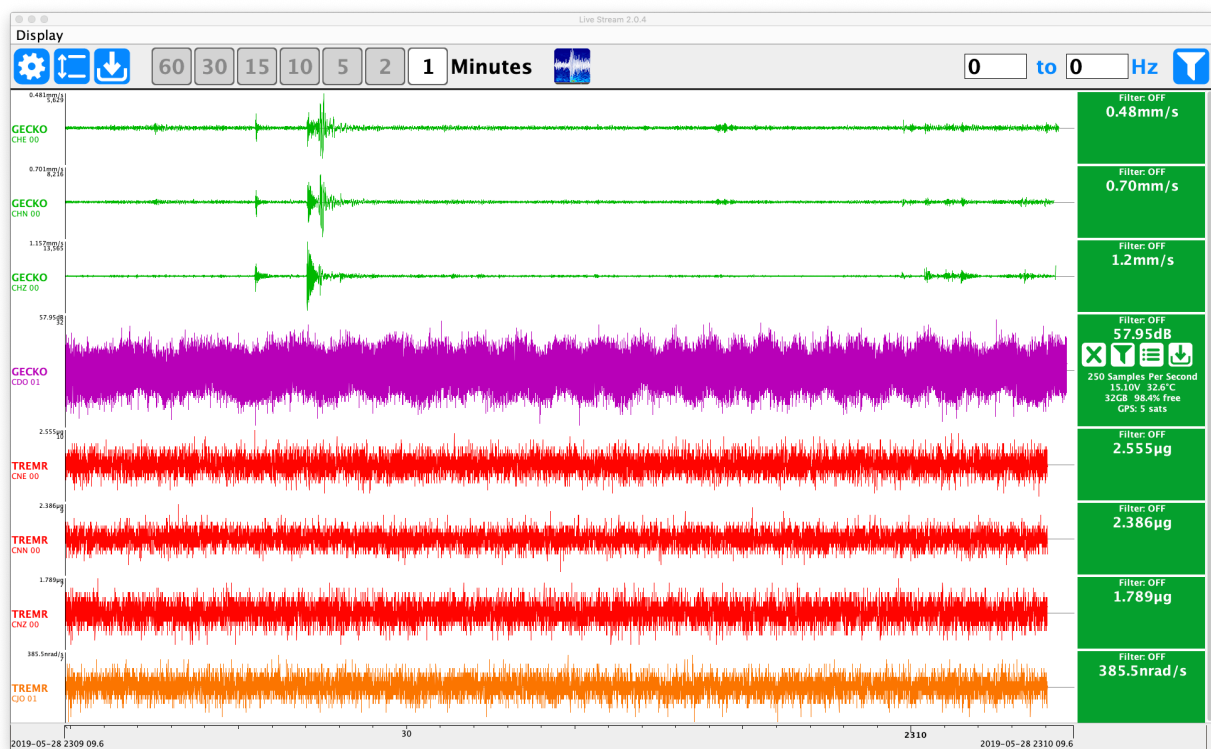
Gecko Telemetry Protocol

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 packets and sent to a routine called Kelunji Hub which is built into Live Stream.

So, how does a serial port connect to the Internet, you may ask? This is where the 3G modem or serial-to-Ethernet/WiFi adaptor comes in. These devices open a TCP (Transmission Control Protocol) socket connection to a remote computer, where Live Stream is running and “listening” on port 58772 for incoming signals. When a connection is established by a Gecko, Live Stream 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 Live Stream on the same port as the computer treats each connection separately.







Kelunji Hub can also operate on a cloud-based computer, but instead of feeding data to the Live Stream application user interface, it feeds the data into our eqServer processing system which allows web-based remote data display and Gecko configuration.

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 telemetry connection to a modern PC, a Gecko should be able to stream multiple channels of data continuously at 500sps, and possibly 1 channel continuously at 4000sps.



Tool Bar

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

	Live Stream Settings	Modify settings controlling archive location, email and more. Also accessible with shortcut Ctrl-comma
	Amplitude Scaling	Toggle amplitude display from auto-scaling to fixed amplitude scale, as defined in Live Stream 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 Live Stream Event and Station alert criteria will be displayed here and on screen.

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

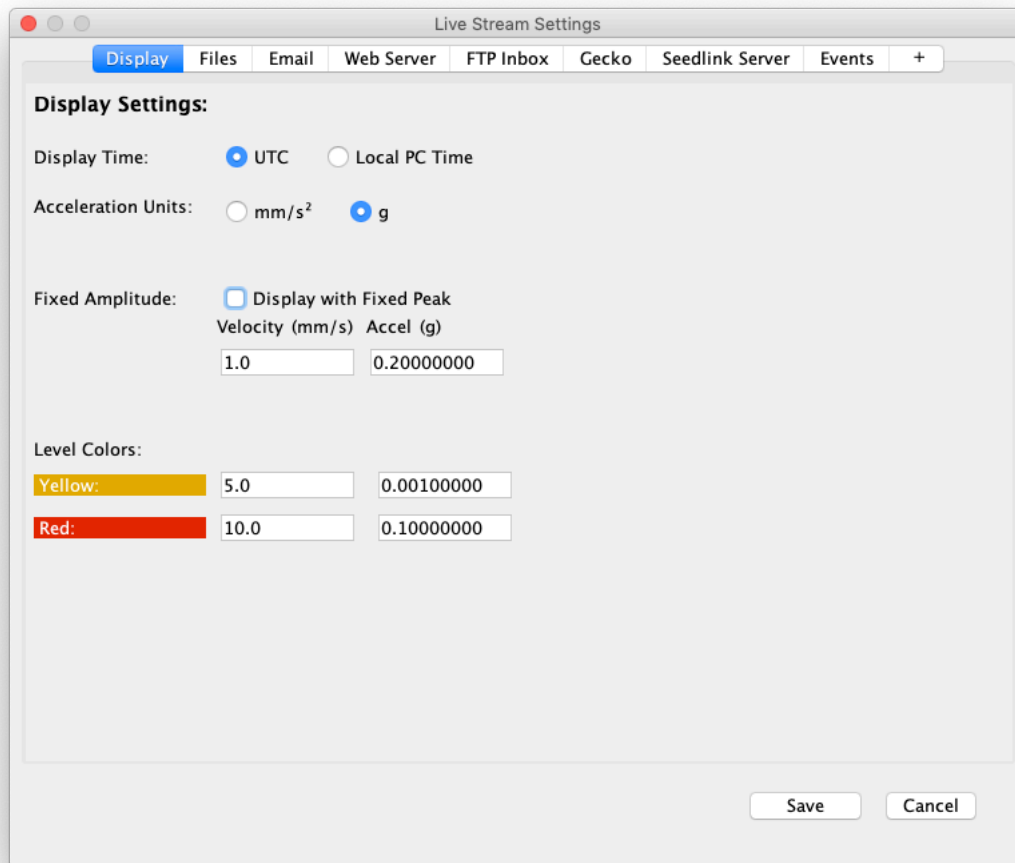
Select this to only display the vertical (Z) channels from all stations.

STATION

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* according to your preference.

The amplitude scale in Live Stream 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.

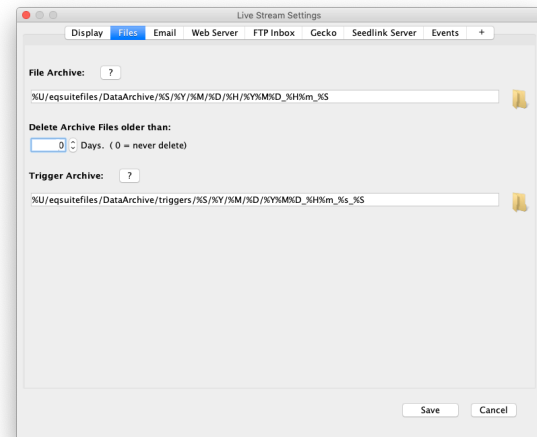
The coloured boxes at the right-hand end of each channel can be colour-coded according to the currently displayed peak signal level. Live Stream has two levels, yellow and red, which could be used to display a visual warning level or alarm level. These levels can be defined in velocity or acceleration.

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 **Data Archive/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 modify the archive location and the 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:



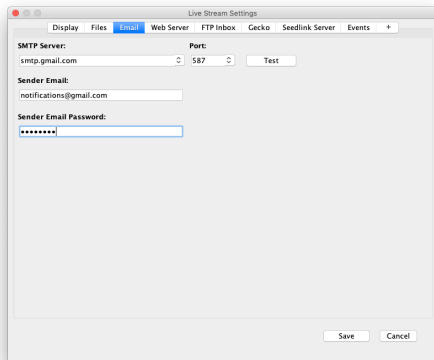
- **%U** - User home directory as defined by your operating system. %U will return the path from the root directory. Alternatively you can start the archive location at a fully qualified path, e.g. “/archive/” or “C:/Users/me/seismic-archive”
- **%N** – Network Code
- **%S** – Station Code
- **%I** – 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  icon at the end of the line will open an operating system file browser window of that folder.

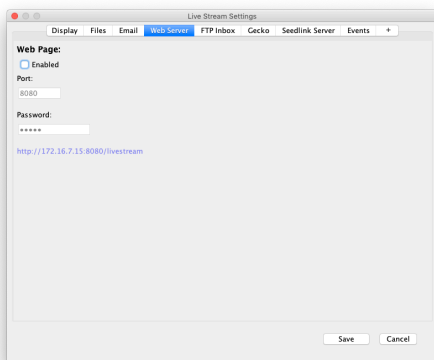
To avoid filling up your hard drive with data, you can choose to only keep a certain amount of time in the archive. Under the **Delete Archive Files older than:** type in a number of days of data to keep, or set it to zero to never delete old files.

Email



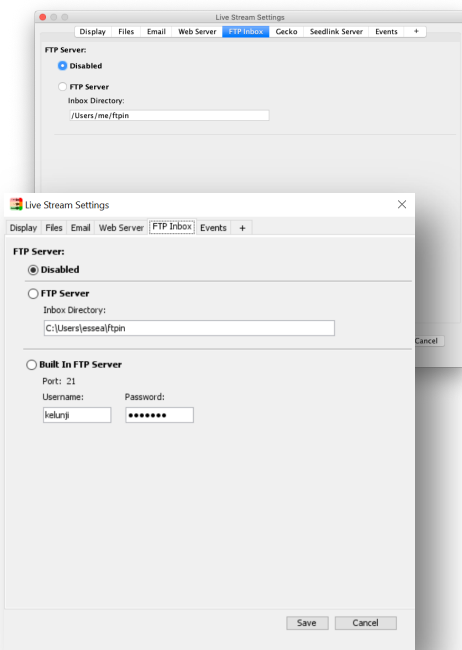
The Email settings defines the mail server and account that will be used to **send** mail from Live Stream. Contact your mail host for SMTP server details such as the SMTP address, port and credentials. If you are using a Gmail account, you will need to log in to Gmail using a web browser on the Live Stream computer once for Google to authorise that PC as a valid sender. Live Stream uses a basic email protocol, so your account will need to “allow less secure apps” to send emails.

Web Server



If you enable the web server, you can view the realtime waveform window from a remote computer by typing the Live Stream computer’s public IP address into a web browser. You can set a custom port (port 80 is the normal web port, 8080 a common alternative) and you can define a password to restrict access to the page (default is **gecko**). The image in the web browser is updated every few seconds automatically.

FTP Inbox

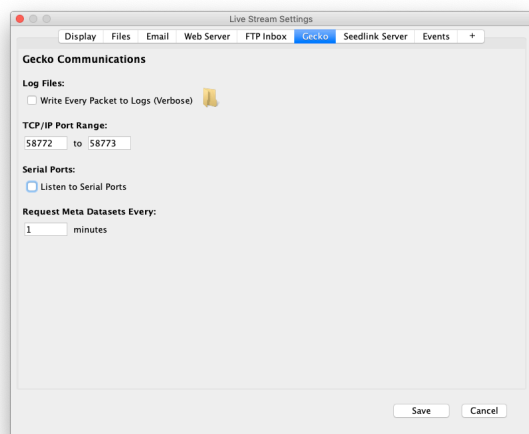


You can send files from other sources into Live Stream via FTP. If Waves can open the file, Live Stream can process it. FTP data reception is disabled by default.

Windows users can use Live Stream’s in-built FTP Server or a 3rd party FTP Server (see next paragraph). When your remote data source connects to Live Stream’s built-in FTP server with the user-defined login and password, it will ignore any sub directory destination defined by the sender and process all incoming files.

If you are using Linux and macOS you will need to run a 3rd party FTP Server program. Enter the path to the folder that is receiving the incoming files. Files received via FTP will be stored in the Live Stream archive, renamed according to the “Files” rules, but otherwise unmodified.

Gecko

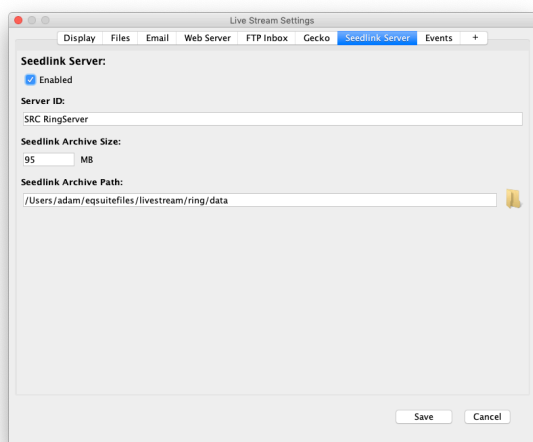


By default the Gecko and Live Stream use port number 58772 for communication. Your firewall or IT administration may require you to use an alternative port number, which would need to be changed in the Gecko/communication adaptor, and if you have two or more Gecko recorders on a multi-serial-port-to-Ethernet adaptor you will need to give them unique port connection numbers. In this case Live Stream 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 Live Stream computer (either RS232-to-USB or a direct RS-232 port), Live Stream 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 Live Stream computer.

Live Stream will periodically ask a connected Gecko for all of its settings and status information – one upon connection, and every minute thereafter. 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 frequency to multiple minutes (e.g. 60 for once an hour, 1440 for once a day, etc).

SeedLink Server



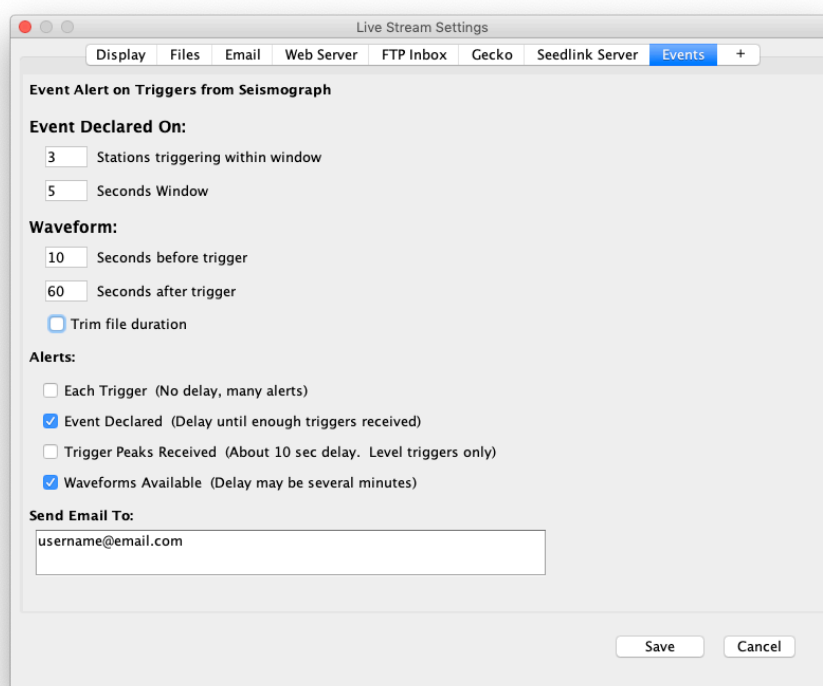
Version 2.2 of Live Stream for Linux and Mac turns Live Stream into a SeedLink server, which means that other seismic software systems can subscribe to a feed of any incoming data. You can set a Server ID (name) and define the amount of space on your hard drive that you wish to allocate for this ring buffer. When the buffer is full, the oldest data will be overwritten. Note that this does not affect the data stored in the Live Stream data

archive as defined under the Files tab. You can also define location of the SeedLink ring buffer, which by default is the user/eqsuitefiles/livestream/ring/data folder.

Events

Because Live Stream can receive data from multiple stations, if those stations have a Level trigger or STA/LTA trigger process enabled, a trigger notification is immediately sent to Live Stream, 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 5 stations spread over a 10km x 10km 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 just one or two stations.



When a trigger notification is received by Live Stream, it will request minute-long data files from the SD cards of all connected Gecko recorders for some number of seconds before and after the trigger time, as defined by the **Waveform** pre-trigger and post-trigger time settings. You can optionally trim the resultant trigger file to this time span, or leave the box unchecked to show the whole minute files extracted from the Gecko recorders.

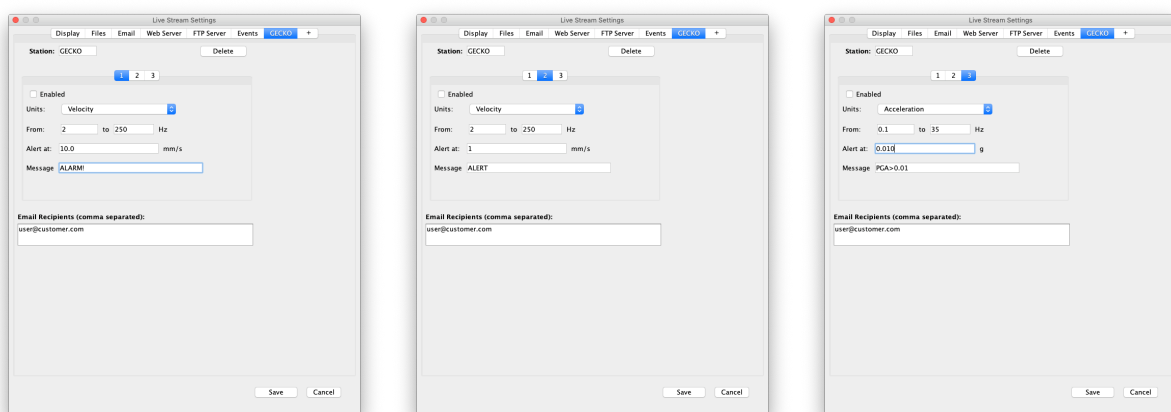
An email can be sent at some or all stages of the triggering process. You can define the recipient email address (or addresses, separated by a comma and/or a space) in the text box at the bottom. An email will be sent when any of the enabled **Alerts** are true:

- 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 “Level” trigger, showing the peak motion in that period
- when the event waveforms have been received from the remote Gecko SD cards

Station Triggering

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

This “station trigger” allows you to define up to three rules for Live Stream to generate a Level trigger message by analysing incoming real time continuous data. 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 .

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 Live Stream > 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.

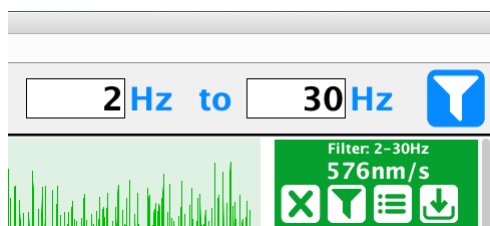
When the data download is complete, the requested data is displayed in a Waves window.

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 Live Stream 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.

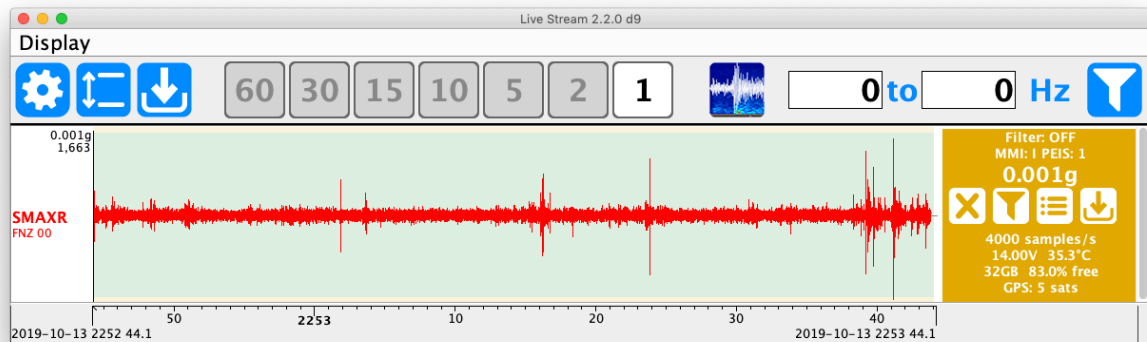
Filter



This button toggles the frequency filter on or off for all channels. Enter the pass band in the text boxes (or leave as zero to not set an upper or lower limit) and the data will be filtered for display. Data is stored to the archive in its original form, unfiltered.


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.



Control Buttons

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


Clicking the  button will toggle the band pass filter on or off for this channel

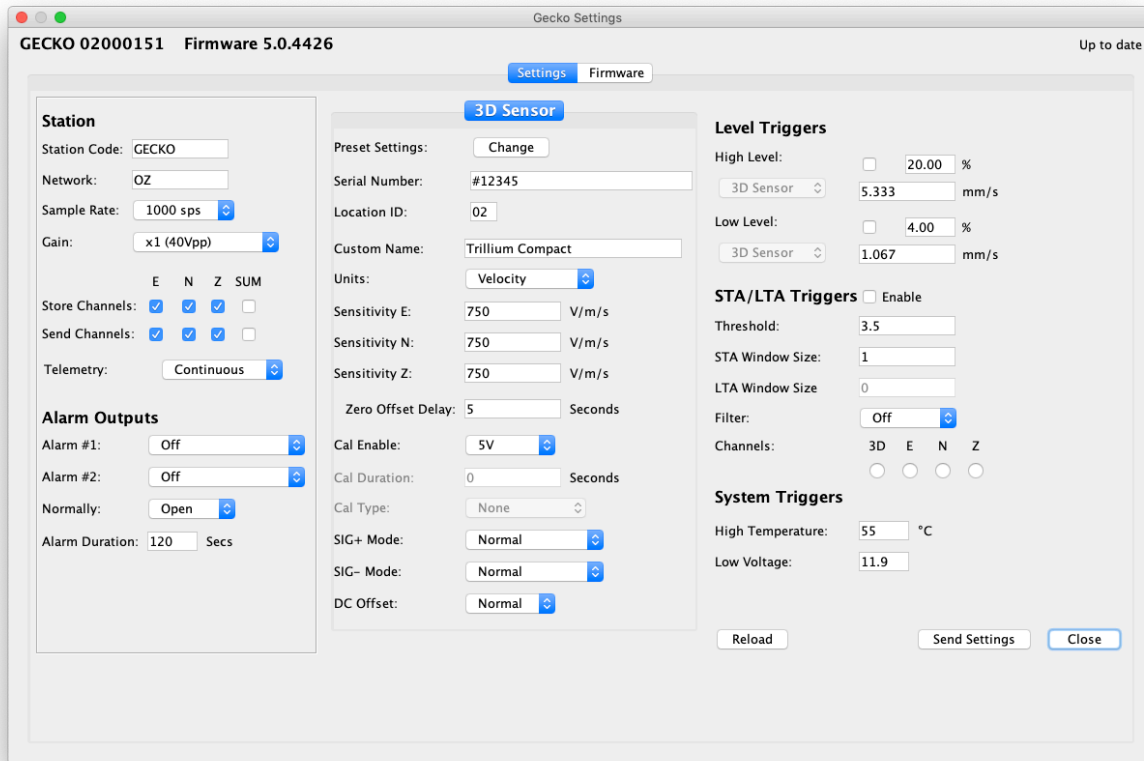
Clicking the  button will bring up data download request for this Gecko.

If a control button is greyed out, it means that it does not apply to this channel. The Filter button will be greyed out for SUM channels (the 3D vector sum of a triaxial set of channels, which can be streamed from a Gecko) and the Gecko Settings and Download buttons will be greyed out if the data is coming from another type of recorder (i.e. via FTP).

Below the control buttons, some Gecko state-of-health information will be displayed, including the data sample rate, supply voltage, CPU temperature, storage size and 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.



The screenshot shows the 'Gecko Settings' application window. The title bar indicates 'Gecko Settings' and the status bar shows 'Up to date'. The main window displays the 'Settings' tab for a device identified as 'GECKO 02000151' with 'Firmware 5.0.4426'. The settings are organized into several panels:

- Station:** Includes fields for Station Code (GECKO), Network (OZ), Sample Rate (1000 sps), Gain (x1 (40Vpp)), and Telemetry (Continuous). It also has checkboxes for Store Channels (E, N, Z, SUM) and Send Channels (E, N, Z, SUM).
- Alarm Outputs:** Features fields for Alarm #1 and #2 (both set to Off), a Normally (Open) dropdown, and an Alarm Duration (120 Secs) field.
- 3D Sensor:** A sub-panel with a 'Change' button for Preset Settings. It includes fields for Serial Number (#12345), Location ID (02), Custom Name (Trillium Compact), Units (Velocity), Sensitivity E, N, and Z (all 750 V/m/s), Zero Offset Delay (5 Seconds), Cal Enable (5V), Cal Duration (0 Seconds), Cal Type (None), SIG+ Mode (Normal), SIG- Mode (Normal), and DC Offset (Normal).
- Level Triggers:** Includes High Level and Low Level settings with checkboxes and numerical values (e.g., 20.00 %, 5.333 mm/s).
- STA/LTA Triggers:** Includes an Enable checkbox, Threshold (3.5), STA Window Size (1), LTA Window Size (0), Filter (Off), and Channels (3D, E, N, Z) with radio buttons.
- System Triggers:** Includes High Temperature (55 °C) and Low Voltage (11.9) settings.

At the bottom right, there are buttons for 'Reload', 'Send Settings', and 'Close'.

You can change any setting (please refer to your 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 Live Stream computer. These changes can only be made through the Gecko LCD-keypad user interface.

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.

Gecko Seismographs and Accelerographs



GECKO COMPACT



GECKO RUGGED

Digitisers
To Record
Any Sensor



BLAST or SMA

Portable
Vibration
Sensors



SMA-HR



TREMOR or PRISM

Professional
Earthquake
Sensors

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