SWARM

Seismic Wave Analysis and Real-time Monitor:

User Manual and Reference Guide

Version 2.6.4

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# Introduction

## About

SWARM, Seismic Wave Analysis and Real-time Monitor, is a Java application designed

to display and analyze seismic waveforms in real-time. SWARM is a functional replacement to the traditional helicorder, but also has many other tools for visualizing wave forms, such as frequency spectra plots and spectrograms. Other features include ability to obtain station metadata for plotting on map, and support for IRIS DMC connections. Recent additions include ability to view NEIC events and do basic picks.

SWARM was developed at the Alaska Volcano Observatory (AVO) in 2004 and is still used at various volcano observatories around the world. The latest version of SWARM can be obtained from <https://volcanoes.usgs.gov/software/swarm/download.php>.

# Getting Started

## System Requirements

SWARM is platform independent (will run on any operating system) but requires a graphical display and a Java Virtual Machine 1.6 or greater. Due to the large volume of data and complex calculations performed it is recommended to run on SWARM with modern specifications for memory and processing speed. The less memory and processing speed the computer has, the more likely that SWARM’s performance is affected when pulling and analyzing large data sets. Minimum screen display of 1024 x 768 is also recommended.

## Installing SWARM

To install SWARM, unzip the download swarn-x.y.z-bin.zip file downloaded from the [USGS SWARM website](https://volcanoes.usgs.gov/software/swarm/download.php). In Windows, your unzipped swarm-x.y.z directory will look like this:



Figure 1 Swarm Directory Contents

## Running SWARM

On Windows, double clicking on swarm\_console.bat will open the SWARM user interface. If nothing happens, you can run the application from a command (or DOS) prompt to see if there are any errors that can be used for troubleshooting. On Linux or Mac operating systems, you will need to execute swarm.sh from the terminal (command-line).

# Data Sources and Channels

## Introduction

After starting SWARM, a panel will be visible on the left side of the main screen. This is the Data Source Chooser and Channel Selector. It’s possible to adjust the size of the two panels by adjusting the split line in the center, either by dragging with the mouse or clicking on one of the small arrows.

The Data Source Chooser, the top half of the panel, is used to select the source of the waveform or helicorder data. The box contains the list of all available data sources, both ones that have been used before and new ones that are created.

The Channel Selector, the bottom half of the panel, is used to select a channel, either

the waveform or the helicorder. Once a data source is selected, the Channel Selector will

be populated with the available channels. The contents of both theWaves and Helicorders

lists depend on the data available from the selected data source.

Figure 2Data source chooser and the channel selector

## General Usage

SWARM is preconfigured with AVO Winston Wave Server. To add another data source click on the ‘New data source’ icon C:\Users\Diana\git\swarm\src\main\resources\images\new_server.gif. Existing data sources can be modified by clicking on the ‘Edit data source’ icon C:\Users\Diana\git\swarm\src\main\resources\images\edit_server.gif. The next icon  will let you collapse the data source trees. To remove an existing data source, select the data source to delete and click on ‘Remove data source’ icon C:\Users\Diana\git\swarm\src\main\resources\images\new_delete.gif. A data source can be refreshed by clicking on it and selecting the ‘Refresh data source’ icon C:\Users\Diana\git\swarm\src\main\resources\images\refresh.gif.

The C:\Users\Diana\git\swarm\src\main\resources\images\closeview.gif icon in the upper right lets the user dismiss the whole data source chooser window if more space is desired. To get it back, type CTRL-D or go to the Window menu and select Data Chooser.

The icons associated with the different data sources have the following meaning:

* C:\Users\Diana\git\swarm\src\main\resources\images\server.gifA data server that the user manually added with the ‘New data source’ option.
* A data server that is broken; e.g. not responding.



* C:\Users\Diana\git\swarm\src\main\resources\images\wave_folder.gif Data channels available after opening a wave in a file (e.g. SEED, SAC format) from the File menu.

Double clicking on a data source will cause a channel tree to appear, listing the available channels. Double clicking on a channel will bring up a helicorder. Alternatively, it’s possible to select a channel (or channels, with CTRL- or Shift-click on Windows) and press one of the five buttons at the bottom of the data chooser:

* C:\Users\Diana\git\swarm\src\main\resources\images\helicorder.gif Opens helicorder views
* C:\Users\Diana\git\swarm\src\main\resources\images\clipboard.gif Puts waves on the clipboard
* C:\Users\Diana\git\swarm\src\main\resources\images\monitor.gif Puts waves on the real time monitor
* C:\Users\Diana\git\swarm\src\main\resources\images\wave.gif Opens waves in the real-time view window
* C:\Users\Diana\git\swarm\src\main\resources\images\earth.gif Shows channels on a map

## Data Source Types

Clicking on the ‘New data source’ icon will open a New Data Source dialog window. Currently supported data source types for SWARM are Winston Wave Server, Earthworm Wave Server, FDSN WS, and SeekLink Server.

### Winston Wave Server

Winston is a Java-based seismic wave server developed by USGS that provides data and plots to clients. It can be obtained from <https://volcanoes.usgs.gov/software/winston/>. Connection to Earthworm requires the IP address or host name of the server, port number, and communication time out in seconds.



Figure 3 Adding new Winston data source

### Earthworm Wave Server

Earthworm is an open-source software system used globally for regional local network seismology. Earthworm Wave Server is essentially the wave\_serverV module of the Earthworm system. Connection to Earthworm requires the IP address or host name of the server, port number, and communication time out in seconds.



Figure 4 Adding new Earthworm data source

### FDSN Web Services

International Federation of Digital Seismograph Networks (FDSN) provides RESTful web service interfaces for accessing wave data. See <https://www.fdsn.org/webservices/> for more information on the FDSN web services.

To add an FDSN web service data source, enter in the dataselect and station URL. A list of available web services can be found at <https://www.fdsn.org/webservices/datacenters/>. Then click on the Update button to get a list of Networks to choose from. You may choose to filter the data further with station, channel, and location information.



Figure 5 Adding new FDSN data source

### SeedLink Server

SeedLink protocol transmits data packets in 512-byte Mini-SEED records. IRIS Data Management Center (DMC) hosts a public accessible SeedLink server. More information on SeedLink and IRIS DMC’s server can be found at http://ds.iris.edu/ds/nodes/dmc/services/seedlink/. To connect to a SeedLink server enter in the IP address or host name, and the port.



Figure 6 Adding a new SeedLink data source

# Helicorder View