EEG@UCSB[1] Data Portal Tutorial

Introduction

The EEG@UCSB web data-portal gives anyone access to sensor waveform data from our seismic monitoring stations. This is data primarily from accelerometers, seismometers and pore-pressure transducers. The type, location, depth etc. of the sensors available depends on the site, this site specific information can be found under the site entry of the facilities tab at http://nees.ucsb.edu

Though we stream and record data continuously, the data made available for download is segmented into records spanning before, during and after actual local earthquakes[2]. The data accessible with the portal is processed based on the reported earthquakes from the region networks[3]. The selection of which earthquakes are significant (might result in useful site response waveforms) for a given site are based on the event magnitude and distance from the site.

The data-portal allows a user to search for data from events based on magnitude, distance, date-range, local maximum PGA (peak ground acceleration). On a site-by-site basis channel data for selected events can be added to a 'cart' for formatting and download.

To aid in the selection of interesting data approximate values for peak acceleration (obviously only relevant for acceleromoeter data!) and signal-to-noise ratio is listed for available data channels and a waveform viewer is available for previewing the data.

Various downloadable data formats are offered along with instrument, site and event metadata. When a 'cart' of selected channels for selected events is processed all data and metadata is packaged into a downloadable zip file.

A recent addition to the data-portal offers the option to post-process the raw accelerometer data available using the USGS "PRISM" tool.

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[1] Formerly NEES@UCSB

[2] Anyone who might need sections of continuous data or data for periods other than around actual earthquake activity should contact us directly to discuss their needs and how we might be able to offer such data.

[3] Regional networks are the folks that locate, size and publish earthquake event details. See https://ds.iris.edu/data/regional_networks.htm for some background

The web interface

The EEG@UCSB Data Portal is a web-based tool to search, view and download recorded earthquake waveforms from sensors (accelerometers, seismometers, pore-pressure transducers etc.) from permanently instrumented strong motion borehole stations.

Data is searched by earthquake magnitude and distance from a selected site, constrained by a selected time period. Events and available data based on the search criteria are listed in table, and displayed visually on a Google map.

On the map, the shaded region corresponds to the search area - a circle of radius "distance" (parameter in the upper left query section, in km) from the selected site. The sizes of the yellow event circles on the map are proportional to the corresponding earthquake magnitude.

Site Selection

To change to a different site than the default, simply click under the station header to see the drop-down menu. The data portal contains sites managed by EEG@UCSB, USGS, SCEC, and other agencies. (The screenshot below shows the DPK site being selected from the drop-down menu).

Clicking the "SITE" tab above the Google Map will display the sites's 'facility' page giving additional information about the station including geologic conditions, instrument layout and cross section etc.

Event Selection

As mentioned above, events are searched by specifying a radius (km) around the site, a min and max magnitude and a start and end date.

In the example below, with the WLA site selected, we search within a time range 1/1/2004 to 2/6/2018, within 150km of the site with a magnitude greater than 4.0 but less than 9.0

Here there are a total of 234 events that match these criteria. They are listed in a 10 page table[4] of results that can be accessed by entering a page number in the "Page [ ] of 10" box or using the left and right arrows around the page number details.

Hovering the cursor over an event, the corresponding yellow dot on the map turns red to highlight that event. Above the cursor is over the M7.2 event that can then be seen on the map.

As shown above the event results have been sorted in descending magnitude by clicking on the 'Mag' heading. Clicking the 'Mag' heading again would sort by ascending order. The list can also be sorted (asc/desc-ending) by date, depth or dist by clicking the corresponding header title.

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4   The number of table rows per page of results can be set by clicking the "show options" box and changing the 'events/page' value.

The full event list for an search can be downloaded into a CSV[5] file by clicking on the circle download icon in the header row to the right of the "Mag".

As a raw text file the first few lines of the example above would look like this – this format is easily imported into Excel etc.

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siteEvt,site,time,ml,depth,dist,azmith,lat,lon,peak,evid,epoch,id
3804,1,2010-04-04 22:40:42 (UTC),7.2,10,100.48,168,32.216,-115.3,1.20012e+09,14607652,1270420842,3804
7284,1,2009-12-30 18:48:57 (UTC),5.8,6,77.43,156,32.464,-115.189,7.3662e+08,14565620,1262198937,7284
4630,1,2010-06-15 04:26:58 (UTC),5.72,5.4,57.36,220,32.7,-115.921,5.63607e+08,14745580,1276576018,4630
4194,1,2010-04-04 22:50:17 (UTC),5.7,10,120.01,158,32.099,-115.048,4.42759e+07,31957759,1270421417,4194
13519,1,2012-08-26 20:57:58 (UTC),5.44,8.2,8.78,186,33.019,-115.54,1.90308e+09,15200401,1346014678,13519
4773,1,2010-07-07 23:53:34 (UTC),5.43,14,96.17,292,33.42,-116.489,1.60274e+08,10736069,1278546814,4773
3811,1,2010-04-04 23:15:14 (UTC),5.43,10,92.32,164,32.3,-115.26,3.33979e+07,14607836,1270422914,3811
```
(Note: some of the fields are internal mnemonic values ('siteEvt', 'site' and 'id'). Distance and depth are in km. Epoch is the event time expressed in seconds since Jan 1[st] 1970)

Advanced (Show) Options

Other options for searching and displaying results can be revealed by checking the "Show Options" box.
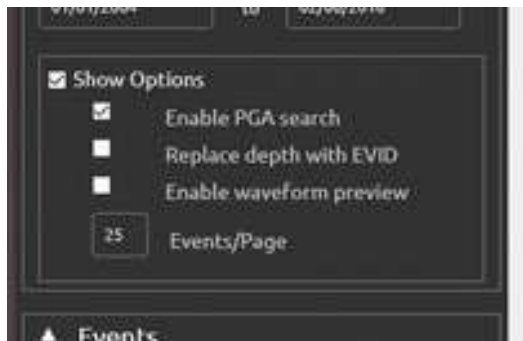
- option to use peak ground acceleration (PGA) as part of your search criteria

- option to replace depth in the list of events below with the event-ID (EVID) information. The EVID is a unique number that is used to identify an earthquake by the regional seismic network that located the event (if available).

- option to enable waveform thumbnail preview capability. This enables a small thumbnail pop-up window that displays the data when hovering the mouse over a particular channel when an event is selected from the list, and the channel list is brought up. (See section below for more details)

- as mentioned above, set the number of events listed per page in the table of event results.

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5   Comma-seperated-values

Exploring Available Channels

Clicking on an event row in the event list will bring up a table of all the channels at the selected site that are available for the event.

The available data channels are list by name where the channel name is in *SEED*[6] format. Approximate signal-to-noise and peak ground acceleration values are listed for reference.

It is beyond the scope of this document to fully describe *SEED*-naming, but the basic format is:

NN_STA_CHN_LO
two character ***Network*** code ---------^   ^   ^   ^----- two character ***Location*** code
***Station*** name/mnemonic----------+   +----- three character (encoded) ***Channel*** name

- The channel name is three characters: the first character represents the data sample-rate, the second character denotes the sensor type (N = accelerometer, D=pressure transducer, H=seismometer etc.) and the third character denotes direction or position...)
- The location code is a number corresponding to a particular instrument at the site, and can be found in the station layout or cross section figures on the site tab.

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6   Standard for the Exchange of Earthquake Data , see http://www.fdsn.org/seed_manual/SEEDManual_V2.4.pdf

Waveform viewing

When trying to decide what channels of data might be most appropriate to add to the cart for download it can be useful for review the waveforms. There are two mechanism available to view the data.

1. Quick and simple thumbnail waveform preview images can be enabled in the 'Show Options' box. When enabled hovering over the " ➔ " icon (right most in the channel list table) will display a waveform pop-up for the corresponding channel.
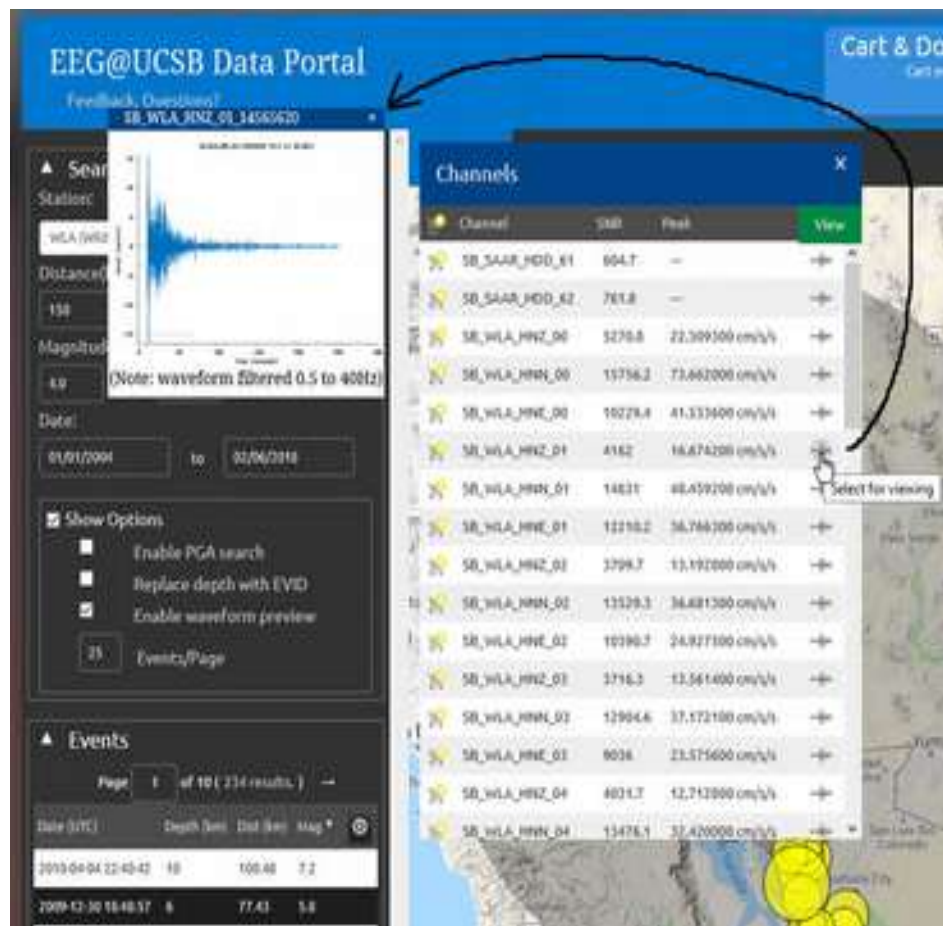

(Note: there are two very faint gray horizontal lines on the thumbnail image that indicate the region of the waveform used for measuring the 'signal' and background 'noise' levels used for calculating the SNR shown in the channel list)

2. For more interactive waveform viewing with options for signal filtering etc there is a web based waveform explorer available.

Channels to be viewed must be selected by clicking the "➔" icon (yes the same icon that hovering over pops-up the waveform thumbnail). When selected a green check-mark will be added to the icon. Up to a maximum six channels (must all have the same 'sta' name) can be selected for viewing.
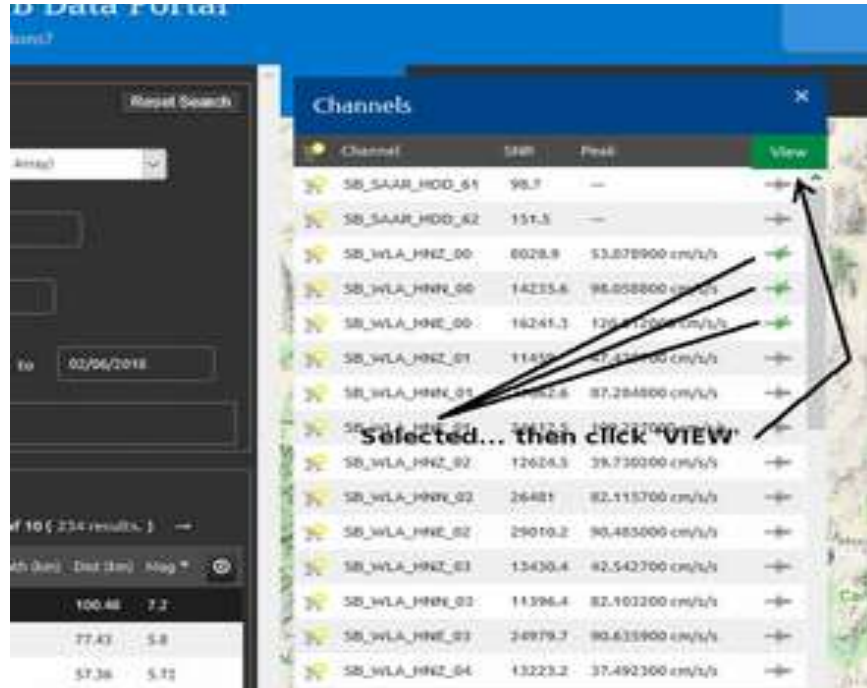
Once the channels of interest have been selected click the green "View" button to launch the explorer.
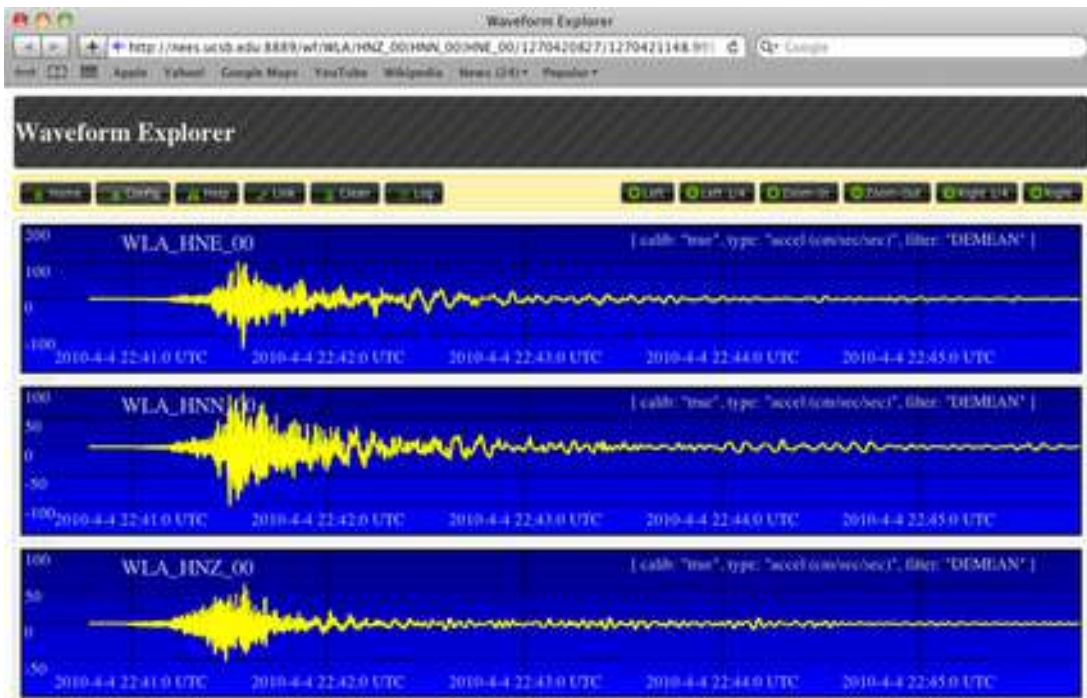

The waveform explorer provides the ability to view the raw data from selected channels without the need to download the data to the users computer first.

The units of each waveform are displayed in the upper right hand side of each channel window.

There are controls for interacting with the waveforms in the header of the Waveform Explorer window. These controls allow the user to zoom in and out on the waveforms and pan left and right, using either the buttons at the top right, or using your mouse buttons (see help button in waveform explorer).

Further options can be found in the "Config" window. Clicking on the "config" button opens a configuration menu window. The configuration menu can be used to change the display of the waveforms, including customization of the waveform and background colors, or apply simple filters on the data, including removing the mean (the raw data does not have the mean removed when you initially load it).
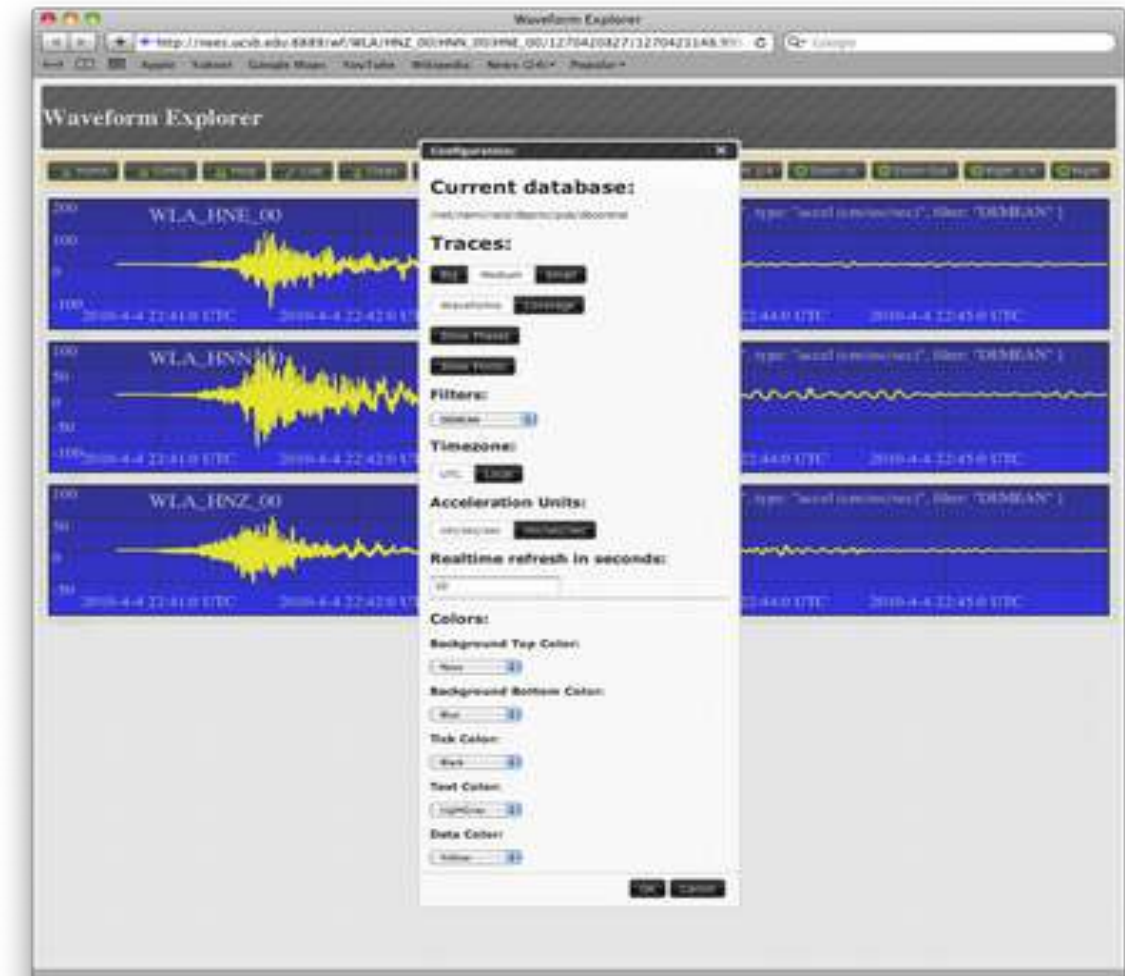
Note, if you make a change to the waveform explorer config options, it will remember them for future data you select during your visit to the data portal.

Downloading the Data

As described above, clicking on an event of interest brings-up a list of available channels for the site selected for this event.

To select channels for download, click on the shopping cart icon ( ) to the left side of the channel name. (You can also click on the shopping cart icon in the header to select all the channels into your cart).

To remove a channel from your cart simple click the checked-shopping-cart icon again.

Channel data that has been put in the cart will have a green check-mark over its cart icon (and any event with at least one channel in the cart will be shown with a check-marked cart in the event list).

The total number of events and channels currently in your cart can be seen in the "Cart&Downloads" button-box in the top right-hand corner of the portal page.

Any number of channels for any number of events for any number of stations can be added to a single cart but it probably makes more sense to build and process/download a number of individual carts (with some logical grouping of data in each cart bundle) if a lot of data is required...

When a collection of data have been stored in a cart click the "Carts&Downloads" button to select data format and to submit the cart to be built into a downloadable zip file.

The cart has distinct left and right sides. The right-hand side takes the user input to complete the data preparation (see below) and the left-hand side has a two-tabbed information section.

- The CART tab shows a summary of the events/channels that have been put in the cart.

- The DOWNLOAD tab allows a user (based on the entered email address) access downloadable data when the current cart is processed and any zipfiles that have been previously generated. One can always visit the cart even when empty to access these previously generated download zips – this allows a user to kickoff/submit a cart which may take several minutes to build and come back later for the downloadable data.
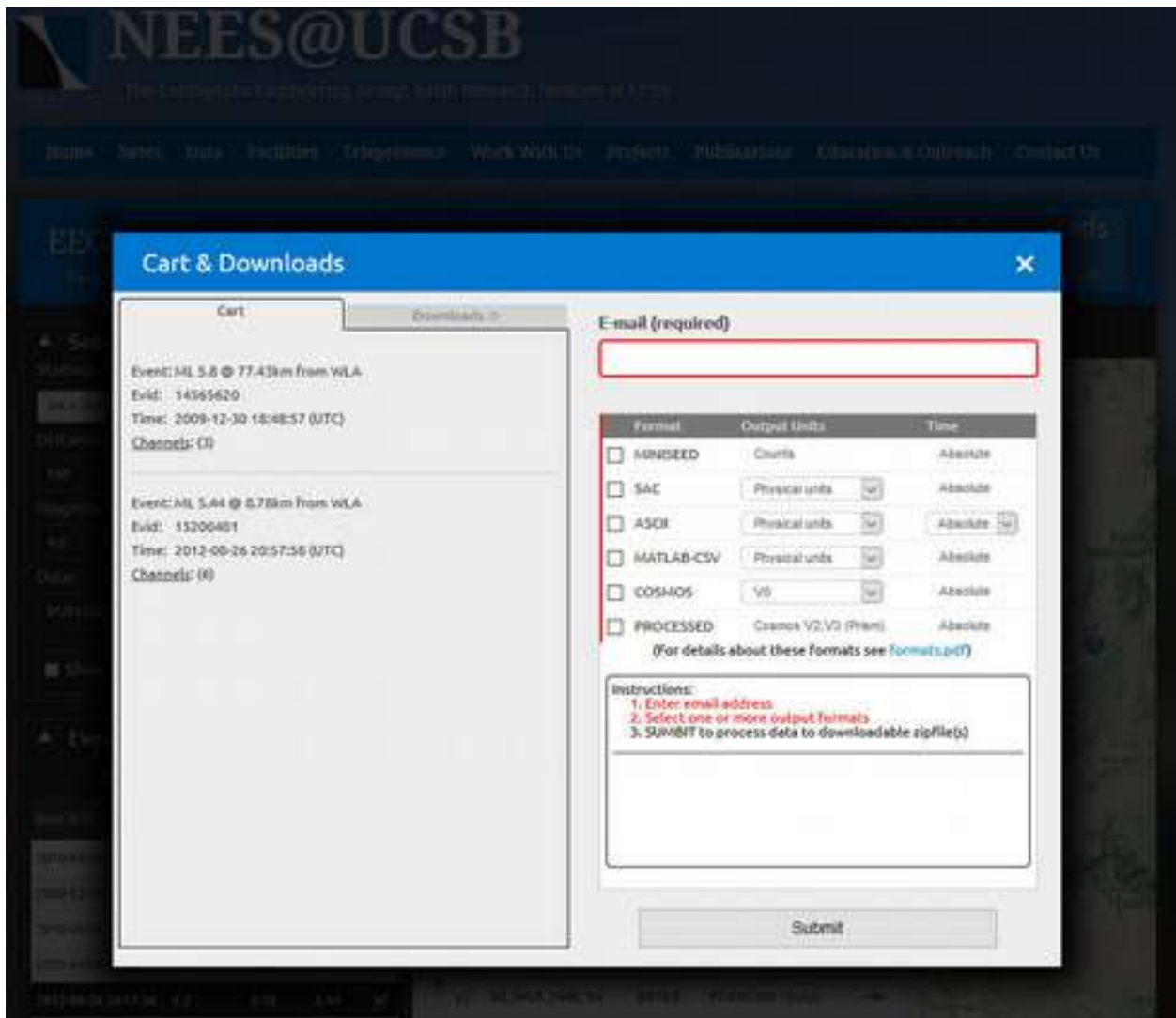
In order to build a downloadable zipfile for the cart data we require an email address (we only use the email address as a unique identifier in the backend preparation of the data), the cart will not process unless an email address is entered.

At least one output data-format must be selected, though more than one can be selected if needed. For details of the data formats listed see the format.pdf document (as appropriate for a selected data format the output units and time-stamping may also be selected).

When data format(s) has been selected, hit the *SUBMIT* button to kickoff backend processing. The data is natively stored in miniseed format and any other format will require a data conversion step to be run on each channel, additionally metadata files must be built. Depending on the data format and the number of channels in the cart the preparation of the downloadable zipfile will take from a few seconds up to several minutes.

With the exception of the "PROCESSED" format[7] (which requires a further post-processing step through the USGS PRISM tool. See below) the final cart download will be in a single zipfile called 'e*egATucsbCART.zip*'.

When the 'SUMBIT' button is pressed a processing progress bar will appear near the top of the cart window and the 'Download' tab on the left-hand side of the cart window will come to the foreground with an hourglass icon appearing by the zipfile-name as the data is prepared.

When the data is available the zipfile listing in the newest processed-cart entry in the 'Download' tab area will be clickable to initiate the download.

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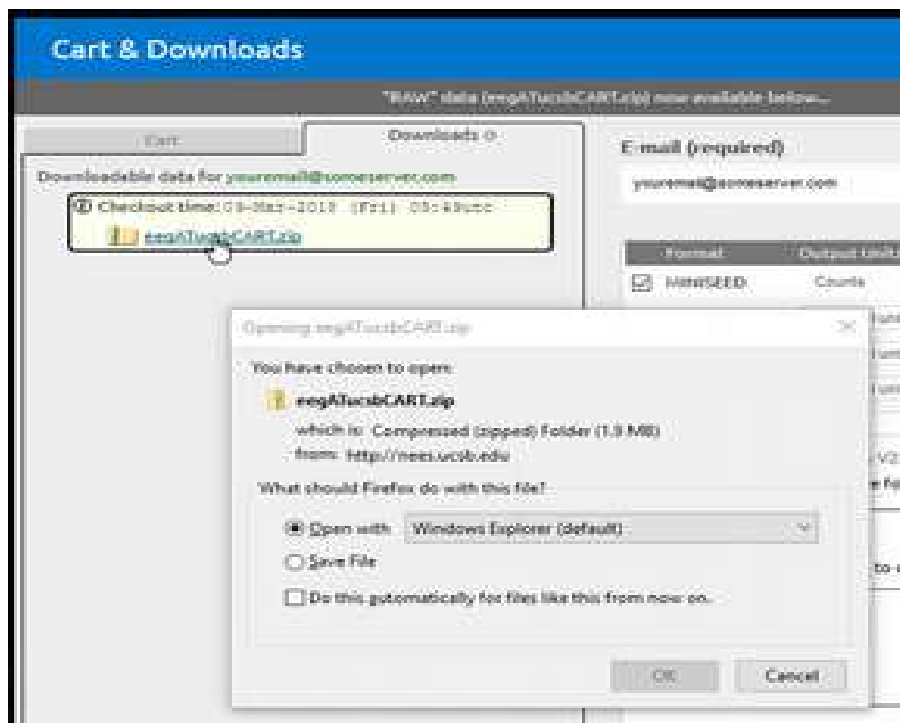
7   Miniseed, sac, ascii, csv and COSMOS formats are all 'raw' data re-formatted or encoded to the desired output type, while PROCESSED involves actual processing and manipulation of the data.
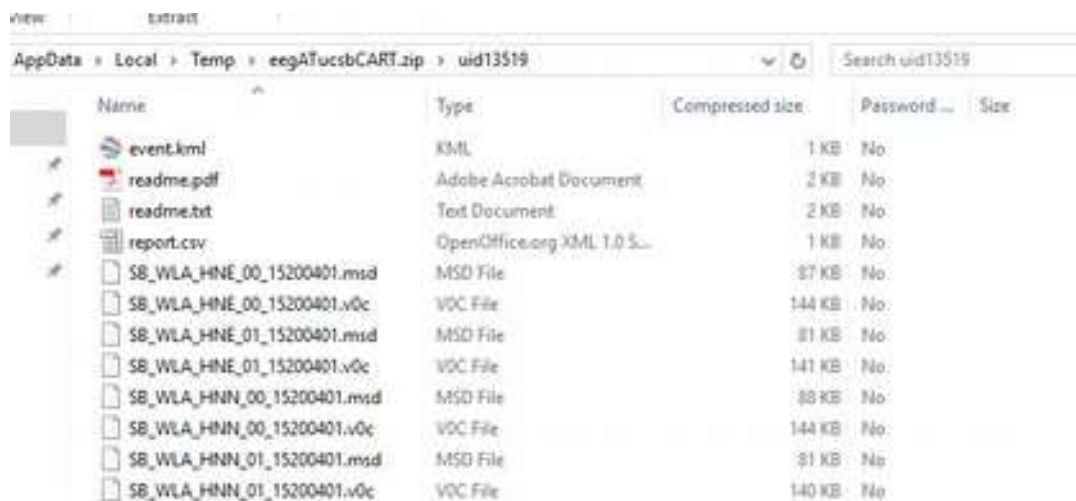
Data in the download zipfile

Once the zipfile is downloaded and extracted each site/event that had been in the cart will have a separate directory with a name in the form "uid<number>" (this directory name has internal database significance but isn't that user friendly alas!).

In each of these directories there are a bunch of metadata files and the waveform data files.

- event.kml: a Google Earth keyhole-markup-language file with the location of the site and event.

- readme.pdf: human readable event and site details as well as channel metadata

- readme.txt: human readable event and site details as well as channel metadata

- report.csv: comma-separated-value event, site and channel metadata

- datafiles in the requested formats

Example:

PROCESSED Data-format

The "*Processed*" data option is more than just re-formatting the basic raw channel data output (all the other output format selections deliver the same raw sample data values but just presented in different ways)."*Processed*" manipulates, filters and truly processes the data.

It is beyond the scope of this document to go into the details of the processing, but those details can be found on the PRISM project pages of the USGS website (USGS Prism).

The PRISM tool feeds off COSMOS V0 files, thus in order to run the PRISM tool the cart data must first be converted into COSMOS V0 and then handed off to the PRISM post-processing.

Even if only the PROCESSED output format is selected (or if other than COSMOS V0 output formats are selected) the first step behind the scenes is to build a regular *eegATucsbCART.zip* file with the COSMOS V0 which is then handed to Prism. Therefore part of the generation of PROCESSED output will first generate a normal downloadable zip file with the readme's etc. When this zipfile has been written (and is downloadable in the normal way by the user) a second processing step is kicked-off to generate a second zipfile with the PRISM output.

This second zip is called "*prismPROCESSED.zip*". The PRISM processing can take many minutes so patience is required! While the processing is on-going an hourglass icon will spin in the Download tab area of the cart, when the data is available the zipfile will be clickable for download. The data organization and files in the zip are a function of the PRISM tool, see the PRISM documentation for details.

PRISM is run with the default configuration. For custom PRISM runs download data using the COSMOS V0 format and run the PRISM locally.

The DOWNLOAD tab

Each time a cart is processed/submitted the resulting zipfile is stored on the EEG@UCSB server based on the time and the user's email address. The cart's Download tab area allows a user come back to the site and easily view and download previously prepared cart zipfiles.

The entries are listed in chronological order, newest to oldest, labeled by the time (in utc) that the cart was 'submit'ed. Each cart has a hover-over " ⓘ " icon that will reveal a brief summary of the site/events that were processed in the cart, though of course full details of whats in a cart is in the readme files in the zipfile.

Important, even though this mechanism allows a user come back and download previously produced cart zipfiles older data on the server will be purged from time to time so there is no guarantee older data will stick around.

Even with nothing in the cart, to browse available downloads click the "Cart&Downloads" button on the main data-portal page, enter the email address used when the cart(s) were processed and click on the Download tab to see the list.