



Earthquake Early Warning Display

Powered by ShakeAlert®

Operations Guide Version 2.8.0

October 2021

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1. Background and Legal Information

The ShakeAlert® Earthquake Early Warning system (ShakeAlert EEW system, ShakeAlert system, ShakeAlert, system) detects significant earthquakes so quickly that alerts can reach many people seconds to tens of seconds before shaking arrives. The USGS has been developing the ShakeAlert system for California, Oregon, and Washington since 2006, jointly with partners from state governments, universities, and private foundations. ShakeAlert is part of the Advanced National Seismic System. For more information see the *USGS Revised Technical Implementation Plan for the ShakeAlert system*: <https://pubs.er.usgs.gov/publication/ofr20181155>.

The ShakeAlert system combines the output from two independently running EEW algorithms, Finite Fault Detector (FinDer) and Earthquake Point-source Integrated Code (EPIC), that use recorded ground motion data to estimate source parameters for an earthquake in progress. The ShakeAlert system provides a continuum of earthquake information including rapid estimates of location, magnitude, and seismic intensities. Magnitude represents the amount of energy released and intensity is the amount of shaking, and is a relevant measure for potential damage.

Outputs of the ShakeAlert system come in the form of XML formatted ShakeAlert Messages published by the U.S. Geological Survey. EEWDisplay is a user-facing demonstration product that visualizes data in ShakeAlert Messages and produces an alert. Earthquake Early Warning Display (EEWDisplay) is powered by the ShakeAlert® system.

Since EEWDisplay requires a connection to the ShakeAlert server, all end-users must have a license agreement on file with the USGS.

EEWDisplay is a Java-based application that presents visual and audio information about an earthquake. Its output shows the end-user's location and the estimated epicenter. As time elapses from the detection and notification of an earthquake, the current locations of the Primary (P) and Secondary (S) wave fronts are also shown. Additionally, the estimated magnitude, shaking intensity, and remaining time until shaking is estimated to start at the end-user's location, is displayed. If the end-user configures EEWDisplay to ingest contour or grid map messages, estimated shaking intensity across the map display will also be shown.

EEWDisplay is for demonstration use only and should not be used for life-safety applications.

ShakeAlert-powered EEWDisplay alerts are stored locally on the end-user's computer and can be replayed. EEWDisplay also has a "Heartbeat" feature which provides a summary of the state of health of the components (e.g., algorithms) of the ShakeAlert system and provides the end-user confirmation that the connection to the ShakeAlert server is active. Additionally, ShakeAlert technical partners with active Pilot or License to Operate agreements can use EEWDisplay with the ShakeAlert Scenario Server for testing purposes.

From the ShakeAlert Evaluation License Agreement (July 2021 Section 9: Disclaimers; Warranties; Limitation of Liability): *“EEWDisplay Users are not authorized to copy, modify, reverse-engineer, publish, rent, lease, loan, sublicense, or distribute ShakeAlert Materials or derivative works based on ShakeAlert products to any third-party without the prior written consent of the USGS. Additionally, Users must obtain prior written approval from the USGS for any public information releases which refer to the Department of the Interior, the USGS, its employees, or ShakeAlert Materials. Development and testing of the ShakeAlert system is ongoing.”*

The USGS does not warrant that EEWDisplay will function at all times, in all geographic areas, without interruption, be error-free, or that any errors will be corrected. **End-users are prohibited from critical actions or making important decisions based on ShakeAlert information as visualized through EEWDisplay. As stated above EEWDisplay is for demonstration use only and should not be used for life-safety applications.**

ShakeAlert’s Joint Committee for Communication, Education, Outreach, and Technical Engagement (JCCEO&TE) collaborates with a variety of stakeholders, including EEWDisplay end-users, to develop messaging and visual representations of ShakeAlert data. Input from the ShakeAlert technical partner community is indispensable in this process.

The USGS seeks Pilot Phase Partners to cooperatively develop products, services, etc. that use ShakeAlert Messages in real-world applications. To learn more about ShakeAlert technical partnerships, visit <https://shakealert.org/implementation/partners>.

EEWDisplay produces ShakeAlert-powered alerts from USGS published ShakeAlert Messages. (see section Menus > Top Menu Bar > Edit > Settings > Event Filter Parameters for details of the User threshold behavior). *Note: Computer cannot be off or in sleep mode.*

2. Download and Installation

Currently, EEWDisplay is only being distributed to a limited number of licensed partners. Upon being authorized to access ShakeAlert servers, you are issued a personal username and password for installation.

It is prohibited to share ShakeAlert server credentials. The USGS maintains the right to refuse, suspend, or terminate access to anyone at any time without notice.

Step 1. Download software

- Go to <https://www.ShakeAlert.org>.
- Within the home page for ShakeAlert.org, access ShakeAlert Utilities at the bottom right-hand side of the page.
- The Utilities page is protected with a **generic** password which was provided to you with your access codes.
- Access the Download and Installation tab.
- It is recommended that you read the README file in the download directory for further information on system requirements, installation and relevant updates before you download the software.

Step 2. Select the installation appropriate to your operating system for download

- Windows: EEWDisplay-X.X.X_yyyymmdd.installer.exe
- Mac: EEWDisplay-X.X.X_yyyymmdd-osx.installer.dmg
- Linux: EEWDisplay-X.X.X_yyyymmdd-linux.installer.run
- UNIX: EEWDisplay-X.X.X_yyyymmdd.tgz
(On UNIX, after extracting the files from the tgz archive, to run, use the runUNIX.sh script)

Step 3. Both Windows and Mac require any program downloaded from the Internet to be digitally signed before it will allow the program to be run. (Linux and Unix files are not digitally signed at this time.)

- Windows: Right mouse on exe file, select properties then select digital signatures. Verify that the installer is signed by California Institute of Technology with a valid date by looking at the details at one or more of the certificates.
- Mac: To manually validate the signature enter the following command in a terminal window:
`codesign --verify --verbose <path to EEWDisplay-X.X.X.YYYMDD-osx.installer.dmg>`
The output should indicate that the file is valid on disk and satisfies its designated requirement.

Step 4. Uninstall previous or pre-release EEWDisplay or UserDisplay versions

You must stop and uninstall any preliminary version of 2.8.0 such as a beta or pre-release with the same version number. Failure to stop and install without properly uninstalling first may cause the program to lock up and/or cause the installation to fail. You may need to restart your computer if you do not stop the program before uninstalling.

If you are running an earlier version of the formerly called UserDisplay (2.7.0 or earlier) you can uninstall it AFTER you successfully install the new version of EEWDisplay 2.8.0.

After you install version 2.8.0, you can copy any history files from a previous version to keep them available for replay. See README file for instructions:
<https://www.shakealert.org/eew-research/caltech/eewdisplay/shakealert-utilities/shakealert-utilities-2/documentationuser-guides/>

To uninstall older versions of EEWDisplay or UserDisplay, use the uninstaller in the program installation directory, or use one of the following options:

- Mac: drag the EEWDisplay or UserDisplay folder to the trash.
- Windows: use the Control Panel uninstall option (Start menu > Control Panel > Programs and Features > right-click on a program and select uninstall).
- Linux/Unix: delete the EEWDisplay folder.

Step 5. Install Program

If you are having difficulties with the installation, please ensure the person performing the installation has administrative privileges on the computer in order to complete the install and that the end-user has both read and write permissions for the folder where the installed application is running.

Step 6: Run EEWDisplay

Once the program is fully installed, you should find a shortcut for the EEWDisplay on your desktop. Do not forget to turn on your computer's volume so you can hear the alert tone and voice announcements when a ShakeAlert-powered alert is delivered by EEWDisplay.



Double-click on the icon and manually enter your **personal** username and password to start your EEWDisplay. If you need to see your password in clear text during or after you enter it on the dialog, check the “Show PassPhrase” box. If you check the “Autologin” box under Settings, you will not need to enter your credentials again unless you install a new version. Please note that you should only check the “Autologin” box once you have verified that your credentials are correct, by seeing the connection status change to green after your first log in. Also, remember to go into “Settings” and enter your latitude/longitude to set

your location, map center and your magnitude and intensity thresholds for receiving alerts. For further information on setting alert thresholds, or other parameters, please see section Menus > Top Menu Bar > Edit > Settings.

On Windows or Mac OSX you can set the EEWDisplay to be restarted automatically when your computer is restarted. On Windows, the installer will set the auto restart option by default (to disable use Windows Task Manager > Settings > Startup). On Mac OSX, put the EEWDisplay application program in the list of "Login items" for your User (System preferences > Users and Groups > Login Items).

If you experience technical difficulties with the EEWDisplay or have any comments, please contact the appropriate ShakeAlert Regional Coordinator:

Southern California	Margaret Vinci (Caltech)	mvinci@gps.caltech.edu	626-395-3298
Northern California	Jennifer Strauss (UC Berkeley)	jastrauss@berkeley.edu	510-642-1067
	Tal Edgecomb (UC Berkeley)	tale@berkeley.edu	
Oregon	Lucy Walsh (University of Oregon)	lwalsh@uoregon.edu	541-346-4654
Washington	Bill Steele (University of Washington)	wsteele@uw.edu	206-685-5880
Washington & Oregon	Gabriel Lotto (University of Washington)	glotto@uw.edu	
USGS	Robert de Groot (USGS)	rdegroot@usgs.gov	626-583-7225

Additional information regarding the ShakeAlert Earthquake Early Warning System can be found at <https://www.ShakeAlert.org>.

Recent earthquake information is available at:
<https://earthquake.usgs.gov/earthquakes/map>

For earthquakes (within ShakeAlert’s service area) that are estimated by the ShakeAlert system to be M 4.0 or greater, a ShakeAlert Post-ShakeAlert Message Summary is posted on the given event page. Before being posted to the event page, the ShakeAlert Message is reviewed and approved by a 24/7 USGS ShakeAlert Duty Review Officer.

The EEWDisplay is a platform-independent Java Application. The program has been successfully tested on Windows 7, 8, and 10; Windows Vista; Windows XP; Linux; and Mac OS X. The program requires Java version 1.8 or higher. Please follow the instructions of the installation manager. You must grant the EEWDisplay access through your firewall to be able to receive ShakeAlert Messages.

Note: Within the ShakeAlert Utilities webpage, the Bug Report/Enhancement Request Submission tab allows you to provide EEWDisplay feedback to the EEWDisplay development team.

Recent Changes

Based on the feedback from our end-users and advances in algorithm development, the following changes were made to the EEWDisplay:

- 1) The latest 2.8.0 version offers the following improvements and new features:
 - Support to process new follow-up ShakeAlert Messages issued by the ShakeAlert system, which provide verification and further details for the most recent event for which a ShakeAlert Message was issued by the USGS.
 - New 'Acknowledge' button which allows the end-user to stop the EEWDisplay from popping-up and grabbing focus while still receiving and logging event alerts. Action to 'Cancel' event alerts is now limited to a key and mouse-click shortcut.
 - Updated graphics for intensity scale, disclaimer and logo, improving the resolution and appearance of the main EEWDisplay screen.
 - Updated vs30 file with greater extent and newer data, matching the file used internally by the ShakeAlert system when computing estimated ground motion. Reading of the file is also optimised for speed.
 - Updated ShakeAlert license agreement and end-user documents/manuals, plus new menu options that will access the latest versions at ShakeAlert.org.
 - Example replay data have been updated with recent earthquakes for which a ShakeAlert-powered alert was delivered, updated historic examples more closely imitating the expected ShakeAlert system performance, and synthetic scenarios for large magnitude events.
 - New Audio Settings options to 'Mute' on start-up and 'Test Audio' at start-up.
 - New Event Filter Settings to set thresholds for audio alerts.
 - New visual Setting to control animation update interval.
 - Updated station and city files to reflect latest information.
 - Updated default NTP server to reduce connection problems.
 - Added checkbox to disable NTP synchronization for cases where connections to an external NTP server are problematic. In this case the EEWDisplay will use the local computer system clock.
 - Updated behavior for connecting to ShakeAlert brokers to find optimum connection.
 - Additional information on ShakeAlert server connections provided in Help->About pop-up.

- Bug fix to test audio files at start-up to prevent problems and provide information in the log file. This test 'chirp' can be disabled in Settings for those who restart frequently.
 - Bug fixes for handling username and password on login pop-up.
 - Bug fix to stop checking NTP servers once a successful connection is made.
 - Bug fix to correctly handle new HA messages (which provide details of the health of the ShakeAlert system).
 - Bug fix for shaking intensity level display.
- 2) Bug fixes for v2.8.0 are listed in the changes file launched from the Help > Changes menu option.
- 3) EEWDisplay v2.8.0 requires Java 1.8 or newer. **NOTE:** There is a known problem with Java 8 update 121, which was released January 17, 2017. This may cause the EEWDisplay to flicker/incompletely refresh and/or the audio to be uneven during a ShakeAlert-powered alert. It affects some video cards. Previous versions of the EEWDisplay may also be affected by the recent java updates. Reverting to versions of Java 8 prior to 101 or a more recent build should improve the display. It may also help to disable some of the more detailed map layers.

3. Menus

There are three menu bars along the top of the EEWDisplay window.



Top Menu Bar

The Top Menu Bar displays items that, when clicked, reveal pull-down submenus of choices to select.

EEWDisplay

Click this drop-down to turn off alerts, reconnect to program services, or exit.

- **About EEWDisplay** displays EEWDisplay version number and copyright information. Additional information is also provided including: the time the program was started, end-user information, system description, software library details, the EEWDisplay properties file and start-up parameters, and alert connection information.
- **Silence Alerts** quiets the current alert. You can also use the keyboard shortcut Ctrl-S or click the Silence button on the **Button bar**. This feature mutes ONGOING alerts, for example to suppress audio alerts for distant earthquakes with long warning times that may be irrelevant to the end-user.
- **Mute All Alerts** will silence all incoming and simulated alerts until the mute is deselected. You can also mute alerts by clicking the Mute checkbox on the **Button bar**, or by using keyboard shortcut Ctrl-M. The keyboard shortcut will toggle Mute on and

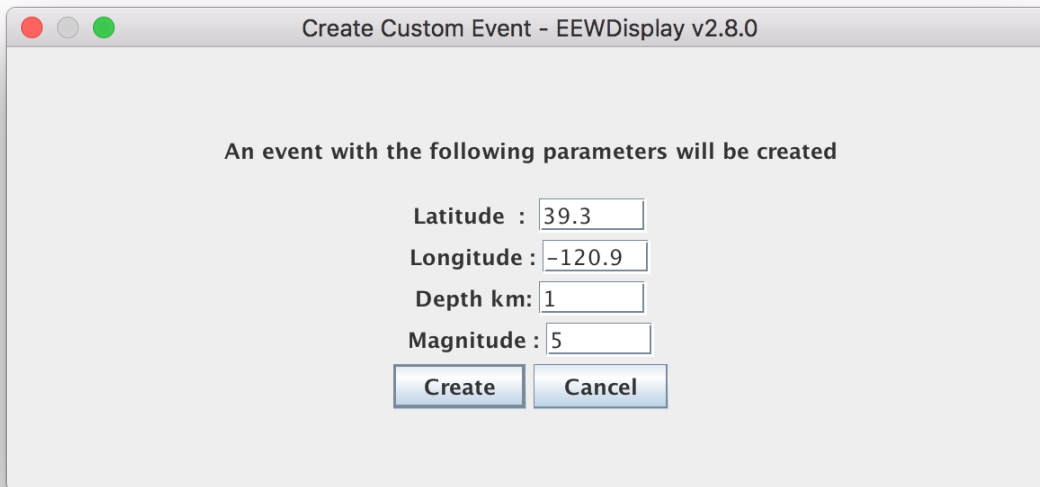
off. You may wish to use this feature if there is an ongoing event swarm, or if you work in a quiet environment where a visual alert is sufficient.

- *Cancel Event* stops an alert from proceeding, whether an actual alert or an example simulation. If you cancel an event, you will no longer receive updates of that event. ***Unless you are demonstrating and making use of example simulations, you should not use Cancel Event***, because it may result in you not receiving relevant alerts as earthquake parameters are updated (e.g., as the earthquake rupture proceeds, it may move closer to your location). Keyboard shortcut: Ctrl-C.
- *Acknowledge Event* will act on the current event to prevent the EEWDisplay from popping-up and grabbing screen focus for event updates. The EEWDisplay will continue to receive and log the updates, so they will be available for replays, and audio-visuals will continue to update in the background. Keyboard shortcut: Ctrl-A.
- *Reconnect to ShakeAlert Server* will attempt to reconnect your EEWDisplay to the ShakeAlert system; if successful, your *Program Status Light* will turn green (for more details on the status light, see the **Button Bar** section). Keyboard shortcut: Ctrl-Shift-R.
- *Reconnect to Time Server* will sync your program with the NTP (official time) server. If you get the message “NTP Status is currently OK”, you don’t have to reconnect or “restart” the NTP synchronization.
- *Exit* will quit the EEWDisplay. You can also click the Power-off icon to quit, located directly below on the **Button bar** (see Button Bar section). Note that this will completely close the program and no alerts will be received. Usual operation is not to exit the program but to close or minimize the EEWDisplay window using the standard controls on the top right/left of the display (see section ‘Minimize/maximize and close the EEWDisplay window’).

Replay

Offers shortcuts to replaying recent events: incoming, or simulated. It also shows the available keyboard shortcuts for these actions.

- *Play Event* opens a file browser so that the end-user can navigate through the history and examples archive and select an event to replay. Both .eew and .xml files are available in the examples and history folders, .xml files will replay information for a single ShakeAlert-powered alert, .eew files will play a sequence of .xml files. Example events are described in further detail in section 8. The keyboard shortcut (ctrl+P) will also open the file browser.
- *Create Custom Event* launches a pop-up dialog allowing the user to specify custom event parameters for replay: epicentral latitude, longitude and depth (in km), and magnitude. The shortcut: ctrl with a mouse click on the map, will also launch the pop-up dialog, with the mouse click location being used to set the epicentral latitude and longitude. A second shortcut is also available: a right-click, or two-finger click on Mac, launches a menu of ‘Location options’. The third option is ‘Create User Event at this location’, and will also launch the pop-up dialog with the mouse click location being used to set the epicentral latitude and longitude. Upon pressing ‘Play’, the EEWDisplay will begin to display audio and visual alerts consistent with an event occurring at the given location. Note that no map or contour ground motion alerts will be generated for this event, only the standard source parameter alerts.



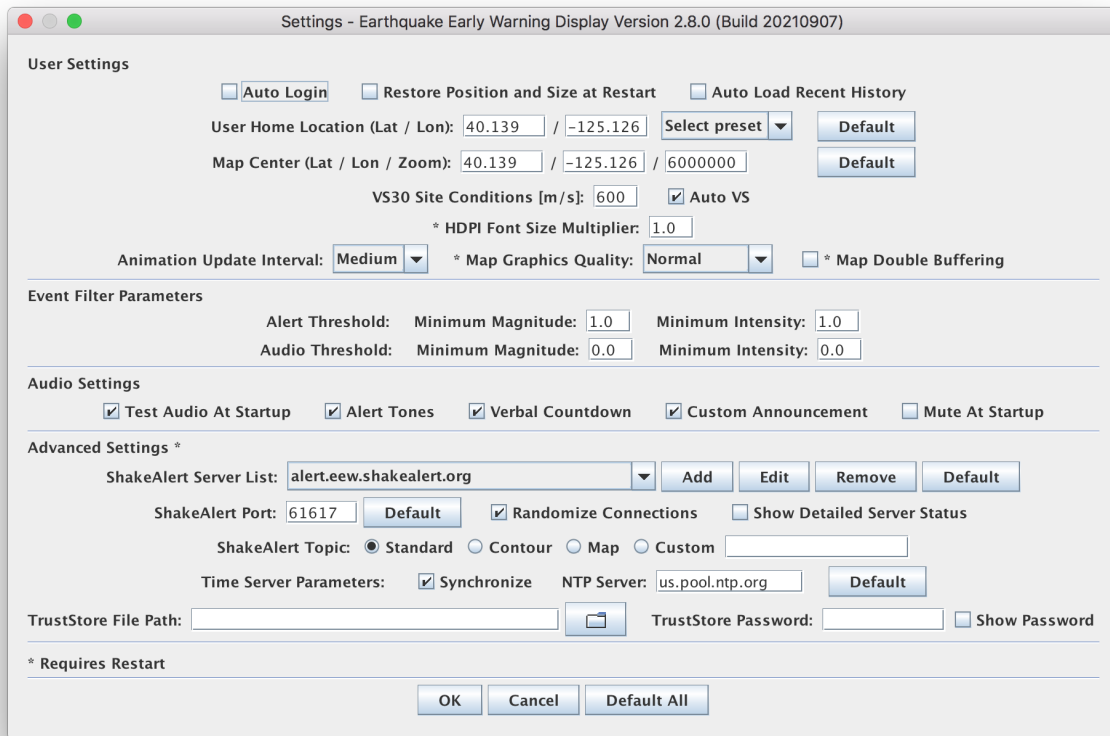
- [Replay Last Event](#) replays the most recent event played or received by the EEWDiDisplay. The keyboard shortcut (ctrl+R) will replay the most recently played event.
- [Event listing](#) displays recently played events for easy selection for replay. Up to 30 events are listed, using their event ID (for events received in real-time this may include the date and time), magnitude, nearest city, and the number of updates in the sequence. The keyboard shortcut (ctrl+R) will replay the most recently played event (number 1) in the list.



Edit

Access your program settings such as the servers you are connecting to, your latitude/longitude location, and other specified details.

- [Settings](#) is identical to the Settings button on the **Button bar**, click to open a dialog box to input various details. *Note that any feature with an asterisk will require a program restart to take effect.*



○ **User Settings:**

- **Checkbox for AutoLogin:** Check this box if you wish to be automatically logged in each time you launch EEWDisplay. *Enable only after you have confirmed that your Username and Password have been accepted. The password is encrypted when saved to disk, so please make sure you know your password before running any new version. Note: Any change to the ShakeAlert connection or alert topic will automatically uncheck this checkbox.*
- **Checkbox for Restore Position and Size at Restart:** Selecting this checkbox stores the window position and size on shutdown so that they can be restored when the program is relaunched.
- **Checkbox for Auto Load Recent History:** Selecting this will automatically load recent events (up to a maximum of 30) into the event history layer when the program is relaunched.
- **User Home location (lat/lon/zoom):** When you first install the EEWDisplay, your latitude, longitude will point off the California coast, to remind you to change this to your approximate location. Convert your address to lat/lon at geocoder.us or www.latlong.net. Some preset values are available with approximate locations for the ShakeAlert collaborating institutions Caltech (southern California; 34.1363, -118.1276), University of California Berkeley (UCB, northern California; 37.8700, -122.2590), University of Oregon (UO, Oregon; 44.0463, -123.0737), University of Washington (UW, Washington; 47.6540, -122.3095) and the location values at startup.

- **Map Center Location (lat/lon/zoom):** Set the map center location and zoom level. Zoom level has a ratio format like 1:6,000,000. Using the Preset values available in the drop-down menu will set both the User Home Location and Map Center, see above (User Home location) for further explanation.
A shortcut for setting your current map view as the default view is available from the map: a right-click (or two-finger click on Mac) launches a menu of 'Location options'. The second option is to 'Set current view as default'. This view will be used if you 'Reset Map', when you re-start EEWDisplay, and if you use the 'Last Startup' option in the Preset location options.
When moving the cursor across the map, the lat/lon values will be displayed in the lower left corner. The zoom level is displayed in a text box near the top in the navigation bar just below the "Play Event" button.
- **Default** buttons reset the lat, lon, zoom boxes to default values.
- **VS30 Site Conditions [m/s]:** Leave this at the default value. If the value 9999 appears in the box, or further explanation of this quantity is needed, read the following *Advanced end-users* section.

Advanced end-users: Enter the Vs30 value (average S-wave velocity of the uppermost 30 m) at your location. This value is important for estimating the seismic intensity at your site, and will vary depending on the rock or soil type in your local area. Enter "0" if you do not know the Vs30 value at your site. The program will automatically determine a Vs30 value from a lookup table using the latitude and longitude you entered. If the automatic lookup attempt results in a value of "9999" in the box, the lookup table file is absent or unreadable go to <https://earthquake.usgs.gov/data/vs30> or contact the appropriate person for your region as listed in Section 3 (Download and Installation) or Section 5 (Contact Information).

- **Checkbox for AutoVS:** Leave this at its default status, which is checked, unless you have more detailed information about your site conditions.
- **HDPI Font Size Multiplier:** This setting is used to adapt the EEWDisplay to high definition displays. The program attempts to set an appropriate level: 0.5, 1.0 or 1.5 depending upon available system information. However, if the font appears too large the multiplier should be reduced, and vice versa. Higher definition screens may need a higher value.
- **Animation Update Interval dropdown:** The end-user is able to select between 'Medium', 'Slow', and 'Fast', controlling the refresh rate for animations including P and S wavefronts. Choose 'Slow' for older computers to reduce system load, and choose 'Fast' for smoother graphics. Default is 'Medium'.
- **Map Graphics Quality dropdown:** The end-user is able to select between 'Low Quality', 'Normal' and 'High Quality', controlling the trade-off between the speed and quality with which the view is redrawn. If the view is slow to be drawn, select 'Low Quality'.
- **Checkbox for Map Double Buffering:** Check this box to apply double buffering, which may reduce stutter, tearing and other artifacts in the rendering of the view.

- **Event Filter Parameters:**
 - You can set alert thresholds, which determine whether the display will pop-up and audio will be played for an incoming message.
 - You can set audio thresholds, which only controls whether the audio will be played. Setting the audio thresholds higher than alert thresholds allows you to pop-up and display smaller events for which you may not want the interruption of the audio alerts.
 - All messages received from the ShakeAlert server will be written to disk, these alert and audio thresholds are only used to decide how the program will notify the user.
 - To gain experience with the EEWDisplay, your **Minimum Magnitude** and **Minimum Intensity** should be low enough to detect relatively small (and therefore frequent) earthquakes.

Advanced End-users: You can specify two threshold parameters, which must all be exceeded before an event message received by the EEWDisplay will be displayed as an alert. Thus, the parameters you set here will control the number of alert messages you will receive. Earthquake magnitude represents the amount of energy released and depends on the surface area of the rupture. Seismic intensity is the amount of shaking, and is a relevant measure for potential damage. The seismic intensity value the end-user sets will filter out all alerts that are below that value for the end-users chosen lat/long settings, not for the earthquake as a whole.

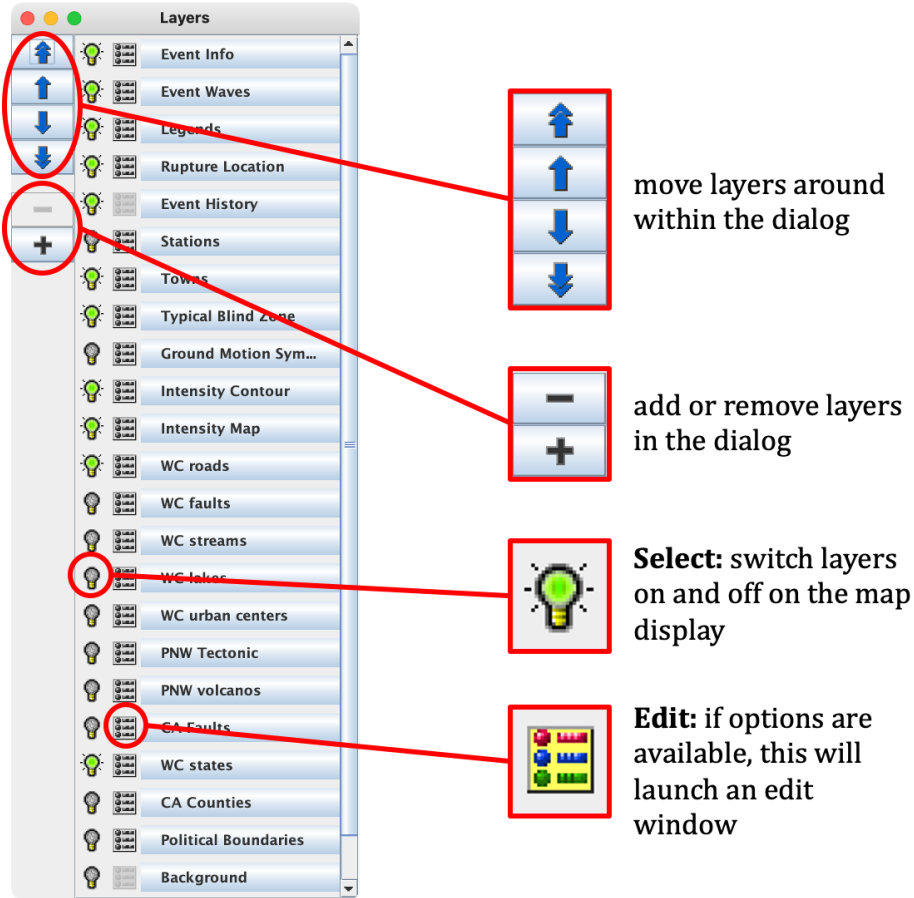
- **Minimum Magnitude:** Enter the minimum magnitude of events for which you will receive alerts. Take care in setting this value. The ShakeAlert system is currently set to issue ShakeAlert Messages for events with magnitudes “3.5” or above. These smaller events are not damaging, but can be used to test the system. If you set the minimum magnitude too high (e.g., “5.5”), you may not see any ShakeAlert-powered alerts in the following weeks or months. We encourage you to try different magnitude thresholds. During the evaluation period, we prefer that you use a small value (e.g. “3.5” to receive all ShakeAlert-powered alerts).
- **Minimum Intensity:** Enter the minimum seismic intensity (MMI scale) to be expected at your location for which you want Shakealert-powered alerts. The scale, shown on the lower left of the EEWDisplay screen, ranges from “1” (not felt) to “10” (extreme shaking). Bear in mind that you will not receive alerts if you set the threshold too high. Start with a small value (e.g., “1.0” to receive all ShakeAlert-powered alerts).
- **Audio Settings:** These allow the end-user some control over the audio alert that will be played when an event message is received or at startup.
 - **Checkbox for Test Audio at Startup:** when checked a short audio clip (chirp by default) will play at startup to test audio is working.
 - **Checkbox for Alert Tones:** when checked the alert tone (a bell or siren sound) will be played during an alert.

- **Checkbox for Verbal Countdown:** when checked announcements will be played during an alert, giving shaking level expected at your location, and number of seconds estimated until strong shaking arrives.
 - **Checkbox for Custom Announcement:** when checked a custom announcement will be played during an alert, which gives the end-user basic instruction that an earthquake is occurring and protective action should be taken.
 - **Checkbox for Mute at Startup:** when checked this enables the 'Mute' feature automatically at startup, which will silence all incoming and simulated alerts. The 'Mute' can be disabled at any time by unchecking the box on the Button Bar.
- **Advanced Settings:** Note that changes to these parameters will require a restart of the EEWDisplay program to take effect. These settings control connections to alert and time servers.
- **ShakeAlert Server List:** Default values will be input here, e.g., the ShakeAlert servers running at the different ShakeAlert system processing centers. A drop-down list will show the servers currently being used. The **Add, Edit** and **Remove** buttons can be used to add, edit or remove ShakeAlert servers. The **Default Servers** button will restore the list of default servers. *Do not change these unless instructed to do so.*
 - **ShakeAlert Port:** A default value will be inputted here automatically, e.g., port 61617 (or 443) for connection to the ShakeAlert server, and port 123 UDP for NTP server. *Do not change these unless instructed to do so.*
 - **Checkbox for Randomize Connections:** This controls the order that the EEWDisplay program will attempt to connect to the ShakeAlert servers. *Leave this at its default status, which is checked.*
 - **Checkbox for Show Detailed Server Status:** *It is recommended to not change this setting.* The ShakeAlert system status box shows the time and data servers being accessed, as well as any error messages. It also shows a latency value in seconds, which is the difference between the ShakeAlert system send time and your EEWDisplay's receive time for the last message. The default view is a summary of each component; checking this box expands the view to show each instance of each component.
 - **ShakeAlert Message Topic:** radio buttons allow the end-user to switch between receiving standard ShakeAlert-powered alerts (containing earthquake source parameters such as origin time, magnitude and location (epicenter and finite fault if available)), contour messages (standard information plus ground motion contours), or map messages (standard information plus ground motion maps). *Advanced (pilot program) end-users can enter a topic name in the Custom text box if they know the full description. Do not use this option unless arrangements have been made in advance.*
 - **Checkbox for time server Synchronize:** If there are problems with your EEWDisplay connecting to the specified NTP server, checking this box will switch the program to using the local system clock on your computer instead. *Do not uncheck this box unless you are certain that your computer clock is correct, otherwise warning times will be incorrect or alerts may be missed.*

- **NTP Server Name:** *It is recommended to not change this setting.* An alternative NTP server address may be specified.
- **TrustStore File Path and Password:** *Most end-users should not need these settings.* End-users participating in pilot programs may be sent a trust store file and details should be entered here. The file button launches a pop-up to navigate the file system to the correct file.
- **Checkbox to Show Password** in plain text.

Notes:

- Changes to parameters marked with an asterisk including graphics, Server Name, or Port will cause a dialog box to appear informing the end-user that a restart is required for changes to take effect. Without auto-login enabled, a restart will re-check credentials.
- The *Default* button can be used to restore the default settings.
- **If you edit any of these settings, click OK.** Click Cancel to discard changed settings you decide you do not want enabled.
- The **Default All** button will set all values in the dialog to their default settings.
- *Layers* launches a dialog to edit the layers visible in the main EEWDisplay window, such as displays of roads and towns, and event features such as P and S wavefronts. This gives the end-user greater control to switch both map and event features on and off in their display. **N.B** *Enabling many map layers increases the graphics processing requirements. If you notice delays or stuttering in map rendering, try reducing the number of map layers enabled.*



Seismic Information	
Event Info	Shaking intensity banner, event information panel, star showing epicenter location, status information.
Event waves	P and S wavefronts displayed as yellow and red circles.
Rupture Location	Shows finite fault rupture
Intensity map	Displays the seismic intensity provided in the ground motion map message as a coarse grid when subscribing to the Contour topic. Color is from the Modified Mercalli Intensity Scale (MMI).
Intensity contour	Displays the seismic intensity polygons provided in the ground motion contour message, which are simple 8-vertex polygons when subscribing to the map topic. Color is from the Modified Mercalli Intensity Scale (MMI).

Event History	Recent events (live and replayed) are shown as squares, colored by age and sized by magnitude. Events can be replayed by double-clicking. <ul style="list-style-type: none"> ○ Red: less than one hour ○ Blue: less than one day ○ Yellow: less than 7 days ○ Grey: more than 7 days
Ground Motion Symbols	Shows station ground motion observations. They are shown colored by shaking intensity with symbols denoting prediction or observation, and differentiating between displacement, velocity and acceleration.
Stations	Network stations contributing data to the earthquake early warning system. Note that symbols (small yellow triangles) will only be visible at higher zoom levels.
Legends	MMI intensity scale, disclaimer.
Typical Blind Zone	Region around the end-user's location denoting the zone where, if an earthquake were to start there, the end-user would likely have a zero warning time.
Map Features	
Towns	Markers and names, scaled by population.
CA faults	Fault traces shown as thin grey lines.
WC roads	Shown as orange lines.
WC faults	Fault traces shown as thin grey lines.
WC streams	Blue lines.
WC lakes	Blue regions.
WC urban centers	Pink shading showing major urban centers.
PNW tectonic	Plate boundaries marked in white (includes San Andreas in California).
PNW volcanoes	Marked and labelled.
CA counties	Boundaries shown as black lines.
WC states	Shows California, Oregon and Washington state areas as white regions.
Political boundaries	Shows global landmasses as blue regions with black country borders.

Background	Changes the background to a gradient blue from top to bottom.
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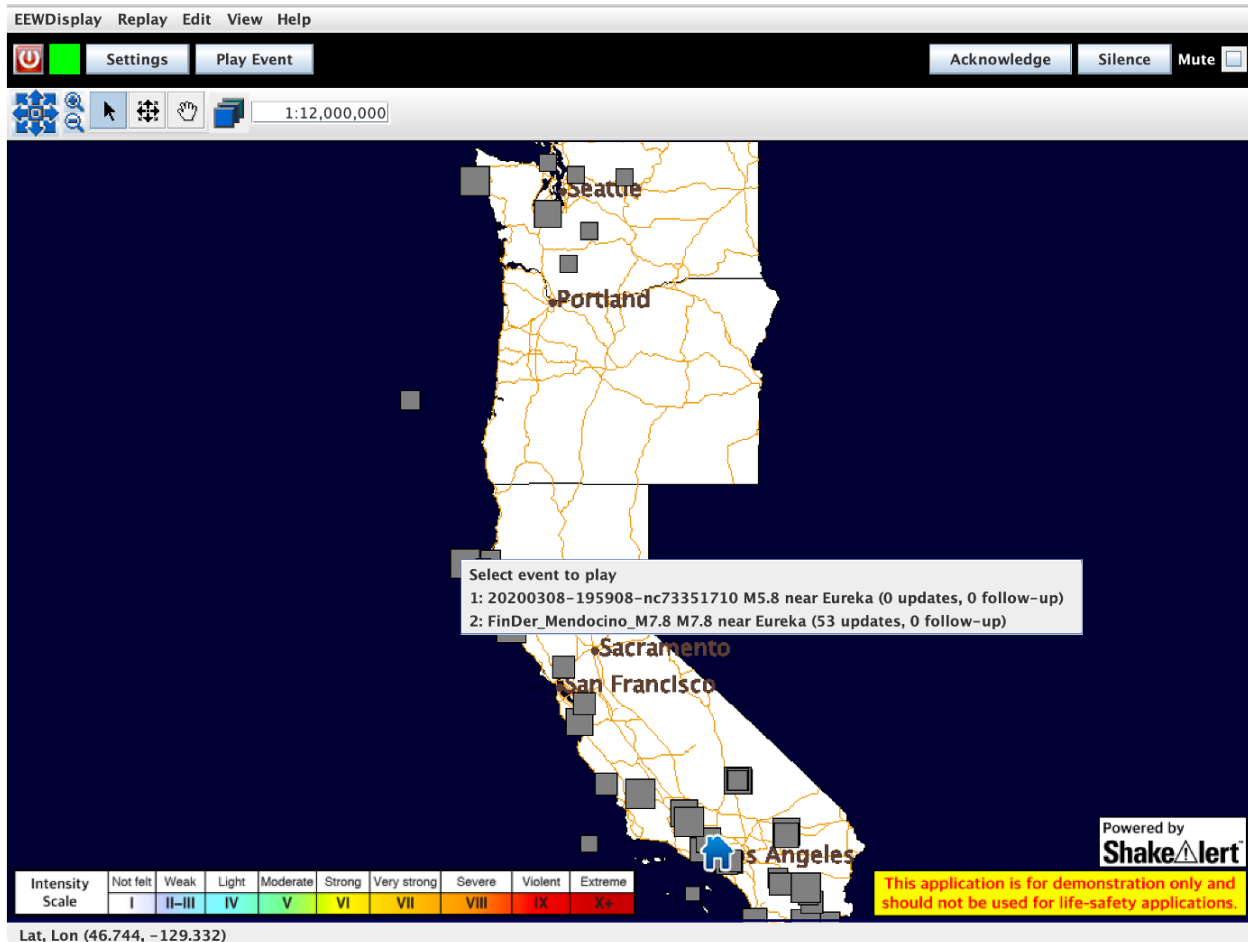
Notes:

- *Only visible layer selections made by the end-user are persistent through a program restart. Controls are present for other end-user modifications: arrows for layer re-ordering, plus/minus buttons for adding or removing layers, edit option for each layer. **We do not describe them further here as we suggest the end-user should not make use of these features in this EEWDisplay version.** Any changes made would not be persistent though a program restart, and would need to be made each time the program is launched.*
- *The vertical arrangement of names in the Layers dialog window represents their relative hierarchy on the display map. The mapping engine will draw the layers at the top of the list after drawing those at the bottom, so layers at the top of this list will be visible ‘above’ layers at the bottom. The end-user should beware of this behavior if moving large area layers (e.g. WC states) to the top of the list.*

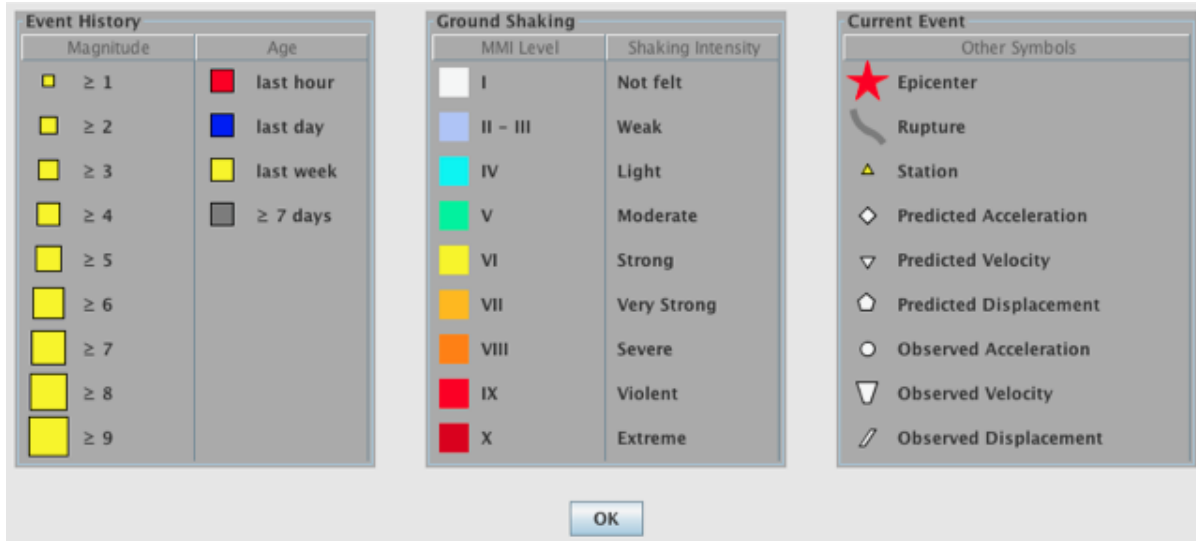
View

Change or refresh your display using the selections here.

- [Reset Map](#) changes your view of the map back to your preferred settings (see Settings panel). You can also use the keyboard shortcut Ctrl-L.
- [Clear Display](#) clears all alerts and other icons from the map. You can also use the keyboard shortcut Ctrl-D.
- [Toggle FullScreen](#) opens your program window to fill the screen (FullScreen) or, by clicking again, returns it to a smaller window. You can also use the keyboard shortcut Ctrl-F.
- [Show Status](#) opens the ShakeAlert Status box, showing the time and data servers being accessed, as well as any error messages. It also shows a latency value in seconds, which is the difference between the ShakeAlert system send time and your EEWDisplay’s receive time for the last message. You can launch this same box by double-clicking the Status Indicator light (the box that should be Green when properly connected) on the **Button bar**.
- [Show Log](#) opens a window and displays log messages.
- [Load Recent History](#) loads the most recent events from the end-user’s history folder into the history layer for easier replay. Up to 30 events will be shown. Events are shown as boxes colored by time. Since a number of events may have occurred at the same, or close, geographic locations, clicking on any event in the example or history layer will launch a pop-up menu listing the available events to play (figure below). Events are listed using their event ID (for events received in real-time this may include the date and time), magnitude, nearest city, and the number of updates in the sequence. Clicking on any event in the pop-up menu begins the replay.



- *Clear Recent History* removes recent history events from the history layer.
- *Load Examples* offers a sub-menu of standard, contour, map, or all, which determines whether the loaded example messages will contain ground motion information. Selecting one of these will load example events into the history layer for easier replay. Events are shown as boxes colored by time. Since all example events are old, they will appear as grey boxes. Note that if the end-user wishes to add further examples, they must be placed in the replay_data directory. Alternatively, if the end-user wishes to keep new examples in a separate folder, the ExamplesDir in the app.properties file can be added or edited to provide a full comma-delimited list of replay directories, e.g.:
ExamplesDir=replay_data/ShakeAlert_examples,replay_data/My_examples
- *Clear Examples* removes example events from the history layer.
- *Show Legend* launches a pop-up containing a legend for the symbols and scales shown on the map (see below). This includes the event symbols, their size and color-scaling, the MMI (intensity) color scale and other symbols that appear on the map such as site ground motion observations or recording stations.




Help


View documentation about ShakeAlert, including version details, copyright, end-user license agreements, and end-user guide link, and also access “Check for Updates” feature.

- [Readme](#) displays EEWDisplay README file. Note that this file contains useful reference information such as default server addresses and program configuration.
- [Changes](#) displays EEWDisplay Changes file. Note that this file contains information on bug fixes and new features available with different versions.
- [User Guide](#) opens a pdf of the EEWDisplay user guide. If a newer version of the document is available online, it will be downloaded and then opened as a pdf.
- [Evaluation License Agreement](#) opens a pdf of the Evaluation License Agreement. If a newer version of the document is available online, it will be downloaded and then opened as a pdf.
- [Check for Updates](#) has the program check for any pending updates to the interface.


Button Bar


- **Power-off icon.** Clicking this icon will terminate the EEWDisplay program. You will not get any more alerts until you restart the EEWDisplay program.
- **Program Status Light.** Click or hover cursor over the status light square, to the right of the Power icon, for information regarding connection status.


 *Green:* The communication between the ShakeAlert system and your EEWDisplay is healthy. You will be able to receive alert messages.

 *Grey:* There is no communication between the ShakeAlert system and your EEWDisplay. This may occur briefly at start-up or during reconnection attempts. If this status persists (several minutes) the end-user should check internet connection and then try using the ‘Reconnect to ShakeAlert server’ option in the

EEWDisplay menu. If the issue does not resolve, the User should exit the program and restart.

 *Yellow:* The ShakeAlert system is only partially operational or there is a connection problem to the Network Time Server. You are likely to receive alert messages. If an 'NTP Error' is showing, try reconnecting to the time server (EEWDisplay menu > Reconnect to Time server).

 *Cyan:* EEWDisplay connections have been disabled. If this is seen, the end-user should restart the program.

 *Red:* There is a connection problem to either the ShakeAlert servers, or the EEWDisplay program is unable to synchronize with a Network Time Server. Make sure your computer has a working Internet connection and that no firewalls are blocking that connection. Try reconnecting to the time server (EEWDisplay menu > Reconnect to Time server).

Problems connecting to the Network Time Server (NTP) are reflected in the color of the program status light, as well as connection issues for receipt of ShakeAlert Messages. If the status light is yellow or red and an "NTP Error" is identified, this can lead the event info panel on the left to report incorrect warning times. NTP status messages are also included in the main log accessible within the program (from the top Menu bar, click View > Log). If errors with specific components of the ShakeAlert servers are indicated the end-user does not need to take any action.

- **Settings button** opens the Settings dialog box; for details, see Top Menu Bar > Edit > Settings.
- **Play Event button** is the same as selecting from the Top Menu Bar, Replay > Play Event, and launches the Select Event dialog box so you can choose a past event to replay.

Advanced End-users: XML-messages from the ShakeAlert system that have been received by the EEWDisplay (while connected to power and internet) will be stored on your computer in the "history" folder. When you click on the "Play Event" button, an open-file dialog appears. You may click on one of the subfolders (within the history folder the name of the subfolders indicates the ShakeAlert eventID; note that this id is different from the eventID that is used in ShakeMap for instance) and replay an event by double-clicking on the file with the ".eew" extension. The event will not be displayed, if the threshold parameters in "Settings" are not exceeded, or if the warning time is zero or negative.

Starting with release v2.4, the EEWDisplay is capable of processing and displaying finite fault ruptures and the estimated slip along these ruptures. This feature improves intensity estimates at the end-user's site for large earthquakes ($M > 6.5$). To get more familiar with the finite fault capabilities of the EEWDisplay, we recommend replaying the examples from the "examples" folder. You will find examples for a number of scenario earthquakes in folders "SYN_". Click on the .eew file to start the corresponding animation. For scenarios in the "SYN_" folder, the grey line shows the estimated rupture of the earthquake. The

EEWDisplay will use the closest distance between the rupture and your site to calculate the expected intensity that you would feel if this event were real.

- **Acknowledge button** will act on the current event to prevent the EEWDisplay from popping-up and grabbing screen focus for event updates. The EEWDisplay will **continue to receive** and log the updates, so they will be available for replays, and audio-visuals will continue to update in the background.
- **Silence button** quiets a current alert. You can also use the keyboard shortcut Ctrl-S. This feature mutes ONGOING alerts, for example to suppress audio alerts for distant earthquakes with long warning times that may be irrelevant to the end-user.
- **Mute checkbox** will silence all incoming and simulated alert. You can also mute alerts with the keyboard shortcut Ctrl-M. The “mute” button is useful to silence the EEWDisplay during a large aftershock sequence after a strong earthquake.

Top of Program Status/Shortcuts

Hover your cursor over the EEWDisplay icon at the top of your computer window (or wherever your taskbar or dock is located) to view the EEWDisplay version number, current date and time, and current connection status to the ShakeAlert servers. The color of the icon shows the EEWDisplay status (see the **Program Status Light** section for explanation of color codes).

Some caveats:

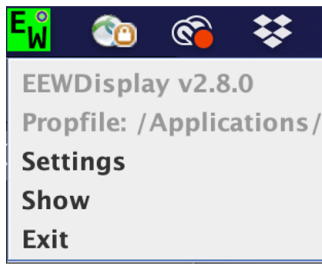
- Linux end-users have reported that the resulting status message does not wrap properly.
- Windows end-users will find the EEWDisplay icon in their Notification Area (see Figure 4). Click the up-arrow on your task bar to open the Notification Area.
- Windows end-users can customize the system tray so the EEWDisplay icon is always visible in the task bar. Right-click the task bar, select Properties, and click “Customize...”; on next screen, choose “Show icon and notifications” for EEWDisplay (Java™ Platform).

If you click once (Mac) or right-click (Windows/Linux) on the EEWDisplay icon, you will get information on the running version and properties file plus three shortcuts for the program:

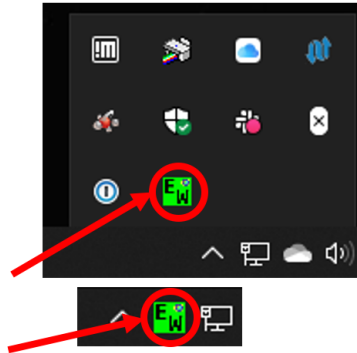
Settings: Displays the Settings dialog box

Show: Brings the EEWDisplay program from a minimized state

Exit: Exits or shuts down EEWDisplay

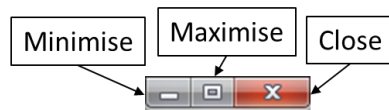


Mac view of EEWDisplay icon; click to view the shown shortcuts menu.



The EEWDisplay icon can be found in the Notifications area for Windows users (top). Right-click to see the shortcuts. It can also be dragged into the taskbar (bottom).

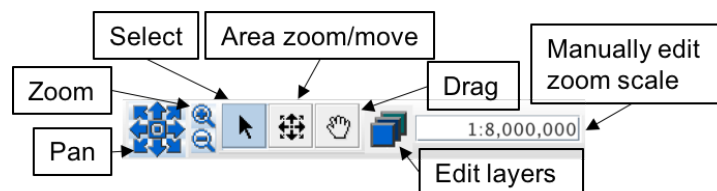
Minimize/Maximize and Close the EEWDisplay Window



Standard operation of EEWDisplay is to close the window using the ‘Close Window’ button. This will ensure that the EEWDisplay will still be running and will pop up automatically when an event alert is received that meets the User’s alert criteria. The status icon on your taskbar or dock is the indication that EEWDisplay is still running. Minimizing the window will lead to the same behavior. (Click the Power Off icon on the **Button Bar** to terminate the program completely.)

Map Navigation

The navigation buttons allow you to move around on the EEWDisplay.



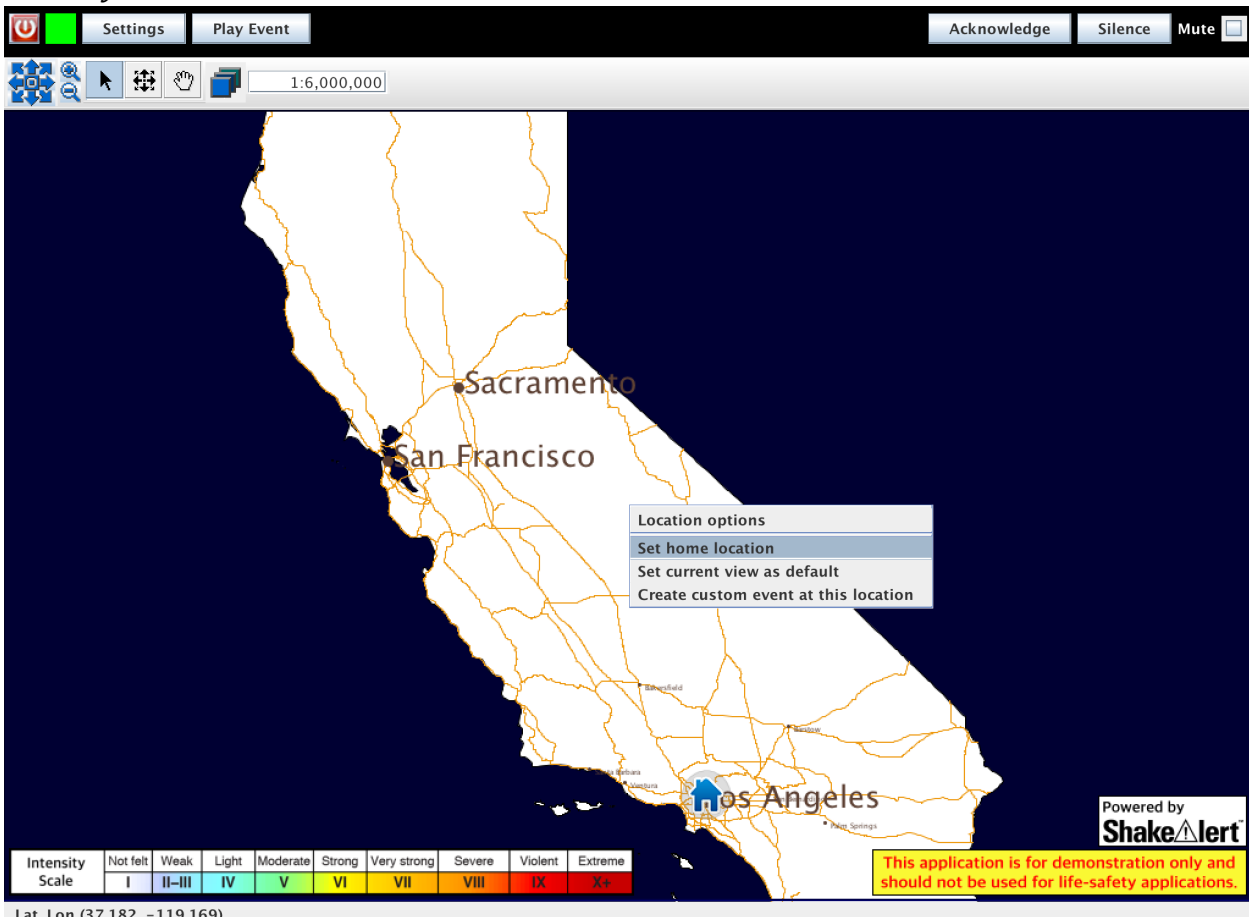
- **Pan:** This button on the far left, when its arrows are clicked, allows you to pan east, west, north, south (horizontal and vertical arrows), as well as northeast, northwest, southwest, and southeast (corner arrows). Click the center of this icon to center the state of California in your window.
- **Zoom:** Click the Plus magnifying glass to zoom into the display, and the Minus magnifying glass to zoom out.
- **Select:** Change your cursor to a selector, e.g., to click buttons, select events for replay.
- **Area Zoom/Move:** Click on the button to use mouse clicks and drags to control map positioning. Clicking on the top, bottom or sides of the map area will move the map in

the desired direction. Clicking and holding the left mouse button allows the end-user to drag to select a desired map area. The area is centered on the position of the mouse click.

- **Drag:** Click on the hand and then click-hold on the screen, to drag the display to where you wish.
- **Edit Layers:** Click on the Layers button to launch a dialog to edit the layers visible in the main EEWDisplay window, such as displays of roads and towns, and event features such as P and S wavefronts. This gives the end-user greater control to switch both map and event features on and off in their display. Further details can be found in the section Top Menu Bar > View > Edit Layers.
- **Zoom level:** Edit the zoom level scaling manually.

A shortcut for setting your current location is also available from the map: a right-click (or two-finger click on Mac) launches a menu of 'Location options'. The first option is to 'Set home location' to the location of your mouse/cursor. The next option is to save the current view and zoom factor as your default at startup. The last option is to create a custom event at this location.

When moving the cursor across the map, the lat/lon values will be displayed in the lower left corner. The zoom level is displayed in a text box near the top in the navigation bar just below the "Play Event" button.



4. Alert Information

When the EEWDisplay receives an XML ShakeAlert Messages message from the ShakeAlert, the following information will be displayed (provided that your thresholds in “Settings” are exceeded and the remaining warning time is greater than 1 second):



The following symbols appear on the map after an event occurs:

- Red star – Location of current event
- Thick grey line – Finite fault rupture (only visible if an algorithm that calculates finite fault reports for the event)
- Yellow triangles (pointed up) – Approximate location of earthquake sensing station(s)
- Ground motion symbols, color coded by MMI at each location. If an algorithm has reported ground motion information for a particular station location, a color-coded symbol will appear, and if the cursor is hovered over the symbol information on the station code and ground motion value will be given. See the legend for which symbol represents which type of ground motion.
- Ground motion contours or maps - Polygons or grids color-coded by MMI for predicted shaking intensities (see screen captures below). These will appear if EEWDdisplay is configured to receive the contour or map message topic.
- Follow-up information reflects the results of Human Review of the ShakeAlert Message. ShakeAlert Duty Review Team follow-up information will be displayed on the map in a grey box in the upper right. The end-user could receive a 'follow-up' message indicating a human review result of:

- Successful Alert: A ShakeAlert Message was issued and the alert delivered to EEWDisplay had a reasonable location and magnitude.
- Inaccurate Alert: USGS issued a ShakeAlert Message for a real earthquake, but the ShakeAlert system misjudged the location and/or magnitude. The alert delivered to EEWDisplay has inaccuracies.
- Cancelled Alert: The USGS issued a ShakeAlert Message when the event posed little or no ground shaking hazard or there was no earthquake at all. The alert delivered to EEWDisplay was cancelled.
- Missed Alert: An acknowledgement message that a significant earthquake occurred but no ShakeAlert Message was issued by the USGS resulting in no ShakeAlert-powered alert delivery to EEWDisplay. Earthquake parameters of the message are imported from an Advanced National Seismic System (ANSS) network solution.

A. **Map**: Your location is shown by a blue house, and the estimated location of the earthquake by a red star (and/or a thick grey line if a finite fault solution is displayed). The map is automatically centered on a point halfway between the two locations. The yellow and red radiating circles show the estimated locations of the P and S wavefronts of the earthquake, respectively.

P-waves, which travel faster than S-waves, rarely cause damage because amplitudes are smaller and ground motions are predominantly in the vertical direction. The yellow circle, representing the P-wavefront at a given time, will always be larger than the red circle (S-wavefront). Damage is typically caused by S-waves.

The “remaining time” is the estimated time it will take for the S-wavefront (red circle) to reach your location. For some events you will also see estimated or observed ground motions at various sites shown by filled inverted triangles or circles respectively.

The map will also display information on a banner in the upper center of the map:

- “Server Warning” - ShakeAlert server is running but there are some issues. No end-user action is required.
- “Server Error” - ShakeAlert server error. No end-user action is required.
- “System Offline” - Connections are disabled. end-user should restart the program.
- “No NTP Connection” - Problem trying to synchronize with the NTP server. end-user should check internet connection. If the warning remains after a few minutes, end-user should try forcing ‘Reconnect to Time server’ from the EEWDisplay menu. If the warning persists and the end-user’s computer clock is accurate, then consider disabling ‘Synchronize’ by unchecking the box on the Settings panel under Advanced Settings > Time Server Parameters.
- “No Connection” - No connection to the ShakeAlert servers can be established. After 1 minute the end-user should try forcing a ‘Reconnect to ShakeAlert server’ from the EEWDisplay menu, or a restart of the program.
- “Connection Pending” - Connection to ShakeAlert servers is being established. No end-user action is required unless the message persists beyond several minutes.

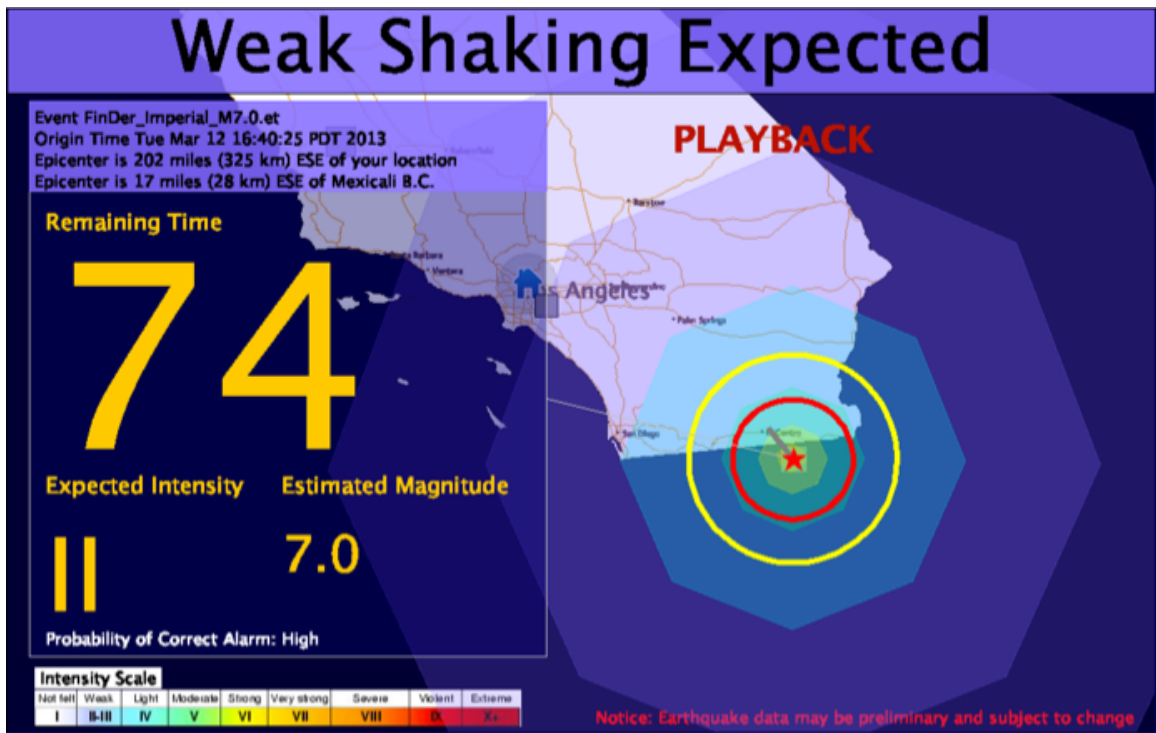
- “Program Error” - Unclassified errors. end-user should restart the program. If the error persists, the end-user should try re-installing the program.
- “Audio Unavailable” - There was an error initializing audio.
- “Audio Muted” - Mute checkbox is selected, click it to toggle.
- “Audio Silenced” - Audio has been disabled for the current event using the Silence button.
- “Audio Filtered” - Current alert has parameters below thresholds set in the Audio Threshold section of the Settings panel.
- “Playback” - Event shown on the map is a replay.
- “Alert Cancelled” - The duty reviewer cancelled the current alert by ShakeAlert system.
- “This is a Test” - Current alert is a test event sent by a ShakeAlert server.

You may notice a grey circle around your location. This approximates the area where, if an earthquake starts within this region, EEWDisplay is extremely unlikely to deliver an alert before shaking arrives. If an earthquake occurs within this area, you will likely experience the shaking before you could receive an alert. We are working to decrease the radius of this area in future versions of the ShakeAlert system.

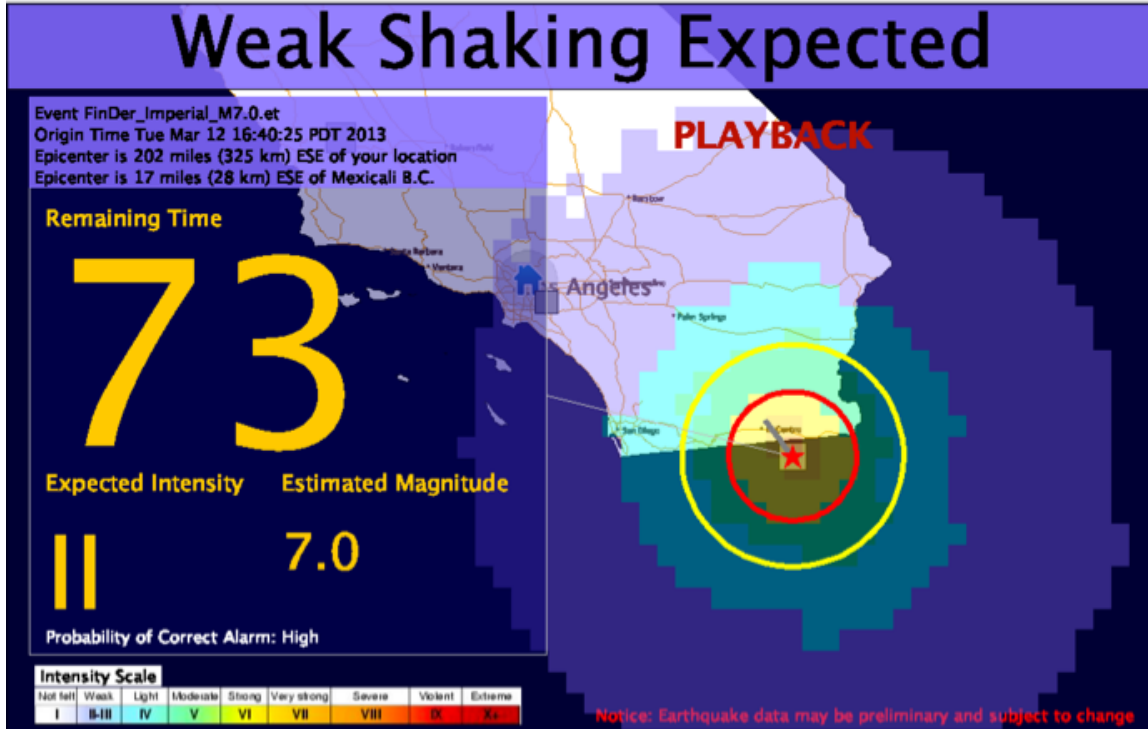
- B. **Information Panel:** The panel on the left side of the screen gives the estimated time (in seconds) remaining until shaking is expected to begin at your location, the estimated seismic intensity on the Modified Mercalli Intensity (MMI) scale, and the estimated magnitude. The Information Panel also gives the Probability of Successful Alert (PCA); we have introduced three PCA levels: “low”, “moderate”, and “high”. The top section of the panel gives event ID, estimated event origin time and epicenter.
- C. **Top Panel:** the top panel describes the level of expected shaking at your location (in words and in color), e.g. “Light Shaking Expected”.



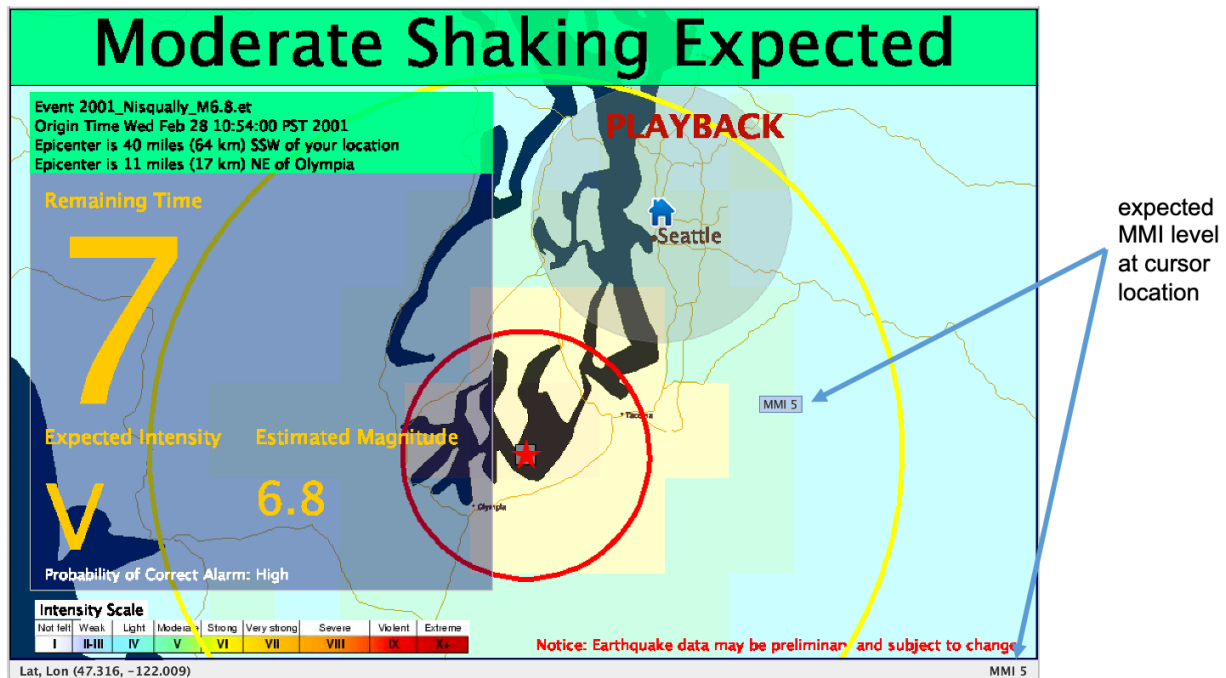
Finite fault detection capability of EEWDisplay. Thick grey line shows extent of current fault rupture.



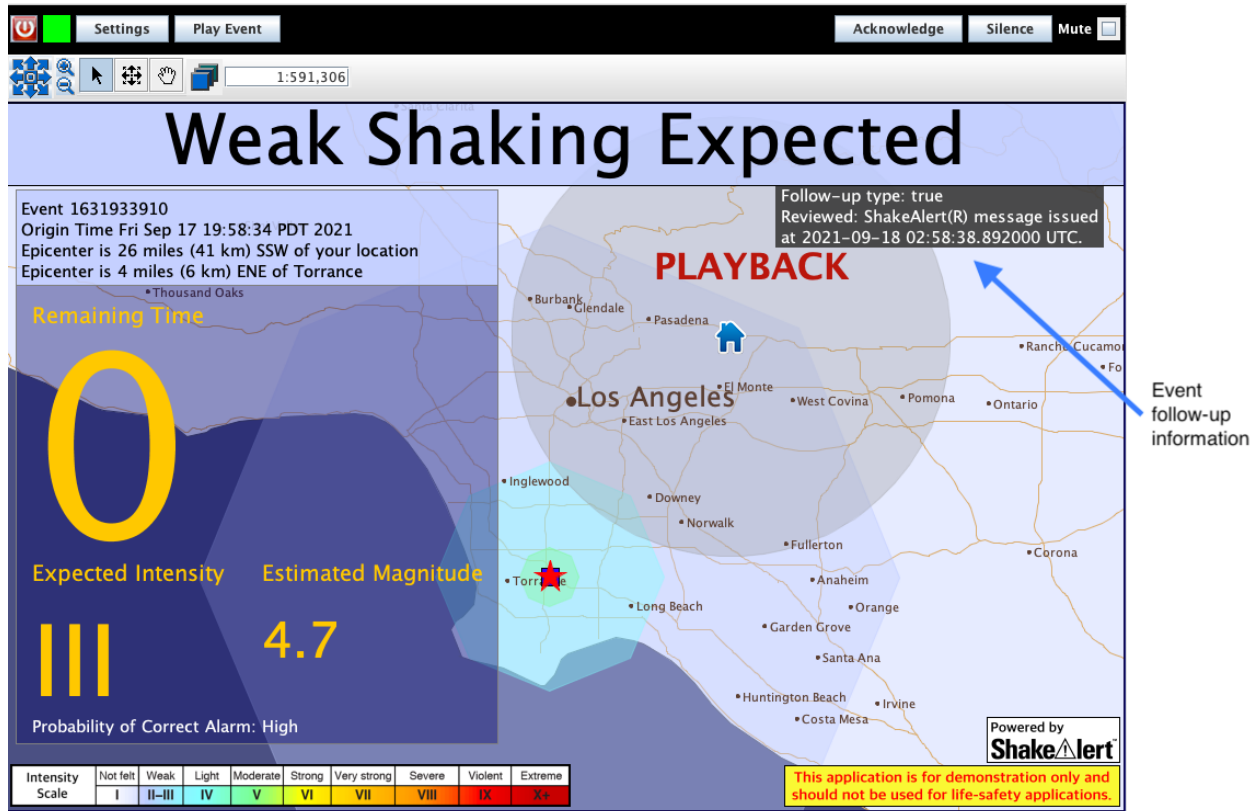
Ground motion message contour display in EEWDisplay. Contours are colored by intensity scale shown.



Ground motion message map display in EEWDisplay. Grid points are colored by intensity scale shown.



Expected MMI level will be shown on the map and in the lower right for the current cursor position when either map or contour messages are displayed.



If a follow-up Message is published by the ShakeAlert system, it will be shown on the map, giving both the type of follow-up and any text sent with the message.

Important: Do not forget to turn on the volume of your computer, and do not check the “mute” box at the top of your EEWDisplay if you want to hear alerts (siren and voice announcement).

This Operations Guide was written by M. Böse and J. Andrews (Caltech), with project overview and installation instructions provided by members of the ShakeAlert Joint Committee for Communication, Education, Outreach, and Technical Engagement (JCCEO & TE), and with input from past and present members of the ShakeAlert team members from the following institutions: UC Berkeley, California Institute of Technology (Caltech), ETH Zurich, USC/SCEC, US Geological Survey.

5. Contact information

For questions or feedback please contact:

Southern California	Margaret Vinci (Caltech)	mvinci@gps.caltech.edu	626-395-3298
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	Tal Edgecomb (UC Berkeley)	tale@berkeley.edu	
Oregon	Lucy Walsh (University of Oregon)	lwalsh@uoregon.edu	541-346-4654
Washington	Bill Steele (University of Washington)	wsteele@uw.edu	206-685-5880
Washington & Oregon	Gabriel Lotto (University of Washington)	glotto@uw.edu	
USGS	Robert de Groot (USGS)	rdegroot@usgs.gov	626-583-7225

Additional information on the ShakeAlert Project can be found at <https://www.shakealert.org>. Thank you very much for your participation. We are looking forward to your feedback.

6. Troubleshooting

You may encounter one or more of the following issues when running the EEWDisplay:

- 1) **Problem:** Warning time is excessive for location of epicenter

Solution: Check the computer's internal clock. If the computer's clock is incorrect, it will adversely affect the accuracy of warning time. Verify the connection to the NTP server to obtain correct time information.

- 2) **Problem:** EEWDisplay did not record recent events in your absence.

Solution: Turn off "sleep mode" on your computer.

- 3) **Problem:** Computer slow to respond or locks up when EEWDisplay is running.

Solution: Computer resources are insufficient to run the EEWDisplay. Close non-essential applications.

- 4) **Problem:** Not receiving email notices about planned ShakeAlert system tests, etc.

Solution: Make sure your correct contact information is in our database. Contact your ShakeAlert Technical Engagement Regional Coordinator as listed in the Contact Information Section.

- 5) **Problem:** Gray circle around Home does not update when location is changed in settings window.

Solution: Force a redraw of the main window by changing the zoom level or pan the display around. Note that the grey zone is only an estimate. It is not used for any calculations within the EEWDisplay.

- 6) **Problem:** What do the different status colors mean: green, grey, yellow, cyan or red?

Solution: Click or hover cursor over the status box for information regarding connection. See the section Button Bar > Program Status Light for detailed descriptions of status light.

- 7) **Problem:** "CONNECTION PENDING" appears in red on map, status may be any color.

Solution: No connection yet. If the problem does not resolve itself within a few minutes, check your Internet connection.

- 8) **Problem:** "NO CONNECTION" appears in red on map, status may be any color.

Solution: No connection to ShakeAlert server. Make sure the computer has access to the internet. Check ShakeAlert server and port settings. See README file for list of servers and ports. If there is a connection problem and the problem does not resolve after several minutes, you can use the EEWDisplay > Reconnect to ShakeAlert server menu item to try re-establishing your connection.

Instead of the default port 61617, you could try using port 443 in the Settings dialog. You will need to restart the program after making any changes to the server settings.

- 9) **Problem:** “NO NTP CONNECTION” appears in red on map, status may be any color, pop-up text says “NTP ERROR”.

Solution: Problem connecting to NTP server. Note that it may take several minutes for this to update. If the problem does not resolve after several minutes, you can use the EEWDisplay > Reconnect to ShakeAlert server menu item to try re-establishing your connection.

Alternative settings for the NTP server can be configured using the NTP Server Name field in the Settings dialog, launched from Settings button or Edit > Settings menu option. The default NTP server is currently set to us.pool.ntp.org. Try changing to other NTP servers such as time.nist.gov or ntp-01.caltech.edu. Each time you change the NTP server you will need to exit the EEWDisplay program (EEWDisplay > Exit or the red ‘power off’ icon on the left of the button bar) and restart the program.

If problems connecting to NTP servers are persistent, the EEWDisplay can be switched to using the clock on the end-user’s computer by unchecking the ‘Synchronize’ box on the Settings dialog, under Advanced Settings > Time Server Parameters. The end-user should be certain that the computer clock is accurate, otherwise warning times will be incorrect or alerts may be missed.

- 10) **Problem:** “SYSTEM OFFLINE” appears in red on map and status may be any color.

Solution: Unless you just tried to change the NTP connection, there may be a problem with one of the ShakeAlert servers. If the problem does not resolve itself in a few minutes you could try to force a reconnect using EEWDisplay > Reconnect to ShakeAlert server or quit and restart the program. It may take several minutes for the status to refresh while the program is trying to reconnect.

- 11) **Problem:** There are no events in my history folder to select for replay.

Solution: When the software is first downloaded there will be no events in the history folder. This is where alerts are stored that have been received by the EEWDisplay while it has been running. See the README file in your installation directory for instructions on how to copy old history files from a previous version.

- 12) **Problem:** Error message appears with the message that you cannot connect to the ShakeAlert server. This is most likely due to your institution’s restrictions on port access through firewalls for example.

Solution: Launch the Settings dialog using the button on the button bar and change the port number from the default 61617 to 443. Press OK, exit the EEWDisplay and restart.

- 13) **Problem:** When I double-click on the EEWDisplay launch icon nothing appears, I do not see the EEWDisplay splash logo.

Solution: There is likely a problem with the java installation and the EEWDisplay program cannot be launched. Try re-installing java.

14)**Problem:** When I double-click on the EEWDisplay launch icon I do see the EEWDisplay splash logo but the program does not start.

Solution: There is likely a problem with the EEWDisplay installation. Try reinstalling EEWDisplay.

15)**Problem:** When launching EEWDisplay I get an error pop-up dialog saying there is a file missing or problem copying a file.

Solution: There is likely a problem with the EEWDisplay installation. Try reinstalling the EEWDisplay program.

16)**Problem:** When launching EEWDisplay I get a warning pop-up dialog saying there is a newer configuration file available, would you like to replace.

Solution: Select 'Yes' to use the new file and a backup copy of your old file will be made should you want to revert (by manually replacing the new file with the old in your local directory). Select 'No' to use your existing file but note you will be prompted at each program re-start.

17)**Problem:** The Auto Login checkbox keeps getting cleared and I have to manually login.

Solution: Any changes to the ShakeAlert server list, port, alert topic, NTP settings will automatically deselect the Auto Login checkbox in case there is a problem reconnecting. Once the new settings are confirmed you can re-enable auto login.

18)**Problem:** EEWDisplay text looks too small on high resolution monitors.

Solution: In the Settings Panel, try using a slightly larger value for HDPI Font Size Multiplier. The default is 1, increment by .5 at a time. You will need to restart the program for the change to take effect. Note if you set it too large then you might not be able to change it back if the OK button does not fit on the screen. If this happens, quit the program, delete your app.properties file and restart the program.

On Windows you can try also try the following:

Right mouse on the desktop shortcut, select properties. On the new dialog select Compatibility then under Settings at the bottom select "Change high DPI settings". Check "Override high DPI scaling behavior. Scaling performed by Application". Hit OK and restart the program.

7. Known Issues

- 1) **Issue:** The EEWDisplay flickers, is incompletely redrawn, and/or the audio is uneven during an earthquake alert.

This is a known problem with Java 8 update 121, which was released January 17, 2017. It does not affect all computers but appears to be particularly worse on Windows. Previous versions of the EEWDisplay may also be affected by the recent java updates. Reverting to versions of Java 8 prior to 101 should improve the display or upgrade to a more recent version. As of July 2021, the most recent version of Java 8 is update 301. It may also help to disable some of the more detailed map layers.

- 2) **Issue:** EEWDisplay does not always recover from an incorrect server/port combination. Using EEWDisplay menu options to reconnect does not always work.

Confirm valid connection to the Internet. Correct server and port entries and restart program.

8. Example Event Directory

Example events are made available for replay to demonstrate ShakeAlert-powered alerts delivered to the end-user featuring the audio and visuals of the EEWDisplay program. Examples include events in different geographic regions and at different magnitudes, as well as ShakeAlert-powered follow-up alerts delivered to the end-user: cancellation, inaccurate, and missed. Additional events could be added to the Scenario Server in the future. Scenario Server events have four categories:

Actual - Events that have previously been detected during actual ShakeAlert operation.

Special - Events and Messages that illustrate peculiar or unusual aspects of the ShakeAlert Message set.

Historical - Historical events known from network archives that occurred within the ShakeAlert operational region. For most events, seismic data have been drawn from the archives, then replayed through ShakeAlert software to develop Messages.

Scenario - Imagined possible large earthquakes. Thankfully, the largest earthquakes are rare. *Scenario* category events help fill in the gaps where locations or magnitudes of real events have not been recorded.

Actual Events

ElMonte_20200919 = Actual, M4.5 El Monte (east LA)

Event ID: M4.5 El Monte (east LA)

Description: Deep (18 km), under east LA , 2020-09-19; with update messages, follow-up

Magnitude: M4.5; Location: 34.07, -118.09; Depth: 18 km
Event Notes: Felt throughout LA. Ex. moderate eqk in densely populated area. Ex. alert before S-wave reaches surface. follow-up realistic at at 348 s

Westmoreland = Actual, M4.6 Westmoreland

Event ID: M4.6 Westmoreland

Description: Westmoreland (S. Imperial Valley), 2020-10-01; with update messages, follow-up

Magnitude: M4.6; Location: 33.04, -115.6; Depth: 8 km

Event Notes: ShakeAlert peak magnitude >5.0; WEA triggered. follow-up realistic at 173s

TCEVENTS/RidgecrestM7.1 = Actual, M7.1 Ridgecrest, mainshock

Event ID: M7.1 Ridgecrest, mainshock

Description: Eastern California, 2019-07-06, long rupture, finite-fault solution, with updates

Magnitude: M7.1; Location: 35.77, -117.62; Depth: 9 km

Event Notes: Widely felt in Los Angeles 200 km from epicenter; magnitude increases with time; event time = time of T&C rerun; "T&C" = Test and Certification, indicates an event with seismic data used to test ShakeAlert software

TCEVENTS/RidgecrestM6.4 = Actual, M6.4 Ridgecrest, foreshock

Event ID: M6.4 Ridgecrest, foreshock

Description: Eastern California, 2019-07-04, with updates, finite-fault solution, no follow-up

Magnitude: M6.4; Location: 35.77, -117.62; Depth: 9 km

Event Notes: Widely felt in north Los Angeles 200 km from epicenter; magnitude updates with time. Event time = time of T&C rerun

TCEVENTS/RidgecrestM5.5 = Actual, M5.5 Ridgecrest aftershock

Event ID: M5.5 Ridgecrest aftershock

Description: Eastern California, 2019-07-05, with updates, no followup

Magnitude: M5.5; Location: 35.77, -117.62; Depth: 9 km

Event Notes: Large aftershock of M6.4; event time = time of T&C test

TCEVENTS/RidgecrestM5Foreshock = Actual, M5.0 Ridgecrest foreshock

Event ID: M5.0 Ridgecrest foreshock

Description: Eastern California, 2019-07-06, near foreshock to M7.1; with updates, no follow-up

Magnitude: M5.0; Location: 35.77, -117.62; Depth: 9 km

Event Notes: Foreshock minutes before Ridgecrest M7.1; event time = time of T&C test

Seattle = Actual, M4.6 Seattle-area

Event ID: M4.6 Seattle-area

Description: Moderate Seattle-area event, 2019-07-12; with update messages

Magnitude: M4.6; Location: 47.89, -121.97; Depth: 9 km

Event Notes: Widely felt

Special Events

ForeMain = Special, Foreshock/Mainshock

Event ID: Foreshock/Mainshock

Description: foreshock-main shock event pair, both with updates; actual event pair

Magnitude: M4.0, 4.9; Location: 34.07, -118.09; Depth: 18 km

Event Notes: Foreshock-mainshock pair. foreshock 26 s. before main; updates interleave - last update of foreshock comes in middle of mainshock updates.

NMexico = Special, M5.5 N Mexico

Event ID: M5.5 N Mexico

Description: 2020-03-07; south of border, with updates

Magnitude: M5.5; Location: 31.74, -114.58; Depth: 8 km

Event Notes: Event in Mexico; ShakeAlert contours reach inside US

Ferndale = Special, M5.1 Ferndale

Event ID: M5.1 Ferndale

Description: 2020-03-18; Moderate event near shore, with updates

Magnitude: M5.1; Location: 40.42, -124.24; Depth: 9 km

Event Notes: ShakeAlert inflates magnitude, moves event far offshore

FerndaleM3 = Special, M3.0 Ferndale

Event ID: M3.0 Ferndale

Description: 2020-11-02; Small event off NW California; with updates and qualified follow-up at 30s

Magnitude: M3.0; Location: 40.29, -124.63; Depth: 8 km

Event Notes: ShakeAlert inflated magnitude, moves event far offshore with large M, outside alert boundary; then back near shore with reasonable magnitude

Point_Source/missed_20200309 = Special, M5.9 Mendocino

Event ID: M5.9 Mendocino

Description: 2020-03-09; Missed alert example

Magnitude: M5.9; Location: 40.39, -125.09; Depth: 3.2 km

Event Notes: ShakeAlert located outside alert boundary; no alert sent. Actual event near shore, felt

FalseAlertFollowUp_M4.6 = Special, M4.6 Salton Sea false alert

Event ID: M4.6 Salton Sea false alert

Description: False alert with update and follow-up

Magnitude: M4.6; Location: 33.24, -115.7; Depth: 8 km

Event Notes: Example false alert, magnitude to trigger apps, with one update before ending; with follow-up message at 25s. Realistic delay to follow-up would be 300-600s.

FalseAlertFollowUp_M5.2 = Special, M5.2 Salton Sea false alert

Event ID: M5.2 Salton Sea false alert

Description: False alert with updates and follow-up

Magnitude: M5.2; Location: 33.24, -115.7; Depth: 8 km

Event Notes: Example M>5 false alert with three updates; with follow-up message at 25s.

Realistic delay to follow-up would be 300-600s.

Historical Events

TCEVENTS/AlumRock = Historical, M5.6 Alum Rock

Event ID: M5.6 Alum Rock

Description: South of San Jose, 2007-10-30, with updates, no follow-up

Magnitude: M5.6; Location: 37.43, -121.76; Depth: 9 km

Event Notes: Felt throughout South Bay region; event time=time of T&C test

TCEVENTS/Napa2014 = Historical, M6.0 South Napa

Event ID: M6.0 South Napa

Description: Napa Valley, NW of San Francisco, 2014-08-24, with updates, no follow-up

Magnitude: M6.0; Location: 38.21, -122.31; Depth: 9 km

Event Notes: Widely felt in North Bay; event time=time of T&C test

TCEVENTS/SanSimeon2003 = Historical, M6.5 San Simeon

Event ID: M6.5 San Simeon

Description: California central coast, 2003-12-22; with updates, no follow-up

Magnitude: M6.5; Location: 35.67, -121.12; Depth: 9 km

Event Notes: Widely felt; west of the San Andreas fault; event time=time of T&C test

Point_Source/1952_KernCounty_M7.3 = Historical, M7.3 Kern County

Event ID: M7.3 Kern County

Description: South of Bakersfield, 1952; point source, no updates

Magnitude: M7.3; Location: 35.00, -119.01; Depth: 10 km

Event Notes: Legacy scenario; largest instrumental era earthquake in SoCal; Intensity V in downtown Los Angeles, widely felt.

TCEVENTS/ChinoHills2008 = Historical, M5.4 Chino Hills

Event ID: M5.4 Chino Hills

Description: East of Los Angeles, 2008; with updates, no follow-up

Magnitude: M5.4; Location: 33.953, -117.76; Depth: 5 km

Event Notes: Intensity IV in downtown Los Angeles; event time = time of T&C test

TCEVENTS/LaHabra2014 = Historical, M5.1 La Habra

Event ID: M5.1 La Habra

Description: East of Los Angeles, 2014; with updates, no follow-up

Magnitude: M5.1; Location: 33.932, -117.917; Depth: 4.8 km

Event Notes: Intensity III in downtown Los Angeles; event time = time of T&C test

Point_Source/1994_Northridge_M6.7 = Historical, M6.7 Northridge
Event ID: M6.7 Northridge
Description: Northridge, 1994-01-17; north of Los Angeles; point source, no updates
Magnitude: M6.7; Location: 34.207, -118.535; Depth: 5 km
Event Notes: Legacy scenario; damaging; widely felt

Point_Source/1971_SanFernando_M6.6 = Historical, M6.6 San Fernando
Event ID: M6.6 San Fernando
Description: North San Fernando Valley, 1971; point source, no updates
Magnitude: M6.6; Location: 34.416, -118.37; Depth: 8.4 km
Event Notes: Legacy scenario; Intensity VI in downtown Los Angeles

SYN_Imperial_M7.0 = Historical, M7.0 Imperial
Event ID: M7.0 Imperial
Description: Imperial fault, finite fault with updates
Magnitude: M7.0; Location: 32.52, -115.21; Depth: 10 km
Event Notes: Legacy scenario

TCEVENTS/HectorMine1999 = Historical, M7.2 Hector Mine
Event ID: M7.2 Hector Mine
Description: Desert northeast of San Bernardino, 1999; finite fault source, with updates, no follow-up
Magnitude: M7.2; Location: 34.63, -116.3; Depth: 0 km
Event Notes: Intensity VII in downtown Los Angeles; event time = time of T&C test

TCEVENTS/Anza2013 = Historical, M4.7 Anza
Event ID: M4.7 Anza
Description: Mountains SE of Los Angeles, 2013; with updates, no follow-up
Magnitude: M4.7; Location: 33.5973, -116.5137; Depth: 9 km
Event Notes: Intensity VI in downtown Los Angeles; event time = time of T&C test

TCEVENTS/NISQUALLY_2001 = Historical, M6.8 Nisqually, WA
Event ID: M6.8 Nisqually, WA
Description: Deep Seattle-area, 2001; with update, no follow-up
Magnitude: M6.8; Location: 47.149, -122.727; Depth: 51.9 km
Event Notes: Intensity VIII in Olympia; event time = time of T&C test

TCEVENTS/COWLITZ_2006 = Historical, M4.5 Cowlitz Chimneys, WA
Event ID: M4.5 Cowlitz Chimneys, WA
Description: SE of Seattle, 20061008, with updates, no follow-up
Magnitude: M4.5; Location: 46.85, -121.6; Depth: 9 km
Event Notes: Cowlitz Chimneys, SE of Mt Hood; event time = time of T&C test

TCEVENTS/LEAVENWORTH_2013 = Historical, M4.0 Leavenworth, WA
Event ID: M4.0 Leavenworth, WA
Description: E of Seattle, 20130627, with updates, no follow-up

Magnitude: M4.0; Location: 47.84, -120.64; Depth: 8 km
Event Notes: Central WA, east of Seattle; small crustal event; event time = time of T&C test

TCEVENTS/MT_ST_HELENS_2011 = Historical, M4.2 Mt St Helens, WA
Event ID: M4.2 Mt St Helens, WA
Description: S Washington, 20110214, with updates, no follow-up
Magnitude: M4.2; Location: 46.27, -122.2; Depth: 9 km
Event Notes: 90 km NNE of Portland; event time = time of T&C test

Point_Source/1993_ScottsMills_Oregon_M5.6 = Historical, M5.6 Scotts Mills, OR
Event ID: M5.6 Scotts Mills Oregon 1993
Description: Scotts Mills Oregon, 1993; point source, no updates
Magnitude: M5.6 Location: 45.035, -122.607; Depth: 19.6 km
Event Notes: New scenario

Point_Source/1993_KlamathFalls_Oregon_M6.0 = Historical, M6.0 Klamath Falls, OR
Event ID: M6.0 Klamath Falls Oregon 1993
Description: Klamath Falls Oregon, 1993; point source, no updates
Magnitude: M6.0; Location: 42.358, -122.058; Depth: 8.5 km
Event Notes: New scenario

TCEVENTS/OFF_OREGON1_2004 = Historical, M4.8 Off Oregon 2004
Event ID: M4.8 Off Oregon 2004
Description: Off shore Oregon, 20040712, with updates, no follow-up
Magnitude: M4.8; Location: 43.65, -126.48; Depth: 8 km
Event Notes: Offshore Oregon; event time = time of T&C test

TCEVENTS/OFF_OREGON2_2010 = Historical, M4.7 Off Oregon 2010
Event ID: M4.7 Off Oregon 2010
Description: Off central Oregon coast, 20100728, with updates, no follow-up
Magnitude: M4.7; Location: 43.65, -126.48; Depth: 8 km
Event Notes: offshore west of Eugene, OR; event time = time of T&C test

TCEVENTS/PUGET_2008 = Historical, M4.1 Puget 2008
Event ID: M4.1 Puget 2008
Description: Puget Sound, WA, 20080731, with updates, no follow-up
Magnitude: M4.1; Location: 48.13, -122.74; Depth: 8 km
Event Notes: NW of Everett, WA; example of mag growing into alert level; mag only greater than 4.0 on 3rd update; event time = time of T&C test

TCEVENTS/VANCOUVER_2011 = Historical, M6.8 Vancouver Isl 2011
Event ID: M6.8 Vancouver Isl 2011
Description: West of Vancouver Isl, 20110909, with updates, no follow-up
Magnitude: M6.8; Location: 49.39, -127.15; Depth: 8 km
Event Notes: West offshore central Vancouver Isl., 280 km to Victoria, Canada; example large earthquake NW of ShakeAlert boundary; initial M 6.2; event time = time of T&C test

Scenario Events

SYN_Mendocino_M7.8 = Scenario, M7.8 Mendocino

Event ID: M7.8 Mendocino

Description: Mendocino area, finite fault with updates

Magnitude: M7.8; Location: 40.35, -124.95; Depth: 5 km

Event Notes: Legacy scenario

SYN_PointArena_M7.8 = Scenario, M7.8 Point Arena

Event ID: M7.8 Point Arena

Description: San Andreas fault N of San Francisco; finite fault with updates

Magnitude: M7.8; Location: 39.00, -123.69; Depth: 5 km

Event Notes: Legacy scenario

Point_Source/1857_FortTejon_M7.9 = Scenario, M7.9 San Andreas

Event ID: M7.9 San Andreas

Description: Fort Tejon, 1857-01-09 on San Andreas fault; point source, no updates

Magnitude: M7.9; Location: 35.43, -120.19; Depth: 5 km

Event Notes: Legacy scenario; Widely felt in California

SYN_Cajon_M7.8_Follow_Up = Scenario, M7.8 Cajon

Event ID: M7.8 Cajon

Description: San Andreas fault; Finite fault with follow-up

Magnitude: M7.8; Location: 34.82, -118.90; Depth: 5 km

Event Notes: Legacy scenario

SYN_SaltonSea_M7.8 = Scenario, M7.8 Salton Sea

Event ID: M7.8 Salton Sea

Description: San Andreas fault; Finite fault with updates

Magnitude: M7.8; Location: 33.35, -115.73; Depth: 5 km

Event Notes: Legacy scenario

SYN_Elsinore_M7.8 = Scenario, M7.8 Elsinore

Event ID: M7.8 Elsinore

Description: Elsinore fault, finite fault with updates

Magnitude: M7.8; Location: 32.53, -115.71; Depth: 5 km

Event Notes: Legacy scenario

Point_Source/RoseCanyon_M6.3 = Scenario, M6.3 Rose Canyon

Event ID: M6.3 Rose Canyon

Description: San Diego, late 1800's; point source, no updates

Magnitude: M6.3; Location: 32.625, -117.150; Depth: 3.5 km

Event Notes: Legacy scenario; felt throughout San Diego area

Point_Source/2015_Olympic_Coast_M8.0 = Scenario, M8.0 Olympic Coast
Event ID: M8.0 Olympic Coast
Description: Off-shore Washington State
Magnitude: M8.0; Location: 47.797, -124.732; Depth: 23 km
Event Notes: Legacy scenario

Point_Source/2017_PortlandHillsFault_M7.1 = Scenario, M7.1 Portland Hills
Event ID: M7.1 Portland Hills
Description: Downtown Portland; point source, no updates
Magnitude: 7.1; Location: 45.525, -122.787; Depth: 9.0 km
Event Notes: Scenario; downtown Portland