Accessing current, recent and historical earthquake data


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Introduction: Many Internet tools are currently available for accessing earthquake data. Using these tools one can obtain information (such as location, origin time and magnitude) about the most recent earthquakes; search historical earthquake catalogs for earthquakes in a given region over a selected time period; and view, download or make maps of recent or historical earthquake activity of the world or of a selected region. The tools support education and research activities related to earthquakes such as: maintaining a classroom map of significant (magnitude greater than or equal to 5) earthquakes; calculating earthquake magnitude from educational seismograph records and comparing with official magnitude estimates; obtaining historical earthquake data for a specific area to relate a recent event to the background seismicity; analyzing sequences of earthquake activity, performing statistical analysis of earthquakes (such as the frequency of occurrence of earthquakes of various magnitudes), and obtaining earthquake data for studies of aftershock sequences or other event time series of interest. Below are some sites, instructions and examples of accessing earthquake data from the Internet. The sites can be used to obtain recent and historical earthquake data. This document is primarily an educational resource for efficiently and effectively using Internet resources related to earthquake event (hypocenter, origin time and magnitude) information. Information on obtaining and using seismograms can be found at Using AmaSeis.

In addition to the web version of this document, MS Word and PDF versions are available at:
http://web.ics.purdue.edu/~braile/edumod/eqdata/eqdata.doc

The web page for this document is:

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Accessing Earthquake Data...

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1. IRIS (Incorporated Research Institutions for Seismology) Seismic Monitor (www.iris.edu, click on “Seismic Monitor”, map is updated every 30 minutes; open “About…” for information on Seismic Monitor): The Seismic Monitor is an attractive display of recent earthquake activity around the world (Figure 1). Additional information related to earthquakes, seismograph stations and recent activity is also provided. By clicking on the map in any location, a close-up view of that region is produced.
Figure 1. IRIS Seismic Monitor (viewed at about 16:00 UTC, October 23, 2004). Recent earthquakes are shown by circles. Size of the circle is proportional to magnitude. Placing the cursor on a circle provides information about the earthquake. Small dots are older events. The day/night line for the current time is also displayed on the map. A magnitude 6.9 earthquake and associated aftershocks are indicated by the red circles near Japan. (The magnitude of the Honshu, Japan earthquake was subsequently revised to 6.6.) Clicking on the boxes at the bottom of the screen provides additional information and links.

To obtain seismograph station information, click on the “Station Info” button. Selecting “Last 30 Days of Earthquakes” produces a list (Figure 2). Clicking on the map generates a close-up view of a region (Figure 3), in this case the northern Pacific region. Clicking on the close-up map view (Figure 3) produces a list (Figure 4) of up to 30 events within 10 degrees of the location that was selected.
Figure 3. Close up view of the north Pacific area created at about 16:00 UTC October 23, 2004. A magnitude 6.9 earthquake and associated aftershocks are indicated by the red circles near Japan. (The magnitude of the Honshu, Japan earthquake was subsequently revised to 6.6.)
Up to 30 Recent Earthquakes
(within 10 degrees of 140°E-138.681°, LAT 37.2673)

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</tr>
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</table>

Figure 4. List of recent events within 10 degrees of the selected location. (The magnitude of the Honshu, Japan earthquake was subsequently revised to 6.6.)

1.1 Option to obtain seismograms for certain events: Earthquakes of sufficient size or of particular interest are selected for automatic generation of seismograms that can be accessed by the IRIS DMC (Data Management Center) online data tool called WILBER II. The link to WILBER II through Seismic Monitor is convenient in that it provides a very quick indication of available data and easy access to seismograms for recent events. A link to WILBER II is available from the event list. For example, the earthquakes shown in the list in Figure 4 that include a link (Date is underlined and shown in blue) can be selected to go directly to the WILBER II data access tool for that earthquake. In this case, selecting the 23 October 2004 M6.9 Honshu, Japan earthquake (Figure 4) produces the screen shown in Figure 5. (The magnitude of the Honshu, Japan earthquake was subsequently revised to 6.6.) The resulting screen lists seismograph stations that have recorded seismograms for the selected earthquake. For example, clicking on station GUMO (Guam) produces the seismogram display shown in Figure 6. Selecting the dataset request link (click on the word “here” under the Advanced users section near the top of the screen) results in the data access screen (Figure 7) from which one can request seismograms to download. More information, including detailed instructions
and example, on downloading seismograms is available in the *Using AmaSeis* document (section 5).

Figure 5. Portion of WILBER II screen for the 23 October 2004 M6.9 Honshu, Japan earthquake. Stations are ordered by distance. (The magnitude of the Honshu, Japan earthquake was subsequently revised to 6.6.)
Figure 6. Seismogram display for station GUMO for the 23 October 2004 M6.9 Honshu, Japan earthquake. Seismograms are the E, N and Z components (top to bottom). (The magnitude of the Honshu, Japan earthquake was subsequently revised to 6.6.)
2. IRIS Event Search (for historical data), from www.iris.edu, select “Data”, then “Types of Data”, then “Search the catalogs”, then “Event Search”). In the Event Search, you can view pre-assembled maps or search the historic earthquake catalog and display a list of earthquakes (you can print or copy and paste to a document) and create a map of epicenters: The IRIS event search tool allows one to search the historical earthquake catalog (by area, time period, magnitude range and depth of focus of earthquakes) to create a list of earthquakes that correspond to the search parameters, create maps of epicenters from the search, and optionally, show user-defined earthquake location information.

2.1 Pre-assembled maps and lists: Near the top of the Event Search page, selecting the link to pre-assembled event maps and lists allows one to access pre-assembled maps and lists for recent earthquake activity. An example is shown in Figure 8. The pre-assembled data link is located near the top of the Event Search page which is illustrated in Figure 9.
2.2 Event Search: The Event Search page (Figure 9; accessed from www.iris.edu, select “Data”, then “Types of Data”, then “Search the catalogs”, then “Event Search”) allows one to search the earthquake catalog for events. For example, the entries shown in Figure 9, search the catalog for events of M6+ that occurred from January 1, 1990 to December 31, 1999 within an area that includes northern South America, Central America and part of North America (latitude -15 to 55, longitude -165 to -65). After entering the search parameters, click on Submit Search. The results of the search are a list of earthquakes (in this case, part of the list shown in Figure 10). Clicking on Make Event Map at the top of the list (Figure 10) results in a map of epicenters as shown (for this event search example) in Figure 11.
Event Search

For your convenience, **pre-assembled event maps and lists** are available for the past 24 hours, 7 days, 1 month, and 1 year.

![Event Search interface with date and time inputs](image)

**Figure 9.** Example of dialog boxes for the **Event Search** tool. The data entered here were designed to search for earthquakes of magnitude 6 and above for an area that includes northern South America, Central America, and part of North America for the time period January 1, 1990 – December 31, 1999. **The pre-assembled event maps and lists** link is shown near the top of this screen.

Your Query Entered 1098 rows.

**ASCI version.** [This file is tab delimited and suitable for printing or downloading for use with other applications. To download this file to your machine, use your browser’s option after viewing.]

![Event Search list](image)

**Figure 10.** List produced by the **Event Search** illustrated in Figure 9. Select **Make Event Map** to generate a map of the selected area and the events on the **Event Search** list shown here.
Figure 11. Map generated by the **Event Search** illustrated in Figures 9 and 10. The options to the right of the map allow the user to enter a title, change the map region (to further zoom in, for example), or add plate boundaries. Scrolling down on this screen allows one to access additional options as shown in Figure 12.

Because the dot size in the resulting map (Figure 11) is fairly large, we use one of the event search mapping options to change the maximum dot size. If we scroll down the page, additional options are available (Figure 12). Changing the maximum dot size to 0.25 as illustrated in Figure 12 and selecting Make Map (to re-plot), results in the map shown in Figure 13. The options shown to the right of the map allow one to select a different area to plot (for example, to zoom in; by changing the latitude and longitude limits, add plate boundaries, change the map to black and white, add city locations, or add a title. Clicking on Make Map (to the right of the map) will re-plot the map with the new options. The link to **Set Advanced Options** allow further mapping options.
Figure 12. Additional options near the bottom of the page illustrated in Figure 11. A link to the instructions for the User Defined Stations options is located near the top of this section. The Maximum dot size for the earthquakes can also be changed (as is done here, selecting the value 0.25 to produce the plot shown in Figure 13 after clicking on Make Map).
2.3 Creating a map with stations and S minus P location circles: The Event Search mapping tool can also be used to generate an attractive map for use with the S minus P earthquake location method. If S minus P times and inferred epicenter-to-station distances are known for 3 or 4 seismograph stations, these data can be entered into the optional user-defined data area (shown near the top of the screen image in Figure 12). The method works best if distinct P and S arrivals are visible on the seismograms and if the seismograph stations are located such that the earthquake is “within” the area covered by the 3- or 4-station “network”. Because S arrivals are weak for epicentral distances of greater than about 105 degrees and are virtually absent for distances of 120 degrees or more, an S minus P location should use stations that are located within about 100 degrees of the epicenter. Station coordinates can be found online (see section 3.13 of Using AmaSeis). Additional instructions for using the Event Search tool to plot stations, an event epicenter and S minus P circles are linked to the Event Search pages or available directly at: http://www.iris.edu/quakes/eventSearchInstructions.htm. The S minus P times can be interpreted from the seismograms with the AmaSeis software or simply by measuring the arrival times on seismograms and using the S minus P tables or travel time curves available at the USGS distance calculator site (http://neic.usgs.gov/neis/travel_times/). Additional information about using AmaSeis to view and interpret seismograms and several pre-assembled S minus P location data sets are available at the Using AmaSeis web page (see sections 3.6 and 6, respectively). Another effective and interactive site for learning about earthquake location is the Virtual Earthquake Courseware.
An example of making a map with the Event Search tool (after performing a search for historical earthquakes in a region as shown in section 2.2 above) and displaying the S minus P results is provided in Figures 14-16. Figure 14 shows the user-defined data for an S minus P location for the September 30, 1999 Oaxaca, Mexico earthquake. Entering these data in the Event Search web page and selecting Make Map results in the map shown in Figure 15. An enlargement of the map without the options and control portion of the page is shown in Figure 16. The data shown in Figure 13 can also be used to locate the earthquake on a globe (convert the distances in km to distance in degrees by dividing by 111.19 km/degree) as described at: http://web.ics.purdue.edu/~braile/edumod/as1mag/as1mag2.htm.

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User Defined Event:
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<th>Longitude</th>
</tr>
</thead>
<tbody>
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<td>-96.93</td>
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</tbody>
</table>

Figure 14. Optional user-defined data for the September 30, 1999 M7.5 Oaxaca earthquake. The latitudes and longitudes for the stations were obtained from seismograph station lists. The latitude and longitude of the user-defined event were found from an event search using online earthquake catalogs (IRIS Event Search as described in section 2.2; or USGS Catalog Search as described in section 4). The estimated distances came from S minus P times interpreted from seismograms using the AmaSeis software.
```
Figure 15. After the optional user-supplied data shown in Figure 14 were added, the Make Map control (to the right of the event map) to produce this map. The Plates option was also checked to plot plate boundaries and a title was added in the Map Title box.
Figure 16.  Final event map (enlarged from Figure 15) showing historical earthquakes of magnitude M6+ for the selected area, and the S minus P location data (circles) that approximately intersect near the correct epicenter (red star). The S minus P circles do not look like perfect circles because of the map projection. Station locations are shown by the red triangles.

3. USGS (U. S. Geological Survey) Earthquake Website (earthquake.usgs.gov, click on “Latest Quakes”, then “NEIC Current Earthquake Information” for list of recent events; can also access last 30 days activity, maps and other data lists): The USGS earthquake web site provides a wealth of information about recent earthquakes as well as links to an online catalog search for historical earthquakes (see section 4 below) and other earthquake and earthquake education resources. Much of the information found at earthquake.usgs.gov is generated automatically when earthquakes occur so it is available very soon (sometimes within minutes) after an event. Because the most recent information is preliminary, changes to location, origin time and magnitude data (and additions to the ancillary information) are sometimes made in subsequent listings and final earthquake catalog entries.
3.1 Recent earthquake lists: To access lists of recent earthquake from the USGS earthquake home page (Figure 17) select Latest Quakes (upper left corner of the page) which results in the “Earthquake Activity” page illustrated in Figure 18. On the “Earthquake Activity” page, select NEIC Current Earthquake Information from the list on the left side of the page. A list of the most recent earthquakes (similar to that show in Figure 19) will appear. Selecting an earthquake from the list (select links from the “Date” or “Comments” columns) will display a page (similar to that shown in Figure 20 for the Honshu earthquake) that provides specific information about that earthquake (including maps of the epicentral area, historical earthquake activity maps) and links to related sites. Information on significant events can also be accessed directly from the USGS earthquake page (Figure 17) by selecting the event from the list under Earthquake News and Highlights. The list of recent earthquakes (Figure 19) includes events during the last 7 days. Scrolling down the page, one can find links to earthquake lists for the past 8-30 days and large or noteworthy earthquakes during the current year and an interactive earthquake map that allows the user to click on an epicenter to find out more information about that event.

The Earthquake Activity page (example shown in Figure 18) also contains links to Shake Maps that show maps of the intensity of shaking for selected events, and Seismogram Displays which accesses sites that can display recent seismograms from seismograph networks.

![USGS Earthquake Hazards Program](https://example.com/earthquake_hazards.png)

Figure 17. The USGS earthquakes page (accessed October 23, 2004). Information on recent significant earthquakes can be found using the links to the right. (The magnitude of the Honshu, Japan earthquake was subsequently revised to 6.6.)
Figure 18. Recent earthquake activity page (accessed October 23, 2004).

Figure 19. List of recent worldwide earthquake activity (accessed October 23, 2004). Click on events (date and time links or location links under Comments heading) to obtain detailed information on specific earthquakes. Links to additional earthquake information are provided on the left. Links for earthquake lists for events from 8 to 30 days ago and for significant earthquakes during the current year are shown near the bottom of the page (scroll down).
Figure 20. Selecting a link to a significant earthquake from the right side of the USGS earthquakes page (Figure 17) will produce a screen similar to the one shown here (this page was for the October 23, 2004 M6.9 Honshu, Japan earthquake). (The magnitude of the Honshu, Japan earthquake was subsequently revised to 6.6.) Information about the selected earthquake and historical seismicity is available through links on this screen (scroll down).

3.2 Detailed information including magnitudes: Detailed information about events can be obtained by clicking on an event (from the recent earthquake lists, example shown in Figure 19). For details of magnitude information including mb, MS and mbLg magnitudes, select an event, select Phase (Arrival Time) Data (scroll down the page to find the “Phase (Arrival Time) Data” link). An example of the Phase Data for the Honshu earthquake is shown in Figure 21.
Figure 21. Phase data for the October 23, 2004 M6.9 Honshu earthquake. Calculated origin time (ot) latitude (lat), longitude (lon), and depth of focus of the earthquake are shown near the top along with the Magnitude (M, or moment magnitude, the preferred magnitude measure for all earthquakes). Additional magnitude determinations are listed near the bottom of this figure, including the body wave magnitude (mb), the mbLg magnitude, and the surface wave magnitude (MS). (The magnitude of the Honshu, Japan earthquake was subsequently revised to 6.6.)

4. USGS Catalog Search (for historical data from earthquake.usgs.gov, click on “Science and Technology”, then on “World National Earthquake Information Center (NEIC)” under “Earthquake Catalog and Seismic Data”, then “Global…”, “Rectangular…” or “Circular…” and enter data for event search; an earthquake list will be produced; to see all magnitude information, choose “Expanded File Format…”, otherwise select “Screen File Format…”): An online search of the official USGS catalogs for historical earthquake information can be performed at the from the USGS earthquake page (earthquake.usgs.gov, Figure 17). Several catalogs are available for the search and the search can be global (worldwide), limited to a rectangular area (within a latitude/longitude range), or circular (earthquakes within a specified distance of a location). The search can also specify a range of dates, magnitudes and depths of events, so that the user can design a search for specific purposes. The search can include data up to the current date although the most recent earthquake data may be provisional and are subject to revision (usually within a few days). The results of the search are a list of earthquakes that can be viewed and copied into other programs such as word processor documents or spreadsheets. To access the catalog search, select Science and Technology (upper right corner) from the USGS earthquake page. On the resulting page (Figure 22), in general, select World – National Earthquake Information Center (NEIC), although other catalogs can be accessed (and others are also available in the next step). Examples of Global (Worldwide) and Rectangular Area searches are shown in sections 4.1 and 4.2 below.
4.1 Catalog search, Global (Worldwide) example: After selecting the World – National Earthquake Information Center (NEIC) catalog (from the screen shown in Figure 22), the resulting screen (Figure 23) allows one to select a Global (Worldwide), Rectangular Area, or Circular Area Search. For the example described here, we select the Global (Worldwide) search option. The resulting screen with additional options is shown in Figure 24. We have selected the expanded file format for the output files so that all magnitude information can be viewed. Also, the USGS/NEIC catalog is selected (several other options are available). Scrolling down the search page (screen shown in Figure 24), additional options (Figure 25) are selected. Here we select the date and magnitude ranges to search for all M7+ earthquakes that occurred during 2003. After entering the search options, select Submit Search (at the bottom of the search options page; Figure 25). The results of the search are shown in Figure 26. The origin time, location and magnitude information for the events are listed. There were 17 M7+ earthquakes during 2003, which is exactly the average number of M7+ earthquakes per year based on statistics since 1990 (Figure 27).
Figure 23. Selecting “World National Earthquake Information Center (NEIC)” under “Earthquake Catalog and Seismic Data” from the screen shown in Figure 22 results in the screen shown here. Select Global, Rectangular or Circular search area.

Select the Search Area:

- **Global (Worldwide)**
- **Rectangular Area**
- **Circular Area**

Select **Output File** Type:

- 1. Expanded File Format with Headers and Spaces
- 2. Compressed File Format
- 3. Screen File Format (80 columns)
- 4. Generate Map (This option takes time; please be patient.)
- 5. Spreadsheet Format (comma delimited)

**Search Parameters**

Select the **Database**:

- USGS/NEIC (PDE) 1973 - Present
- USGS/NEIC (PDE-Q) Most Recent Events (2004 09 02 - 2004 10 16 )
- Significant Worldwide Earthquakes (2150 B.C. - 1994 A.D.)
- Significant U.S. Earthquakes (1568 - 1989)
- California, 1735 - 1974
- Canada, 1568 - 1992
- India, 1063 - 1984
- Mexico, Central America, Caribbean, 1900 - 1979
- South America, 1471 - 1981
- Eastern, Central and Mountain States of U.S., 1534 - 1986

Figure 24. Output file and search parameter options for the global search. In this case the Expanded File Format and the 1973-Present catalog were selected.
Optional Search Parameters:

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Submit Search  Clear form

**Figure 25.** Optional search parameters for the global search. In this example, the time period from January 1, 2003 to December 31, 2003 was selected. The search was for earthquakes of magnitude 7 and greater.

**Figure 26.** Results of the search (only part of the list is shown here) illustrated in Figure 25. Seventeen earthquakes of M7 and greater occurred during 2003. Origin time, location, depth and magnitude information are listed for each earthquake.
Earthquake Facts and Statistics

Frequency of Occurrence of Earthquakes

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<tr>
<td>Great</td>
<td>8 and higher</td>
<td>1 (^1)</td>
</tr>
<tr>
<td>Major</td>
<td>7 - 7.9</td>
<td>17 (^2)</td>
</tr>
<tr>
<td>Strong</td>
<td>6 - 6.9</td>
<td>134 (^2)</td>
</tr>
<tr>
<td>Moderate</td>
<td>5 - 5.9</td>
<td>1319 (^2)</td>
</tr>
<tr>
<td>Light</td>
<td>4 - 4.9</td>
<td>13,000 (estimated)</td>
</tr>
<tr>
<td>Minor</td>
<td>3 - 3.9</td>
<td>130,000 (estimated)</td>
</tr>
<tr>
<td>Very Minor</td>
<td>2 - 2.9</td>
<td>1,300,000 (estimated)</td>
</tr>
</tbody>
</table>

\(^1\) Based on observations since 1900.  
\(^2\) Based on observations since 1990.

The USGS estimates that several million earthquakes occur in the world each year. Many go undetected because they hit remote areas or have very small magnitudes. The NEIC now locates about 50 earthquakes each day, or about 20,000 a year.

Figure 27. Worldwide frequency of occurrence of earthquakes of various magnitude ranges from the USGS. This information (and additional earthquake statistics) can be accessed using the link How Many Earthquakes? Located at the bottom of the Global Search page (Figure 25) or directly at: [http://neic.usgs.gov/neis/eqlists/eqstats.html](http://neic.usgs.gov/neis/eqlists/eqstats.html).

4.2 Catalog search, Rectangular Area example: Performing a catalog search for a rectangular area is similar to the worldwide search described in section 4.1, above, except that a rectangular area is selected using latitude and longitude ranges. As an example (similar to the Event Search example in section 2.2, above), we select an area the includes the northern part of South America, Central America and most of North America (latitude -15 to 55 degrees; longitude -165 to -65 degrees). We also select earthquakes of magnitude 6 and above that occurred in the search area from January 1, 1990 to December 31, 1999. The search parameters are shown in Figure 28 and the results of the search (partial list shown) are given in Figure 29. A total of 189 earthquakes are included in the search results. The earthquake list (screen shown in Figure 29) can be copied and pasted into a word processing document or imported into a spreadsheet such as Excel for further viewing, sorting, mapping or analysis.
Input **Rectangular Area** Search Parameters:

Input **SOUTH** Latitudes and **WEST** Longitudes as **NEGATIVE** numbers. Input latitude and longitude in decimal degrees.

- **Top Latitude of Rectangle**: 55
- **Bottom Latitude of Rectangle**: -15
- **Right Longitude of Rectangle**: -65
- **Left Longitude of Rectangle**: -185

**Optional Search Parameters:**

**Date**

- **Starting Year**: 1990
- **Ending Year**: 1999
- **Starting Month**: 01
- **Ending Month**: 12
- **Starting Day**: 01
- **Ending Day**: 31

**Magnitude**

- **Minimum Magnitude**: 6
- **Maximum Magnitude**: 10

*Figure 28. Optional search parameters for the rectangular area search. In this case, we specify a search for earthquakes in the area -15 to 55 degrees latitude and -165 to -65 degrees longitude (northern South America, Central America and part of North America), for the time period January 1, 1990 to December 31, 1999, and earthquakes of magnitude 6 and greater.*
Figure 29. A part of the list resulting from the rectangular area search shown in Figure 27. Origin time, location, depth and magnitude information are listed for each earthquake.