Accessing earthquake location databases

Earthquake locations are measured by many different agencies around the world, often with multiple agencies providing different locations and magnitudes for the same earthquake. When looking for earthquake data it is important to understand the limitations of the data source that you are using.

UK earthquakes

The definitive source for UK earthquake information is the British Geological Survey who measure and locate all earthquakes within the UK with magnitudes greater than Ml=2.0 (and lots smaller than this) They have records for over 10,000 earthquakes going back to 1048 with the catalogue considered complete for instrumentally recorded earthquakes since 1980

https://earthquakes.bgs.ac.uk/earthquakes/dataSearch.html

This site gives access to Earthquake locations, origin times and magnitudes in a downloadable .csv format

The site also gives information about earthquake intensities from felt effect reports

A graphical database of UK earthquakes can also be found at http://mapapps.bgs.ac.uk/geologyofbritain/home.html?mode=earthquakes

Global earthquake catalogues

ISC Bulletin

Definitive catalogue http://www.isc.ac.uk/iscbulletin/

The Bulletin of the International Seismological Centre is the primary output of the ISC and is regarded as the definitive record of the Earth's seismicity. The ISC Bulletin contains data from 1900 to present day (2018-05-10). The Reviewed ISC Bulletin, which is manually checked by ISC analysts and relocated (when there are sufficient data) is typically 24 months behind real-time and is currently up to 2015-07-01.

USGS catalogue

Earthquake catalogue produced by USGS https://earthquake.usgs.gov/earthquakes/search/

Definitive for earthquakes within the USA, good for global earthquakes >M5

Graphical earthquake browser (good for visualising earthquake locations and selecting by depth or magnitiude, includes 3D viewer) http://ds.iris.edu/ieb/

Glossary of terms

Magnitude

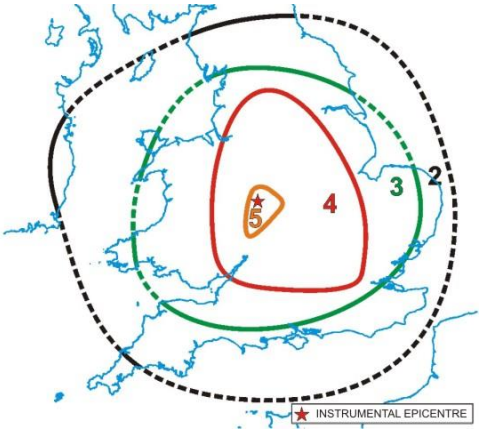
The magnitude is a number that characterizes the relative size of an earthquake. Magnitude is based on measurement of the maximum motion recorded by a seismograph. Several scales have been defined, but the most commonly used are (1) local magnitude (ML), commonly referred to as

"Richter magnitude", (2) surface-wave magnitude (Ms), (3) body-wave magnitude (Mb), and (4) moment magnitude (Mw). The moment magnitude (Mw) scale, based on the concept of seismic moment, is uniformly applicable to all sizes of earthquakes but is more difficult to compute than the other types. All magnitude scales should yield approximately the same value for any given earthquake.

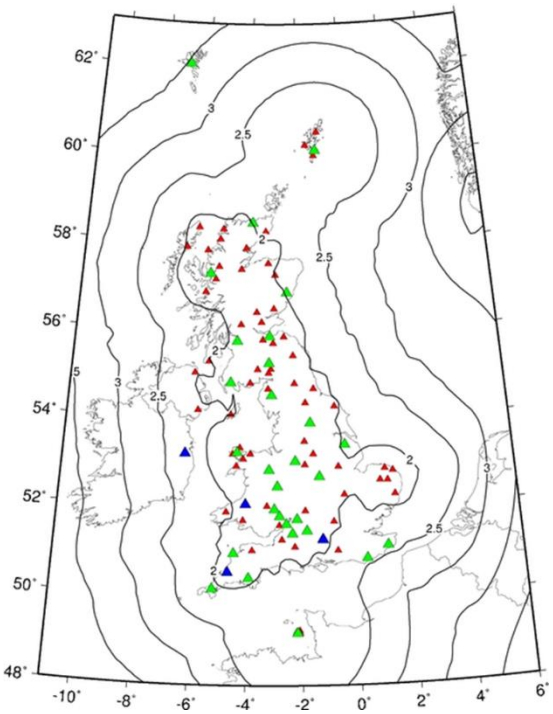
http://www.bgs.ac.uk/discoveringGeology/hazards/earthquakes/magnitudeScaleCalculations.html

Intensity

The intensity is a number describing the severity of an earthquake in terms of its effects on the earth's surface and on humans and their structures. Several scales exist, the one most commonly used scale in the UK is the European Macroseismic Intensity Scale. There are many intensities for an earthquake, depending on where you are, unlike the magnitude, which is one number for each earthquake.



http://www.bgs.ac.uk/discoveringGeology/hazards/earthquakes/intensity.html



Completeness

In an earthquake catalogue, the magnitude of completeness (Mc) is the minimum magnitude above which all earthquakes within a certain region are reliably recorded. In the UK this is generally about Ml=2.0

http://quakes.bgs.ac.uk/monitoring/detection_capability.html

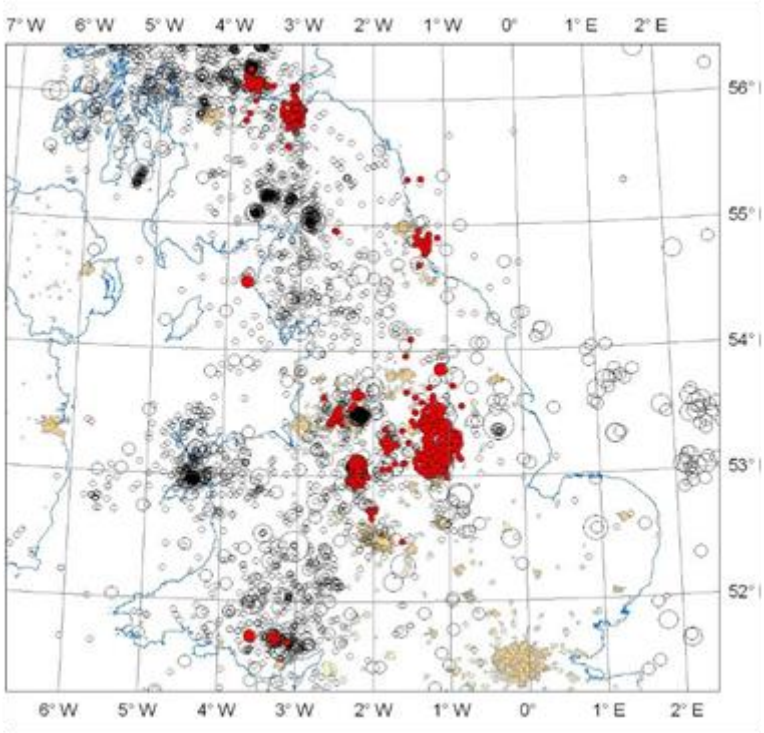
Aftershocks

Aftershocks are earthquakes that follow the largest shock of an earthquake sequence. They are smaller than the main shock and within 1-2 rupture lengths distance from the main shock. Aftershocks can continue over a period of weeks, months, or years. In general, the larger the main shock, the larger and more numerous the aftershocks, and the longer they will continue.

Induced or man-made events

Seismic signals can be registered by seismometers from a wide range of man-made sources, for example explosions (quarry blasts, or bombs, both conventional or nuclear), building collapses, sonic booms from aircraft, old mine-workings collapsing, oil and gas drilling operations or extraction, dams filling, synchronised movement of people at rock concerts or football stadiums.

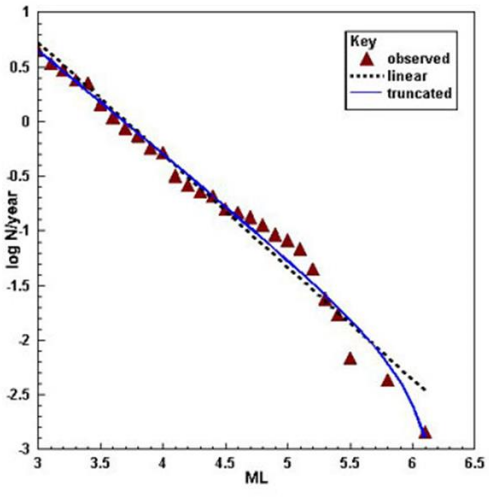
https://doi.org/10.1093/astrogeo/atu217



Mining Seismicity in the UK (red circles) alongside natural background earthquake activity (open circles)

Gutenberg-Richter relationship

The number and magnitude of earthquakes in a specific area are usually related with a simple logarithmic relationship. The number of earthquakes of a given magnitude threshold will decrease by a factor of 10 for each increase ion magnitude of one unit. This is true for most regions in the world and is claaed the Gutenberg-richetr relationshops



Some possible questions to investigate

Remote triggering of earthquakes

After a large (>M8) earthquake the seismic surface waves from the event can circle the world several times with amplitudes of displacement of several mm even thousands of km from the main event. Is it possible that the passing of these waves could trigger events in locations thousands of km from the main event ?

https://agupubs.onlinelibrary.wiley.com/doi/full/10.1029/2012GL051015

Tidal triggering of earthquakes

The gravitational attraction of the moon and the sun cause deflections in the earth's crust just as they cause tides in the oceans. Is it possible that these "earth tides" can trigger the onset of earthquakes ? How would you test such a hypothesis

https://www.nature.com/articles/ngeo2796

Earthquake weather

Are earthquakes more prevalent during storms or prolonged periods of rain or droughts ?

https://www.nature.com/news/hurricane-may-have-triggered-earthquake-aftershocks-1.12839

Identifiying aftershocks

A large >M7 earthquake will cause an underground rupture along a fault line hundreds of km long. In the days and weeks after such an event a whole series of smaller (usually) earthquakes occur on or near this initial fault plane. These are called aftershocks and usually follow of predictable pattern of decaying in frequency and magnitude with time. Identifying and locating these aftershocks is an important task.

1) because the location of the aftershock sequence from a large earthquake helps scientist to locate and map the geometry of the fault plane which has ruptured.
2) these aftershocks are all statistically related to the initial main-shock. If scientists want to estimate the likelihood of an earthquake occurring in a particular region they often want to work with a "de-clustered" earthquake catalogue which contains only main-shocks and ignores aftershocks.

Man-made events

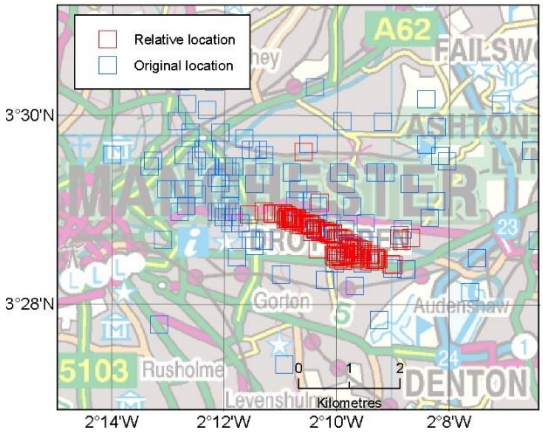
A simple earthquake catalogue will contain information about any ground disturbance which registers on a seismometer. Sometimes these events will be man-made or caused by human activity. Examples include quarry blasts or collapses of old mine workings. Can you find a way of identifying man-made or induced events from an earthquake catalogue.

https://earthquakes.bgs.ac.uk/earthquakes/recent_events/ollerton_earthquakes.html

https://earthquakes.ok.gov

Swarms

Sometimes a swarm of earthquakes will occur in a relatively small region, often with no explanation as to why the events started or why they stopped. One example is the Manchester earthquake swarm Oct-Nov 2002



http://www.earthquakes.bgs.ac.uk/research/manchester_sequence.html