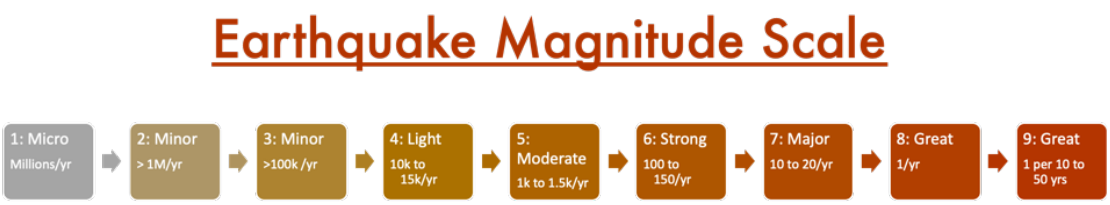
MATLAB for Geoscientists 2 - University of Maryland

Historical Earthquake Data

These earthquakes are rated using the Richter magnitude scale () which is determined from the logarithm of the amplitude of waves recorded by seismographs.



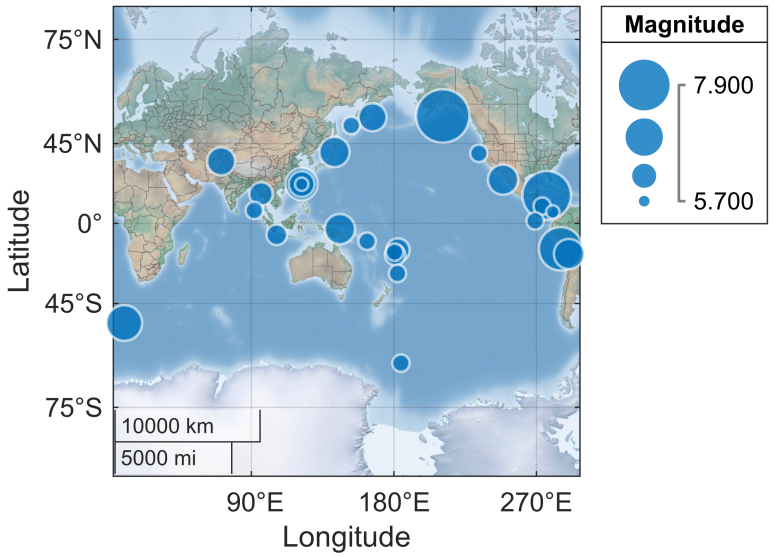
The formula is: $M_L = \log_{10}A - \log_{10}A_0(\delta) = \log_{10}[A/A_0(\delta)]$. Earthquake Data Credit: U.S. Geological Survey; Department of the Interior/USGS

```
load EarthquakesFebruary2018 quakes
```

Earthquakes around the world

Let's take a look at where earthquakes occur and how strong they are. Filter out the smallest earthquakes.

```
% minmagnitude = 3.0;
minmagnitude =5.6;

theseQuakes = quakes(quakes.Magnitude > minmagnitude,:);

figure
geobubble(theseQuakes,"Latitude","Longitude","SizeVariable","Magnitude",...
    "Basemap","colorterrain");
```



Displaying Fault Lines on a Geographic Globe using Mapping Toolbox

```
folder = "Qfaults_GIS/SHP";
shapefile = "Qfaults_US_Database.shp";

filename = fullfile(folder, shapefile);
faults = shaperead(filename,"UseGeoCoords",true); % load shape as a structure
faults2 = geoshape(faults); % We can convert this shape from the structure it
% loaded as into a geoshape shape. Geoshapes require latitude and longitude vectors
% and can also incorporate "Geometry" and "Metadata"
```

Filtering data based on fault length

```
numberOfFaults = length(faults)
```

```
numberOfFaults = 112809
```

```
firstElement2 = faults(1);
cutoffLength = 15000;
data = faults(faults2.Shape_Leng > cutoffLength);
```

```
fault_table = struct2table(data)
numLocations = unique(fault_table.Location)
```

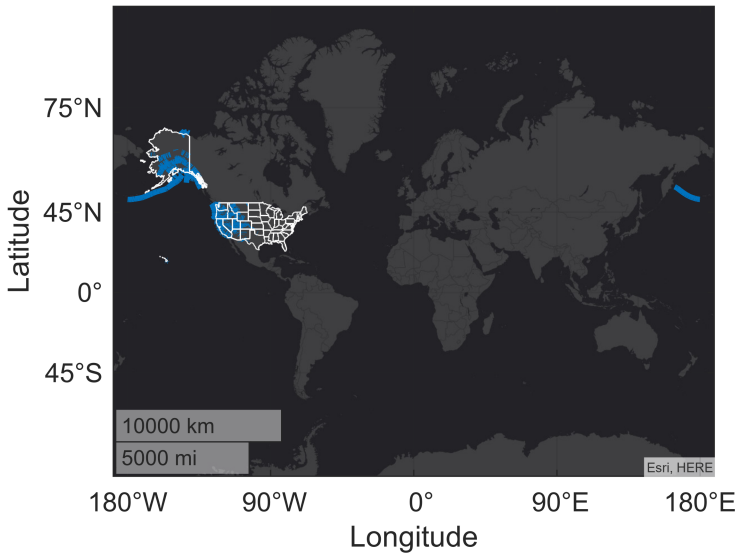
```
numLocations = 17×1 cell
'Alaska'
'Arizona'
'California'
'Colorado'
'Hawaii'
'Idaho'
```

```
'Kansas'
'Montana'
'Nevada'
'New Mexico'
     ⋮
```

Display Fault Lines using Geographic Axes

Display the fault lines on a 2-D map. Construct a geographic axes using `geoaxes` and plot the data using `geoplot`. The geographic axes supports eleven different basemaps. The use of "darkmode" is popular in many applications. For visual contrast, select the "darkmode" (`streets-dark`) basemap. For a contrasting visual effect, display state boundaries in white. Read the state boundaries using `shaperead`.

```
data_geo = geoshape(data);
lat = data_geo.Latitude;
lon = data_geo.Longitude;

states = shaperead("usastatelo.shp","UseGeo",true);
states = geoshape(states);
basemap = "streets-dark";

figure
gx = geoaxes("Basemap",basemap,"NextPlot","add");
geoplot(gx,lat,lon,"LineWidth",2)
geoplot(gx,states.Latitude,states.Longitude,"w")
```



Display Fault Lines using Geographic Globe

Display the fault lines on 3-D globe. 3-D visualizations with terrain provide more context for fault lines. The 2-D map is in a Web Mercator coordinate projection system which causes a scale distortion. Construct a

geographic globe using `geoglobe` and plot the data using `geoplot3`. The fault lines contain many different segments, not one continuous line.

```
uif2 = uifigure;
g = geoglobe(uif2,"Basemap",basemap,"Terrain","none","NextPlot","add");
geoplot3(g,lat,lon,[],"LineWidth",2)
geoplot3(g,states.Latitude,states.Longitude,[],"w")
```

Find the San Andreas Fault

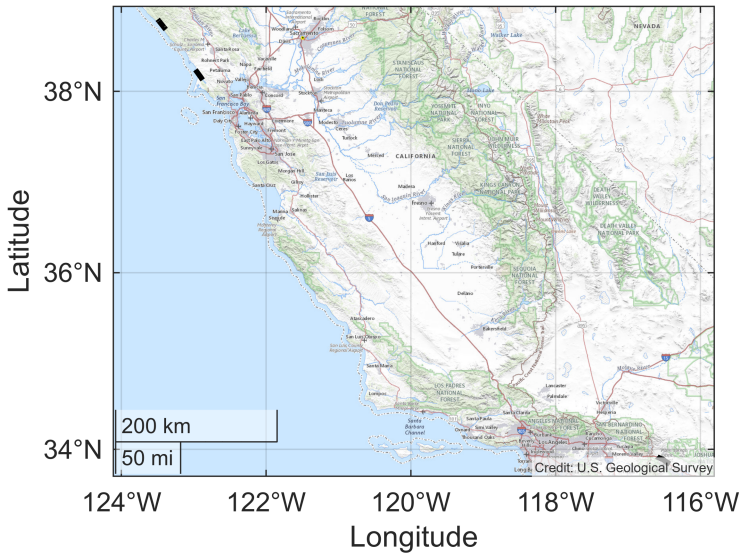
The San Andreas fault is the most famous fault in the world and forms the tectonic boundary between the North American Plate and the Pacific Plate. The fault passes through California, a highly-populated state.

Search for the fault by using the fault_name property. Display the first element of the geoshape vector.

```
fault_name = "San Andreas";
index = contains(data_geo.fault_name,fault_name,"IgnoreCase",true);

sanandreas = data_geo(index);

lat = sanandreas.Latitude;
lon = sanandreas.Longitude;
firstElement = sanandreas(1)
```

```
firstElement =
 1×1 geoshape vector with properties:

 Collection properties:
      Geometry: 'line'
      Metadata: [1×1 struct]
 Vertex properties:
      Latitude: [38.2351 38.2307 38.2287 38.2265 38.2239 38.2217 38.2198 38.2183 38.2170 38.2155 38.2131 38.2103 38
     Longitude: [-122.9767 -122.9727 -122.9707 -122.9685 -122.9660 -122.9639 -122.9623 -122.9610 -122.9600 -122.958
 Feature properties:
    fault_name: 'San Andreas fault zone'
    section_na: 'North Coast section'
      fault_id: '1'
    section_id: 'b'
      Location: 'California'
      linetype: 'Inferred'
           age: 'historic'
    dip_direct: 'Vertical'
     slip_rate: 'Greater than 5.0 mm/yr'
    slip_sense: 'Right lateral'
         scale: '1:62,500'
         class: 'A'
     certainty: 'Poor'
        strike: 'N36°W'
    fault_leng: 1082
    cooperator: 'California Geological Survey'
    earthquake: 'San Francisco earthquake'
    review_dat: '20021210'
     fault_url: 'https://earthquake.usgs.gov/cfusion/qfault/show_report_AB_archive.cfm?fault_id=1&section_id=b'
     symbology: 'historic Inferred'
        ref_id: '1b'
    Shape_Leng: 1.9169e+04
```

```
basemap = "usgstopo";
baseURL = "https://basemap.nationalmap.gov/ArcGIS/rest/services";
url = baseURL + "/USGSTopo/MapServer/tile/${z}/${y}/${x}";
attribution = "Credit: U.S. Geological Survey";
displayName = "USGS Shaded Topographic Map" ;
maxZoomLevel = 16;
addCustomBasemap(basemap,url,"Attribution",attribution, ...
    "DisplayName",displayName,"MaxZoomLevel",maxZoomLevel)


figure
gx = geoaxes("Basemap",basemap,"NextPlot","add");
geoplot(gx,lat,lon,"LineWidth",2,"Color","k")
```



Loma Prieta Earthquake Analysis Example

This example shows how to analyze and visualize earthquake data.

```
%openExample('matlab/quake')
```