Earthquake Epicenters in Relation to Major Fault Lines Within and Off the Coast of Humboldt County

Humboldt State University
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Lecture Instructor: Dr. David Gwenzi
Lab Instructor: Dr. Amy Rock
Authors: Amanda Albright, Michael Erickson, Aidan Klaver, Daviel Vasquez

Abstract

Earthquakes are a common occurrence in California causing significant damage, and even death, like the 1906 San Francisco earthquake. The Humboldt County region is not immune to large earthquakes, which can create significant damage as well. On November 8, 1980, the Tompkins Hill overpass south of Eureka over Highway 101 dropped out from underneath Tom Mariani and his family while driving at night (Driscoll, J., 2010). Although no one died in that case, there were several people injured and damage to structures in the area, particularly in Ferndale and Fortuna, was significant. That 1980 quake measured 7.2 on the Richter scale and occurred within an area offshore from Humboldt Bay where geologic forces driven by the colliding of three tectonic plates merge in an area called the Mendocino Triple Junction. The 1980 earthquake ruptured a 95-mile long zone, nearly five times the size of the segment that ruptured more recently in January 2010 during a 6.5 magnitude event. More people remember the more recent quake in 2010 because even though it was slightly less in size, the resulting damage was significantly more, with 463 buildings sustaining damage and repair costs totaling approximately $40 million.

Our project utilized ArcMap along with several data sets obtained online to find how many earthquakes have occurred within the past four years in the Humboldt County area. Within our map we captured forty-seven registered earthquakes, with the ten strongest ranging from 4.25-5.72 in magnitude. The majority of these quakes occurred just off of Humboldt County's coast, in close proximity to the Mendocino Triple Junction. The data presented here could aid future work on earthquake safety and preparation, and in construction work near Earthquake hot zones.

Introduction

Earthquakes are not new to Californians. These tremors often occur in areas where tectonic plates rub against one another and release the resultant energy from this friction in the form of a seismic shock wave (USGS, 2016). The magnitude of earthquake events are measured through the use of seismographs and are given a magnitude that range from 0 to 8 and above, 8 being disastrous and anything under a 2.5 is typically not felt. The 1906 earthquake in San Francisco for example, had a magnitude of 7.9, and was the cause of 700 deaths and several fires (USGS, 2016). One of the most active regions in North America lies just south of Humboldt County, and west of Cape Mendocino, it is known as the Mendocino Triple Junction. This is where the Gorda, Pacific, and North American plates meet. While the distance of this particularly active seismic region too much of the states' population is not much cause for alarm, its proximity to those of us along the North coast poses a real concern.

Our goal is to present how many earthquakes have occurred and why over the past four years in the Humboldt County region, with data provided by various websites and the use of ArcMap. As noted previously, the majority of the earthquake epicenters, particularly the larger ones are located just off Humboldt County's coast.

Figure 1. Locator Map.

Methods

Data on earthquake locations and magnitudes, earthquake.shp, for the Humboldt area was downloaded from http://www.ncedc.org/ncedc/catalog-search.html. The group is called Northern California Earthquake Data Center (NCEDC). For this set of data we converted the latitude and longitude to X, Y coordinates in excel and converted it to a shapefile to use in ArcMap. The shapefile for fault zones, sectionsALL.shp, was downloaded from http://earthquake.usgs.gov/hazards/qfaults/, which is from the U.S. Geological Survey (USGS) website. The Humboldt county outline (see Figure 1. Locator Map), CNTYOUTL.shp, as well as the basemap were taken from the Y drive on the HSU system. Following the data collection, all of the layers were batch-projected to WGS 1984. In order to focus on the Humboldt County area

and directly off the coast a polygon was used to select the faults and earthquake epicenters in the area of interest. The two layers were then clipped and the symbols used for the earthquake events were changed to graduated circles based on their individual recorded magnitudes.

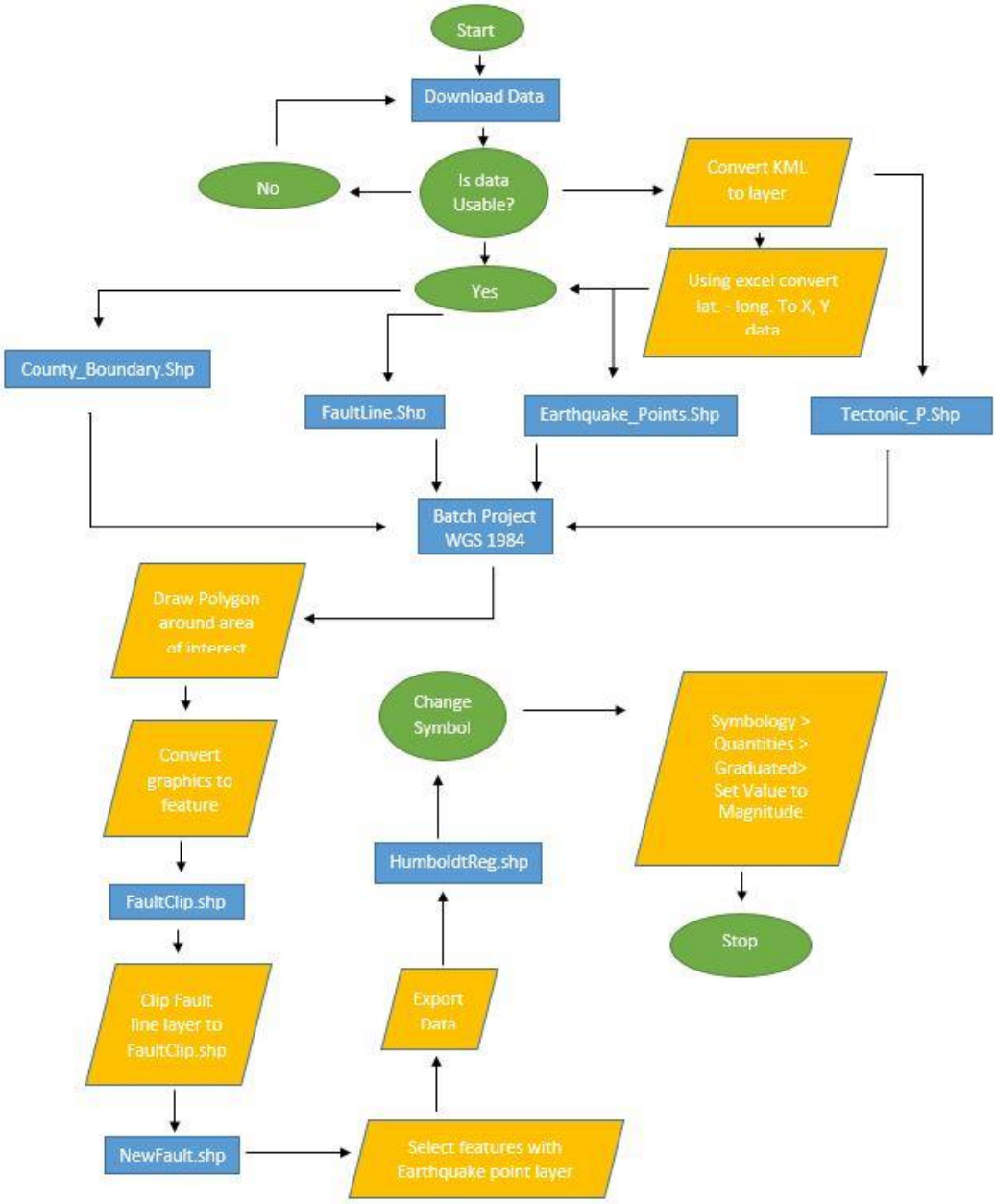

Figure 2. Flow chart. Methods to creating maps via ArcMap.

Results

The map below shows the epicenters of all the earthquakes in the Humboldt County region from January 2012 to present with a minimum magnitude of 3.0. Although USGS records earthquake magnitudes less than that size, we elected to show a minimum quake magnitude of 3.0 because at this level, people are able to feel seismic shock. As the figure below shows, the majority of the earthquake epicenters in the past four years, including the largest earthquakes recorded, are centered off the southern coast of Humboldt County in the area of the Mendocino Triple Junction. For reference earthquakes with recorded magnitudes ranging from 5.5-6.0 are likely to cause slight to moderate damage to buildings and other structures, whereas those measured from 4.5-5.4 in magnitude typically only cause minor to little damage (UPSeis).

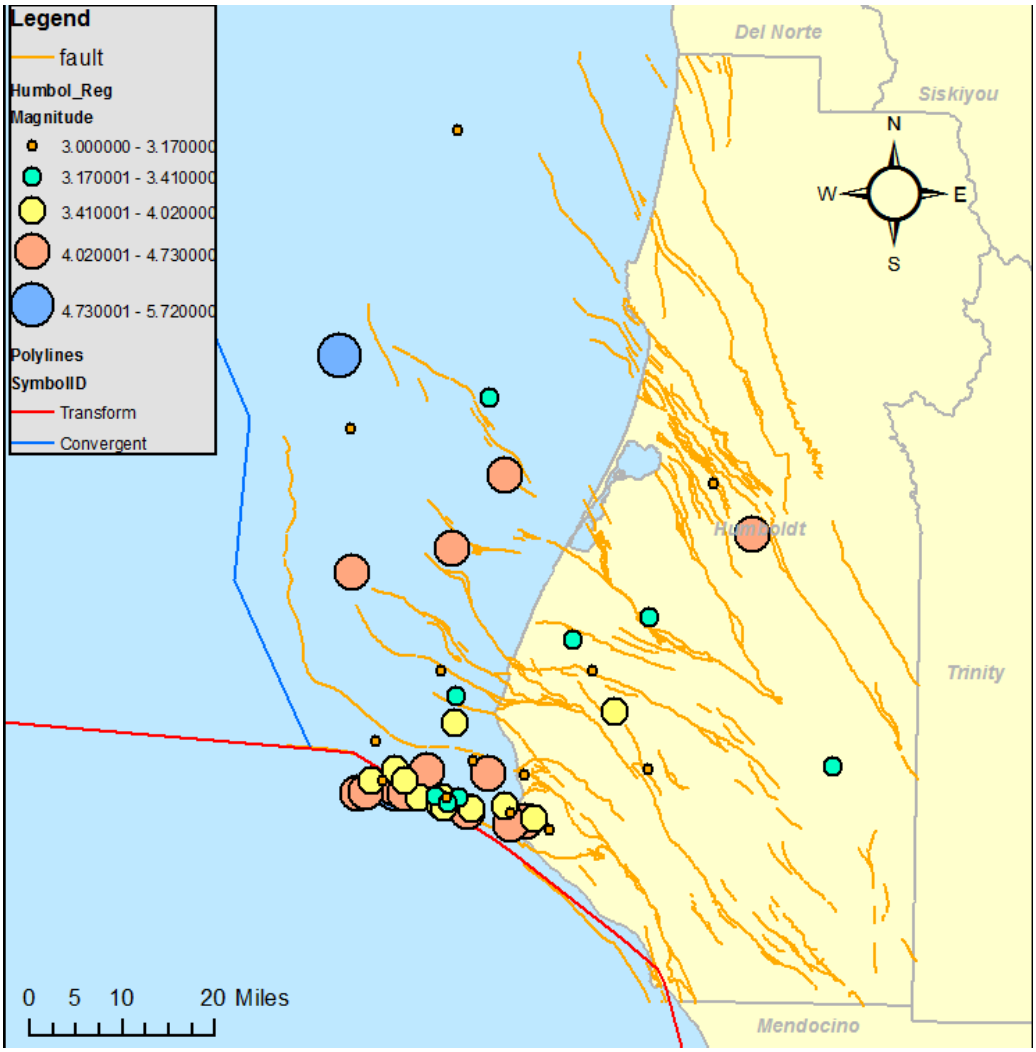

Figure 3. Site Map. Earthquake epicenters in and around Humboldt County (Jan 2012 – Dec 2016).

The ten earthquakes with the largest magnitudes in the Humboldt County area that we analyzed are listed in the graph below along with their latitude and longitude and the date that they occurred.

Table 1. Latitude and Longitude of 10 most severe earthquakes around Humboldt County in the past 4 years.

Epicenter (Lat, Long)	Date (dd/mm/yyyy)	Magnitude
40.31783, -124.60667	28/01/2015	5.72
40.9835, -124.74983	11/10/2013	4.94
40.72433, -123.89183	21/07/2016	4.73
40.80817, -124.40183	03/08/2013	4.47
40.30833, -124.68716	02/01/2016	4.44
40.65083, -124.712	26/05/2015	4.34
40.27317, -124.3395	07/01/2016	4.31
40.28583, -124.46033	18/05/2013	4.28
40.3195, -124.61217	14/01/2015	4.28
40.31133, -124.58916	29/01/2015	4.25

Discussion

Within our map we captured a total of 47 earthquakes that occurred just off the Coast of Humboldt County since 2012. The strongest one occurring in January 2015 with a magnitude of 5.72 off the Coast of Humboldt County is most likely due to the North American, Pacific and Gorda tectonic plates converging at the Mendocino Triple Junction shown above (Figure 3). One cause of damage to coastal structures and infrastructure by Earthquakes can be tsunamis (tidal waves). Given that the majority of the largest earthquakes occur offshore, there is the potential that a large quake located 100 miles off the coast could generate a really bad tsunami. Others located closer to the coast do not have enough distance to allow for the formation of a large tsunami.

Conclusion

The information presented here should serve as a reminder of the importance of earthquake safety awareness and provide a refresher into what population regions in Humboldt County are most in need of attention and emergency response preparedness. For southern Humboldt County residents this information can help determine evacuation plans and housing structural foundations in preparation for the worse case scenario. This could also aid the real-estate business community and help educate homebuyers on the sensitivity of certain county regions geological state to potential greater ground shaking during earthquake events. .

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