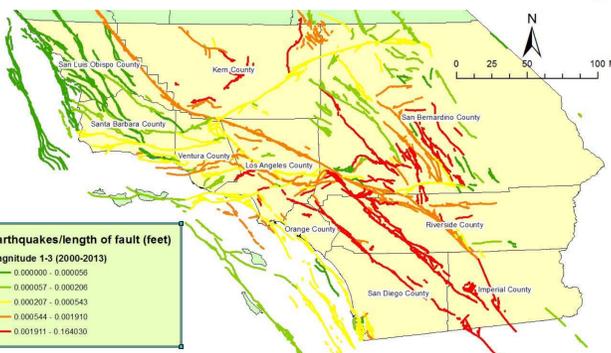
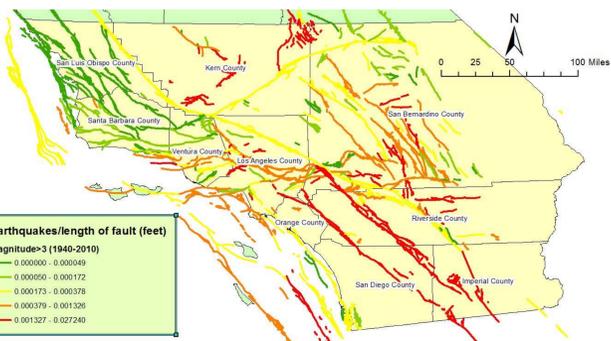
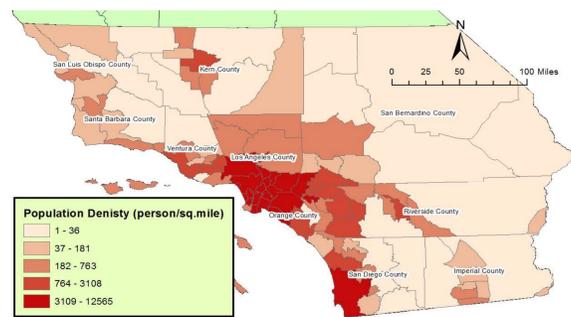




Introduction

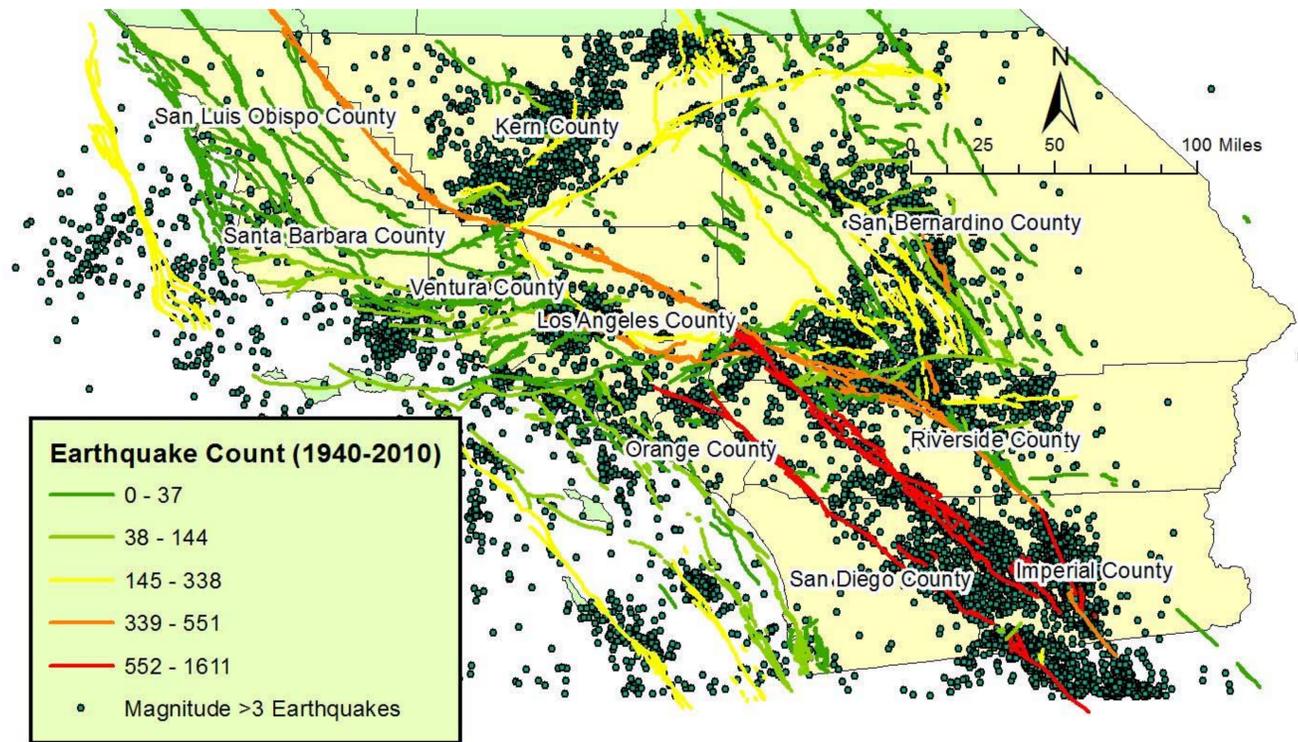
Southern California has always been a hotspot for earthquake activity, lying on the border between two massive tectonic plates, the Pacific plate and the North American plate. Growing up in the area, I remember worrying about when the next "Big one" would hit, the "Big one" referring to an earthquake with a very high devastating effect, due to magnitude, duration, and proximity to highly populated areas.

Today, geologists say there is a 99.7% chance that an earthquake with at least a 6.7 magnitude will strike California in the next 30 years, with Southern California being the most at risk. Predicting where and when the next large earthquake will strike is no straightforward matter, and must be proceeded with caution. Many geologists and seismologists use the occurrence of smaller earthquakes to predict future large ones. This project analyzes the fault lines of Southern California that are most at risk of a future devastating earthquake by taking into account the occurrence of large and small earthquakes relative to the length of the fault line, the increase of occurrence of small and high magnitude events, and the fault's proximity to highly populated areas.



Southern California Fault Lines

Where will the Next "Big One" Hit?



Methodology

Step 1

The fault lines were given the count, average magnitude, and sum of magnitude for all earthquakes that were closest in proximity. Earthquake data was separate into categories based on their magnitude, as well as their date. Earthquakes with magnitude 1-3 were analyzed from 2000-2013, and earthquakes with magnitude 3 and up were analyzed from 1940-2010, in 10 year intervals. This was the case because higher magnitude events happened much less frequently than lower magnitude ones. The summarized population density of the area surrounding each fault was also found.

Step 2

The number of earthquakes, both low and high magnitude, was normalized by the length of the fault line for each major fault in Southern California. From this, a list was made for both high and low magnitude events. The top 20 most-active fault lines was determined by combining the two lists.

Step 3

Temporal analysis was undertaken for the top 20 most active faults. The rate of increase of each fault line was normalized by the average number of earthquakes. The results can be found in Table 1

Step 4

A score was found for the 20 faults based on

- 25% high magnitude earthquakes, normalized by length
- 25% low magnitude earthquakes, normalized by length
- 20% population density
- 15% rate of increase, high magnitude events
- 15% rate of increase, low magnitude events

Top 20 Faults



Cartographer: Dennis Fee
 Course: CEE 187- Geographic Information Systems
 Projection: NAD_1983_2011_StatePlane_California_V_FIPS_0405_Ft_US
 Data Sources: census.gov (Population density); Quaternary Fault & Fold Database of the United States, USGS (Faultlines); Undergrad Studies in Earthquake Information Technology (California Counties); Southern California Earthquake Data Center (Earthquakes) http://theweek.com/article/index/260116/when-will-the-big-one-strike-california (information on California earthquakes)

Table 1: List of Earthquake Rates

Fault Name	Rate (High magnitude events over 70 years)	Rate (Low magnitude events over 14 years)
Breckenridge	-0.241	0.005
Eureka Park	0.357	-0.06
Brawley	0.055	0.082
Burnt Mountain	0.069	-0.011
Imperial	0.143	0.007
Yuha Wells	0.29	0.135
East Montebello	0.2	0.001
Wheeler Ridge	-0.225	-0.076
Cady	0.025	-0.291
Lavic Lake	0.497	-0.269
Long Canyon	-0.576	0.021
Santa Ana	0.274	-0.001
White Wolf	-0.383	-0.075
Southern Sierra Nevada	-0.358	-0.173
Edison	-0.286	-0.232
Smoketree Wash	-0.135	0.069
Kern Gorge	-0.387	-0.056
Elsinore	-0.04	0.152
Berdoon Canyon	0.023	0.106
San Jacinto	-0.054	0.001



Table 2: Summary of the top 5 at-risk fault-lines

Name of fault line	Location (County)	Score	Reason
Yuha Wells	Imperial	55	Highest frequency of low magnitude earthquakes relative to length. Also demonstrated an increase in earthquake occurrence for both high magnitude and low magnitude events
Breckenridge	Kern	49	Very high frequency of low and high magnitude earthquakes relative to its length
Brawley Seismic zone	Imperial	35	Medium frequency of low and high magnitude events relative to length, and demonstrated an increase in low magnitude occurrence
East Montebello	Los Angeles	34	Located in area of very high population density, and has shown an increase in high magnitude events over the last 70 years
Lavic Lake	San Bernardino	29	Medium frequency of low magnitude events relative to length, and had the highest increase of high magnitude events over the last 70 years

Results and Discussion

Through the scoring system outlined in Step 4, the top 5 highest-risk faults were determined. These faults were the Yuha Wells fault, the Breckenridge fault, the Brawley Seismic Zone, the East Montebello fault, and the Lavic Lake fault. The summary of the scoring can be found in Table 2. It was found that there was a correlation between high magnitude earthquakes over the past 70 years, and low magnitude earthquakes over the past 14 years. However, there wasn't much correlation between the rates for earthquake events. Many fault lines showed a decrease in occurrence of earthquakes, or no change. Interestingly, the highest-risk faults happen to be relatively small in length, due to the fact that very long faults, such as the San Andreas, did not have a high density of earthquake activity relative to their length. Trying to find out if a fault will have a devastating earthquake is not simple because of the randomness of earthquake events. However, taking into account many important parameters, my results highlight the need for inquiry into my top 5 and top 20 at-risk faults, such as why these faults have such a high density of earthquake activity around them.