Earthquakes aren't the only thing to worry about!

Loss Estimation of California due to Liquefaction

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Data Source: California Geoportal
Projection: NAD 1983 California Teale Albers (Meters)

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Introduction

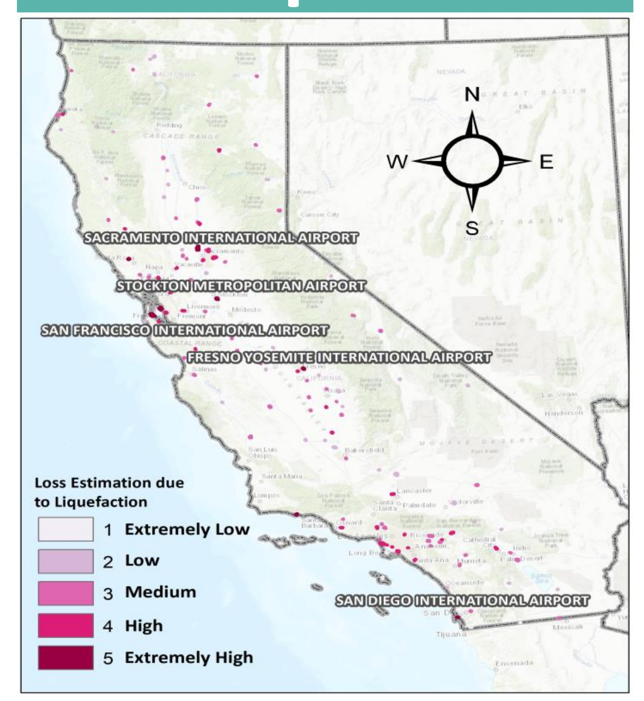
Seismic Events tend to have secondary effects that can cause more damage aside from the initial shaking, and liquefaction is a secondary effect that my project will focus on. Liquefaction is the process of increase in water pressure in saturated soils to the point where the soil particles are being pushed to the surface by a seismic event or possibly during a construction project. California is known to be susceptible to liquefaction since the 1989 Loma Prieta earthquake in San Francisco Bay Area, CA, where a significant amount of damage was caused by liquefaction. This event caused California to create new building codes that would take into consideration not only the shaking from earthquakes, but the secondary effects as well. However, there are still a significant amount of buildings that were built before the revision to the building codes, so there are still susceptible infrastructure being used today.

Damage from the Loma Prieta earthquake due to Liquefaction

Methodology

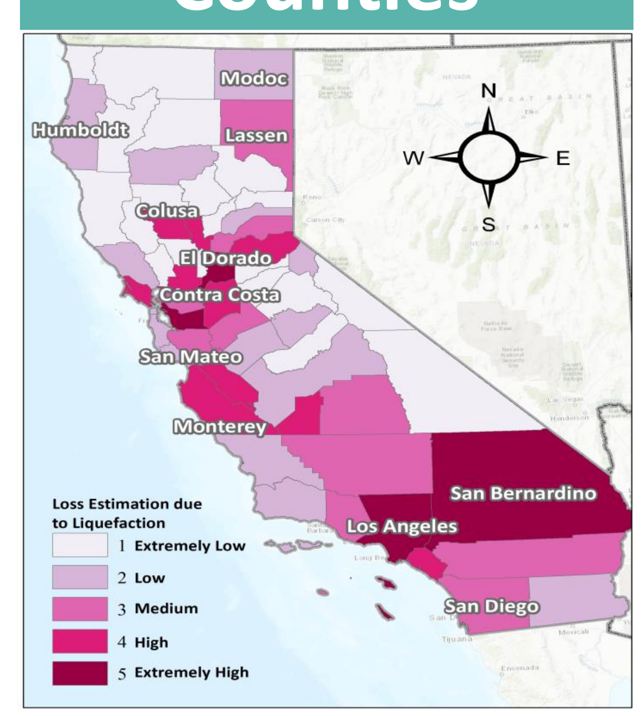
The methodology of the project was to create a ranking system of the different factors that would need to be taken into account to find cost of damages to a structure due to liquefaction. The three main infrastructure used in the study are highways, airports, and bridges. The infrastructure's age, susceptibility to liquefaction, amount of activity, and size were ranked from 1 to 5, where 1 meant the least amount of cost of damages and a 5 meant the most amount of cost of damages. After classifying the factors, I used the weighted overlay function to find the ranked estimated loss from 1 to 5 for raster data. When I kept the data in a polygon, I then used the field calculator to act as a weighted overlay, and I was able to get a ranked estimated loss from 1 to 5. After the analysis was complete, I was able to find the infrastructure in California that would have the most damage due to liquefaction.

Airports



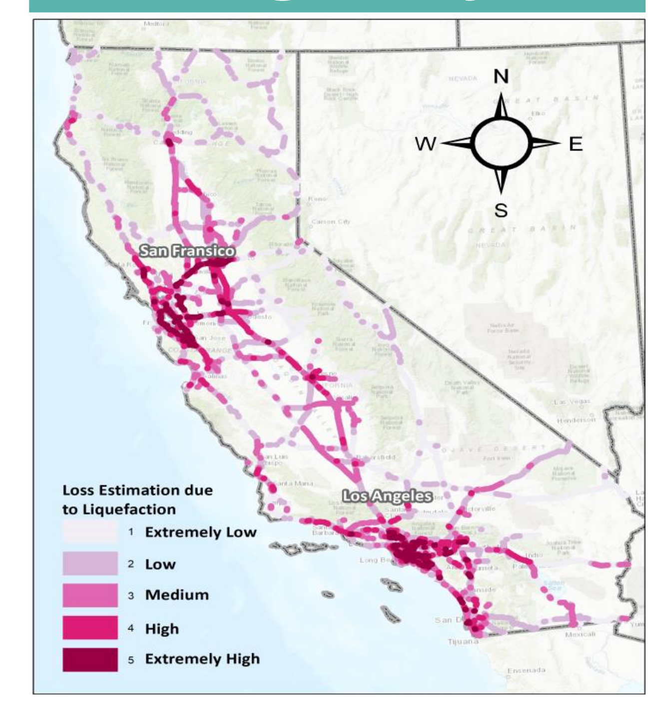
All of the airports in California were ranked according to its size, amount of activity, and its susceptibility to liquefaction. Since the airport boundaries were used, then the maximum liquefaction probability was used to characterize its susceptibility. Airport activity was categorize by what type of airport such as metropolitan or a private airport.

Counties



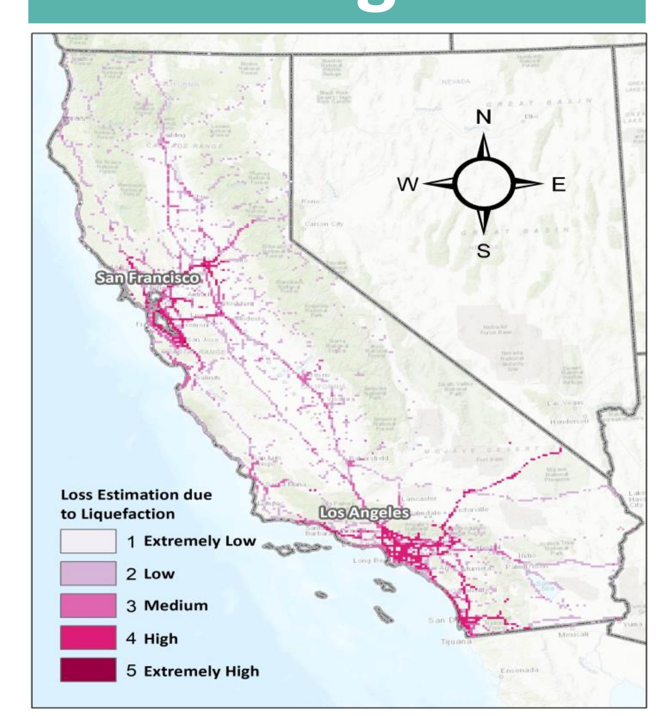
The counties of California were taken into consideration to find which county would be affected the most because of the effects of liquefaction to its infrastructure. The minority value of liquefaction was taken to represent the liquefaction probability of a county. Population data from each county was ranked from 1 to 5, where 1 is the less populated and a 5 is the most populated. Both ranks were then used to create a loss estimation in relation to counties.

Highways



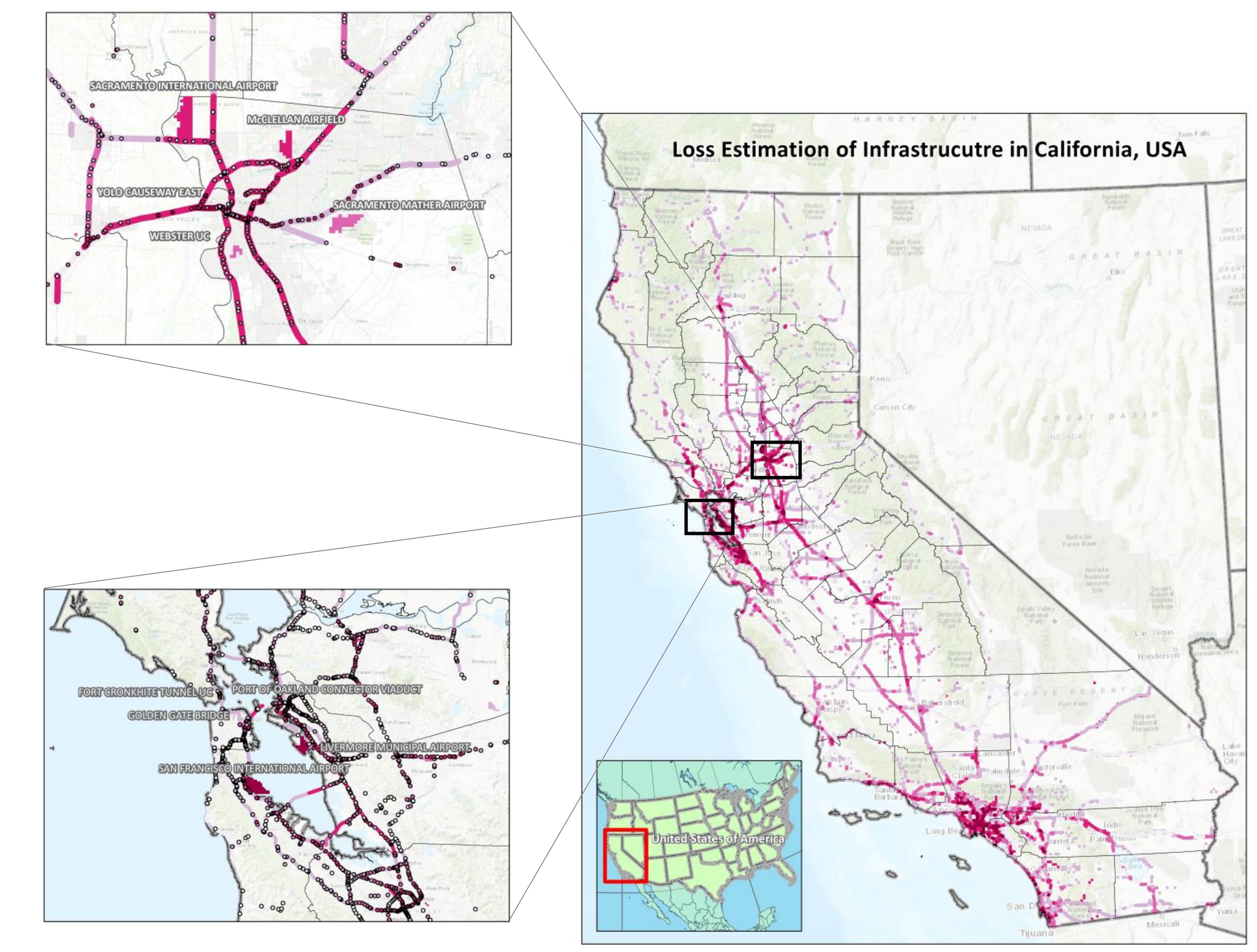
The California National highway system was used to provide analysis on the loss estimation due to liquefaction. The annual average daily traffic of both lanes of traffic was used to find the amount of activity for the highway system.

Bridges



Data on the major bridges in California were obtained. The size of the bridge was taken into account because a larger bridge would be more costly than a smaller bridge. The annual average daily traffic of both lanes was used to find the amount of activity. A buffer was created for the bridge locations to find its susceptibility to liquefaction, and the maximum value was used as the bridge susceptibility. Additionally, the age of the structure was ranked by assigning a high value to any structure that was built before 1989 because any bridge made before then would not be built to withstand liquefaction.

Results



From the analysis, I am able to locate the areas where liquefaction can cause the most damage in California. San Francisco and Sacramento are examples of two cities that would be the most affected. Additionally, I will be able to locate the structures that would need restorations to account for liquefaction.

Limitations

There was a limited amount of information for many different structures such as hospitals, levees, ports, and others. However, the most information found was for highways, bridges, and airports. However, some of these infrastructures did not have enough information as others. The bridge data had traffic volume, the age of the structure, and the type of bridge. The airport data layer did not have the age of the airport. Additionally, the study can be supplemented with other data such as the number of times a structure has been repaired or altered in any way. That data would be used as another factor to be considered when evaluating the loss estimation value of the structure.

Credit: U.S. Geological Survey
Department of the Interior/USGS
U.S. Geological Survey/photo by D. Perkins