Relationships Between Earthquake Multiplicity and Maximum Magnitude For USGS Data

When we were attempting to gather historical data analysis for earthquakes using USGS data we noticed some irregularities in our graphs. To find historical trends we merged the earthquakes of each month into a singular data point and filtered out the data. When plotting the number of earthquakes in each month, we noticed that there were a few extreme values

A red line on a white background

Description automatically generated

These extreme values were not present when looking at the results of ETAS/QuakeGPT and it give an overall more consistent plot and comparing ETAS and USGS we get an even more clear discrepancy

A white background with orange and blue lines

Description automatically generated

We also noticed that there were a few similarities in the shape of the graphs of monthly earthquake counts and the another graph we made about the maximum magnitude earthquake in each month, which made us question if there was a correlation between them.

Here is a normalized graph of earthquake counts in each month and maximum magnitude earthquake of each month.

A blue and orange lines

Description automatically generated

Looking at this we can see that the peaks of both graphs occur on largely similar dates.

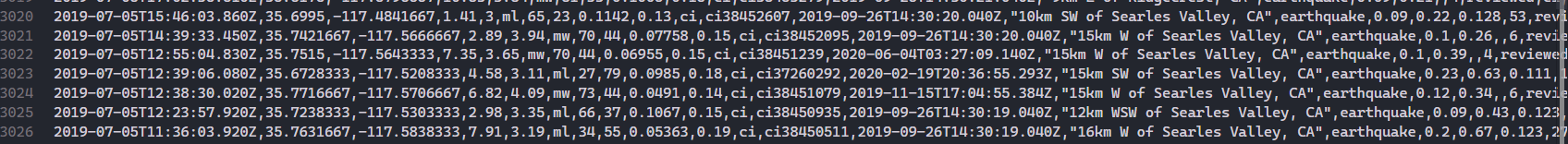
We then tried to see if the data values and so compared the top 15 values for earthquake magnitude and no. of earthquakes and found a positive trend.

A red line with blue dots

Description automatically generated

Looking at this we can see that the peaks of both graphs occur on largely similar dates.

Our hypothesis for this was that these large earthquakes are being recorded multiple times by different sensors and so double checked the dataset and found this:

Several hundreds of rows were dedicated to record earthquakes seemingly seconds apart. This was the July 4th Earthquake in 2019. When these large earthquakes are happening, it seems that USGS data is recording them many times.

Data Transformations:

We filtered the USGS data by Date >= 1960-01-01 and Date <= 2023-01-01, longitude > -123 and longitude < -113, and latitude > 29 and latitude < 39