Water injection wells and earthquakes in Oklahoma:
(From Kaggle)
https://www.kaggle.com/ksuchris2000/oklahoma-earthquakes-and-saltwater-injection-wells

Context

Beginning in 2009, the frequency of earthquakes in the U.S. State of Oklahoma rapidly increased from an average of fewer than two 3.0+ magnitude earthquakes per year since 1978 to hundreds per year in 2014, 2015, and 2016. Thousands of earthquakes have occurred in Oklahoma and surrounding areas in southern Kansas and North Texas since 2009. Scientific studies attribute the rise in earthquakes to the disposal of wastewater produced during oil extraction that has been injected deeply into the ground. (Wikipedia)

Injection wells are utilized to dispose of fluid created as a byproduct of oil and gas production activities. Likewise, hydraulic fracturing, ie "fracking", produces large byproducts of water. This byproduct is then injected deep back into the earth via disposal/injection wells.

Content

This dataset contains two data files. One detailing "active" saltwater injection wells in Oklahoma, as of September 2017. The second file lists earthquakes in the Oklahoma region (Oklahoma and surrounding states) since 1977.

Questions

1) Do wastewater injection wells cause the increase in earthquake activity?
2) Is it the volume of wells in a given area or the volume of injection that drives the activity?
3) Can current/past injections be used to predict future earthquakes and/or intensity?

Method

Part 1 will mainly be visualization, it will be interesting to see line plots of the number of earthquakes with notation of when wells come on line. Another (possibly more informative) way to look at it would be a line plot of the number of wells over time and number of earthquakes but only include earthquakes within a certain radius of the newly online wells (various sizes to be tested)

Part 2 will be interesting to experiment with, similar to part one several plots will be made this time exploring total volume injected not just number of wells online

Part 3 will utilize time series analysis with a neural network using Keras to try to predict the number/location of future earthquakes. This will have to train on incremental times to try to predict the next 3 or 6 months. Then that time frame of testing data will be included in the training and the next increment of time becomes the test set. I will probably do it every 6 months from when the earthquakes became more frequent until the end of the data, 2009-2017.

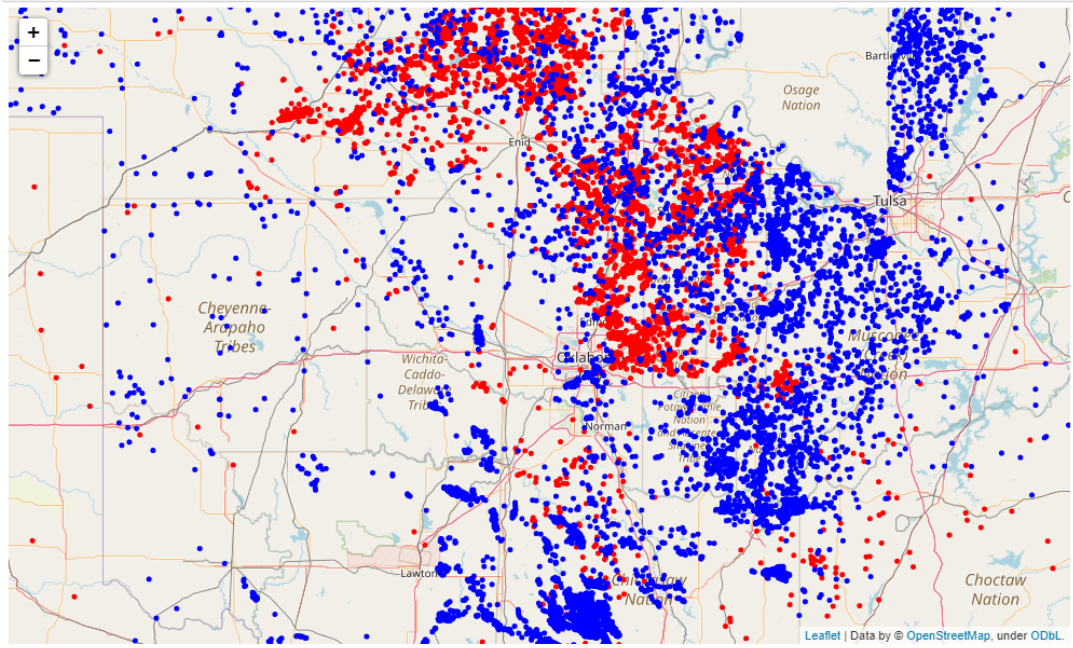
Wells Dataframe:

```
Int64Index: 11125 entries, 0 to 11124
Data columns (total 21 columns):
 #   Column         Non-Null Count  Dtype
---  ------         --------------  -----
 0   API#           11125 non-null  float64
 1   Operator       11125 non-null  object
 2   Operator ID    11125 non-null  float64
 3   WellType       11125 non-null  object
 4   WellName       11124 non-null  object
 5   WellNumber     11124 non-null  object
 6   OrderNumbers   11124 non-null  float64
 7   Approval Date  11125 non-null  object
 8   County         11125 non-null  object
 9   Sec            11125 non-null  object
 10  Twp            11125 non-null  object
 11  Rng            11125 non-null  object
 12  QQQQ           11125 non-null  object
 13  LAT            11125 non-null  float64
 14  LONG           11125 non-null  float64
 15  PSI            9689 non-null   object
 16  BBLS           9689 non-null   object
 17  ZONE           11125 non-null  object
 18  Unnamed: 18    0 non-null      float64
 19  Unnamed: 19    0 non-null      float64
 20  Unnamed: 20    0 non-null      float64
dtypes: float64(8), object(13)
```

Earthquakes Dataframe:

```
RangeIndex: 13954 entries, 0 to 13953
Data columns (total 23 columns):
 #   Column           Non-Null Count  Dtype
---  ------           --------------  -----
 0   time             13954 non-null  object
 1   latitude         13954 non-null  float64
 2   longitude        13954 non-null  float64
 3   depth            13954 non-null  float64
 4   mag              13948 non-null  float64
 5   magType          13933 non-null  object
 6   nst              5389 non-null   float64
 7   gap              12433 non-null  float64
 8   dmin             5621 non-null   float64
 9   rms              12749 non-null  float64
 10  net              13954 non-null  object
 11  id               13954 non-null  object
 12  updated          13954 non-null  object
 13  place            13954 non-null  object
 14  type             13954 non-null  object
 15  horizontalError  10756 non-null  float64
 16  depthError       12144 non-null  float64
 17  magError         6055 non-null   float64
 18  magNst           6133 non-null   float64
 19  status           13954 non-null  object
 20  locationSource   13954 non-null  object
 21  magSource        13954 non-null  object
 22  marker_color     13948 non-null  category
dtypes: category(1), float64(12), object(10)
```

Locations of wells and earthquakes:



Red dots = Earthquakes

Blue dots = Active Injection Wells