

# Can Changing Climate with More Rainfall Increase the Number of Small Earthquakes

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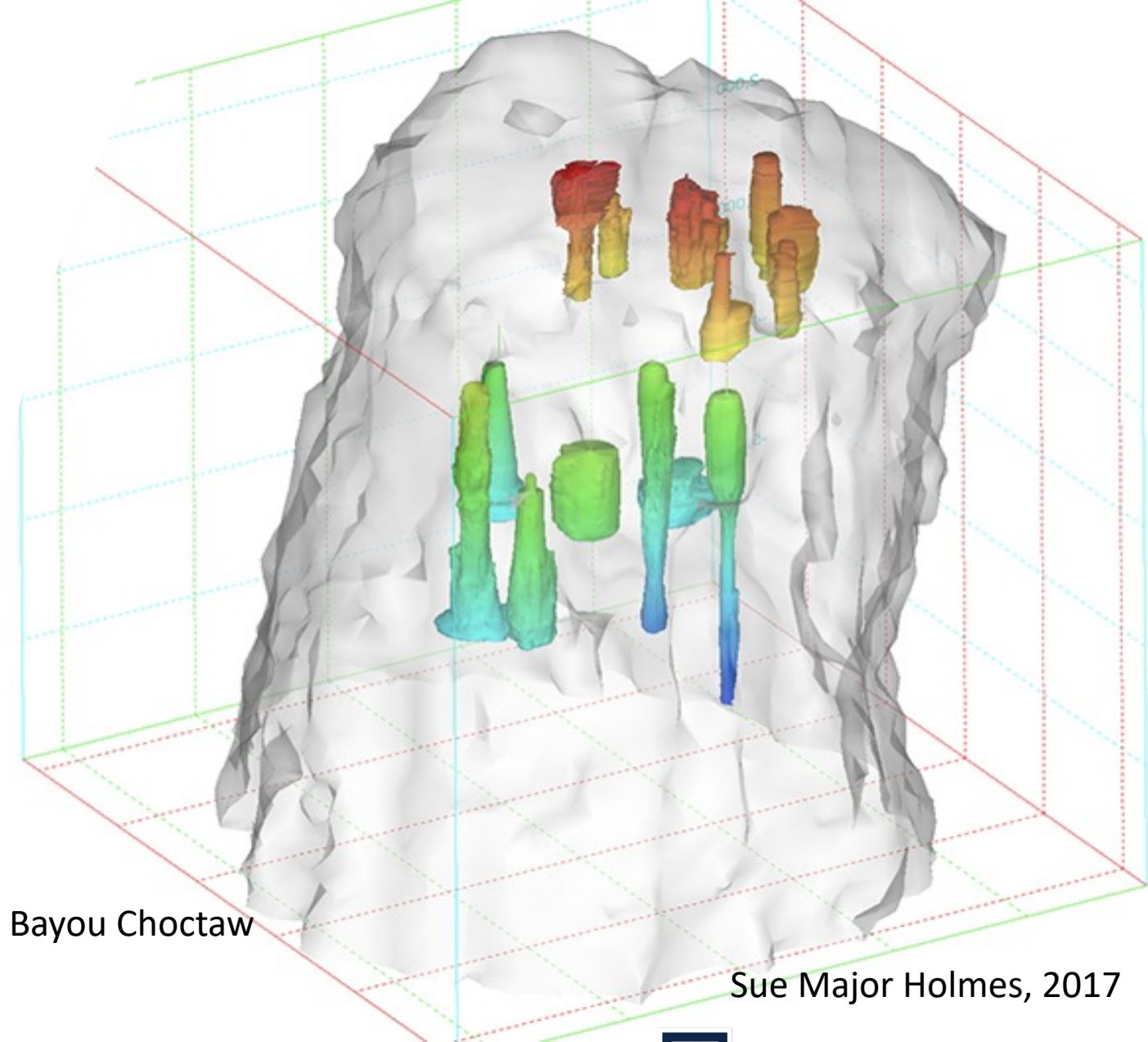
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# Background

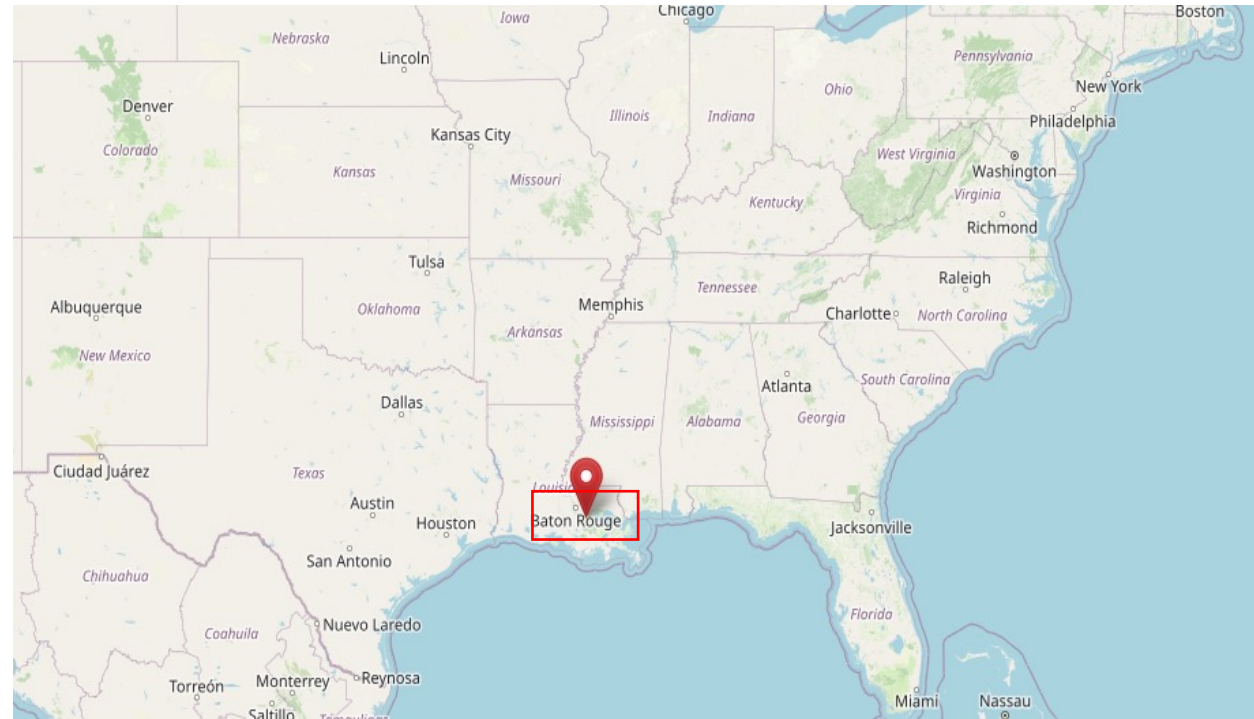
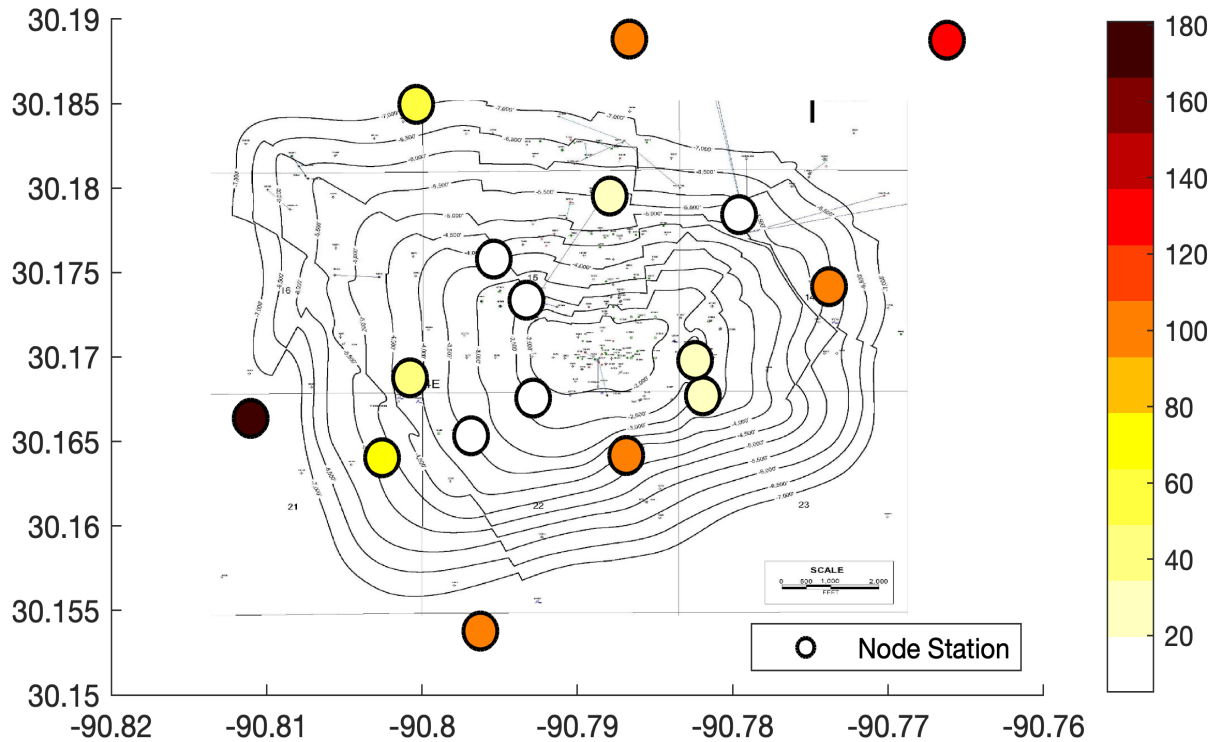
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- Microearthquakes and Rainfall
- The knowledge of looking into rainfall and eq in an area where a salt dome is present is relatively new.
- What are the uses of salt domes?
- How do microearthquakes affect the stored fuel contained in the salt dome?
- Is there a correlation between microearthquakes and rainfall?
- Would more rain cause more earthquakes?
- Is it possible to forecast earthquakes from the rain?



Sue Major Holmes, 2017

# Background



Location of Sorrento Node Stations with Top of Salt Contours



# Datasets

- 17 Node Stations
  - Identify Microearthquakes and PTRBs(Potentially Triggered Rock Bursts)
- Total Number of Microearthquakes: 146
- Total number of PTRBs: 1019
  - February 3, 2020-July 10, 2022
- Total number of Rainfall: 91,976
  - January 1, 2020-October 4, 2022

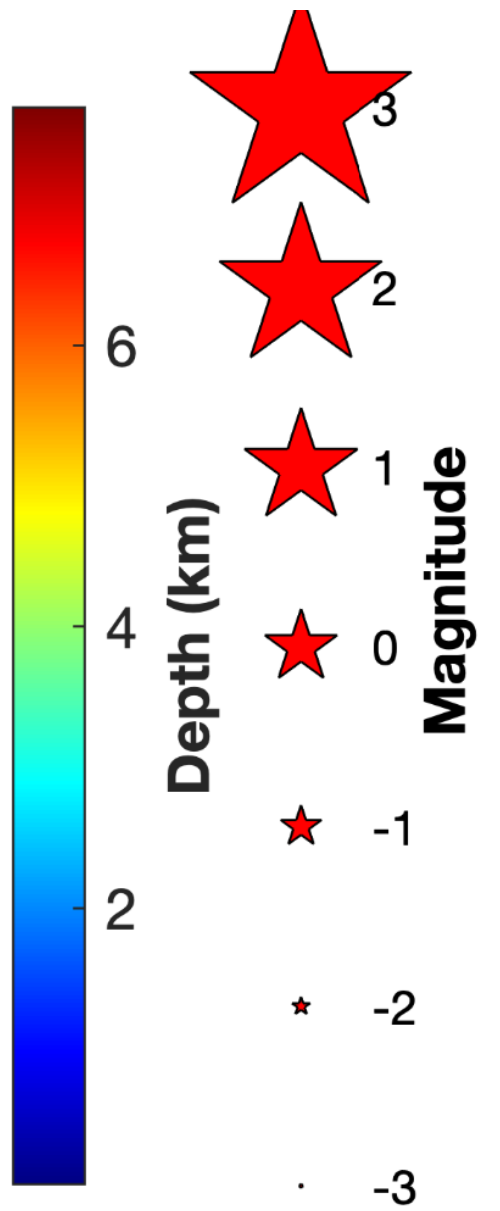
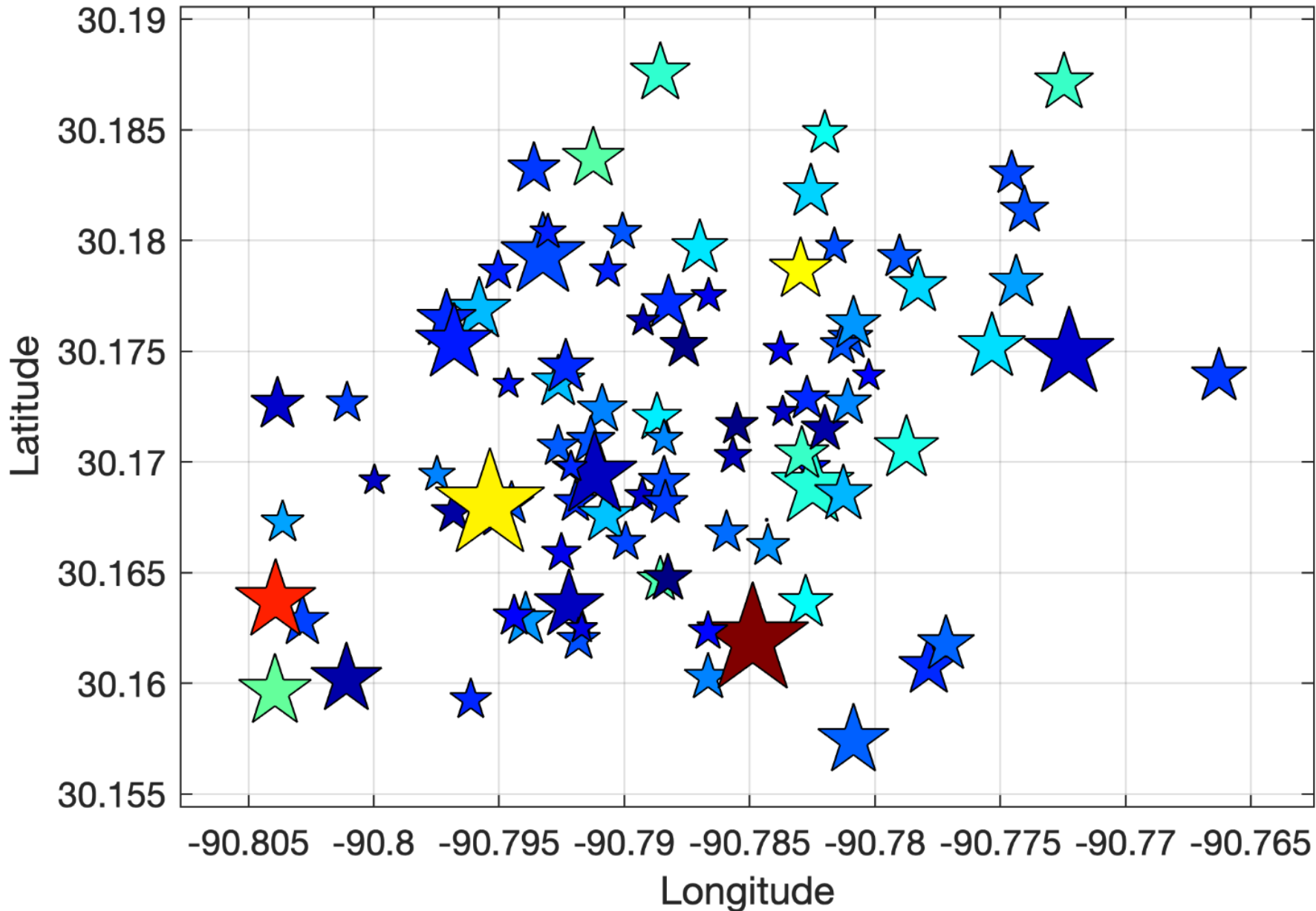




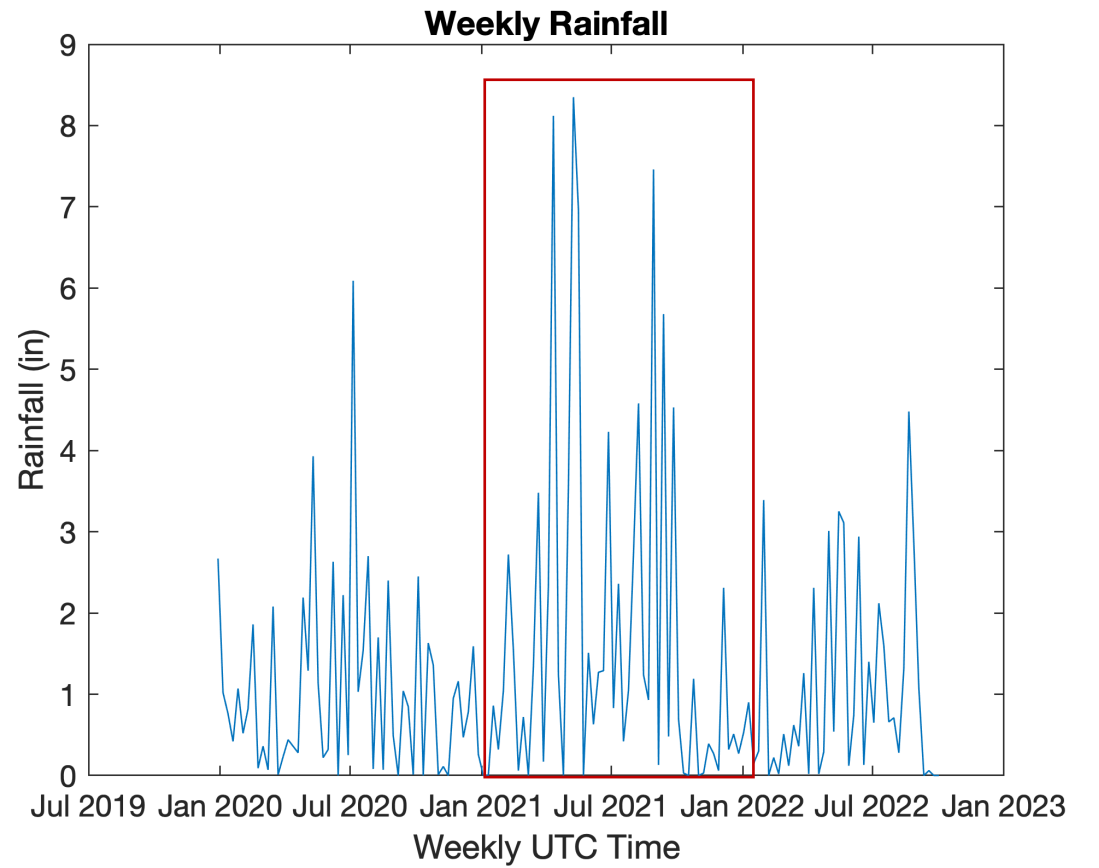
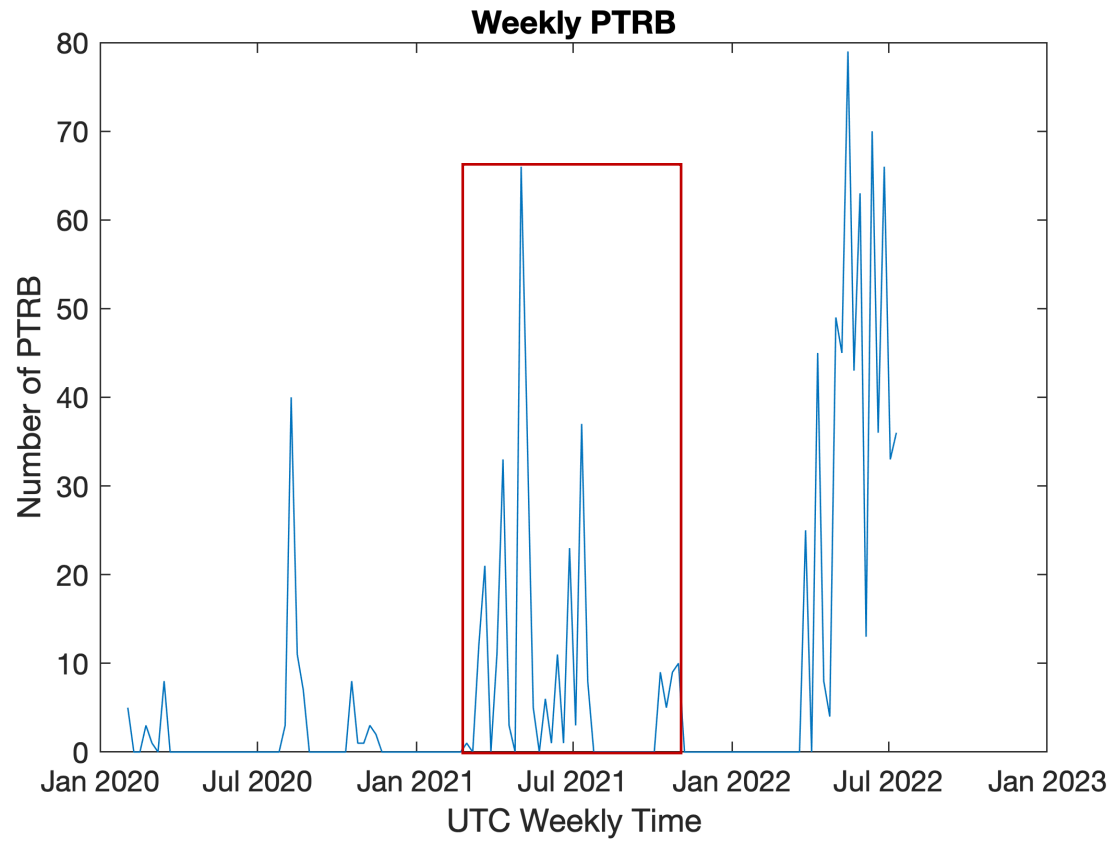
# Methods

- The Rainfall datasets are measured 15-30 mins apart.
- I analyzed the datasets by creating Matlab scripts.
- This step involved producing plots and graphs.
- The dataset was turned it into a table, then to a time-table and plotted.
- Next, I created a code to create a contingency table.
- Used a Bayesian Probability Model to estimate the probability of earthquakes occurring in the presence of rainfall.

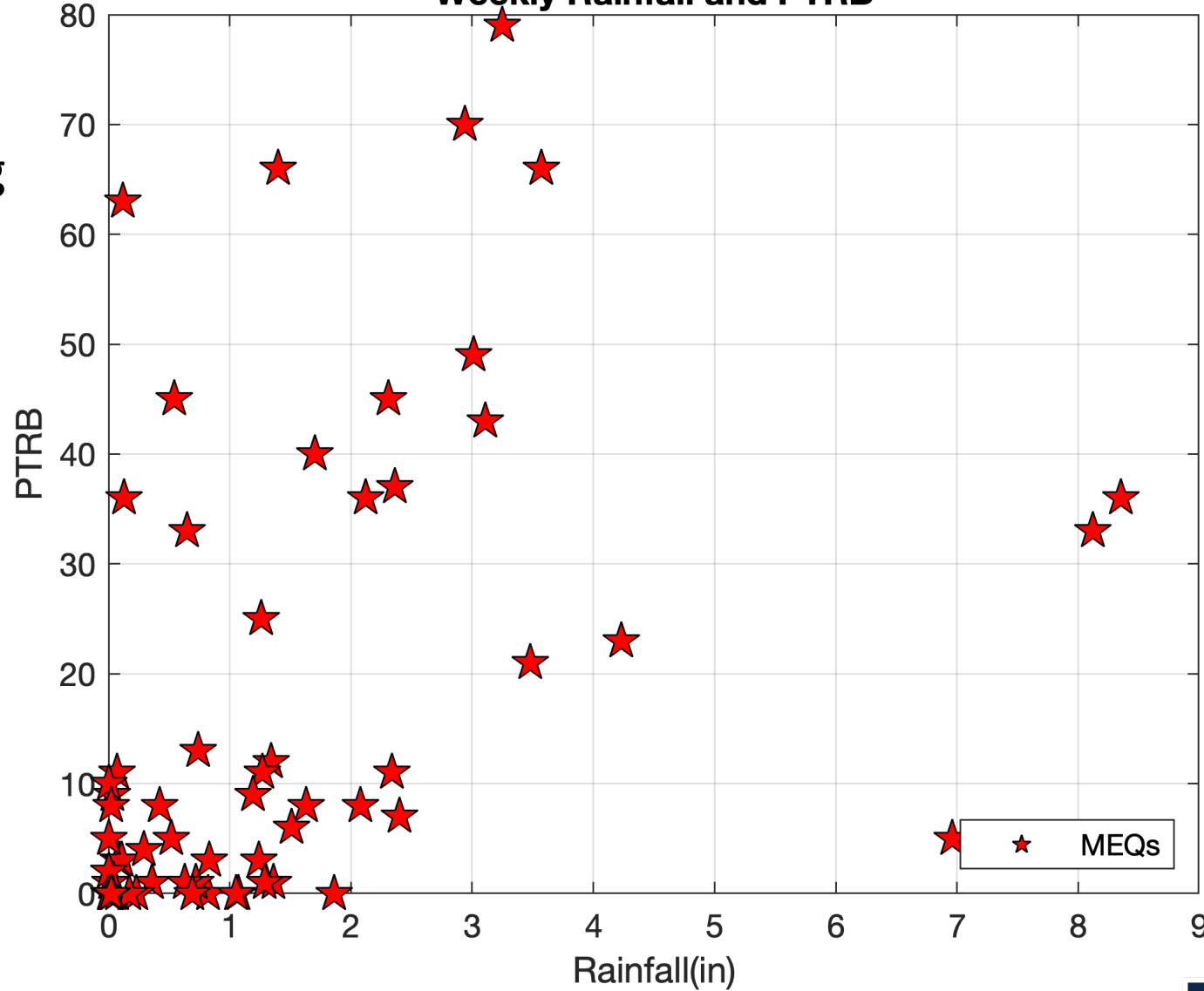
### Scatter Plot of Earthquakes







Weekly Rainfall and PTRB

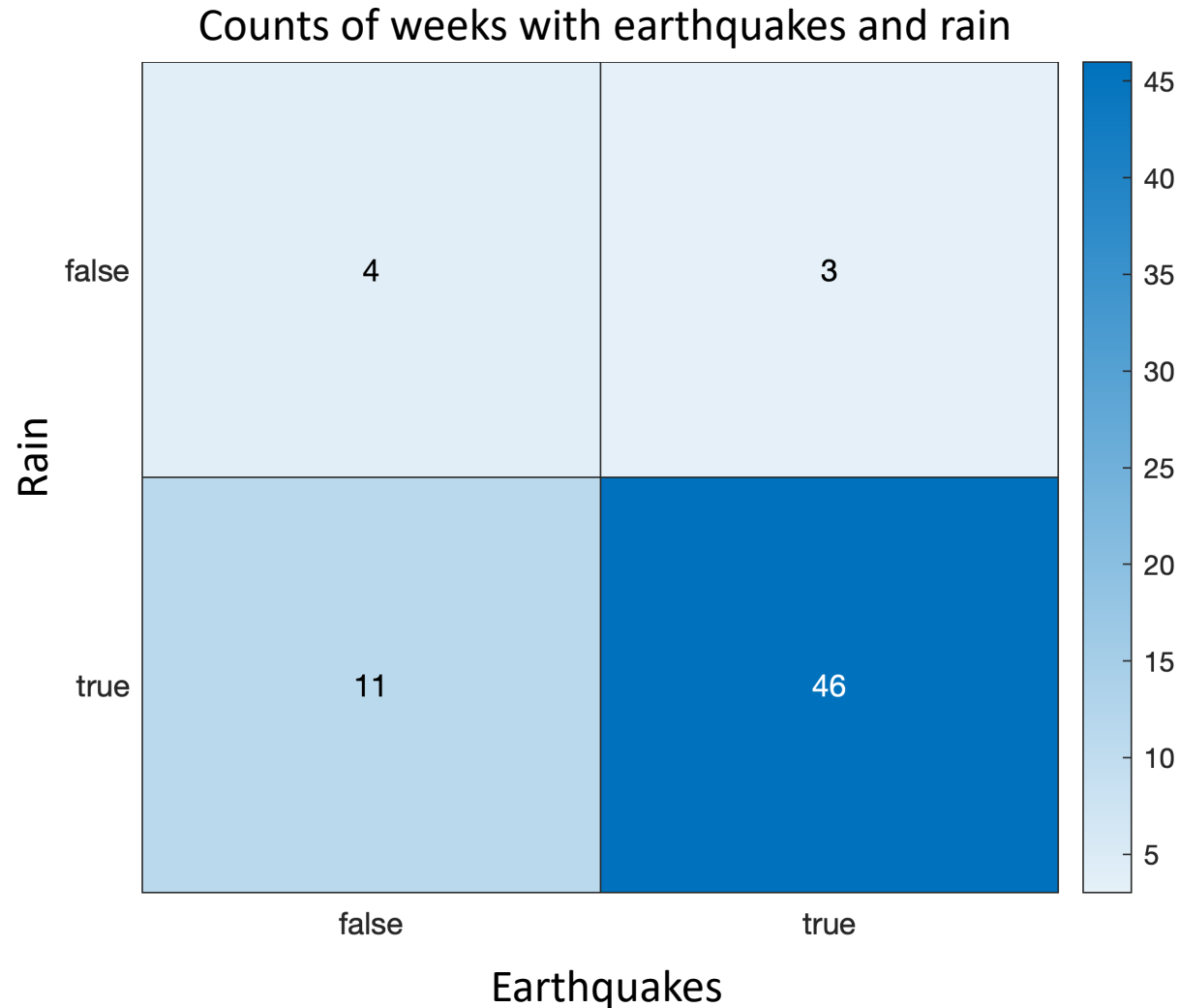


- Scatter plot showing the weekly number of PTRBs as a function of weekly Rainfall.
- The correlation coefficient between the datasets is  $r = 0.42$
- Moderate correlation



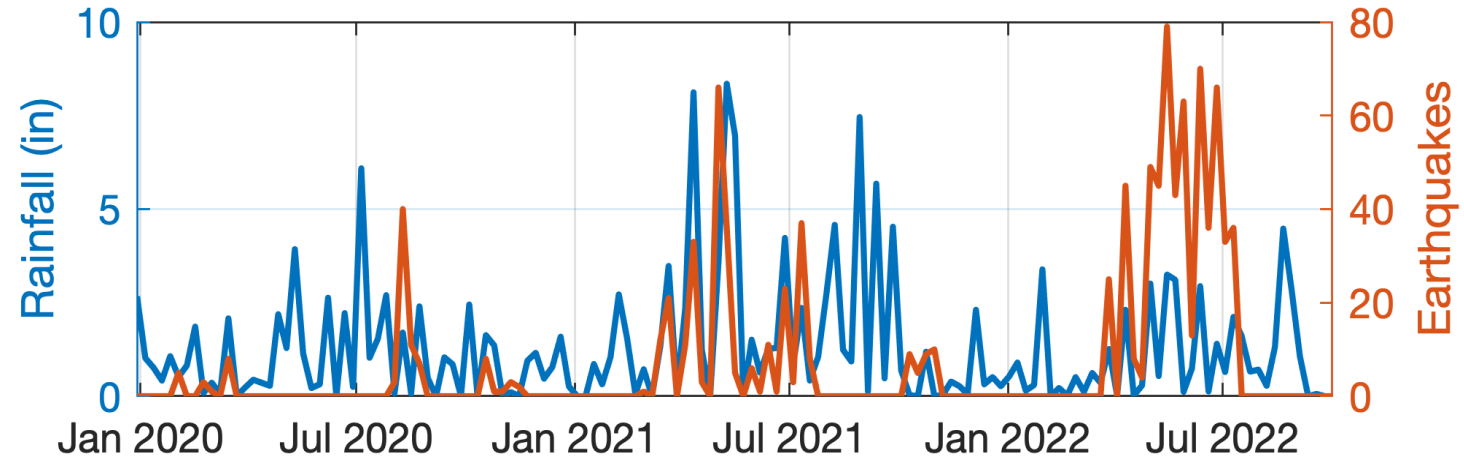
# Contingency Table of Weekly Rainfall and Earthquakes

- The contingency table shows the relationship between weeks with rain and earthquakes
- To create the contingency table, I made it so that we would only count rain that is >1 (in)
- True is variables = 1 and false is variables = 0

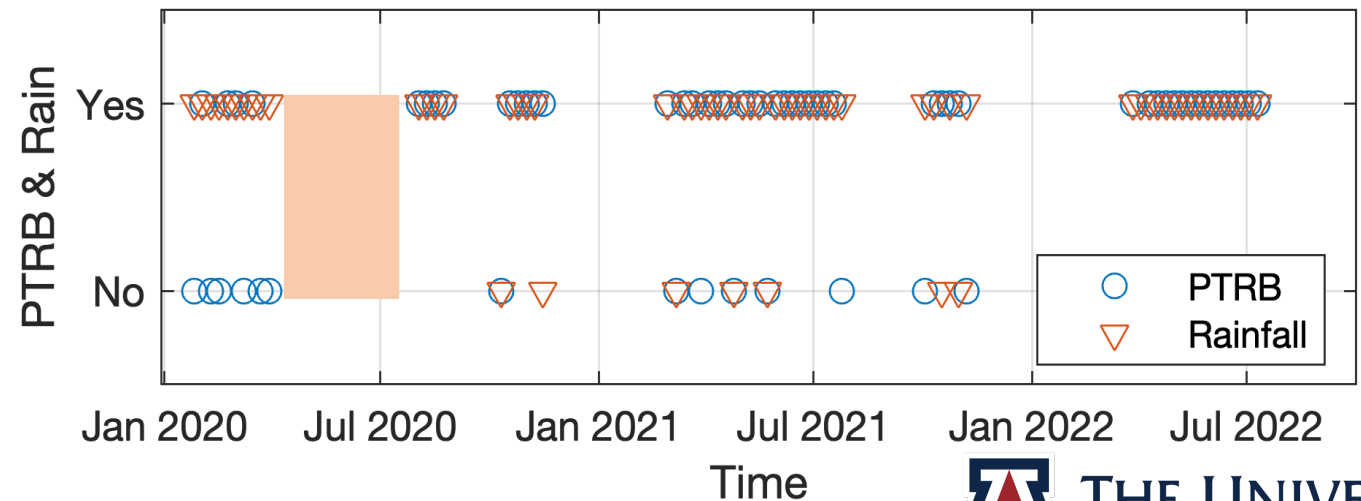


# Discussion/Synthesis

- The results backed up my question of is there a correlation between earthquake and rainfall.
- Using the Bayesian Probability Model, I found that when we factor rainfall to the background rate, we find an increase of 16.5%
- In the future, I would suggest looking at the mechanisms and time dependent forecasting.



**Weeks with Rainfall and PTRB**

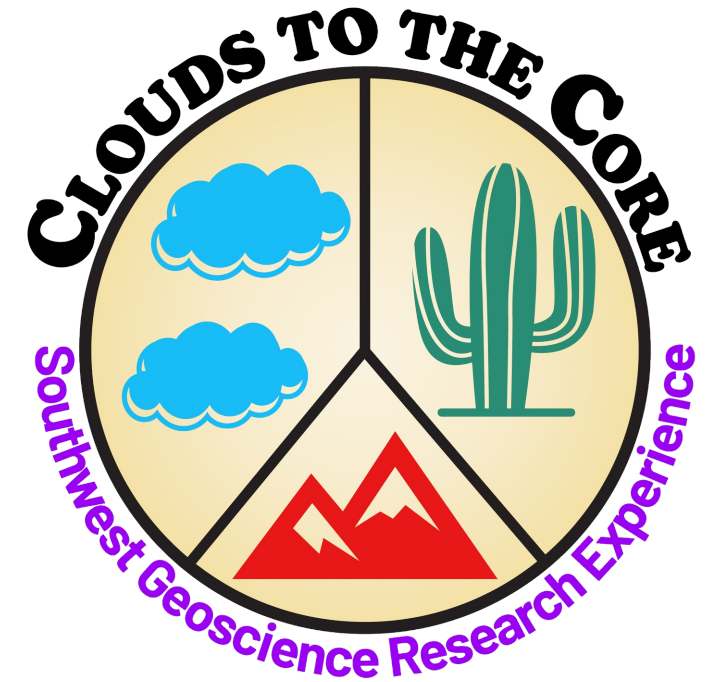




# Conclusions

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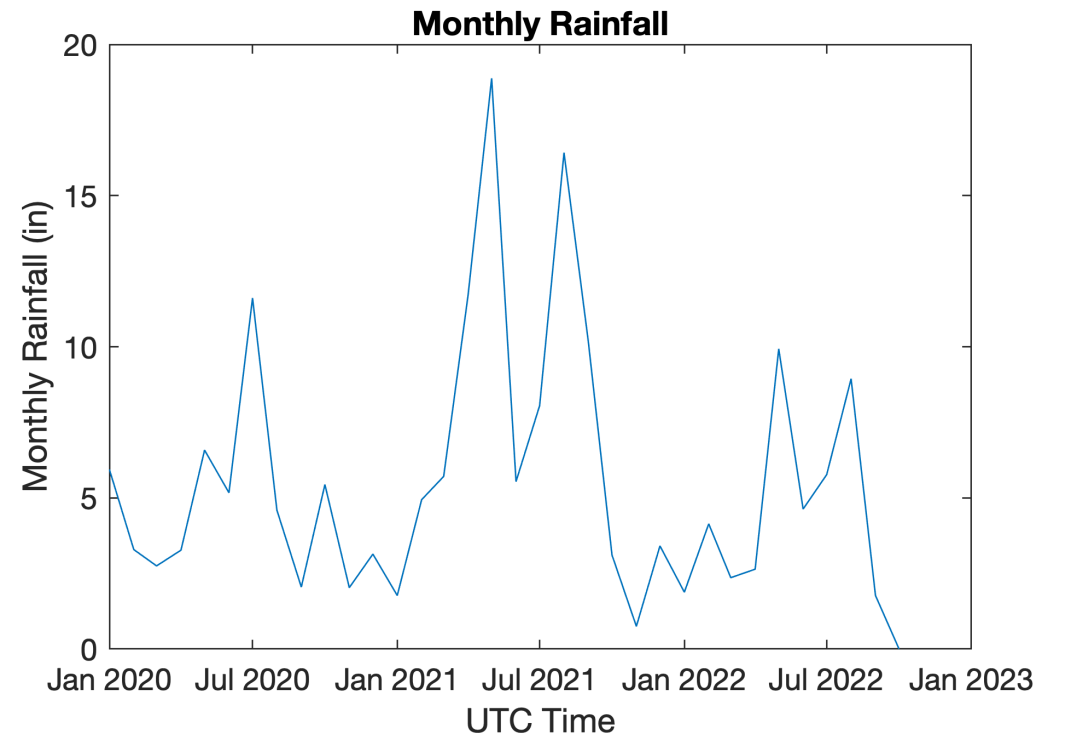
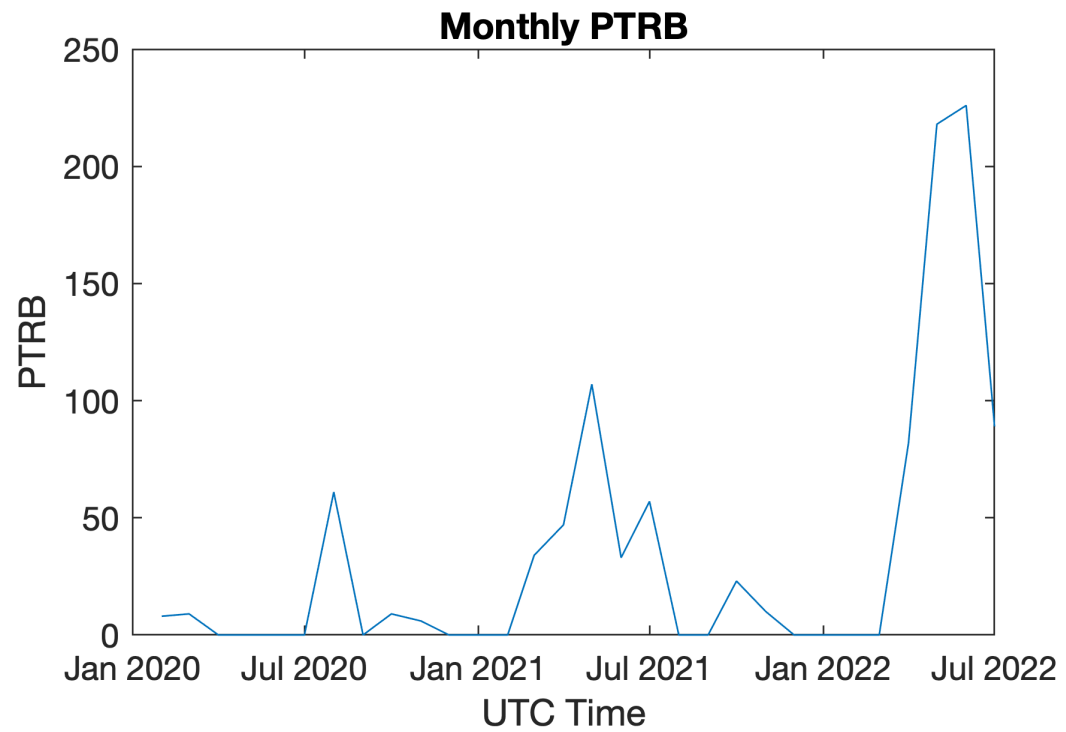
- I had two objectives for this project:
  1. Find a correlation between earthquakes and rainfall.
  2. Determine if it would be possible to forecast earthquakes given that there's rain.
- Background rate (no background knowledge of what's causing eqks, just what the data says): 76.5%
- When rainfall was added in the Bayesian model, the probability: 93%
- There is a correlation between rainfall and earthquakes.
- A big thank you to Dr. Patricia Persaud and Alan Juarez-Zuniga.



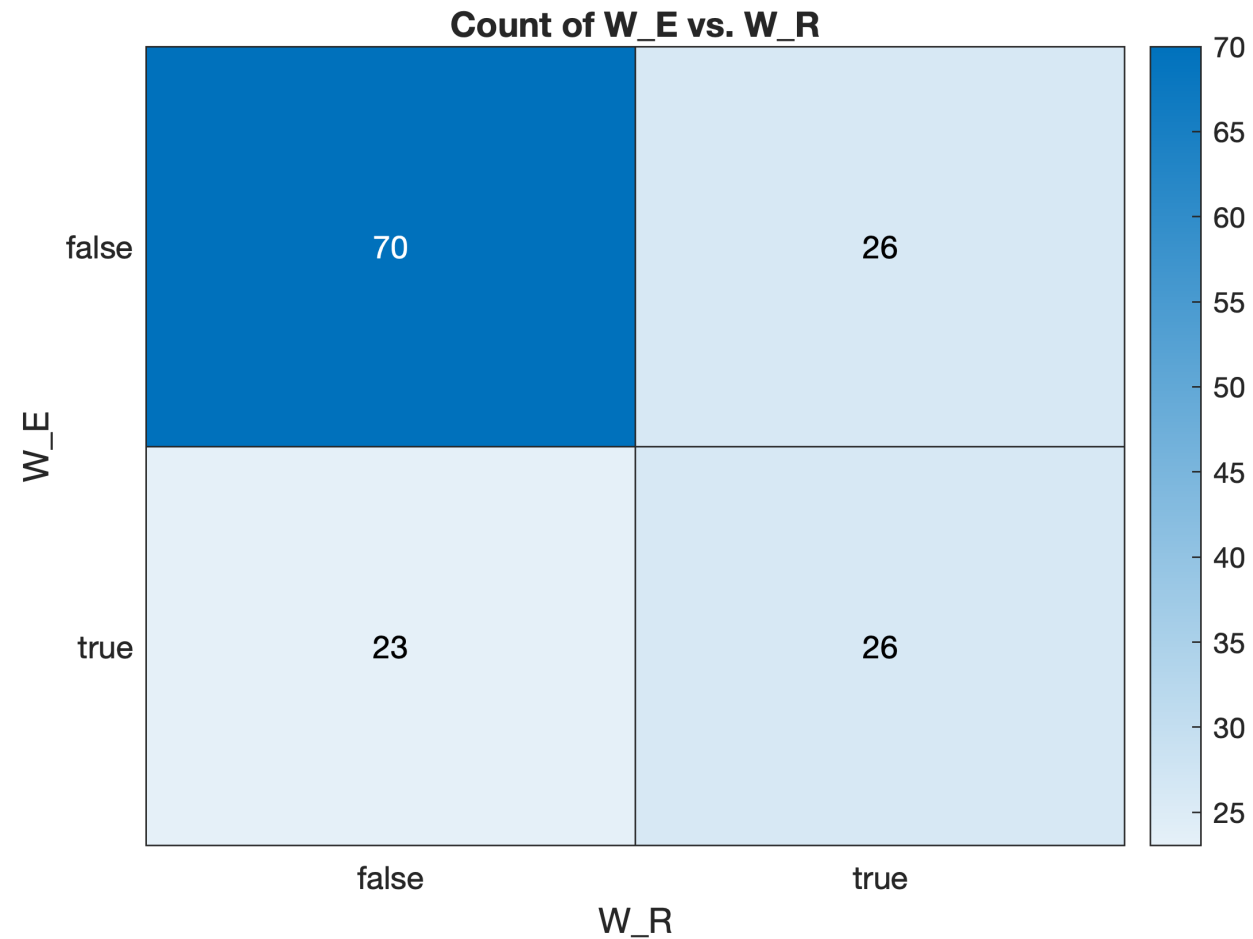
# References

- *Strategic petroleum reserve taps sandia expertise in Salt*. LabNews. (n.d.).  
<https://www.sandia.gov/labnews/2017/04/21/strategic-petroleum-reserve-taps-sandia-expertise-in-salt/>

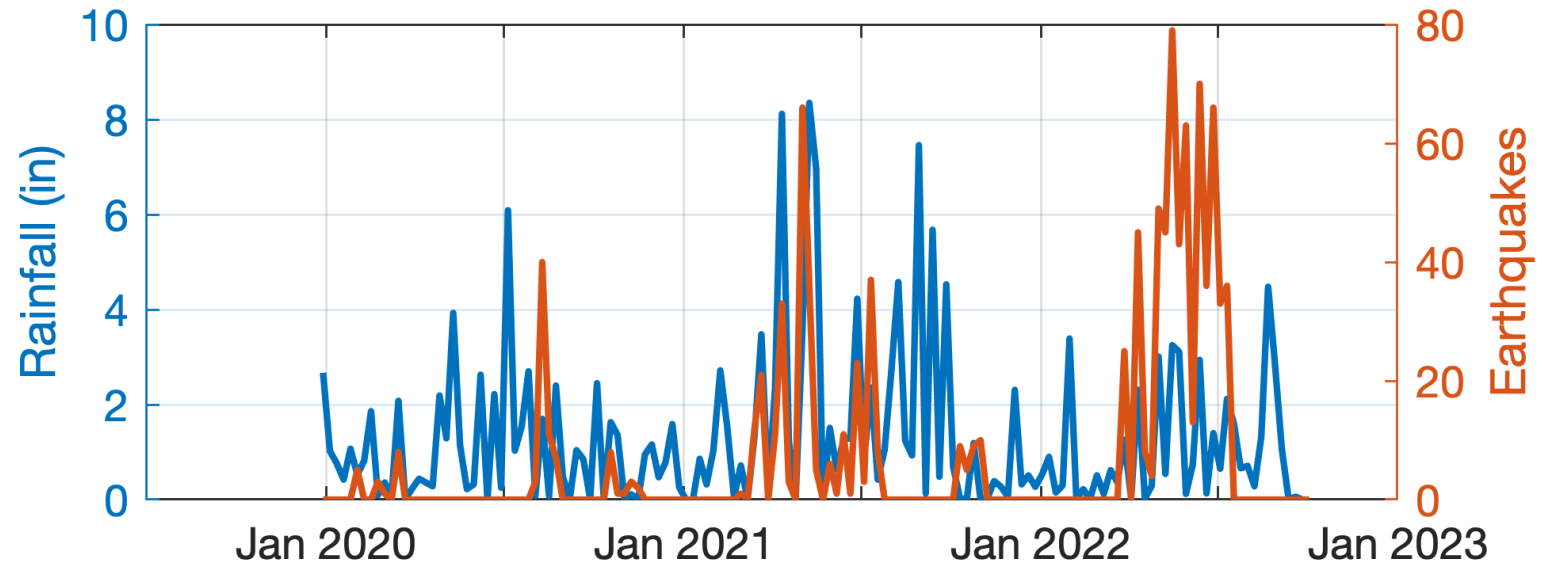




# Contingency Table of Weekly Rainfall and Microearthquakes







### Weeks with Rainfall and PTRB

