



**Hold onto your seats...because  
we are going to 'QUAKE' you up!**

**Project 1 Presentation**  
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October 4<sup>th</sup> , 2021

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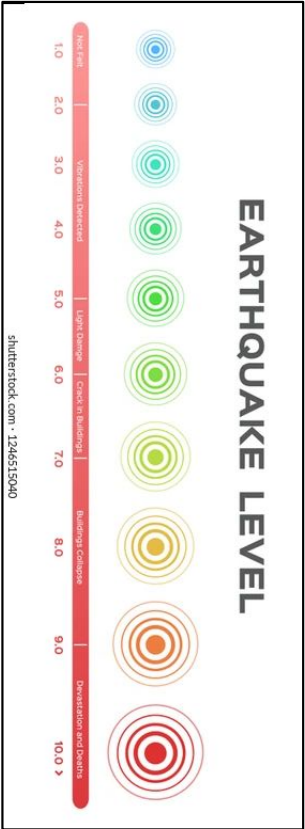
# Project Scope

- An investigation of earthquakes globally, during a 10 year time frame (2010-2020).
- Looking at various factors with earthquakes (when, where, and a possible trend).

# Definitions

- **Large Oceanic Event:** Whether a large event in the Ocean occurred or not.
- **Country Code Module standard:** ISO 3166-1

- **Magnitude Richter Scale**
- **Alert Levels**

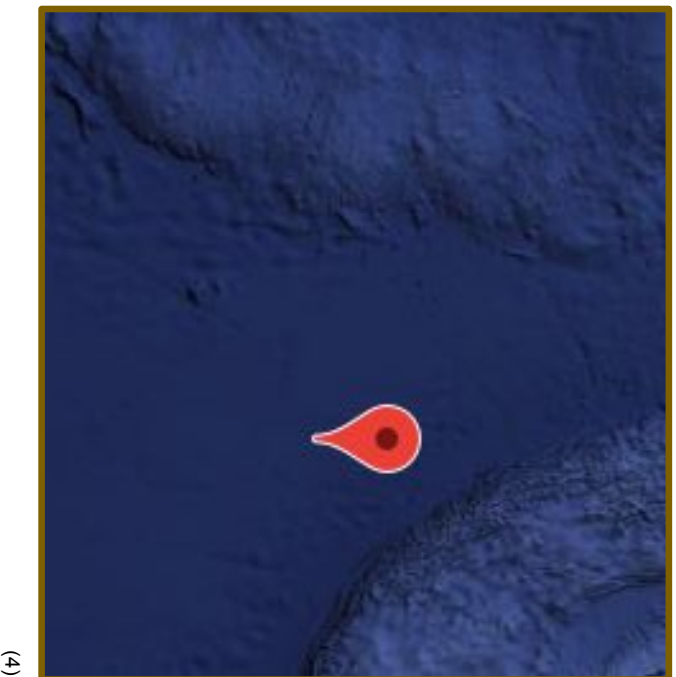


(2)

Alert Level and Color	Estimated Fatalities	Estimated Losses (USD)
Red	1,000+	\$1 billion+
Orange	100-999	\$100 million - \$1 billion
Yellow	1-99	\$1 million - \$100 million
Green	0	<\$1 million

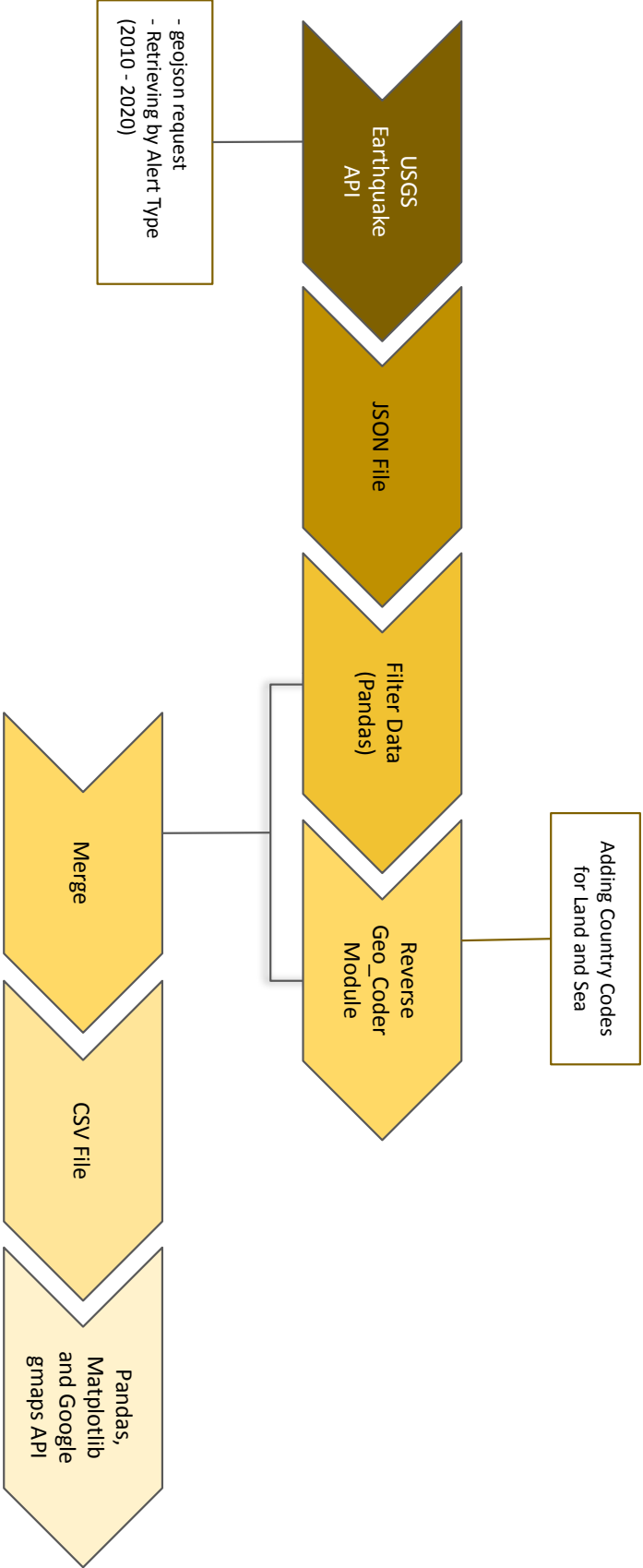
(3)

# Research Questions



1. Where do earthquakes happen by country?
2. What is the density of magnitudes for earthquakes?
3. What month do earthquakes mostly occur?
4. What is the alert level density of earthquakes
5. Is there a relationship between magnitude and % chance of large oceanic event?

# Data Retrieval and Methods

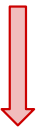


# Data Retrieval and Methods – Cleaning Data

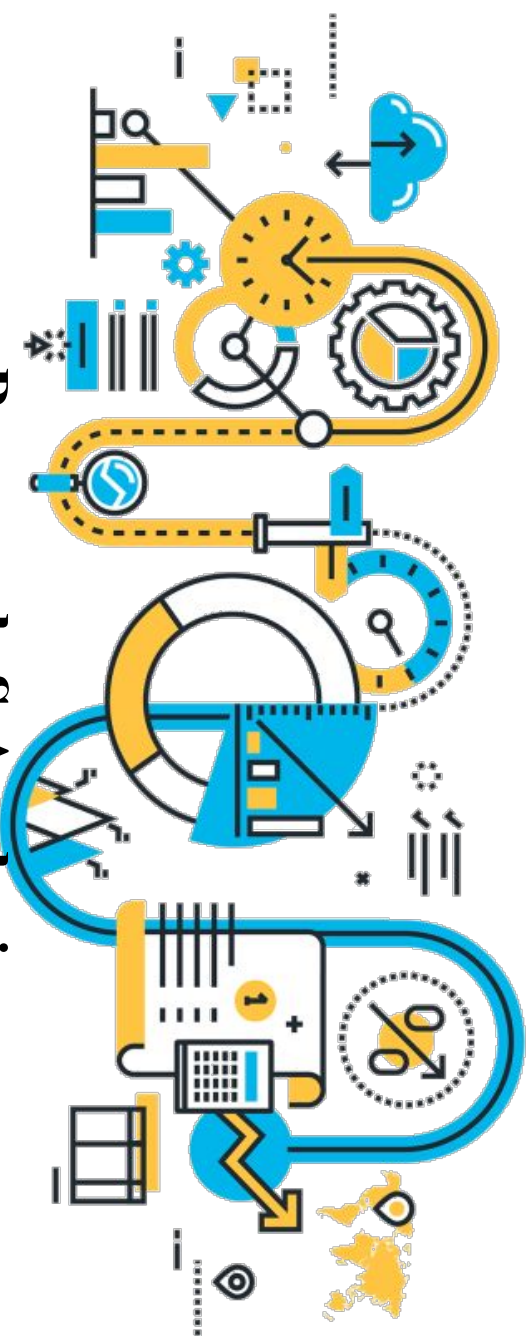
```
1 #display the null value rows
2 null_rows = earthquake_data[earthquake_data.index.isin(rows_with_nan) == True]
3 null_rows
```

	id	Latitude	Longitude	Depth (km)	Lat_Lng	Alert	Place	Date	Magnitude	Tsunami	Type
64	us7000cinv	52.7551	-168.2401	23.00	(52.7551, -168.2401)	green	None	2020-12-01 11:22:39.923	6.4	1	earthquake
3798	us20004fw7	-4.0520	129.5097	10.00	(-4.052, 129.5097)	green	102 km SE of Amahai, Indonesia	2015-12-09 09:56:58.040	NaN	0	earthquake
3827	us100041nt	22.5019	94.8414	11.45	(22.5019, 94.8414)	green	53 km NW of Momywa, Myanmar	2015-11-27 03:33:57.810	NaN	0	earthquake

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 6049 entries, 0 to 6048
Data columns (total 13 columns):
#   Column              Non-Null Count  Dtype
---  -
0   id                   6049 non-null  object
1   Latitude             6049 non-null  float64
2   Longitude            6049 non-null  float64
3   Depth (km)          6049 non-null  float64
4   Lat_Lng              6049 non-null  object
5   Alert                6049 non-null  object
6   Place                6048 non-null  object
7   Date                 6049 non-null  object
8   Magnitude            6049 non-null  float64
9   Tsunami              6049 non-null  int64
10  Type                 6049 non-null  object
11  Country              5794 non-null  object
12  Country Code         6048 non-null  object
dtypes: float64(4), int64(1), object(8)
memory usage: 614.5+ KB
```



# Our findings through...



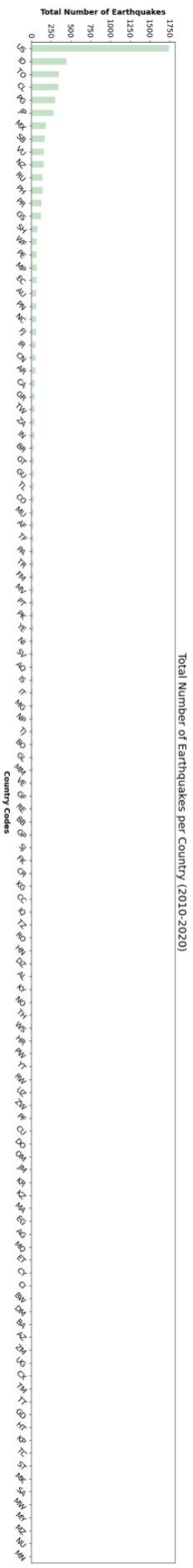
**Research & Analysis**



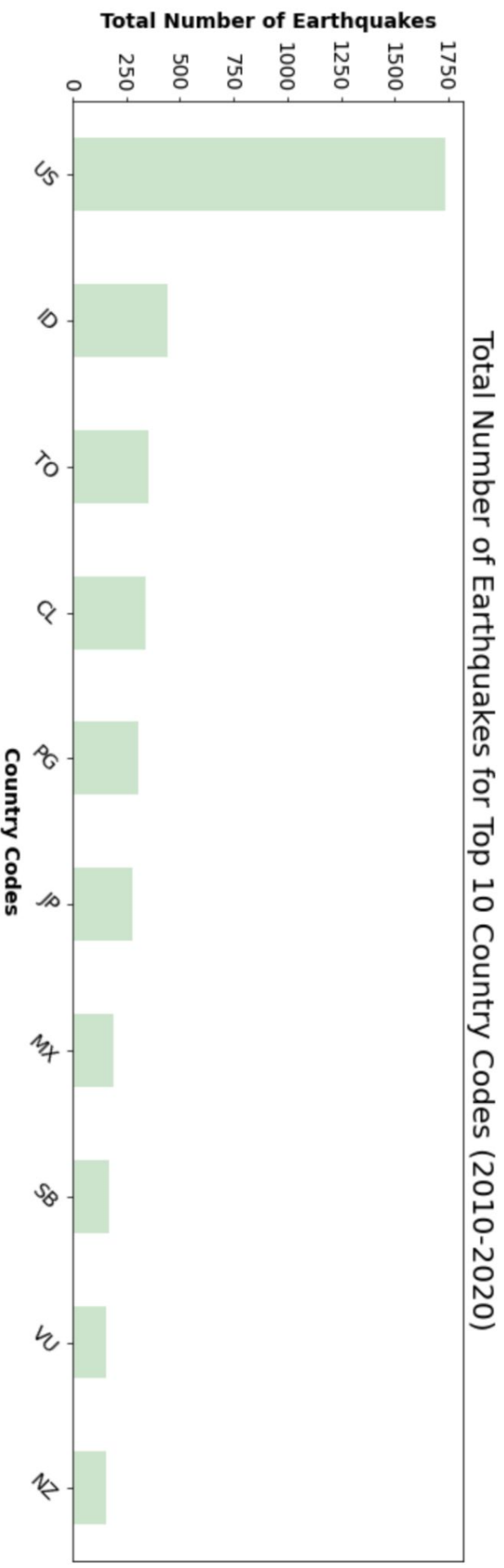
Where do earthquakes happen by  
Country?



# Where do Earthquakes Happen by Country?

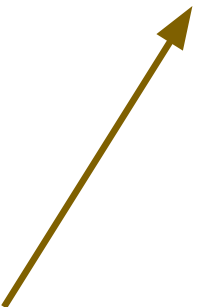


# Where do Earthquakes Happen – Top 10?



1. **US** - United States
2. **ID** - Indonesia
3. **TO** - Tonga
4. **CL** - Chile
5. **PG** - Papua New Guinea
6. **JP** - Japan
7. **MX** - Mexico
8. **SB** - Solomon Islands
9. **VU** - Vanuatu
10. **NZ** - New Zealand

What is the density of magnitudes for earthquakes?

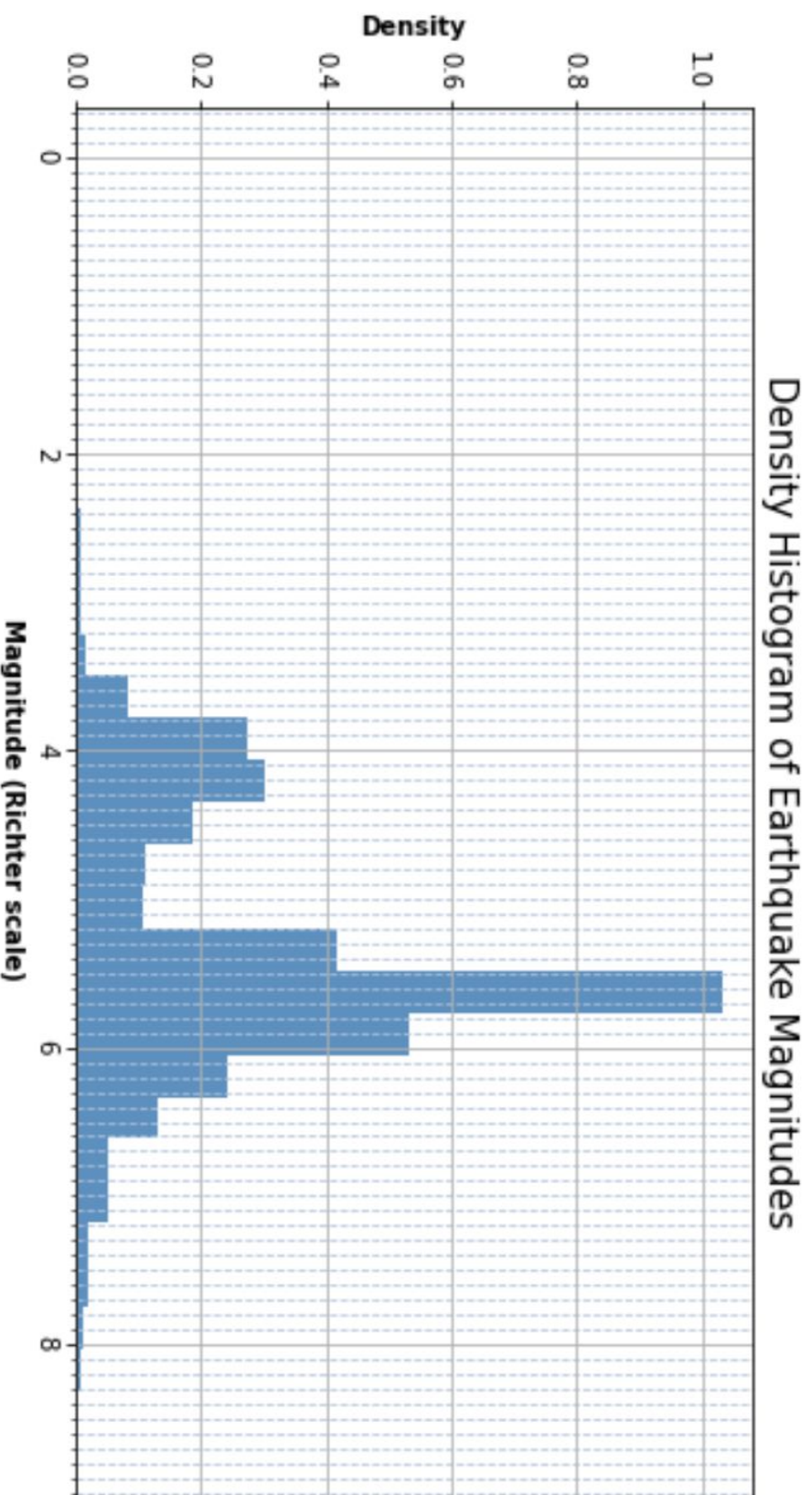


Where do earthquakes happen by Country?



(5)

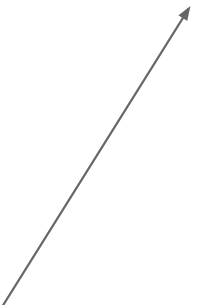
# What is the Density of Magnitudes for Earthquakes?



**What month do earthquakes mostly occur?**



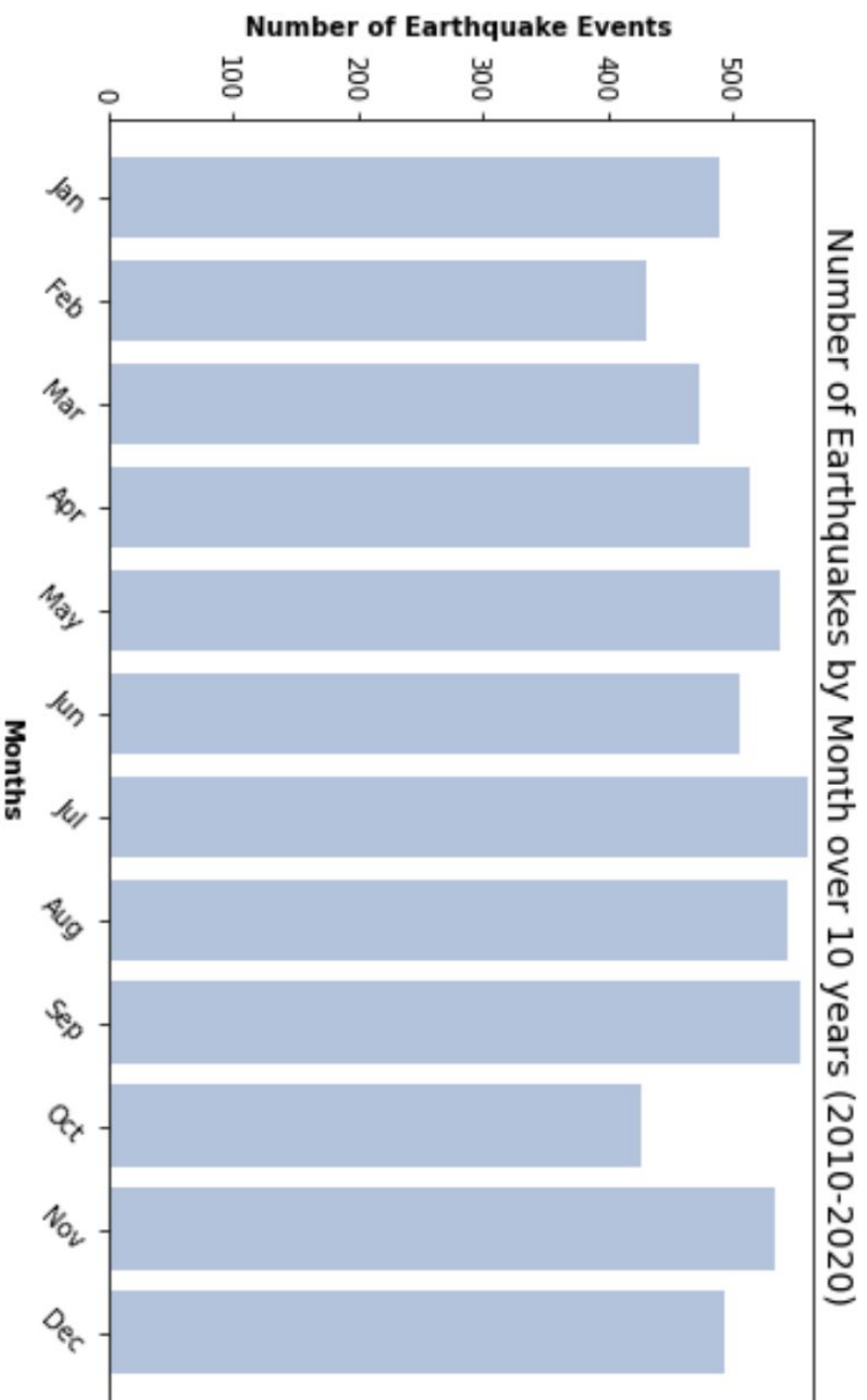
What is the density of magnitudes for earthquakes?



Where do earthquakes happen by Country?



# What Month do Earthquakes Mostly Occur?



What month do earthquakes mostly occur?

**What is the alert level density for earthquakes?**

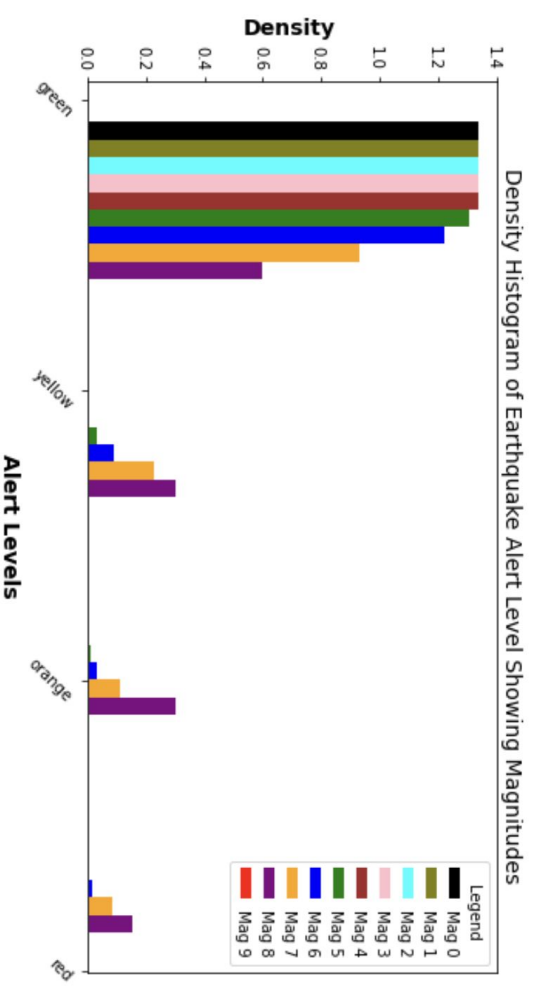
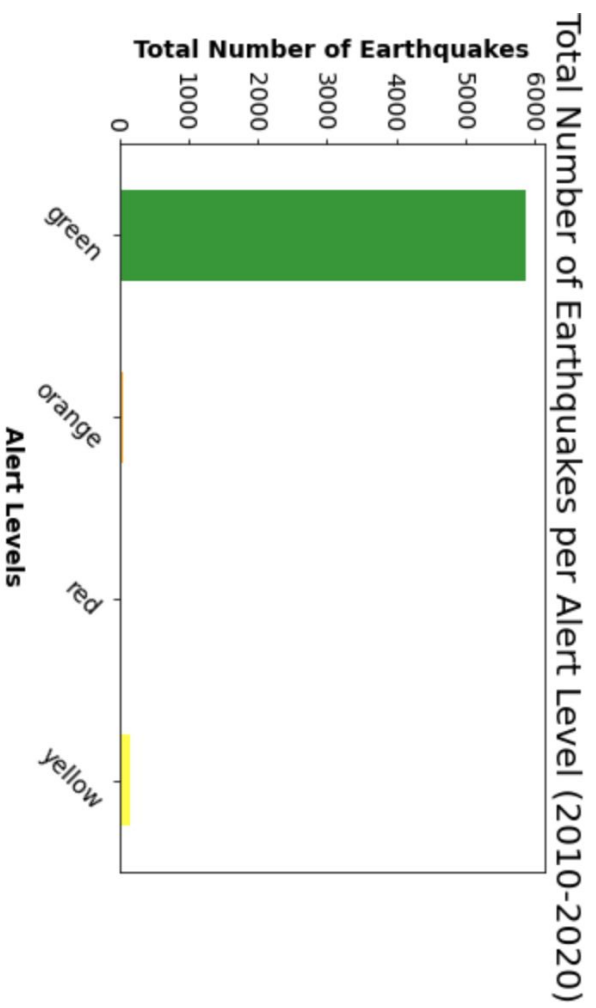
What is the density of magnitudes for earthquakes?

Where do earthquakes happen by Country?

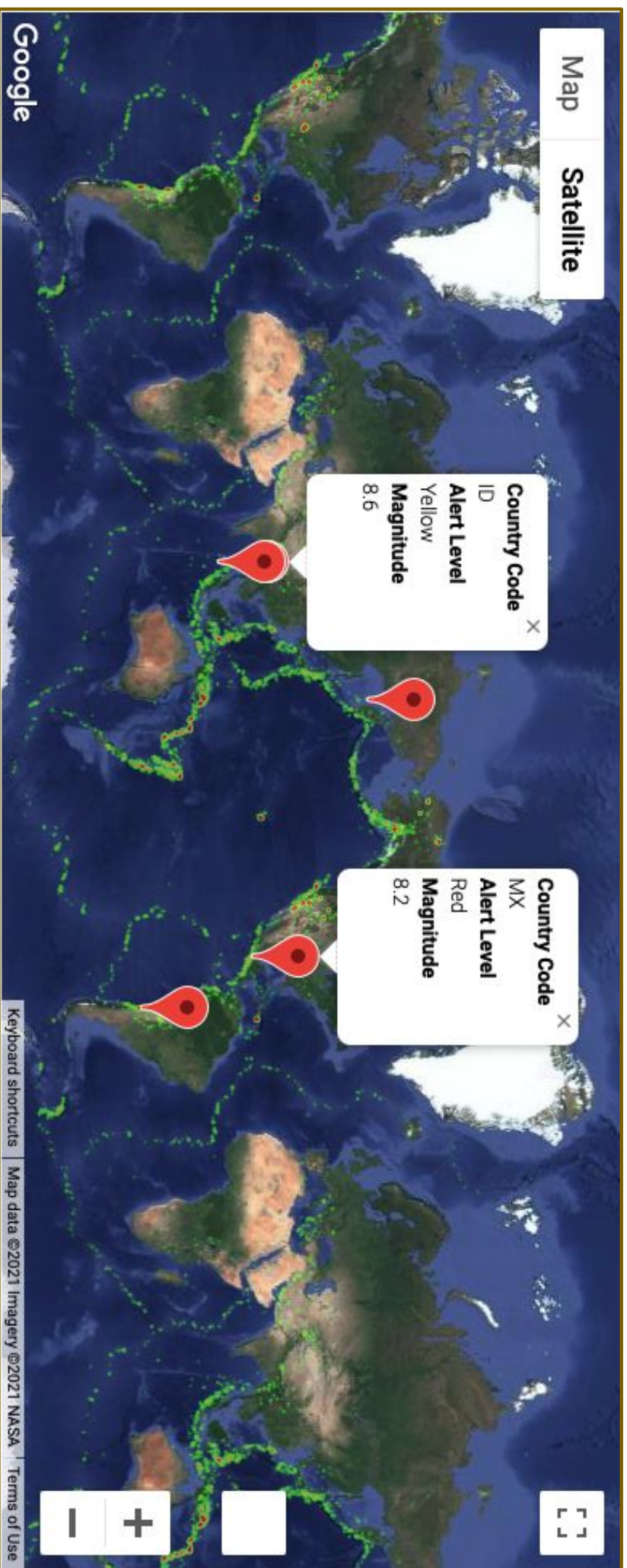


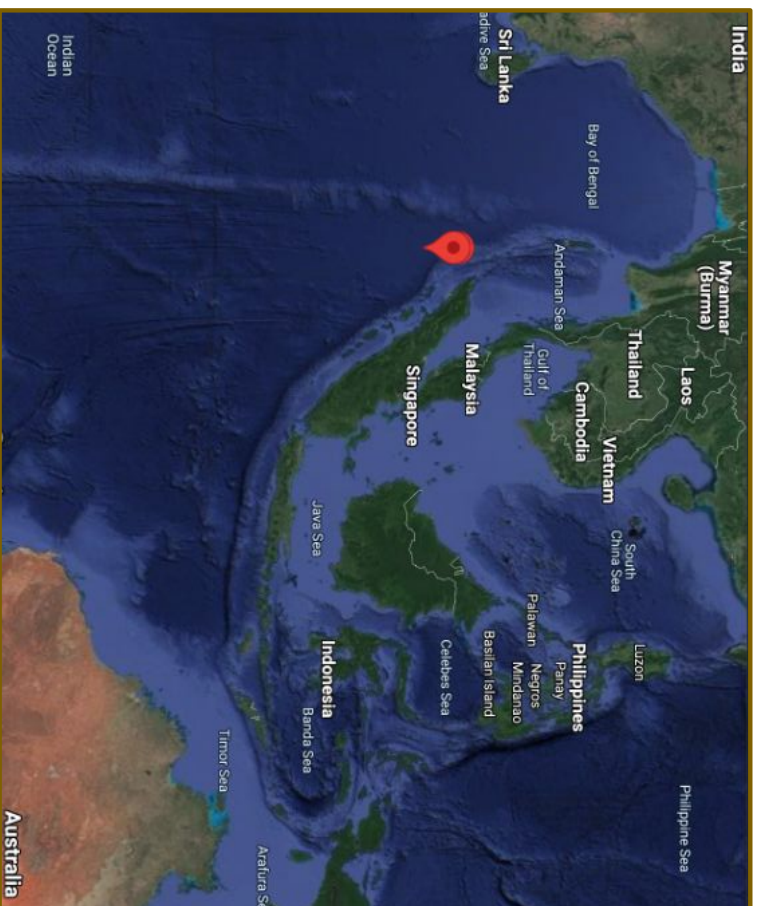


# What is the Alert Level Density for Earthquakes?



# An interesting observation...

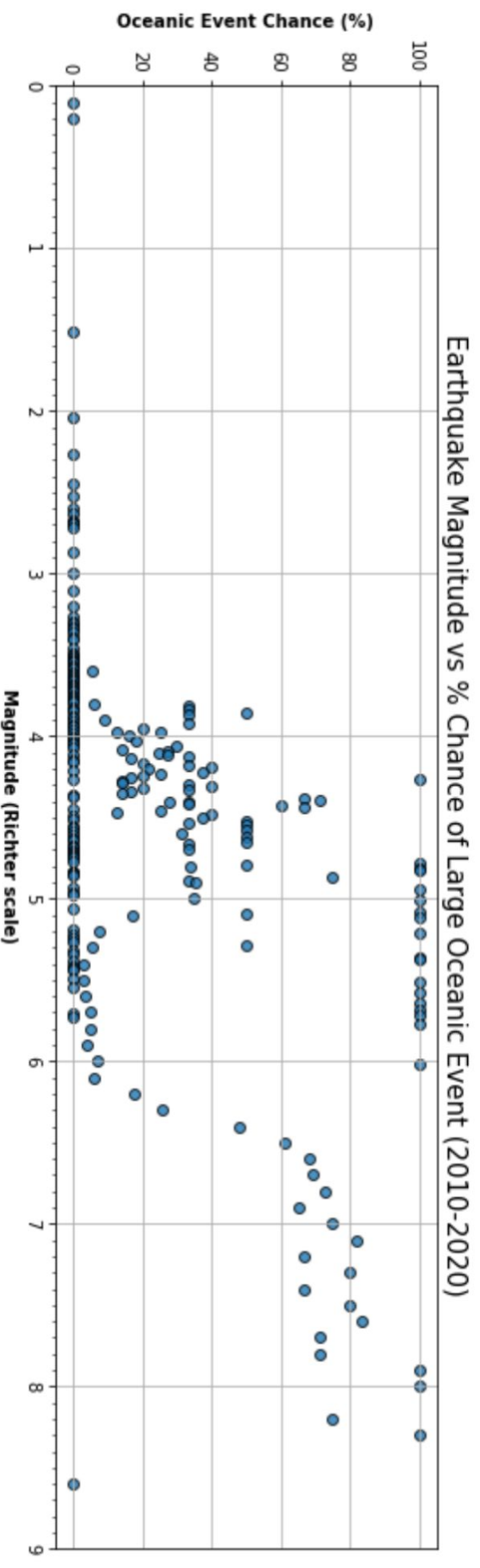




(7)

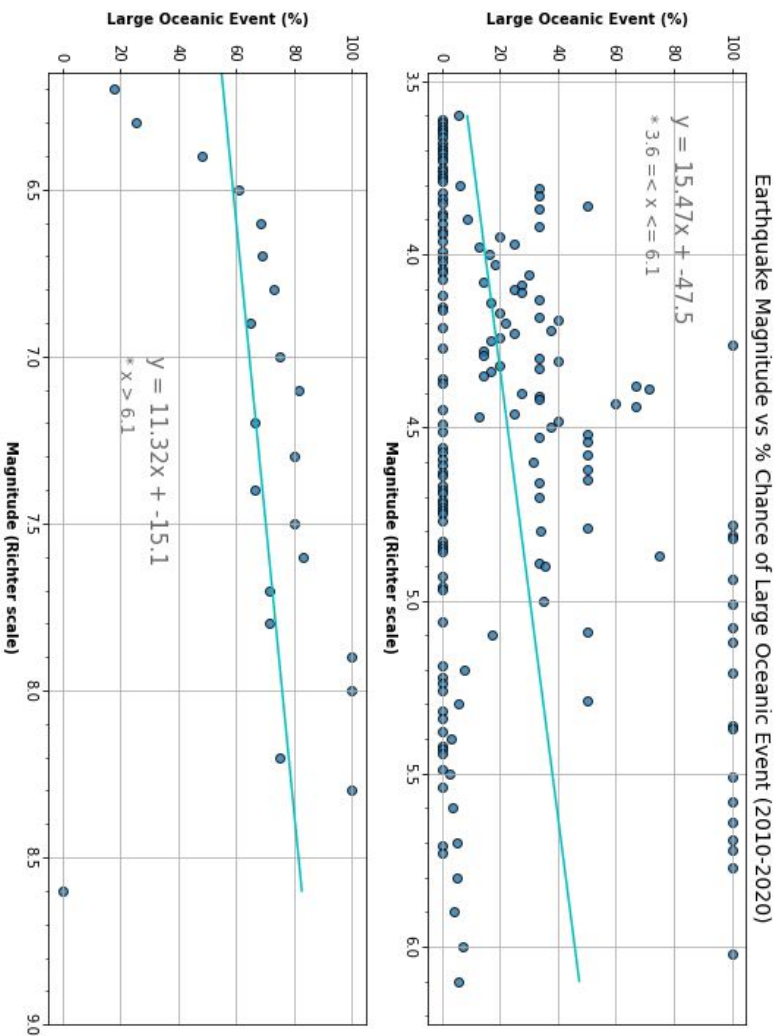
**Is there a relationship between the magnitude of earthquakes and % chance that a large oceanic event will occur?**

# Is there a Relationship between Magnitude and % Chance of Large Oceanic Event?



# Relational Analysis: Magnitude vs % Chance of Large Oceanic Event

## Linear Regression



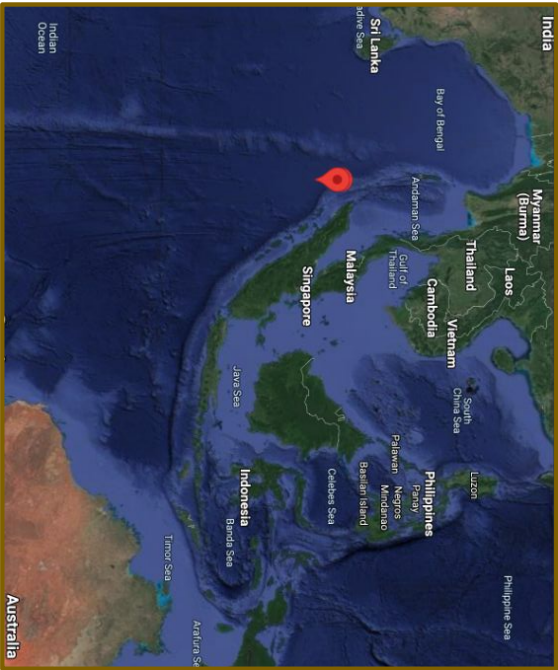
$$r^2 = 0.09215164953783814$$

$$r^2 = 0.08933200291320782$$



# Did this large earthquake cause an oceanic event?

- Indeed this earthquake happened in the Indian Ocean with a magnitude of 8.6.
- This was the highest in the 10 years of data.



(7)

Large Oceanic											
Event											
Type											
Country											
Country_Code											
ID											
id	Latitude	Longitude	Depth (km)	Lat_Lng	Alert	Place	Date	Magnitude			
5990	official20120411083836720_20	2.327	93.063	20.0	(2.327, 93.063)	yellow	off the west coast of northern Sumatra	2012-04-11 04:38:36.720	8.6	0	earthquake Aceh
ID											

# Conclusions

What month do earthquakes mostly occur?

Earthquakes can happen at any time of the year.

What is the alert level density for earthquakes?

Green alerts (5852) have far more number of earthquakes than the other alerts.

All levels of magnitudes observed were present in the Green alert level. Magnitudes 6 - 8 were present at much lower densities in the remaining alert types.

What is the density of magnitudes for earthquakes?

Magnitudes around 5.5 to <6.0 are the most dense.

Where do earthquakes happen by Country?

USA (count : 1733) has far more earthquakes than any other country over the ten years (2010-2020).



Is there a Relationship between Magnitude and % Chance of Large Oceanic Event?

No correlation was observed between Magnitude and Large Oceanic Events.



# Limitations

- One relationship:
  - Magnitude vs % Chance of Oceanic Event
- Questions in our scope:
  - Limiting question
  - Timeframe constraint
- Using Linear Regression Analysis only:
  - Better model to suit data
- Using comparison of just two variables:
  - Potentially comparing with Depth?

# Future Considerations

- Looking into **Depth** trends with Magnitudes
- Looking at Earthquake **Types** with Magnitudes
- Looking at **more variables** at a time:
  - ie) latitude/longitude in ocean only, with depth, and magnitude
- Looking at an **alternative Model** to fit the trends
- Density Analysis of **number of Earthquakes per day** over 10 years

# Written Analysis (1)

## Where do earthquakes happen by Country?

- The Total number of earthquakes by Counties, showed that USA (count: 1733) has far more earthquakes than any other country over the ten years (2010-2020).
- Indonesia being the second highest at 438.
- Most countries approximately one.

## What is the density of magnitudes for earthquakes?

- The Density Histogram of Earthquake Magnitudes shows that the Magnitudes around 5.5 to <6.0 are the most dense and thus, these magnitudes will occur more frequently than others around the world.

## What month do earthquakes mostly occur?

- The Density Histogram of Earthquake Magnitudes plot shows that earthquakes can happen at any time of the year.
- The numbers reveal how 'almost evenly' spread the number of earthquake events are, in each month.
- Varying between 400 and 550 each month.

## What is the alert level density for earthquakes?

- The 'Total Number of Earthquakes per Alert Level (2010-2020)' plot, and the heat map shows that the Green alerts (5852) have far more number of earthquakes than the other alert levels (orange:37, red:16, yellow:144).
- This is a good thing. As the alert levels tell us the number of fatalities and infrastructure damage value respectively.
- Additionally, the plot 'Density Histogram of Earthquake Alert Level Showing Magnitudes' shows that all levels of magnitudes that were noticed in this green alert level. Green level density: >1.3 and other alert levels were all lower than 0.3 .

# Written Analysis (2)

## Is there a Relationship between Magnitude and % Chance of Large Oceanic Event?

- The linear regression plots 'Earthquake Magnitude vs % Chance of Large Oceanic Event (2010-2020)' shows that no correlation between Magnitude and Large Oceanic Events were seen because the value of both charts  $r\text{-squared} = 0.09$  rounded.
- This indicates that no correlation can be depicted.
- Note: Charts were separated by magnitude because the scatter plots showed two distinct separations of clustering. One set of clusters for magnitudes  $\geq 3.6$  and  $< 6.1$  and then another set of cluster  $> 6.1$ .

**Notes:** It was interesting to see that in the second regression analysis plot, where magnitudes were above 6.1, that there was one possible outlier at 8.6. However, this was indeed an earthquake at this great magnitude, that did not cause a large oceanic event. Therefore, we need to include other variables that cause large oceanic effects such as the depth of the earthquake to further analyse how earthquakes can cause a large oceanic event.

- Include latitudes and longitudes, only in the ocean
- Include magnitude
- Include depth of the earthquake
- Look at other possible Models that could fit better

# Resources

1. [USGS Earthquake API](#)
2. [USGS Documentation](#)
3. Google Maps API (Google Cloud Platform)

## Modules Added

1. **gmaps**: for heat map
2. **reverse\_geocoder** : for the Country, City and country codes from latitude and longitude coordinates

# Images Resources

- (1) <https://purvesinsurance.com/earthquake-insurance-davis-ca/>
- (2) <https://www.shutterstock.com/search/richter+scale>
- (3) <https://earthquake.usgs.gov/data/pager/background.php>
- (4) Satellite Image via google maps
- (5) [205-2051050\\_earthquake-clipart-free-earthquake-clipart-at-getdrawings-png.png](205-2051050_earthquake-clipart-free-earthquake-clipart-at-getdrawings-png.png)
- (6) Satellite Image via google maps
- (7) Satellite Image via google maps
- (8) [Research and Analysis Picture](#)