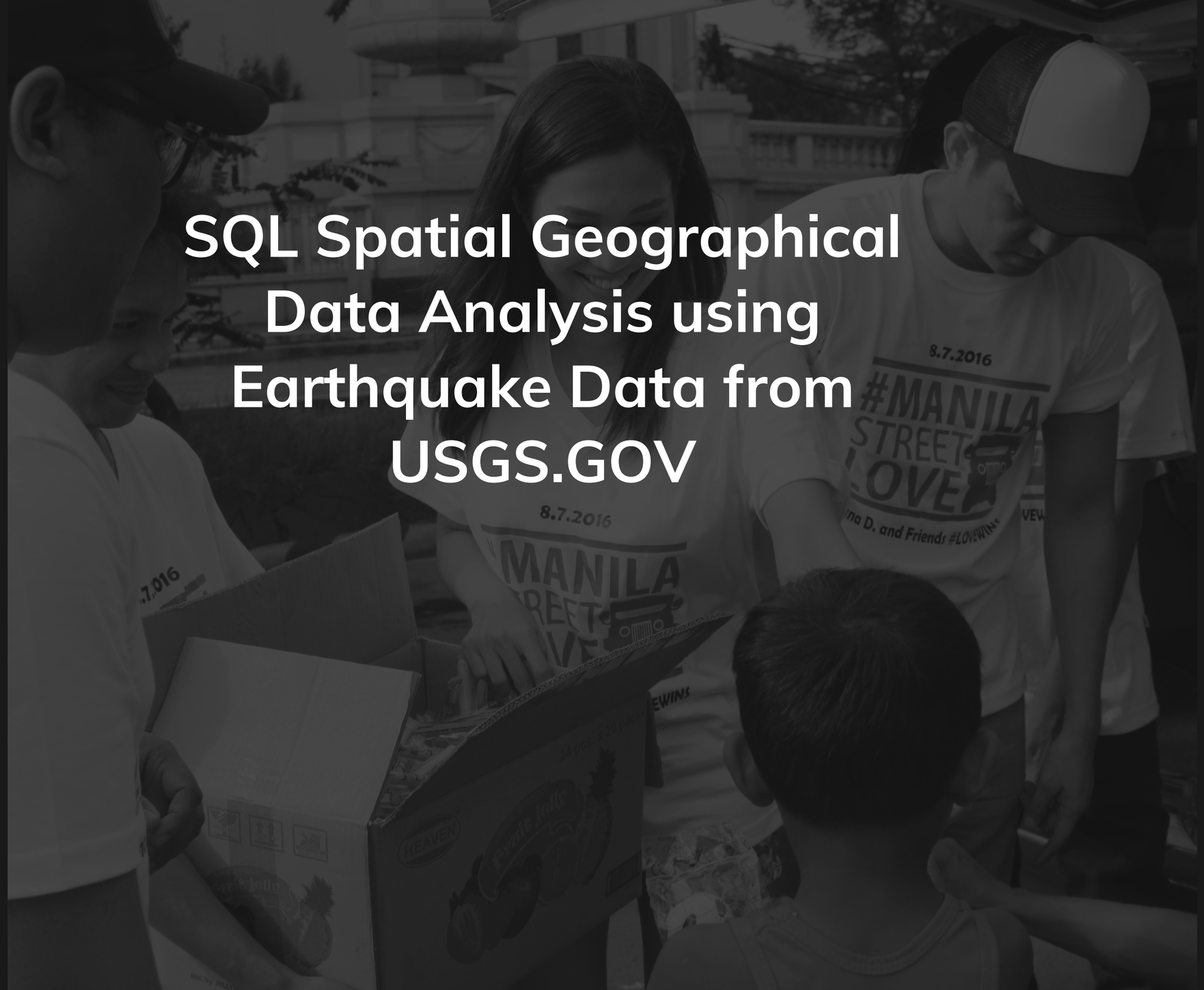


SQL Spatial Geographical Data Analysis using Earthquake Data from USGS.GOV

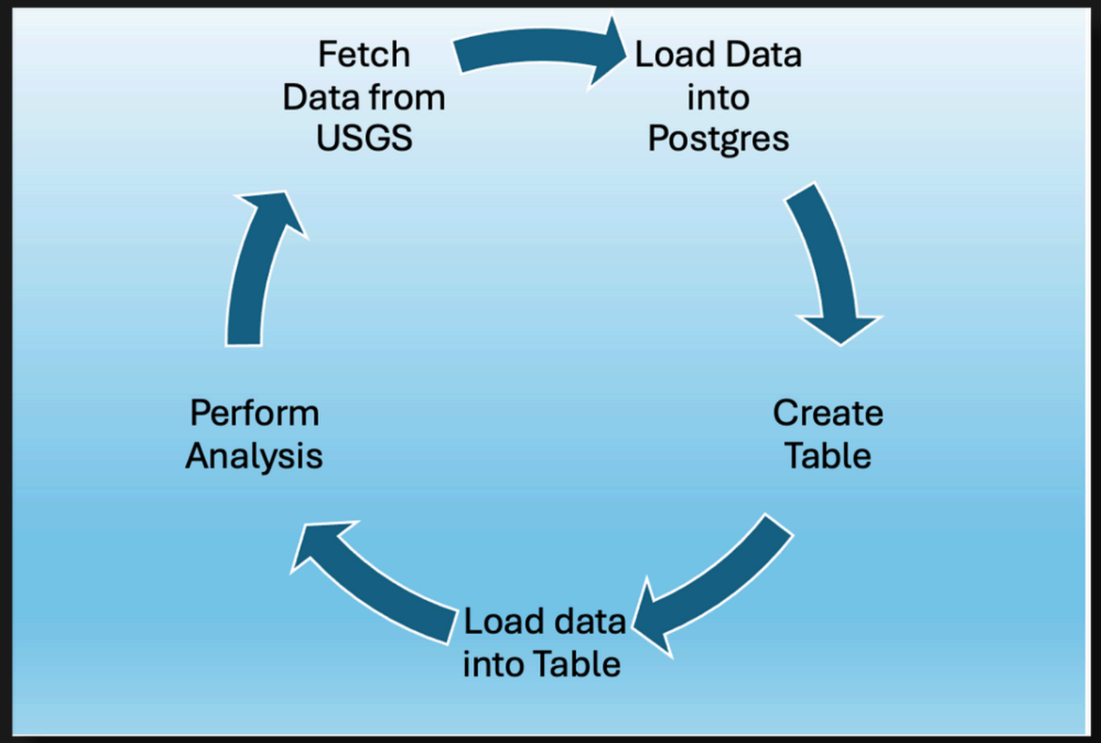
Comprehensive Analysis and Visualizations by Sunita Inderjit

Business Problem

Identifying High-Risk Areas for Earthquake Preparedness and Resource Allocation

Objective

The goal is to analyze earthquake data to identify geographical regions with high seismic activity. This information can help governments, emergency response teams, and insurance companies to prioritize and allocate resources effectively, plan for disaster preparedness, and develop risk mitigation strategies



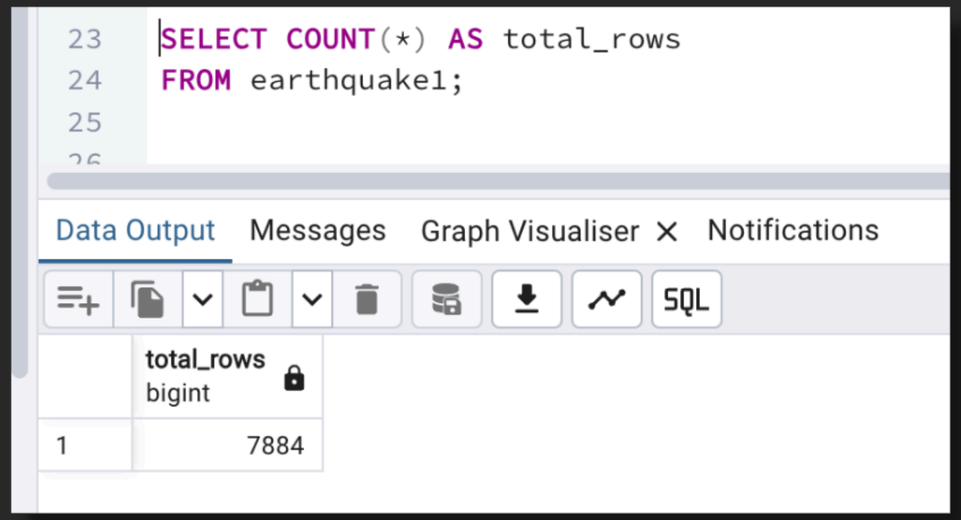
Data Connection and Integration

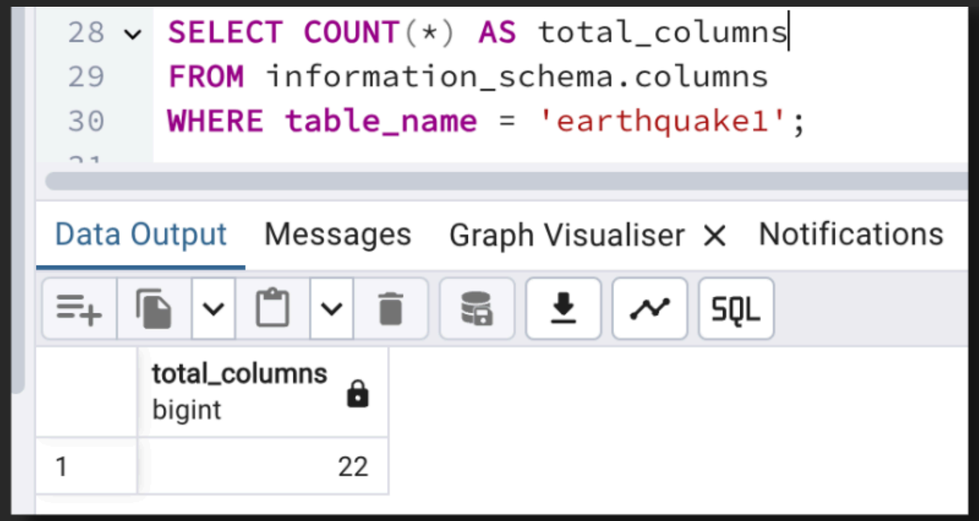
Data Formate CSV, consisted of
22 columns and 7884 rows
Year 2023 July to 2024 August

```
Create extension postgis;
create extension hstore;

CREATE TABLE earthquake1 (time TIMESTAMP,latitude DOUBLE PRECISION,longitude DOUBLE PRECISION,
                          depth DOUBLE PRECISION, mag DOUBLE PRECISION,magType VARCHAR(10),
                          nst INTEGER,gap DOUBLE PRECISION,dmin DOUBLE PRECISION,rms DOUBLE PRECISION,
                          net Varchar(10),id VARCHAR(255) PRIMARY KEY,updated TIMESTAMP,place VARCHAR(255),
                          type VARCHAR(50),horizontal DOUBLE PRECISION,depthError DOUBLE PRECISION,
                          magError DOUBLE PRECISION,magNst INTEGER,status varchar(50),
                          locationSource VARCHAR(50),magSource VARCHAR(50));
```

Create Table





COUNT ROWS |COLUMNS

UTILIZED THE SQL COUNT() FUNCTION TO DETERMINE THE TOTAL NUMBER OF ROWS IN THE TABLE

GET TOTAL NUMBER OF COLUMNS FROM INFORMATION_SCHEMA

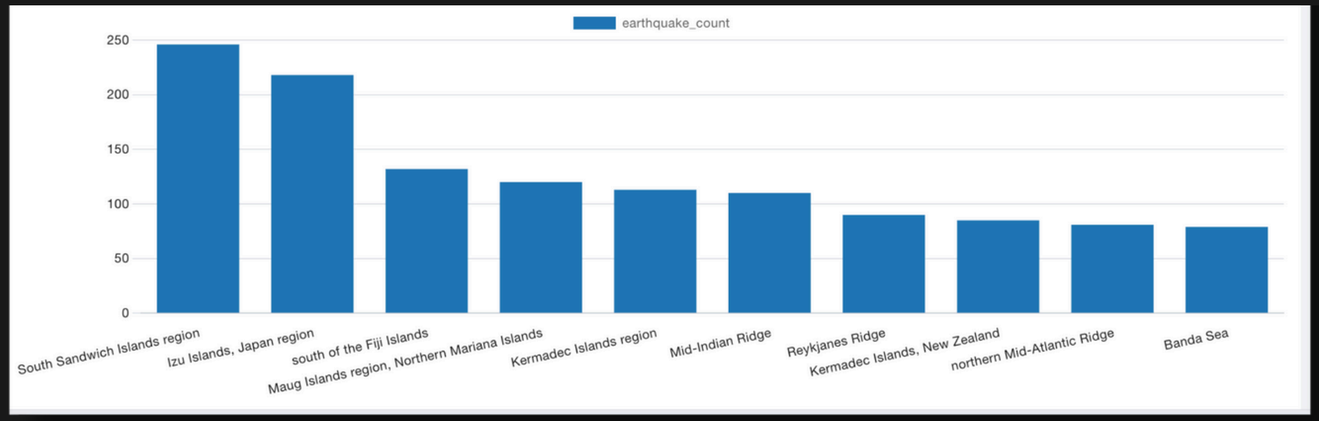
Top Regions

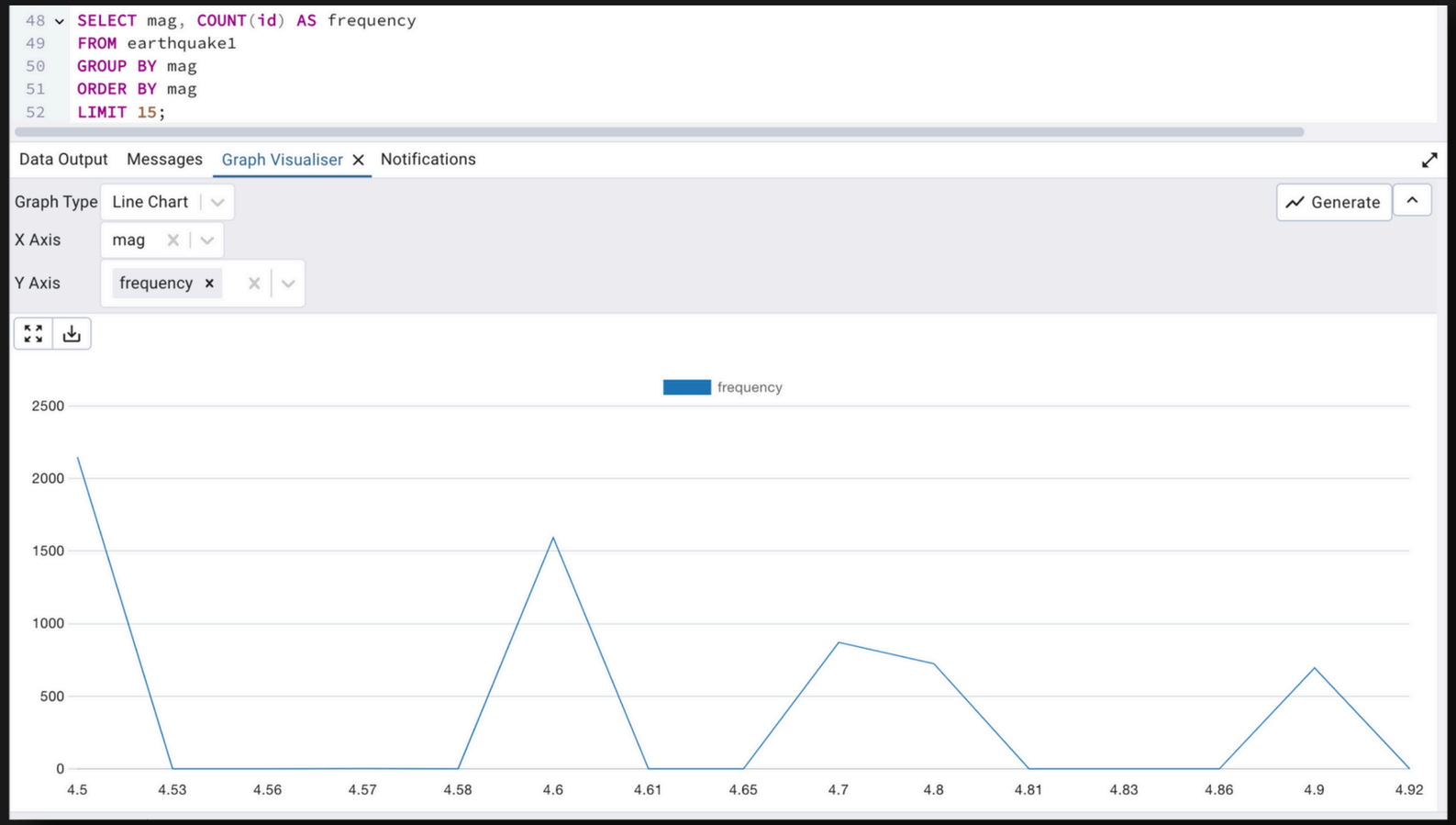
The region with the highest earthquake count is South Sandwich Islands with 246 earthquakes and 2nd highest is Izu Islands in Japan with 218 earthquakes

```
38  SELECT place, COUNT(id) AS earthquake_count
39  FROM earthquake1
40  GROUP BY place
41  ORDER BY earthquake_count DESC
42  LIMIT 10;
43
```

Data Output | Messages | Graph Visualiser | Notifications

	place character varying	earthquake_count bigint
1	South Sandwich Islands region	246
2	Izu Islands, Japan region	218
3	south of the Fiji Islands	132
4	Maug Islands region, Northern Mariana Islands	120
5	Kermadec Islands region	113
6	Mid-Indian Ridge	110
7	Reykjanes Ridge	90
8	Kermadec Islands, New Zealand	85
9	northern Mid-Atlantic Ridge	81
10	Banda Sea	79

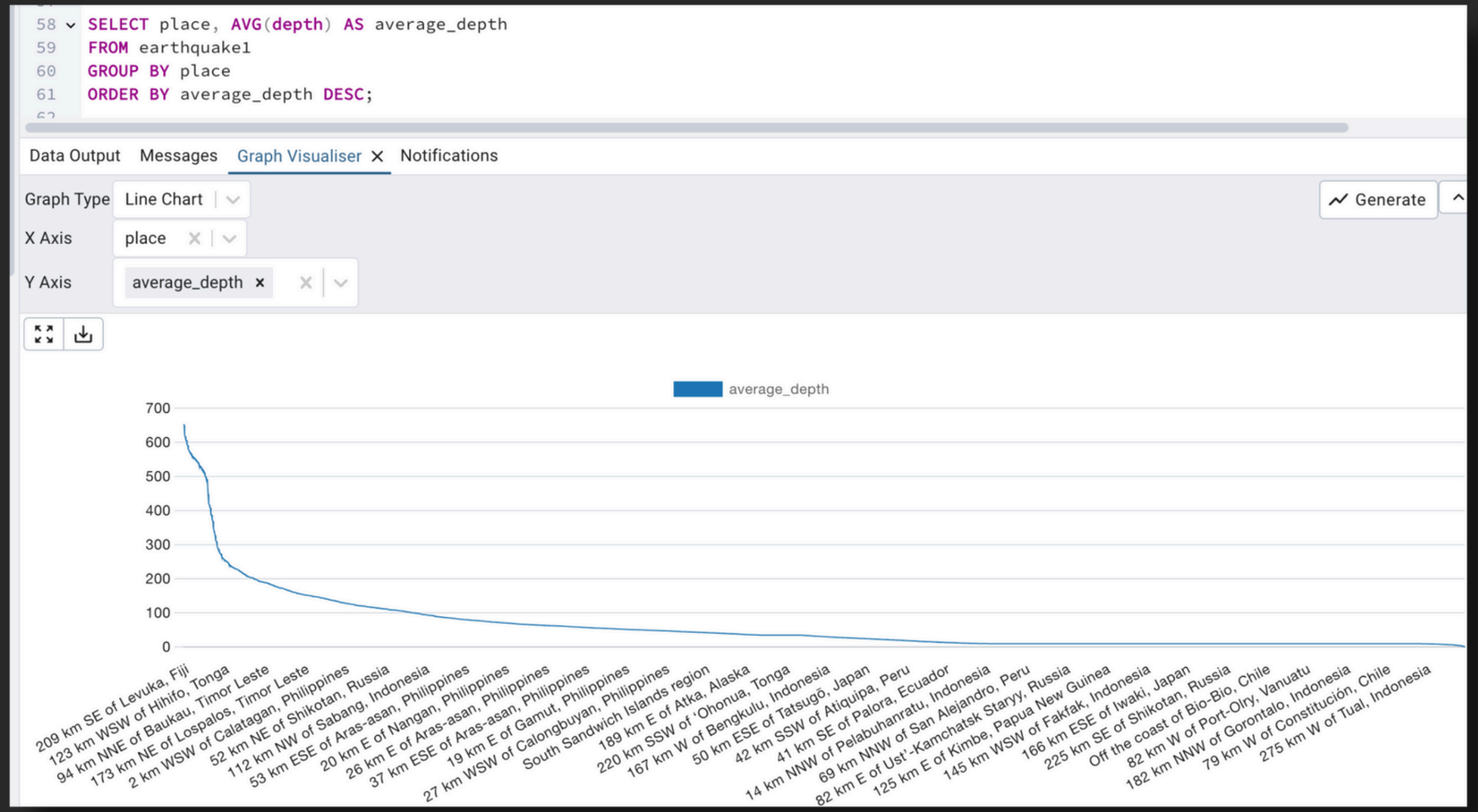




Analyzing Earthquake Magnitude Distribution

Understanding the frequency of different magnitudes

Average Depth of Earthquakes by Region



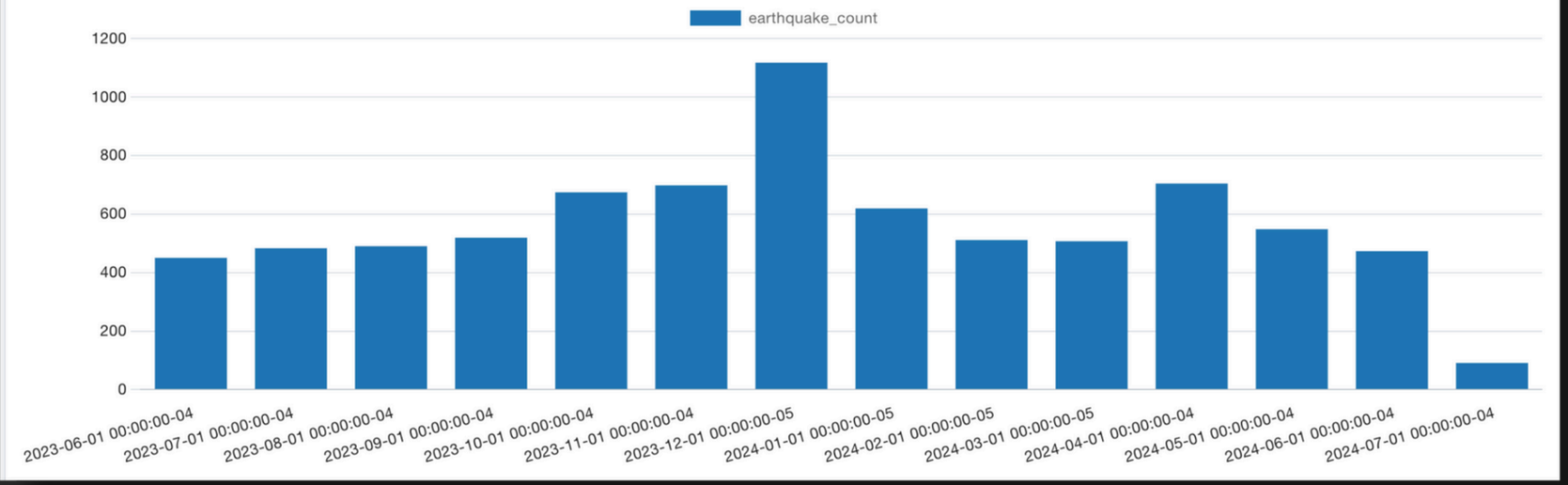
Calculating the average depth of earthquakes for each region to understand the typical depth at which earthquakes occur

MONTHLY EARTHQUAKE TREND

```
75
76  SELECT DATE_TRUNC('month', time) AS month, COUNT(id) AS earthquake_count
77  FROM earthquake1
78  GROUP BY month
79  ORDER BY month;
```

Data Output | Messages | Graph Visualiser | Notifications

Graph Type: Bar Chart | X Axis: month | Y Axis: earthquake_count | Generate




```
76  SELECT DATE_TRUNC('month', time) AS month,
77  COUNT(id) AS earthquake_count
78  FROM earthquake1
79  GROUP BY month
```

Data Output | Messages | Graph Visualiser | Notifications

	month timestamp with time zone	earthquake_count bigint
1	2023-06-01 00:00:00-04	450
2	2023-07-01 00:00:00-04	483
3	2023-08-01 00:00:00-04	490
4	2023-09-01 00:00:00-04	519
5	2023-10-01 00:00:00-04	674
6	2023-11-01 00:00:00-04	698
7	2023-12-01 00:00:00-05	1117
8	2024-01-01 00:00:00-05	619
9	2024-02-01 00:00:00-05	511
10	2024-03-01 00:00:00-05	507
11	2024-04-01 00:00:00-04	704
12	2024-05-01 00:00:00-04	548
13	2024-06-01 00:00:00-04	473
14	2024-07-01 00:00:00-04	91

Examined the trend of earthquakes over time on a monthly basis. December 23 had 1117 earthquakes followed by April 2024 with 704 and October 23 with 698 counts

Magnitude vs Geographical Distribution

Analyze the distribution of earthquake magnitudes across different latitude and longitude ranges

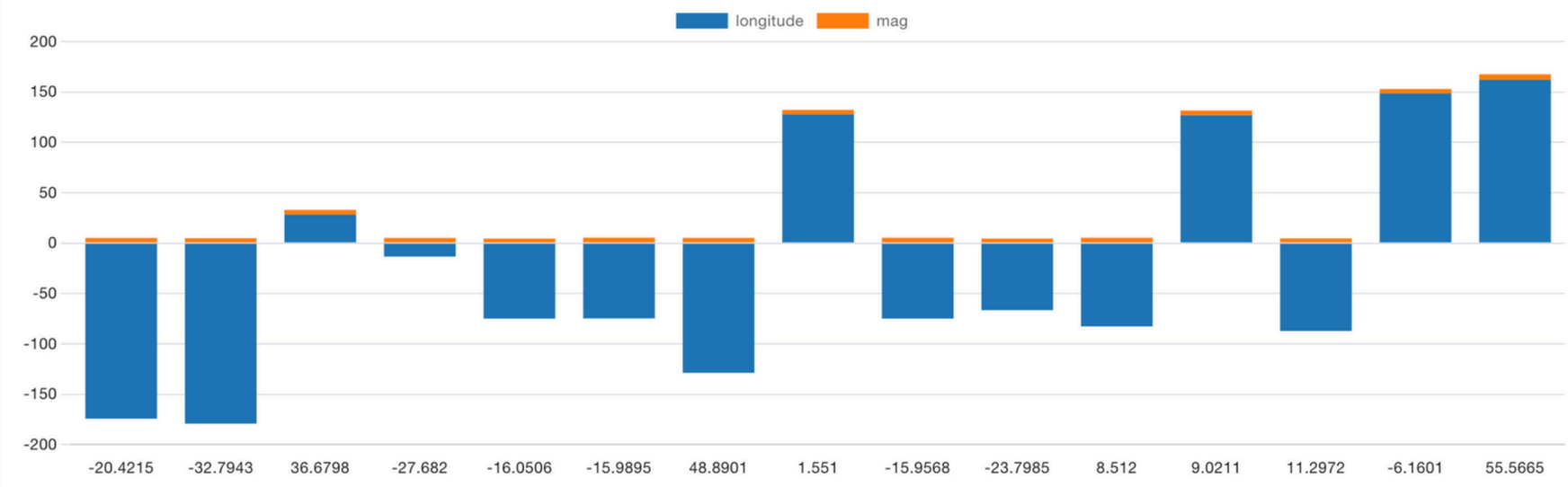
```
87  SELECT latitude, longitude, mag
88  FROM earthquake1
89  WHERE mag IS NOT NULL
90  limit 15;
```

Data Output | Messages | Graph Visualiser | Notifications

Graph Type: Stacked Bar Chart | Generate

X Axis: latitude

Y Axis: longitude × mag ×



High-Risk Earthquake

Identify the types of earthquakes that occur most frequently and their average magnitude

```
96  SELECT type, COUNT(id) AS frequency, AVG(mag) AS average_magnitude
97  FROM earthquake1
98  GROUP BY type
99  ORDER BY frequency DESC;
100
```

Data Output | Messages | Graph Visualiser | Notifications

SQL

	type character varying	frequency bigint	average_magnitude double precision
1	earthquake	7876	4.800226003047128
2	volcanic eruption	8	4.6125

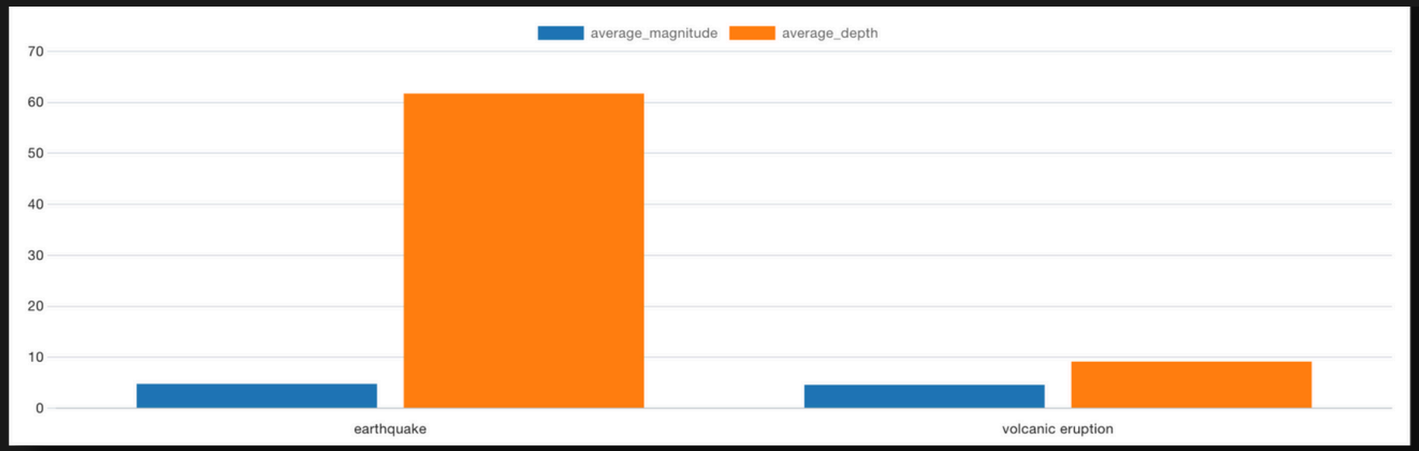
```sql
SELECT
    type,
    AVG(mag) AS average_magnitude,
    AVG(depth) AS average_depth
FROM earthquake1
GROUP BY type
ORDER BY average_magnitude DESC;
```

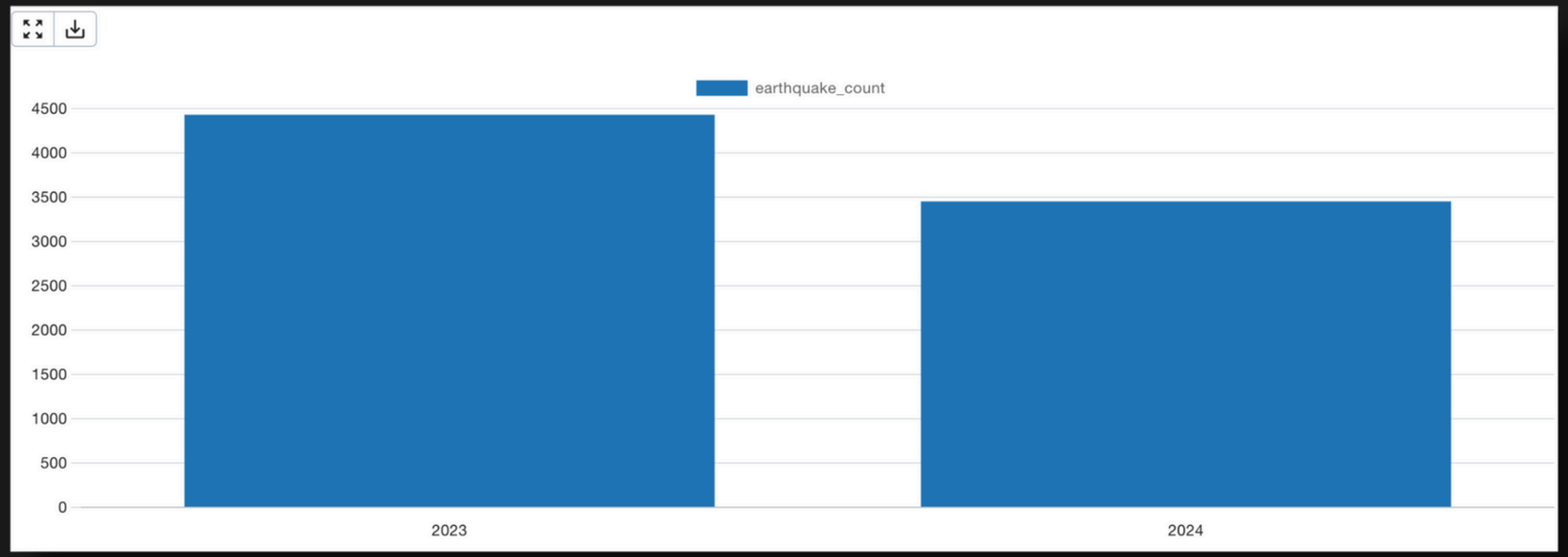
Data Output | Messages | Graph Visualiser | Notifications

	type character varying	average_magnitude double precision	average_depth double precision
1	earthquake	4.800226003047128	61.7421510030473
2	volcanic eruption	4.6125	9.167750000000002

Average Magnitude and Depth by Earthquake Type

calculate the average magnitude and average depth for each type of earthquake

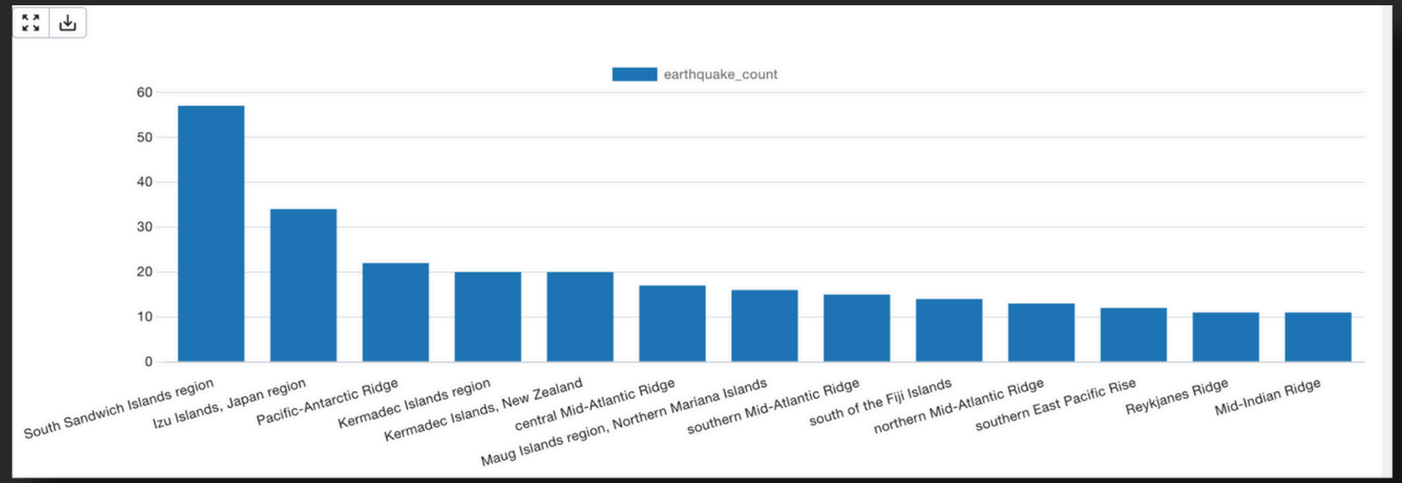




Frequency of Earthquakes by Year

The number of earthquakes that occurred each year.

High-Risk Areas Based on Magnitude Thresholds




```
153  WHERE mag > 5.0
154  GROUP BY place
155  HAVING COUNT(id) > 10
156  ORDER BY earthquake_count DESC;
157
```

Data Output | Messages | Graph Visualiser | Notifications

SQL

	place character varying	earthquake_count bigint
1	South Sandwich Islands region	57
2	Izu Islands, Japan region	34
3	Pacific-Antarctic Ridge	22
4	Kermadec Islands region	20
5	Kermadec Islands, New Zealand	20
6	central Mid-Atlantic Ridge	17
7	Maug Islands region, Northern Mariana Islands	16
8	southern Mid-Atlantic Ridge	15
9	south of the Fiji Islands	14
10	northern Mid-Atlantic Ridge	13
11	southern East Pacific Rise	12
12	Reykjanes Ridge	11
13	Mid-Indian Ridge	11

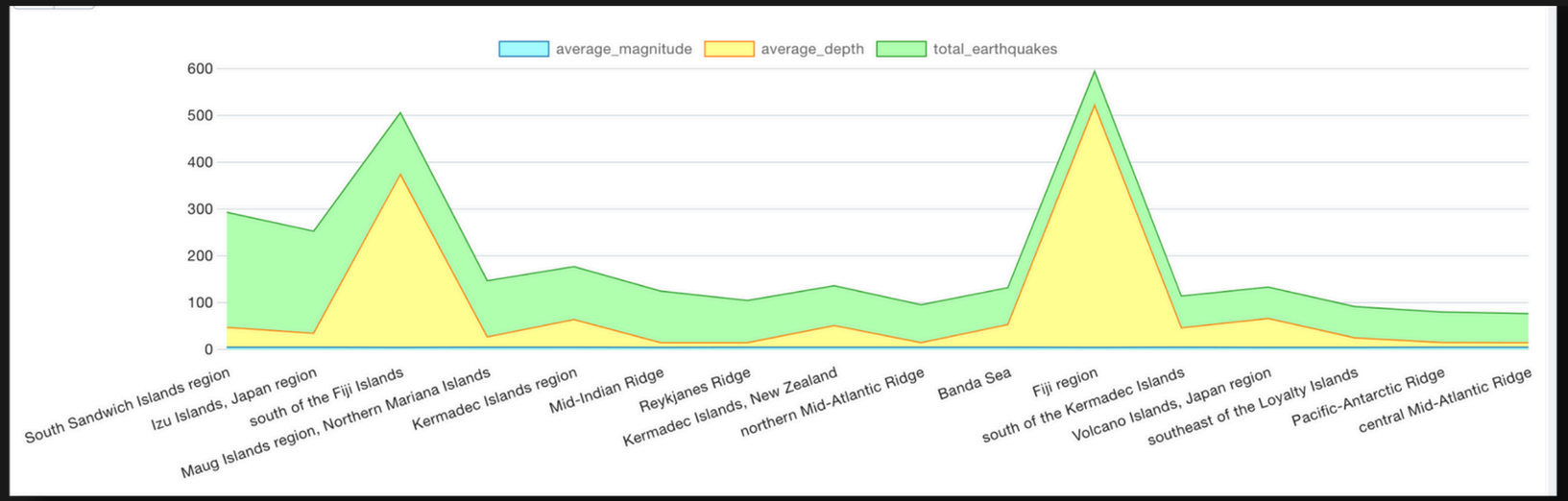
Identify regions that frequently experience earthquakes with a magnitude greater > 5.0

Compare AVG Magnitude, Depth, and total number of earthquakes for different regions

```sql
SELECT
    place,
    AVG(mag) AS average_magnitude,
    AVG(depth) AS average_depth,
    COUNT(id) AS total_earthquakes
FROM earthquake1
GROUP BY place
HAVING COUNT(id) > 50
ORDER BY total_earthquakes DESC;
```

Output | Messages | Graph Visualiser | Notifications

place character varying	average_magnitude double precision	average_depth double precision	total_earthquakes bigint
South Sandwich Islands region	4.825203252032523	42.48431300813008	246
Izu Islands, Japan region	4.784862385321103	30.113825688073398	218
south of the Fiji Islands	4.69166666666667	369.36824242424234	132
Maug Islands region, Northern Mariana Islands	4.770000000000005	22.185108333333332	120
Kermadec Islands region	4.78495575221239	59.29980530973454	113
Mid-Indian Ridge	4.715454545454548	10.101963636363635	110
Reykjanes Ridge	4.741111111111111	10.056377777777778	90
Kermadec Islands, New Zealand	4.817647058823529	46.43021176470589	85
northern Mid-Atlantic Ridge	4.798765432098767	10	81
Banda Sea	4.762025316455698	48.5433417721519	79
Fiji region	4.683561643835616	517.0562328767123	73
south of the Kermadec Islands	4.758823529411764	41.57698529411765	68
Volcano Islands, Japan region	4.67910447761194	61.81705970149253	67
southeast of the Loyalty Islands	4.717910447761194	20.107089552238804	67
Pacific-Antarctic Ridge	4.93846153846154	10.100107692307693	65
central Mid-Atlantic Ridge	4.879032258064518	10	62



```sql
SELECT
    EXTRACT(YEAR FROM time) AS year,
    AVG(mag) AS average_magnitude,
    MAX(mag) AS max_magnitude,
    MIN(mag) AS min_magnitude
FROM earthquake1
GROUP BY year
ORDER BY year;
```

Data Output | Messages | Graph Visualiser | Notifications

	year numeric	average_magnitude double precision	max_magnitude double precision	min_magnitude double precision
1	2023	4.805287745429912	7.6	4.5
2	2024	4.793295684911709	7.5	4.5

Severity of Earthquakes Over Time

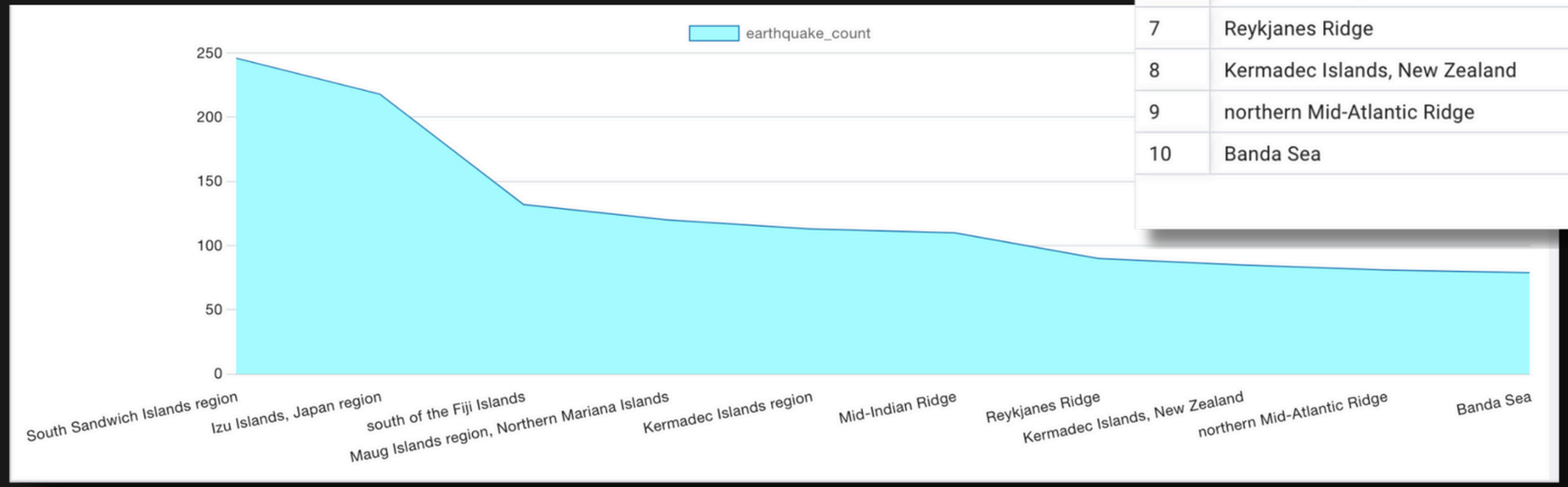
Analyze how the severity (measured by magnitude) of earthquakes has changed over the years

Regions Most Affected by Earthquakes

```sql
SELECT place, COUNT(id) AS earthquake_count
FROM earthquake1
GROUP BY place
ORDER BY earthquake_count DESC
LIMIT 10;
```

Data Output | Messages | Graph Visualiser | Notifications

	place character varying	earthquake_count bigint
1	South Sandwich Islands region	246
2	Izu Islands, Japan region	218
3	south of the Fiji Islands	132
4	Maug Islands region, Northern Mariana Islands	120
5	Kermadec Islands region	113
6	Mid-Indian Ridge	110
7	Reykjanes Ridge	90
8	Kermadec Islands, New Zealand	85
9	northern Mid-Atlantic Ridge	81
10	Banda Sea	79



Rank Earthquakes by Magnitude, Depth, and Gap

```
245
246 SELECT id,place, mag,depth,gap,
247     RANK() OVER (ORDER BY mag DESC) AS rank_by_mag,
248     RANK() OVER (ORDER BY depth DESC) AS rank_by_depth,
249     RANK() OVER (ORDER BY gap DESC) AS rank_by_gap
250 FROM earthquake1;
251
```

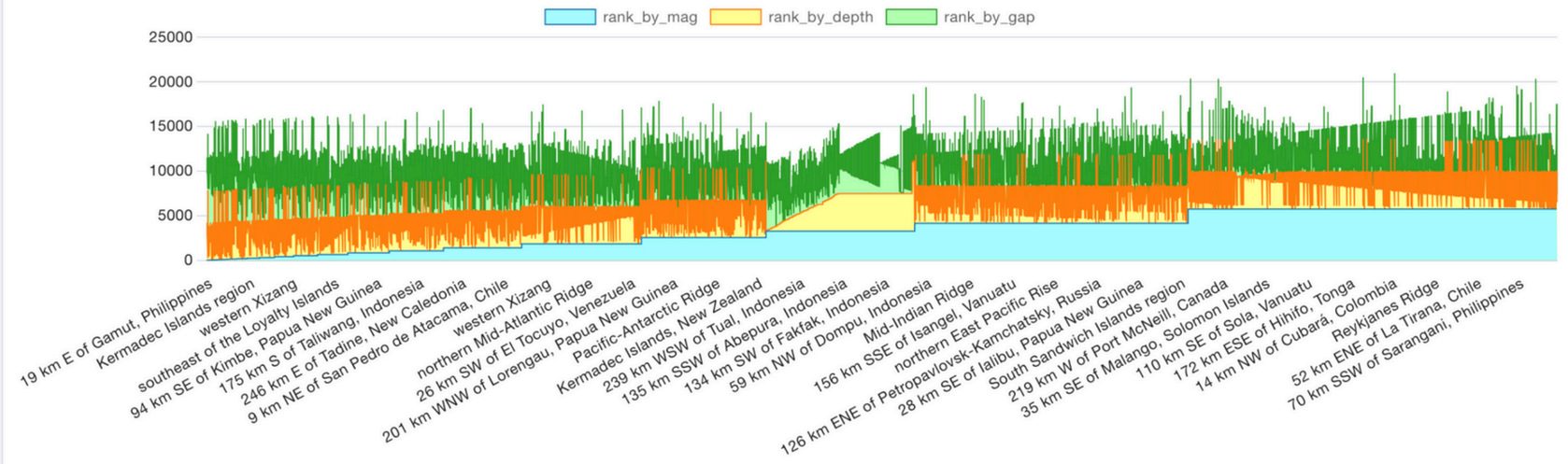
Data Output | Messages | Graph Visualiser | Notifications

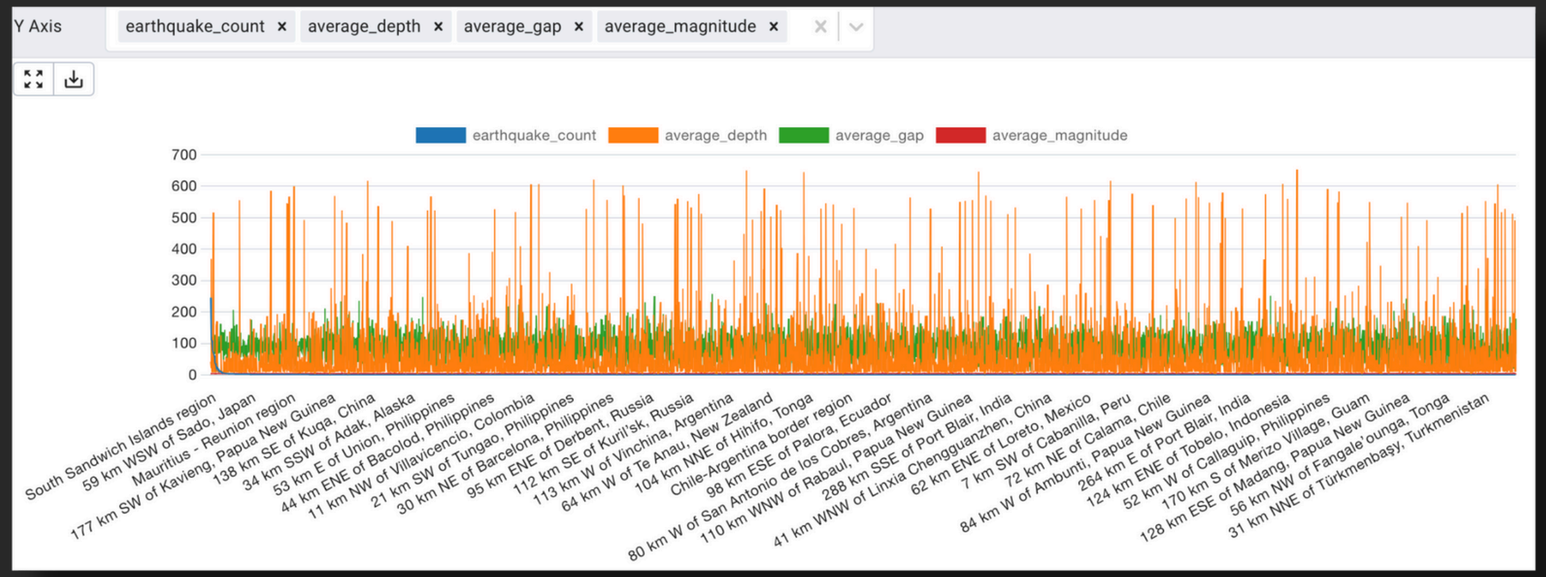
Graph Type: Stacked Line Chart

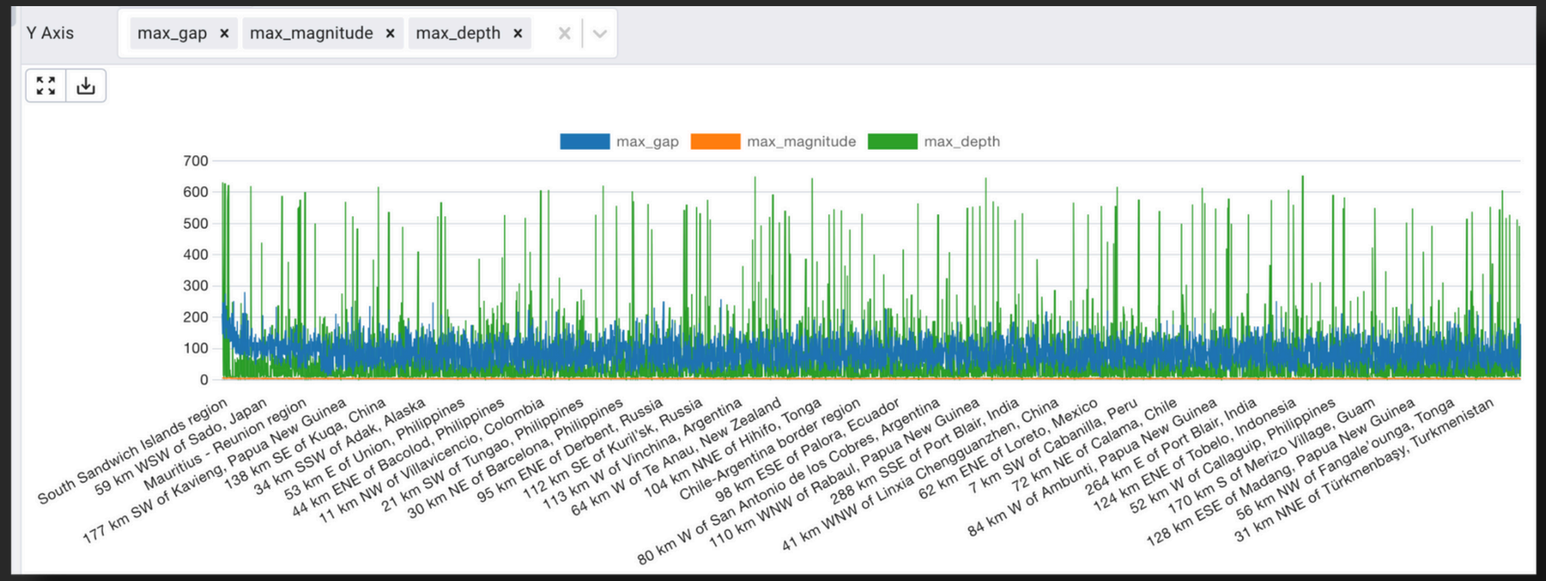
X Axis: place

Y Axis: rank_by_mag × rank_by_depth × rank_by_gap

Generate





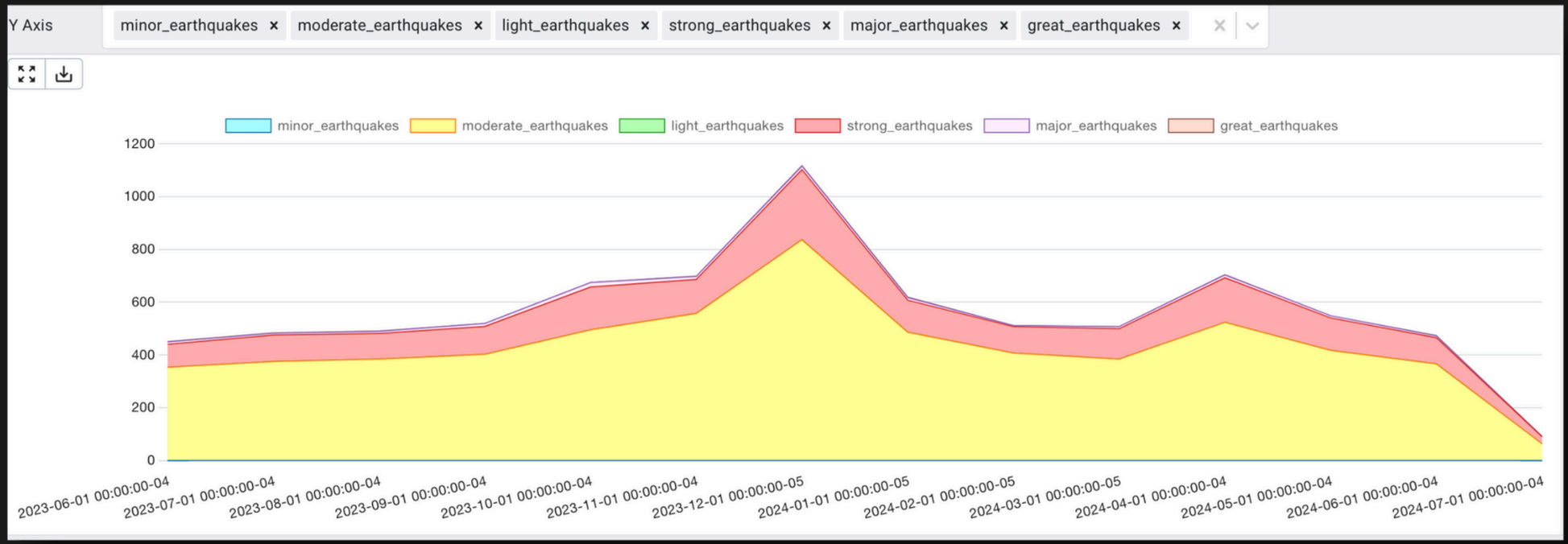



```sql
CREATE VIEW most_impacted_areas AS
SELECT
    place,
    COUNT(id) AS earthquake_count,
    AVG(mag) AS average_magnitude,
    AVG(depth) AS average_depth,
    AVG(gap) AS average_gap,
    MAX(mag) AS max_magnitude,
    MAX(depth) AS max_depth,
    MAX(gap) AS max_gap
FROM
    earthquake1
GROUP BY
    place
ORDER BY
    earthquake_count DESC;
SELECT * FROM most_impacted_areas;
```

Create View for Most Impacted Areas

```sql
SELECT
    DATE_TRUNC('month', time) AS month,
    COUNT(CASE WHEN mag < 3 THEN 1 END) AS minor_earthquakes,
    COUNT(CASE WHEN mag >= 3 AND mag < 4 THEN 1 END) AS light_earthquakes,
    COUNT(CASE WHEN mag >= 4 AND mag < 5 THEN 1 END) AS moderate_earthquakes,
    COUNT(CASE WHEN mag >= 5 AND mag < 6 THEN 1 END) AS strong_earthquakes,
    COUNT(CASE WHEN mag >= 6 AND mag < 7 THEN 1 END) AS major_earthquakes,
    COUNT(CASE WHEN mag >= 7 THEN 1 END) AS great_earthquakes
FROM earthquake1
GROUP BY month
ORDER BY month;
```

Number of earthquakes each month, classified by magnitude categories



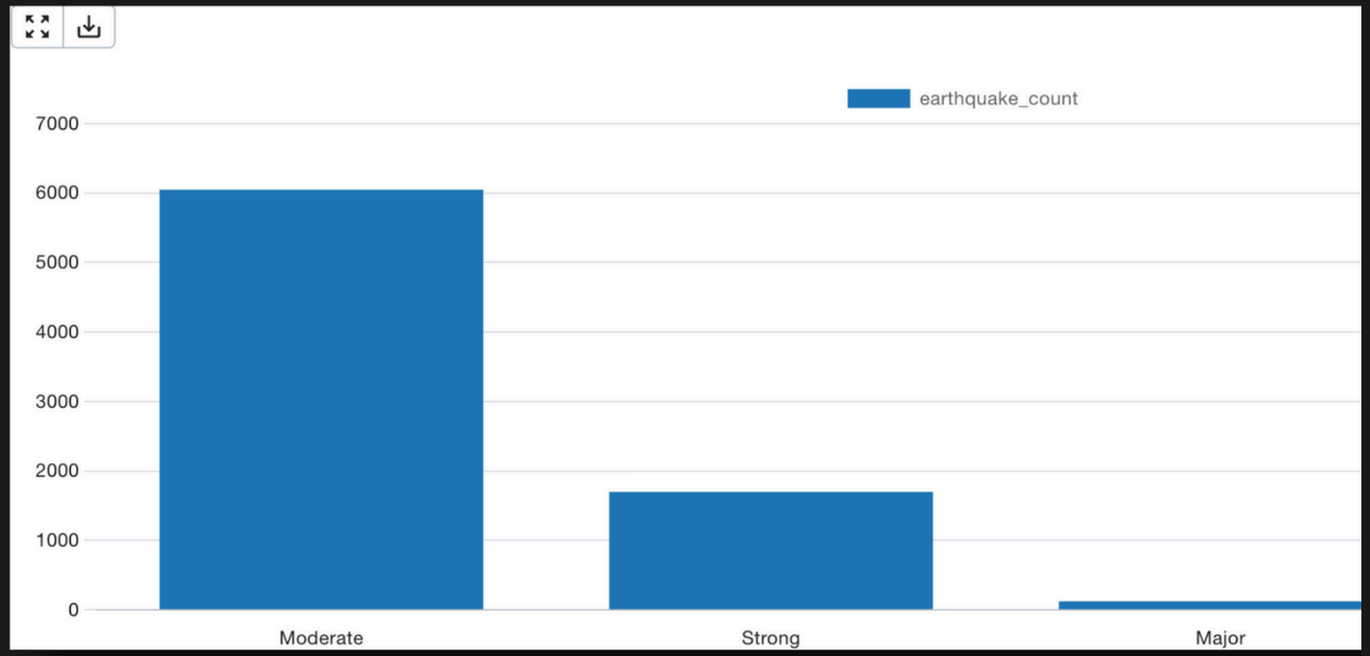
Classify Earthquake Magnitudes.

Classify earthquakes into categories such as minor, light, moderate, strong, major, and great, and count the number of earthquakes in each category

```sql
SELECT
    CASE
        WHEN mag < 3 THEN 'Minor'
        WHEN mag >= 3 AND mag < 4 THEN 'Light'
        WHEN mag >= 4 AND mag < 5 THEN 'Moderate'
        WHEN mag >= 5 AND mag < 6 THEN 'Strong'
        WHEN mag >= 6 AND mag < 7 THEN 'Major'
        ELSE 'Great'
    END AS magnitude_category,
    COUNT(id) AS earthquake_count
FROM earthquake1
GROUP BY magnitude_category
ORDER BY earthquake_count DESC;
```

Data Output | Messages | Graph Visualiser | Notifications

	magnitude_category text	earthquake_count bigint
1	Moderate	6048
2	Strong	1701
3	Major	125
4	Great	10



Results & Key Findings

By leveraging detailed data analysis, we have identified key regions affected by earthquakes, understood the magnitude and depth distribution, and observed temporal trends. These insights are crucial for informed decision-making and developing targeted strategies for earthquake preparedness and risk mitigation. Implementing the recommendations can help in reducing the impact of earthquakes and enhancing the resilience of communities in high-risk areas.

Regions Most Affected:

- The top regions with the highest earthquake occurrences were identified as South Sandwich Islands region and Izu Islands, Japan. These regions experienced significantly more earthquakes compared to others, indicating high seismic activity zones

Magnitude Analysis:

- Most earthquakes were classified as Minor to Moderate, with fewer instances of Strong, Major, and Great earthquakes. This indicates that while earthquakes are frequent, extremely high-magnitude earthquakes are relatively rare.

Depth Analysis:

- The average depth of earthquakes varied by region, with some areas experiencing deeper seismic activities than others. This information is crucial for understanding the underlying geological processes and potential risks.

Thank You for Reading
for complete notebook ,
please check out my
github account
https://github.com/Inderjito