Nuclear Power and Earthquake Risks

The Fukushima nuclear accident of 2011 was the most severe nuclear disaster since the Chernobyl incident in 1986. Only until recently, Chernobyl has become a safer location and yet it still remains an unwelcome location. The fallout from Chernobyl extended beyond Ukraine's borders and the effects may not be fully understood. I personally witnessed a phenomenon in Georgia where thyroid issues appeared common; according to my doctor, this was a result of Chernobyl, even to today.

An earthquake and tsunami caused the Fukushima incident. In light of this, it struck my interests about earthquake activity and nuclear power stations across the globe. Below are visualizations that help create an understanding of the risks that exist.

Data sources:

1. https://sedac.ciesin.columbia.edu/data/set/ndh-earthquake-frequency-distribution/data-download (https://sedac.ciesin.columbia.edu/data/set/ndh-earthquake-frequency-distribution/data-download)
2. https://www.kaggle.com/usgs/earthquake-database#database.csv (https://www.kaggle.com/usgs/earthquake-database#database.csv) (National Earthquake Information Center (NEIC))

In [1]:
```
import numpy as np
import matplotlib.pyplot as plt
import pandas as pd
import seaborn as sns
import folium
from folium import plugins
```

In [2]:
```
power_stations = pd.read_csv('Nuclear_power_stations.csv')
```

In [3]:
```
earthquakes = pd.read_csv('Earthquakes_db.csv')
```

In [4]:
```
power_stations.head()
```

Out[4]:

	Country	Name	Location	Total number of reactors	Active Reactors	Reactors Under Construction	Shut Down Reactors
0	ARGENTINA	ATUCHA	-34,-59.166672	2	1	1	0
1	ARGENTINA	EMBALSE	-32.23333,-64.433327	1	1	0	0
2	ARMENIA	ARMENIA	40.166672,44.133331	2	1	0	1
3	BELGIUM	BR	51.216671,5.0833302	1	0	0	1
4	BELGIUM	DOEL	51.333328,4.25	4	4	0	0

In [5]:
```
new = power_stations["Location"].str.split(",", n = 1, expand = True)
power_stations["Lat"]= new[0]
power_stations["Long"]= new[1]
power_stations.drop(columns =["Location"], inplace = True)
```

In [6]:
```
power_stations['Location'] = list(zip(power_stations.Lat, power_stations.Long))
```

In [7]:
```
power_stations.drop(columns = ['Lat', 'Long'], inplace = True)
```

In [8]:
```
power_stations.head()
```

Out[8]:

	Country	Name	Total number of reactors	Active Reactors	Reactors Under Construction	Shut Down Reactors	Location
0	ARGENTINA	ATUCHA	2	1	1	0	(-34, -59.166672)
1	ARGENTINA	EMBALSE	1	1	0	0	(-32.23333, -64.433327)
2	ARMENIA	ARMENIA	2	1	0	1	(40.166672, 44.133331)
3	BELGIUM	BR	1	0	0	1	(51.216671, 5.0833302)
4	BELGIUM	DOEL	4	4	0	0	(51.333328, 4.25)

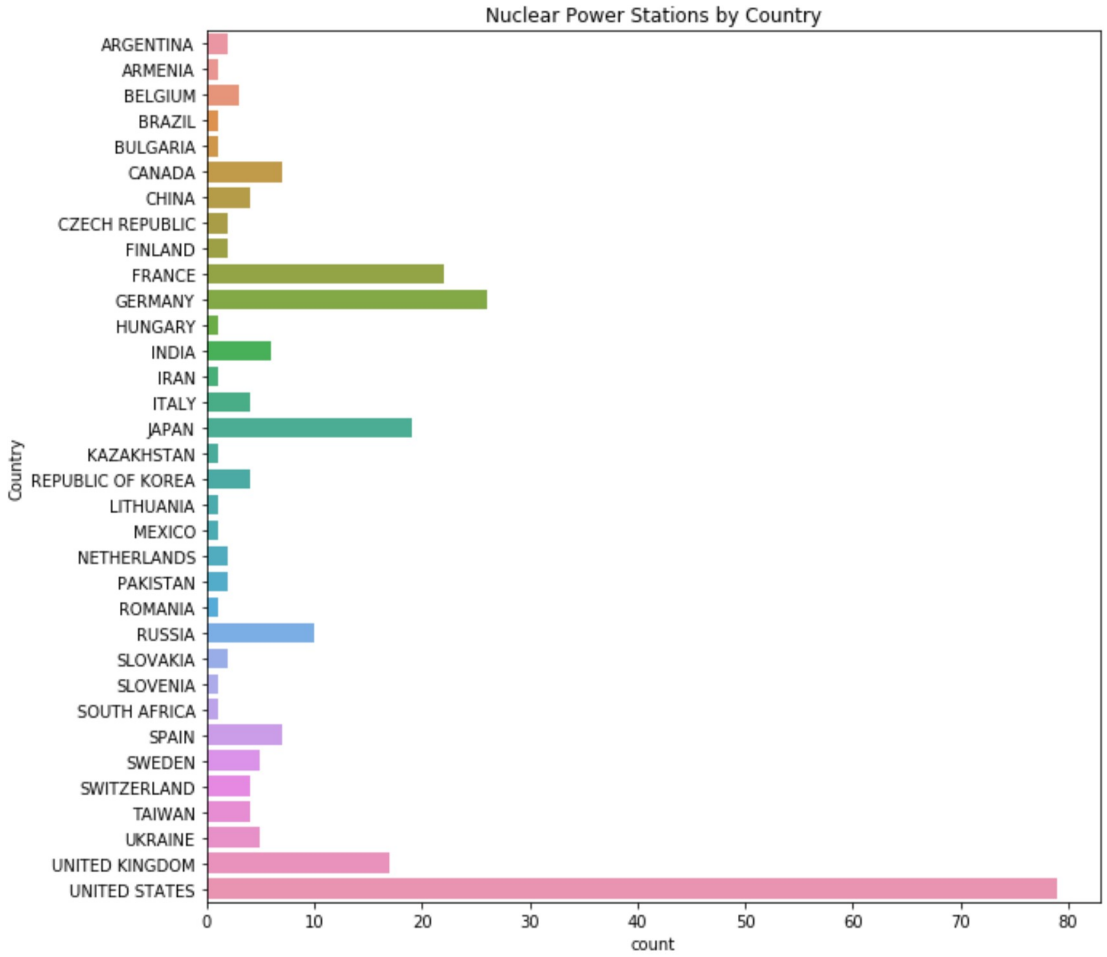
In [9]:
```
earthquakes.head()
```

Out[9]:

	Date	Time	Latitude	Longitude	Type	Depth	Depth Error	Depth Seismic Stations	Magnitude	Magnitude Type	...	Magnitude Seismic Stations	Azi
0	01/02/1965	13:44:18	19.246	145.616	Earthquake	131.6	NaN	NaN	6.0	MW	...	NaN	
1	01/04/1965	11:29:49	1.863	127.352	Earthquake	80.0	NaN	NaN	5.8	MW	...	NaN	
2	01/05/1965	18:05:58	-20.579	-173.972	Earthquake	20.0	NaN	NaN	6.2	MW	...	NaN	
3	01/08/1965	18:49:43	-59.076	-23.557	Earthquake	15.0	NaN	NaN	5.8	MW	...	NaN	
4	01/09/1965	13:32:50	11.938	126.427	Earthquake	15.0	NaN	NaN	5.8	MW	...	NaN	

5 rows × 21 columns

In [10]:
```
plt.figure(figsize=(10, 10))
stations = sns.countplot(y = "Country", data = power_stations)
plt.title('Nuclear Power Stations by Country')
plt.show()
```



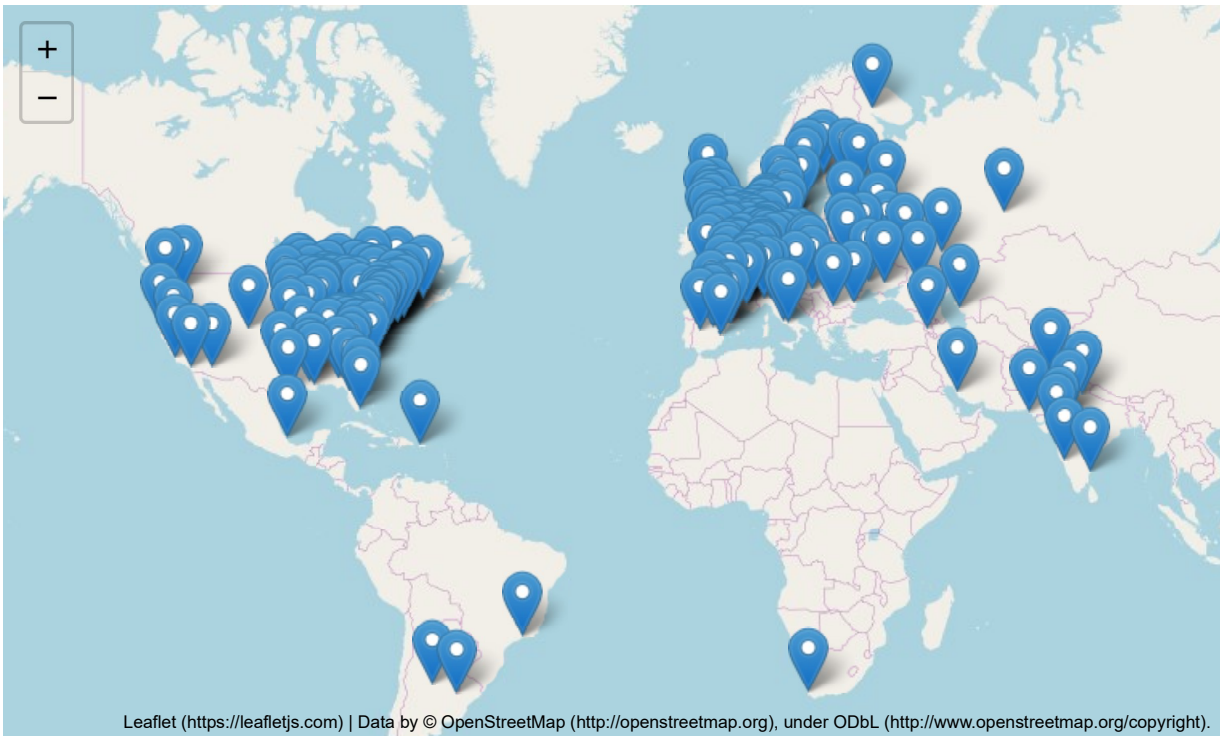
In [11]:
```
# folium map generator
st_map = folium.Map([51.5074, 0.1278], zoom_start=2)
for index, row in power_stations.iterrows():
    text = 'Country: {}, Name: {}, Active Reactors: {}'.format(row['Country'], row['Name'],
row['Active Reactors'])
    folium.Marker(location = row['Location'],popup=text).add_to(st_map)
```

Nuclear Power Station Locations Across the Globe

Click the popup markers for Country, Station Name, and Number of Active Reactors

In [12]:
```
st_map
```

Out[12]:

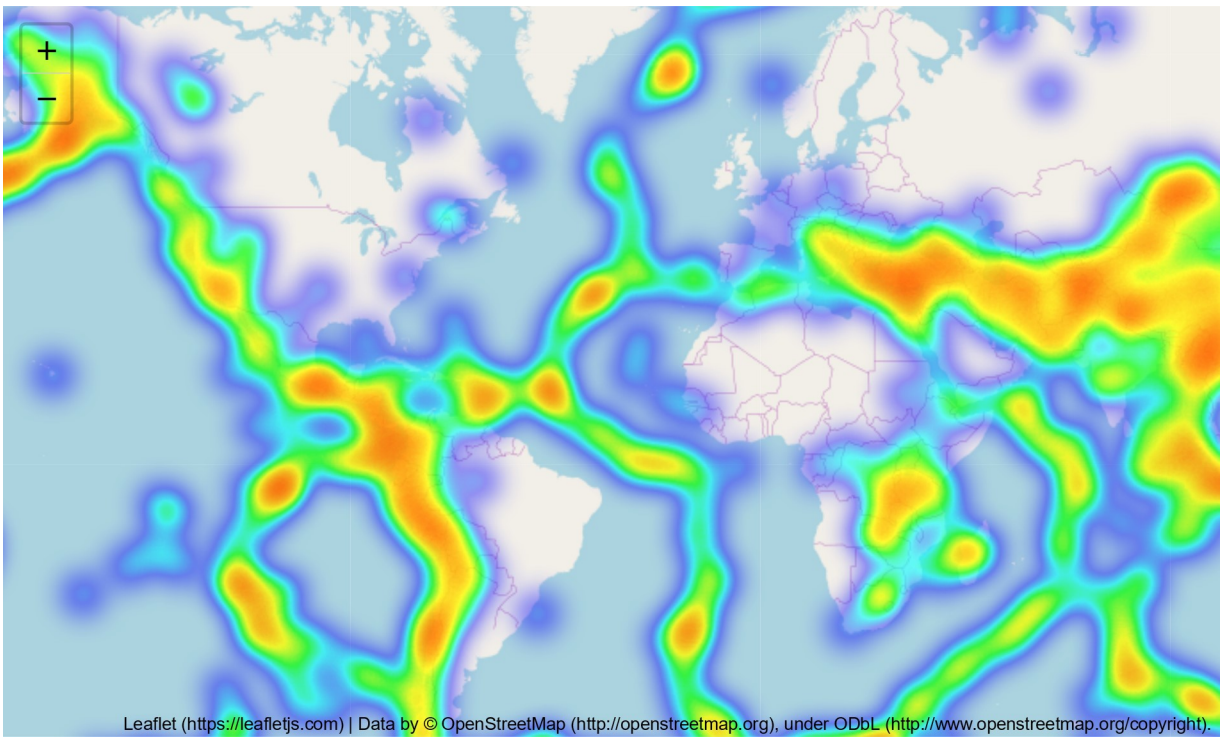


In [13]:
```
# list of earthquake locations
eq_locs = list(zip(earthquakes.Latitude, earthquakes.Longitude))
```

Earthquake Activity Across the Globe - 5.5 Magnitude and Higher (1965 - 2016)

In [14]:
```
eq_map = folium.Map([51.5074, 0.1278], zoom_start=2)
eq_map.add_child(plugins.HeatMap(eq_locs, radius=15))
```

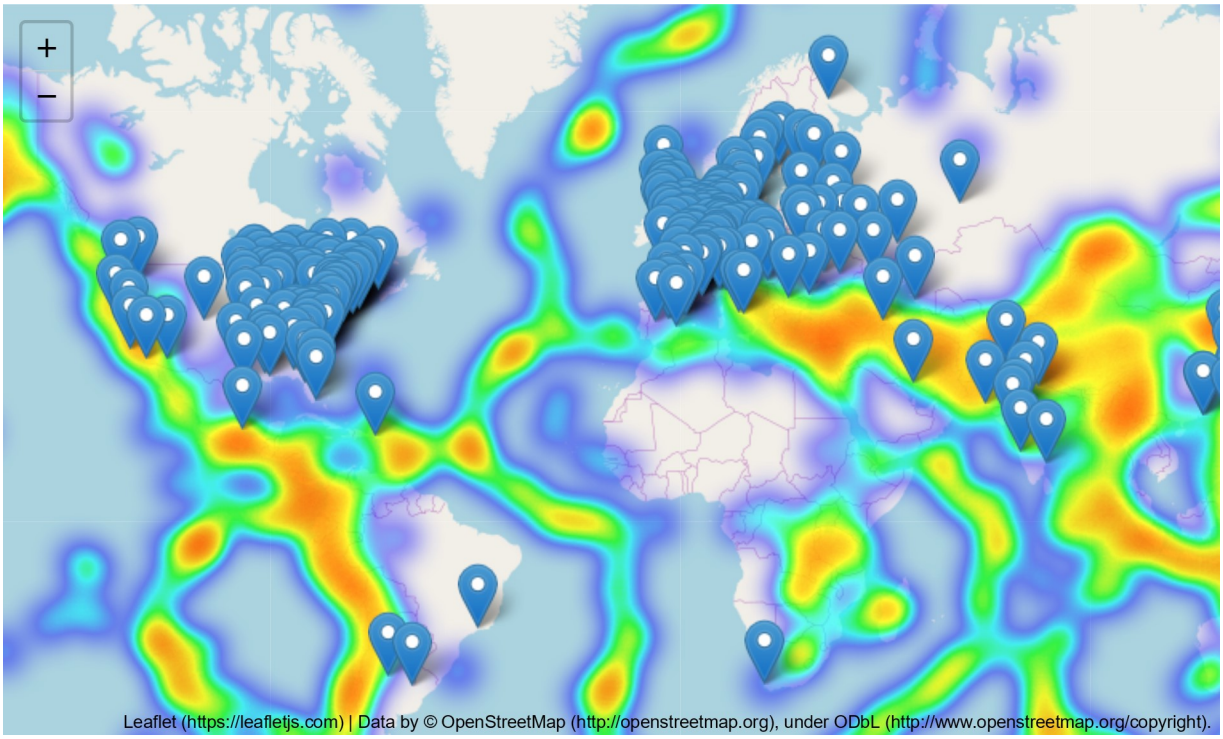
Out[14]:



Earthquake Activity and Power Stations - Understand the Risks

In [15]:
```
# combine the maps
eq_map = folium.Map([51.5074, 0.1278], zoom_start=2)
for index, row in power_stations.iterrows():
    text = 'Country: {}, Name: {}, Active Reactors: {}'.format(row['Country'], row['Name'],
row['Active Reactors'])
    folium.Marker(location = row['Location'],popup=text).add_to(eq_map)
eq_map.add_child(plugins.HeatMap(eq_locs, radius=15))
```

Out[15]:



In [ ]: