ENVIRONMENTAL GAMMA-RAY MONITORING FOR EARTHQUAKE PREDICTION

Team: C. Warren, J. Bigelow, Z. Ginnings
Mentor: Dr. A. Farsoni

PROJECT OBJECTIVES

- Gather Earthquake and gamma detection data for our target areas.
- Use the data to select geographical time's location to add gamma detectors where there currently aren't any for better data collection.
- Produce a code that uses the data we collected, along with a correlation between gamma spike and drop, to make a predictive model.

METHODS

- Earthquake data from the USGS
- Gamma count rate data from the EPA
- Specifically looked at channel 5 for the gamma detectors to encompass the desired 609 keV gammas
- Averaged the count rate for each day to make the data easier to analyze and visualize on a graph
- Overlayed the scatter plot of earthquakes onto the graph of the gamma count rates at different locations to try to find a correlation
- Python was used to help streamline the process of formatting and combining the data into one file in a way that would be compatible with graphing with Excel

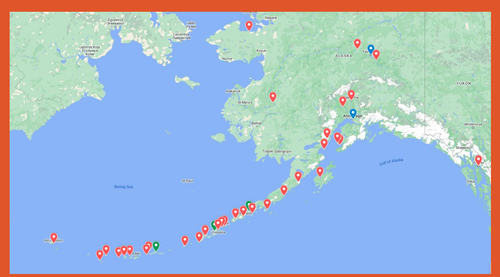

Figure 1: Depicts earthquakes with magnitude 3.0 or greater in Alaska (Red), while also depicting current detectors (Blue), and locations for future detectors (Green).

INTRODUCTION

Earthquakes are a deadly natural disasters that effect many people in the world, especially those who live on/near active fault lines. When earthquakes occur, they cause land destructions and can initiate additional natural disasters; landslides, tsunamis, avalanches, and soil liquefaction. There have been multiple studies indicating and proving ways that earthquake can be predicted. The prediction of earthquakes would be pivotal to many communities, by increase evacuation time and overall preparedness if individuals are not able to evacuate.

Many prediction techniques include monitoring and measuring gamma rays from the decay of Radon-226, specifically from Bismuth-214. Gamma rays that are emitted from this element produces energies between 609 kev-2.5 Mev. In this broad range, the team focused on gammas that emitted an energy of 609 kev, highest intensity. Given the gamma energy observed for states in the western United States, were chosen to compare earthquakes in those state that correlated with intense fluctuation of gammas.

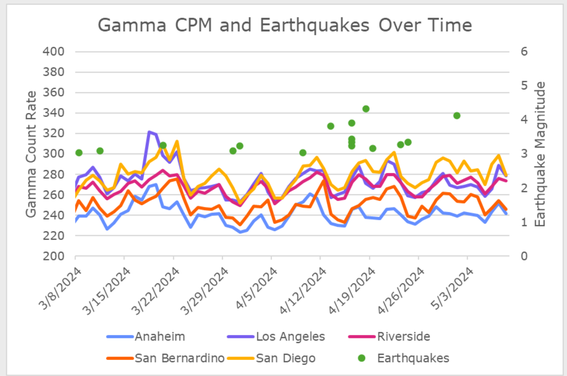

Figure 2: Illustrates the gamma count rates of 600-800 keV gammas and earthquakes from 3/8/2024 to 5/8/2024 in California

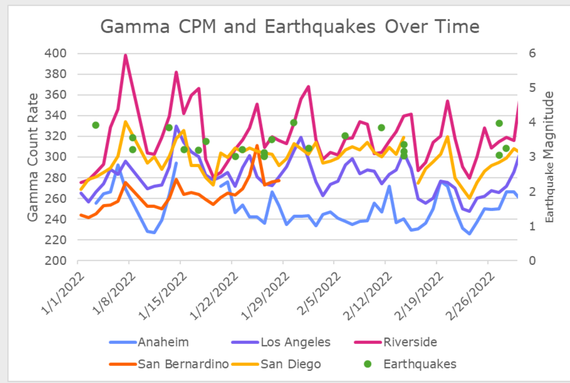

Figure 3: Illustrates the gamma count rates of 600-800 keV gammas and earthquakes from 1/1/2022 to 3/1/2022 in California

RESULTS

New detector locations:

Alaska- Atka, Cold Bay, Makushin

California- Ferndale, Santa Rose, Death Valley

The new locations were chosen based on correlation of earthquake and gamma data for the state from records between 2022-April 2024. New detectors would potentially be placed in the ground/rock locations in the areas or in open water locations.

DISCUSSION

The group collected data from the United States Geological survey for majority of the earthquake data. This data was organized to present the magnitude of the earthquake, location, date and time in both Alaska and California. Earthquake data collected was then overlayed on to the gamma count data as shown in Figures 2 and 3.

The gamma count data shown above was collected in the respected Environmental protection agencies in those states, specifically gamma channel five which contains the energy rangy of 600-800kev. After analysis, the team was able to confirm the correlation by observing high spikes followed by drops in gamma count which then lead to an earthquake in the following days (typically a week after).

FUTURE WORK

- Complete predictive model to receive incoming gamma counts from all detectors implemented.
- Implement and place new detectors in specified locations and ensure the detectors will not have an environmental impact.

RESOURCES AND LIMITATIONS

- United States Geological Survey (USGS)
- Environmental Protection Agency: RadNet Dashboard
- Manpower limited the amount of data analysis and progress and advancement we could put into our code
- Time limit stopped further expanding on implementing detectors and completion of code for prediction.

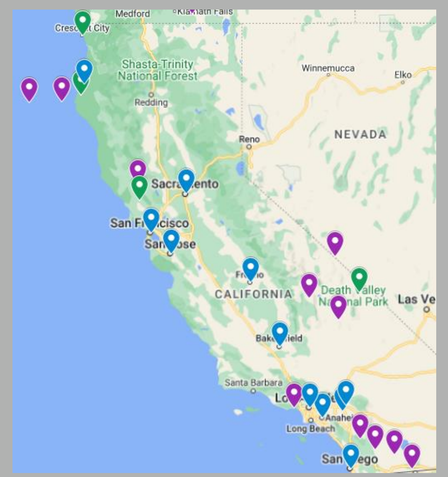

Figure 4: Depicts earthquakes with magnitude 3.0 or greater in California (Purple), as well as current detectors (Blue) and locations for new ones (Green).

Oregon State University