Report on Exploratory Data Analysis

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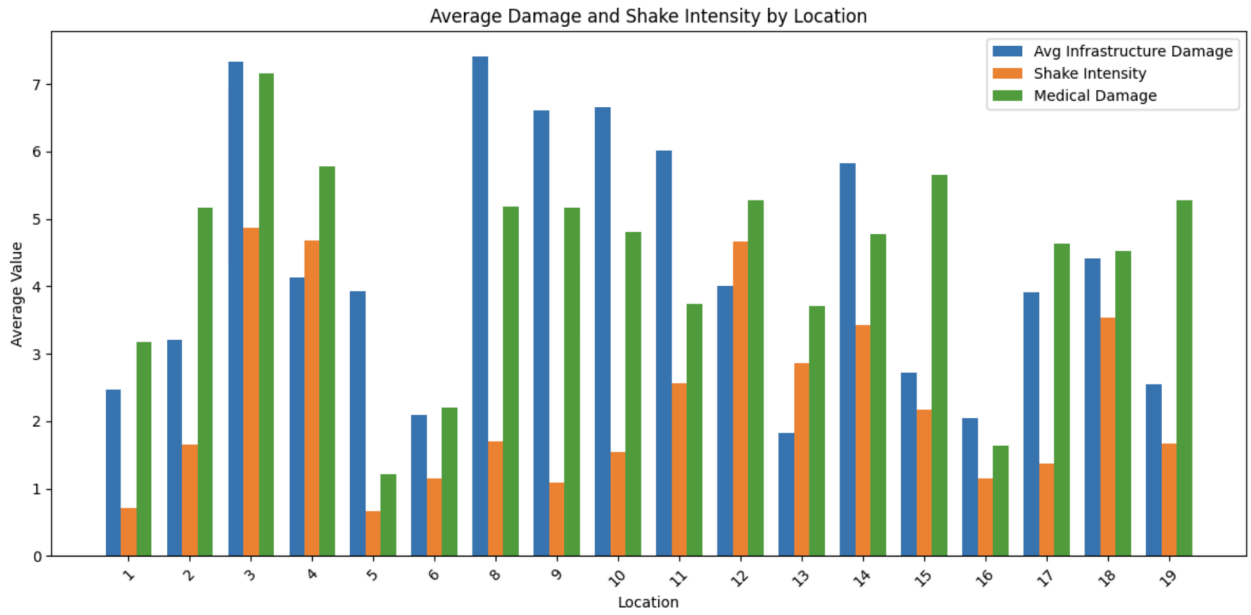
Introduction

St. Himark, located in the Oceanus Sea, experienced a major earthquake beginning on April 6, 2020. The community continued experiencing aftershocks through April 10th. Throughout the quake, emergency responders have had to make decisions about how to allocate resources based on the data they have available, including social media messages, shake intensity and damage reports, and radiation sensor data. The following report details the results of our study using their data and provides recommendations for emergency response and investigation.

Hypotheses

Hypothesis 1a: Some communities reported a disproportionate amount of damages to shaking intensity.



[Fig. 1] The average shave intensity, medical damage and infrastructure damage reported by each community on a scale of 1-10.

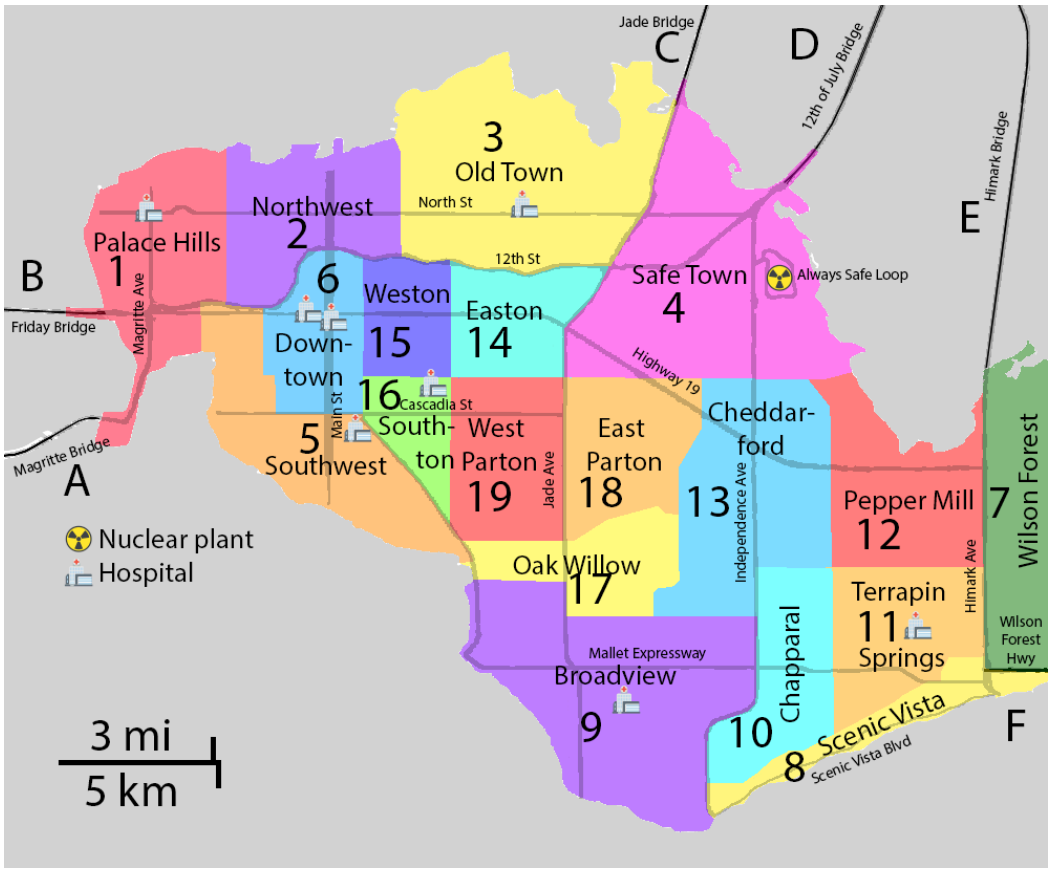
Some communities are reporting far more damages in comparison to perceived shake intensity. For example communities 5, 8, 9, 10 and 17 appear to have suspiciously low shaking intensities in comparison to medical and infrastructure damage. Specifically communities 8 and 9 reported a shake intensity of below 2, but among the highest damages of all communities. Although this

does not mean members of those communities are lying it does indicate that further investigation is needed before prioritizing emergency aid towards those communities.

Hypothesis 1b: Communities with damages that seem consistent with the shaking intensity.

Certain communities like community 3, 4, 12, 13, 14, 18 have damages consistent with the amount of shaking they reported. This may indicate that these communities are more reliable with their reporting. Unfortunately we cannot know how urban these neighborhoods are. More urban communities may experience far greater damages from less seismic activity.

Hypothesis 1c: Seismic activity may not be responsible for all of the damages.



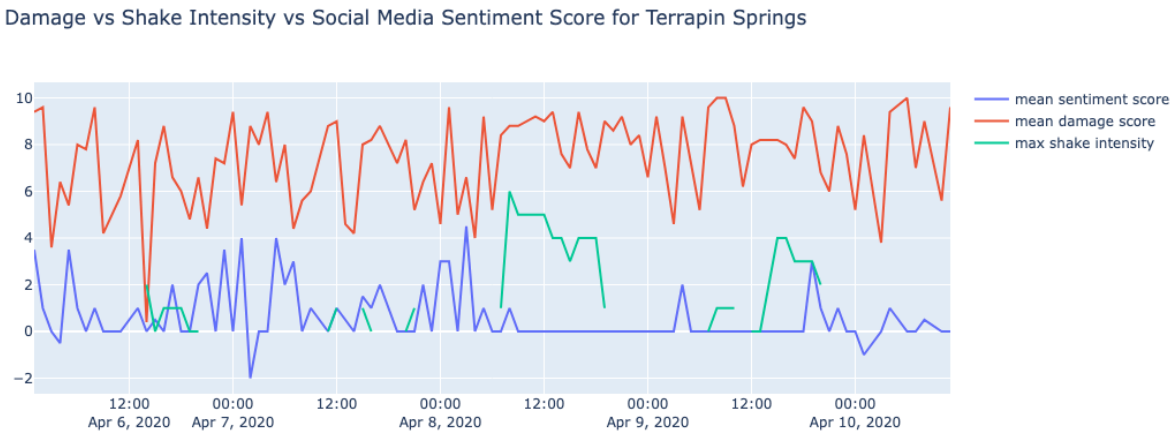
[Fig. 2] Map of city with neighborhoods labeled by district number.

Here we can see that of the neighborhoods reporting inconsistent damages and seismic activity, 5, 8, 9, 10 and 17, most neighborhoods are coastal. It is possible that water damage in coastal communities has caused more damage than the seismic activity. This would make those communities' damage reports valid and emergent. Such communities include all of those with drastically different reports of seismic activity and damages. We can conclude that earthquake activity alone must not guide our distribution of emergency services.

Hypothesis 1d: Safetown requires immediate emergency aid to repair infrastructure damage and obtain medical aid.

In Fig. 1 we can see that Safe Town experienced moderate infrastructure damage. Unfortunately, in Fig. 2 we can see that Safe Town has a nuclear power plant. Damage to a potentially dangerous piece of infrastructure should be repaired first to prevent impacts from affecting the entire city.

Hypothesis 2: Damage and earthquake shaking has a negligible impact on social media sentiment.



[Fig. 3] Graph of mean social media sentiment score, mean damage score, and maximum shake intensity by hour

In Fig. 2 we see that social media posts from a particular do not seem to grow more negative overall in response to damage to the neighborhood or earthquakes within a neighborhood. Fig 2 shows data specifically for Terrapin Springs, however exploring the graphs generated for other neighborhoods reveals the same lack of a trend. This indicates that monitoring social media to make emergency response decisions may be fruitless.

Hypothesis 3: the earthquake did impact the reactor, and suspicious activity occurred in Scenic Vista

The following four figures display screenshots from an animated heat map showing density of mobile sensor reports weighted by the value of the report (more reports and higher radiation levels equals brighter spot), where each frame shows a 5.5 hour time window, jumping 2 hours each time, from 12am April 6th to 11:59pm April 10th. A recording of the heatmap can be accessed here: radiation-reports_heatmap.MOV. We recommend watching it sped up.

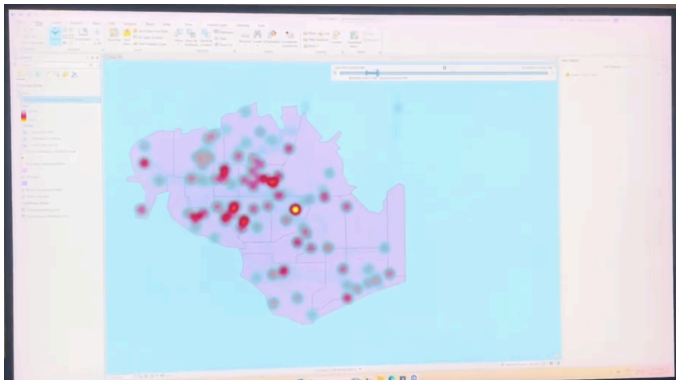


Fig 4

Fig 5

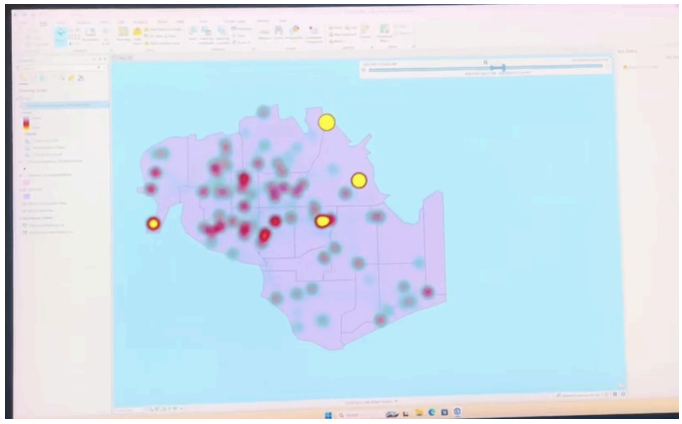


Fig 6

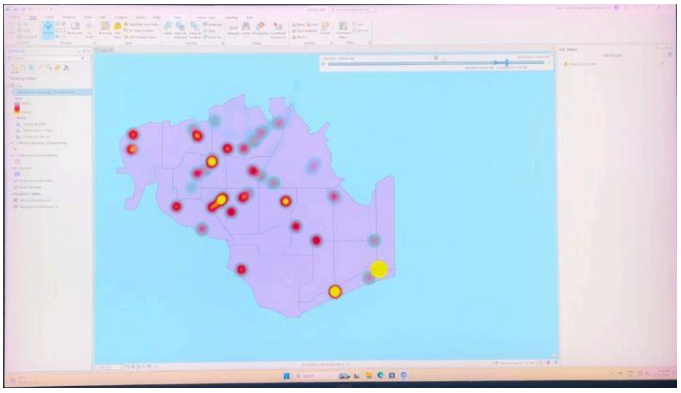


Fig 7

Below, we provide interpretations of each figure and conclusions drawn from them.

Figure #	Video Timestamp	Time range	Interpretation
4	0:36	April 6, 1:46pm-7:11pm	This is a representation of assumed normal levels
5	2:24	April 8, 1:46pm-7:11pm	We believe this is when the reactor started emitting excess levels of radiation…
6	2:28	April 8, 3:46pm-9:11pm	…Which continued for the next few hours
7	3:35	April 9, 9:46pm- April 10, 3:11am	There is an unexplained extremely high level of radiation and/or reports in the middle of the night, far away from the reactor.

In conclusion, we believe that the earthquake impacted the reactor on the afternoon of April 8th, and that someone should investigate what happened in Scenic Vista in the middle of the night on April 9th into the 10th.

Recommendations

1. Collect data on population density and building density to fully understand why some areas might report damages inconsistent with seismic activity.
2. Collect data on water levels to ascertain whether coastal communities are experiencing significant water damage that is contributing to overall damages.
3. People should have been evacuated from Safe Town starting sometime after 1:46pm on April 8th.
4. Investigate what happened in Scenic Vista in the middle of the night on April 9th into the 10th.