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STAT 495
Final Report

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I. INTRODUCTION

In this report, Alaska and its social, economic, cultural and environmental status will be investigated and then its natural hazards and disaster profile will be further investigated with some data to obtain an idea about how the city can be made more resilient.

II. INTRODUCTION TO ALASKA

Alaska is often referred to as “The Last Frontier” as it is the northernmost and the largest state in the US. It is renowned for its vast wilderness and extraordinary landscapes.

From a social standpoint, Alaska is home to various communities such as the Iñupiat, Yupik, Aleut, Tlingit, and Haida. With unique and many communities, Alaska forms a unique social fabric where traditional knowledge, subsistence lifestyles and modern influences coexist. Alaskans also have strong social ties because of their shared experiences and resilience. Alaska has 730000 residents with are growth rate close to 1% per year, it is the least densely populated US state.

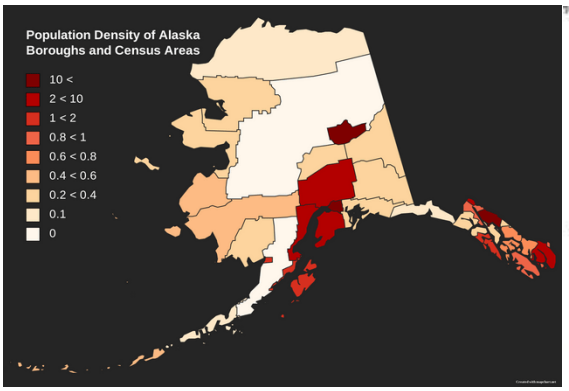


Figure 1: Settlement locations in Alaska

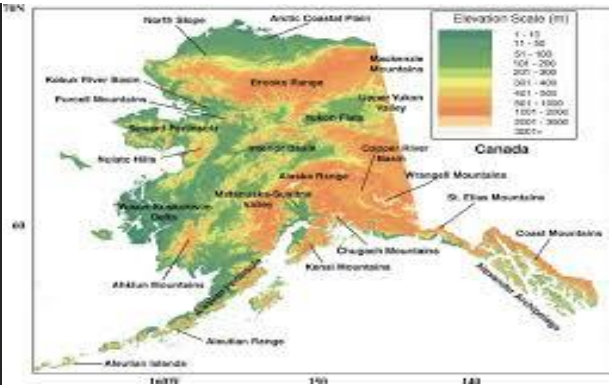


Figure 2: Topography of mountain ranges in Alaska

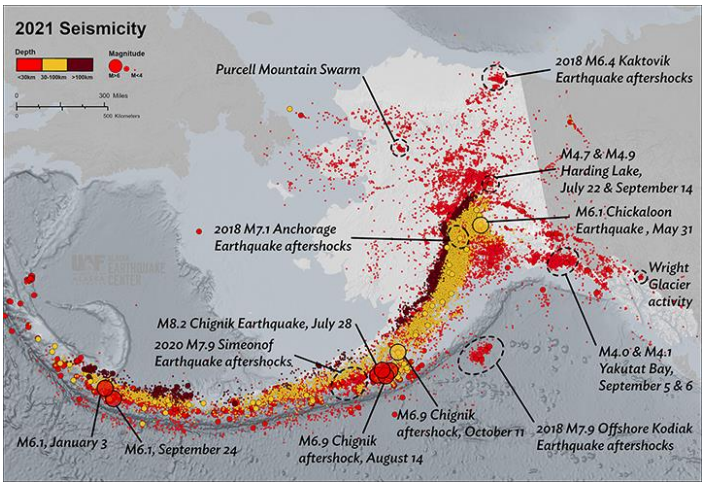
Economically, it is mostly dependent on natural resource extraction such as chiefly oil, timber and fishing. The Alaskan economy is also subject to tourism as millions of tourists visit per year. Balancing resource development with environmental problems is Alaska’s biggest ongoing economical challenge. It has an estimated GDP of $55-60 billion and 5-6% unemployment rate.

Alaskans also have centuries old traditions such as hunting, fishing, crafting and community gatherings. Alaska’s diverse and dynamic culture celebrates indigenous heritage through art, dance, and storytelling that connect the past to the present.

Lastly, its unique environment is defined by its vast mountain ranges, expansive forests and icy waters, all of which create dramatic seasonal variations. Warming trends and melting permafrost pose pressing concerns for infrastructure and local ecosystems. Conservation efforts focus on safeguarding wildlife habitats and striking a balance between resource development and preserving the state’s breathtaking natural heritage.

III. HAZARD PROFILE OF ALASKA AND PREVIOUS DISASTERS

There are 7 main hazards in Alaska which are earthquakes, tsunamis, volcanic eruptions, extreme weather, permafrost/erosion, wildfires and landslides/avalanches.



Alaska is sitting on a seismically active Pacific Ring of Fire, where the Pacific plate subducts under the North American Plate. Because of this, Alaska experiences frequent earthquakes with large magnitudes. The second largest earthquake in terms of magnitude, namely "1964 Good Friday Earthquake" has also happened in Alaska with a magnitude of 9.2. This massive earthquake caused destructive tsunamis which damaged the coastal areas of Alaska. This terrible disaster resulted in 130 fatalities with immense infrastructure damage.

Figure 3: 2021 seismicity map for Alaska with notable earthquake events and sequences labeled.

Alaska has over 40 active volcanoes in the Aleutian Arc. These volcanic eruptions can cause numerous complications either to the short range and long range such as ash clouds, pyroclastic flows and lahars. These complications cause disruptions in air travel and local communities. There are also more physical consequences of volcanic activity such as infrastructure damage and fatality. Alaska is currently trying to maintain the severity of these volcanic activities by sending immediate evacuation orders. There have been a few very severe volcanic activities throughout the history of Alaska such as Mount Redoubt Eruption which sent ash plumes 30000 feet into the atmosphere that complicated the air travel. These said ash plumes can travel hundreds of kilometers and can cause interesting environmental events even from long-range. These long-range environmental events are changing soil fertility and alternates river chemistry (critical for salmon).

Figure 4: Active volcano map of Alaska

Alaska's extreme weather conditions and coastal storms also pose hazardous situations which are a result of Alaska's vast size and diverse climate. These events can be fatal and cause infrastructure damage. Which can be avoided with decent day-to-day meteorology information given to Alaska citizens so they can prepare for what is to come with the help of the government. In 1974, a winter storm in Anchorage brought record-breaking snowfall and blizzard conditions. This event strained transportation and emergency services which left citizens of Alaska helpless. In the future, this should be avoided by making more resilient roads and better planning of emergency situations. If these problems are not fixed, it may be unavoidable to discuss the relocation of some villages.

Permafrost in Alaska is also a huge problem because it significant portion of Alaska is underlain by it. With rising temperatures, more and more of this said permafrost melts, and damages the roads, buildings and pipelines. Coastal erosion therefore is also a possible hazard which happened before at Shishmaref and Kivalina. These arctic communities faced severe coastal erosion which started the discussions of the relocation of these said communities.

While having extreme cold weather conditions, Alaska is also subject to wildfires where in 2004 Fire Season, being one of the largest on record, burned 6.6 million acres of land.

There are also landslides and avalanches in Alaska because of its mountainous terrain. Frequent seismic activity also contributes to this phenomenon. In 2015 Sitka Landslide, heavy rainfall triggered a severe landslide which resulted in fatalities and economical damage. In southeast Alaska, many communities are investing in avalanche mitigation measures such as controlled releases.

IV. EMERGENCY MANAGEMENT AND INSTITUTION INVOLVED

Alaska Division of Homeland Security & Emergency Management (DHS&EM) is the primary state agency that is responsible for coordinating emergency preparedness, response and recovery. Local governments are also very key in mitigation as they are usually the first to respond. There are also federal agencies such as FEMA, USCG and USACE which provide training, funding, additional resources, rescue operations, flood control etc. To ensure clear communication and coordination, Incident Command System (ICS) plays a crucial role.

There are different methods for different kinds of hazards. For example, for earthquakes, DHS&EM ensures the statewide preparedness is met and it also conducts response drills called the Great Alaska Shake Out. USGS monitors seismic activity and creates real-time data in Alaska. AEC maintains the network of seismograph stations and LEPCs maintain citizen level response plans, conduct building resilience tests and enforce building laws.

For tsunamis however, NOAA gives the first warnings, DHS&EM coordinates the evacuations if it is necessary. USGS provides seismic data, and Local Governments build the evacuation routes and maintain siren systems.

In terms of volcanic activity however, AVO (partnership between US geological survey, University of Alaska and Alaska Division of Geological & Geophysical Surveys) monitors, forecasts and alerts. DHS&EM coordinates response in case of an endangerment to the communities. FAA works with AVO to control air travel in case of an ash cloud event.

During the event of extreme weather, NOAA first tracks the situation, DHS&EM again coordinates the response, Local emergency services organize the clearing of roads and opening shelters.

For the wildfires, Alaska Division of Forestry lead the suppression and BLM oversees wildfire response.

And the landslide & avalanches are monitored by DOT&PF.

V. HAZARD ANALYSIS DONE BY THE US GOVERNMENT AND LOCAL GOVERNMENTS AT ALASKA

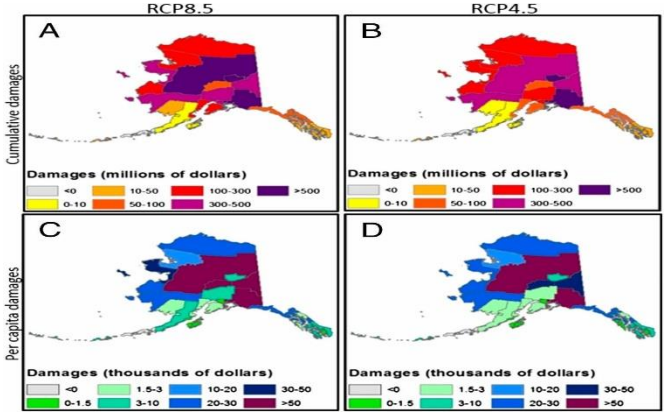
For the state hazard mitigation plan, the Alaska Division of Homeland Security & Emergency Management develops and updates a statewide plan which recognizes key hazards and assesses vulnerabilities to outline strategies to reduce risks. Locak governments also create community-specific plans using local data and historical event records. These plans contribute further to the plan designed by the Alaska Division of Homeland Security & Emergency Management and help prioritize funding for mitigation projects.

Seismic risk assessments are done at AEC at the University of Alaska where seismic data is collected in real time to better evaluate and understand the seismic situation in Alaska. They produce shaking-intensity maps and building vulnerability assessments to estimate the potential damage. With this potential damage output, they conducted a few relocations of villages and as can be seen from figures 1 and 3, most of the settlements that are on the most severely seismic zones are relocated. With these events, it is also determined that the most dangerous place in terms of tsunami is the “tail” of Alaska as there are a lot of earthquakes and it is on the coastline.

Seismic satellites and geophysical data are also used for volcanic monitoring by AVO. AVO produces ash fall advisories and dispersion models that show likely air and ground impact areas. To avoid complications by these said procedures, the settlements’ locations are again far from the tail of the Alaska also because of its volcanic activity.

Because of climate change, permafrost problems arise with each year in Alaska. Several different types of data are investigated to estimate the severity of the permafrost problem for each year by the researchers at the University of Alaska to assess the importance of new regulations and controls.

VI. SUGGESTIONS AND RECOMMENDATIONS



To contribute to mitigation of earthquakes, expansion of sensor networks can be made as there are many remote regions in Alaska that may thrive with better data collection, also the patterns then maybe more obvious and preparedness for the earthquakes in settlement locations can be further improved. Updating seismic hazard maps and doing more regulations with village zones because of the seismic events may results in better overall performance by buildings as the US government data shows that most of the infrastructure damage in Alaska occurred in relatively remote areas where compact villages were constructed. The visualization of the said event can be found on the left.

Figure 5: Distribution of the economic damage in Alaska by seismic events.

For the mitigation of tsunamis, old evacuation maps which are determined with respect to the old knowledge, data and maps should be reevaluated and reconstructed. As the old routes have changed with new hazard maps and disasters such as avalanches and landslides and are also changing constantly throughout the year because of permafrost complications. The old evacuation routes should therefore be subject to change as they are outdated and consequently, unreliable. They can be adjusted such that the escape routes are more dynamic with respect to the changes of Alaska landscape throughout the year. This can be done by having different escape routes for different times of the year. A permafrost map which is constructed by how continuous the permafrost is shows how unstable the routes of Alaska are throughout the year.

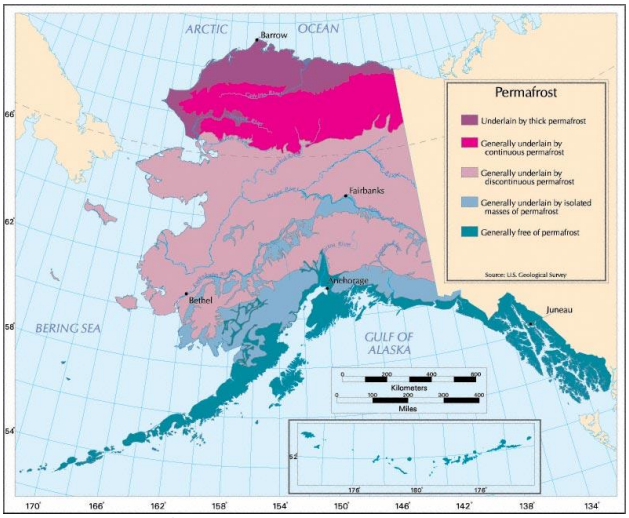


Figure 6: Permafrost map

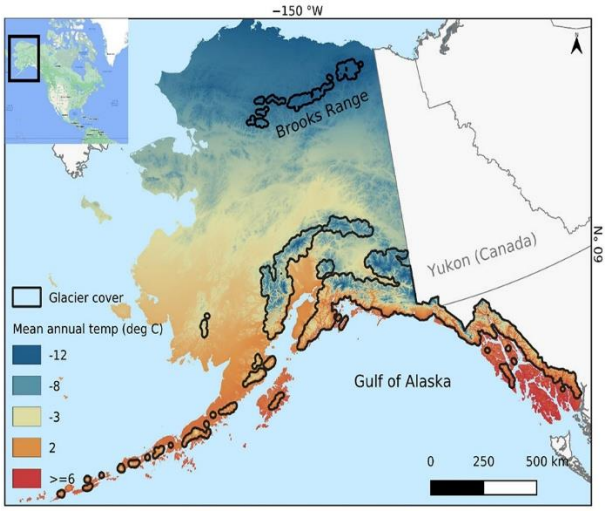


Figure 7: Glacier change

Volcanic activity is generally very thoroughly studied in Alaska, but mostly because of its possible damage and short-range implications. The advice for this topic would be to study more of its long-range implications and its possible advantages and disadvantages to the ecosystem. It plays a crucial role in the environment and studying may potentially benefit the possible agricultural aspects of neighboring states of Alaska.

VII. CONCLUSION

In conclusion, currently Alaska is a highly valuable tourist attraction because of its unique environment. To prevent future tourist casualties, economic damage and environmental complications; there should be clearer and updated escape routes that are adjusted to the changed landscape of Alaska, and better seismic equipment which should be located also in relatively remote locations.

For the outdated maps, a more dynamic map which has different escape routes for different times in a year should be adjusted which also takes the changed landscape because of years of avalanches, landslides etc. into consideration

Also, volcanic activities are seen as more of a short-rage hazard while it has very complicated long-range implications where some are advantageous in terms of soil quality and environment, and some are disadvantageous such as complications caused by excess ash clouds. These negative impacts may result in economical disruptions on agriculture working citizens. Potential damages and advantages should be further studied to make up a mitigation plan for the long-range impacts.

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