Effects and Coastal Resilience

Tsunami and Earthquake Effects and Coastal Resilience in Palmer, Alaska.
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Just For the Halibut

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Abstract

We of the Palmer High Ocean Bowl team based our research project on the concept that the Matanuska-Susitna Valley could be washed out by a tsunami of a significant size. We chose this topic because our team members are residents of the valley and wanted to investigate the effects of a tsunami on the local area and what could be done to protect our home and keep it resilient.

Our local geography does render the probability of a tsunami hitting us rather low; however, if one did hit us directly, its effects would likely be absolutely devastating. To research these effects, we studied multiple past earthquakes, both locally and internationally, that caused tsunamis and had devastating effects on the land. Our intention was to research the likelihood of a tsunami hitting the Matanuska-Susitna Valley. Some of our questions were: what would occur if one hit, and what measures could be taken to prevent large-scale damage? Through the study of these past earthquakes and of the geography of our local land, we investigated tsunami effects as well as what could be done to prevent devastation and protect our local home. After our research, we determined that it is very unlikely that a tsunami would hit us; however, we still need to be prepared for anything.

Keywords: Coastal resilience, tsunamis, earthquakes, damage prevention
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**Topic & Purpose**

Our topic this year is the effects of earthquakes and tsunamis in the Matanuska-Susitna Valley. We selected our topic based on the given topic of coastal resilience. Our team came to a rather fast realization that the valley is only 76 kilometers away from Anchorage, and Anchorage is directly off of the Cook Inlet, which is part of coastal Alaska (see appendix B1 & B2 for mapping of the Cook Inlet). We envisioned a tsunami could come crashing through the Cook Inlet and actually affect the Valley. Our purpose was to find the possible effects of an earthquake large enough to cause a tsunami to hit the Valley. To do this we researched some of the largest earthquakes of the past in areas similar to our own.

**Research**

**1964 Alaska Earthquake**

On March 27th 1964, in the Prince William Sound area of Alaska, approximately 90 kilometers west of Valdez and 120 kilometers east of Anchorage, there was a 9.2 magnitude earthquake on the seafloor. This earthquake caused the earth's crust to compress and warp. The power of the earthquake caused the crust in some areas of the Alaska Coast to uplift, and in other areas, sink. For example, the Latouche Island moved approximately 15 meters southeast while areas around Portage sunk as much as 3 meters. (See appendix A graph A1 for visual on how fast this earthquake advanced).

The seismic waves caused by the 1964 earthquake were reported to have traveled around the earth for several weeks, known as the “ringing of the church bell” effect. Tsunamis were reported to have occurred in Alaska, Canada, the Pacific Northwest, and Hawaii. Texas and Florida were reported to have been affected with vertical motions of five to ten centimeters. Even areas surrounding Louisiana reported to have multiple sunken ships due to the sloshing effects of
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Giant waves crashing along the shores. Oscillations in the height of water wells were seen as far away as South Africa. Apart from these, there were various other effects, such as seiches (standing waves in enclosed water bodies).

It is said to be that 139 people lost their lives: some from the physical earthquake, some from buildings falling and boats being torn apart, and still others from aftershocks occurring all the way from Alaska to Oregon and California. The estimated amount of damage done was roughly 311 million dollars. (See amount of damage done Appendix C1)

The 1964 Niigata Japan Earthquake

This earthquake hit Japan off the shore of the island of Awa-shima at a depth of 57 meters below the surface and at a magnitude of 7.5. This was in a coastal area near the small town of Niigata, on the coast of Honshu (the main Japanese island). The resulting tsunami completely tore apart the west coast of the main island. The accumulated damage was recorded to have destroyed 3,534 houses and damaged approximately 11,000 more (images in Appendix C2). Beyond this, 36 people were recorded dead and 385 injured due to the tsunami. It rose the east shore of Awa-shima 150 meters, and subsided 45 centimeters off nearby Hayakawa’s coast. This actually created a new fault line off the shore of Awa-shima.

The lower half of the town of Niigata was built on a thick layer of sand. The tremor caused dynamic problems with the sand, which caused the buildings to sink into the ground. One of these buildings was the Kawagishi-cho apartment complex. They had a bearing capacity problem due to the sinking sand and were severely tilted. Even so, the apartment buildings did not actually have much substantial structural damage. Several bridges across the Shinano River collapsed, and the liquidation of the sand also affected the nearby railways. In result, the
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earthquake devastated a large area of the Honshu Japanese coast, affecting many unprepared residents.

2011 Honshu Japan Earthquake

On March 11, 2011 in mainland Japan, there was an earthquake of magnitude 9.0. It occurred about 72 kilometers east of Tohoku, and had a depth of 24 kilometers. Soon after this earthquake, scientists drilled down and found that there was a thin layer of soft clay along the fault line. It was this that led to the tectonic plates sliding about 50 meters, and led to centuries of pent up stress being let out.

About 400 kilometers of Japan’s northern shore of Honshu had dropped down 61 centimeters. The mainland of Honshu also moved eastward by 2.5 meters, causing the pacific plate to move westward in the direction of the epicenter by 79 meters. This earthquake created a tsunami, which flooded 349 kilometers of inland Honshu.

The total damage cost was roughly 300 million dollars, or 25 trillion yen. By April 10, 2011, 15,891 people had died because of this natural disaster, and to this day 2,500 people are still reported missing. The tsunami stood 1.5 meters tall and destroyed many sections of the sea wall surrounding the coast of Honshu Japan. It devastated a massive three story building and created a whirlpool offshore. It also caused a malfunction with the Fukushima Daiichi Nuclear Power Plant’s cooling system. This malfunction created a nuclear meltdown of a level seven on the nuclear event scale. To this day they are still reporting findings of chemical radiation from the power plant along the coast of California and Canada.

Geography of Cook Inlet

The Cook Inlet located in Southcentral Alaska is considered a shallow water basin. If the southern part of the state were to have an earthquake that was big enough to create a tsunami, the
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A tsunami would quickly diminish in the inlet. In the deeper portion of the inlet, the wave would move rapidly and as the water got shallower the wave would slow down to such a speed that it would fall on itself. This means that the tsunami would never make landfall, leaving little to no damage. However, Cook Inlet contains many active volcanos that have a potential to cause earthquakes and tsunamis, and can also trigger huge landslides. These rock slides can then rapidly raise the water level creating a wave that can be much closer to land making the distance traveled considerably less.

Discussion

Through this research we found that an earthquake of enough magnitude could theoretically affect the Matanuska-Susitna Valley drastically, in similar ways to how large-scale earthquakes affected Japan and Anchorage. A strong earthquake could have many possible effects that could disturb the valley. However, the geography of the local area would prevent the worst part of any tsunami from reaching our area (the shallow water of cook inlet, which increases the energy of the tsunami quickly, but then diminishes it, which causes cook inlet to act as a natural diffuser), and by implementing the right solutions and effects could reduce damage or even completely prevent it.

Possible Effects

The effects from a large earthquake could result in land shifting up or down causing the two rivers surrounding Palmer, Alaska (the Knik River and the Matanuska River) to shift. If the land dropped, the rivers could reroute, flood homes, tear down bridges and make transportation difficult. If the land were to rise then the river might reroute and destroy other lands near the Butte, a local residential area. Also if the land shifted and rivers flooded, eroding soil in local agricultural areas could cause damages to crops and livestock grazing fields.
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Local Resilience

As discussed above, the geography of our nearby Cook Inlet, as well as our relative distance from the actual coast, helps prevent most tsunamis from affecting us. We are in a well-protected area geographically as well as socially. Having the Tsunami Warning Center close to home makes access to its instruments and warnings readily available. However, the direct effects of earthquakes could change sea levels, affect rivers, and destroy land. And, of course, an earthquake greater than 9.5 could create a tsunami of huge proportions that would directly affect us; in such a scenario, we are quite unprepared, as we would have never expected such a disaster.

Solutions

It is almost impossible to plan for or prevent tsunami effects in the short term. There is generally only about a ten to fifteen minute space between the issuing of a tsunami warning and the impact of the tsunami--leaving no time for more than a quick evacuation. In this short time between the warning and the impact of the tsunami itself, all that can truly be done is safe evacuation and perhaps the securing and elevating of possessions to protect property.

The majority of tsunami damage prevention comes in the long-term--the preparation for tsunamis that are yet to come. Though it is unlikely that a large tsunami would hit the Matanuska-Susitna Valley, it is still a possibility, and ideally we would be well-prepared for it. On a public level, efficient modes of warning and evacuation routes could greatly improve survival chances, and even such things as seawalls and other large-scale projects could greatly help prevent damage, even in such a low-risk area. On a more private level, individual families should have emergency plans, supplies, and evacuation procedures ready in case disaster hits.
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Conclusion

Initially, we thought that there could be a slight possibility that an earthquake could cause a tsunami and make an impact on the valley. We wanted to get input from someone who knows the area better than we do and could give us the probability of it actually accruing. We found a solution after visiting the Tsunami Warning Center in Palmer, where we talked to Geologist Chris Popham and asked a wide variety of questions involving how big and how close an earthquake have to be in order to have a tsunami reach the Matanuska-Susitna Valley. By the end of our discussion it was quite clear that the valley would not be affected by a tsunami anytime soon. However, as Chris Popham stated “Nothing is impossible.”
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References


3D Seismic Wave Field. Figure 1 [Photograph]. Retrieved from http://srl.geoscienceworld.org/content/85/2/245/F1.large.jpg
Appendix A

1964 Alaska Earthquake

Appendix A: Graph A1
Appendix B

Appendix B: Graph 1

Appendix B: Graph 2
Appendix C

Appendix C1: 1964 Alaskan Earthquake.

Appendix C2: 1964 Niigita Japan Earthquake

Appendix C3: 2011 Honshu Japan Earthquake