

**Earthquakes in the Metro Vancouver Area: Why should one care?**

Geography 130 case study paper

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## Introduction

Metropolitan Vancouver is an area bustling with people all year long. The Government of Canada's (2016) website reports a population of 2 463 431 people, suggesting how it can be a popular area to live. Not only does it have a large population, but it is also growing every year. From 2011-2016 the population increased by 6.5 percent, and will likely continue to increase in the coming years. Vancouver is located next to the Pacific Ocean and is also beside the Fraser River running through much of British Columbia (BC). With such a large population, and a land area of 2 882.68km, it is a vulnerable area to live in if natural disasters were to hit (Government of Canada, 2021).

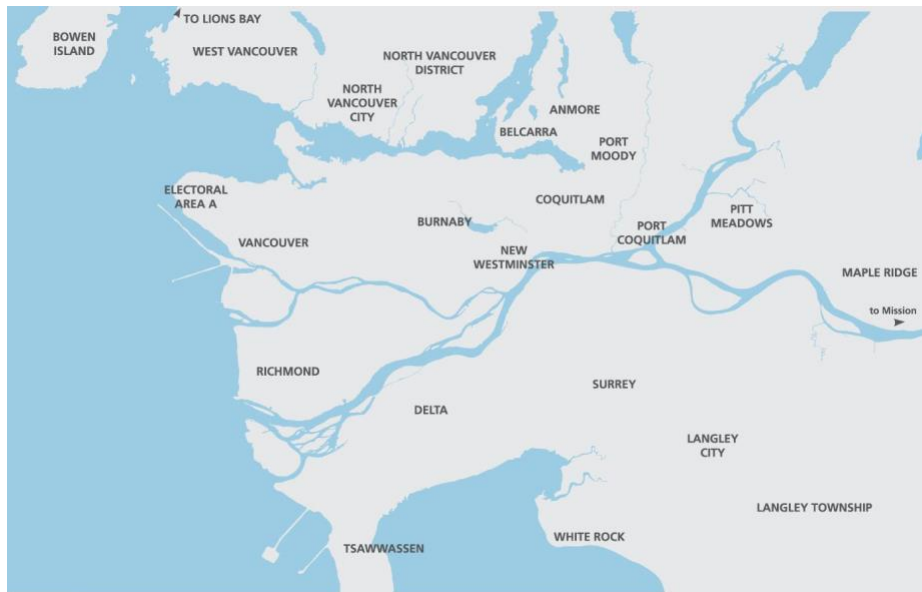
Much of Vancouver, especially downtown, is filled with tall structures located close together, creating an even larger risk. One of the major risks to Metro Vancouver is earthquakes. To quote from Bolt (2021), earthquakes are, "any sudden shaking of the ground caused by the passage of seismic waves through earths rocks". Earthquakes most commonly occur near fault lines. And since this area of BC is located right next to the Juan de Fuca plate and is near the Pacific plate and located on the North American plate, there are numerous earthquakes that occur each year. Many are smaller, but there have been a few larger ones in recent years. And with rising climate change, there is the possibility that it could affect the frequency of them in Vancouver. Therefore, this paper will discuss earthquakes in Metro Vancouver and the likelihood of climate change affecting them in various ways and possible actions to prepare for this possibility in the coming future.

## Background

Metro Vancouver extends beyond the city of Vancouver itself. It also includes 20 other municipalities (Metro Vancouver, 2021). These municipalities extend north, south, and east, and along the Fraser River. It is one of the largest metropolis' in all of Canada, making this area vulnerable if any major weather event were to occur. In Figure 1, one can see the intricate water systems and the proximity that Metro Vancouver is to the coast. Since there are many rivers and water systems between the municipalities, bridges are required, adding another layer of vulnerability to the area.

**Figure 1**

*Metro Vancouver Map*



*Note.* Metro Vancouver Map. (n.d.). *Vancouver City Planning Commission*. map. Retrieved December 3, 2021, from <http://vancouverplanning.ca/our-work/projects/rethinking-the-region/citizen-advisory-bodies-metro-vancouver/metro-vancouver-map/>.

Vancouverites are very used to a rainy climate. According to Climate Vancouver (n.d.), even in the warmer and dryer times of the year some rain will come around. It is a very wet area to live in with an average of 2351mm rain every year. The average temperature annually is also 9.5 °C (*Climate Vancouver*, n.d.). What should also be mentioned is the fact that north of Vancouver are glaciers. As climate change progresses, these glaciers are melting, which could affect earthquake activity (Alam, 2021).

Not only are there many water systems located in and around Metro Vancouver, there are also multiple tectonic plates. As mentioned in the introduction, there is the North American plate, the Juan de Fuca plate, and the Pacific plate farther west in the Pacific Ocean. In Figure 2, one can see these labeled along with the various subduction zones and crusts located near Metro Vancouver. The most important thing to note from this map is that these plates are in close proximity to Vancouver and its surrounding municipalities, suggesting the great risk of large earthquakes.

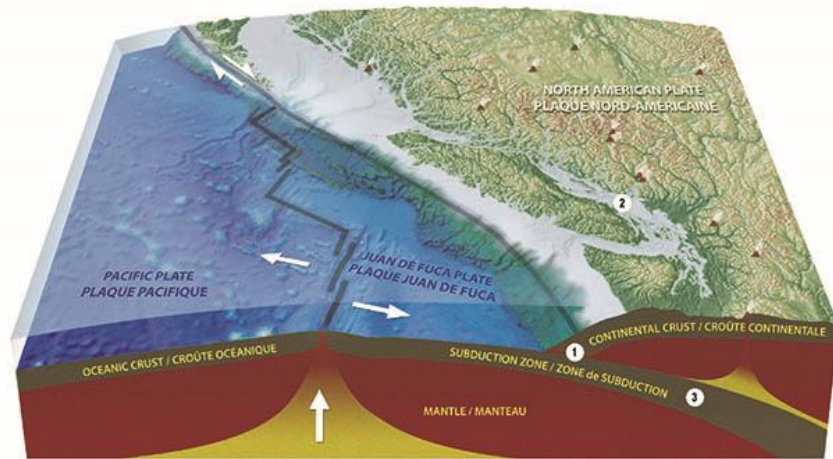
There are four different types of earthquakes. As the United Nations (n.d.) explains, there are tectonic, volcanic, collapse, and explosion earthquakes. A tectonic earthquake is one that is caused in the earth's crust because of two plates coming into contact. A volcanic earthquake is one that is caused by tectonic movement, along with volcanic activity. A collapse earthquake is generally small and happens because of rock movement or explosion on the surface that leads to underground spaces collapsing. And lastly is an explosion earthquake which occurs because of some type of explosion (*Earthquake*, n.d.). In relation to Metro Vancouver, the earthquakes that do occur are generally tectonic earthquakes due to the proximity to the plate boundaries.

Tectonic plates are a part of the earth's crust. There are multiple different types; four, to be exact. Three of these are located near the Metro Vancouver area. The Juan de Fuca plate and the Pacific plate are divergent plate boundaries. The north American plate and the Pacific plate are transform plate boundary. And there is also the Cascadia subduction zone which is where the Juan de Fuca plate and the North American plate meet and it is located west of Vancouver Island and it is a convergent plate boundary that also can affect the earthquakes and cause the earthquakes in Vancouver. These are important to note because certain types of plate boundaries have certain effects on the earthquakes. Some are more likely to cause them than others. To note on Figure 2, these three tectonic plate zones that are located near Vancouver.

As Natural Resources Canada explains (2011), a convergent boundary is two plates striking each other, or coming together. The Juan de Fuca plate and the North American plate are convergent and what happens is the Juan de Fuca plate is "subducted" under the continental plate because it is denser. West of that is the Pacific plate and the Juan de Fuca plates divergent boundary in which they essentially move away from each other creating a type of ridge. Lastly is the transform boundary that is located farther north but still near BC and that is where the Pacific plate and the North American plate slide past each other. The Pacific plate moves northwest and the North American plate, southeast. This is significant because the movements of these different plate boundaries are what causes earthquakes to occur (Natural Resources Canada, 2011).

## **Figure 2**

*Earthquake Plate Graphic*



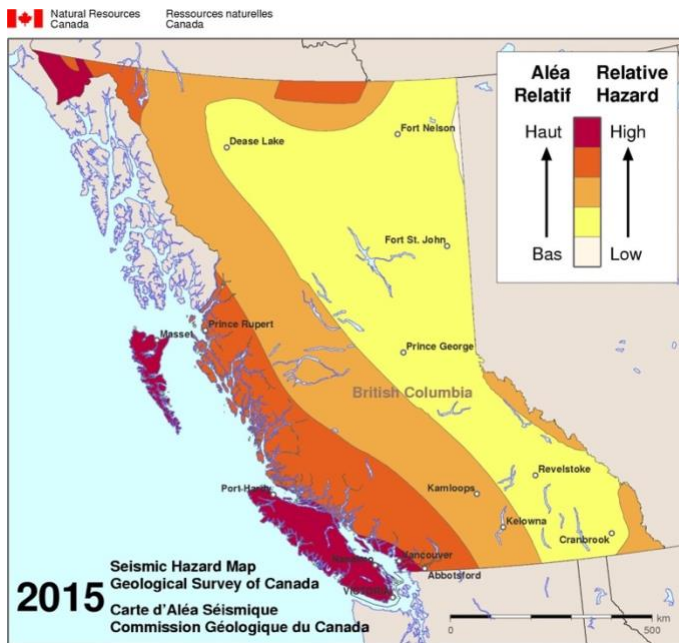
Note. Earthquake Plate Graphic . (n.d.). *City of Vancouver*. map. Retrieved December 3, 2021, from <https://vancouver.ca/home-property-development/understanding-earthquakes.aspx>.

Earthquakes are a common occurrence in Metro Vancouver. The reason for this is the proximal location to the tectonic plates. Tectonic plates are essentially what causes earthquakes since an earthquake will often occur when two plates move up against each other, causing a rupture. In figure 3, we can see the earthquake hazard map across BC, and located in the bottom left of BC is Metro Vancouver. It is depicted in a dark red colour which essentially means there is a high risk of seismic activity. This implies a high risk of vibrations due to earthquakes. In Southwest BC, there is an average of one earthquake a day (“Vancouver-earthquake”, n.d.). That does not mean that they are all large enough on the seismic meter (the way earthquakes are measured based on force) to be felt, but none the less they are very common here. As earthquakes happen every day, it might not seem unnerving to hear that climate change could affect the frequency or the damage earthquakes do. However, there is a possibility. As more research is conducted, a better understand can be established of how

exactly earthquakes are being impacted by the climate change, both presently and in the future.

**Figure 3**

*Seismic Hazard Map Geological Survey of Canada*



*Note.* Natural Resources Canada. (2021, April 6). Seismic Hazard Map Geological Survey of Canada . *Government of Canada*. map. Retrieved December 2, 2021, from <https://seismescanada.rncan.gc.ca/hazard-alea/simphaz-en.php#BC>.

To further understand earthquakes, one should understand their impacts. BCAA (2017) listed how earthquakes can lead to damage to buildings, and infrastructure, as well as cause other natural disasters like tsunamis. This would devastate the Metropolitan area of Vancouver because of its proximity to the water, as shown in Figure 1. Overall, Metro Vancouver is at a great risk of damage and loss if it were to see a large earthquake.

### Climate Change

Climate change is becoming more and more apparent in recent years. It is important to the discussion of earthquakes in that on a global scale, people are learning whether the prospect of rising temperatures affects them in anyway, such as frequency or force. It is important to first establish that in BC, specifically Metro Vancouver, the climate is becoming warmer. In a report created by Metro Vancouver (2016) that describes the climate projections of said area, it is explained that the climate will become warmer; there will be less snow, more rain, and longer heat waves in the summer, along with other extreme weather events. They have also predicted a 4.9 °C increase in the yearly temperature during the day by the 2080s (Metro Vancouver, 2016).

The Metro Vancouver report (2016) not only explains the change in temperature due to climate change but also the change in precipitation that is likely to occur. They predict that due to the increase in heat, there will be a 29% decrease in rainfall in the summer. However, in the winter they expect a 14% increase, in fall a 20% increase, and in spring a 12% increase all by the 2080s. These projections also estimate the average annual precipitation increase by the 2080s which is 11%. Now Metro Vancouver has always been a place that experiences a lot of rainfall each year. Knowing that raises the question of how that could potentially affect the people living there (metro Vancouver, 2016).

### Discussion

As illustrated, climate change is affecting Metro Vancouver and will continue to affect it in the coming future. The question now becomes why should we care? Mario Picazo from The Weather Network explains (2021), “a number of studies have indicated that climate change has acted as a trigger for several quakes”. Consequently, there is a potential correlation between



earthquakes and climate change which might be cause for concern since earthquakes are extremely damaging. Metro Vancouver is already vulnerable to earthquakes, and with the large population, a lot of people could be affected.

One should first look at the relation between climate change and temperature rise. In Metro Vancouver it is predicted that annually the temperature will rise by approximately 4.9°C by the 2080s. As the temperature is rising, BC has seen glaciers-receding. As these glaciers recede a weight is taken off the ground and as Tania Kouht of Global News (2017) writes, this change in weight can cause earthquakes, usually small ones, to occur.

One of the more convincing arguments for why or how climate change affects earthquakes is illustrated in an article written by Richard A. Lovett (2021) who explains how scientists say that heavy rainfall can cause earthquakes. The question then is how does rainfall effect earthquakes. He argues that “[t]he weight of the water itself does not trigger the earthquake --- rather it’s the ensuing erosion from landslides”(Lovett, 2021). In Metro Vancouver there is already a lot of rainfall each year, and there are many mountains surrounding it. Due to the mountainous terrain, landslides are a commonality in BC (Strouth & McDougall, 2021). Since landslides can be triggered by water, specifically rainfall, there is a likely chance that earthquakes would occur more often because of climate change, due to the increase in precipitation in the fall, winter, and spring months. Also, to point out, landslides can be caused by glaciers melting in BC. North of Metro Vancouver glaciers are melting and the water that melts from the glaciers comes down and can cause landslides. This expedited recession of the glaciers stems from increased temperatures due to climate change.

Now that a link has been created between climate change and potential for causing earthquakes, one must consider why this matters, or why should people care? In a paper written by Ventura and Schuster (1994), it is explained how about 70% of British Columbians live in the Vancouver area, illustrating how there is both a large population and high population density in the area. The paper also goes on to explain how it is likely a large earthquake will occur sometime in the future; possibly soon, and thus one can conclude that it would have devastating effects. With the added risk climate change proposes on the frequency of earthquakes, one can deduce that, because of this increase in precipitation along with other effects such as the temperature increase, a large earthquake could very well happen sooner with the impacts of climate change. Scientists predict that this earthquake has a one in five chance of coming in the next 50 years (Wagstaffe, 2016).

Although there is no way to stop an earthquake from happening since it is a natural disaster, reducing the impact that Vancouverites have on climate change could possibly slow down how soon a large earthquake may happen. Part of the way climate change is impacted by humans is through the creation of greenhouse gases used for energy. The transition towards using more sustainable and green options such as solar, nuclear, biofuels, and wind energy instead could help to decrease the amplification of climate change (Herring & Lindsey, 2021).

Another way that Metro Vancouver could prepare is by doing everything it can to try and reduce the damage that an earthquake could cause. According to The Guardian (2017), steel used for building structures actually helps to reinforce that building. They say that steel can be added to the interior or exterior of the building. Researchers found that the buildings

that used steel did a better job at protecting the structure versus a concrete building (Giles, 2017).

When comparing Vancouver to New Zealand and their preparedness for earthquakes in an article in CBC news (2021), Jenei explains the ways in which New Zealand is much more prepared for an earthquake than the people of Metro Vancouver. Even though New Zealand has many more earthquakes, some say it's safer to live there because of the precautions taken. For example, they are much more prepared in terms of knowing what to do when one does hit. Quakes are much more talked about in emergency planning and children learn about them much more there. One of the most important initiatives is making sure that buildings are up to code with earthquake standards. In Vancouver, there are many buildings researchers deem to be unsafe if an earthquake were to hit (Jenei, 2021). From all this we can gather that Metro Vancouver should consider taking more initiative in improving buildings, along with public knowledge, in the case of emergency.

Going back to the waterways in Metro Vancouver and the bridges: if a large earthquake were to occur, it is likely that these bridges would collapse or break. Thus, each municipality that is separated from each other would have to individually be prepared for an earthquake. This includes emergency responders. A suggestion for this could be making sure boats are in place to carry supplies and help from one area to another, since an earthquake is predicted to happen by scientists sooner rather than later. A director of emergency management explained to CBC News how fires are likely to break out, and the roads will be damaged along with bridges and phone communication (Wagstaffe, 2016). A large-scale earthquake would devastate Metro Vancouver, and so becoming prepared is extremely important for that Metropolitan area.

## Conclusion

This paper set out to study the effects of earthquakes in Metro Vancouver, posing the question, why is this cause for concern? People should care because there is the possibility that an earthquake's risks can be reduced by changing the human impact on climate change. This paper demonstrates how climate change alters precipitation and temperature, leading to potential landslides that could cause earthquakes. If Metro Vancouver were to put policies in place however to try and reduce their impacts on climate change, such as changing the way energy is produced by eliminating greenhouse gases, it is probable that less earthquakes could happen and allow for the municipalities to prepare better for a future quake(s). This could look like improving the structure of buildings, especially ones that are quite out of date, and creating more complex plans just in case necessary. These changes could limit the catastrophic events that this metropolitan city could face, like mass casualties and destruction.

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