FUNH5000_ESSAY 1

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1 Introduction

In our society, significant challenges present a threat to human lives and environments, such as the draining of food resources, clean water, energy supplies, unbalanced regional development, etc. Studies among these topics have been continuously investigated to improve the quality of human lives. Recently, a hot topic that floods social media is the prediction of strong earthquake in Japan at a specific date, which has already been proved to be false. However, the popularity of such a topic indicates an important fact - the lack of current ability to accurately predict the occurance of an earthquake.

In general, the earthquake alarm is usually issued to the public after it has been detected by specific institution, leaving a very short window for people to find an absolute safe method to protect themselves. This indicates that there are a lot of work for human society to take in order to prevent severe destrution from earthquakes. Luckily, researches have been conducting to track the trend and possibilities of earthquakes. In this essay, methods of "predicting" earthquakes are discussed.

2 Methods

Geographical change is one of the most important reasons of earthquake. Due to the reason of plate motion, some places on the earth are more likely to have frequent earthquakes. For example, Japan is a country that has frequent earthquakes due to its location - which is exactly at the edge of three different plates. Other places around the world have frequently earthquakes includes: Chile trench, Cascadia, Tonga-Kermadec. In these regions, mega earthquakes use to happen in a period, which may cause severe threat to human society. The similarity behind these places are the geographical structure of plate. Recently in July, there are reports of earthquake at southwest Japan almost everyday. The frequent alarm of earthquakes have put local people and tourists into fear. This is because that Japan agency has announced a high possibility to have a very strong earthquake in the next 30 years. However, the question is why it is 30 years and why is the possibility high?

The first reason of such a statement comes from statistical data. Since the energy of earthquake comes from the break of geographical plate, the stress has been accumulating all the time as long as two plates are moving towards each other. When there is a break happens, the accumulated stress is relieved until the next earthquake. This can indicate a strong earthquake trend, but is not accurate enough. As this is not a linear mathematical model.

An example is the Nankai Though earthquake, which used to occur in a period of 90-150 years (resources from the Internet).et). The reason for this earthquake is the squeeze and crash of two giant plate. And they are moving toward each other at 4-5 cm per year. The last time the Nankai Though earthquake occurred was in 1946, which is about 80 years from now.

In addition to the statistical data, there are more advanced techniques that are helpful to "predict" the occurrence of earthquakes. One method is the distance measurement using ultrasound techniques. Ultrasound techniques are widely used in our daily life, such as the rear parking assistant system of cars. Now, many ultrasound sensors are placed under water to track the movement of plates. The accuracy can be smaller than centimeters thanks to the high accuracy of the ultrasound waves. These sensors are also combined with GPS to ensure the accuracy as GPS can precisely pin the absolute location of these sensors. To enable the operation of these sensors, water-proof long battery-life power system is needed. Novel sensors can even obtain the energy from the movement of the water flow. This has ensured a continuous and uninterupted service of these sensors.

The second method is to place the pressure sensor and temperature sensor deep into the rock layers by drilling. This can provided more information of the movement of the plate. When an abnormal phenomenon occurs, actions could be taken in advance to prevent disasters.

Third method could be the utilization of big data and AI-assisted model, which is popular in recent research. The combination of various data features like the temperature, magnitude, historical data of geographical stress, may reveal the occurrence of earthquake. The model can be set to be automatically triggered when conditions are met. The development of AI-model can utilize those historical data in a more effective way compared to the traditional regression model, saving a lot of human efforts.

With such advancements in technologies, the monitoring of geographical changes can achieve the real-time feature, giving the society to take actions once abnormal signals are detected. However, the principles of earthquake still require deeper investigation.

3 After earthquake

Actually, in addition to the prediction of the earthquake, technologies are also developed to reduce the damage caused by the disasters. For example, the alarm that Japan agency is issuing include the occurrence of earthquake and the detailed threat to the human life and property. Whether there is a tsunami threat, level of the tsunami, and the regions that are affected. Big data could help to guide local people to enter the proper center for safety. The role of big data and AI model can indicate whether the current places are safe or not with enormous training taking, which is unrealistic in the past.

4 Conclusion

In this essay, we start from the introduction of one of the recent hot topics - earthquakes. Methods of monitoring and "predicting" earthquakes are introduced and discussed. The development of modern technology has improve the ability of preventing huge damage that caused by natural disasters like earthquakes. However, further investigation are still needed to completely understand the principle of the earthquakes' occurrence. Beyond the prediction of earthquakes, technology improvements also help to prevent losses at the post-disaster stage. While a disaster may not be preventable, a more efficient system could work to reduce human and property

losses. With the assistance of advanced AI models and hardware, disaster management may become more and more mature.

Advanced technology has completely transformed the earthquake response, directly enhancing social safety. Real-time sensing networks like Japan's DONET can now provide up to 50 seconds of warning time, triggering automatic shutdowns of nuclear facilities and the Shinkansen, reducing secondary disasters by about 30 percent. AI-driven building diagnostic tools, such as Tokyo's building resonance simulators, optimize the prioritization of seismic retrofitting, while satellite damage assessment accelerates rescue response by 4-6 hours. Crucially, public alert applications can synchronously push accurate evacuation routes to millions: during the 2023 Noto Peninsula earthquake, 92 percent of users received warnings before the strong tremor occurred. These innovative technologies collectively transform the seemingly inevitable vulnerability into actionable resilience, saving thousands of lives each year through scientifically guided disaster preparedness (The data comes from AI model).

5 Declarations

In this essay, AI is used for the fact check part and (historical data of earthquakes, Japan, Tonga, Cascadia, data of people that benefits from alarm and warnings).

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