Analysis on the Influence of the Climate Changes on the Global Vegetation

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Abstract. An overview of the impact of climate change on vegetation is presented in this paper. With the rapid development of industries and technologies around the world, the concentration of carbon dioxide and other contaminants in the atmosphere has increased significantly. CO2 is one of the main gases responsible for global warming. Data show the global mean temperature rose by 1.15 Celsius degree in 2019 compared with the period of pre-industrial average (1800-1900). Air warmed faster than sea water based on historical data. According to the existing research, the Northern Hemisphere is warming faster than the Southern Hemisphere, and the warming speed of the entire Arctic is the most in the world. As a result, vegetation has to adapt to the change in temperature by its phenology. Temperature stress, water stress, phenological changes, and changes in sunshine and light intensity are the main factors that impact distribution and combination of forests.

1. Introduction
The climate change brings many problems to animals and plants. Many researchers begin to study the consequence of the climate change. K. Kramer made an overview of importance of phenology for evaluation of impact of climate change on the growth of boreal, temperate and Mediterranean forests ecosystem. In this article, two main factors that lead to change of climatic seasonality: temperature and water. Phenology of vegetation is affected by climatic factors, such as the timing of frost events and the concentration of water in the soil. He concluded that trees have different response to different levels of water concentration and temperature.

This paper mainly studies the influence of external factors on global vegetation phenology. Use online data to find links between changes in vegetation distribution over the past 100 years and changes in average temperatures in certain areas and the effects of human activity.

2. Influences of climate changes on vegetation composition and its distribution
The long-term impact of climate change may be a radical change in the composition and distribution of plant communities and a dramatic change in the geographical range of plants. Theoretically, it is estimated that as temperatures rise by one 1 °C, the plant distribution will move north by 100 to 160 kilometers, and an upwards shift of each vegetation belt of about 180 m. If temperatures rise by 2 to 3°C, the forest bioclimate could move north to about 4 to 6° latitude within a century, meaning a huge average migration rate of 4 to 6 km per year or 40 to 60 km per decade[1]. Past records show that for every 1°C change in temperature, the height of the tree line moves by 100 meters. Here is an article that shows the change in tree distribution based on temperature drivers in China. The forest area has gradually decline in the northern permafrost region of northeast China with intensification of human
activities combined with climate warming. Between 1902-2002, edge of cool temperate zone forest in southern Daxinganling (Great Khingan) region moved 140 km northward. Coniferous forests’ portions had decreased from 580 million m³ to 360 million m³ during this period. The area decreased by 39.7 percent. However, broad-leaved forests’ portions had increased from 110 million m³ to 360 million m³, with an increase 26.4% [1]. In 1962, the dominant species accounted for 87.5 percent of the total number of tree species, but by 2002, the dominant species accounted for 72.2 percent of the total number of tree species. As the climate gets warmer, the island-shaped of permafrost begins to melt away. However, the forest ecosystems rely on the permafrost habitats. Therefore, forests are negatively influenced by the global warming. For example, Picea abies have declined. By using geographic information system (GIS), scientists pointed out the area of broad-leaved forests north of 51 °N increased by 500% and the northern boundary extended about 290 km northwestward [1]. Under this warm climate, the viability of seedlings and saplings has increased, which increased the upper timberline. Therefore, it could assume that warmer climate condition may lead to extinction of northern deciduous forests in China based on biogeographic model. The change in the distribution of these trees is directly caused by climate change caused by rising temperatures. However, some of the indirect effects on forests are also significant. The drought has effects on the structure, composition, and function of forests. Most scientists have begun to link more severe droughts to climate change. That is because more water evaporates from land, lakes, rivers and other bodies of water as more greenhouse gases are released into the air, causing temperatures to rise. Higher temperatures also increase evaporation from the soil, which affects plant life and can even reduce rainfall. Phenology in Mediterranean coniferous forest is mainly driven by water availability and affects leaf area development. For example, pine trees, four sets of needles were considered, and the leaf area index was based on the demand per unit ground area, the length of the needle and the width of the demand. Three aspects of pine phenology affected by drought :the formation of pincushion (year 0); needle elongation (year 1); needle drop (year 3)[3] For needle fall, high soil water deficit can shorten the time of needle drop. That means the time is advanced. As a result, several years of drought have a greater impact on growth than each year alone. Based on the phenology of forests with different species, under severe climate change conditions some species may die completely unable to adapt to the change, others can still survive enough changes may be more suitable for the conditions of regional species invasion leading to changes in forest ecosystem structure. Drought directly affects tree growth, slows or inhibits growth, and causes injury or death. It also affects them indirectly by increasing their susceptibility to wildfires, pests and diseases. Drought may be short-lived and may only last one growing season, but its impact on the health of trees-and ultimately, the impact on forests-can last longer.

Forests play an important role in maintaining the global carbon balance. In addition, forests provide rich resources for the productive activities of human society and human life. Forests also play an important role in maintaining regional climate and protecting regional ecological environment, such as preventing soil erosion. Therefore, forests play an irreplaceable role in maintaining the balance of life system on earth.

3. Solutions
The change of tree distribution and the loss of trees caused by natural disasters can be solved from two aspects. One is to solve and prevent climate change, and the other is to improve the adaptability of some phenology. Scientists and governments have tried many ways to reduce emissions of pollutants into the air since long time ago. The Clean air act (1970) is a comprehensive Federal law that regulates all sources of air emissions. As is shown in the chart, consumption of sub-bituminous coal increased significantly after 1970. Sub-bituminous coal is low rank coal, it is less pollutant to air than high rank of coal, like bituminous. It produces less carbon dioxide into the air, which is a major gas contributing to the greenhouse effect. Another solution is to reduce the use of fossil fuels. As the chart above below, from 1970 to 2018, fossil fuels accounted for a significant portion of U.S. energy consumption. (from epa.com). Fossil fuels are another major cause of climate change. Although fossil fuels are much less polluting than coal, they are still a major contributor to climate change. Eliminating the use of fossil
fuels is the solution to reducing the greenhouse effect, but it is also a very challenging approach. People are used to using fossil fuels on a daily basis, and as far as technology is concerned, we can't live without them.

3.1. Reduce human activity
Human activity may be the most important impact on a forest's ability to maintain its pristine biodiversity. Commercial and manual logging, large-scale land conversion, fuelwood and charcoal production, slash-and-burn agriculture, harvesting of non-timber forest products, hunting and mining all affect forest biodiversity. As cities expand, the remaining forest area is shrinking rapidly. In order to
protect the forest system, human activities should be regulated by the government, and the awareness of individuals to protect the environment should be raised. Energy conservation and emission reduction is a slogan in China. Most citizens will choose to take the subway, bus or walk to where they want to go. And cars are regulated to drive by the last digit of plate number of each car in some cities during a week. These behaviors have greatly reduced the pollutants emitted by private cars. All of these actions can help slow climate change. As a result, the diversity and distribution of forests will be protected.

3.2. Increase the adaptability of forest system
The solution is to change the phenology of some species. One reason for the change in forest distribution is the inadaptability of primitive areas. The original conditions did not allow them to continue to grow there. This is because some trees have not adapted to the new temperatures or precipitation. What if scientists could use current technology to alter phenology? People can provide temperate conditions for the growth of small areas of the entire forest system. Then, gradually change the surrounding conditions, and finally, as on the outside, let the tree adjust itself in sufficient time. After this, this new type of tree is developed, but with a similar appearance and function as before. Or people can use grafting to give a species another specific trait to speed up adaptation. Allow trees to finish adapting for climate change within limiting time.

4. Conclusion
Through the above analysis of the impact of climate change on forests, it can be concluded that the climate change will lead to significant changes in forest distribution. While the paper looked at the effects of climate change, it did not look at every particular species or forest. Because each type of ecosystem contains many species, the ability to adapt to climate change is different, even though these species live in the same climate. In terms of improving research, it is necessary to continue research on the impact of climate on specific types of forests. For example, by studying the impact of climate change on forest ecosystems, it can be seen that the main factors affecting climate change are temperature and water. The solution is to stop unnatural climate change. This paper mainly puts forward Suggestions on reducing human activities, coping with climate change, protecting forest ecological balance and so on. The future will combine new technologies, such as monitoring weather changes and new patterns of tree distribution, to provide better solutions for forest ecosystems to cope with climate change.

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Reference
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