

Research Status and Progress on the Relationship Between Climate Change and Ambient Air Quality

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Abstract: With the acceleration of the overall development of China's industry, the amount of industrial exhaust gas, wastewater, heat, and automobile exhaust gas is increasing, and environmental pollution issues are gradually emerging. This study aims to shed light on the environmental protection industry by briefly analyzing the impact of current international and domestic climate change on human society, and analyzing it from both outdoor and indoor perspectives.

Keywords: Climate Change; Air Quality; Impact Relationship

Introduction

Since the Industrial Revolution, with the changes in human lifestyles, the content of long-lived greenhouse gases such as CO₂, N₂O, and CH₄ has significantly increased in the atmosphere, which has had a certain impact on the global climate. With the development of transportation, the emission of harmful gases from motor vehicle exhaust has also increased, causing a significant impact on the atmospheric environment. There are also particles in the air formed by the combustion of fossil fuels. It can absorb and scatter sunlight, and block sunlight from reaching the surface. The quality of ambient air is closely related to climate change, which has a certain impact on indoor and outdoor air quality, and also has a certain relationship with people's physical and mental health.

1. Research status of the interaction between ambient air quality and climate change

In essence, overall air quality is not only determined by local air pollution, but also closely related to regional and even global climate change. For example, due to global warming, mid latitude cyclones have moved northward, wind speeds have decreased, and the frequency of tropical cyclones has decreased, leading to increasingly serious regional air pollution issues. In recent years, the research on air pollution in China has gradually entered people's attention, and the research on its severe problems is still in the preliminary exploration stage. For example, regional tropospheric ozone, particulate pollution phenomena, climate change, and especially the impact of tropospheric ozone have a very wide range and significant random characteristics^[1]. In the context of increasingly serious global climate change, the emissions of environmental pollution have been significantly reduced compared to the past. Therefore, it is necessary to understand the impact of climate change on environmental pollution, regional environmental quality, regional environmental quality, and regional impact. In addition, as climate change may have a certain impact on the quality of the atmospheric environment and even public health, real-time monitoring of air pollution is particularly important.

2. Ozone layer and its precursors

Studies have shown that the formation of O₃ is closely related to the formation of its precursors. Many cities in China are still located in the "VOCs control zone" or "transition zone" of O₃, while most rural areas are still located in the "control zone" of NO₃. Previous studies have found that the rise in atmospheric temperature due to climate change will to some extent lead to an increase in VOCs emissions in the region, while high temperature and humidity weather is more prone to lightning strikes, leading to an increase in NO_x generation [2]. Therefore, in the context of global warming, global warming will likely increase the pre ozone content in the atmosphere, resulting in an increase in surface ozone content. When the ozone content in the air is high, it will increase the probability of patients suffering from chronic respiratory and cardiovascular diseases, thereby affecting their immunity. Climate change has different impacts on local surface temperature, precipitation frequency, atmospheric circulation, and surface solar radiation. Especially in summer, these factors have a significant adverse impact on urban air quality. In autumn, as the intensity of sunlight increases, local precipitation decreases, which can also have a negative impact on the local atmospheric environment. Air quality largely depends on weather conditions, and therefore is easily affected by climate. At the same time, with the decrease in global circulation intensity, the weakening of mid latitude cyclone activity, and the instability of future wind fields, these are the main reasons for the increase in pollutant content. Some scholars have found through model analysis that in the next 10 years, the global atmospheric O₃ concentration will increase by 1-10 pp. Urban areas are the areas with the most severe atmospheric O₃ pollution. Such climate impacts require the control of pollution emission density to meet a specific atmospheric quality standard. Due to the presence of O₃ in the atmosphere, the O₃ background content in the atmosphere is relatively low, so there is a certain difference between the pollution level of O₃ and the sensitivity of the background.

3. Inhalable particles in the air

Compared to the ozone layer, climate change has a greater impact on particles in the air and is more random. The results show that there is a significant random effect on the content of atmospheric fine particles, with the greatest impact on the content of atmospheric fine particles and the greatest impact on the content of atmospheric fine particles. The existing research results show that after 10 years, the content of fine particles in the atmosphere will change from -1.1-0.9 mg/m³, and natural forest fires caused by warming are also a major source of atmospheric pollution [3]. Particles in the air are aerosols in the air, and they are also particles in the air. Atmospheric particulate matter is a mixture of liquid and solid substances. Its origins include both the direct release of some particulate matter and the indirect generation of some particulate matter. Under suitable circumstances, such particles may be released millions of kilometers away from their source, causing atmospheric pollution. Suspended particles can improve the utilization of sunlight and warm the atmosphere. Among them, sulfide can generate acid rain in the atmosphere, seriously endangering the soil and ecological environment.

4. Transmission of air pollution

Previous studies have shown that the long-range transport and deposition of Asian sourced aerosols through the Pacific Ocean has had a certain impact on the surface air quality in the United States. However, in East Asia, apart from Japan, the long-distance transmission of other anthropogenic aerosols (including carbon sources, sulfates, etc.) and dust aerosols (including dust) has an important impact on the atmospheric environment in Japan. Although Asia is dominated by sand and dust, less than 15% of PM₁₀ is transmitted to Taiwan over long distances in winter and spring. Under the action of strong winter winds, the passage of cold air from the northeast through the atmosphere is an important reason for the long-distance transmission of pollution. It is estimated that in the northern and eastern regions of Taiwan, the contribution rate of long-distance transmission to PM₁₀ is around 30 micrograms/m³, but in the western region of Taiwan, it is relatively small.

Therefore, under climatic conditions, long-distance transmission of pollutants in the air is possible, but the transmission effect is relatively weak. At the same time, due to the impact of climate change, the wind intensity in some regions has decreased, and the number of stops in the weather system has increased, which has weakened the long-distance transmission of pollutants in the air, thereby exacerbating pollution in local areas. Some studies have shown that in China, the release of atmospheric aerosols is an important factor leading to a decrease in wind speed in this area. As the intensity of the East Asian monsoon decreases, the transport and diffusion of pollutants in China will be affected to a certain extent, which will affect the air quality in China. Therefore, the increase in particulate matter such as sulfate and black carbon generated by human activities will not only have a direct impact on atmospheric pollution, but also provide favorable conditions for the formation of pollution by changing the morphology of the atmosphere.

5. Relationship between indoor air quality and climate change

The impact of climate change on indoor air quality and on public health. The summary is as follows: (1) Due to climate change, the concentration of O₃ in outdoor air increases, resulting in an increase in the concentration of O₃ in indoor air. However, indoors, O₃ can easily react with terpenoids in perfume, detergents, and VOCs produced in carpets, coatings, etc. to form toxic substances. This product may contain fine particles, formaldehyde, and other aldehydes (such as acrolein). With the continuous rise of ozone in the atmosphere, the accumulation of these toxic substances will cause potential harm to human health; (2) Due to changes in the weather, indoor temperatures rise, making VOCs and SVOCs in indoor carpets, paints, cleaning agents, and other components more volatile, which can also cause harm to people after inhalation; (3) Due to changes in weather, changes in air flow have resulted in the accumulation of indoor pollutants; (4) Due to changes in the weather, indoor humidity has increased, resulting in a large number of indoor mold, mosquitoes, and other reproduction, resulting in an increase in allergens in the indoor air, leading to a variety of human allergic and respiratory diseases; (5) Due to the increasing number of extreme weather phenomena such as floods caused by climate change, people often build temporary shelters to avoid such disasters. However, the content of formaldehyde, VOCs, and other components in such shelters is high, and the exposure to people will also increase; (6) Due to the increase in extreme weather phenomena such as high temperature weather caused by global warming, the use of indoor air conditioning devices is increasing, resulting in a large amount of greenhouse gas emissions, and entering a "global warming" cycle.

6. Conclusion

Through a comprehensive analysis of relevant research at home and abroad, we can see that under different climatic conditions, the content of ozone and its precursors in the atmosphere will significantly change, while also causing an increase in the content of particulate matter, resulting in greater adverse effects on air quality. Therefore, Chinese scholars must strengthen the research on climate change and environmental air quality, in order to create a suitable environment for people to live in.

References

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