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Report on climate and climate change on the East Coast of the United States

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Abstract. In the context of global climate change such as rising sea level, rising temperature, and increasing greenhouse gas emissions, according to the climate change of the East Coast of the United States in recent years, the report analyzes the current impact and future trends of four cases on the East Coast of the United States through relevant data and models: The damage scale of Atlantic hurricanes increases year by year, with increased vertical growth and carbon sequestration capacity of coastal wetlands, increased Vibrio vulnificus infection, and increased flood disasters. The relationship between human activities and climate change cases is explored. In the end, different specific recommendations are made based on the four major climate change phenomena on the East coast of the United States. And put forward the "forest vegetation restoration" plan, hoping to adjust the negative impact of climate change in the region through this plan.

Keywords: Hurricane disasters, coastal wetlands, bacterial infections, floods.

1. Introduction

Global temperature rise, global sea level rise, and massive greenhouse gas emissions are three representative climate changes that have occurred in recent years. At the same time, global climate change has also greatly affected the climate of the East Coast of the United States, directly or indirectly leading to climate change in this region. Four representative climate change phenomena are summarized, including hurricane intensity, coastal wetlands, bacterial infections, and flooding.

For the above four climate changes on the East Coast of the United States, scholars put forward the following research viewpoints based on climate data and professional climate model analysis. Studies have shown that there has been increased destruction associated with Atlantic hurricanes in the past few decades. Therefore, how human activity may contribute to hurricane intensity change in the future, particularly landfalling hurricanes, is an extremely urgent question for society at large [1].In the future scenarios of carbon emissions, the overall carbon accumulation rate will show an upward trend. This result indicates that the carbon sequestration capacity of coastal wetlands has a significant negative feedback effect on climate change, thereby mitigating climate change [2]. Climate change will have a significant impact on the distribution and number of Vibrio vulnificus infections in the eastern United States [3].

With the projected increase in coastal populations, it is clear that flood risk is a growing problem, and that coastal flood hazards will increase in the coming decades [4].

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This paper explores the causes and effects of four representative climate phenomena on the East Coast of the United States, and their relations and effects with human activities in the climate change environment. This paper analyzes these climate phenomena and their causes and effects through models and data. These studies have helped to identify and initially understand climate changes along the East Coast of the United States and their relationship to human activities, so that people can better respond to them.

2. International climate change background

The Earth's average temperature rise per decade has escalated from 0.11°F (0.06 °C) between 1850 and 1982 to 0.36°F (0.20 °C) currently. All ten of the warmest years on record have transpired within the last decade (2014-2023). Given the wide expanse of the Earth's seas and their substantial heat retention capacity, a considerable quantity of heat must be absorbed or released to effect a notable alteration in the global average yearly temperature. Nonetheless, average global temperatures have increased by approximately 2 degrees Fahrenheit (1 degree Celsius). The average temperature rise since the industrial era (about between 1850 and 1900, as per the National Oceanic and Atmospheric Administration) may seem minimal, although it signifies a substantial accumulation of additional heat on Earth.

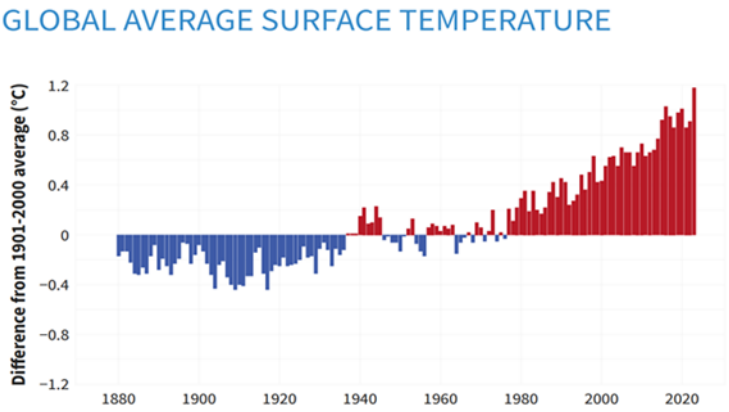

Figure 1. Global Average Surface Temperature [5]

In 2023, according to satellite records, global sea levels have reached their highest point since 1993. In the decade from 2014 to 2023, the rate of sea level rise is more than twice as fast as the previous decade's record [5] .

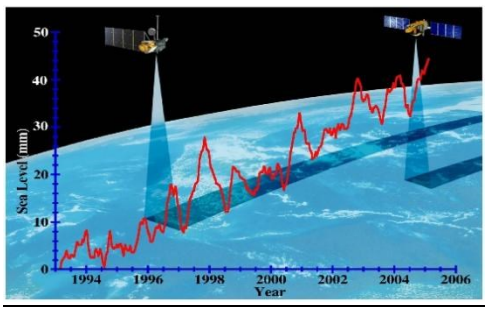

Figure 2. GMSL [6]

The observed concentrations of the three main greenhouse gases reached record levels in 2022. In 2022, fluorinated gas emissions grew by 5.5%, followed by methane at 1.8% and nitrous oxide at 0.9%. By 2023, concentrations will continue to rise. Carbon dioxide levels are 50 percent higher than in pre-industrial times [7].

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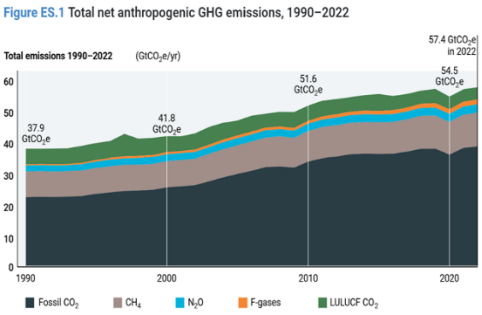

Figure 3. Total net anthropogenic GHG emission,1990-220 [7]

3. Climate conditions on the East Coast of the United States

3.1. Increased Hurricane Disasters in the United States

The Atlantic coast of the United States has become a breeding ground for super-strong hurricanes. Studies have shown that there has been increased destruction associated with Atlantic hurricanes in the past few decades. How human activity may contribute to hurricane intensity change in the future, particularly landfalling hurricanes, is thus an extremely urgent question for society at large. A new concept, vertical wind shear (VWS): The ocean and atmosphere in the North Atlantic are coupled through a feedback mechanism that excites a dipole pattern in VWS, a metric that strongly controls Atlantic hurricanes. In other words, the VWS protection mechanism can effectively limit the intensity of hurricanes, and greenhouse gas emissions will erode the VWS mechanism, thereby indirectly increasing the intensity of hurricanes.

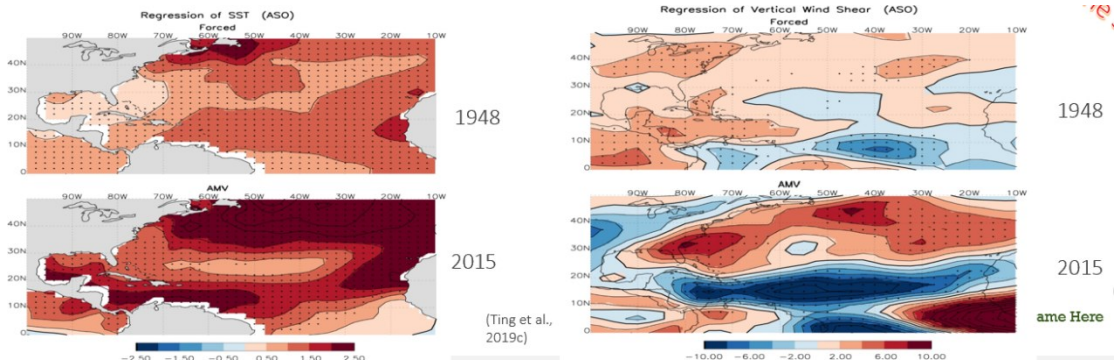

Figure 4. Regression of SST & Regression of Vertical Wind Shear [1]

The dark red areas on the left reflect rising greenhouse gas emissions. The blue areas on the right reflect the increased intensity of hurricanes [1].

3.2. The increase of vertical height and carbon sequestration capacity of coastal wetland

In the future scenarios of carbon emissions, the overall carbon accumulation rate will show an upward trend. This result indicates that the carbon sequestration capacity of coastal wetlands has a significant negative feedback effect on climate change, thereby mitigating climate change. Overall, the sedimentation rate of these coastal wetlands increases with the rise of sea level. The average carbon sequestration rate of coastal wetlands is about 162 gCm-2yr-1, which makes the wetland rise year by year in the vertical direction, and can largely offset the impact of sea level rise [2,8].

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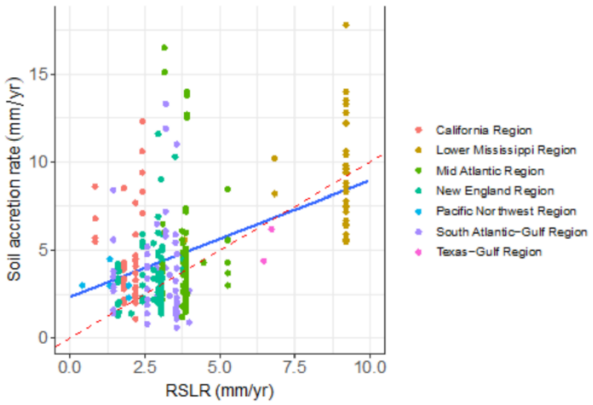

Figure 5. Relationship between sea level rise rate and coastal wetland sedimentation rate [2]

However, the buffer capacity of coastal wetlands exists within a certain range of climate change. When the sea level continues to rise and breaks through a certain critical value, this balance will be broken, perhaps leading to a new equilibrium, but more likely, the wetland will suffer permanent damage.

3.3. The increase of Vibrio vulnificus infection

Climate change will have a significant impact on the distribution and number of Vibrio vulnificus infections in the eastern United States. Vibrio vulnificus is a bacterial pathogen found in warm, low-salinity waters. Wound infections from seawater exposure are rare but have a high mortality rate. Between 1988 and 2018, Vibrio vulnificus wound infections increased eightfold in the eastern United States. Climate change will have a significant impact on the distribution and number of Vibrio vulnificus infections in the eastern United States. Changes in meteorological conditions such as temperature and precipitation affect SST, salinity, and seawater temperature, which can affect Vibrio vulnificus, possibly due to warming coastal waters and changes in salinity that favor the presence of the bacteria. Climate change has also affected human activities, especially increased recreational activities in coastal areas, which have also increased vibrio infections [3].

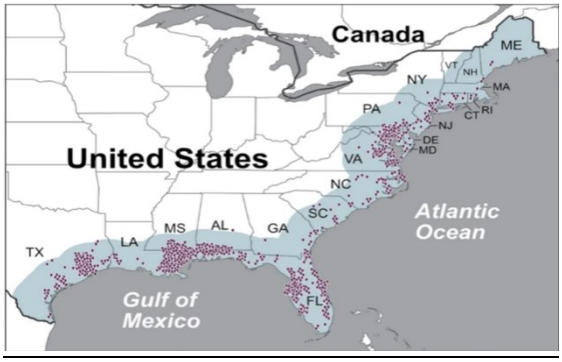

Figure 6. Distribution of Vibrio vulnificus infections in 2018 [3]

3.4. The increase in flooding

With the projected increase in coastal populations, it is clear that flood risk is a growing problem and that coastal flood hazards will increase in the coming decades. By the end of the century, given SLR projections, coastal flood hazards are likely to increase substantially, and the annual probability of exceeding 100-year floods could increase seven-fold across all study areas. There is no doubt that the rise of sea level, the intensification of extreme weather such as hurricanes in coastal areas, the increase of precipitation, and the subsidence of urban ground in coastal areas caused by human activities have all led to a significant increase in the frequency and intensity of flood disasters [4].

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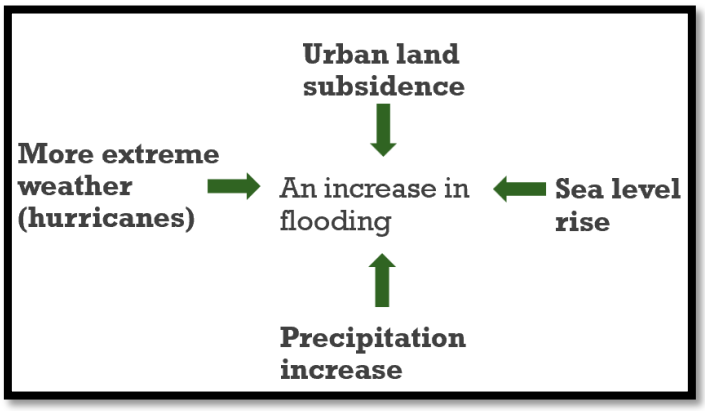

Figure 7. Causes of flood disaster

4. Suggestions

The impact of climate change on people cannot be ignored, in the face of increasingly severe forms, human nature cannot sit still.

This paper proposes some specific solutions to these climate phenomena caused by climate change on the East Coast of the United States.

Hurricane risk management involves utilizing climate models to predict potential changes in future hurricane activity, while also strengthening building codes to ensure both new and existing structures can withstand severe storms. In parallel, coastal wetland conservation and restoration are crucial, emphasizing the protection of existing wetlands to prevent loss from development activities, as well as restoring degraded wetlands to enhance their ecosystem services. Additionally, preventing and controlling Vibrio vulnificus infections requires robust water quality monitoring, particularly following hurricanes, to promptly detect contamination and implement measures to mitigate it. Public awareness campaigns are essential to discourage activities in polluted waters, especially for those with wounds. Effective flood disaster response includes improving urban drainage systems, incorporating green infrastructure like rain gardens and permeable paving, and enhancing the capacity for surface water infiltration and storage. A comprehensive approach to climate change also highlights the importance of forest restoration as a beneficial strategy.

Increased hurricane damage significantly impacts forest structure and function, resulting in reduced leaf area, decreased biomass, and plant mortality. However, implementing forest vegetation restoration can accelerate the phenological recovery of the forest, allowing for a restoration of the ecosystem's physiological functions to pre-hurricane levels. This recovery not only helps the forest regain its vitality but also contributes to overall ecosystem resilience. Studies have shown that the first summer after a hurricane, the physiological function of the ecosystem begins to recover, which corresponds to a recovery in the length of the growing season. In addition, the restoration of forest vegetation can improve the resilience of forests to hurricanes and reduce the damage caused by future hurricanes [9].

Vertical growth and increased carbon sequestration capacity of coastal wetlands: coastal wetlands are important carbon sinks with strong carbon sequestration capacity. By restoring and protecting coastal wetlands, their carbon sequestration capacity can be enhanced to combat climate change. Studies have shown that the carbon sequestration rate of coastal wetlands is much higher than that of terrestrial forests, 15 times that of terrestrial ecosystems and 50 times that of Marine ecosystems Therefore, forest restoration programes should include the protection and restoration of coastal wetlands to improve their carbon storage capacity [10].

The rise in Vibrio vulnificus infections, a pathogen associated with seawater pollution, is likely linked to rising sea levels and coastal flooding driven by climate change. Forest restoration can indirectly mitigate the risk of these infections by reducing soil erosion and improving water quality. Additionally, increased flooding, often a result of extreme weather events associated with climate change, poses

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significant challenges. However, forest restoration plays a crucial role in this context by enhancing soil permeability and water storage capacity, which helps reduce surface runoff. Furthermore, restored forests can serve as natural flood barriers, lessening the impact of flooding on coastal communities and contributing to overall resilience against climate-related challenges.

In summary, forest vegetation restoration programs can not only directly improve the resilience and carbon sequestration capacity of ecosystems, but also indirectly reduce the impact of natural disasters such as hurricanes and floods, and combat the challenges brought by climate change. Through scientific and rational forest management and restoration measures, we can be effectively improved and regulated by the climate change problem on the East coast of the United States.

5. Conclusion

This study has an overview of climate change on the East Coast of the United States. The Earth's temperature is rising, greenhouse gas levels are at record highs, and sea levels are rising. For the East Coast of the United States, the threat of extreme hurricanes, bacterial infections and flooding is a serious concern. However, the situation is not entirely negative. This research also examines notable aspects, like coastal wetlands' difficulties in adapting to increased tides. Human activities impact climate change. Conversely, climatic change also impacts human activities.

Several recommendations have been proposed; nevertheless, there is a deficiency in comprehension about the present measures enacted by local government agencies and the public, as well as an understanding of local regulations. These recommendations remain theoretical, lacking viability, offering only potential pathways that cannot be immediately implemented in practice.

In the future, combined with the current characteristics of The Times, future studies can further refine the climate model to ensure that more detailed meteorological data and the prediction and analysis of some climate phenomena can be obtained. Interdisciplinary research and the application of interdisciplinary knowledge can be strengthened in the designation of countermeasures. Some new technological innovations should also be applied in operations, including some exploring new technologies such as drone monitoring, remote sensing technology, and the application of artificial intelligence and machine learning in climate adaptation and disaster management. So that the climate change, from data collection and analysis to response decision-making, to program implementation, and finally to the presentation of effects, can be modernized, precise, and scientific.

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