

## **River Flooding due to Climate Change**

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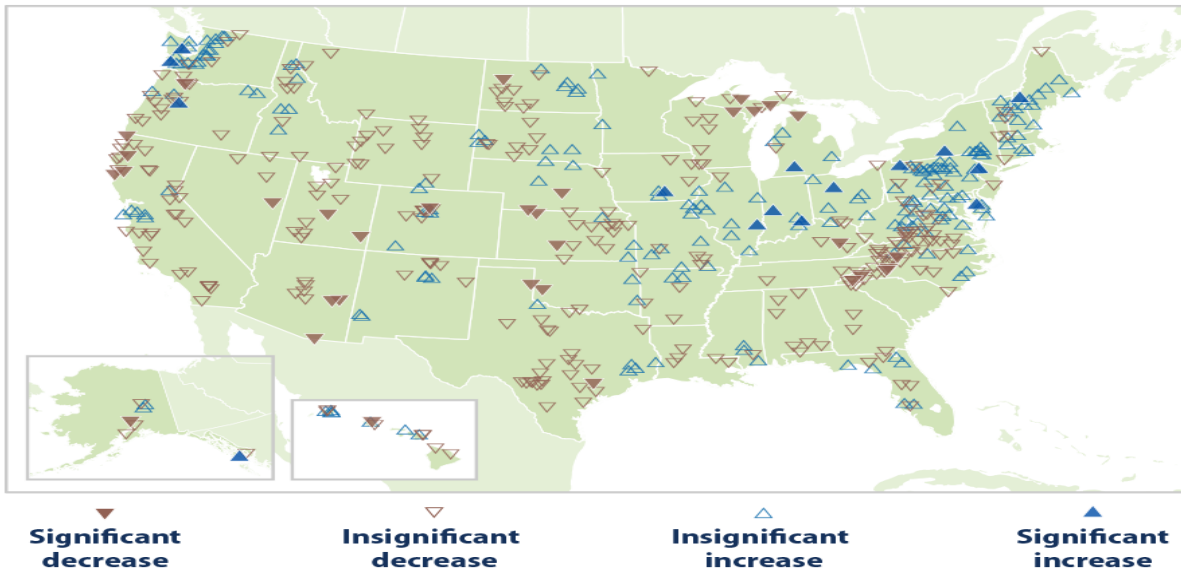
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## **The Effects and Causes of River Flooding in the United States**

Severe weather has been evident in many places, causing many damages like river flooding, heavy precipitation, and tropical cyclones. One form of severe weather that has strongly impacted human life throughout the world, especially in places with more water and streams, is river flooding. As shown in Figure 1 below, the most significant increase in the magnitude of river flooding is near coastal areas where water and more people reside and near rivers and streams. River flooding happens when a river overflows its natural banks and dry land caused by heavy rainfall, ice jams and rapid snow melting (Denchak, 2019). River flooding can have many powerful and destructive impacts on people and homes as well as their daily usage of water and electricity. They are known to have caused damage and destruction to every state in America. Human activities such as building of dams, agriculture, and changes in land use all contribute to the increasing likelihood of river flooding and its aftermath (Slater & Villarini, 2016). Other causes of river flooding in the United States include the increasing amount of greenhouse gasses in the atmosphere due to human activities which would increase the damages caused by river flooding throughout the years and would increase more in the coming years. Also, as temperature gets warmer, which happens mostly due to human activities, it causes more water to evaporate. Even though flooding may seem natural to many people, climate change can have a powerful impact on the intensity of damage caused by river flooding. River flooding is primarily caused by climate change such as warmer temperature, greenhouse gasses, and human activities.

### **Figure 1**

Change in the Magnitude of River Flooding in the United States, 1965–2015



Note. This figure shows the changes in size of flooding in rivers and streams in the United States between 1965 and 2015. The blue upward symbols show places where the flood is larger and the brown shows where they became smaller. The solid symbols represent a meaningful change.

Slater, & Villarini. (2016, August 1). Climate Change Indicators: River Flooding | US EPA. EPA.

Retrieved November 13, 2022, from

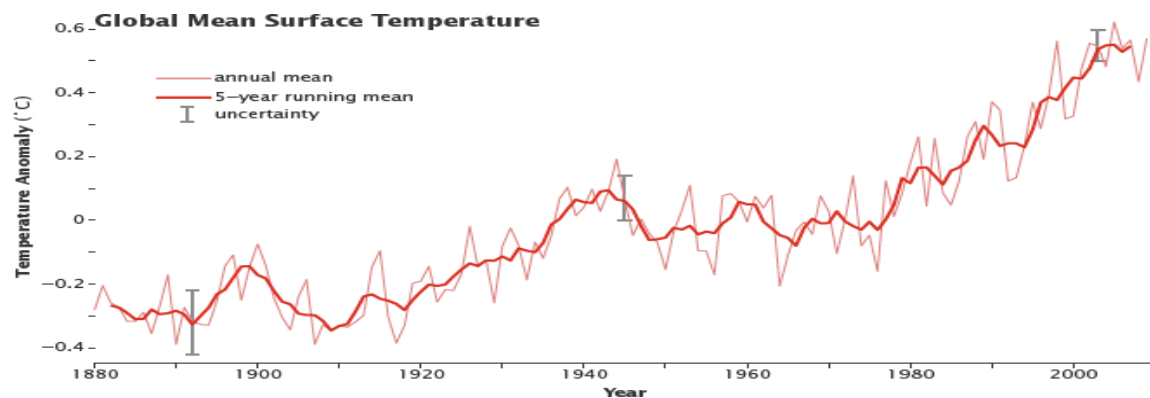
<https://www.epa.gov/climate-indicators/climate-change-indicators-river-flooding>

What is Global Warming and its Relationship to River Flooding? Out of the many causes for the increasing likelihood of river flooding events, global warming is believed to be one of the most dangerous and most contributing causes to river flooding. Global warming is defined as the unusual rapid increase in the average temperature of the earth due to factors such as the burning of fossil fuels by humans that increases the greenhouse gasses released (Riebeek, 2010). As the average temperature of Earth increases, it

causes more water to evaporate from the oceans and seas. The higher the temperature is, and the more water evaporating, the higher its effect on the size and frequency of natural disasters like river flooding and heavy precipitation. Since the 1880s, the average annual temperature has been rising each year throughout the globe (see Figure 2). Global warming is not only affecting the Earth's climate, but it is also affecting the sea level. As the temperature gets warmer and more ice melts, sea levels increase leading to more intense and frequent floods especially around oceans and seas which are occupied by around 10 percent of the world's population. Studies have shown that between 1870 and 2000, sea level was rising at an average of 1.7 millimeters (about 0.07 in) each year. However, since 1993, average sea level has been accelerating, averaging 3 millimeters (about 0.12 in) each year up until 2009 (Riebeek, 2010). In the United States alone, floodplains are expected to grow by about 45 percent by the end of the century because of sea level rise due to global warming (Denchak, 2019). As warmer temperature moves more water vapor, atmospheric rivers (AR) are intensified, increasing the damage caused by river flooding.

**Figure 2**

Global Annual Average Temperature, 1880-2010



Note. This graph shows two lines. The light line is for the average mean yearly and the darker line is for the average of 5 years. The graphs show an overall increasing pattern of average

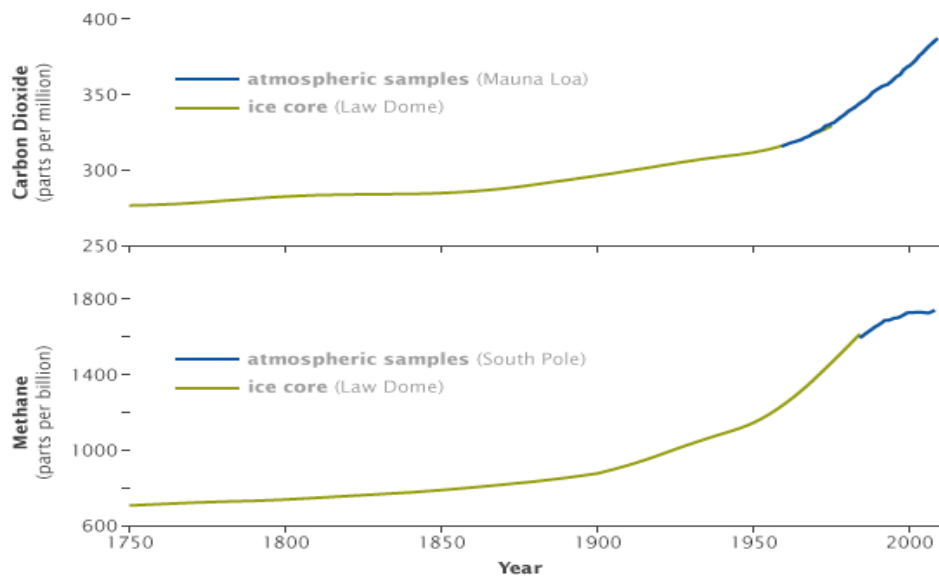
temperature from the 1880s through the early 21st century. Riebeek, H. (2010, June 3). Global Warming. NASA Earth Observatory. Retrieved November 13, 2022, from <https://earthobservatory.nasa.gov/features/GlobalWarming>

### **The Role of Greenhouse Gasses in River Flooding**

Not only global warming, but the amount of greenhouse gasses (GHG) in the atmosphere has a powerful impact on the intensity and frequency of river floods that take place. One of the most perceived causes of the increasing amount of greenhouse gasses in the atmosphere is the burning of fossil fuels. Studies of future greenhouse gas concentration have shown that even if the amount of greenhouse gasses is reduced, it is believed that temperature will rise between 2 °C and 6 °C by the end of the 21st century due to the environmental changes that have already taken place (Riebeek, 2010). As shown in Figure 3 below, the concentration of some of the most effective greenhouse gasses (GHG), methane and carbon dioxide have been increasing exponentially. The concentration of carbon dioxide in the atmosphere increased from around 275 parts per million (ppm) in the 1750s to around 400 parts per million (ppm) in the early 2000s. As the concentration of greenhouse gasses in the atmosphere increases, the average temperature increases in the earth's surface and the troposphere causing more water to evaporate and accelerate the planet's hydrologic cycle (Manabe, 2019, p. 1). Even though temperature increases throughout the Earth's surface, warming tends to be stronger in regional areas, the northern hemisphere, and not in water areas which affects the precipitation and evaporation distribution over the surface of the Earth. Water-rich regions tend to have more precipitation and water discharge which affects the frequency and intensity of flooding. Therefore, global warming is primarily caused by the rapid increase in concentration of greenhouse gasses in the atmosphere.

**Figure 3**

Concentration of greenhouse gasses (GHG) from 1750 to 2000



Note. Both line graphs show the concentration of greenhouse gasses (GHG) in parts per million (ppm) from the 1750s until 2000. Riebeek, H. (2010, June 3). Global Warming. NASA Earth Observatory. Retrieved November 13, 2022, from

<https://earthobservatory.nasa.gov/features/GlobalWarming>

### **Effects of Increased Urbanization**

Even though global warming and concentration of greenhouse gasses in the atmosphere may seem natural and out of human hand, there are many human activities that can have a powerful impact on the intensity and frequency of river flooding. One of the main human activities that affect the climate is urbanization. Increased urbanization causes the natural drainage system leading to more homes being built on floodplains (Denchak, 2019). Another example of human



activity that leads to more frequent flooding is how waterways such as dams, levees, and reservoirs are managed. As mentioned earlier, river flooding happens when rivers overflow its natural banks and dry land. As more vegetation is removed and drainage networks are built, rainfall and snow melting will run more to streams (Konrad, 2016). As more buildings and roads are constructed in flood-prone areas, they are exposed to an increasing flood-hazard like inundation and erosion. Because of the limitation of places for water to run to, as more rainfall takes place and the more snow melting happens, the more likely for flooding to take place and be worse in certain areas. Therefore, as developments in the world take place, one of its common consequences are increased peak discharge and frequency of floods.

### **Conclusion**

All the indicators and reasons that could lead to an increase in the frequency and intensity of river flooding in the United States and around the world show a negative pattern since global warming seems to only increase throughout the years and the concentration of greenhouse gasses is also increasing due to different human activities. One thing for sure, is that everybody is affected by the floods; students and teachers that use the train or even vehicles to get to schools will definitely be affected. However, there are some actions that could reduce the risk of frequent and more intense river flooding in the United States. These solutions include limiting climate change and the factors that contribute to its rapid changes. According to Denchak (2019), “As the IPCC has made explicitly clear, limiting global average temperature rise to within 1.5 degrees this century will be critical to limiting many future weather extremes, including those that most contribute to flooding, such as heavy rainfall.” Even though entirely preventing river flooding could be almost impossible, actions such as building new safer homes and public buildings and green infrastructure could have a significant impact on increasing flooding resiliency.

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