Flooding in the Mississippi Embayment - St. Louis, Missouri

Large Banner (300 words) – 301 words

Known for its baseball and the famous Gateway Arch, **St. Louis** in Missouri is located at the confluence of the Mississippi and Missouri Rivers. It is also at the geographic center of the United States.

The Mississippi River is the largest river in North America, originating in Minnesota and ending in the Gulf of Mexico. Bodies of water from 31 contiguous states drain into the Mississippi. It is also one of the most engineered rivers in the world. The Missouri River which originates in the Rocky Mountains, is the longest tributary of the Mississippi River and the second longest river in the United States.

The intermingling of warm and moist air from the Gulf of Mexico, and the cold air mass originating from Canada, gives rise to severe storms, often accompanied by hail and damaging winds, and tornadoes. Normally, St. Louis receives an average annual precipitation of about 34 inches - most of which is experienced in the spring months of March through May.

In the recent years however, **climate change** has drastically altered the rainfall pattern, in not just St. Louis, Missouri area, but the entire Midwest. A warmer atmosphere holds more water vapor. Recent storms along the Mississippi River have been supercharged by running over a warmer ocean and through an atmosphere made wetter by global warming. This has increased both, the frequency and magnitude of floods on the Mississippi in the past 150 years.

According to the most recent National Climate Assessment, the region can expect to see higher average number of days without rainfall or snow, which could lead to agricultural droughts, reduced yields, and other serious economic impacts. The increased precipitation interspersed with periods of no rain, creates what is known as a **weather whiplash effect**, which increases the risk of severe weather at both extremes.

1. Information Display 17x11 (~290 words) – 290 words

According to the 10 cities reporting to CDP in the Mississippi River basin in 2016, **the surveyed cities reported varying susceptibility to the following risks**:

- ✓ 60% face river flood as a hazard;
- ✓ 50% face heat waves as a hazard;
- ✓ 30% face severe wind; 80% face flash/surface flood;
- ✓ 40% face drought; 20% face extreme winter conditions;
- ✓ 40% face extreme hot days;
- ✓ 20% face tornadoes;

- ✓ 20% face vector-borne diseases

With the exception of tornadoes, all of the above-mentioned hazards have proven to have links to climate change. Over the last ten years, ten or more **disaster declarations have been designated in thirty states** of the basin, while **six states have received twenty or more**.

Some of the economic ramifications of climate change and flooding are stated below:

- **Rain and flood related disasters along the Mississippi River have become persistent and systemic, incurring over $50 billion in costs since 2011.**
- **In 2015-2016, the Mississippi River Valley incurred over $13 billion in impact costs:**
- **In 2012, disasters cut into the total revenue of the Mississippi River economy by 8.75 percent in actual losses, and more in follow-on losses.**
- Of the 10 cities that reported to CDP in 2016, **8 of these cities stated that they consider the effects of climate change could threaten the ability of businesses to operate successfully in their city**.
- In 2016, **7 of the 10 cities of the basin surveyed by the CDP identified substantive risks to their city's water supply** in the short or long term.
- **47 companies reported exposure to either current or future water risks** in the Mississippi River Basin severe enough to substantively change their operations, revenue or costs. Of these 47 companies, flooding was the top risk reported.

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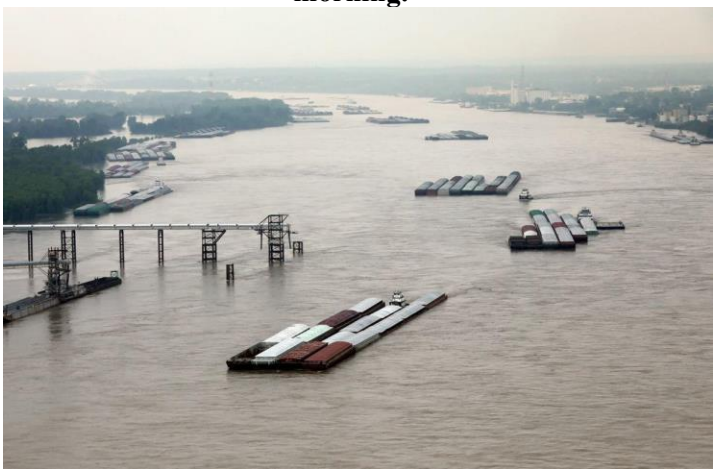
The flooding that occurred this spring (2019) was outrageous, not only in terms of height of the rivers, but also for the duration spent at flood stage. A flood warning statement issued by the National Weather Service in St. Louis, MO on August 7, 2019, read as follows:

"Rainfall heavier than forecast; Could cause river levels to rise even higher than predicted." It further read, "Flood stage is 22 feet. The river is forecast to crest near 24.1 feet by early Tuesday morning."



After heavy rainfall in May 6, 2019, the Mississippi river was estimated to rise to its fourth-or-fifth highest level since records began in the 1700s. The USGS projected a crest of about 41.9 feet, which is nearly 12 feet above flood stage. The main stem of the Mississippi River has been above flood stage since March 2019, and the latest flooding in the St. Louis region added more than six inches of rain in the past week. That precipitation joined a watershed that was already saturated. “It was set up in March, of course, by snowmelt and rain, but now that snow is pretty much all in the system and getting flushed downstream,” said Mark Fuchs, a senior service hydrologist for the St. Louis forecast office of the National Weather Service. “What we’re seeing now is rain getting added to that base.”

On May 24, 2019, the Coast Guard issued a notice closing portions of the Mississippi and Illinois rivers near St. Louis to all vessels because of extremely high water and fast-moving currents. Earlier that month the river registered another crest – seventh highest recorded in St. Louis.

Highway 12 is seen damaged after a storm triggered historic flooding, over Niobrara River, Neb., on March 16, 2019.

Small-Scale map

2. Information Display 17x11 (~290 words) - 292

Besides climate change, the construction of the levees, and other man-made navigation structures is changing the character of the river and the surrounding habitat in the St. Louis region. According to another research published recently in the journal of Marine Geology, scientists have discovered that the seafloor from the Mississippi River Delta to the Gulf of Mexico is eroding due to the construction of thousands of dams. In fact, it was determined that the Mississippi River Delta has entered a **stage of decline.**

Following is a list of adverse impacts caused due to the engineering of the Mississippi river basin.

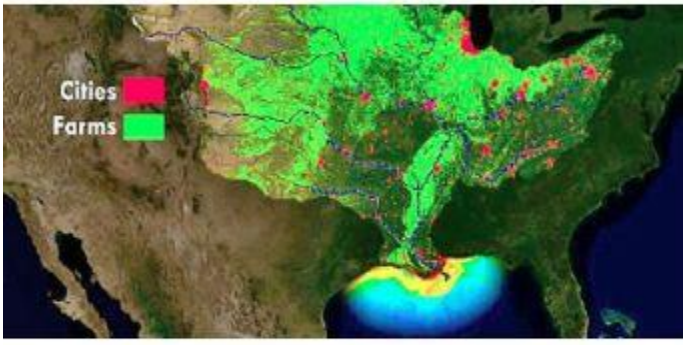
- ✓ **Extensive land loss**: The levees disconnect the river and an estimated 210 million tons of sediment that would naturally flow down to the delta and build the wetlands and the seafloor.

- ✓ Land loss **affects marine plants and animals**, as well as how pollution is absorbed and broken down, which affect many processes that occur from the coast to the open ocean, including marine organisms' lifecycles and underwater landslides.

- ✓ Dams stop the flow of fine silt, clay and other sediments from reaching the delta and seafloor to offset erosion. Without this sediment, land in the form of wetlands and the seafloor is lost. This **threatens offshore and inland infrastructure** in the face of waves, hurricanes and surge, or flooding, from storms.

- ✓ **Hypoxic/Dead Zones**: Big floods sweep more pollutants and fertilizers from the Mississippi River into the Gulf of Mexico, causing oxygen-depleted "dead zones," which can kill fish and other marine life. The dead zone occurs cyclically every year, but scientists predict that this year's growth was one of the largest in recorded history - approximately 7,829 square miles, or roughly the size of the land mass of Massachusetts (USGS).

Stories



The primary reason for the occurrence of a larger-than-usual dead zone this year (2019) is the abnormally high amounts of rainfall received in many parts of the Mississippi River watershed. The intense rainfall washed tons of fertilizer and sewage water out to sea, leading to a large

area of polluted water. The sediment containing pollutants from fertilizers caused a spike in algal blooms developing an eight thousand mile, **"Dead Zone"** off the coast of Louisiana and Texas.

According to the USGS estimates, the discharge in the Mississippi and the Atchafalaya Rivers was approximately 67% above the long-term average between 1980 and 2018. This abnormal river discharge is believed to have carried an outrageous 16,000 metric tons of nitrate and 25,300 metric tons of phosphorus into the Gulf of Mexico, just in the month of May 2019. The nitrate loads were estimated to be about 18% above the long-term average and phosphorus loads were 49% above the long-term average.

Small-Scale map

3. Information Display 17x11 (~290 words) – 307 words

The Missouri State Hazard Mitigation Plan includes five counties in eastern Missouri (Franklin, Jefferson, St. Charles and St. Louis Counties and the independent City of St. Louis). The two relevant Goals and Objectives under the Prepared Theme in OneSTL include the following:

Goal 1: Protect communities from known risks of natural disaster by focusing on prevention.

Objectives:

1. Reduce exposure to risks and hazards through improved disaster planning actions.

2. Increase understanding of risks and take appropriate actions to minimize risks of flooding.

3. Reduce the severity of future events through mitigation and adaptation efforts.

Goal 2: Strengthen capabilities for shared disaster response. Objectives

1. Increase cooperation among first responders.

2. Promote community involvement in preparedness efforts.

In July 2013, the Federal Emergency Management Agency released its **Levee Analysis and Mapping Procedure (LAMP)** for **Non-Accredited Levees New Approach,** which specified a four-prong approach to modeling to make the final determination of the risk for these areas.

1. Conducting the Natural Valley Procedure which results in a new Zone, "D" designation

2. Conducting an interior drainage analysis inside the protected area (landward of the levee) which assumes the levee stays in place

3. Conducting an analysis of the flooding source assuming the levee stays in place (wet side of the levee) .

4. Merging the risk areas and then map for each levee reach.

Additionally, Flood Resilient construction is being used in flood risk management strategy in the St. Louis area. Flood resilient construction are designed and constructed to avoid, prevent, or reduce the damage caused when flooding takes place, and thus minimizes the impact of these actions on people and property in the event of a flood using the principles of **avoidance, water exclusion, and resilience**. They can play an important part in flood risk management strategy by reducing damage and, importantly, speeding up the recovery process.

Stories

Small-Scale map