Risk Mitigation Consulting Inc.

Intelligence and Analysis Division

WHITE PAPER SERIES

Potential Climate Change Impacts on Weather, Disease, and Transportation

INTENT

This white paper is designed to provide analysis of relevant, publicly available information on threat and hazard events/trends and their potential impacts to the interests of the United States, both at home and abroad. This product is not intended to be an all-encompassing assessment of the subject.

Potential Climate Change Impacts on Weather, Disease, and Transportation

Introduction

This white paper will examine the potential adverse impacts of climate change on extreme weather, infectious disease, and select transportation systems. Recent national and international climatological assessments indicate each of these hazards may be undergoing a shift in long term trends. Many of these effects are currently observable and are likely to continue developing in the coming decades.

Globally, extreme weather events are occurring more often. Climate change will likely worsen the frequency, intensity, and impacts of some types of extreme weather events. Additionally, there is evidence of association between climatic conditions and infectious diseases. Malaria and a variety of waterborne diseases are predicted to thrive as some areas experience an increase in both extreme heat and flooding. Accidents involving trains, and/or hazmat materials also have an increased potential to occur in conjunction with an increase in extreme weather events.

Extreme Weather Events

According to the European Environment Agency, hot days are getting hotter and increasingly frequent. The global average surface temperature has increased by 0.74 °C in the 20th century, the global sea level has been rising 1.8 mm per year since 1961, and the Arctic sea ice has been shrinking by 2.7% per decade. Among other effects, this has likely led to the increased number of extreme weather events. Over the last 50 years, much of the U.S. has seen increases in prolonged periods of excessively high temperatures, heavy downpours, and in some regions, severe floods and droughts. Climate change is expected to worsen the frequency, intensity, and impacts of some types of extreme weather events. For example, sea level rise increases the impacts of coastal storms and warming can place more stress on water supplies during droughts. When assessing the likelihood of occurrence and potential impact of hazards such as heat waves, wildfires, heavy downpours, flooding, hurricanes, and winter storms, it is vital to account for the effects of climate change.[1, 3]

Extreme Heat & Heat Waves

A heat wave is a period of abnormally hot weather lasting days to weeks. In recent decades there has been an increasing trend in high-humidity heat waves, which are characterized by the persistence of extremely high night-time temperature. In 2011 and 2012 the number of intense heat waves was almost triple the long-term average. Multi-month heat waves are occurring at the most frequent rate since measurements began.[1, 2, 4]

Over the past decade, daily record high temperatures have occurred twice as often as record lows across the continental United States, up from a near 1:1 ratio in the 1950s. By midcentury, if greenhouse gas emissions are not significantly curtailed, scientists expect 20 record highs for every

record low. In parts of the South, the frequency of days above 95 degrees Fahrenheit could triple, to over 75 days per year.[2]

In the United States, extreme heat events are responsible for 600 deaths annually-more deaths than hurricanes, lightning, tornadoes, floods, and earthquakes combined. Extreme heat can also increase the risk of other types of disasters, such as wildfires, and exacerbate droughts. [4, 2]

Flooding

As global temperatures rise, the increasingly warm air contains more water vapor than cooler air. The increased moisture in the air results in heavier rainfalls. Climate change is likely altering the characteristics of the atmosphere that affect weather patterns and storms. According to the National Climate Assessment, heavy downpours have been increasing nationally. Observed trends since 1900 indicate both the heaviest rainfall events have become heavier and more frequent, and the amount of rain falling on the heaviest rain days has also increased. There has also been an increase in flooding events in the Midwest and Northeast, where the largest increases in heavy rain amounts have occurred. [1]

Flooding may intensify in many U.S. regions due to major weather factors including heavy or prolonged precipitation, snowmelt, thunderstorms, storm surges from hurricanes, and ice or debris jams. Other human factors include structural failures of dams and levees, altered drainage, and land-cover alterations (such as pavement). The risks from future floods are significant, given expanded development in coastal areas and floodplains, unabated urbanization, land-use changes, and human-induced climate change. Worldwide, from 1980 to 2009, floods caused more than 500,000 deaths and affected more than 2.8 billion people. In the United States, floods caused 4,586 deaths from 1959 to 2005. [1]

Biological

Overall, climate conditions constrain the geographic and seasonal distributions of infectious diseases, and weather affects the timing and intensity of disease outbreaks. Studies have found that long-term climate warming tends to favor the geographic expansion of several infectious diseases and that extreme weather events may help create the opportunities for more clustered disease outbreaks or outbreaks at non-traditional places and time. Several infectious diseases, such as malaria, salmonellosis, cholera and giardiasis, may show increased outbreaks due to elevated temperature and flooding.[3]

Malaria

Floodwaters provide breeding grounds for disease vectors such as mosquitoes. Mosquitoes are also sensitive to temperature change. If their habitat becomes warmer, then their rate of reproduction increases, as does the number of bites and consequently blood meals they take. Warmer weather also extends their breeding season and reduces the parasite incubation rate. As a result, the incidence of diseases such as malaria and yellow fever could be affected. Malaria seems likely to be the vector-borne disease most sensitive to long-term climate change. Recent analyses have shown that the malaria epidemic risk increases by approximately five-fold in the year following an El Niño event.[5, 6]

Waterborne Diseases

Changes to rainfall patterns may also reduce fresh water supplies. This will likely have a negative impact on the hygiene and health of many communities, potentially leading to the increased incidence of illnesses such as trachoma (an eye infection that can cause blindness) and diarrhea. Diarrheal diseases already kill more than 1.8 million people annually. Higher rainfall in other areas and rising sea levels may lead to flooding which increases the risk of water-borne diseases such as cholera. The bacterium which causes cholera thrives in warmer water.

Hazardous Materials Release

As previously noted, climate change is likely leading to an increase in extreme weather events. As events such as hurricanes and typhoons worsen, there comes an increased "potential for hazardous chemicals to spread due to facility damage, storm surge, and flooding" according to the National Institute of Environmental Health Sciences.[8]

Train Mishaps

Railways and rail transport are generally sensitive to the effects of many weather events. Trains are a particularly vulnerable sector of transportation due to the limited number of alternate routes available. A variety of extreme events, such as rainstorms and the resulting floods, heat waves, freezing, snowfall, violent winds, thunder, and rising sea levels, can disrupt traffic and compromise safety in rail transport. A single incident may affect many trains, and disruptions may take a long time to clear. The increasing severity and likelihood of extreme weather events will most likely accelerate wear on railways and equipment as climate change progresses. The increasing frequency of rainstorms and the resulting floods cause erosion and make the ground around rail tracks less stable. Increasing rainstorms may also cause the capacities of drainage wells and tunnels as well as bridge arches to be exceeded. Increasing rainfall is expected to raise water levels and groundwater levels, which is likely to make railway infrastructure less stable and increase the risk of damage. Although snow cover is estimated to decrease on the whole, the intensity of short-lived snow showers and snowstorms is likely to increase. This causes problems in terms of railway equipment, such as blockages and failures as well as frozen points.[7]

Conclusion

As climate change continues, it is likely to have an increasingly significant impact on a number of hazards. The frequency, intensity, and impact of some extreme weather events is likely to increase, potentially resulting in an increase in direct damages from the event, as well the potential effects on the spread of disease and the ability of transportation systems to function. When assessing the likelihood of occurrence and potential impact of hazards such as heat waves, wildfires, heavy downpours, flooding, hurricanes, and winter storms, it is vital to account for the effects of climate change.

Source List

1. U.S. Global Change Research Program. *National Climate Assessment.* 2014.
2. Center for Climate and Energy Solutions. *Heat Waves and Climate Change*.

3. Environment International. *Impact of climate change on human infectious diseases: Empirical evidence and human adaptation.* January 2016.
4. Climate Communication. *Heat Waves.*
5. World Health Organization. *Climate Change and Human Health*.
6. Microbiology Society. *Climate Change and Health.*
7. Climate Guide. *Climate change has both positive and negative implications on rail transport.*
8. International Union of Painters and Allied Trades Ontario Council. *The Impact of Climate Change on Toronto's Hazmat Technicians.* 30 October 2017.