Risk Mitigation Consulting Inc.

Intelligence and Analysis Division

WHITE PAPER SERIES

Hazard Seasonality: An Overview

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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.

Hazard Seasonality: An Overview

Introduction

Unlike most threats and hazards, many meteorological hazards occur within a predictable cycle. Understanding the likely times these hazards will occur benefits those seeking to mitigate risks. When multiple hazard events occur within a short time frame, the impact of the events will be more intense and compounding. Furthermore, understanding the overlap between numerous hazard seasons highlights times in which multiple hazards may occur, further increasing the potential severity of impact. For example, tropical cyclone season outlines the months in which tropical cyclones are most likely to occur. However, the same weather systems that bring tropical cyclones may also bring high winds, storm surges, floods, flash floods, lightning, and tornadoes. Hypothetically, the effects of flooding may be made more severe due to high winds, and safety responses for tornadoes may be hindered by tropical cyclone preparation. One further example of hazard seasons can be seen in damaging winds events. The likelihood of damaging wind events occurring depends in large part on local considerations. The location in question may deal with tropical cyclones, tornadoes, dust storms, or other unique local events such as the Santa Ana winds.[1]

While some hazards have a set season annually, the seasons of some meteorological hazards shift in relation to large scale global cycles such as El Niño-Southern Oscillation (ENSO). For example, during La Niña, the first three months of the year during a La Niña typically feature average precipitation across the Pacific Northwest, in the northern Intermountain West, and over scattered sections of the north-central states, Ohio Valley, and upper Southeast, increasing the chances of flood events. Further seasonal shifts can be seen changing due to climate change. For example, fire season in the United States has gradually expanded to encompass almost the entire year due to increasing global temperatures it's the associated impacts. Globally, by 2050 it is anticipated that there will be a 35% increase in days with high fire danger across the world. Climate change is also triggering an increase in extreme weather events. These events may be outliers in both severity and the time of year in which the occur. It is important to keep this trend in mind, understanding the seasonality of some hazards is not a 'hard boundary' for the occurrence of severe events.[2,3,4]

Hazard Example: Flooding

There is no singular season during which flooding occurs. It often depends on local conditions, geography, and proximity to bodies of water. However, flooding is more likely to occur in seasons with pronounced rainfall, which means, broadly speaking, Spring to Fall. This makes tropical and sub-tropical regions the most vulnerable. The United Nations has reported that the 10 countries most prone to flooding are all located in tropical South and South East Asia, with countries in South America and Africa also widely affected.[5] The effects of flooding are particularly destructive in developing countries, which may lack the infrastructure and public services to respond and rebuild. Climate change has also exacerbated the effects. Severe flooding can not only cost lives and damage property, but it can also disrupt the supply chain, damage critical infrastructure, disrupt public services, and occupy emergency responders for lengthy periods of

time. Standing water can also result in an increase in biological hazards. Waterborne, vector-borne, and zoonotic diseases are all more likely to spread after a flood.[6]

Flooding is itself a secondary effect to different weather events. Seasons with tropical cyclones and monsoons are significantly more likely to cause flooding. The official Atlantic hurricane season is 01 June-30 November. However, tropical cyclones can occur before and after those dates. The peak of the hurricane season is 10 September. Most activity occurs between mid-August and mid-October.[7] The North American Monsoon starts in Mexico in June and moves into the U.S. Southwest in July. By early to mid-September, wind patterns have generally reverted back, bringing an end to the monsoon.[8] One example showing the severity of a monsoon season was seen in July 2017, when the North American Monsoon caused torrential rains north of Phoenix, Arizona, causing flash floods that killed nine (9) people.[9]

Snowpack melt can also result in flooding, which increases the likelihood during even winter months. However, flooding from snowpack melt alone is relatively rare. Rain can cause the packed snow to melt. In June 2022, low temperatures and precipitation with "an unusually high June snowpack" caused flooding in southwest and south-central Montana. At least five (5) rivers in Park, Carbon and Stillwater counties set records for high flows. The waters wiped out bridges and roads and carried entire buildings downstream.[10]

Hazard Example: Wildfire

Across the world, wildfires are growing in intensity and spreading in range. From Australia to Canada, the United States to China, across Europe and the Amazon, wildfires negatively impacting the environment, human health, and infrastructure. Wildfires are most prevalent in the summer when conditions are hot and dry, increasing the likelihood that this hazard will occur during summer months. The peak month of the wildfire season occurs in August when areas become increasingly hot and dry, leading environments to become more susceptible to a wildfire in the summer month of August. Additionally, the spring and winter seasons experience more rain and show which is why minimal wildfires occur during these seasons. However, multiple studies have found that climate change has already led to an increase in wildfire season length and frequency due to warmer spring and summer seasons in addition to drier soils and vegetation. Climate change is projected to increase the frequency, extent, and severity of fires through increased temperatures and drought.[11]

There are a several hazards that lead to wildfire occurrences such as: lightning strikes (which are more frequent throughout the summer season), human-caused fires, droughts, and climate change. Drought is defined as a period of abnormally dry weather sufficiently prolonged for the lack of water to cause a serious hydrologic imbalance in the affected area. The Wildland Fire Management Information (WFMI) and U.S. Forest Service Research Data Archive have estimated that approximately 85% of wildland fires in the U.S. have human causes, including unattended campfires, discarded cigarettes, equipment malfunctions, arson, etc. Furthermore, climatic conditions, such as long-term drought, play a major role in the number and intensity of wildfires. Lack of rainfall, in conjunction with very warm temperatures, allow forest fuels, such as dead leaves, trees and branches, to become unusually dry. The dry forest fuels are very susceptible to

fire, especially when daytime relative humidity is low and wind speeds are high. Drought is a natural hazard that has far reaching repercussions. Based on recent trends of longer wildfire seasons and larger wildfire sizes, it is likely that more frequent and longer droughts will occur.[12,13,14,15]

Wildfires have proven to contribute to climate change by emitting large quantities of greenhouse gases into the atmosphere, spurring more warming, drying, and burning. Climate change changed the Earth's environment as the frequency and magnitude of wildfire activity is increased through "longer drought periods, high air temperatures, low relative humidity, dry lightning, and strong winds; all of which, result in hotter, drier, and longer fire seasons." Climate change influences on wildfires can be categorized as: "direct effects on fire weather through drought, higher temperatures, and changes in the strength and seasonality of winds; indirect effects resulting from changes in the nature and availability of biomass/fuel; and direct and indirect changes in the frequency and location of natural and human-caused ignitions via changes in dry lightning profiles."[16]

Over the last ten (10) years, more wildfires are occurring in regions where seasonal fires are common as well as in regions where fires do not normally occur. The west coast and Midwest regions of the U.S. and parts of eastern Australia typically experience more frequent fires during the summer seasons but has seen record breaking wildfire numbers within the last couple of years. Additionally, regions not as prone to extensive wildfires such as the Arctic and Amazon have also witnessed record breaking wildfire numbers. Studies have indicated that persistently hot, dry, and windy conditions in addition to increased temperatures are triggering an increase in wildfire events.[16,17]

Outlook

Emergency management personnel (and other stakeholders) who may be affected by meteorological hazards should consider hazard seasonality in order to facilitate effective planning and mitigation efforts. Awareness of peak/low seasons can drive active risk reduction and efficient utilization of resources. When appropriate, the effects of climate change should also be considered in regard to seasonal hazard frequency and severity. RMC's Intelligence & Analysis Division continues to provide detailed hazard analysis, to include hazard assessment methodologies which account for seasonality and climate factors.

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