

Climate Change

Long Term Trends and their Implications for Emergency Management

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Overview

A significant amount of existing research indicates that the world's climate is changing. Emergency managers should consider the implications of climate change regardless of the cause. Several climate change-related trends may present critical challenges to emergency managers and warrant in-depth analysis. These include:

- Rising temperatures
- Increased storm intensity and frequency
- Rising sea levels
- Changing drought and fire risk
- Shifting threats to human health and disease patterns

This document contains preliminary research conducted on behalf of the Strategic Foresight Initiative on the Climate Change driver. This research is intended to serve as a discussion point for further discussions, and does not represent a forecast by the Federal Emergency Management Agency (FEMA). This paper is a starting point for conversations around a highly complex topic, and SFI encourages feedback about this paper from the emergency management community.

SFI is a collaborative effort of the emergency management community that is being facilitated by FEMA. SFI was launched so the emergency management community can seek to understand how the world is changing, and how those changes may affect the future of emergency management. It will do so by encouraging members of the community to think about how the world may look over the next 15 years, and what steps the community should begin taking to thrive in that world. Participants in SFI include emergency managers at the Federal, state, and local level, subject matter experts on relevant topics, and other stakeholders.

Anybody who would like more information about SFI should contact the team at FEMA-OPPA-SFI@fema.gov.

Key Trends and Drivers

Global temperatures are projected to increase by a significant amount. Over the past 50 years, the average temperature in the United States has increased by about 2°F.¹ By the end of the century, global average temperatures are projected to increase 2.5°F to 11.5°F, depending on future emissions of heat-trapping gases.² Projected changes in long-term climate are expected to precipitate more frequent extreme events such as heat waves, heavy downpours, infectious diseases, drought, and flooding, which will affect many aspects of life throughout the United States, and the world.

The intensity of hurricanes is likely to increase.³ Over the past few decades, there is data suggesting higher than average numbers of severe hurricanes (category 4 and 5) are occurring.⁴ Tropical storms and hurricanes develop and gain strength over warm ocean waters. As oceans warm in response to a warmer climate, they will provide additional energy for hurricane growth. As ocean temperatures continue to increase in the future, it is likely that hurricane rainfall and wind speeds will increase. Simulation models suggest for each 1.8°F increase in tropical sea surface temperatures, core rainfall rates from hurricanes will increase by 6 to 8 percent and the surface wind speeds of the strongest hurricanes will increase by approximately 1 to 8 percent.⁵ In the eastern Pacific, severe hurricanes have become stronger since the 1980s, even while the total number of storms has decreased.⁶

Sea levels will likely rise, although there is a great deal of uncertainty regarding how high. Projecting future sea levels presents special challenges.⁷ Because sea level processes are not well understood, it is difficult to predict their future impact. To that end, based on the state of science, the Intergovernmental Panel on Climate Change in 2007 conservatively projected that the world's ocean levels would rise from 8 inches to 2 feet by the end of this century.⁸ This would subject coastal areas to increasing risk from sea-level rise and storm surge, thus threatening homes and infrastructure including water, sewer, transportation, and communication systems. Should current trends continue along their present trajectory, many barrier islands and coastal marshes that protect the coastline and support healthy ecosystems will be lost.

Floods and droughts are likely to become more common and more intense. Regional and seasonal precipitation patterns are likely to change, and rainfall will become more concentrated into heavy events with longer, hotter dry periods in between.⁹ Climate change has already altered and will continue to alter the water cycle, affecting where, when, and how much water is available for all uses.¹⁰ In the United States, mid-continental areas and the Southwest are particularly threatened by future drought and longer lasting dry seasons.

The effects of climate change are likely to pose a threat to human health. The percentage of the U.S. population over age 65 is currently 12 percent and is projected to be 21 percent by 2050 (over 86 million people).¹¹ The elderly are expected to need different types of emergency services and supplies, particularly in environments presenting extreme weather conditions, such as heat waves. Heat is already the leading cause of weather-related deaths in the United States, with more than 3,400 deaths between 1999 and 2003 reported as a result of excessive heat exposure.¹² Heat waves are projected to become more frequent and severe due to climate change.¹³ Moreover, the risk of diseases transmitted by food, water, and insects may increase as

a result of changing climatic conditions such as increasing temperatures, precipitation, and extreme weather events.¹⁴ This may occur because diseases and species will migrate as climate trends shift.

Implications for Emergency Management

The general comment from the emergency management community is that regardless of why the climate is changing, it is changing, and will affect how the community operates in the future. Research performed by the U.S. Global Change Research Program on the implications of climate change on the United States shows how it could affect emergency management. Climate change becomes particularly challenging when considered in combination with other drivers such as increased urban populations and aging critical infrastructure. Potential international impacts of climate change that could affect the United States include migration due to climate issues, increased conflict over resources, and shifting disease patterns.

Many scientists and emergency managers recognize that storms are becoming more intense. They see the effects of climate change in events such as intensified wildfires, higher sea levels, extreme rainfall, windstorms, diseases spreading to new areas, and heat waves. There have been a number of record-setting severe weather events, from the Australian bushfires in February 2009, when hundreds of fires broke out during record-breaking temperatures, to the May 2010 flooding in Tennessee, which was the highest since recordkeeping began there in the 1880s.

Anticipated climate change implications such as more intense storms and rising sea levels could demand more elaborate and extensive emergency response. More frequent heavy downpours and floods in urban areas, and more extensive coastal flooding will cause greater property damage, thus creating a heavier burden on emergency responders, and a growing financial toll on businesses and homeowners. Flood insurance program policies may have to be reevaluated. Higher threats of infectious diseases will likely require better coordination of emergency management and public health efforts. Emergency managers may have to be poised to pre-position more stocks to be responsive to potentially catastrophic events. The emergency management community may be required to reevaluate how services are provided to accommodate the potentially hazardous impacts of climate change, and implement comprehensive changes to strategic plans.

Correlation to Other Drivers

- **Critical Infrastructure:** Much of the country's existing infrastructure (roads, bridges, water systems, electrical grids, dams, levees) is decades old. Heavy downpours are already coming more frequently and are very harmful to transportation and water treatment infrastructure. As global warming increases the competition for water access and use, the energy sector will be strongly affected because power plants require large amounts of water for cooling.¹⁵ Though global warming may decrease demand for heating energy in the winter, it will increase demand for cooling energy in the summer.¹⁶ This will result in significant increases in electricity use and higher peak demand in most U.S. regions during the summer months. Many barrier islands and coastal marshes that protect the coastline and

support healthy ecosystems will be lost.¹⁷

- **Global Interdependencies:** According to the Intergovernmental Panel on Climate Change, by 2050, as much as 42 percent of the world’s population (nearly half of a projected 10 billion+) may live in countries with insufficient freshwater stocks to meet the combined needs of agriculture, industry, and domestic use.¹⁸ Based on the National Intelligence Assessment of National Security Implications of Global Climate Change to 2030, the most significant impact for the United States will be indirect—linked to the outcomes of climate change effects on other countries and their potential to affect U.S. national security interests seriously.¹⁹ Consequently, the United States can expect to deal with large groups of “climate migrants” from varying regions around the world fleeing water scarcity and perhaps conflicts waged because of significant water shortages.
- **Government Budgets:** The current near-term forecasts for non-governmental and private organizations, local, state, and Federal budgets are grim and may lead to critical shortfalls in funding requirements vital to climate change initiatives, strategies, and investments. Tight budgets will mean fewer resources to address the impacts of climate change. Specifically, addressing aged infrastructure and disaster recovery efforts will be resource intensive. It is not yet clear if efforts such as cap-and-trade or the imposition of a carbon tax may generate revenue to fund such efforts—given the current national debate, such efforts may be used to offset current budget imbalances.
- **U.S. Demographic/Metro Area Populations:** The impacts of climate change on cities are compounded by aging infrastructure, buildings, and population, as well as air pollution and population growth. As the U.S. population grows, ages, and becomes further concentrated in cities and coastal areas, society is faced with additional challenges. Population growth in the United States over the past century has been most rapid in the south, near coasts, and in large urban areas. The four most populous states in 2000—California, Texas, Florida, and New York—accounted for 38 percent of the total growth in U.S. population during that time.²⁰ Over 80 percent of the U.S. population resides in urban areas, which are among the most rapidly changing environments on earth.²¹ In 1900, only one in 20 of the world’s 1.6 billion people lived in cities; today over half of the world’s 6.6 billion people live in urban areas.²² As the world population grows to between 9 billion and 10 billion by 2050, the vast majority of that growth will take place in the cities of the Global South.²³

Conclusions & Questions

There are now many observed, well-documented impacts of climate change on natural resources and ecosystems in many regions of the United States and the world. These observed changes in climate conditions are projected to continue during the current century, and to grow in both number and magnitude. Climate change and its effects present serious challenges for emergency management leaders and first responders alike.

How will communities manage the significant changes that are projected in sea level, temperature, rainfall, and extreme weather events?

Will growth continue as projected in vulnerable areas, despite the possible associated risks?

Will the Federal and state governments have the ability to adapt infrastructure, particularly in light of inevitable budget constraints?

How should the emergency management community become more involved in climate change policy discussions?

What actions can/should emergency managers take now to prepare for the potential implications of climate change?

How will climate change impact your community?

¹ U.S. Global Change Research Program, “Global Climate Change Impacts in the United States”, June 2009

² U.S. Global Change Research Program, “Global Climate Change Impacts in the United States”, June 2009

³ Ibid.

⁴ Ibid.

⁵ Ibid.

⁶ Ibid.

⁷ U.S. Global Change Research Program, “Global Climate Change Impacts in the United States, Highlights”, June 2009

⁸ Ibid.

⁹ U.S. Global Change Research Program, “Global Climate Change Impacts in the United States”, June 2009

¹⁰ Ibid.

¹¹ Ibid.

¹² Ibid.

¹³ Environmental Health Perspectives and the National Institute of Environmental Health Sciences, *A Human Health Perspective on Climate Change*, April 22, 2010.

¹⁴ Ibid.

¹⁵ U.S. Global Change Research Program, “Global Climate Change Impacts in the United States”, June 2009

¹⁶ U.S. Global Change Research Program, “Global Climate Change Impacts in the United States, Highlights”, June 2009

¹⁷ Ibid.

¹⁸ Nils Gilman, Doug Randall, Peter Schwartz, *Impacts of Climate Change*, Global Business Network, January 2007

¹⁹ Department of Homeland Security, Climate Change Adaptation Task Force, Pre-Decision Draft, “Climate Change Adaptation Report”, October 2010

²⁰ U.S. Global Change Research Program, “Global Climate Change Impacts in the United States”, June 2009

²¹ Ibid.

²² Nils Gilman, Doug Randall, Peter Schwartz, *Impacts of Climate Change*, Global Business Network, January 2007

²³ Ibid.