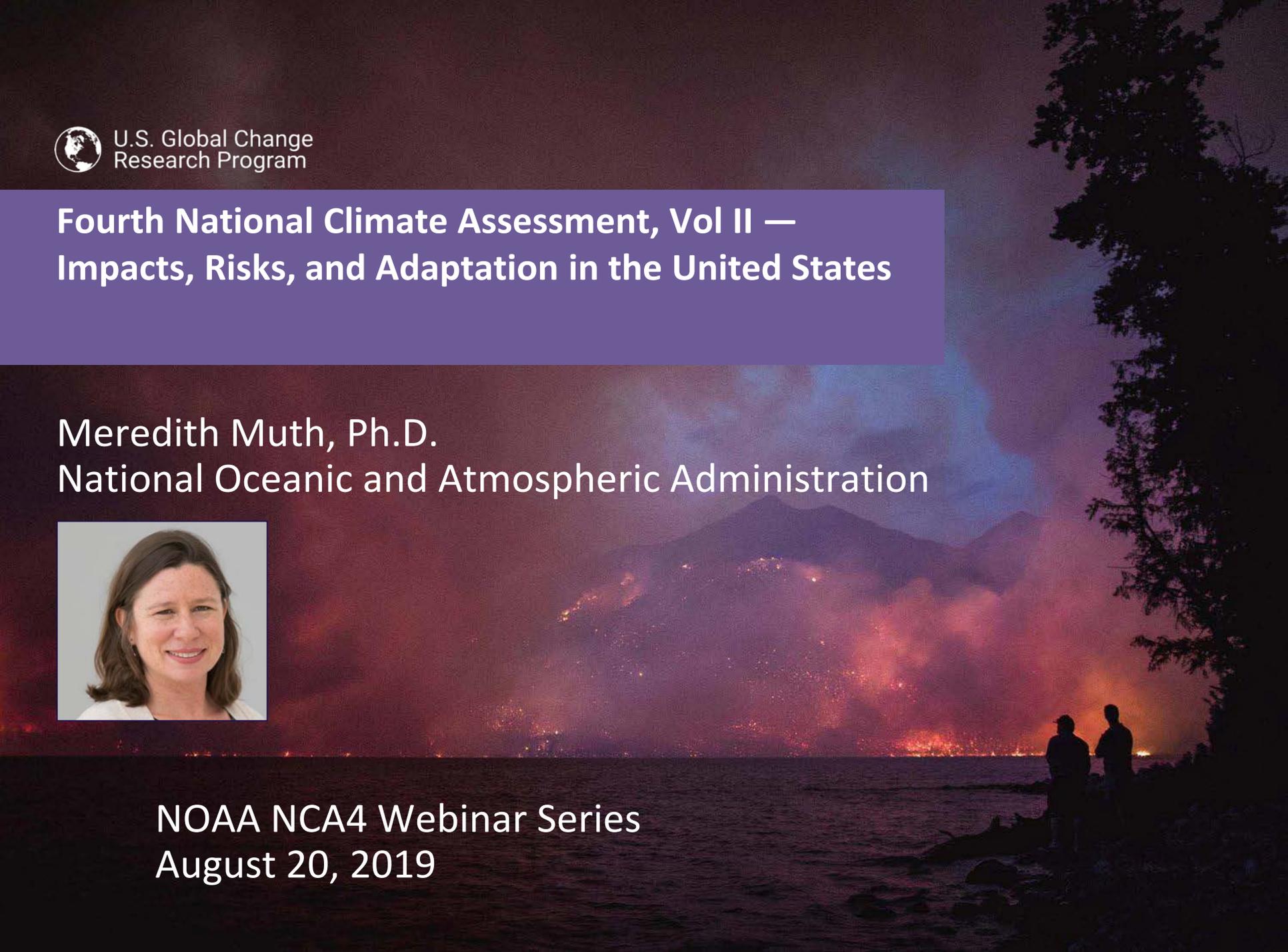


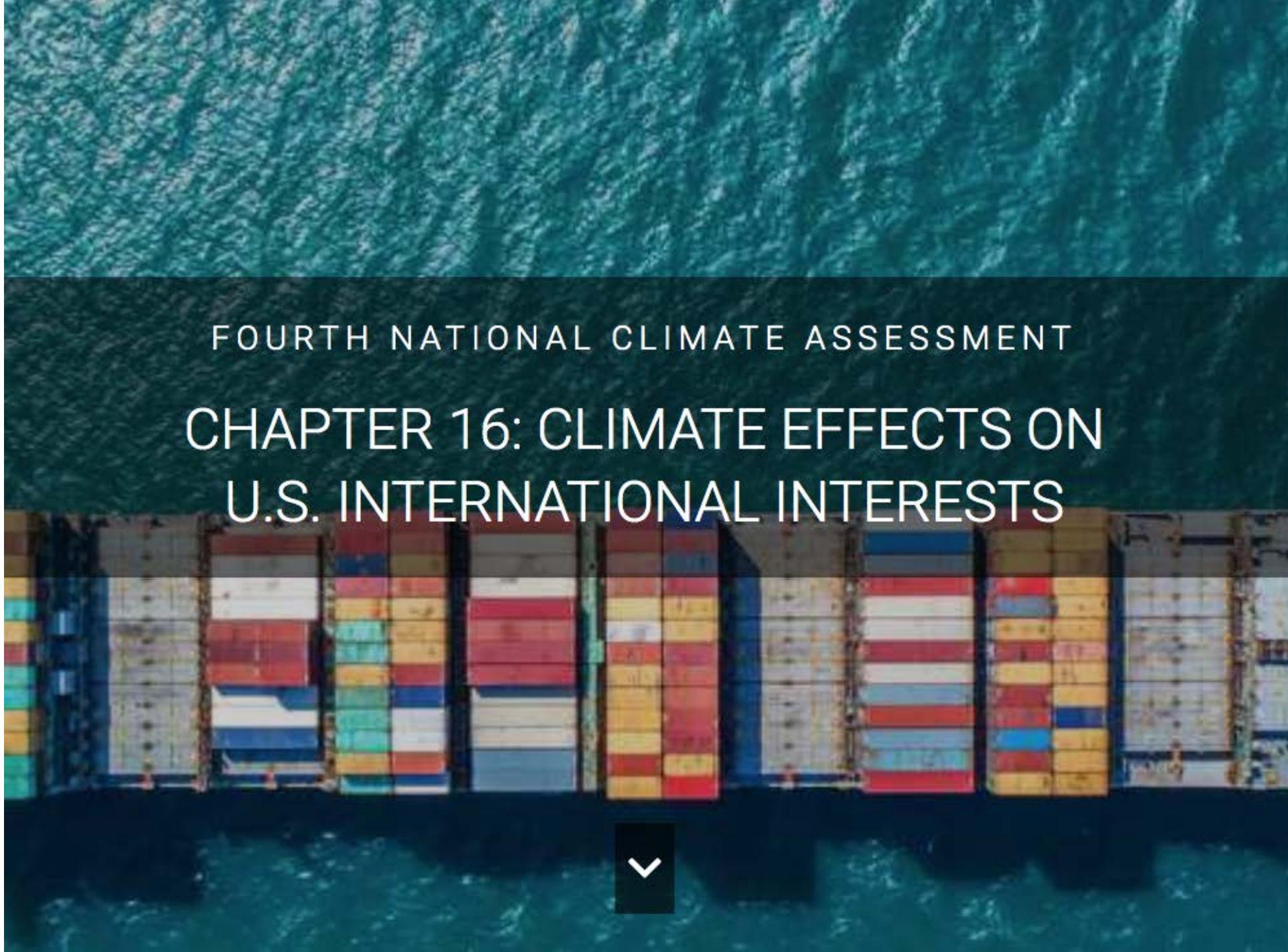
## Fourth National Climate Assessment, Vol II — Impacts, Risks, and Adaptation in the United States

Meredith Muth, Ph.D.  
National Oceanic and Atmospheric Administration



NOAA NCA4 Webinar Series  
August 20, 2019





FOURTH NATIONAL CLIMATE ASSESSMENT  
CHAPTER 16: CLIMATE EFFECTS ON  
U.S. INTERNATIONAL INTERESTS



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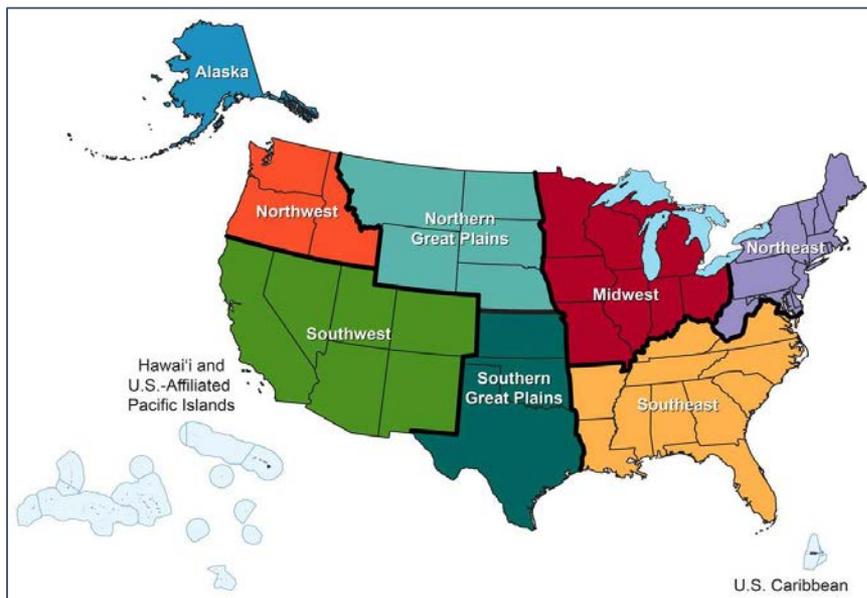
# The International Context of NCA4

U.S. interests that can be affected by **climate-related impacts outside of U.S. borders.**

- Economics and Trade
- International Development and Humanitarian Assistance
- Climate and National Security
- Transboundary Resources



NCA4 Appendix 4: Looking Abroad: How Other Nations Approach a National Climate Assessment



# Economics and Trade: Risks and Actions

The impacts of climate change, variability, and extreme events outside the United States **are affecting and are virtually certain to increasingly affect U.S. trade and economy, including import and export prices and businesses with overseas operations and supply chains.**

The 2011 flooding in Thailand illustrates how an extreme event on another continent can affect U.S. business interests



Western Digital, a U.S.-based company that produces 60% of its hard drives in Thailand, sustained **\$199 million in losses** and a shipment reduction of **51% fewer hard drives** in the last quarter of 2011.

Shortages temporarily **doubled** global hard drive **prices** affecting United States-based Apple, HP, and Dell.



**Production** of Ford vehicles temporarily **halted** in Thailand due to the flooding.

**Production** of Honda vehicles in the United States and Canada temporarily **decreased ~50%**

# International Development and Humanitarian Assistance: Risks

The impacts of climate change, variability, and extreme events can **slow or reverse social and economic progress in developing countries**, thus **undermining international aid and investments made by the United States** and **increasing the need for humanitarian assistance and disaster relief**.



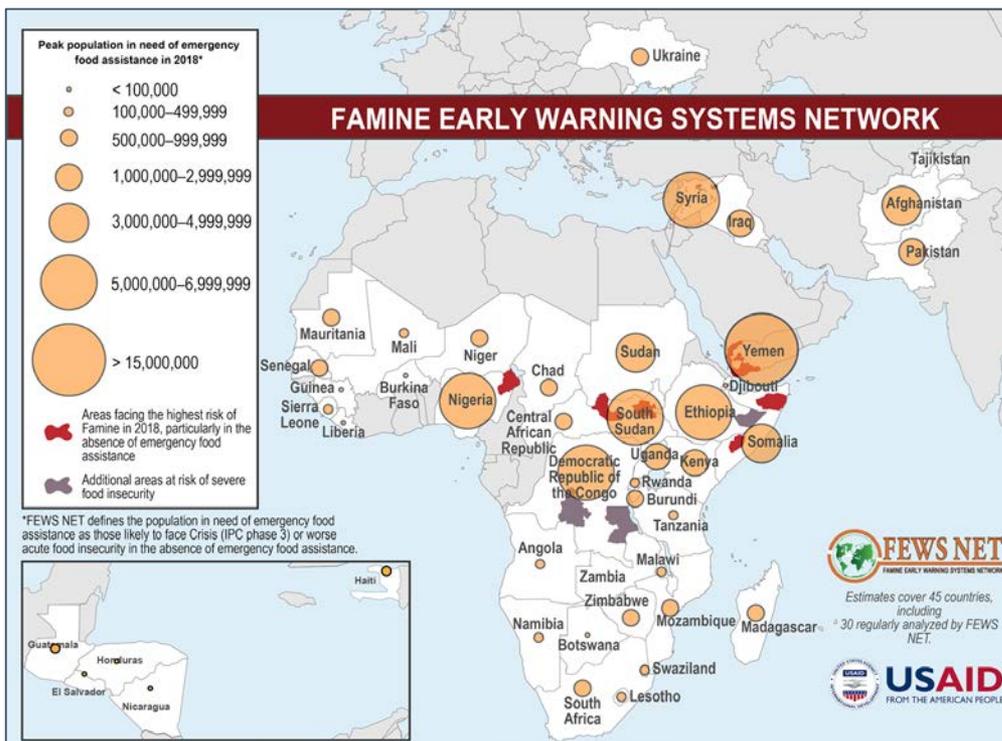
Hurricane Mitch, 1998. NOAA



U.S. conducted humanitarian and disaster relief efforts following Typhoon Haiyan in the Philippines, 2013. Source: U.S. DOD

# International Development and Humanitarian Assistance: Actions

The United States provides technical and financial support to help developing countries better anticipate and address the impacts of climate change, variability, and extreme events.



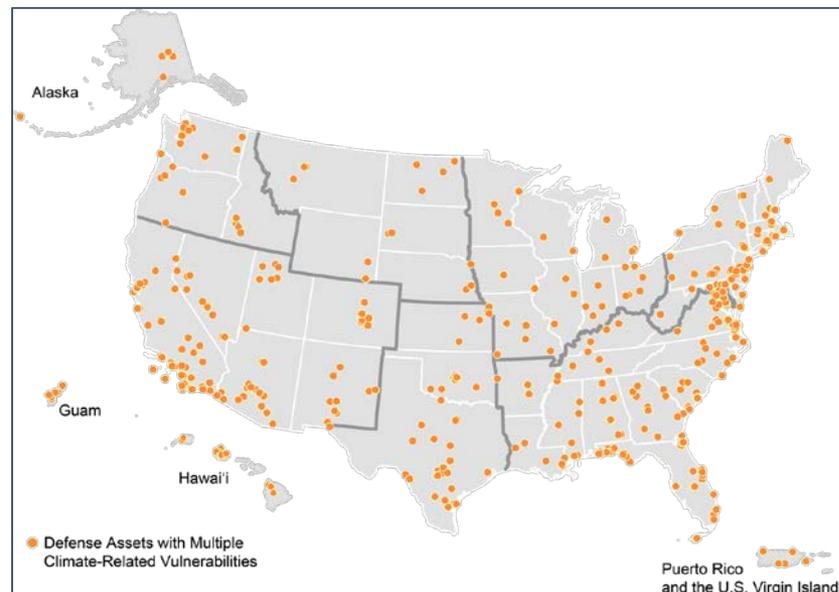
**The Famine Early Warning Systems Network.** Projections of peak populations in need of emergency food assistance in 2018. Source: adapted from USAID 2018.

# Climate and National Security: Risks and Actions

Climate impacts **already affect U.S. military infrastructure**, and the U.S. military is **incorporating climate risks in its planning**



Low-lying Norfolk, Virginia. Local relative sea level is projected to rise between about 2.5 and 11.5 feet by the year 2100 under the Lower and Upper Bound USGCRP sea level rise scenarios, respectively. See **Ch. 8, Coastal Effects**.



Preliminary qualitative picture of DoD assets currently affected by severe weather events and future sea level rise. Source: adapted from Department of Defense 2018. See **Ch. 1, Overview**.

# Climate and National Security: Risks and Actions

Climate change, variability, and extreme events, in conjunction with other factors, **can exacerbate conflict**, which has **implications for U.S. national security**.

- Resource competition
- Commodity price shocks
- Food insecurity

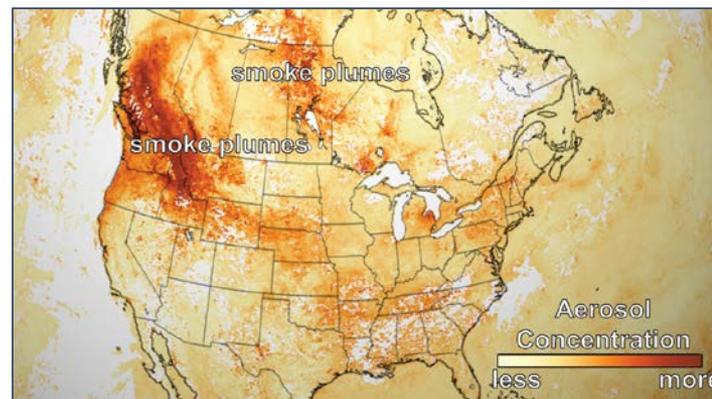
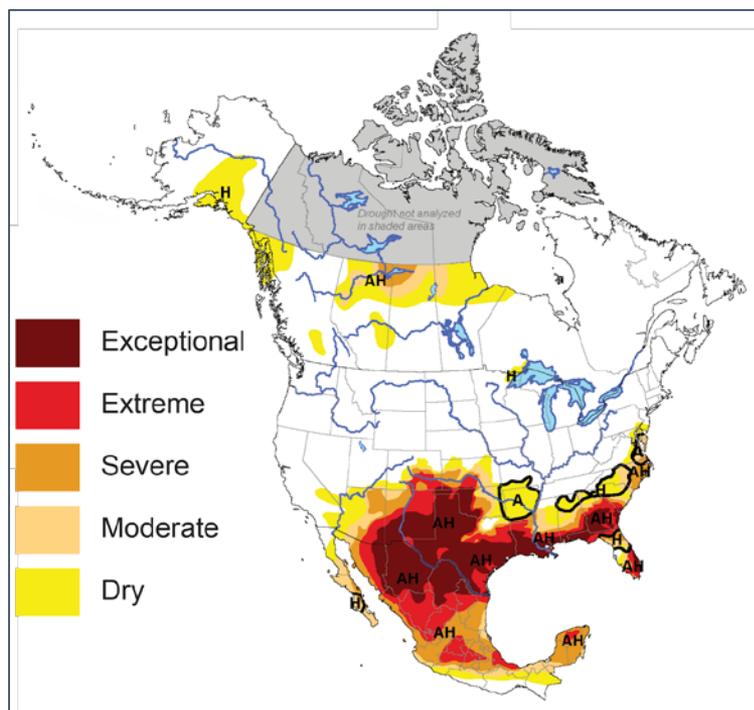
Direct linkages between climate-related stress and conflict are unclear



*Russia's wheat crop has been damaged by severe drought and wildfires. Credit Mikhail Metzger/Associated Press*

# Transboundary Resources: Risks

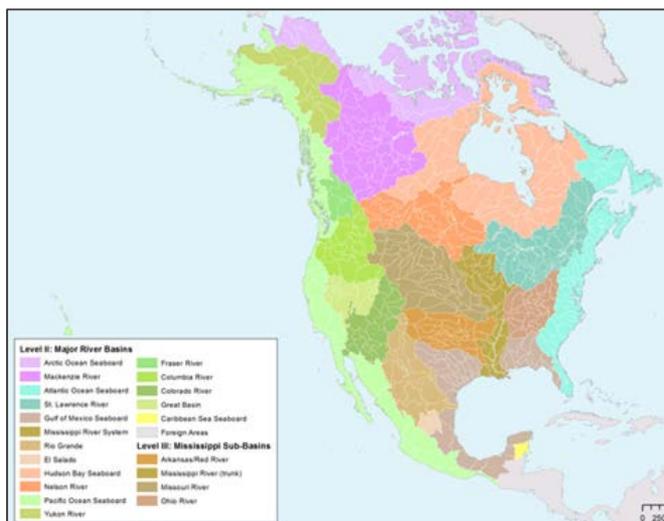
Climate-related impacts span across U.S. national borders: Drought, Wildfire, Infectious Disease



- (A) NADM map, June 2011. Darker colors indicate greater intensity of drought. Source: adapted from NOAA.  
 (B) Smoke from wildfires in 2017, with darker areas indicating smoke moving across US-Canada border, Source: adapted from NOAA. (C) *Aedes* species mosquito. Source: CDC.

# Transboundary Water Resources: Risks

Shared resources along U.S. land and maritime borders provide direct benefits to Americans and are **vulnerable to impacts** from a changing climate, variability, and extremes.



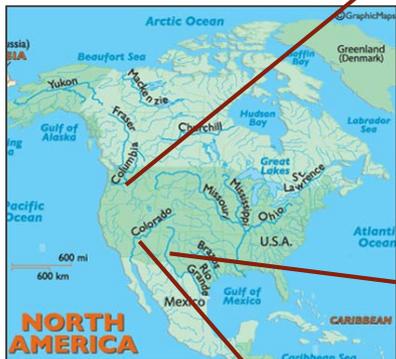
North American river basins. Source: CEC.

- Irrigation
- Drinking water supplies
- Power generation
- Flood risk management

Chapter 3, Water: “Continued collaboration on transboundary watershed coordination...are among the actions that could facilitate more sustainable binational water management practices.”

# Transboundary Water Resources: Actions

Multinational frameworks that manage shared resources are increasingly incorporating climate risk in their transboundary decision-making processes.



worldatlas.com



**Columbia River:** Grand Coulee Dam. Source: usbr.gov.



**The Rio Grande Gorge,** New Mexico. Source: © josephmccowie. **Ch. 23, Southern Great Plains.**



**Colorado River:** Hydrological drought in Lake Mead, Nevada, 2014. Source: U.S. BLM. **Ch. 25, Southwest.**

# Regional and Global Cooperation

**International collaboration** enables the U.S. to **better observe, understand, assess, and manage the impacts on U.S. interests** within and outside of national borders

- Access to observations, data, knowledge
- Leverage funding and maintenance
- Joint research and assessments
- Share lessons learned on risk management and adaptation

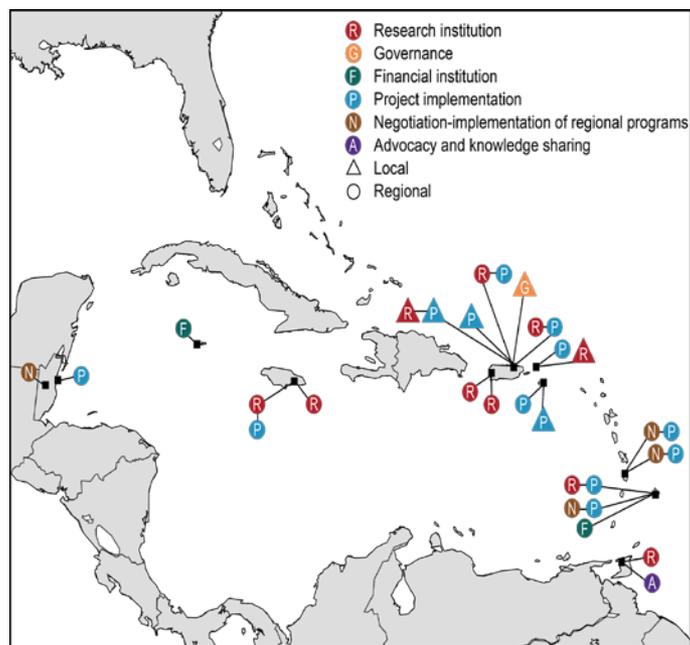


Fig. 20.18: Climate Risk Management Organizations. **Ch. 20, U.S. Caribbean**

# Key Takeaway Messages

The impacts of **changing weather and climate patterns beyond U.S. borders affect those living in the United States**, often in complex ways that can generate both challenges and opportunities.

It is highly **unlikely that the measures implemented so far will fully avoid or offset the adverse impacts** of a changing climate on U.S. international interests.

Emerging areas that are not well understood:

- The ***mechanisms*** by which climate impacts beyond American borders can affect U.S. interests
- The ***effectiveness*** of actions, and their potential to offset adverse impacts (or take advantage of positive impacts)



## Fourth National Climate Assessment, Vol II — Impacts, Risks, and Adaptation in the United States

THANK YOU!

[nca2018.globalchange.gov](http://nca2018.globalchange.gov)

Chapter 16: Climate Effects on U.S. International  
Interests

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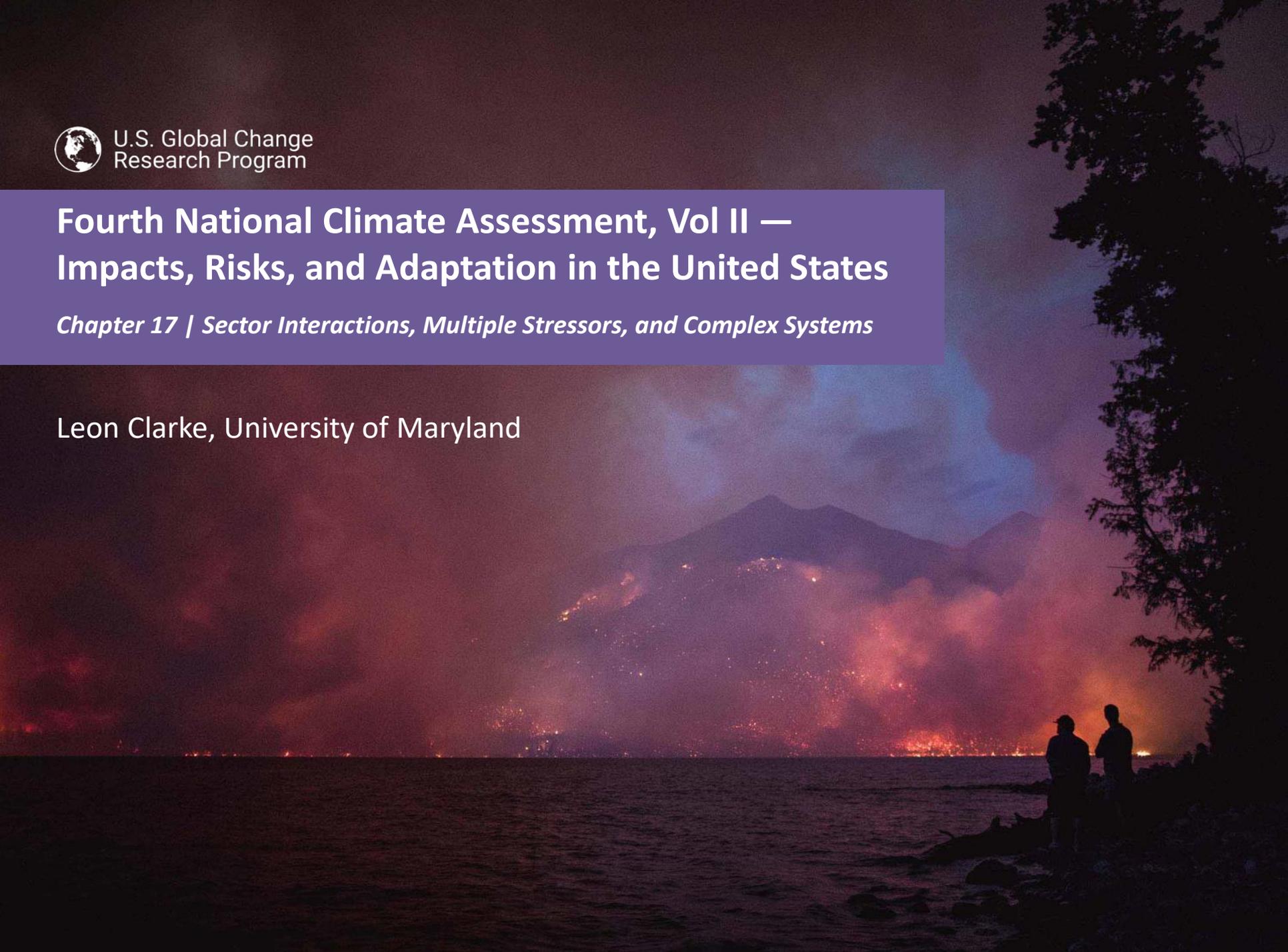
APPENDIX 4: Looking Abroad: How Other Nations Approach a National Climate  
Assessment



# Fourth National Climate Assessment, Vol II — Impacts, Risks, and Adaptation in the United States

*Chapter 17 | Sector Interactions, Multiple Stressors, and Complex Systems*

Leon Clarke, University of Maryland



# 17 Introduction

- Climate related risks such as **heat waves, floods, and droughts** can impact many of the natural, built, and social systems of the world we live in
- While these risks affect systems individually, **they also affect one another**, and often in ways that are hard to predict
- **Non-climate stressors** such as population growth, economic forces, technological change, and deteriorating infrastructure can further climate risks
- Assessing the risks associated with climate change requires also **understanding the complex dynamics** that arise from interactions and interdependencies among systems

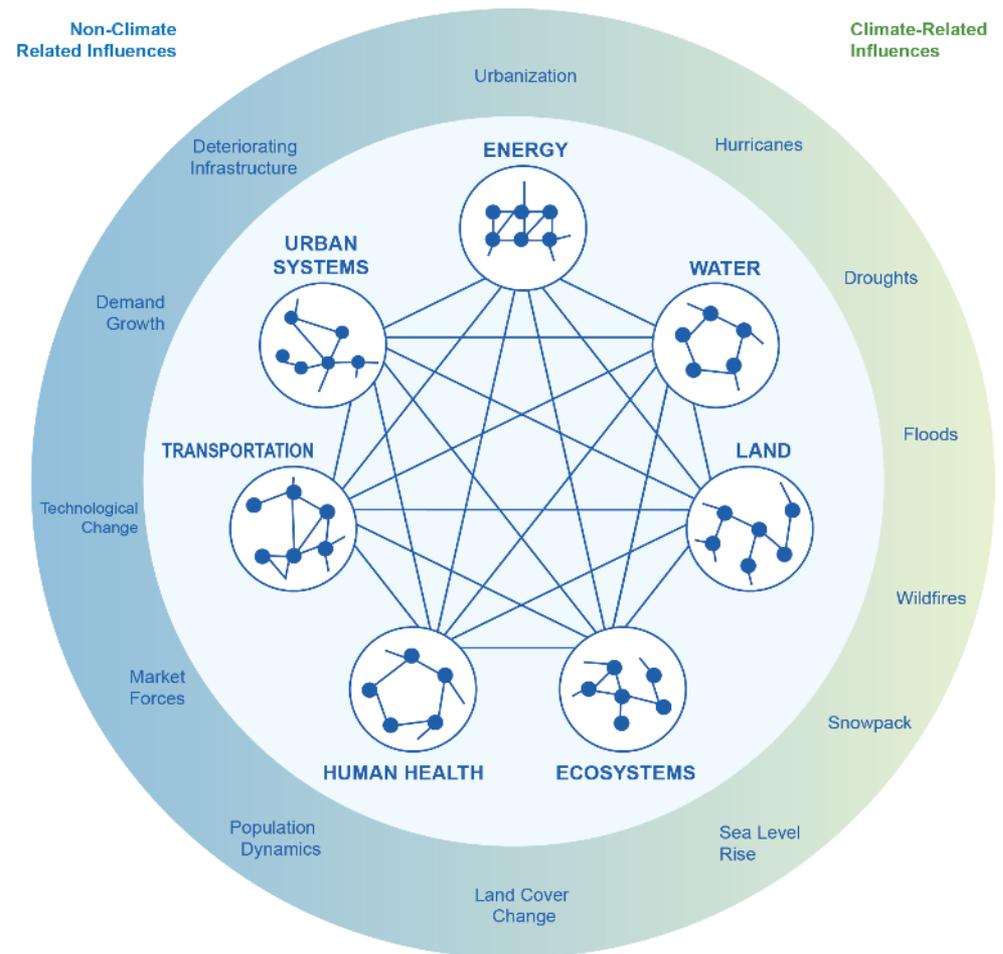
# 17 Key Message #1

## Interactions Among Sectors

The sectors and systems exposed to climate (for example, energy, water, and agriculture) interact with and depend on one another and other systems less directly exposed to climate (such as the financial sector). In addition, these interacting systems are not only exposed to climate-related stressors such as floods, droughts, and heat waves, they are also subject to a range of non-climate factors, from population movements to economic fluctuations to urban expansion. These interactions can lead to complex behaviors and outcomes that are difficult to predict. It is not possible to fully understand the implications of climate change on the United States without considering the interactions among sectors and their consequences.

## Fig. 17.1: Complex Sectoral Interactions

Sectors are interacting and interdependent through physical, social, institutional, environmental, and economic linkages. These sectors and the interactions among them are affected by a range of climate-related and non-climate influences. *Sources: Pacific Northwest National Laboratory, Arizona State University, and Cornell University.*



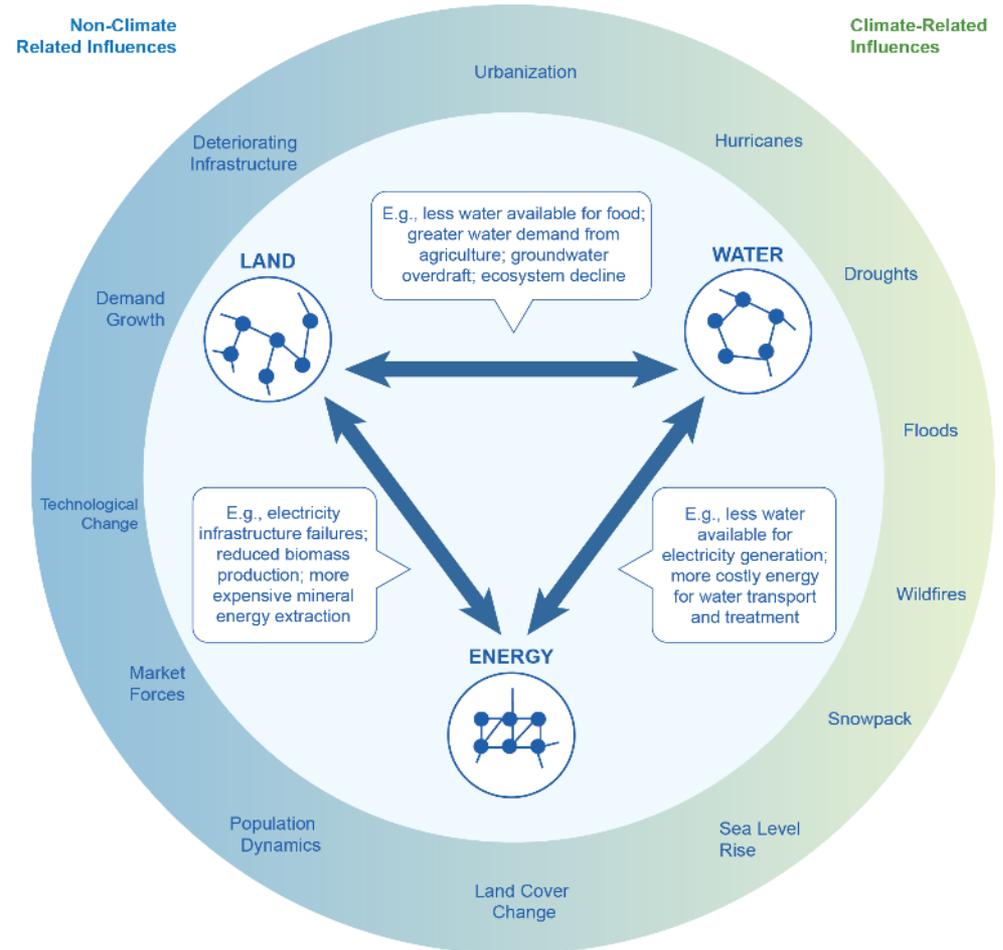
## Fig. 17.2: Hurricane Harvey Flooding

Hurricane Harvey led to widespread flooding and knocked out power to 300,000 customers in Texas in 2017, with cascading effects on critical infrastructure facilities such as hospitals, water and wastewater treatment plants, and refineries. The photo shows Port Arthur, Texas, on August 31, 2017—six days after Hurricane Harvey made landfall along the Gulf Coast. *Photo credit: Staff Sgt. Daniel J. Martinez, U.S. Air National Guard.*



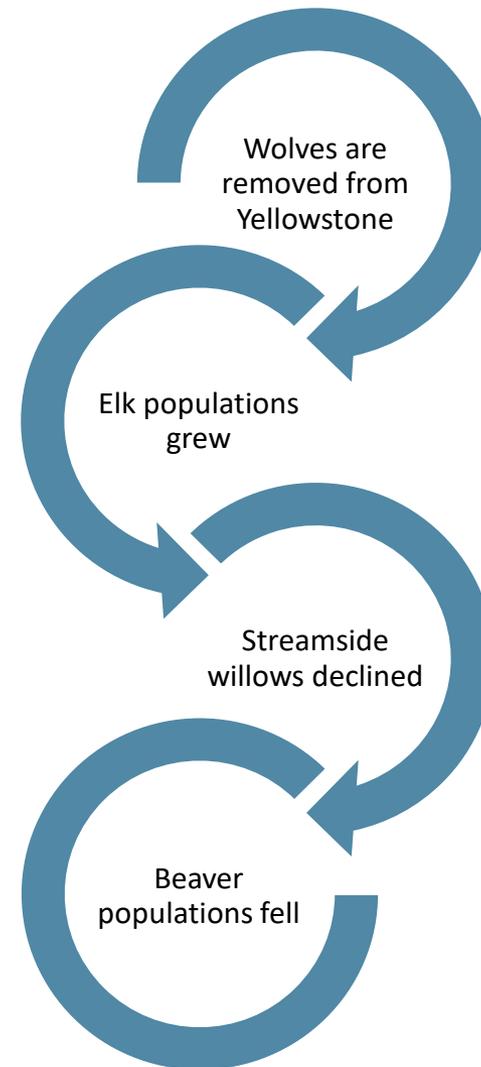
## Fig. 17.3: Energy–Water–Land Interactions

Energy, water, and land systems are interconnected and impacted by both climate-related and non-climate stressors. These influences affect these systems individually as well as the dynamics among these sectors. A multisector perspective is necessary to understand risks and develop response strategies that enhance resilience across multiple systems. *Sources: Pacific Northwest National Laboratory, Arizona State University, and Cornell University.*



## Uncovering System Complexities: Wolves and the Yellowstone Ecosystem

Since wolves have been reintroduced, there have been some effects on willow stands, but these appear to largely be due to reductions in overall elk number, rather than strictly to behavioral responses to the presence of the wolves. But in areas where beavers were also lost, the overall system has not returned to its state before the eradication of wolves. The changes due to the loss of beavers have apparently reduced the capacity of the system to return to its original state, even when the wolves returned.



# 17 Key Message #2

## Multisector Risk Assessment

Climate change risk assessment benefits from a multisector perspective, encompassing interactions among sectors and both climate and non-climate stressors. Because such interactions and their consequences can be challenging to identify in advance, effectively assessing multisector risks requires tools and approaches that integrate diverse evidence and that consider a wide range of possible outcomes.

# 17 Key Message #3

## Management of Interacting Systems

The joint management of interacting systems can enhance the resilience of communities, industries, and ecosystems to climate-related stressors. For example, during drought events, river operations can be managed to balance water demand for drinking water, navigation, and electricity production. Such integrated approaches can help avoid missed opportunities or unanticipated tradeoffs associated with the implementation of management responses to climate-related stressors.



## Fig. 17.4: Wildfire at the Wildland–Urban Interface

Wildfires pose significant health and economic impacts through interfaces between wildlands and human settlements. Shown here is a wildfire in the Whiskeytown National Recreation Area in California in August 2004. *Photo credit: Carol Jandrall, National Park Service.*



## Fig. 17.5: Northeast Blackout

During the August 2003 blackout, an estimated 50 million people in Canada and the northeastern United States lost power, with cascading impacts on public health and critical infrastructure. These images show (clockwise from upper left): nighttime satellite imagery of the area before the outage; the same view during the blackout; people walking on the Manhattan Bridge; and passengers being evacuated from a subway train on the Manhattan Bridge during the outage. *Image credits: (top) NOAA; (bottom left) Jack Szwergold ([CC BY-NC 2.0](https://creativecommons.org/licenses/by-nc/2.0/)); (bottom right) Eric Skiff ([CC BY-SA 2.0](https://creativecommons.org/licenses/by-sa/2.0/)).*

# 17 Key Message #4

## Advancing Knowledge

Predicting the responses of complex, interdependent systems will depend on developing meaningful models of multiple, diverse systems, including human systems, and methods for characterizing uncertainty.



U.S. Global Change  
Research Program

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## Read the full chapter

<https://nca2018.globalchange.gov/chapter/complex-systems>

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