

In the Path of the Storm

Weather-Related Disasters, Extreme Precipitation,
and the Implications for New England
and the U.S. in a Warming World

Tony Dutzik
Senior Policy Analyst, Frontier Group
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Today's Presentation

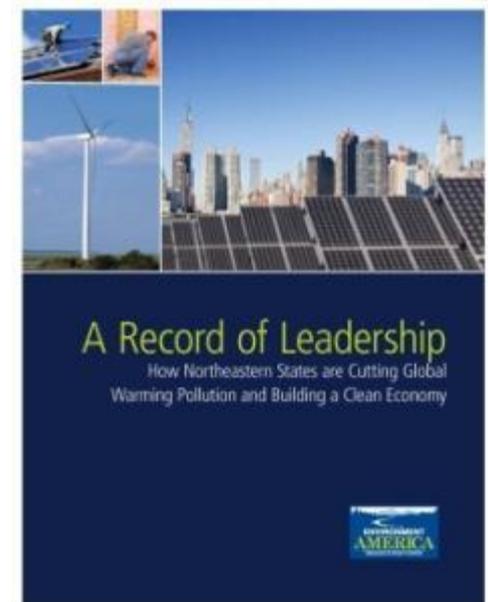
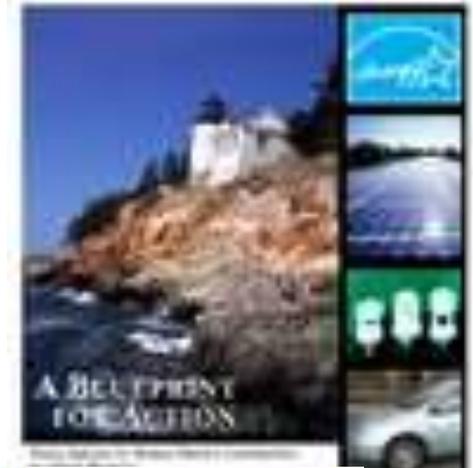
- ▶ Introducing Frontier Group
- ▶ Role of extreme weather in public discussion of climate change
- ▶ Recent findings
 - Extreme precipitation
 - Weather-related disasters
- ▶ Looking toward the future

Introducing Frontier Group

- ▶ Non-profit, multi-issue public interest think tank, founded in 1996.
- ▶ Part of larger network of public interest advocacy organizations, including Environment America and its state affiliates, with whom we often partner on research endeavors.
- ▶ Unique focus on state-level policy issues.

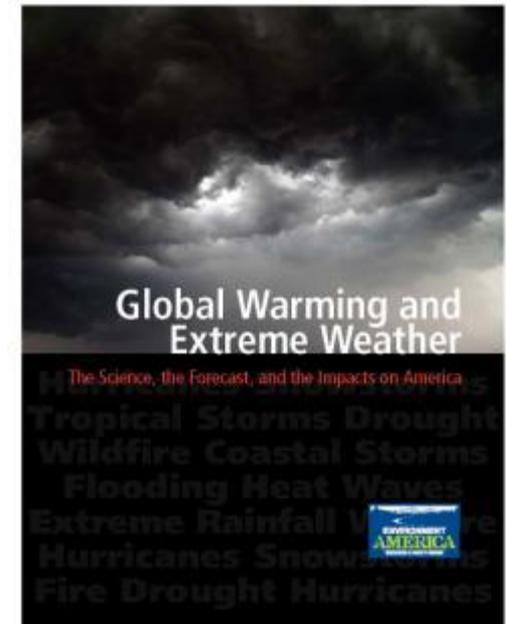
A Decade of Work on Climate Change in New England

- ▶ Early work focused on emission reduction strategies and policies.
- ▶ Provided research support for New England Climate Coalition (2003–08), evaluating NEG/ECP process regionally and state efforts. Continuing work on Regional Greenhouse Gas Initiative.
- ▶ Need to highlight the local impacts of climate change to tell story that resonates at state and local level.
- ▶ In Northeast, tremendous work done by many to create locally relevant content on climate change impacts.



Work Related to Climate Change Impacts

- ▶ *When It Rains It Pours* – 2007 edition, detailed national and local trends in extreme precipitation.
- ▶ *Global Warming and Extreme Weather* – 2010 edition, reviewed links between climate science and various types of extreme weather events.
- ▶ Plus the two 2012 reports we'll be discussing today.



Why Talk About Extreme Weather?

From a climate communications standpoint:

- ▶ Kitchen table topic. People like to talk about the weather.
- ▶ Nearly universally relevant. Almost everyone has experienced some form of extreme weather.
- ▶ Strong scientific evidence linking increases in frequency or severity of some types of extreme weather to global warming, if not attribution of specific incidents (though even that is beginning to emerge).

Why Talk About Extreme Weather?

Substantively, it's very important

- Key societal decisions regarding public and private investments are made based on the historical climate record.
- The historical record is becoming less and less relevant to those decisions
- People, environment and infrastructure are at risk.



Impacts of Extreme Weather

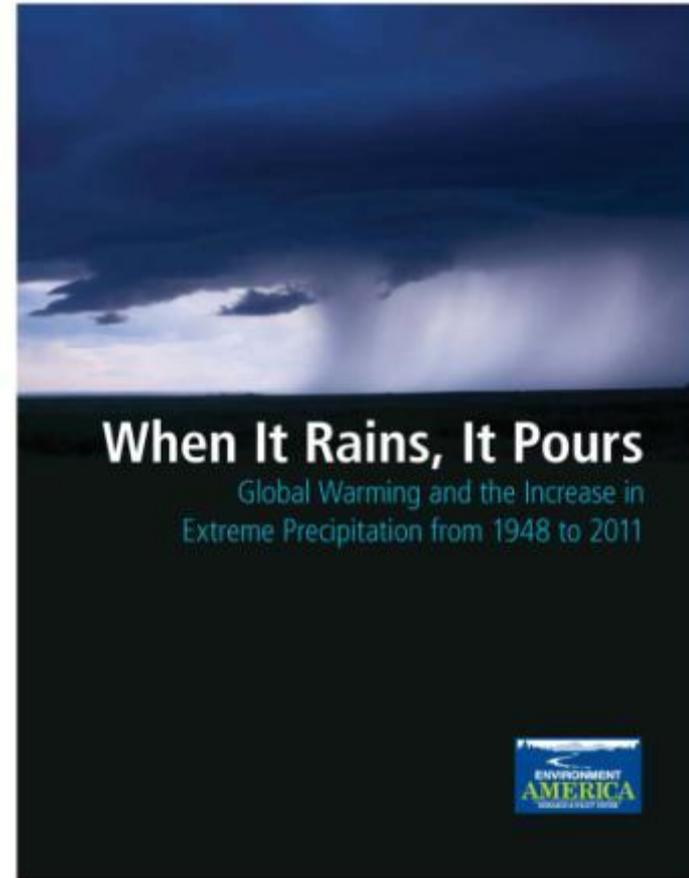
Beyond “dollars and cents”

- Death and injury.
- Permanent changes to ecosystems.
- Property and crop damage.
- Emergency response costs.
- Economic disruption.
- Investments in preventive measures (i.e., adaptation costs)
- Broader and longer-term impacts. (e.g., *NYT Magazine* story: “Since Katrina, parts of me have grown,” the final entry said. “And much of me still remains broken.”)

When It Rains It Pours: National Summary

On average across the contiguous United States, from 1948 to 2011:

- ▶ Extreme rainstorms and snowstorms became 30 percent more frequent.
- ▶ The largest annual rainstorms and snowstorms produced 10 percent more precipitation.



Background

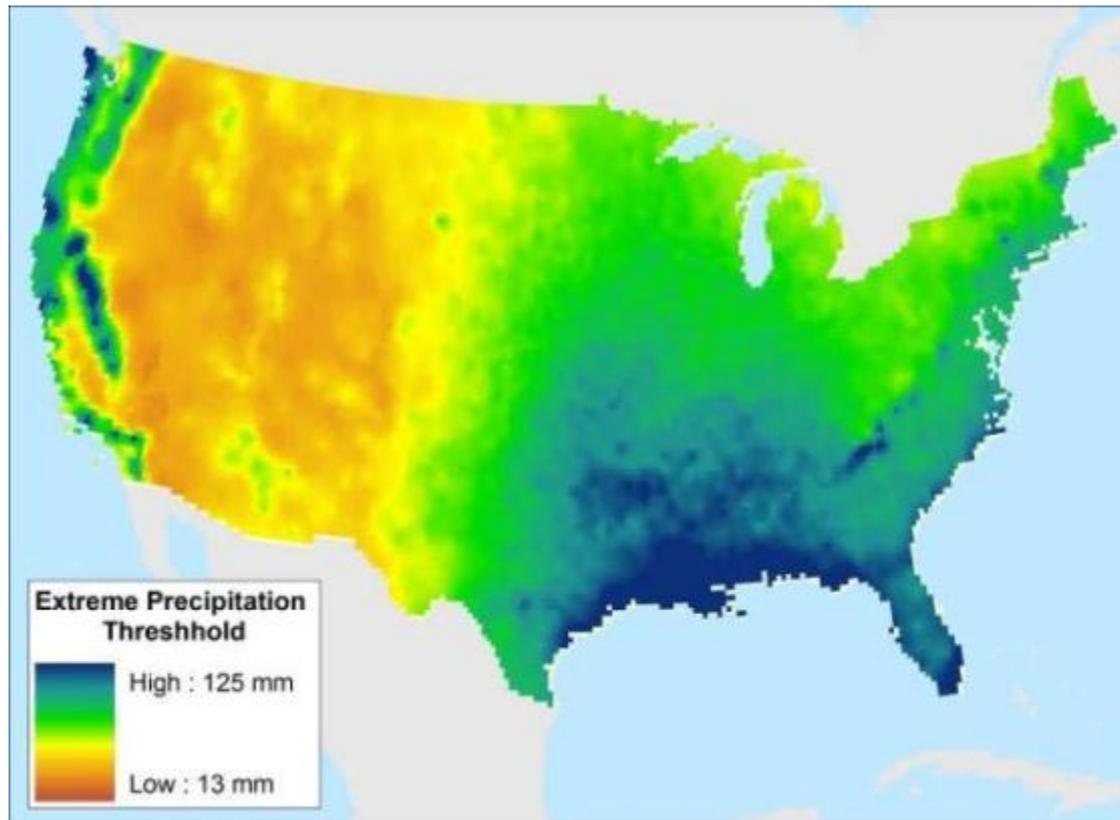
- Based on well-established methodology (first developed in K. Kunkel et al., “Long-Term Trends in Extreme Precipitation Events over the Conterminous United States,” *Journal of Climate* 12: 2515–2527, 1999.)
- Conservative approach to data (elimination of data with quality flags, analysis of statistically significant trends, elimination of weather stations with incomplete records.)

We Used Daily Precipitation Data from 3,700 Weather Stations

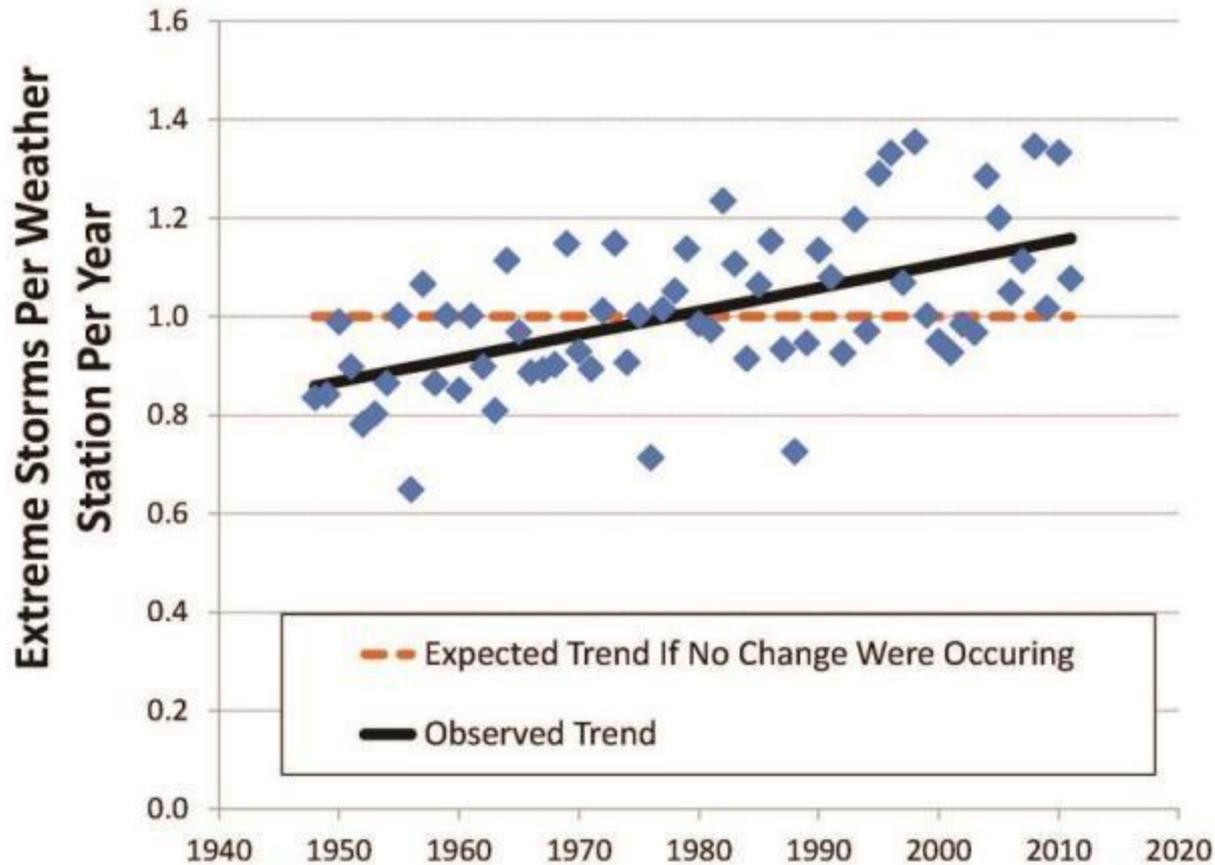


We Defined Extreme Precipitation Relative to the Local Climate

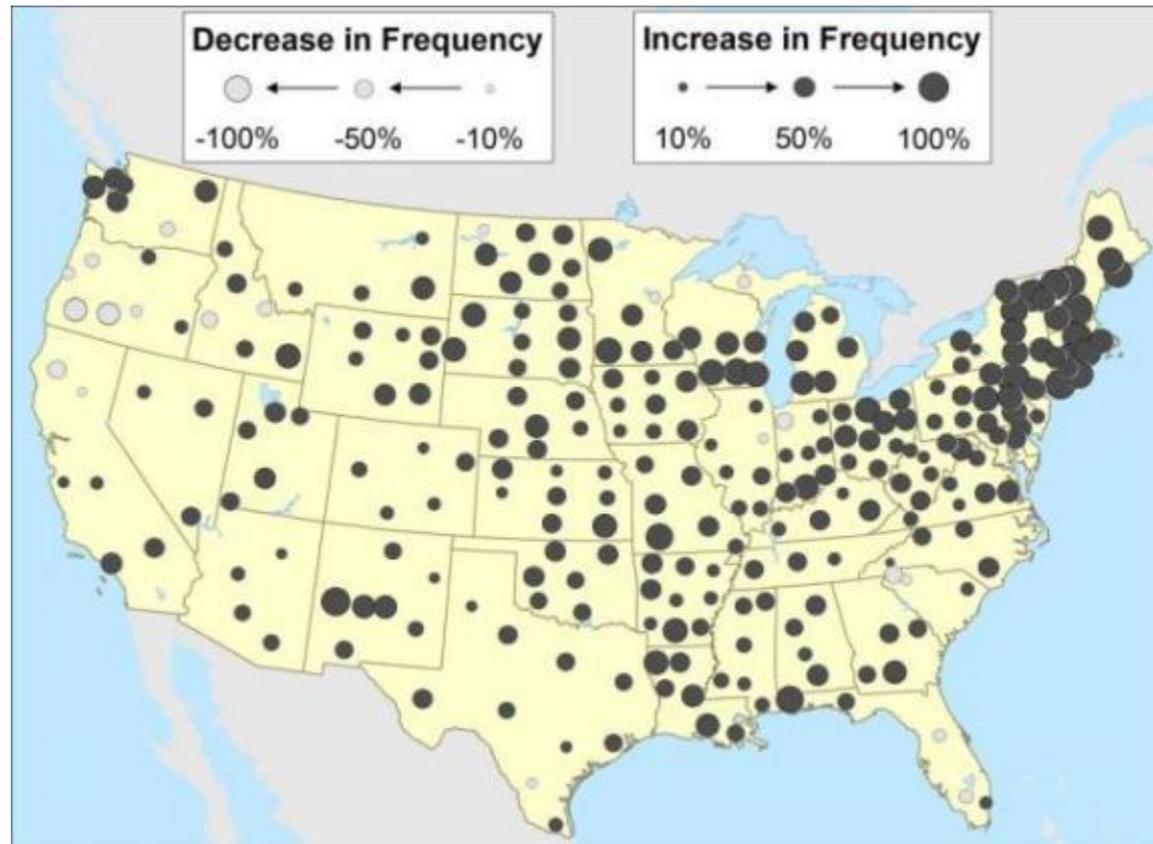
Threshold = “one-year” storm, based on 24-hour precipitation total.



Extreme Rainstorms and Snowstorms Have Become More Frequent

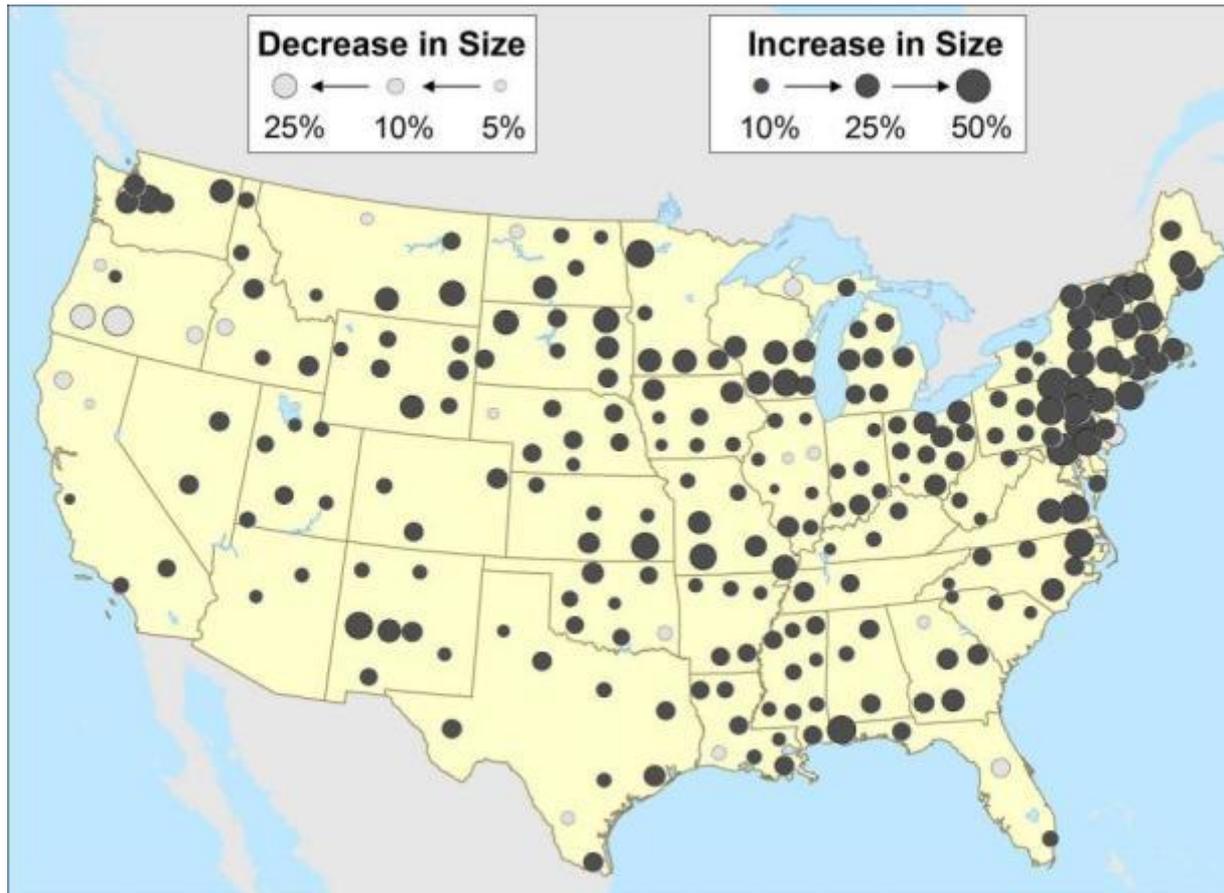


Extreme Precipitation Became More Frequent Across Most of the Nation



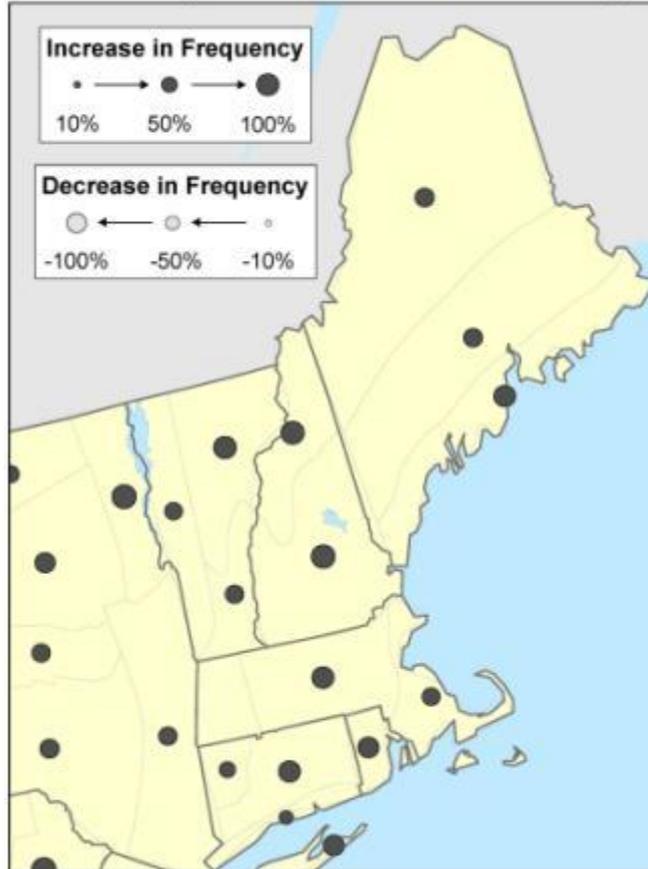
Only statistically significant changes shown.

The Biggest Storms Have Become Bigger



In New England ...

Extreme Downpours Have Become More Frequent



Frequency of extreme downpours increased by 85% between 1948 and 2011. (Most of any U.S. region.)

Significant trend in all six New England states:

CT: 73% increase

MA: 81%

ME: 74%

NH: 115%

RI: 90%

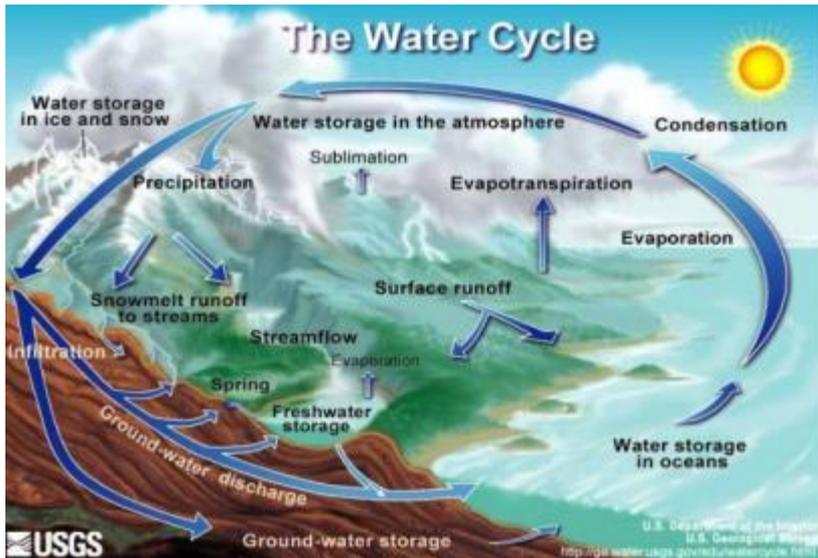
VT: 84%

Also, regional increase of 26% in size of largest annual downpour. (Significant trend in all states except RI: small sample.)

By state

- ▶ 43 states saw significant increase in frequency of extreme precipitation (only one, Oregon, saw significant decrease)
 - ▶ Similarly, 43 states saw significant increase in amount of precipitation dropped by largest annual storm (not the same states).
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Confirmed by Science, Linked to Climate Change

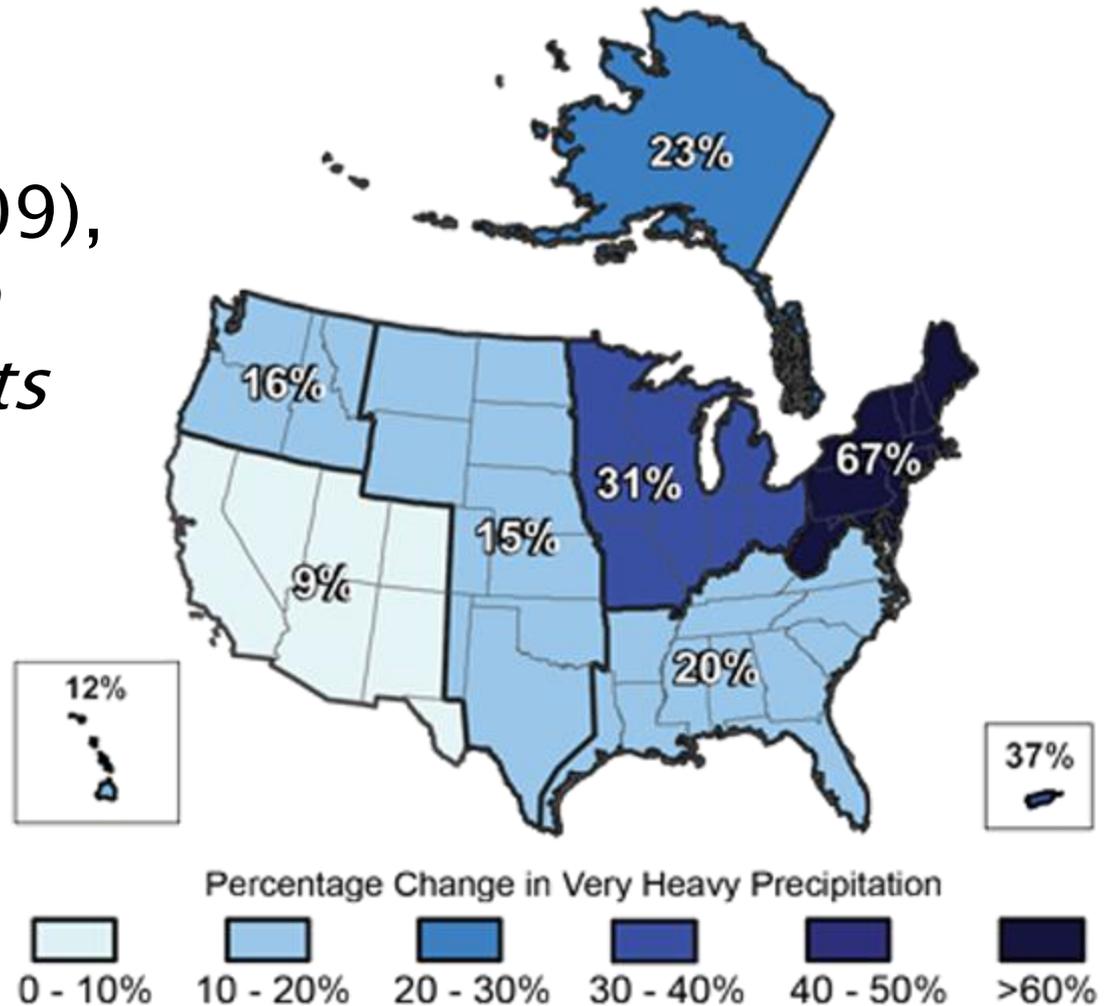


Consistent with increase in atmospheric water vapor.

“One of the clearest precipitation trends in the United States,” U.S. Global Change Research Program, *Global Climate Change Impacts in the United States*, 2009.

“It is likely that the frequency of heavy precipitation ... will increase in the 21st century over many areas of the globe.” IPCC, *Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation*, 2012.

- ▶ U.S. GCRP (2009), *Global Climate Change Impacts in the U.S.*



1958–2007 trend

Comparison with 2007 report

- ▶ 1948–2006 data: 24% nationwide increase in extreme precipitation frequency; 61% in New England.
- ▶ 1948–2011 data: 30% nationwide increase in extreme precipitation frequency, 85% in New England.
- ▶ Data are not strictly comparable, but suggest that trend toward increasing heavy precipitation may be accelerating.

When it Rains, It Pours: The Takeaway

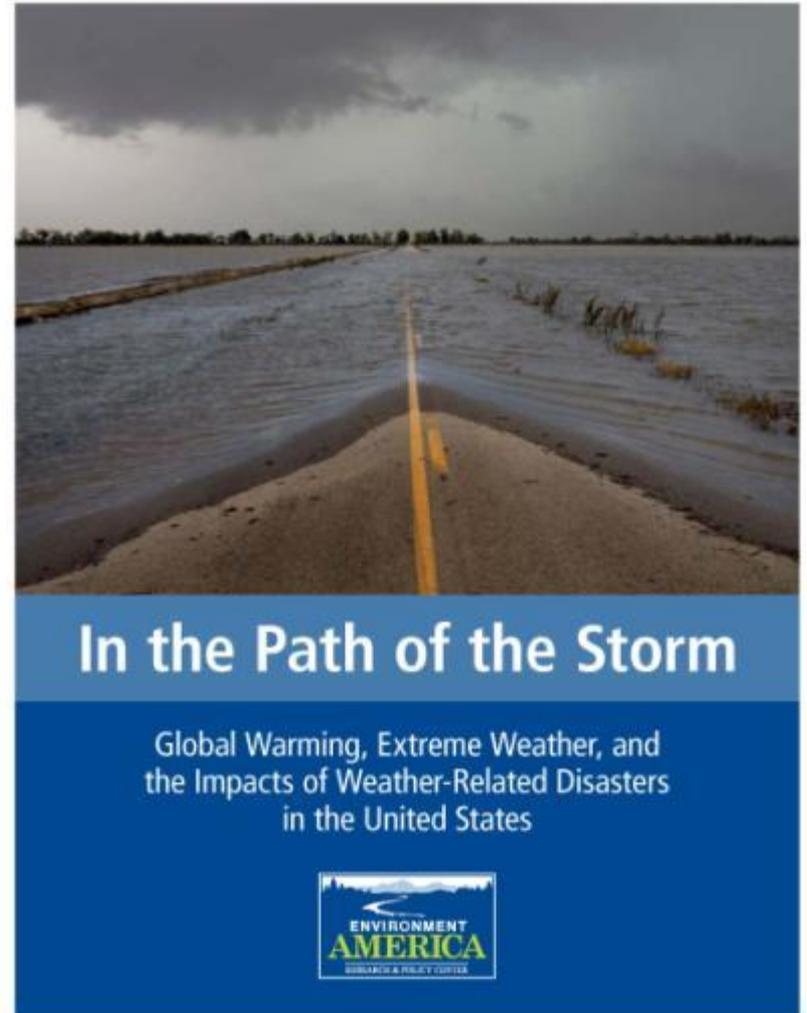
- ▶ Increases in the frequency and severity of extreme precipitation events are anticipated results of climate change.
- ▶ The United States is already experiencing a trend toward increases in heavy precipitation.
- ▶ These trends have thus far been most pronounced in the New England states.

In the Path of the Storm: National Summary

242 million Americans – four out of five – live in counties that experienced a presidentially declared weather-related disaster from 2006 to 2011.

Average of 88 million Americans affected per year, 2001–2011.

>15 million Americans experienced an average of one or more weather-related disasters *per year* between 2006 and 2011.



Objectives and Data

- To demonstrate the widespread and serious impacts of weather-related disasters in the United States.
- To review latest science on links between global warming and various types of extreme weather events.
- Not to assert attribution of any specific event – or even every category of event – to climate change.

Data on presidentially declared weather-related disasters obtained from FEMA.

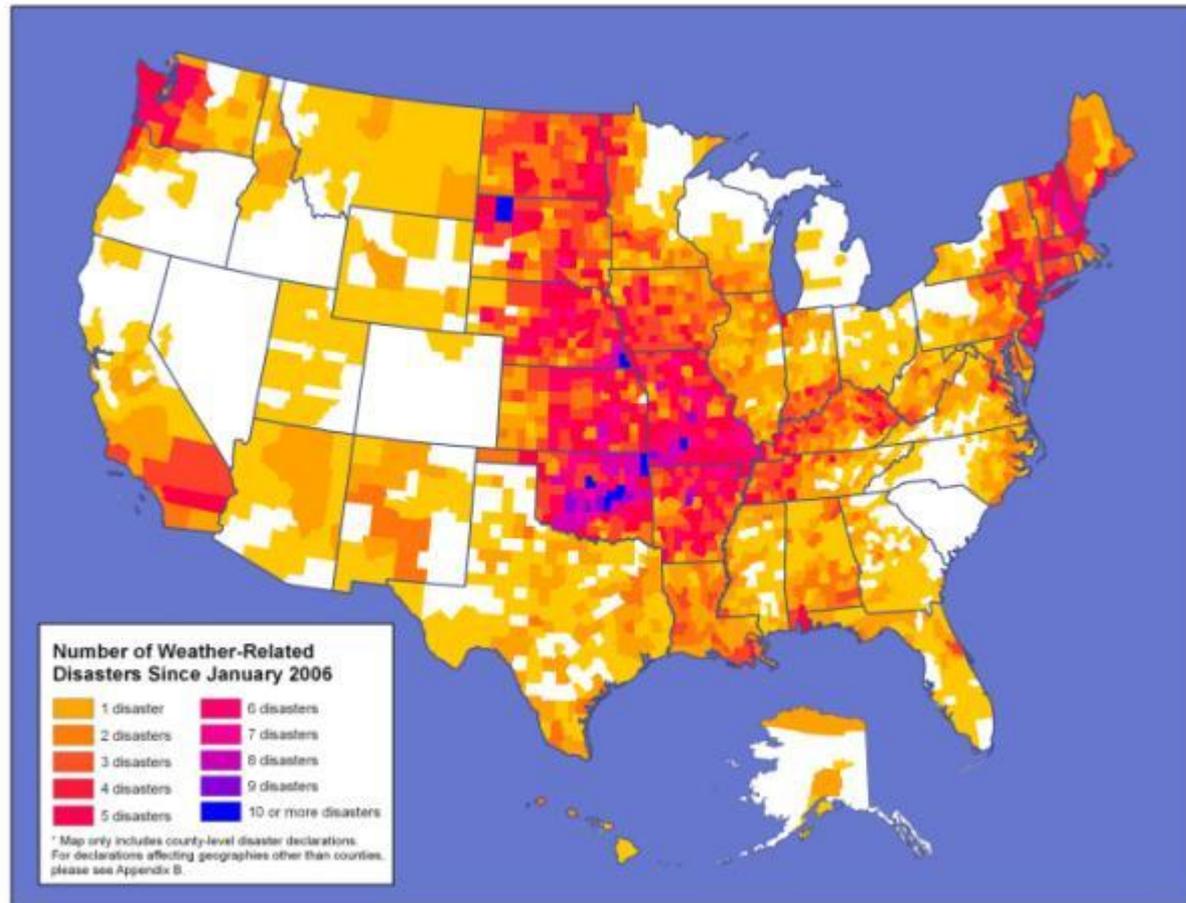
(FEMA misses some types of extreme weather impacts – such as impacts from drought – which are subject to USDA disaster declarations.)

Why Disaster Declarations Matter

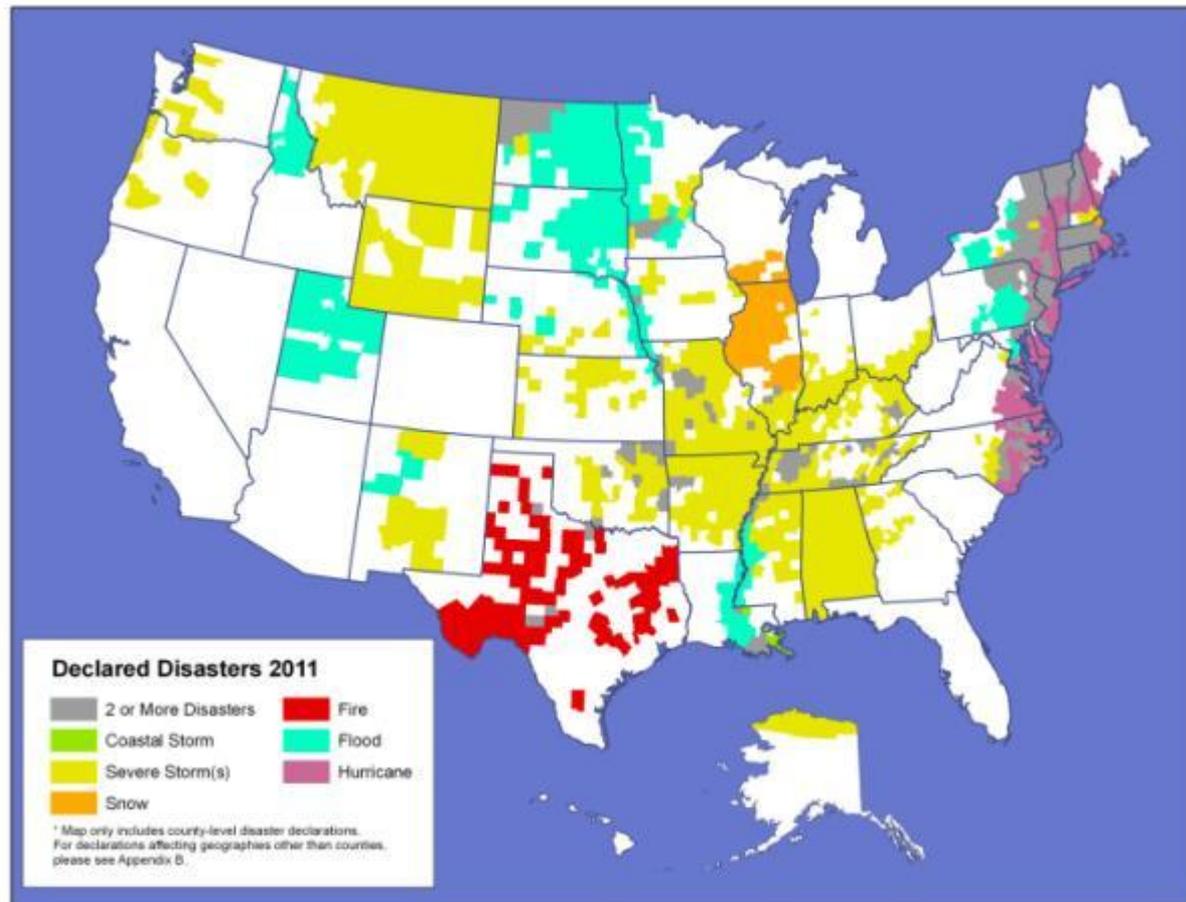
- Disaster = event that causes damage that exceeds a community's ability to cope and is recognized as a disaster.
- Inherently subjective – based on human perceptions and a community's resources and preparedness.

Trends in weather-related disasters cannot tell us much about extreme weather ... but they can help us understand the potential impacts of extreme weather on society.

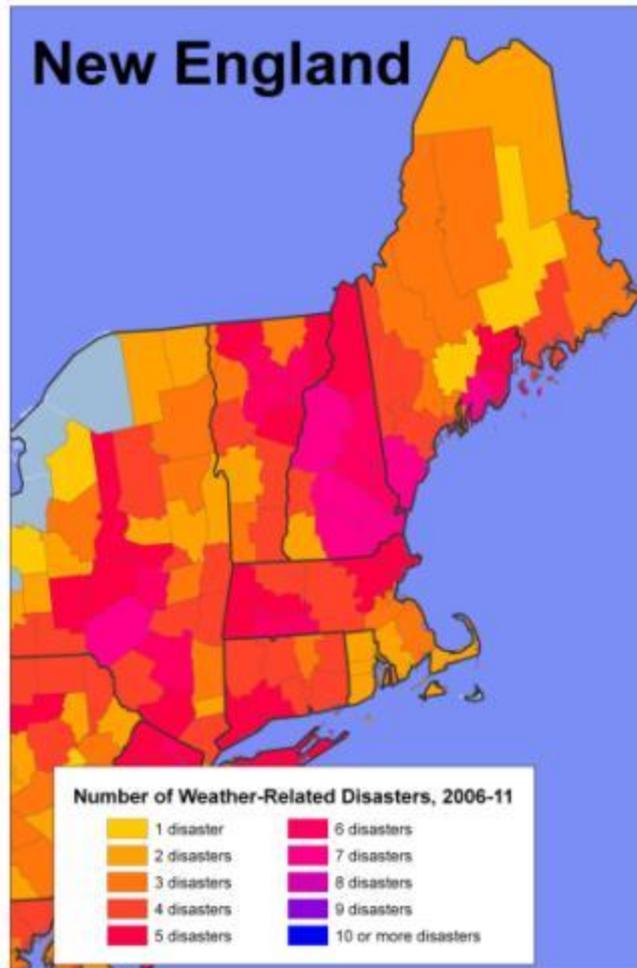
County-level disaster declarations, 2006-11



Disaster declarations in 2011 by type of event



In New England ...



Weather-related disasters affected residents of every New England county between 2006–2011.

15 New England counties averaged > 1 disaster per year (8 in NH, 3 in ME, 3 in VT, 1 in MA)

Weather-Related Disasters in New England

Hurricane Irene

“... it was Irene’s massive size and intense rains – rather than its winds or storm surge – that caused the greatest damage ...”



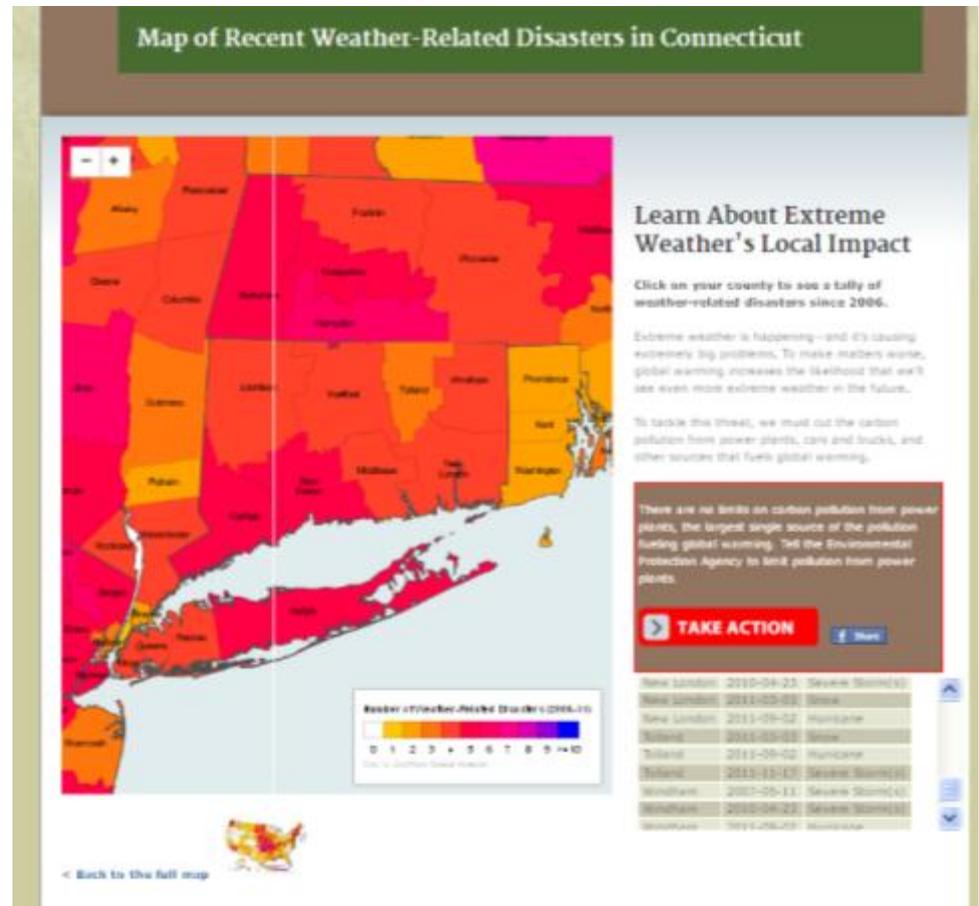
Wendell Davis, FEMA

Freak October Snowstorm

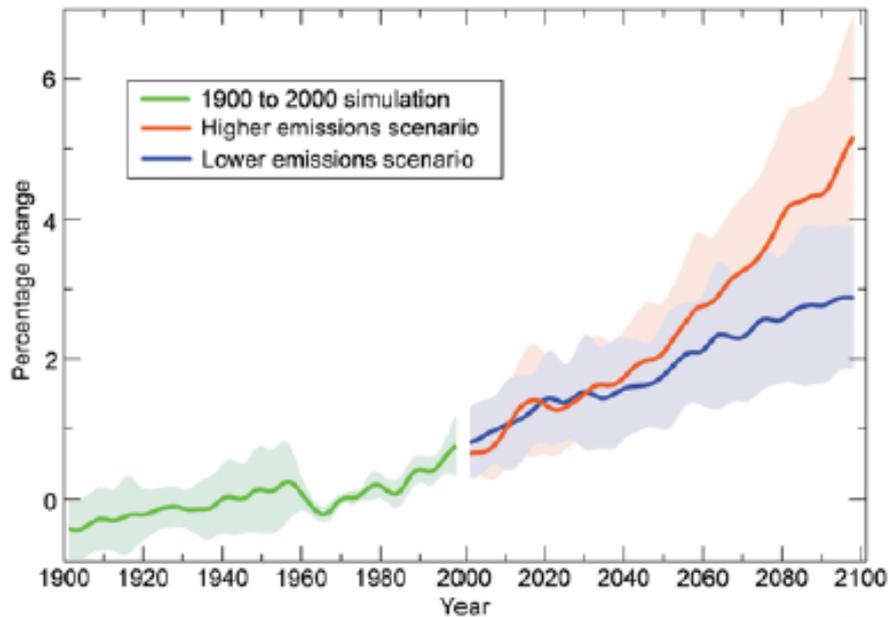
“ ... what was exceptional about the storm was not the cold but the convergence of cold with a moisture-packed storm of the type that scientists believe will be capable of holding and dropping more precipitation in a warming world ...”

Interactive map

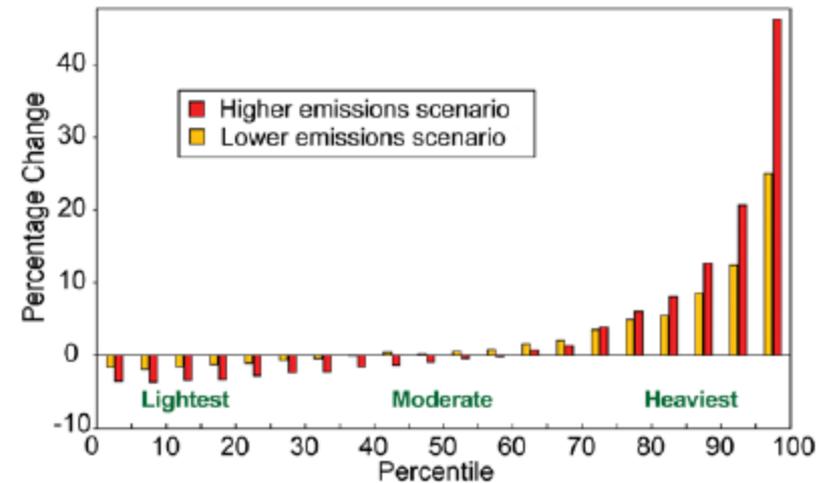
Partners at Environment America developed clickable, interactive map enabling users to identify extreme weather events that had taken place in their state/county.



Future Global Trends in Extreme Precipitation



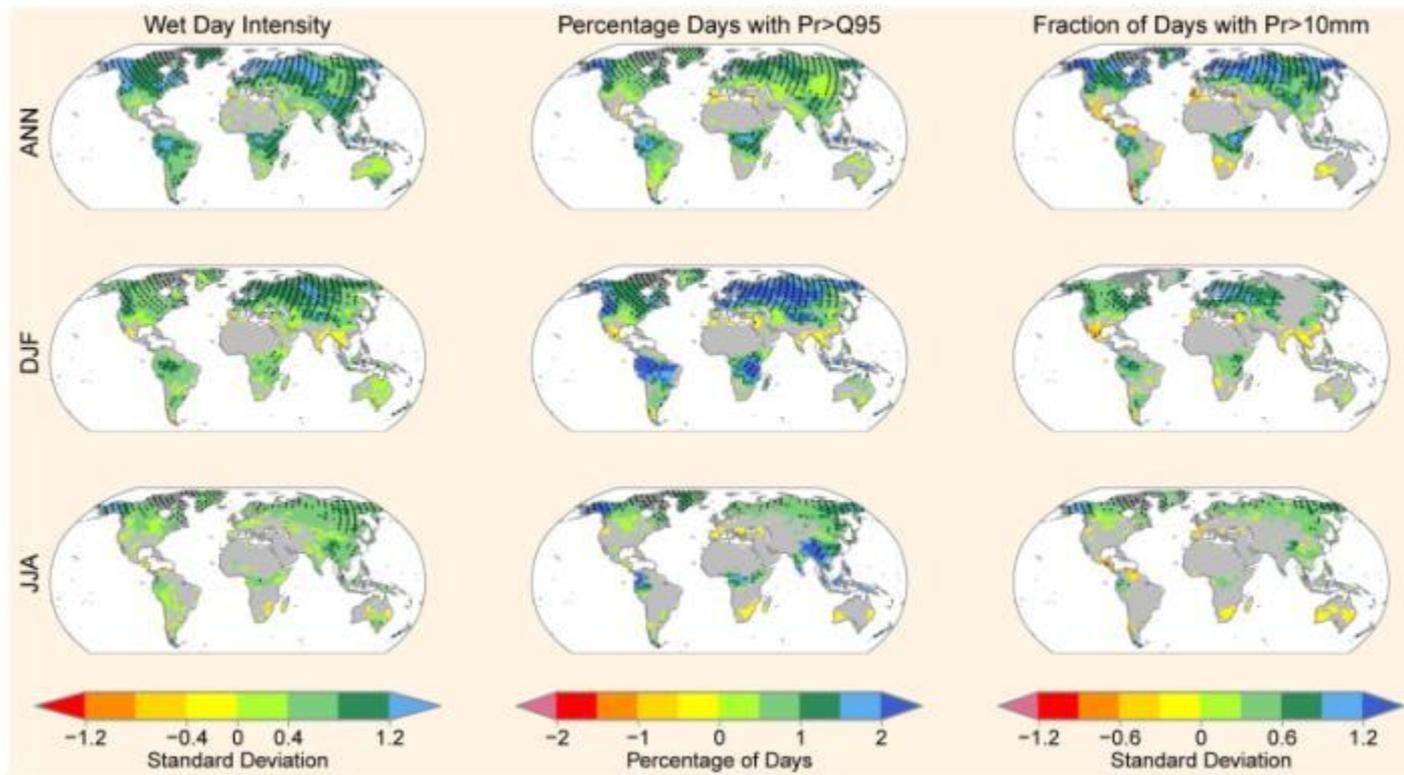
This figure, produced by the U.S. Global Change Research Program, shows the projected increase in the amount of daily precipitation over the globe that falls in the heaviest 5 percent of downpours in a given year, compared to the 1960-1979 average. As a result of global warming, heavy downpours are very likely to further increase in frequency and intensity, with more emissions producing greater changes. The lines represent central projections, while the shaded areas show likely ranges. On the world's current emissions trajectory, we may exceed even the higher emissions scenario shown here.⁷²



This figure, produced by the U.S. Global Change Research Program, shows projected changes from the 1990s average to the 2090s average in the amount of precipitation falling in light, moderate and heavy precipitation events in North America. The x-axis represents the spectrum of precipitation event size, with the lightest drizzles on the left and the heaviest, most unusual downpours on the right. The figure shows that the largest changes are anticipated at the highest extreme, with the heaviest downpours becoming much more intense as a result of global warming, while the lightest storms become slightly less intense. It also shows that higher emissions of global warming pollution produce larger impacts.⁷⁴

U.S. GCRP, 2009.

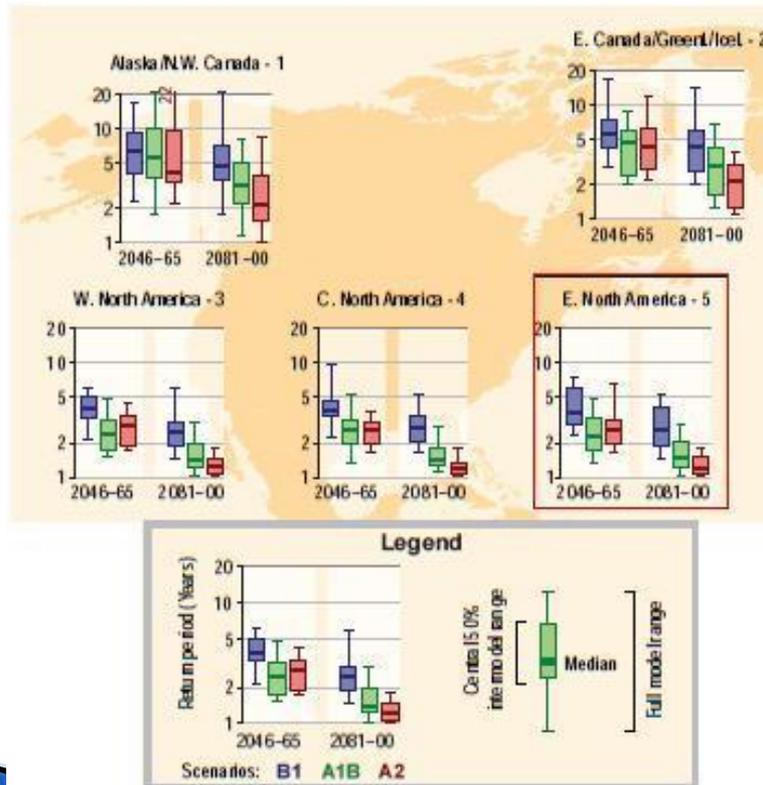
Future Regional Trends



IPCC, *Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation*, 2012

Future Regional Trends

Projected return time of late 20th century “20-year storm” under various emissions scenarios. Could drop to 2–5 yrs. by mid-century.



IPCC, *Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation*, 2012

Looking Toward the Future

- Recognize that changes in patterns of extreme weather are important both for communicating the stakes of climate change and for adaptation planning.
- Work with scientific community to develop locally relevant assessments of extreme weather and impacts (beginning to happen).
- In New England, changes in extreme precipitation already appear to be a leading indicator of climate change ...

Resources

When it Rains, it Pours and *In the Path of the Storm* are both available at www.frontiergroup.org/our-research/global-warming

Interactive extreme weather map available at: www.environmentamerica.org/page/ame/map-recent-weather-related-disasters-united-states

Thank You

Tony Dutzik
Senior Policy Analyst
Frontier Group

44 Winter St., 4th Floor, Boston, MA 02108

617-747-4331

tony@frontiergroup.org

www.frontiergroup.org