

NIST Climate Portfolio Update

Visiting Committee on Advanced Technology

Disaster Resilient Buildings, Infrastructure, and Communities

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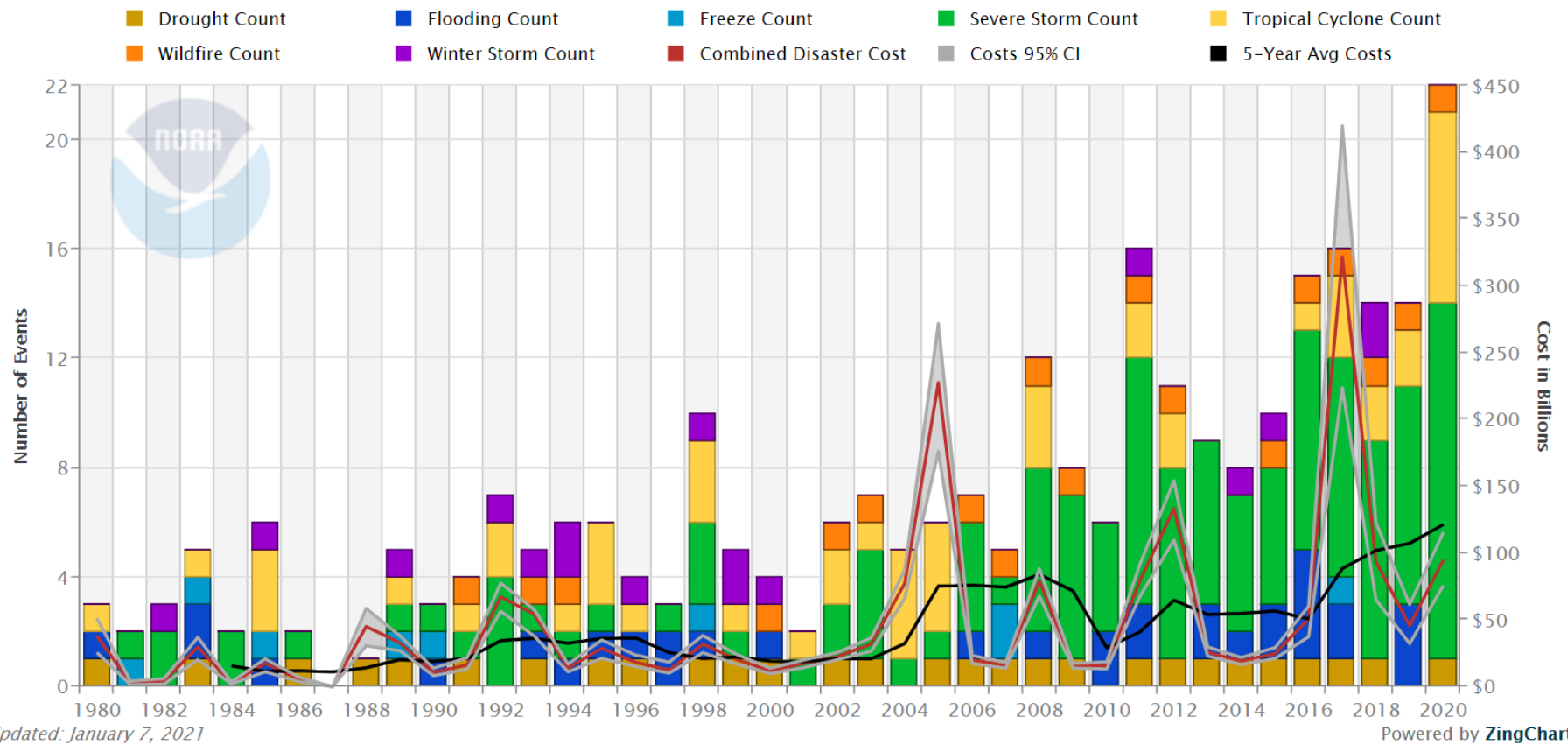
Disaster-Resilient Buildings, Infrastructure, and Communities Goal

Goal: To reduce the risk and enhance the resilience of buildings, infrastructure, and communities to natural and manmade hazards through advances in measurement science.



Disaster Resilient Buildings, Infrastructure, and Communities

United States Billion-Dollar Disaster Events 1980–2020 (CPI-Adjusted)



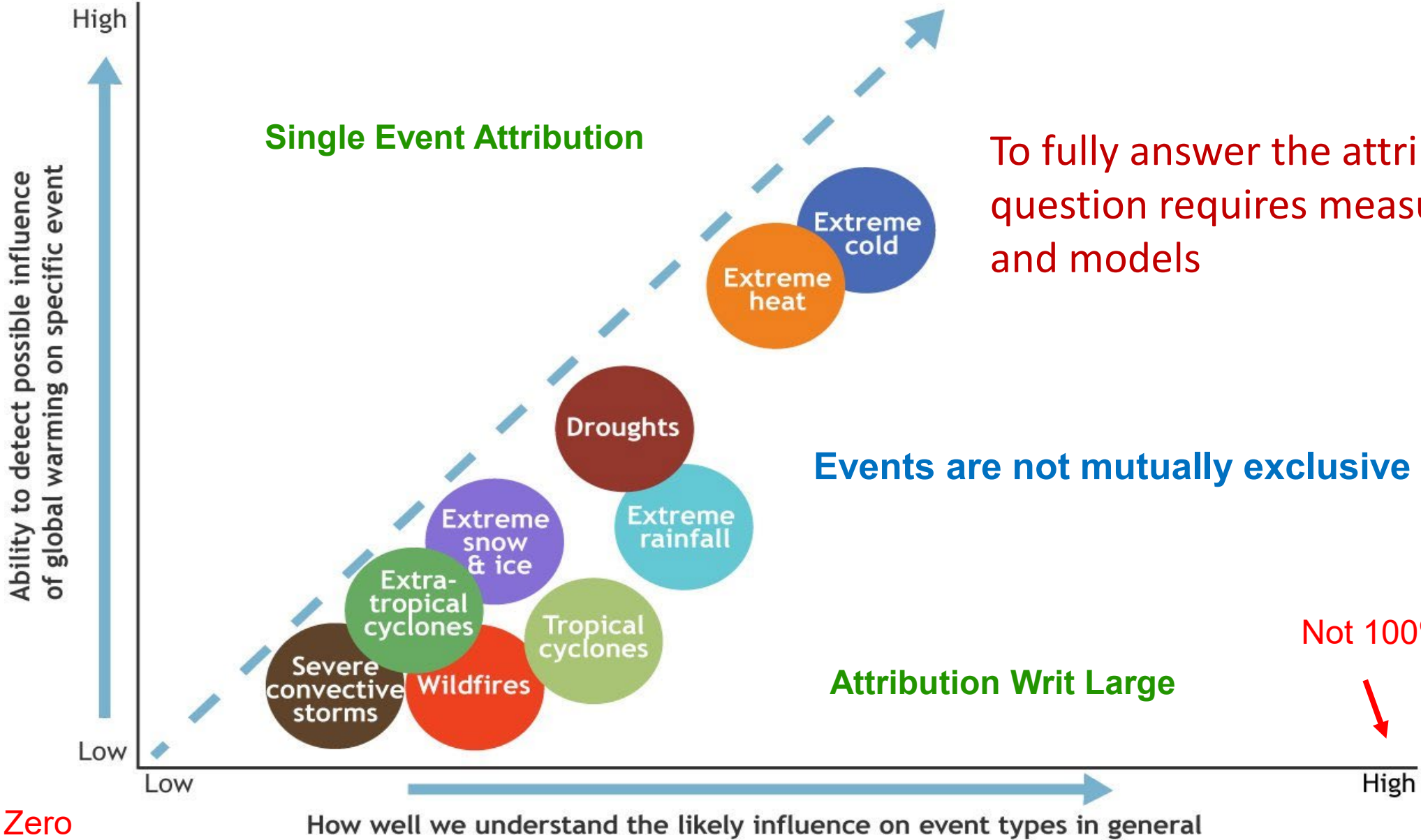
Through Oct 8, 2021:
18 weather/climate disaster events with losses exceeding \$1 billion :

- 9 severe storms,
- 4 tropical cyclones,
- 2 floods,
- 1 drought,
- 1 wildfire, and
- 1 winter storm.

The 1980–2020 annual average is 7.1 events (CPI-adjusted);
the annual average for the most recent 5 years (2016–2020) is 16.2 events (CPI-adjusted).

NAS Extreme Event Attribution Report 2016

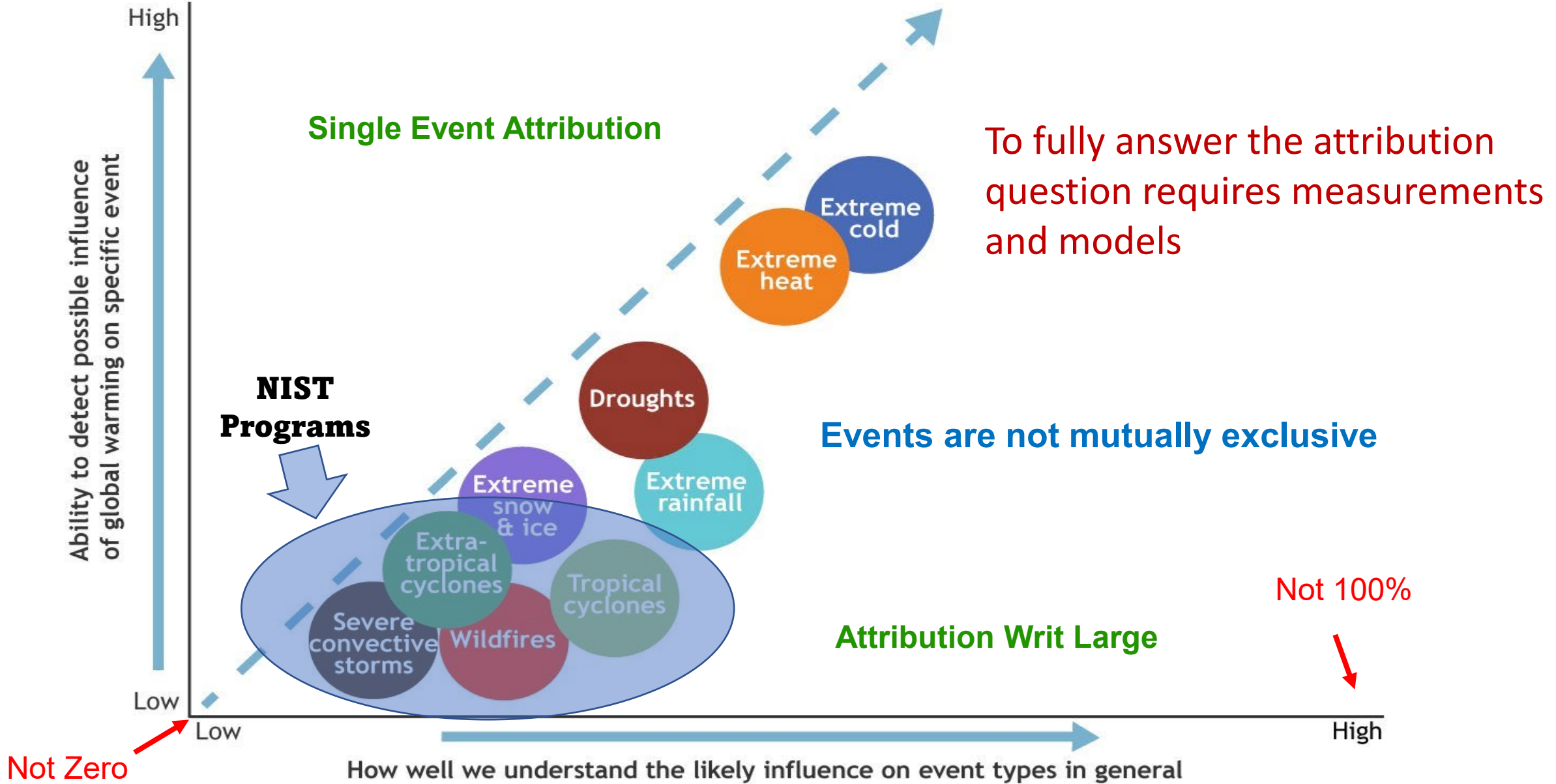
Relative confidence in attribution of different extreme events



To fully answer the attribution question requires measurements and models

NAS Extreme Event Attribution Report 2016

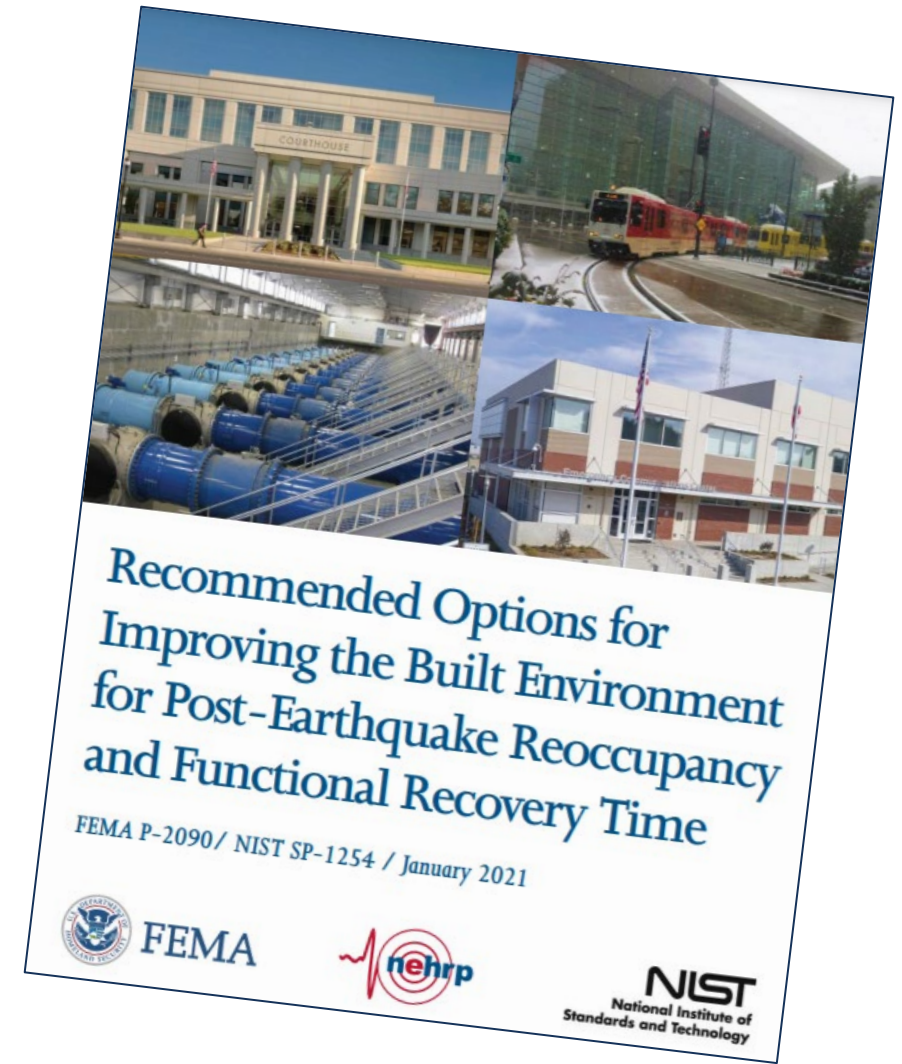
Relative confidence in attribution of different extreme events



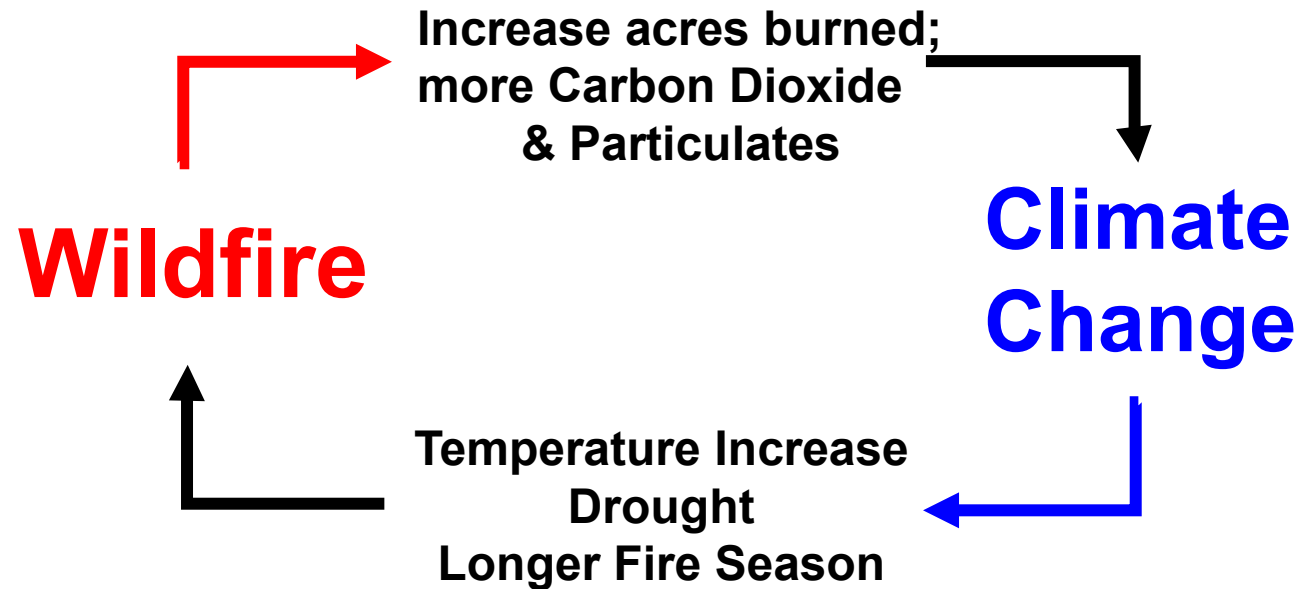
Changing Expectations

Citizens and community leaders now expect more than life safety from the built environment. Interruptions to schools, health care, employment, supply chain, & government services are less tolerated.

- These services are often unavailable due to damages to buildings, power, water/wastewater, communications, roads, bridges, and public transportation.



Example: Wildfires and Climate Change



Camp Fire, Paradise, CA, Nov 2018
from NASA Earth Observatory/Aqua/MODIS.

- **Global Wildfires**

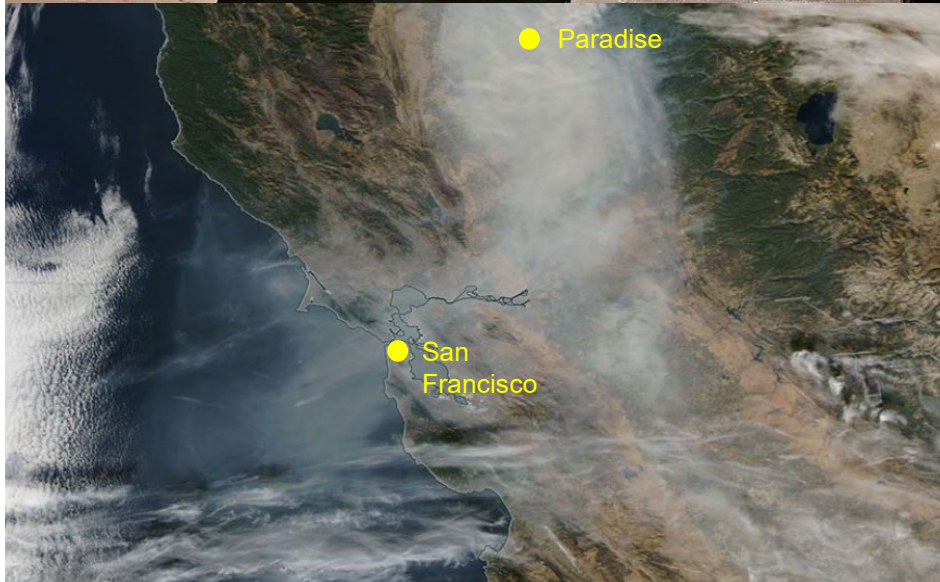
- Annual Global Carbon emission estimate (2017)
 - Carbon dioxide - 7.32 billion tons
 - Particulates- 46 million tons
 - About 24% of total carbon emissions
- Summer wildfire season are 40 to 80 days longer than 30 years ago
- Emit between 5 and 30 tons of carbon per hectare (2 to 12 t/acre) burned (brush vs forest)

- California- wildfire emission 25% of CO2 fossil fuel energy emissions
- Australia- 90% of industrial CO2 emissions
- Other major sources are fires in
Brazil
Siberia
Indonesia.....

Van Der Wert, G. et al., Global Fire Emissions Estimates during 1997-2016, Earth Syst. Sci. Data, 9, 697-720, 2017
https://www.futuredirections.org.au/publication/wildfires-greenhouse-gas-emissions-and_climate-change/

Alberts, E. C., Off the Chart: CO2 from California fires dwarf state's fossil fuel emissions, Mongabay News, 9/18/2020

Smoke from Camp Fire (2018)



- Destroyed over 19,000 structures
- Paradise CA –
 - San Francisco CA - 275 km (171 miles)
 - Sacramento CA – 142 km (88 miles)
- Sacramento, CA –
 - Worst air pollution for any major city on Earth (11/16/2018)
 - Beating out big cities in India and China
 - 24 hour PM 2.5 – $> 145 \mu\text{g}/\text{m}^3$

Masters, J., Smoke from Camp Fire Making Sacramento the Most Polluted City, Weather Underground, November 16, 2018

NWIRP Strategic Plan

Goal A

Improve Understanding of Windstorm Processes and Hazards

Objective 1: Advance understanding of windstorms and associated hazards

Objective 2: Develop tools to improve windstorm data collection and analysis

Objective 3: Understand long term trends in windstorm frequency, intensity, and location

Objective 4: Develop tools to improve windstorm hazard assessment

Goal B

Improve Understanding of Windstorm Impacts on Communities

Objective 5: Advance understanding of windstorm effects on the built environment

Objective 6: Develop computational tools for use in wind and flood modeling on buildings and infrastructure

Objective 7: Improve understanding of economic and social factors influencing windstorm risk reduction measures

Objective 8: Develop tools to improve post-storm impact data collection, analysis, and archival

Objective 9: Develop advanced risk assessment and loss estimation tools

Goal C

Improve Windstorm Resilience of Communities Nationwide

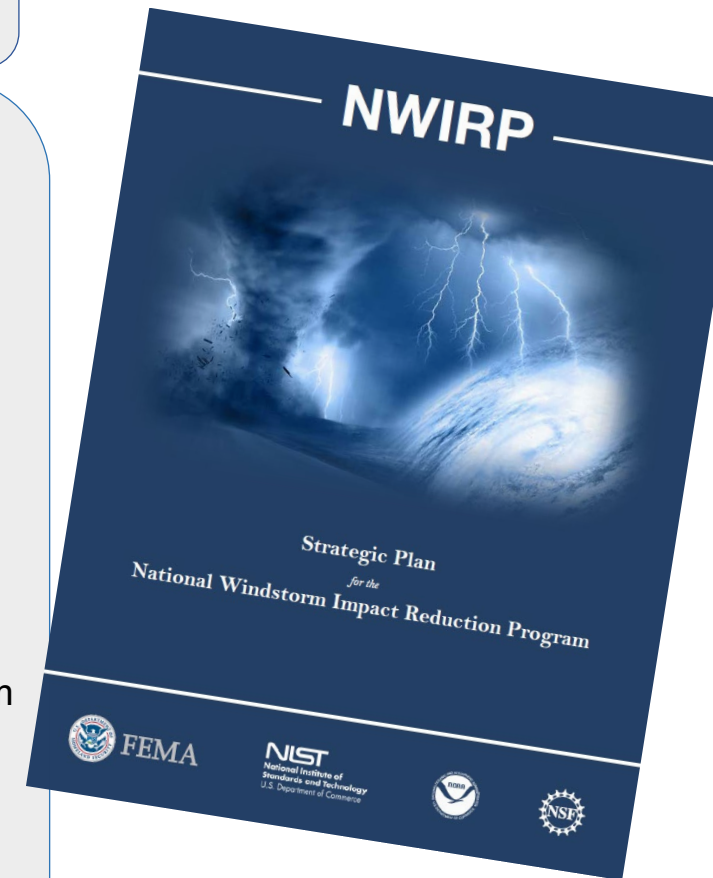
Objective 10: Develop tools to improve the performance of buildings and other structures in windstorms

Objective 11: Support the development of windstorm-resilient standards and building codes

Objective 12: Promote the implementation of windstorm-resilient measures

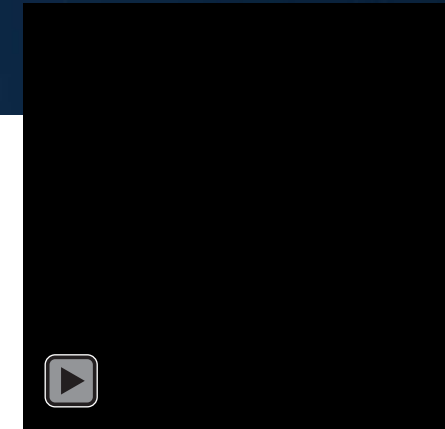
Objective 13: Improve windstorm forecast accuracy and warning time

Objective 14: Improve storm readiness, emergency communications and response

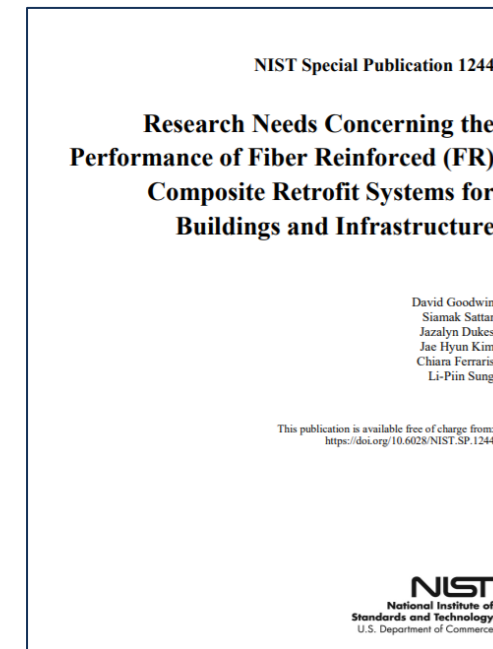


Selected Current Priorities

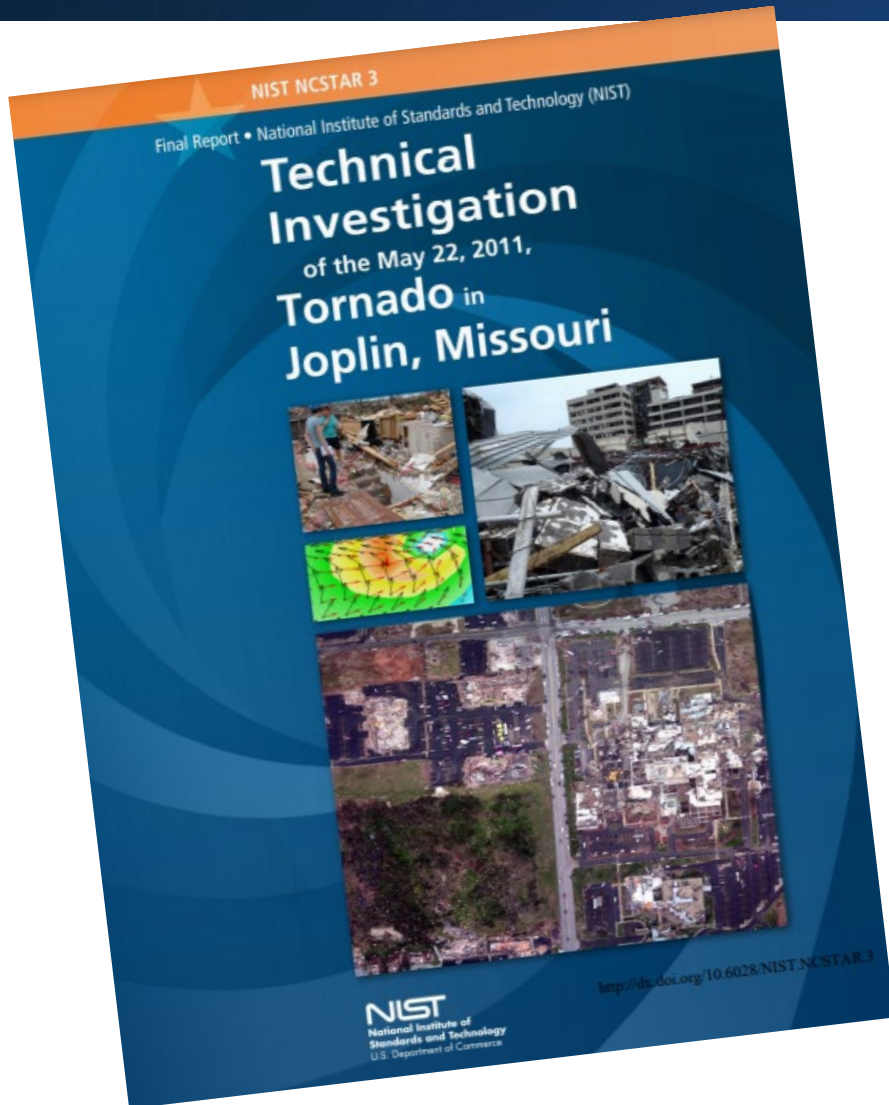
- Structure to structure fire exposure
- Source Term Characterization
 - Composition of smoke
 - Indoor Air Quality
- Material Weathering Research
- SERI Physical Infrastructure Research
- Functional Recovery



Corner view during test



Impact: NIST Tornado Hazard Maps



Other Program Impacts

- ARC, EDGE\$, and IN-CORE for community resilience modeling
- Identified building component vulnerabilities to WUI firebrand attack and importance of fire fighting resource allocation, pre-fire planning, and post-fire data collection
- Developed Firebrand Generator, Emberometer for real time tracking of embers, and Burn Observation Bubble
- Developed data collection protocols for WUI and flooding damages, as well as standardized survey protocols



EDGE\$ (Economic Decision Guide Software) Online Tool

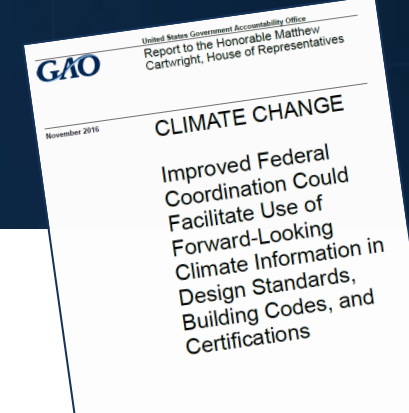
Designed to support community-level resilience planning, the powerful online [EDGE\\$ Tool, Version 1.0](#), assists in selecting cost-effective community resilience projects. Produced by the National Institute of Standards and Technology (NIST), the EDGE\$ **platform-independent app** can help community planners and resilience officers, as well as economic development, budget, and public works officials.

EDGE\$ provides a standard economic methodology for evaluating investment decisions required to



Version	1.0
Type of Software	Economic Planning Guide Support
Last Updated	2020-02-20
NIST Author	Jennifer F. Helgeson David Webb

Climate Science and Building Codes Workshop



January 2021

- Dr. Alice Hill, Keynote
- Rep. Cartwright

Building Codes

- ASCE
- ASHRAE
- Broward County, FL
- ICC
- NFPA
- GSA

Climate Science

- DOE/LBNL
- EPA
- NASA
- NOAA
- USACE

A screenshot of the NIST website page for the Climate Science and Building Codes Workshop. The page features the NIST logo, a search bar, and a navigation menu. The main content area is titled "MATERIALS AND STRUCTURAL SYSTEMS DIVISION" and "Climate Science and Building Codes Workshop". It includes a list of groups and programs, a description of the workshop, and a video broadcast player. The video player shows a thumbnail with the text "Climate Science and Building Code Workshop" and a timestamp of 01:37:53. To the right of the video player is a section titled "Overview and Plenary Talks" with a paragraph of text.

Groups +
Statutory Programs +
Staff Directory
Employment
Topic/Subject Areas +

Climate Science and Building Codes Workshop

At the request of the U.S. House of Representatives' Committee on Appropriations, NIST held a workshop on January 26, 2021 with the goal to connect the U.S. building codes and standards development communities with agencies and organizations collecting and disseminating climate change data.

The following are video broadcasts of the proceedings.

Overview and Plenary Talks

In the opening session, James Olthoff (NIST) welcomed attendees to the workshop. Congressman Matt Cartwright provided a Congressional perspective and motivation for the workshop, Alice Hill (Council on Foreign Relations) delivered plenary remarks on Building Resiliently in a Changing Climate, and Francis Zwiers (U. Victoria) and Zoubir Lounis (National Research Council - Canada) provided an overview of Canada's Initiative on Climate-Resilient Buildings and Core Public Infrastructure.

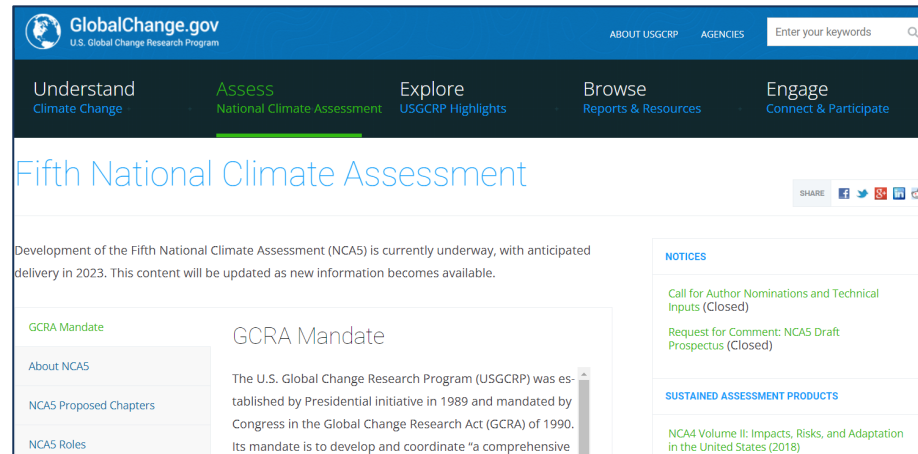
<https://www.nist.gov/el/materials-and-structural-systems-division-73100/climate-science-and-building-codes-workshop>

Are we designing buildings and infrastructure today that will withstand the hazards of tomorrow?

1. Measure the hazard

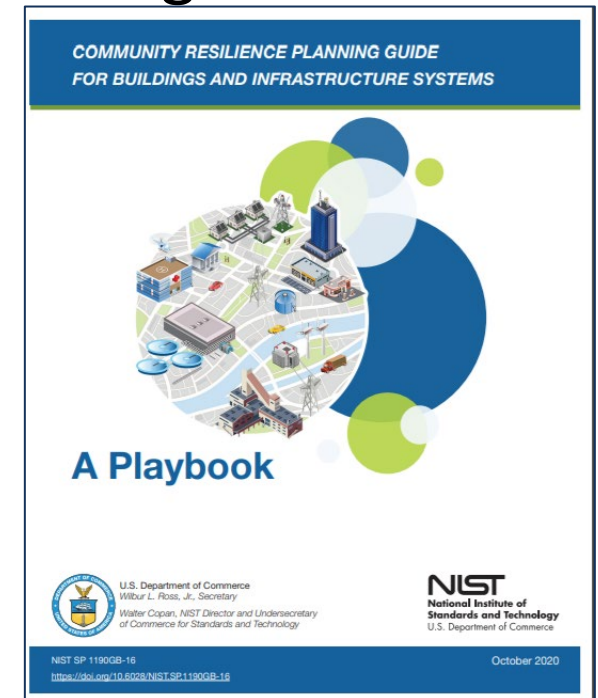


2. Quantify nonstationarity



<https://www.globalchange.gov/nca5>

3. Design for resilience



<https://nvlpubs.nist.gov/nistpubs/SpecialPublications/NIST.SP.1190GB-16.pdf>