Smart Cities and Resilience across Hazards: Current Practices and Opportunities in the United States

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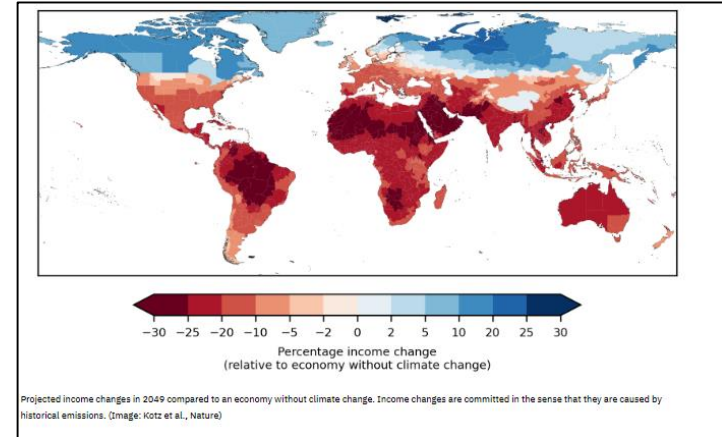Emergency Management
and Homeland Security
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Presentation Objective

Thinking about Smart Cities from a Disaster Management Perspective

Question: What constitutes a resilient Smart City?

Central argument: Smart City efforts need to be Integrated with hazards management strategies and operations

Percentage income change
(relative to economy without climate change)

Projected income changes in 2049 compared to an economy without climate change. Income changes are committed in the sense that they are caused by historical emissions. (Image: Kotz et al., Nature)

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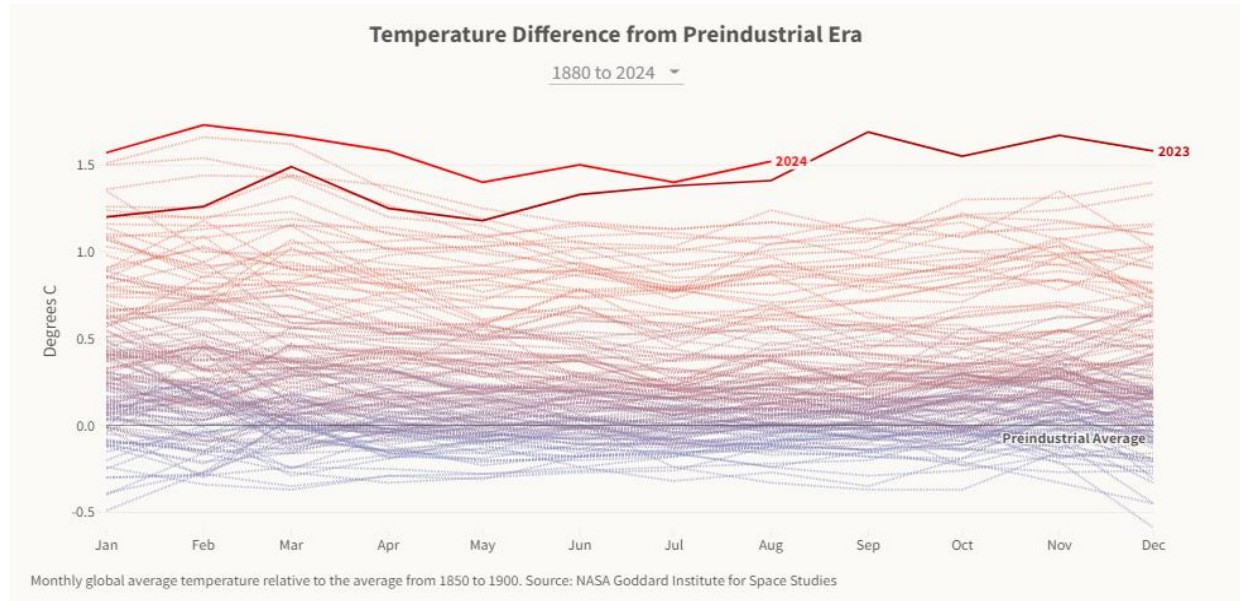
Setting Context

7 Key Global Hazards Trends – 21st Century

- Climate change / extreme weather

- Urbanization

- Population aging issues & vulnerability

- Ecological stress/failure

- Cyber, Biologic hazards prevalence

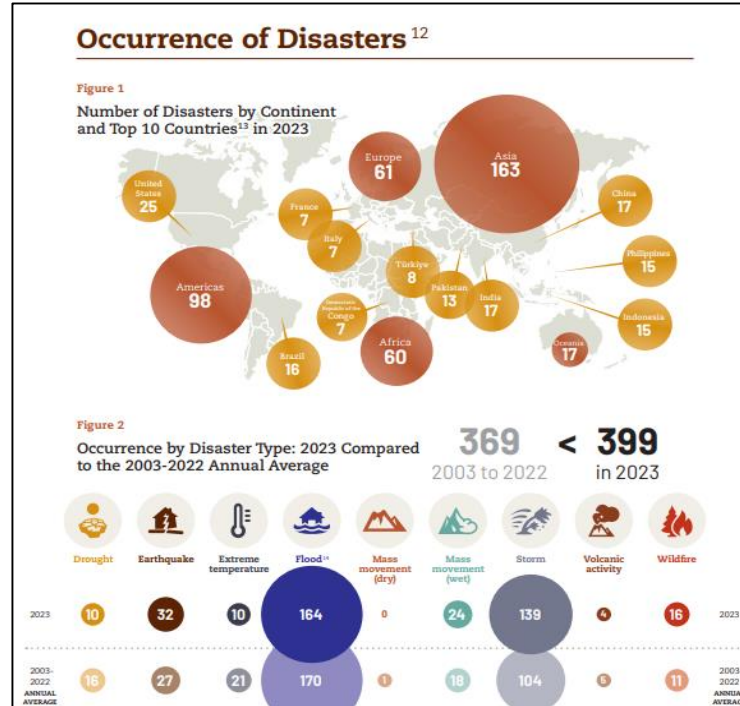- Increasing hazard losses

- Population displacement

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Setting Context

Climate Change & Extreme Weather

Temperature Difference from Preindustrial Era
1880 to 2024 ⌄

Monthly global average temperature relative to the average from 1850 to 1900. Source: NASA Goddard Institute for Space Studies

Article link: https://e360.yale.edu/features/gavin-schmidt-interview

Setting Context

Climate change has produced a consistent trend toward more frequent and severe disaster incidents

Occurrence of Disasters [12]

Figure 1
Number of Disasters by Continent and Top 10 Countries [13] in 2023

Europe 61 · Asia 163 · United States 25 · France 7 · China 17 · Italy 7 · Türkiye 8 · Philippines 15 · Americas 98 · Pakistan 13 · India 17 · Indonesia 15 · Democratic Republic of the Congo 7 · Oceania 17 · Brazil 16 · Africa 60

Figure 2
Occurrence by Disaster Type: 2023 Compared to the 2003-2022 Annual Average

369 < 399
2003 to 2022   in 2023

	Drought	Earthquake	Extreme temperature	Flood [14]	Mass movement (dry)	Mass movement (wet)	Storm	Volcanic activity	Wildfire
2023	10	32	10	164	0	24	139	4	16
2003-2022 ANNUAL AVERAGE	16	27	21	170	1	18	104	5	11

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Setting Context

Economic Loss from Disaster –

U.S. as illustration

Source NOAA NCEI: https://www.ncei.noaa.gov/access/billions/time-series
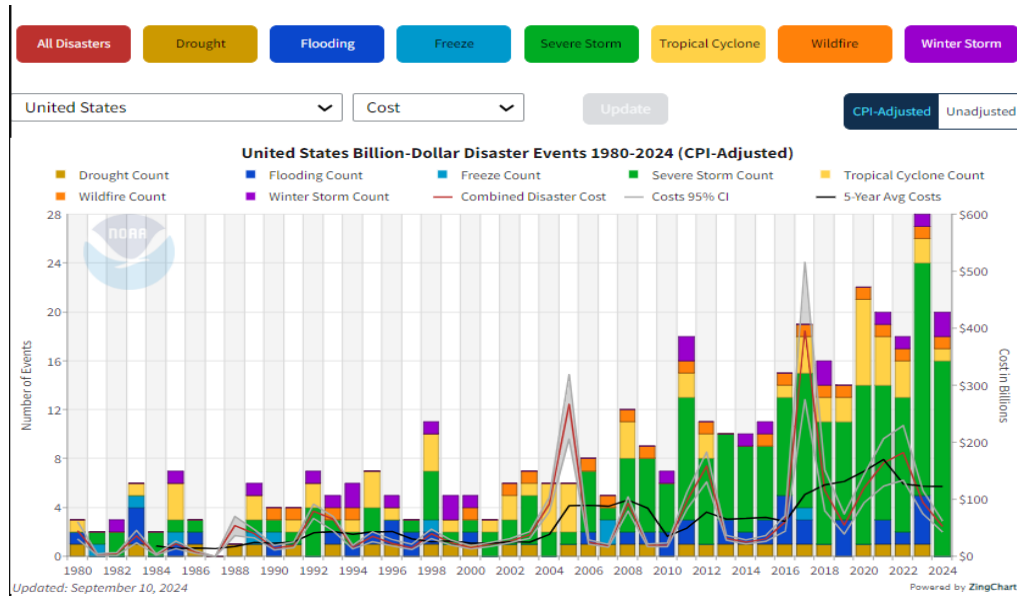
How "Smart" & "Resilient" are Assessed

Smart Cities Assessment: Index Approaches

National Institute of Standards & Technology (NIST)

Five core metrics of assessment method:

1 - alignment of KPIs with community priorities across districts and neighborhoods
2 - investment alignment with community priorities
3 - investment efficiency
4 - information flow density
5 - quality of infrastructure services and community benefits

Link*: https://www.nist.gov/news-events/news/2022/02/nist-international-collaboration-develops-new-framework-smart-cities-and*

How "Smart" & "Resilient" are Assessed

Assessment:

Program Activity

Approach

8. Charlotte, North Carolina

Charlotte is a good example of a smart city initiative, due to their devotion to sustainability. The city partnered with Microsoft Corporation to build out the city's digital infrastructure so that more residents can benefit from the Internet. For example, there will be greater access to public Wi-Fi, **traffic monitoring** to reduce congestion and air pollution as well as new training programs for public employees to help them perform better in their roles.

Additionally, the city has rolled out a project called Envision Charlotte, a public/private collaborative that "leads Charlotte's progress as a global Smart City through innovations that strengthen economic competitiveness, environmental sustainability and positive community impacts."

Link: *https://www.digi.com/blog/post/smart-cities-in-the-us-examples#:~:text=Given%20that%20Texas%20is%20an,of%20water%20loss%20each%20year*.

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How "Smart" & "Resilient" are Assessed

Disaster Resilience Assessment: Community Index Approach

Community Indicators Benchmarking Approach

Social resilience indicators
  (e.g. education levels, health care coverage)
Economic resilience indicators
  (e.g. employment levels, housing capital)
Institutional Resilience
  (e.g. mitigation planning, flood insurance coverage)
Infrastructure Resilience
  (e.g. medical capacity, emergency sheltering capacity)
Community Capital
  (e.g. civic & political engagement, place attachment)

Q: How to Achieve "Smart" & "Resilient" Communities

Two Considerations:

- What is included in defining smart and resilient?
- What is excluded in defining smart and resilient?

Challenges when thinking about whether a city has become "smarter" and "more resilient"?

- Included: static indicators and program-specific initiative
- Excluded: addressing complex problems with multidimensional and long-term demand - i.e. – *problems arising from the 7 global trends in hazards, risk & vulnerability*

Q: How to Achieve "Smart" & "Resilient" Communities

**Smart Cities
Can Create
 Challenge in
Operations:
Interdependence &
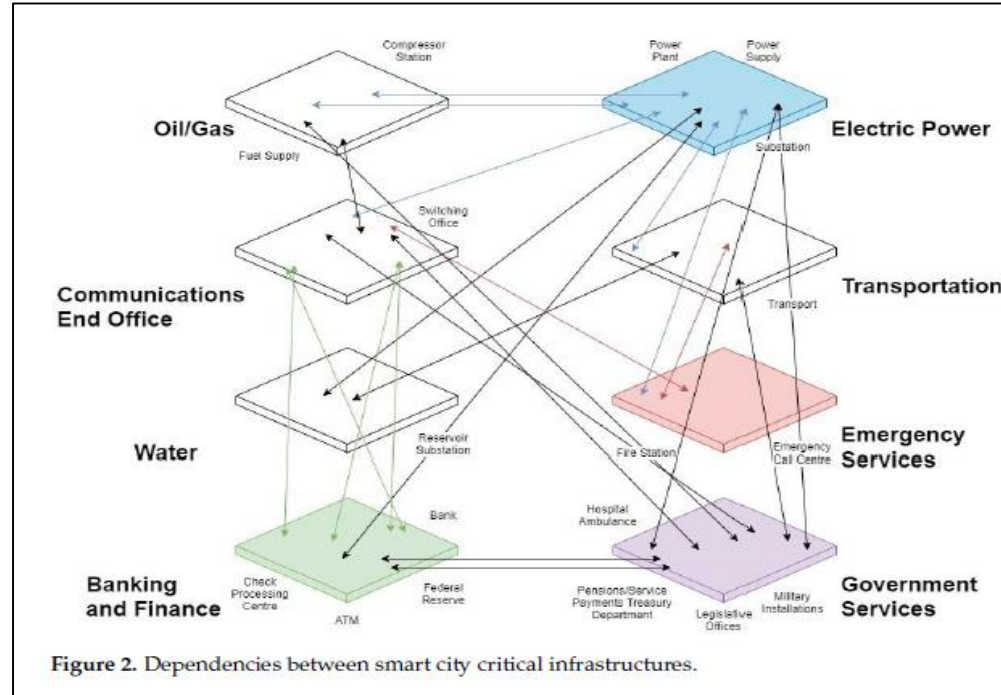Potential
Cascading Failure**

Image Source: Elvas, et al (2021)

Figure 2. Dependencies between smart city critical infrastructures.

Q: How to Achieve "Smart" & "Resilient" Communities

Reporting index results does not indicate / predict operational needs & performance capabilities in a crisis situation
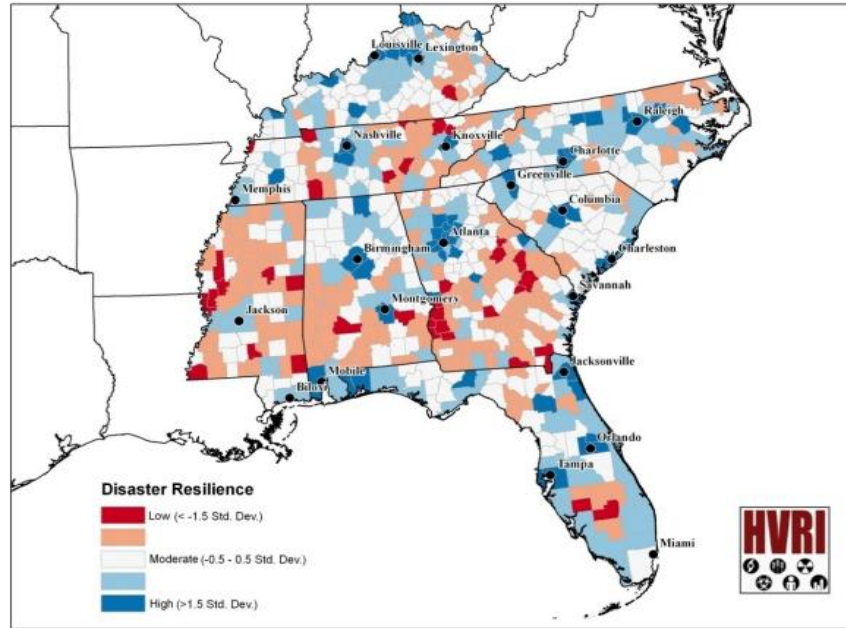
Map source: *Cutter, et al (2010)*

Figure 2: Spatial distribution of disaster resilience for FEMA region IV

Q: How to Achieve "Smart" & "Resilient" Communities

Complex or "Wicked" Problems from the 7 Global Trends List

- Ill-defined parameters, spatial and temporal diffusion, and transboundary challenges
- Conditional outcomes – not complete or incomplete resolution
- Interjurisdictional conflict, intergovernmental conflict
- Cross-sector incentives and preferences misalignment

Q: How to Achieve "Smart" & "Resilient" Communities

Solutions to Complex Problems from the 7 Global Trends List

- How to Resolve?
- Smart City technology and data systems are essential tools to serve hazards risk management and disaster risk reduction strategies

- Examples applications where Smart systems can improve planning and reduce risk:
    - Digital twining, microgrids, nanogrids

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Objective 3: Understanding Policy & Operational Needs

Hurricane Milton

(DR-4834-FL)

~ 25 deaths

~$50 Billion losses

Landfall south of Tampa, FL

Case of Cortez, FL: One section
of the city was mostly undamaged,
in spite of 120 mph winds, major storm surge and the rest of
Cortez losing power and suffering major damage

Objective 3: Understanding Policy & Operational Needs

Three Key
Features:

1. Elevated
structures

2. Highly resistant
building materials

3. Nanogrid system

10-11-2024 | IMPACT

Why this Florida neighborhood still has power

Florida's disaster-proof community of Hunters Point withstood yet another hurricane.

[Photo: courtesy Pearl Homes]

Objective 3: Understanding Policy & Operational Needs

Nanogrid:

Solar panel and battery system

[Photo: courtesy Pearl Homes]

Concluding Observation

Thinking about Smart Cities from a Disaster Management Perspective

Question: What constitutes a resilient Smart City?

Answer:

- **Smart City efforts need to be Integrated with hazards management planning strategies and operations**
- **Smart technologies and data systems are key to more effective risk management approaches**
- **Operational innovations will follow from smart technologies and data systems**

Smart and Resilient only truly is achieved through these integrations

**Questions / Comments /
and, of course,
Go Brewers!**

Thank You

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