

THE LAVA IS ENTERING THE SEA, AND
NEW RIFTS ARE OPENING TO THE NORTH!

GET A GIS SURVEY TEAM IN
THE AIR! WE NEED TO REVISE
OUR COASTLINE SHAPEFILES!



I WANT TO MAKE A DISASTER MOVIE
THAT JUST SHOWS SCIENTISTS RUSHING
TO UPDATE ALL THEIR DATA SETS.

Harnessing the Power of AI for Disaster Response and Preparedness



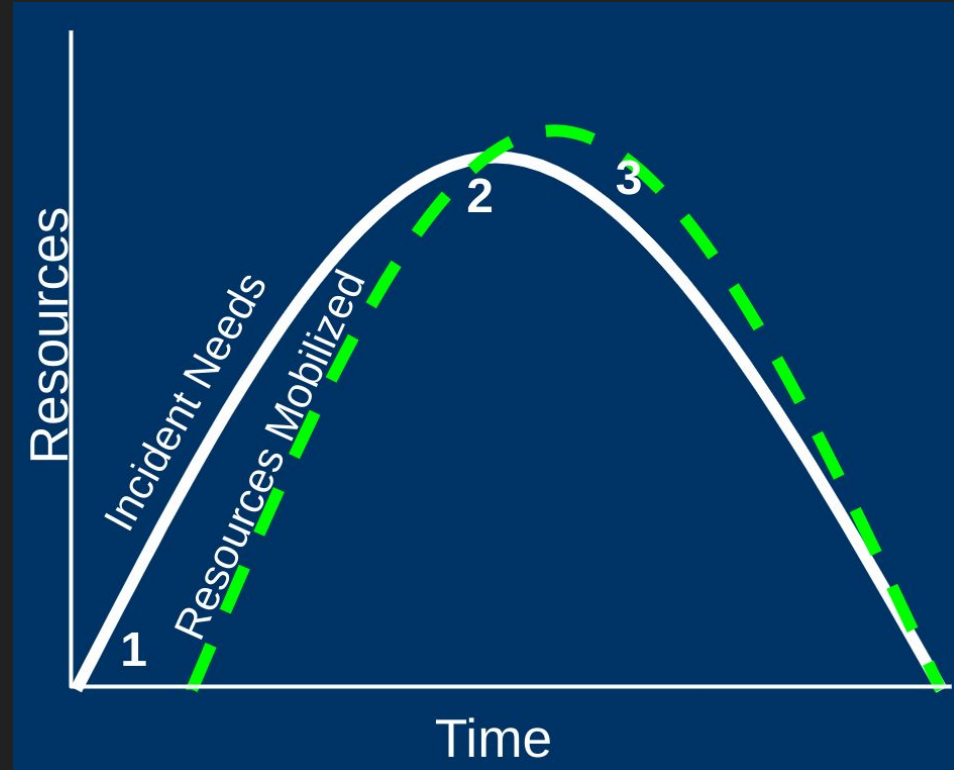
InSPIRE
Innovation Summit for
Preparedness & Resilience



NAPSG
Foundation

The Promise of AI?

- When disaster strikes, we are overtaxed, under resourced
- Can AI help us to bring these curves into alignment?
- Can it help us to reduce the amplitude of the curve through preparedness?
- What role will AI have on the future public safety knowledge workforce?



Session Overview

- Big Challenges in Disasters
- The Landscape, Trends, and Research
- Design Methodology
- Workshop with your tables
- Observations
- Where you can learn more and stay informed

Big, Bad, and Slow: Quantifying problems in disaster management

Katie Picchione

November 16, 2023



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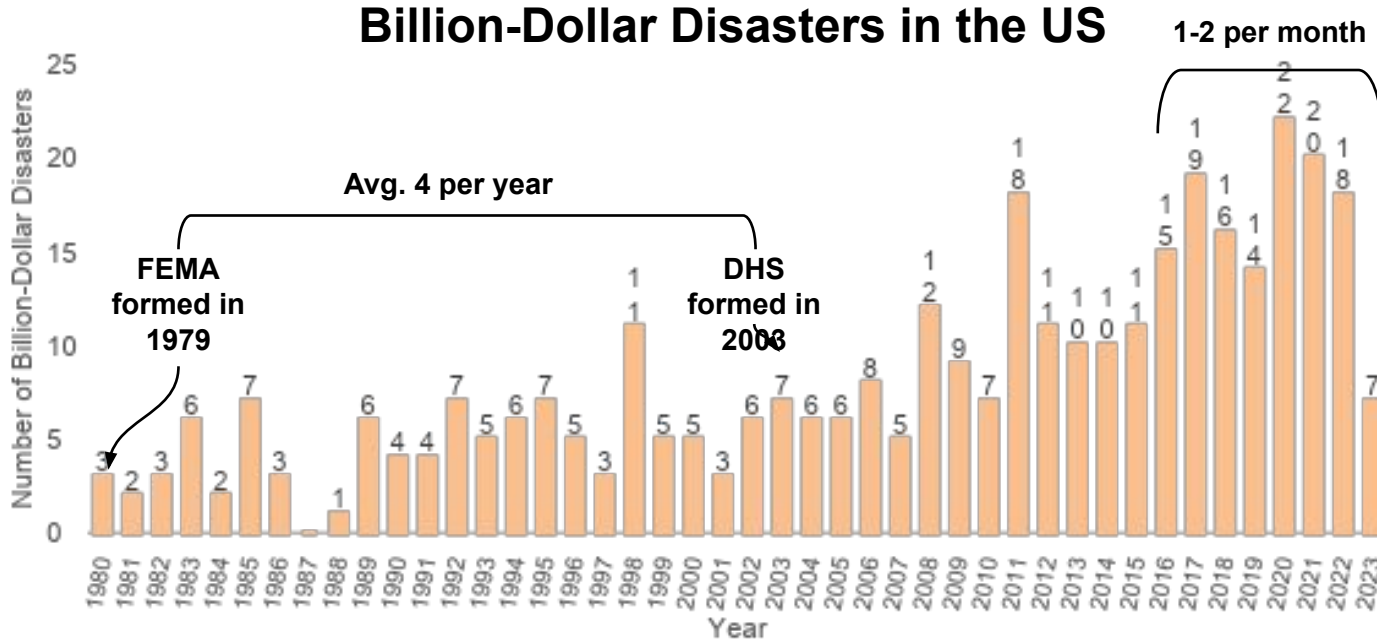


Challenges in Emergency Management

- **Outdated processes and worse disasters**
- **Lengthy damage assessments**
- **Large areas affected**
- **Long recovery times**
- **Workforce shortage**



Severe disasters are occurring more frequently



This CPI-adjusted data was updated in early 2023 to account for inflation. Source: NOAA National Centers for Environmental Information (NCEI) U.S. Billion-Dollar Weather and Climate Disasters (2023). <https://www.ncei.noaa.gov/access/billions/>, DOI: 10.25921/stkw-7w73.

Our emergency management system was not designed to handle the severity and frequency of current and future disasters.

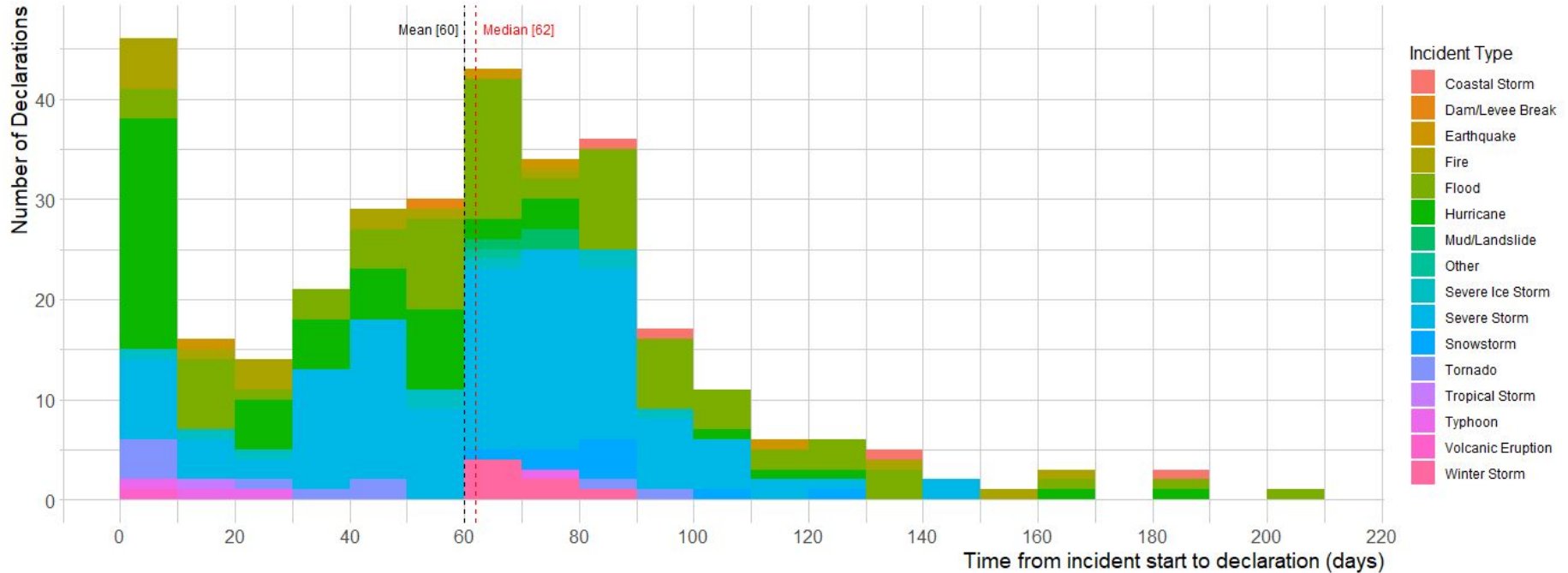


How long do preliminary damage assessments take?



Public Assistance: 50% of preliminary damage assessments took 60 days or longer

Time to conduct PDAs that resulted in PA declarations | A Histogram: June 1, 2017 - June 1, 2023

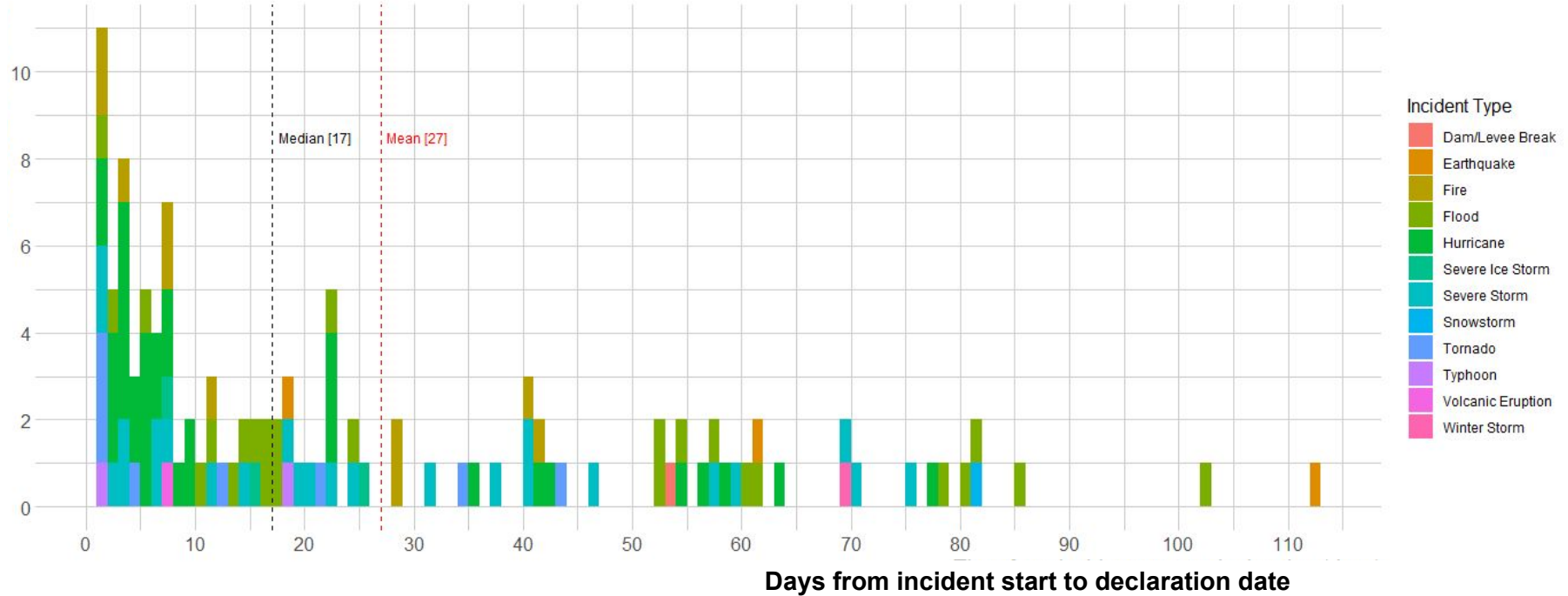




Individual Assistance: 50% of damage assessments took 17 days or longer

Number of Major Disaster declarations (by DR#)

Time to conduct PDAs that resulted in IA declarations for natural hazards | A Histogram: June 1, 2017 - June 1, 2023

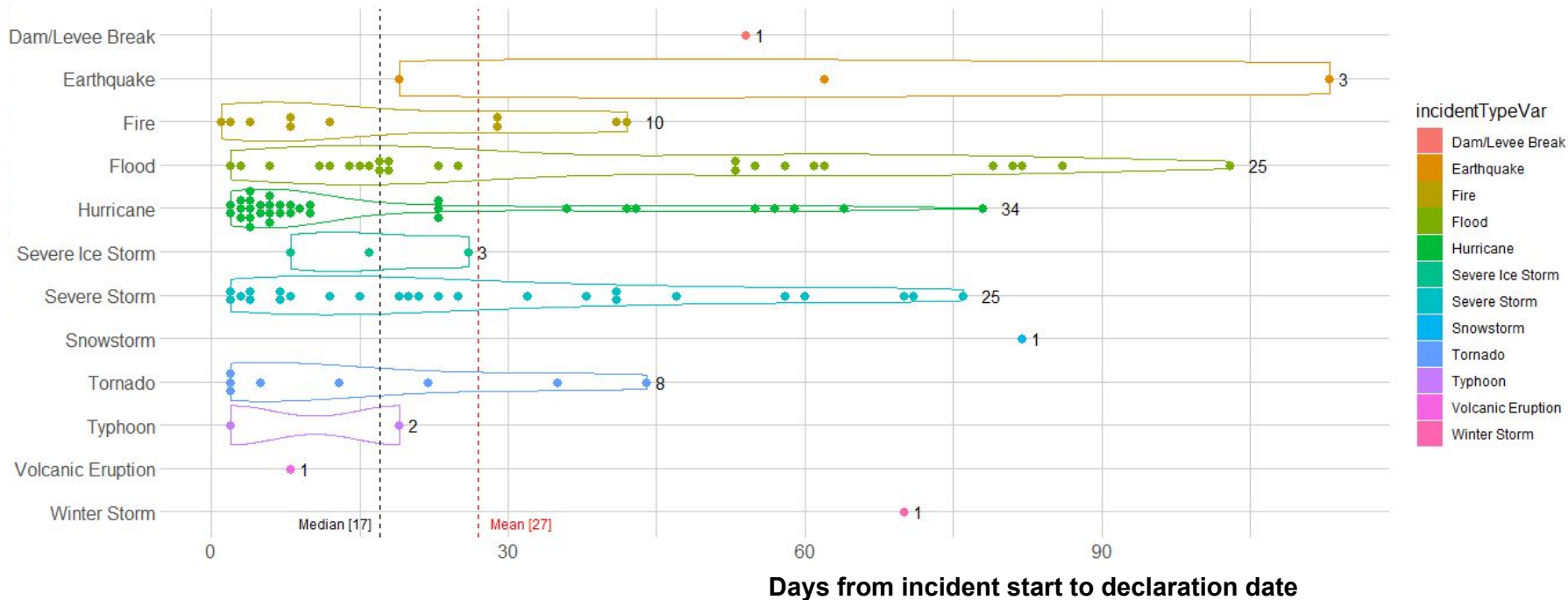




Individual Assistance: 50% of damage assessments took 17 days or longer

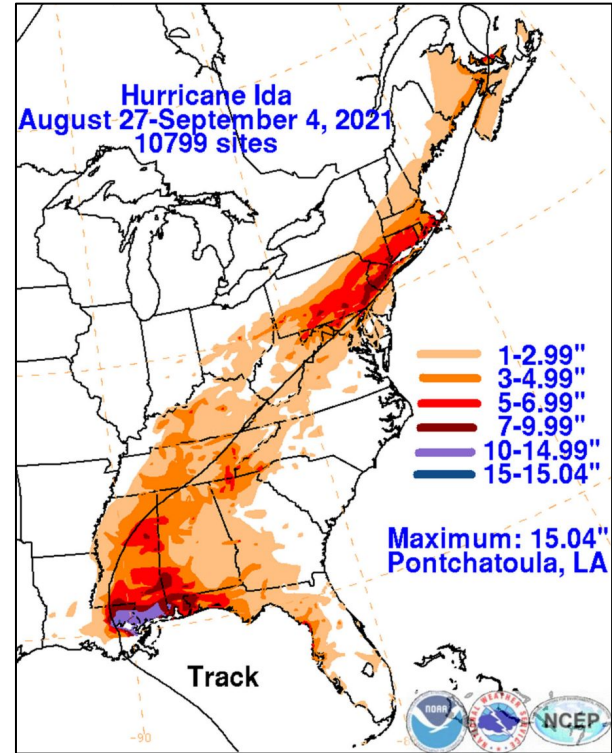
Major Disaster declarations per hazard type (by DR#)

Time to conduct PDAs that resulted in IA declarations for natural hazards | June 1, 2017 - June 1, 2023



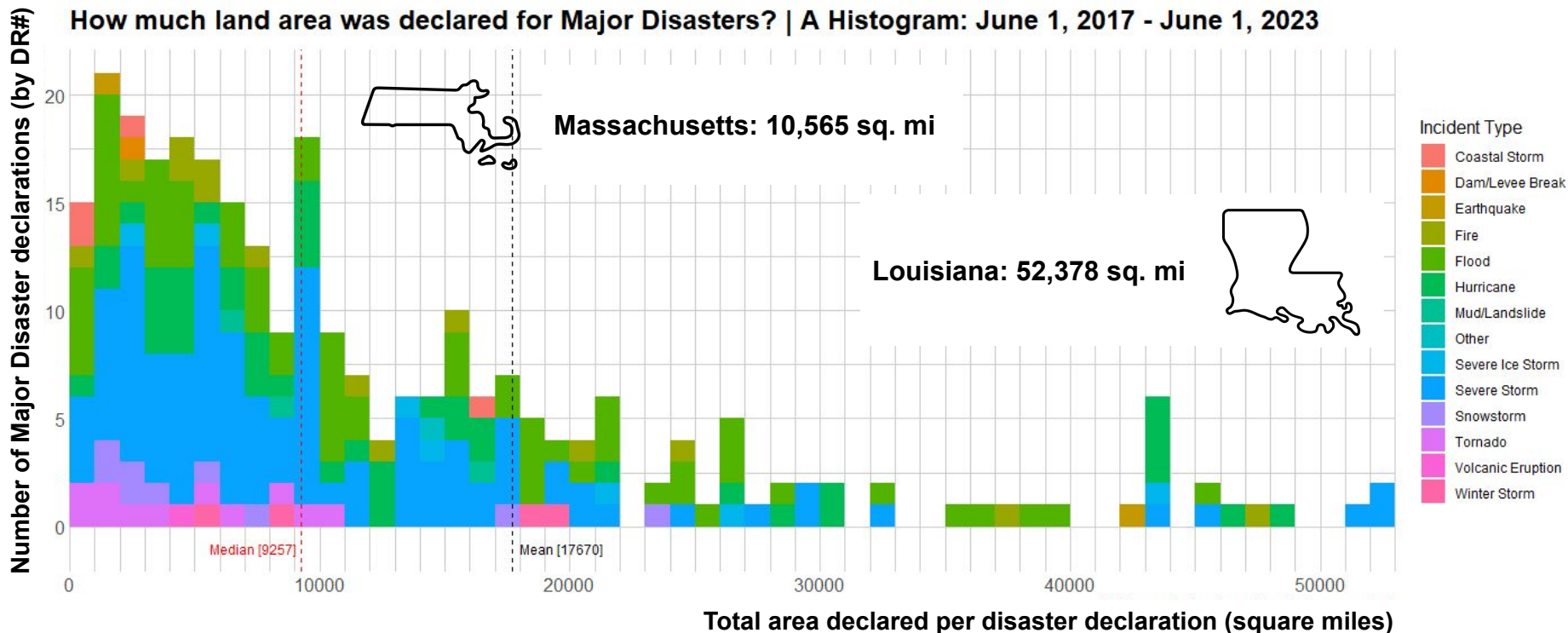


How large is the affected area
per state?





Declared area per state: 9200 square miles or more for 50% of disasters

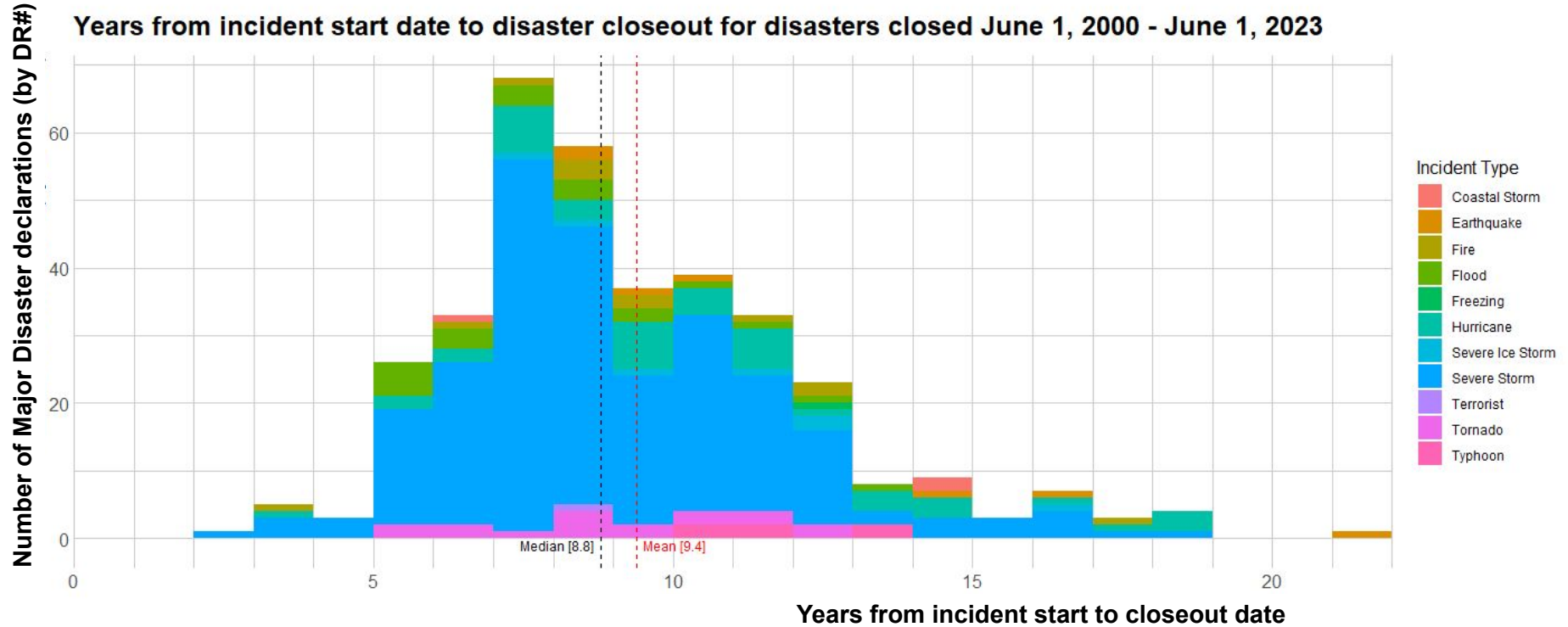




How long does recovery take?



Recovery: Incident start to declaration closeout took 8.8 years for more than 50% of incidents



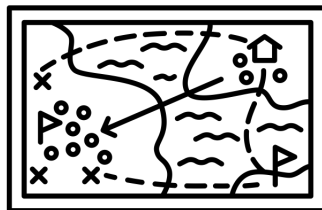


Summary



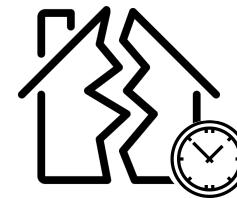
Expensive

**1-2 “billion dollar”
disasters each
month**



Large area

**9200 sq mi. declared
per state on average**



**Long response and
recovery**

**17 days to Individual
Assistance Declarations**

**60 days to Public
Assistance Declarations**

9 years to closeout

While these are system problems, technology can help!



Summary of time required for response and recovery

Preliminary Damage Assessments for...

• Individual Assistance

- 25% < 6 days
- 50% > 17 days
- 25% > 42 days

Average IA PDA:
27 days

• Public Assistance

- 25% < 34 days
- 50% > 62 days
- 25% > 82 days

Average PA PDA:
60 days

Recovery

• Incident start date to closeout

- 25% = 2.8-7.4 years
- 50% > 8.8 years
- 25% > 11 years

Average time to closeout: 9.4 years

Data in this analysis is aggregated by disaster number (e.g. DR-4611-LA) not by natural hazard incident. For example, even though Hurricane Ida was a single incident, it resulted in disaster declarations for 7 states. Each of these state-level declarations is represented as a data point. For PDA analysis, only PDAs that resulted in declarations for incidents 2017-2023 are included. Closeout data considers declarations that were closed between 2000-2023. Disasters declared during that period which are still open have been omitted.



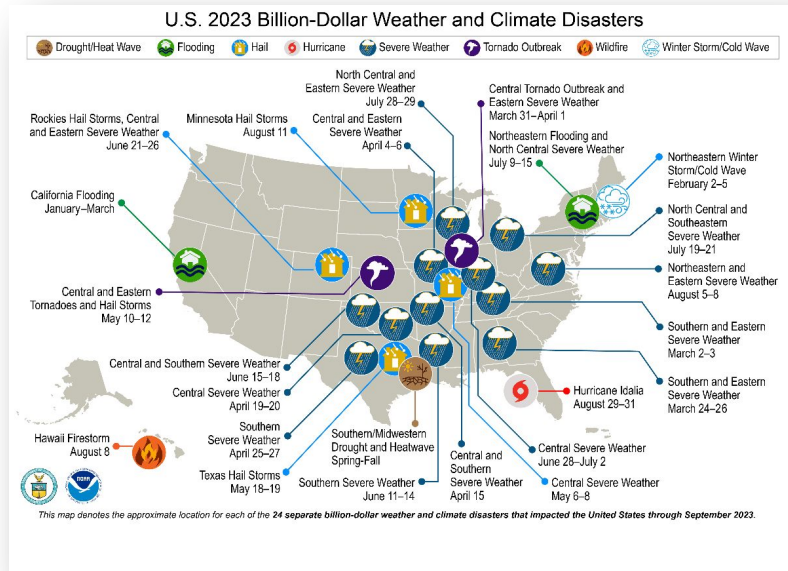
Data sources

OpenFEMA Dataset: Disaster Declarations Summaries - v2

Version: 2

Last Data Refresh: 11-01-2023

Entity Name	DisasterDeclarationsSummaries
API Endpoint	https://www.fema.gov/api/open/v2/DisasterDeclarationsSummaries
Update Frequency	R/PT20M
Program URL	https://www.fema.gov/disasters/how-declared
Category	Disaster Information
Keywords	disaster



United States Government Accountability Office
Report to Congressional Requesters



Approach

OpenFEMA Dataset: Disaster Declarations Summaries - v2

Version: 2

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Entity Name	DisasterDeclarationsSummaries
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Category	Disaster Information
Keywords	disaster

1. Download data from OpenFEMA
<https://www.fema.gov/openfema-data-page/disaster-declarations-summaries-v2>
2. Select major disasters only and filter for recent incidents
3. Declaration data is recorded at the county level aggregate by DR number
4. Analysis
 - Use Census data to calculate total area declared for each disaster
 - Calculate PDA time as the number of days from incident start to first declaration
 - Calculate closeout time as the number of days from incident start to closeout



Analysis Approach in R

1. Download declaration data from OpenFEMA <https://www.fema.gov/openfema-data-page/disaster-declarations-summaries-v2>

```
res <- GET("https://www.fema.gov/api/openv2/DisasterDeclarationsSummaries.json")
data <- fromJSON(rawToChar(res$content))
decs <- data$DisasterDeclarationsSummaries
```

2. Format dates; calculate number of days from incident to declaration and closeout

```
decs$incidentBeginDate <- as.Date(decs$incidentBeginDate)
decs$incidentEndDate <- as.Date(decs$incidentEndDate)
decs$declarationDate <- as.Date(decs$declarationDate)
decs$pdaTime <- decs$declarationDate - decs$incidentBeginDate
decs$pdaTime <- as.numeric(decs$pdaTime)
decs$disasterCloseoutDate <- as.Date(decs$disasterCloseoutDate)
decs$closeoutTime <- decs$disasterCloseoutDate - decs$declarationDate
decs$closeoutTime <- as.numeric(decs$closeoutTime)
```

3. Select major disasters only and filter for recent incidents, then filter by IA, PA, or closeout date

```
DR <- decs[decs$declarationType == "DR", ]
DR_2017 <- DR[DR$incidentBeginDate > "2017-06-01" & DR$incidentType != "Biological" & DR$incidentBeginDate < "2023-06-01", ]
DR_2017_HP <- DR_2017[DR_2017$ProgramDeclared == TRUE, ]
DR_2017_PA <- DR_2017[DR_2017$ProgramDeclared == TRUE, ]
DR_2017_closeout <- DR[DR$disasterCloseoutDate > "2000-06-01" & DR$incidentType != "Biological" & DR$disasterCloseoutDate < "2023-06-01" & DR$closeoutTime > 0, ] %>% na.omit()
```

4. Aggregate by DR number and append data for the shortest PDA time or closeout time recorded (declaration data is recorded at the county level)

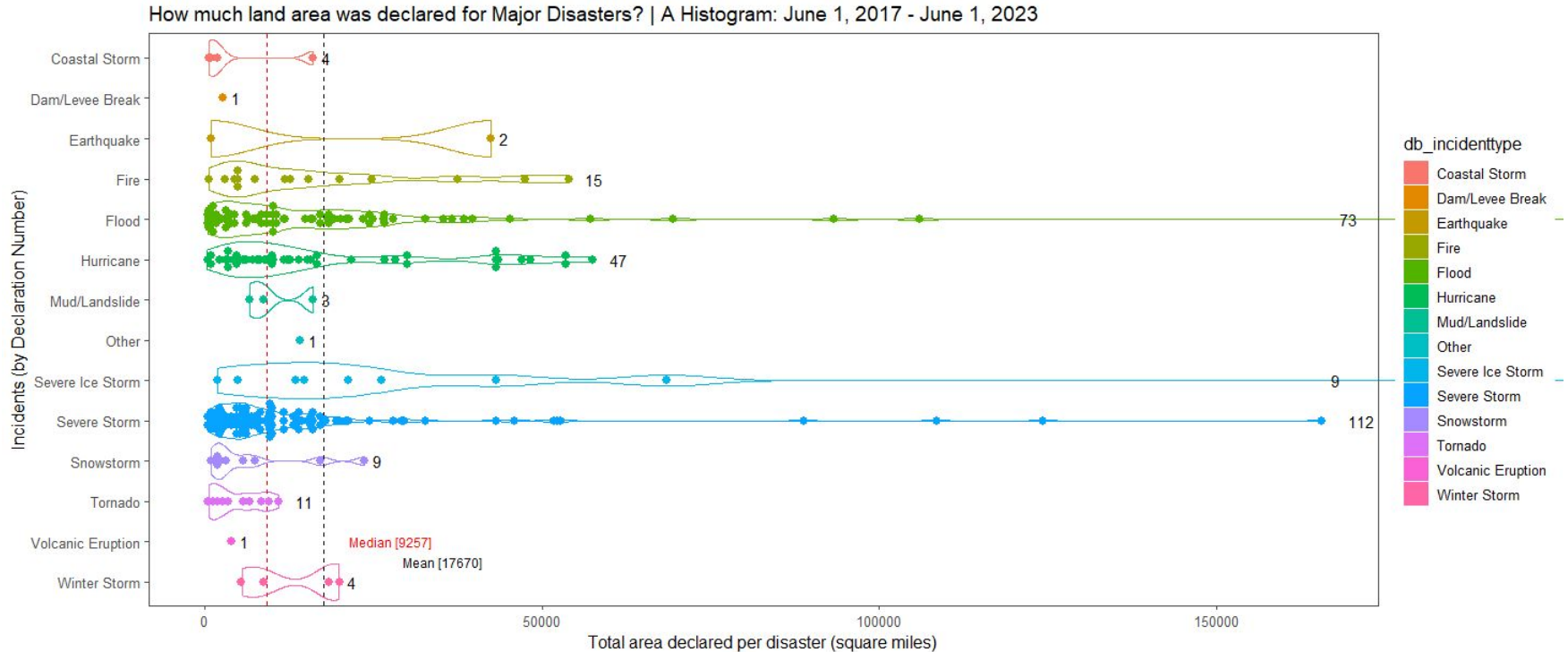
```
DR_numbers <- unique(DR_2017_HP$disasterNumber)
for (i in 1:DR_numbers){
  iis_var <- row(DR_2017_HP[DR_2017_HP$disasterNumber==DR_numbers[i],]) #return the longest pdaTime
  max_var <- max(DR_2017_HP[DR_2017_HP$disasterNumber==DR_numbers[i],]$pdaTime)
  min_var <- min(DR_2017_HP[DR_2017_HP$disasterNumber==DR_numbers[i],]$pdaTime)
  startDateVar <- min(DR_2017_HP[DR_2017_HP$disasterNumber==DR_numbers[i],]$incidentBeginDate)
  type <- min(DR_2017_HP[DR_2017_HP$disasterNumber==DR_numbers[i],]$incidentType)
  maxPdaTime <- append(maxPdaTime, max_var)
  minPdaTime <- append(minPdaTime, min_var)
  incidentStartDateVar <- append(incidentStartDateVar, startDateVar)
  incidentTypeVar <- append(incidentTypeVar, type)
}
DR_2017_summary <- data.frame(DR_numbers, incidentStartDateVar, incidentTypeVar, decCount, maxPdaTime, minPdaTime)
```

5. Aggregate by incident type

```
for (j in disasterTypes) {
  dtypos <- row(DR_2017_summary[DR_2017_summary$incidentTypeVar == j])
  maxpdaltimevar <- max(DR_2017_summary[DR_2017_summary$incidentTypeVar==j,]$maxPdaTime)
  disasterTypecount <- c(disasterTypecount, dtypos)
  maxpdaltimecount <- c(maxpdaltimecount, maxpdaltimevar)
}
disasterTypeCounts <- data.frame(disasterTypes, disasterTypecount, maxpdaltimecount)
```



An analysis of OpenFEMA Declaration Data: Area Declared

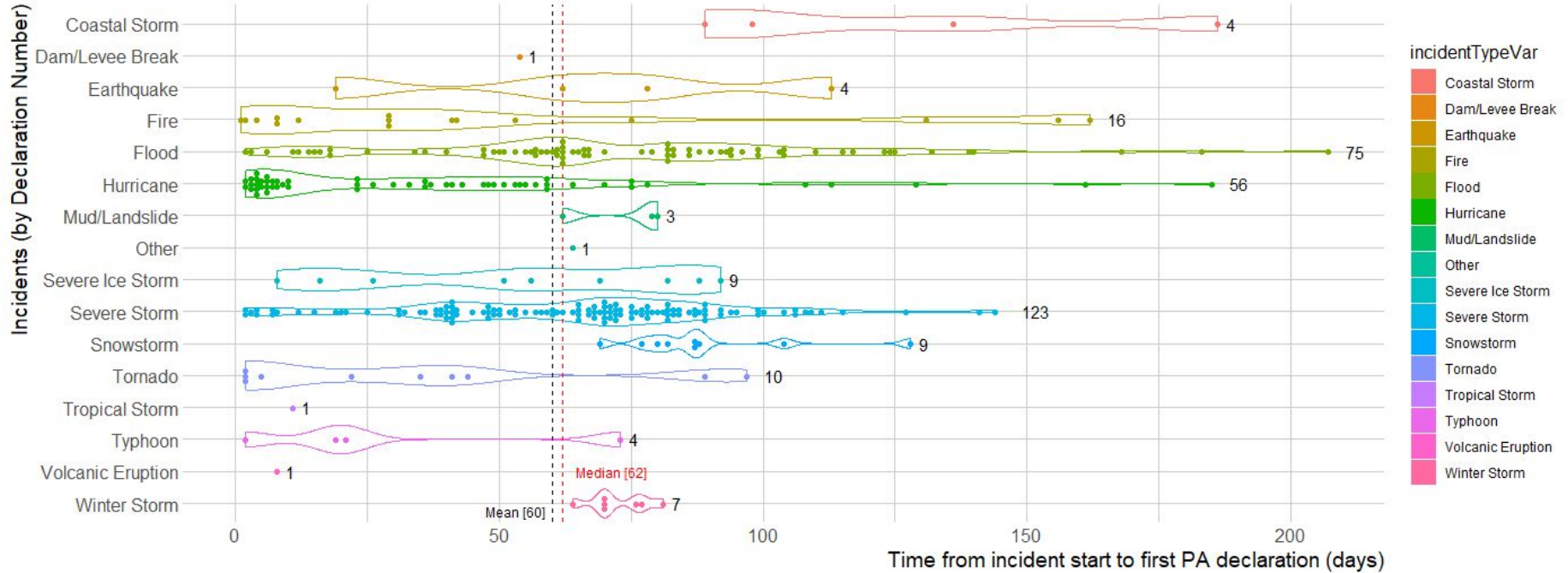


From June 1, 2017 to June 1, 2023, the declared area was larger than 9200 square miles for more than half of disasters.



Days to conduct Preliminary Damage Assessments for Public Assistance Declarations

Minimum time to conduct PDAs that resulted in PA declarations | June 1, 2017 - June 1, 2023

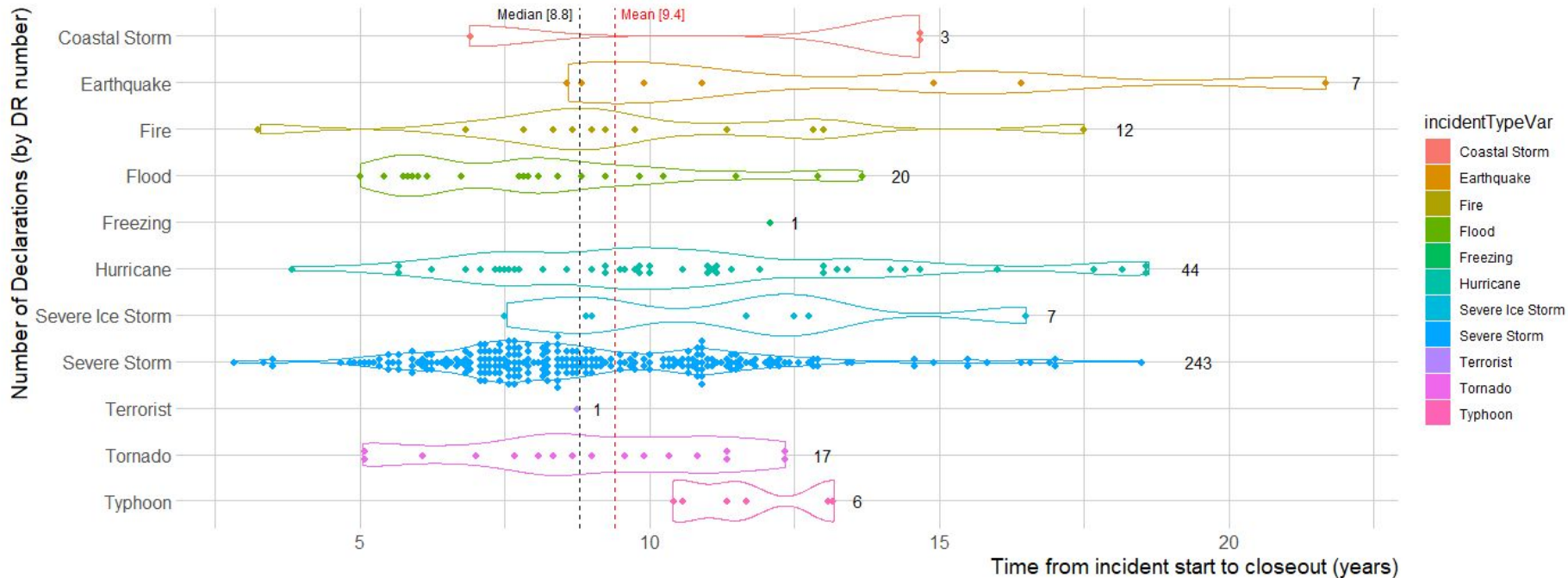


50% of PA PDAs took 60 days or longer for declarations made from June 1, 2017 to June 1, 2023.



Years of Recovery: Incident start to closeout

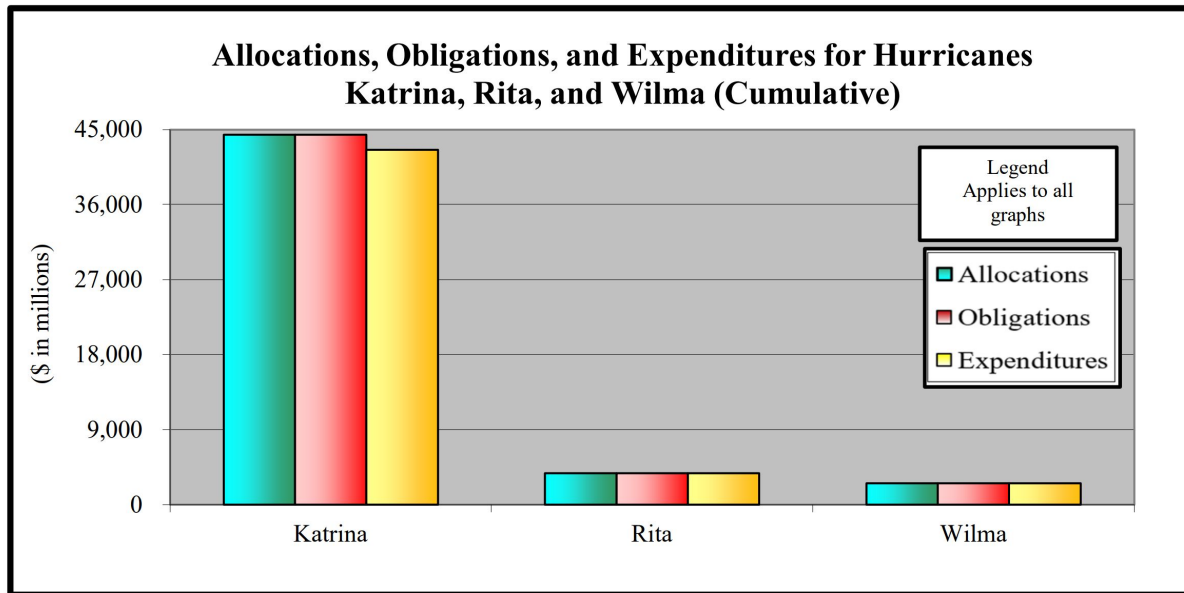
Years from incident start date to disaster closeout for disasters closed June 1, 2000 - June 1, 2023



For 75% of disasters that achieved closeout between June 1, 2000 and June 1, 2023, recovery took **7.8 years or longer**.

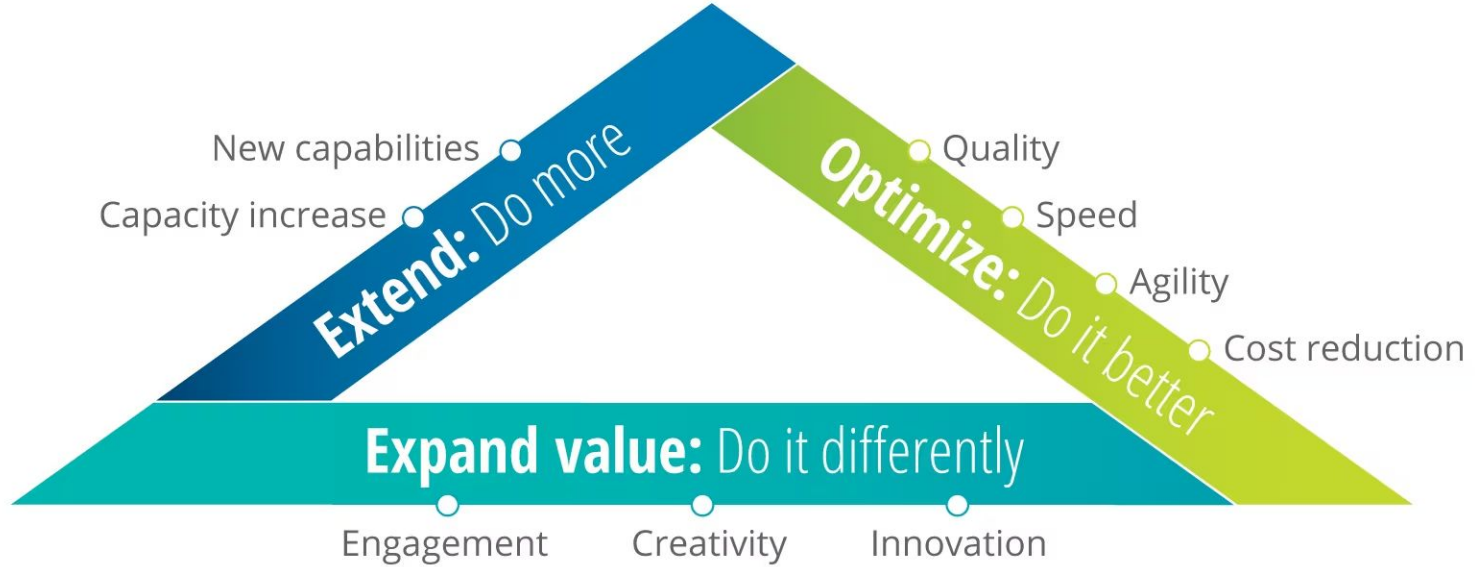


What hasn't been closed out?



	Katrina	Rita	Wilma	Total
Allocations	\$ 44,393	\$ 3,801	\$ 2,567	\$ 50,761
Obligations	44,393	3,801	2,567	50,761
Expenditures	\$ 42,555	\$ 3,776	\$ 2,563	\$ 48,894

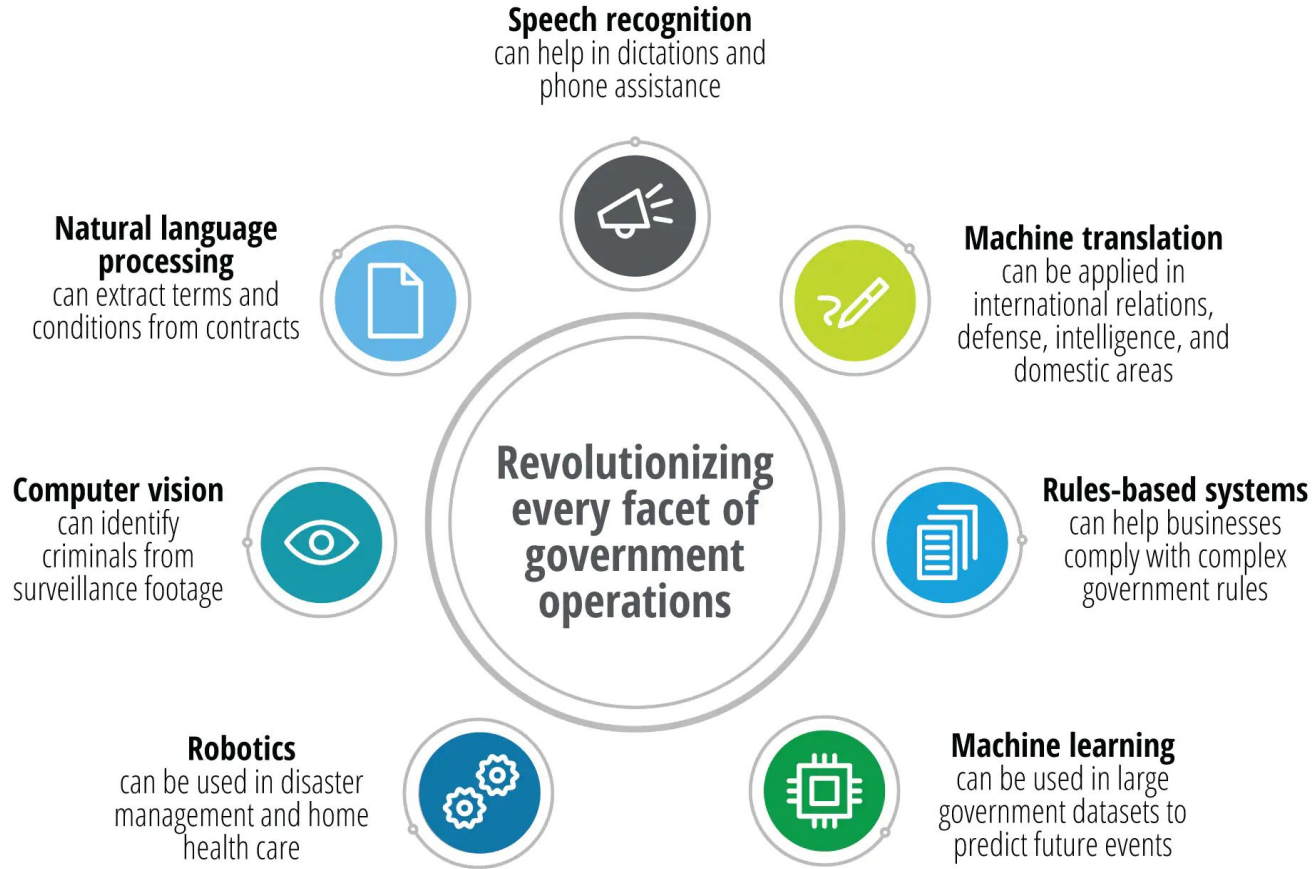
Value drivers of AI and automation



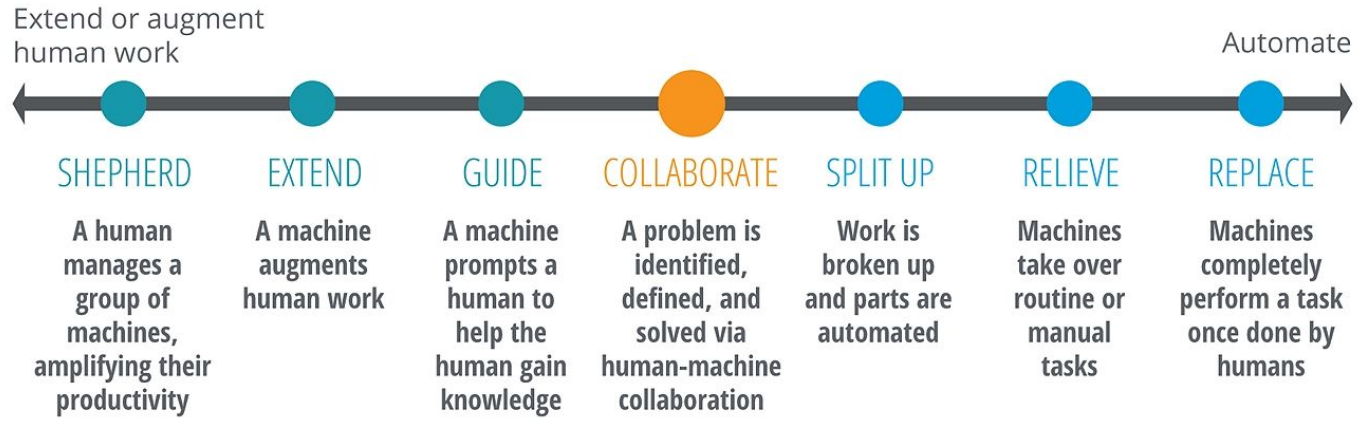
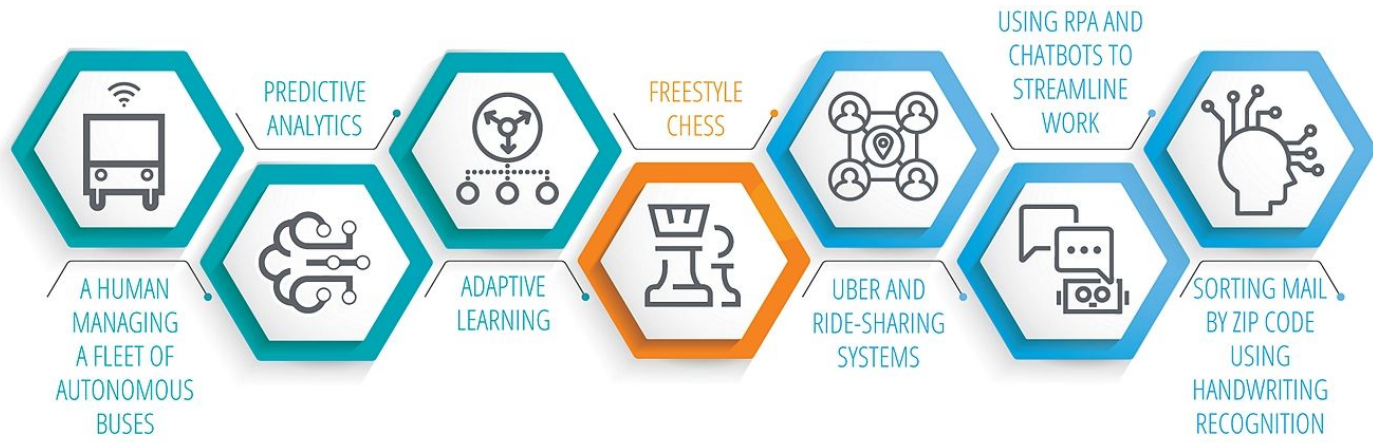
Source: Deloitte analysis.

The Landscape

Different types of AI can be used for different government problems



Scenarios for human-machine pairing



Source: The Deloitte Center for Government Insights.

Governments can make the most of what humans and machines can offer



MACHINES ARE BETTER AT ...

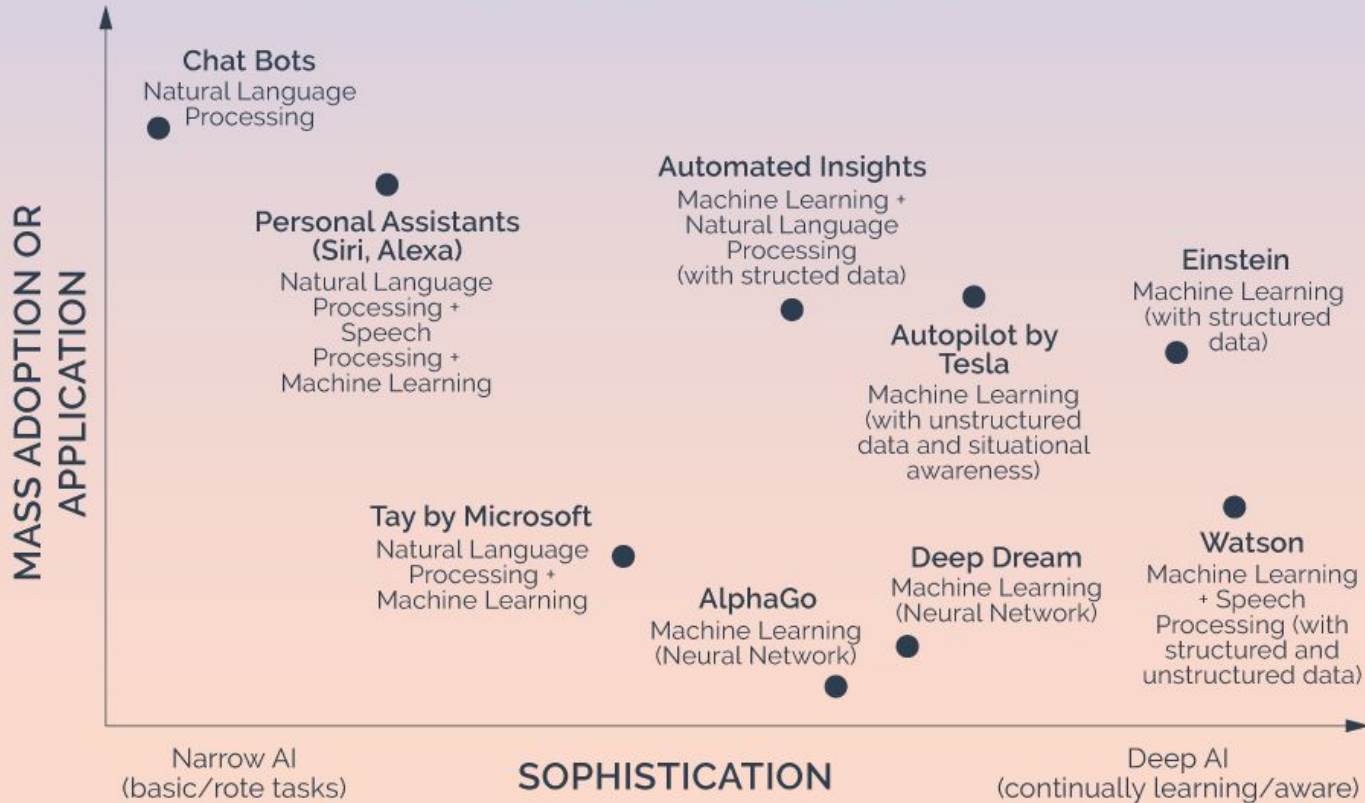
- Processing huge data sets with speed and accuracy
- Working 24/7 without breaks, tiring, or getting distracted
- Scaling work up or down quickly
- Performing repetitive work such as opening emails
- Doing dangerous work such as underwater search and rescue, or bomb disposal



HUMANS ARE BETTER AT ...

- Displaying empathy and humor
- Understanding context and picking up social cues
- Transferring their skills to others (teaching)
- Adapting their skills to different situations
- Demonstrating critical thinking, defining problems, and creative pursuits

SIMPLIFIED AI LANDSCAPE



ChatGPT

- Accessible/Free
- Basic Tasks
 - Writing
 - Analysis
 - Queries
 - Brainstorming/Creative



Chat GPT - Applications

- Emergency Alerts Message Design
- The best 360-character Wireless Emergency Alerts will use this evidence-based template:
 - Source, hazard name/description, location, consequences of threat, protective action, time.



Chat GPT 3.5

You

create a 360-character Wireless Emergency Alerts in this format:
Source, hazard name/description, location, consequences of threat, protective action, time. From Public Health for a boil water order for all of Nashua, due to contamination do not drink, cook or bathe with water. Boil water for at least 1 minute. Bottled water available at city hall for pickup. more information at nashuanh.gov

ChatGPT

Source: Public Health
Hazard: Boil Water Order
Location: Nashua, NH
Threat: Contamination - Do not drink, cook, or bathe with tap water.
Action: Boil water for 1 minute before use. Bottled water available at City Hall.
Time: Immediate. Visit nashuanh.gov for details.

You

write it as a text message

ChatGPT

From: Public Health
Alert: Boil Water Order for Nashua, NH. Water Contaminated! Don't use tap water for drinking, cooking, or bathing. Boil for 1 min. Get bottled water at City Hall. Details: nashuanh.gov



Chat GPT 4

You
create a 360-character Wireless Emergency Alerts in this format:
Source, hazard name/description, location, consequences of threat, protective action, time. From Public Health for a boil water order for all of Nashua, due to contamination do not drink, cook or bathe with water. Boil water for at least 1 minute. Bottled water available at city hall for pickup. more information at nashuanh.gov

ChatGPT
Wireless Emergency Alert: Public Health Advisory

- **Source:** Public Health Department
- **Hazard:** Boil Water Order
- **Location:** Nashua
- **Consequence:** Contaminated water; do not drink, cook, or bathe with unboiled water
- **Protective Action:** Boil water for at least 1 minute before use. Bottled water available at City Hall for pickup.
- **More Information:** Visit nashuanh.gov
- **Time:** Effective Immediately

You
write it as a text message

Which response do you prefer?
Your choice will help make ChatGPT better.

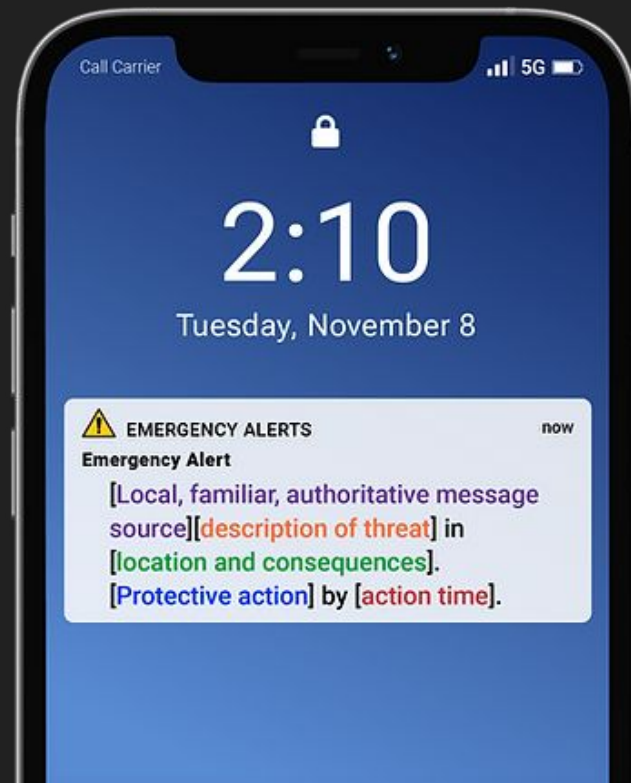
Response 1

Public Health Alert for Nashua:

Due to water contamination, a Boil Water Order is in effect immediately. DO NOT drink, cook, or bathe with unboiled water. Ensure to boil water for at least 1 minute before use. Bottled water is available for pickup at City Hall. For more info, visit nashuanh.gov. Stay safe!

Response 2

Public Health Alert for Nashua: BOIL WATER ORDER in effect due to contamination. DO NOT drink, cook, or bathe with water unless boiled for 1 min. Bottled water available at City Hall. Details at nashuanh.gov

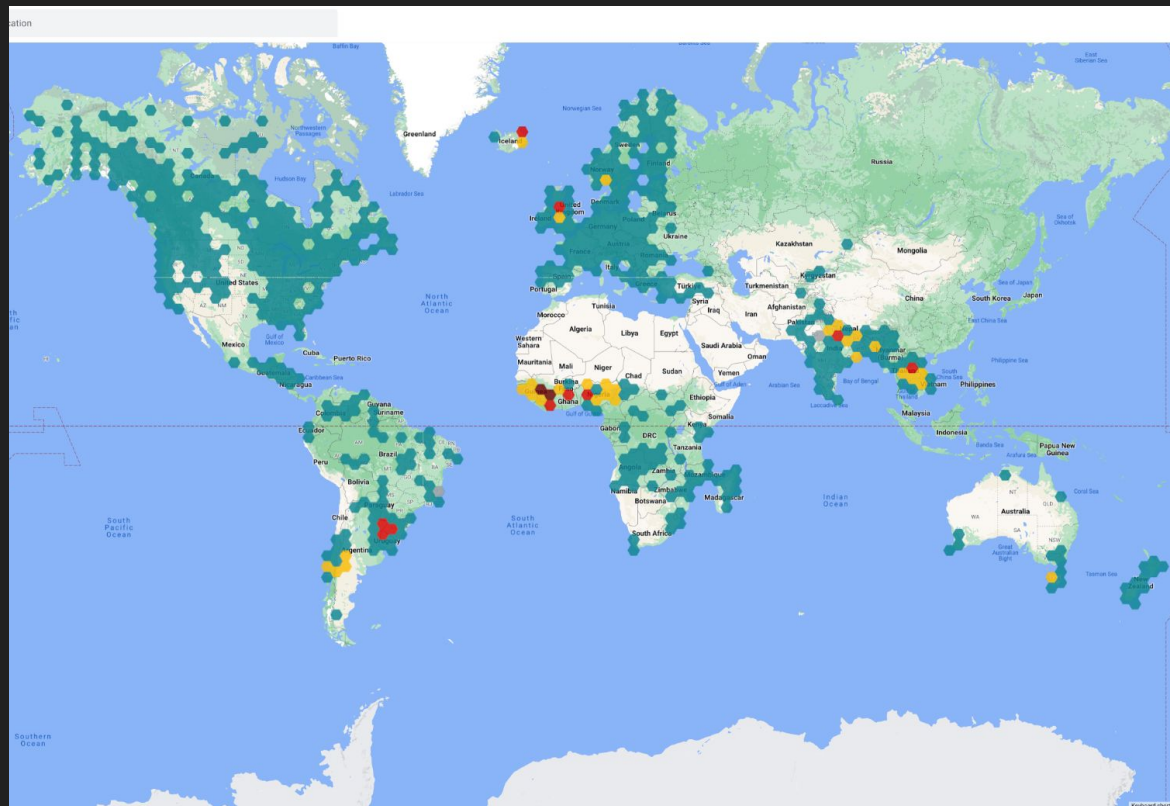


Future of ChatGPT (and tools like it)

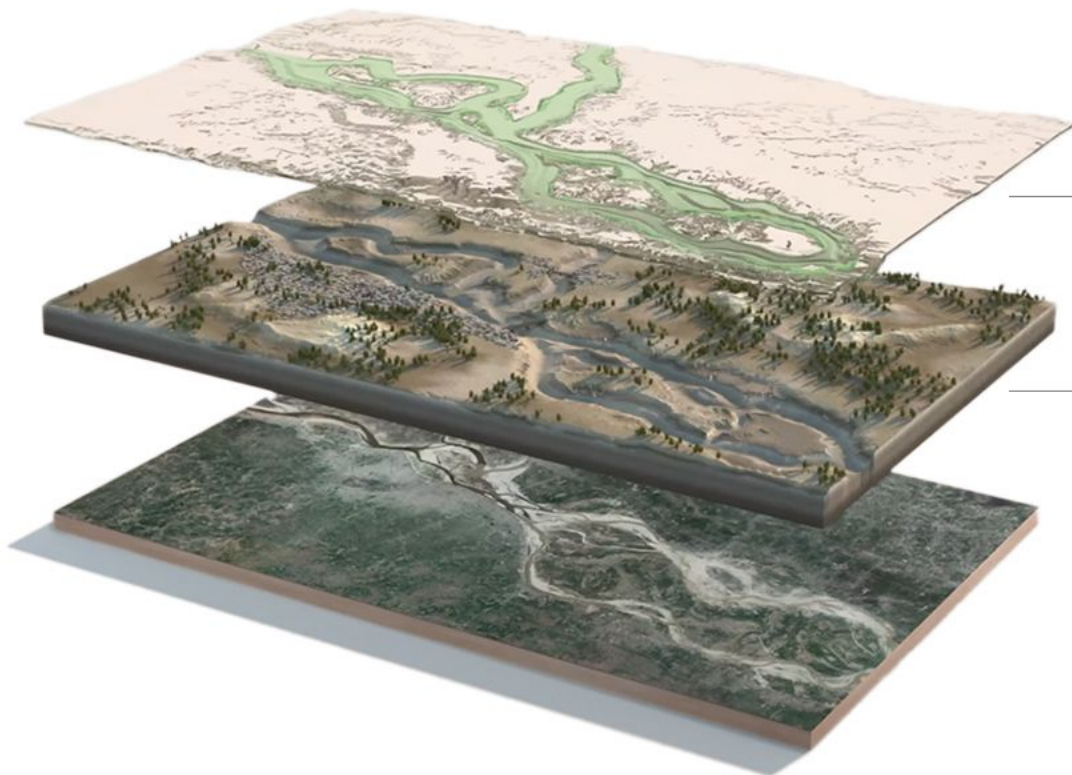
- Integration into Platforms
 - Google, Microsoft
- Personalization and Contextual Adaptability
 - Learns and adapts to the human users preferences
- Multimodality
 - Understand and process multiple forms of input, such as text, images, video, and audio
- Specialized models for specific industries or domains
 - GPTs
- Faster, Cheaper, More Functionality

Google Flood Hub

- AI Model
- Pulling Open Data



Flood Hub - Future



Hydrological model

How will the river water change in the next few days?

Inundation model

Where will the river flood water reach?

AI Generated Damage Assessments

- Half of Disaster declared from 2017-2023 were over 9,200 square miles
- Imagery is abundant but must be reviewed for information
- Very people intensive process
- Often a sample of damages is done - not comprehensive or complete
- Rapid classification of damages leads to faster recovery

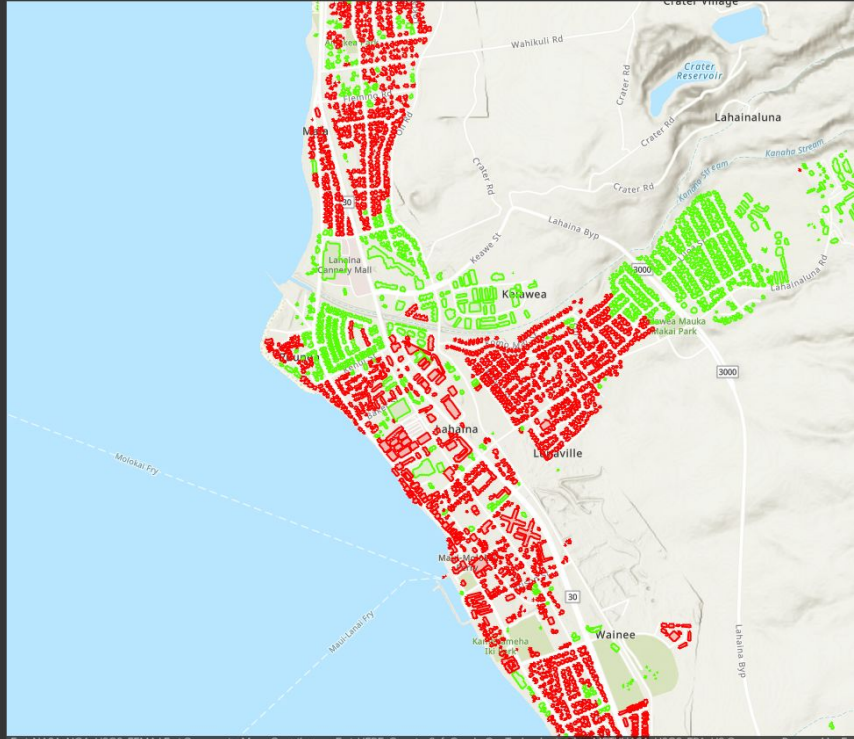


Esri AI Generated Geospatial Damage Assessments

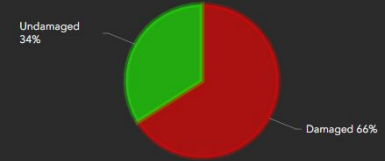
Maui Fires Damage Assessment - Data derived from Airbus imagery distributed through SkyWatch

Damaged Buildings
1,896

Undamaged Buildings
976



Building Damage



D
a
m
a
g
e
d
1,896

U
n
d
a
m
a
g
e
d
976

Amenities	Count
bank	1
bench	10
bicycle_parking	2
cafe	2
charging_station	1
doctors	2
fast_food	1

Trends and Research in AI

Buzzwords

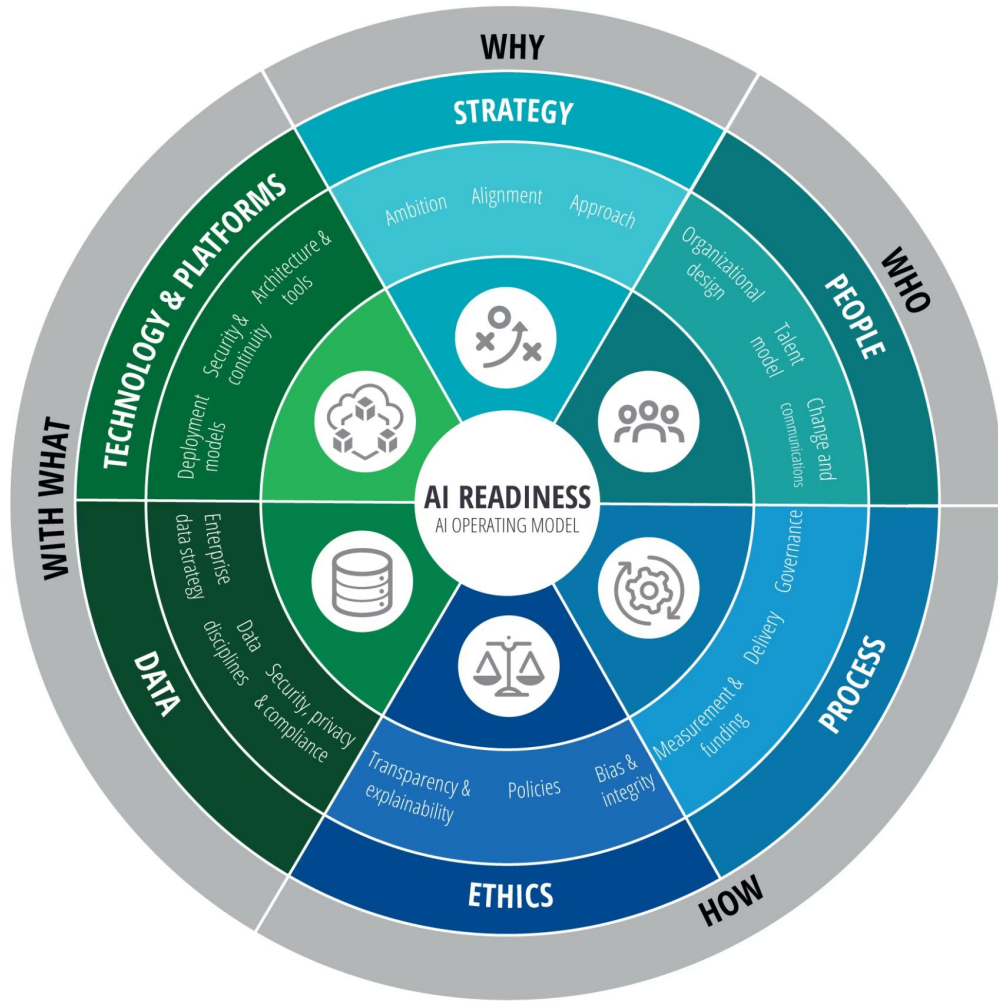
- Foundational models
 - Large language models
 - Vision models
 - Geospatial data (GeoAI)
- Hardware
 - GPUs and supercomputers
 - Edge computing
 - Neuromorphics
- Data analysis and creation
 - One-shot learning
 - Synthetic training data
 - Non-optical imagery data analysis (e.g. Lidar, synthetic aperture radar)

Disaster-related research topics

- Flood mapping
- Damage detection and classification
- Ocean hazard detection (tsunamis)
- Wildfire forecasting
- Estimation of human condition
- Wilderness search and rescue
- Recovery forecasting

AI+HADR Workshop:

<https://www.hadr.ai/home>



Workshop Instructions

1. Within your groups pick one challenge to tackle (Katie's or your own)
2. Deconstruct the challenge into tasks
3. Identify opportunities to apply AI to the challenge
 - a. Consider human/machine interface
 - b. Consider Strategy, People, Process, Ethics, Data, Technology & Platforms
4. Back Brief

Considerations

1. Deconstruct the challenge
 2. Where do you already use automation or AI? What works? What doesn't?
 3. Where are there untapped opportunities for automation or AI?
 4. How should it interface with humans?
- Strategy (Why)
 - Ambition, Alignment, Approach
 - People (Who)
 - Organizational design, Talent model, Change and communications
 - Process (How)
 - Measurement & funding, Delivery, Governance
 - Ethics (How)
 - Transparency & explainability, Policies, Bias & integrity
 - Data (With What)
 - Enterprise data strategy, Data disciplines, Security, privacy & compliance
 - Technology & Platforms (With What)
 - Deployment models, Security & continuity, Architecture & tools

What did you learn?

Want to learn more?

- [Learnprompting.org](https://learnprompting.org)
- [Futuretools.io](https://futuretools.io)
- [Deloitte & McKinsey AI and Future of Work Resources](#)

Suggested resources on AI

Learnprompting.org

Futuretools.io

Deloitte & McKinsey AI and
Future of Work Resources

Book: A World Without
Work by Daniel Suskind

Ask Chatgpt for the list

[https://www.dhs.gov/data/
AI_inventory](https://www.dhs.gov/data/AI_inventory)

Machines have taken
over...save yourselves!!!!

Contact Info

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