



BRIDGING THE GAP BETWEEN STANDARDS AND UNCERTAINTY USING EXTREME RAINFALL DATA

2024 NOAA EAST REGION

NOVEMBER 21, 2024

HNTB

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PRESENTERS



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Climate Resilience
Practice Leader



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Structural Engineer
Bridge Technology Lead

RESILIENT INFRASTRUCTURE SOLUTIONS



East Side Coastal Resiliency Project, Lower Manhattan

The future of transportation is complex, evolving rapidly, and confronted with increased risk from extreme weather.

HNTB's transportation and resilience experts help clients navigate the uncertainty of the future and prepare, adapt, and respond to shocks and stressors.

INTEGRATED SERVICES



NY MTA Adapted Subway Entrance

PREPARE

Planning services to prepare for and anticipate impacts and disruptions from shocks and stressors.

ADAPT

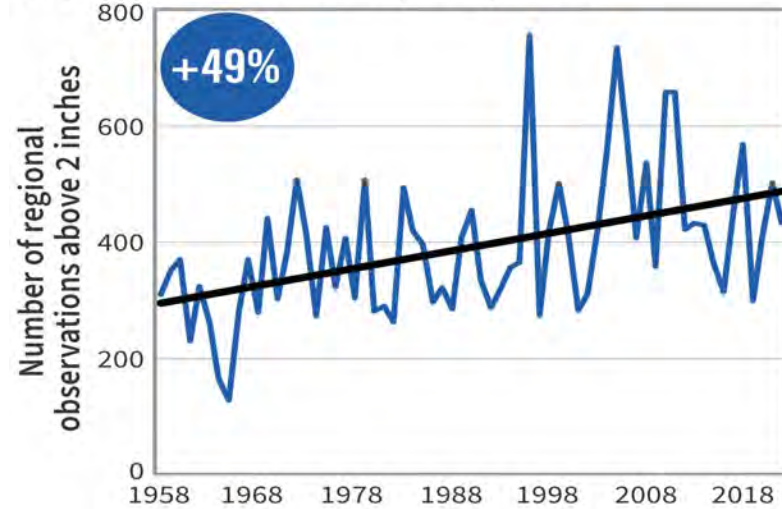
Resilient design and engineering services to reduce risk, as well as adapt to changing conditions.

RESPOND

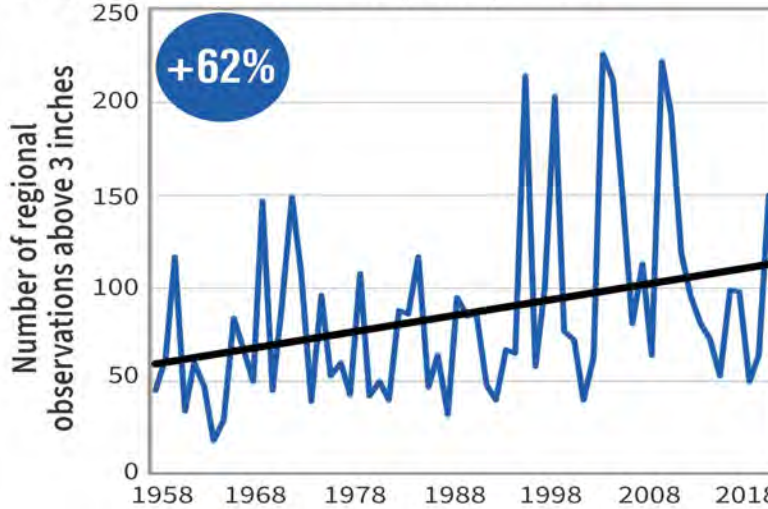
Support services to recover quickly and respond to rapid changes to reduce disruption and prioritize safety.

The number of days with extreme precipitation has **increased** in the Northeast

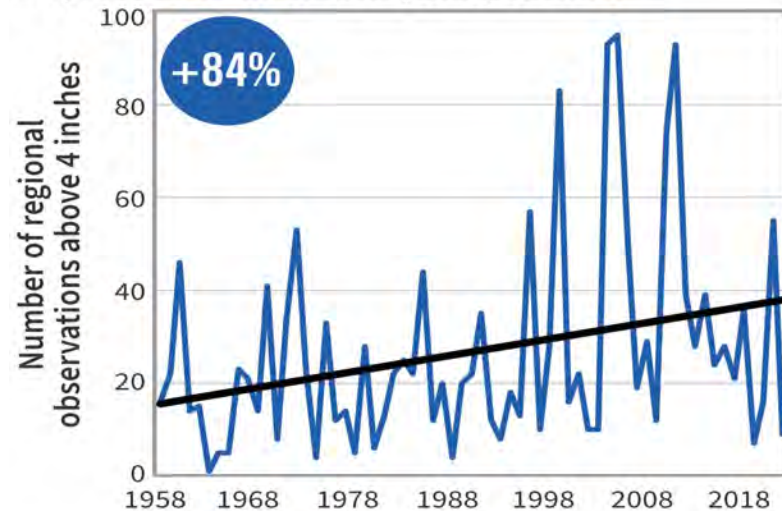
Days with 2+ inches of precipitation



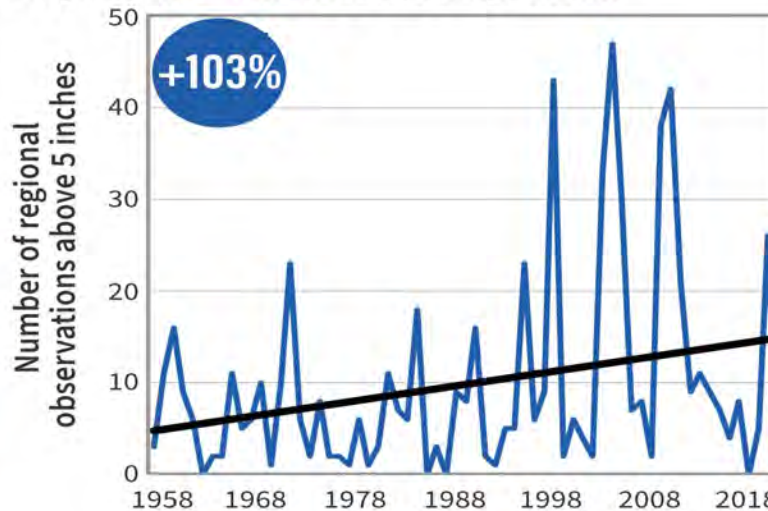
Days with 3+ inches of precipitation



Days with 4+ inches of precipitation



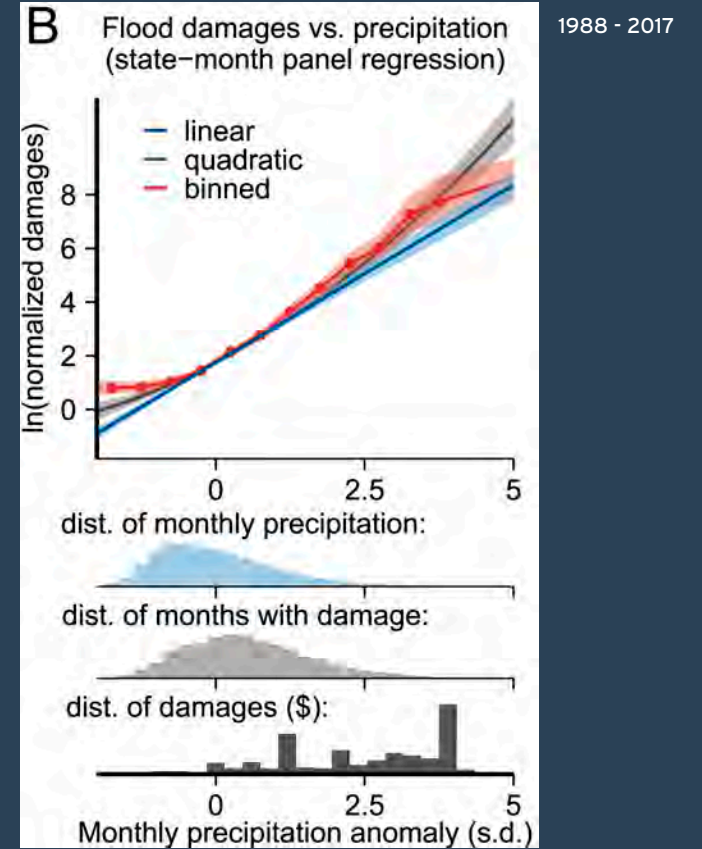
Days with 5+ inches of precipitation



1958-2021

NOAA Climate.gov
Data: Adapted from NCA5

Extreme rainfall events are becoming increasingly frequent and intense



F.V. Davenport, M. Burke, N.S. Diffenbaugh, Contribution of historical precipitation change to US flood damages, Proc. Natl. Acad. Sci. U.S.A. 118 (4) e2017524118, <https://doi.org/10.1073/pnas.2017524118> (2021).



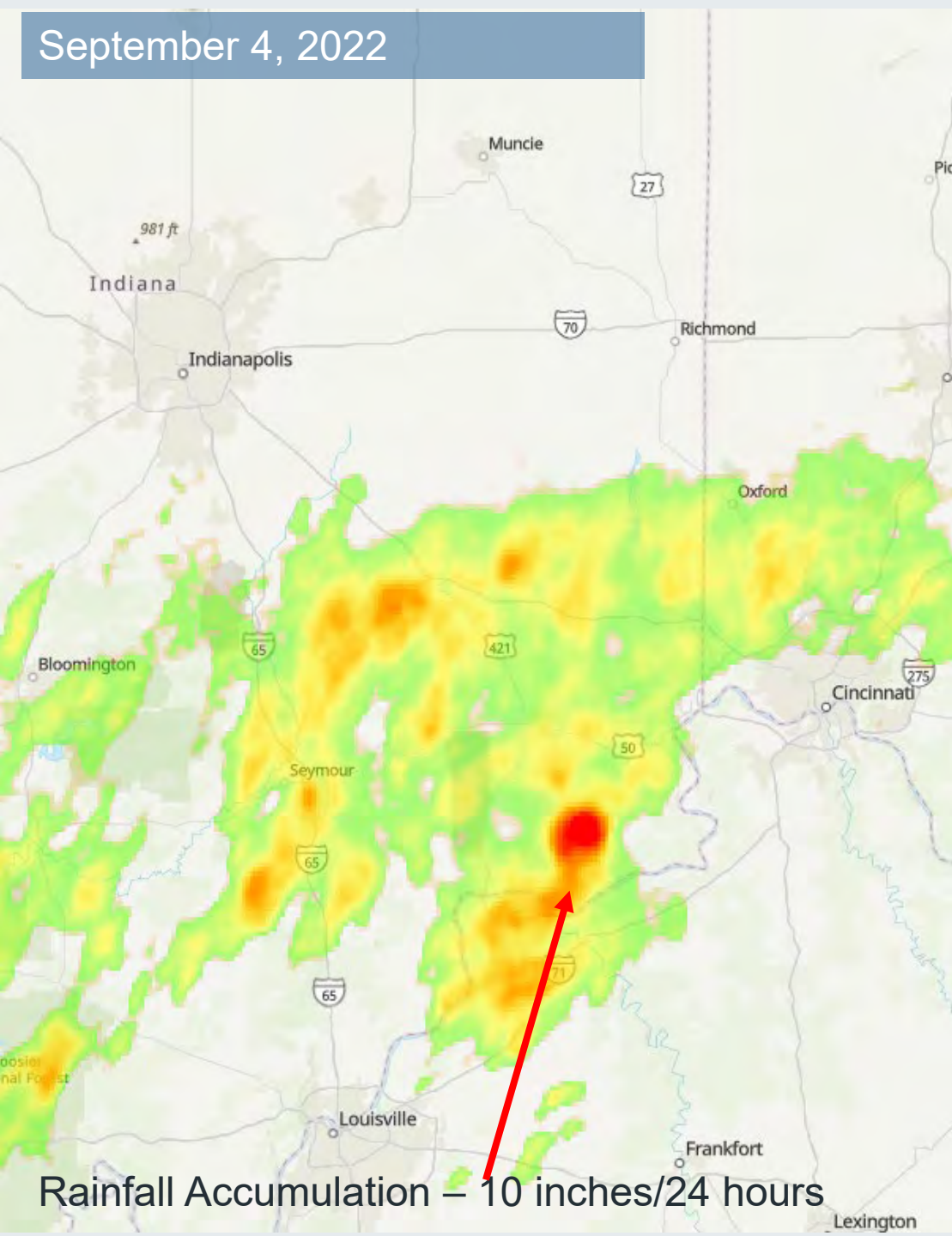
MetroNorth – Rapid, Resilient Recovery

Hudson Line HU 21.16 over Wicker's Creek

- Sept. 1, 2021: ~6 inches of rain over ~ 6 hours (0.5% likelihood of occurring based on NOAA Atlas 14 precipitation frequency estimates), with a peak rainfall 2.2 inches/hour.
- All 4 tracks of Hudson Line knocked out of service - 142 trains/day
- Partial collapse of existing 100-year old culvert



September 4, 2022



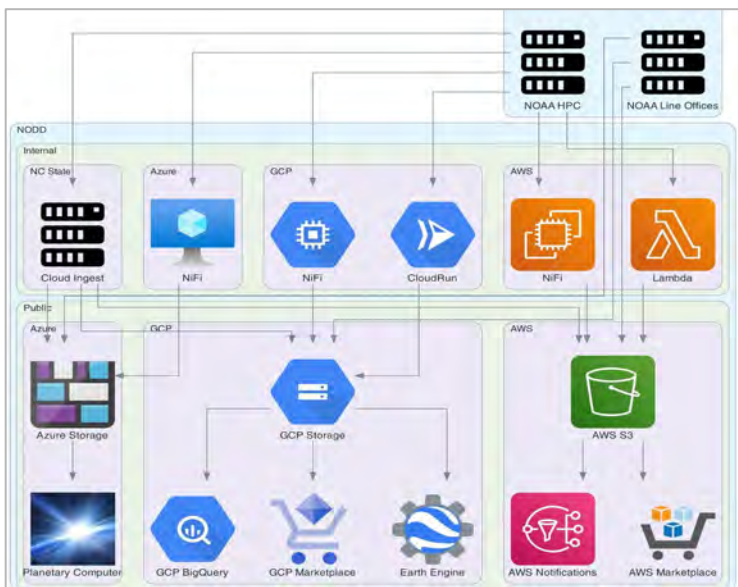
CLOUDBURSTS/MICROBURSTS & BRIDGE RISK





NOAA Open Data Dissemination (NODD)

Providing free & open access to hundreds of NOAA's valuable environmental datasets via three cloud service providers (CSPs):



NODD Architecture:

NODD architecture displaying data movement from NOAA on-prem systems to each of the three cloud service providers.

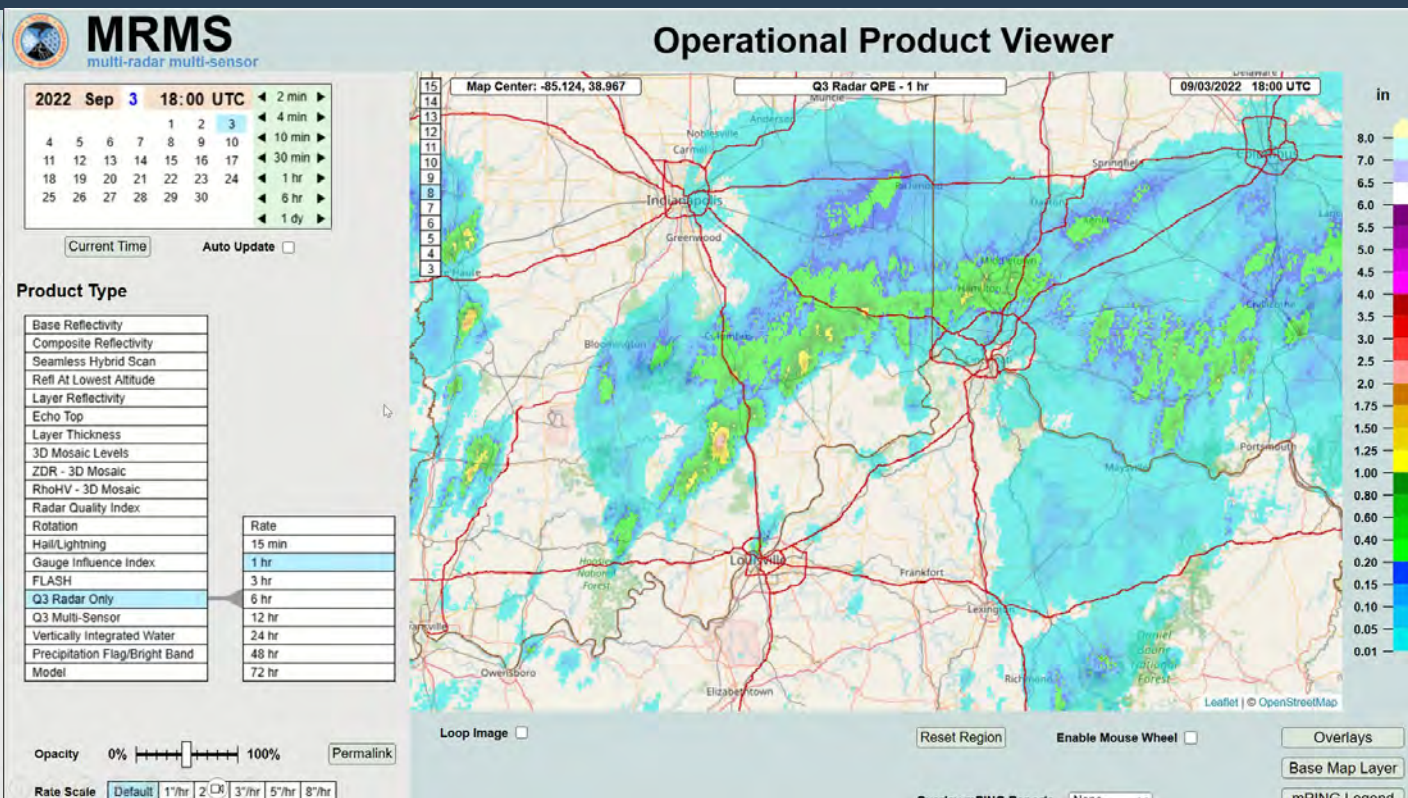
NODD Helps Drive Innovation
 Improved access to NOAA's data via the cloud enables users' innovative data analysis and decision-making. NODD users ranging from small startups, to large corporations, to researchers, have expressed benefits such as enhanced data access, lower latency, and lower associated operational costs.



Please visit NOAA.GOV/NODD to learn more about the program & available datasets. Or to get in touch to ask questions or share your use case, please email NODD at NODD@NOAA.GOV.

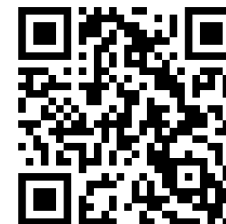


LEVERAGING PRECIPITATION DATA



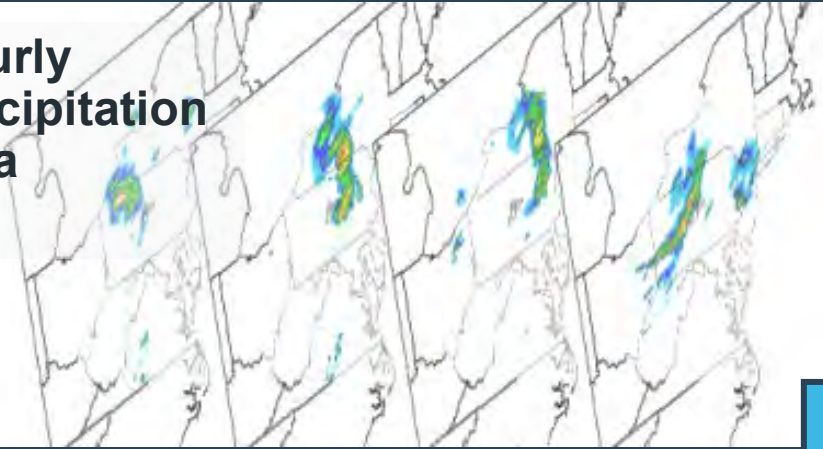
NOAA'S MULTI-RADAR MULTI-SENSOR (MRMS) DATA

- Rainfall accumulation
- Continental US
- Hourly basis
- Approx. square mile grid
- Near real time

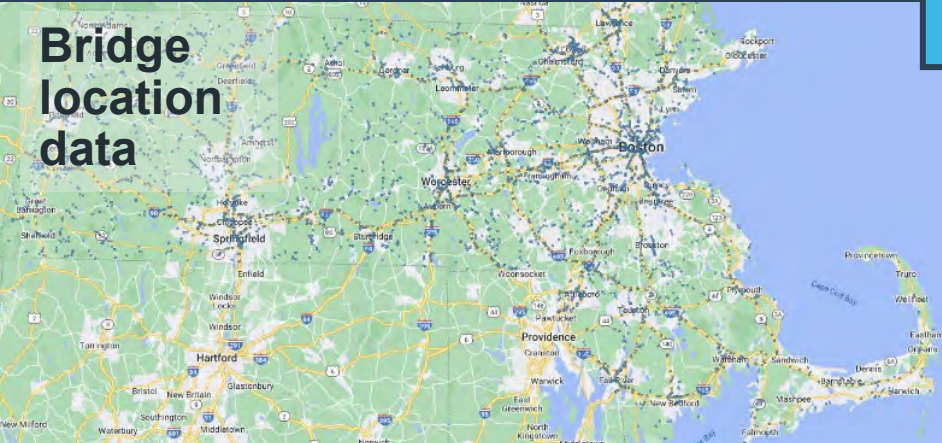


ASSET LEVEL RAINFALL ANALYSES EXERCISE (ALRAE)

Hourly precipitation data



Bridge location data



Rainfall Time History for Single Asset

Select Asset by Bridge ID

243432

Filter by Date



“Virtual Rainfall Gauge” at Each Bridge

Rainfall (in)



May 2023

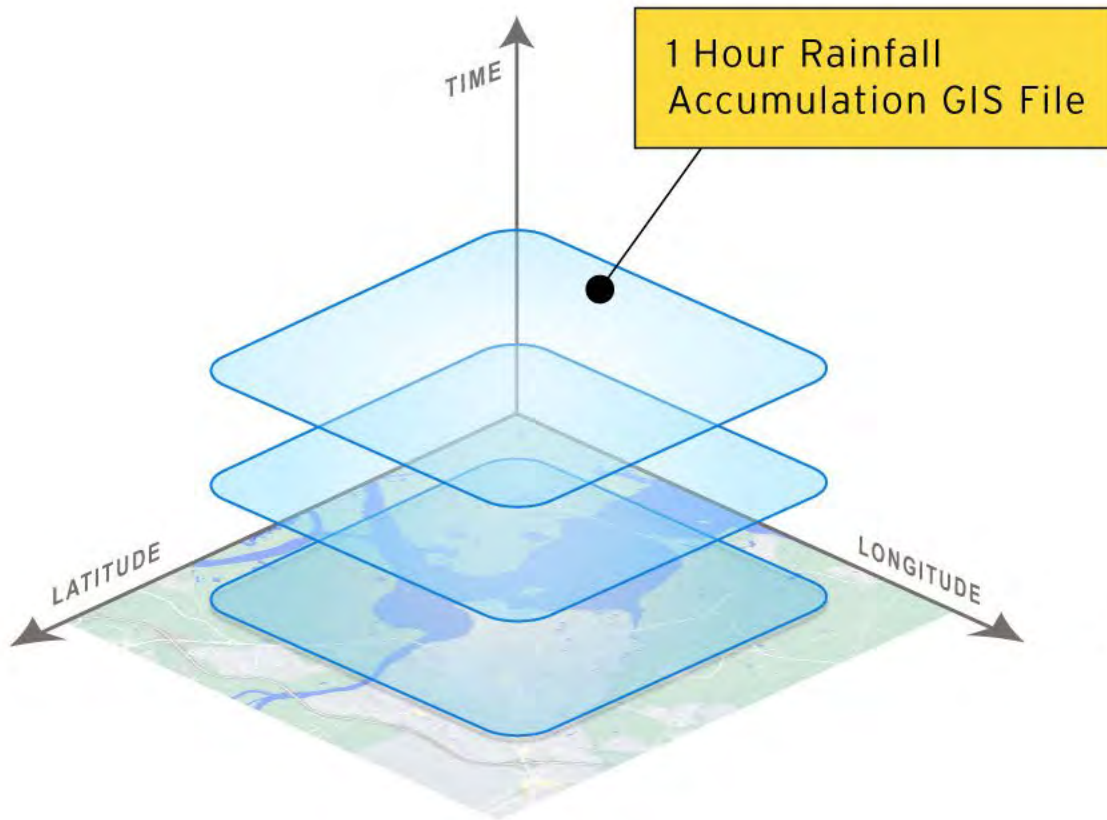
Jul 2023

Sep 2023

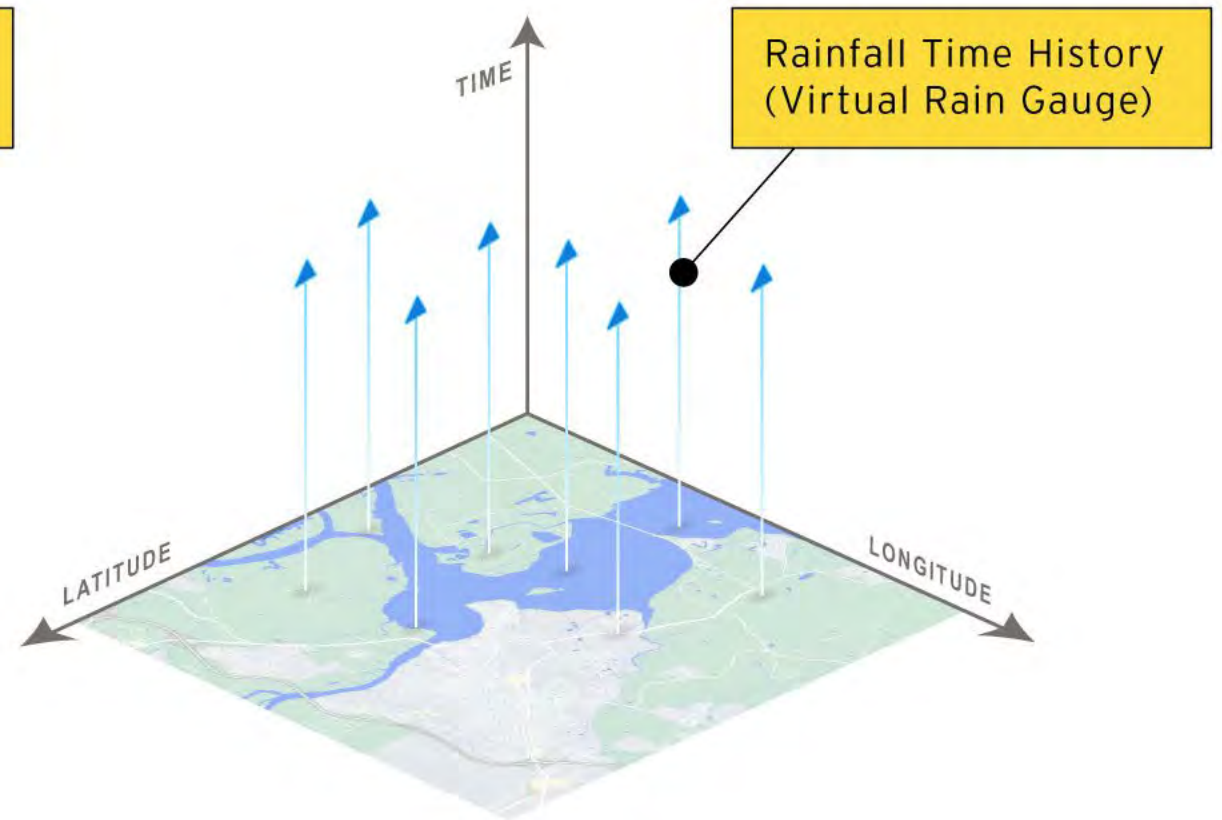
Date

Image credit: USACE (top), InfoBridge (FHWA) (bottom)

LEVERAGING NOAA'S PRECIPITATION DATA



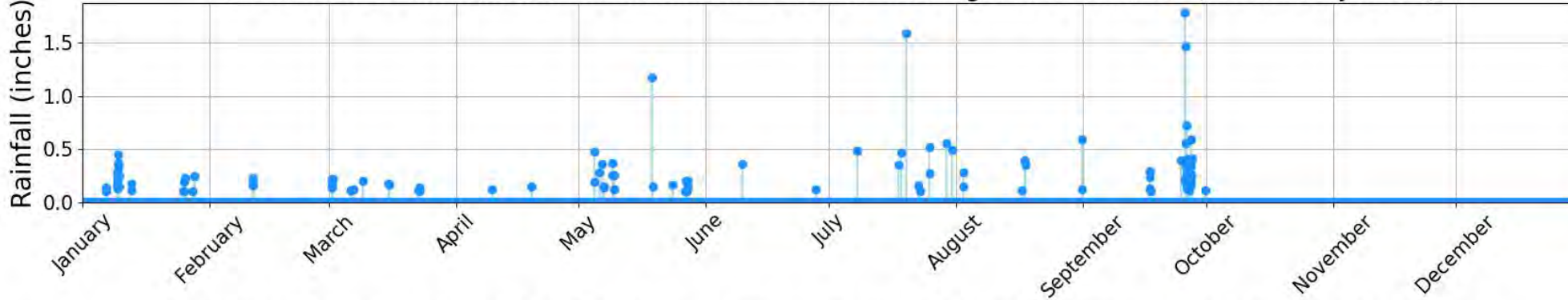
NOAA Provided Data



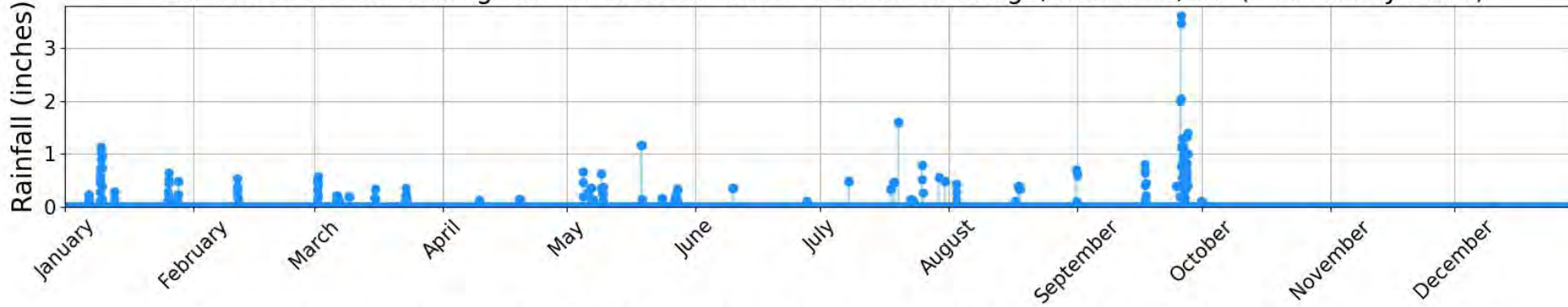
Preliminary ALRAE Data

ALRAE / LOCATION SPECIFIC RAINFALL TIME HISTORY

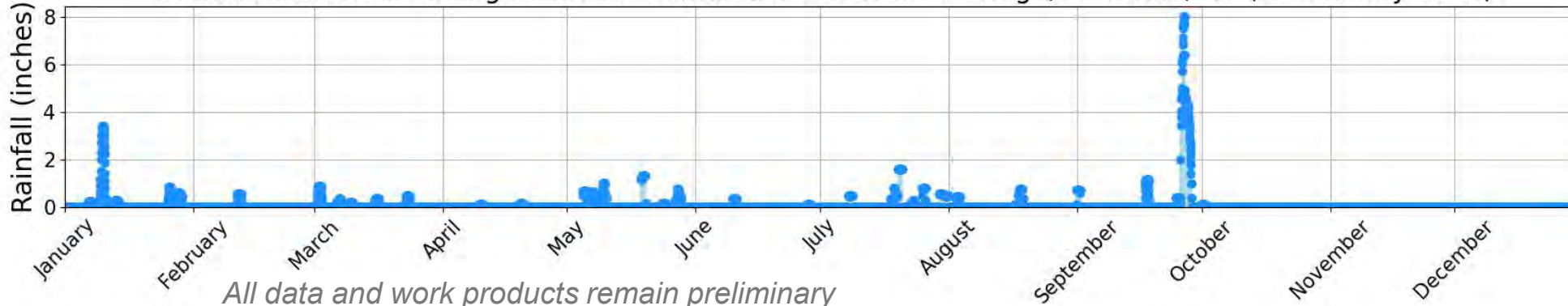
Estimated 1-Hour Rainfall Accumulation - Craven St Bridge, Asheville, NC (Preliminary 2024)



Estimated 3-Hour Rolling Rainfall Accumulation - Craven St Bridge, Asheville, NC (Preliminary 2024)



Estimated 24-Hour Rolling Rainfall Accumulation - Craven St Bridge, Asheville, NC (Preliminary 2024)

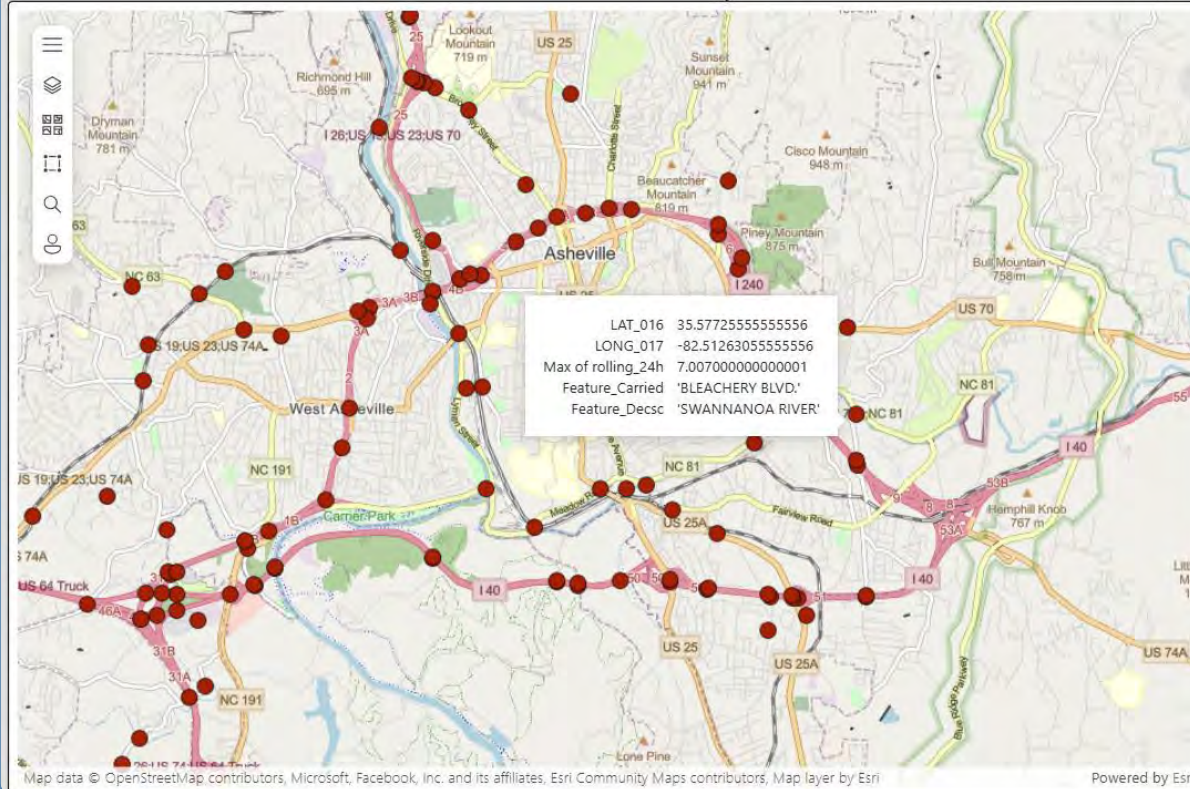


All data and work products remain preliminary

RAINFALL PEAK DASHBOARD

Peak 2024 Rainfall for 24 Hour Duration

Source: National Oceanic and Atmospheric Administration (NOAA) MRMS precipitation dataset. The information shown is part of a preliminary research effort and the data set utilized has not been evaluated for accuracy or completeness. HNTB provides this data "as-is" without warranty of any kind, either expressed or implied.



Filter By Max Rainfall (in)

7.00

19.49



Filter By Date

6/21/2024

9/30/2024



Scour Criticality

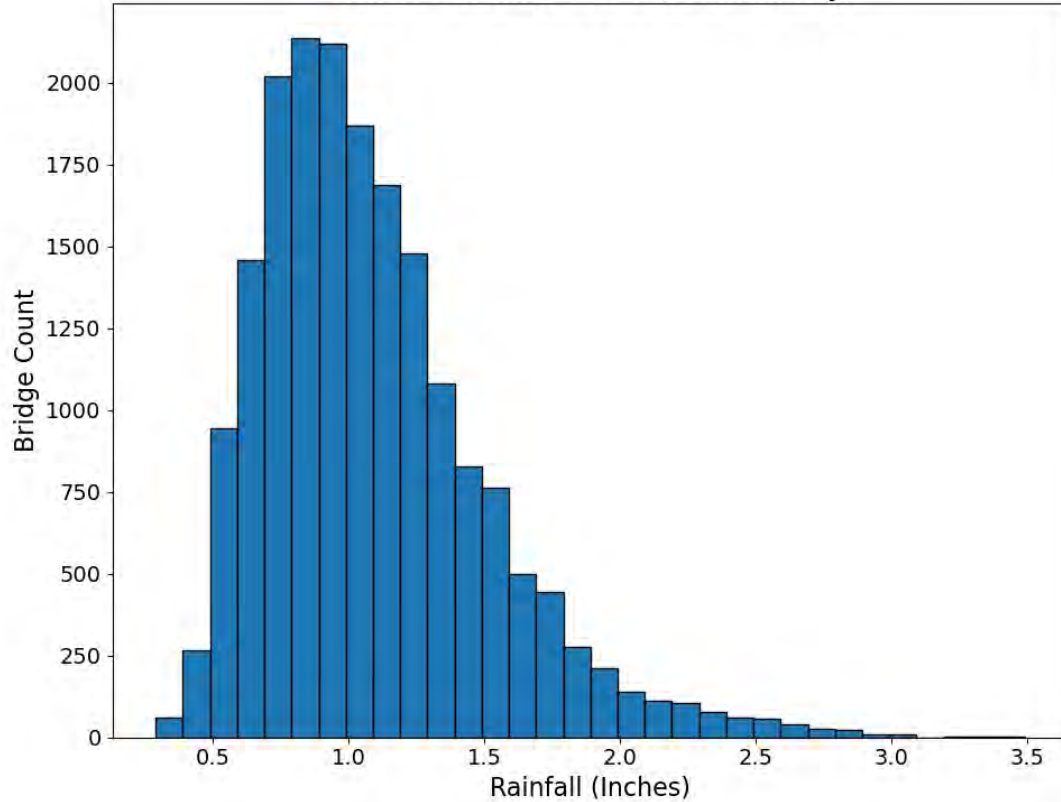
All

Note: All rainfall records below 0.5" in 24 hours have been removed

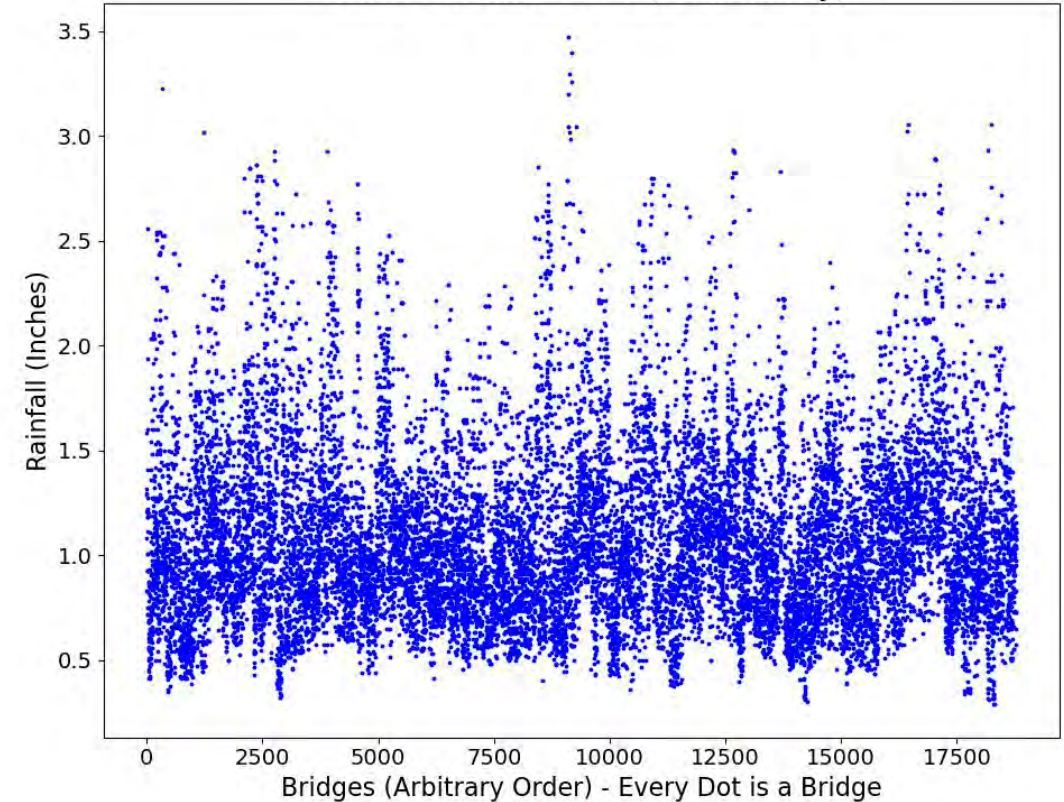
HNTB

RISK PROFILE ACROSS A POPULATION OF ASSETS

Histogram of Maximum 1 Hour Rainfall
North Carolina 2021 (Preliminary)

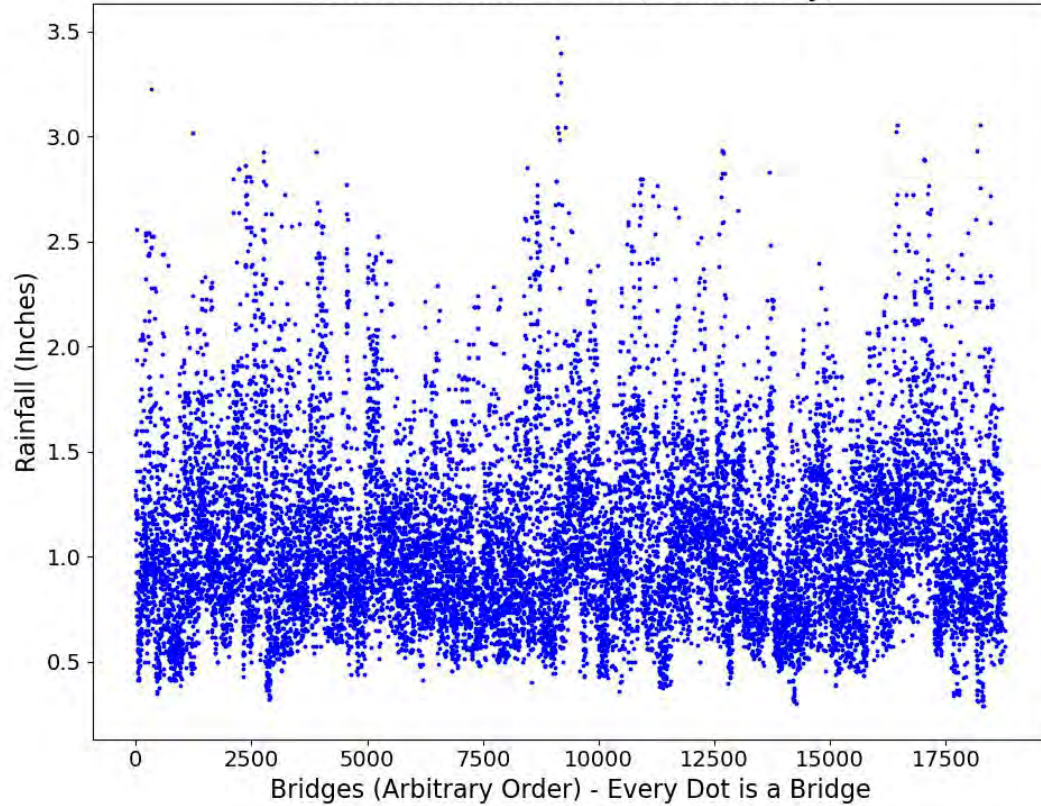


Scatter of Maximum 1 Hour Rainfall
North Carolina 2021 (Preliminary)

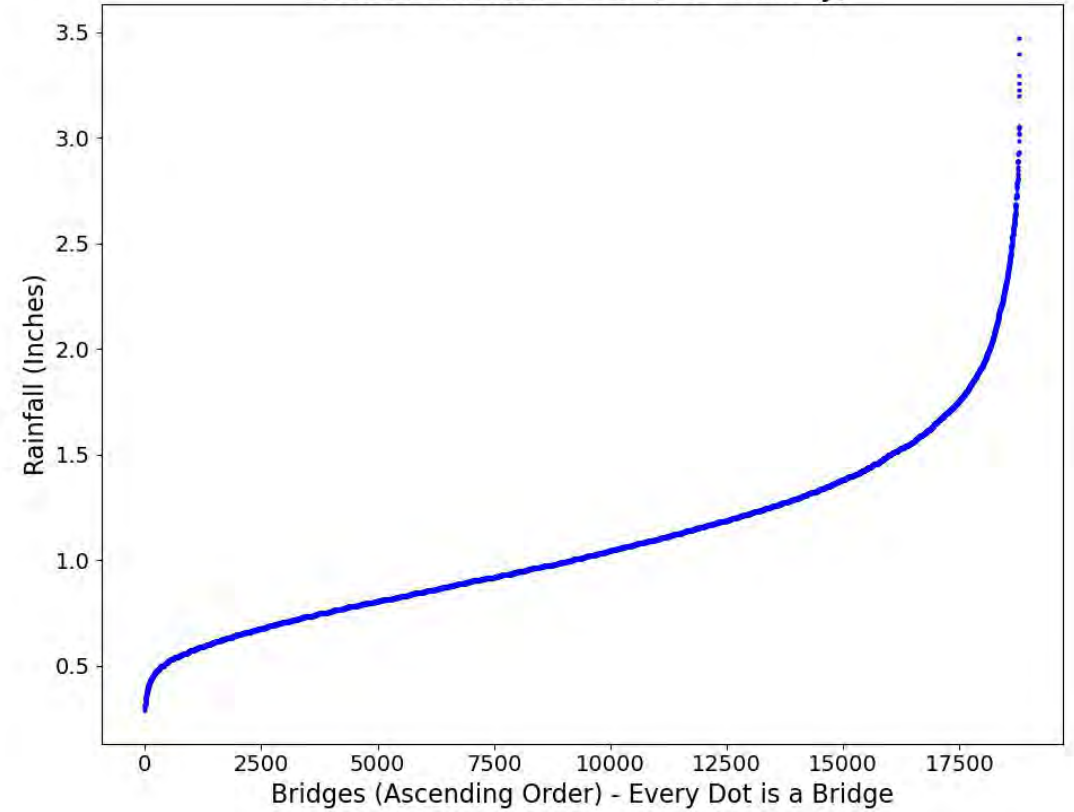


RISK PROFILE ACROSS A POPULATION OF ASSETS

Scatter of Maximum 1 Hour Rainfall
North Carolina 2021 (Preliminary)

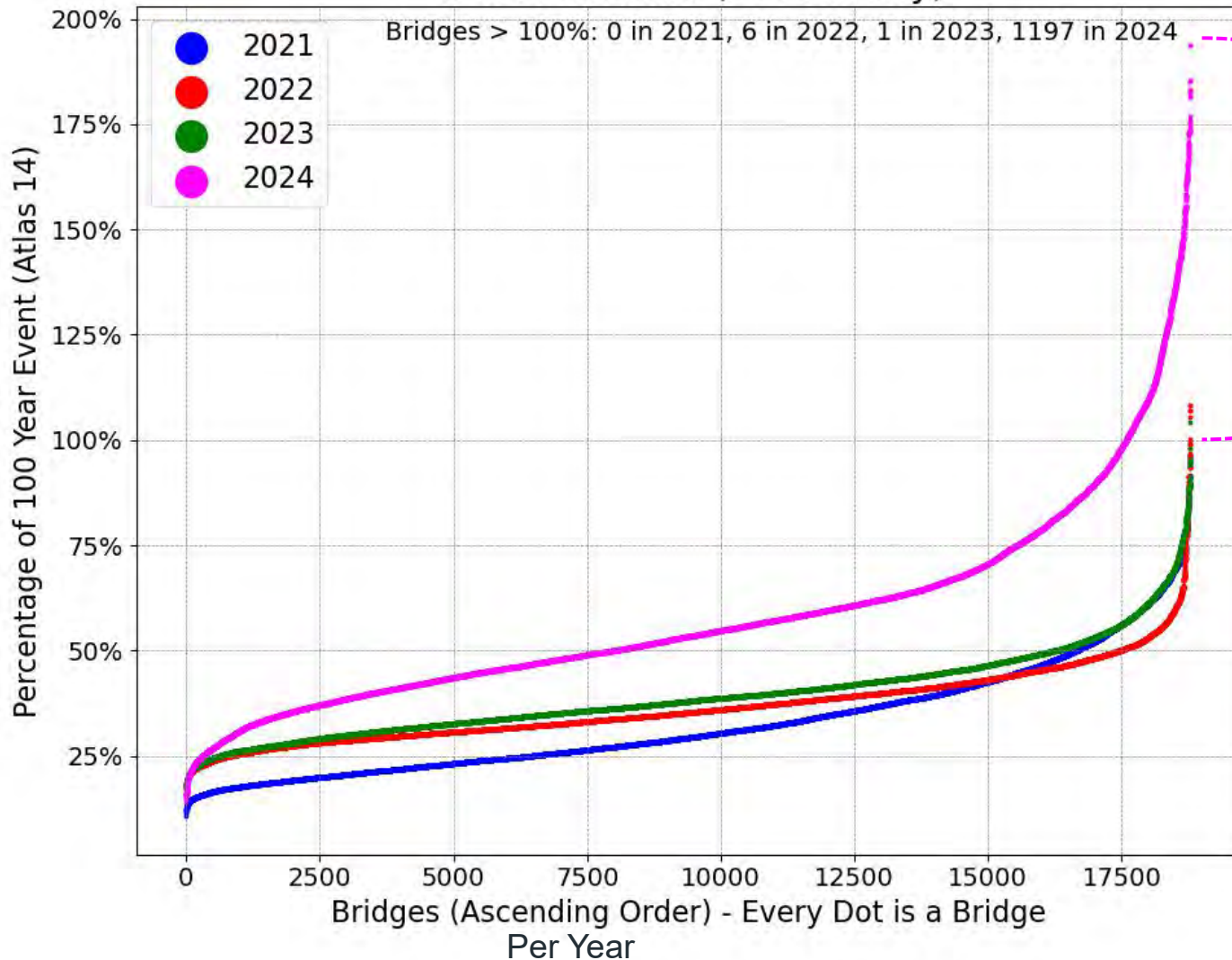


Scatter of Maximum 1 Hour Rainfall
North Carolina 2021 (Preliminary)



RISK PROFILE ACROSS A POPULATION OF ASSETS

Maximum 24 Hour Rainfall as Percent of Atlas 14 (100 year)
North Carolina (Preliminary)



~6% of bridges
in 2024

- Visualize and quantify extreme events - particularly "tail" conditions
- Evaluate proposals for new design criteria and strategies

INITIAL PERSPECTIVES / TEST USE CASES

Climate Scientists

Demonstrate trends?

Apply future projections?

Bridge Engineers

Improve real time awareness?

Refine risk assessments?

HNTB

Prepare

Quantify extremes in time and space (microburst to hurricane)

Compare to design criteria / assumptions

Vet resilience strategies

HNTB

Adapt / Respond

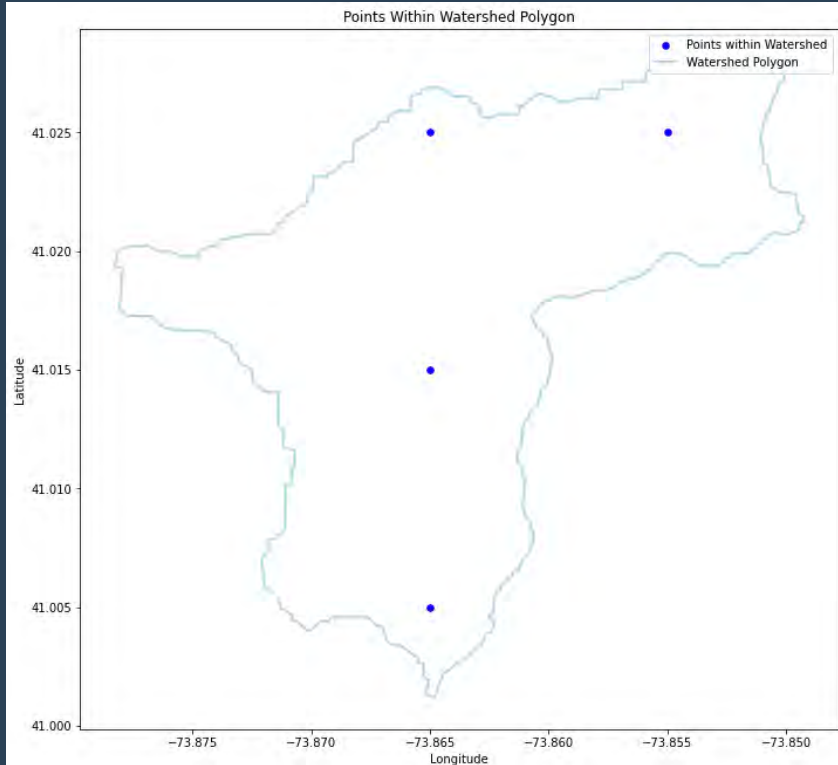
Rapid Bridge Replaceability Response

Hardened Corridors

Bridge-type survival analyses

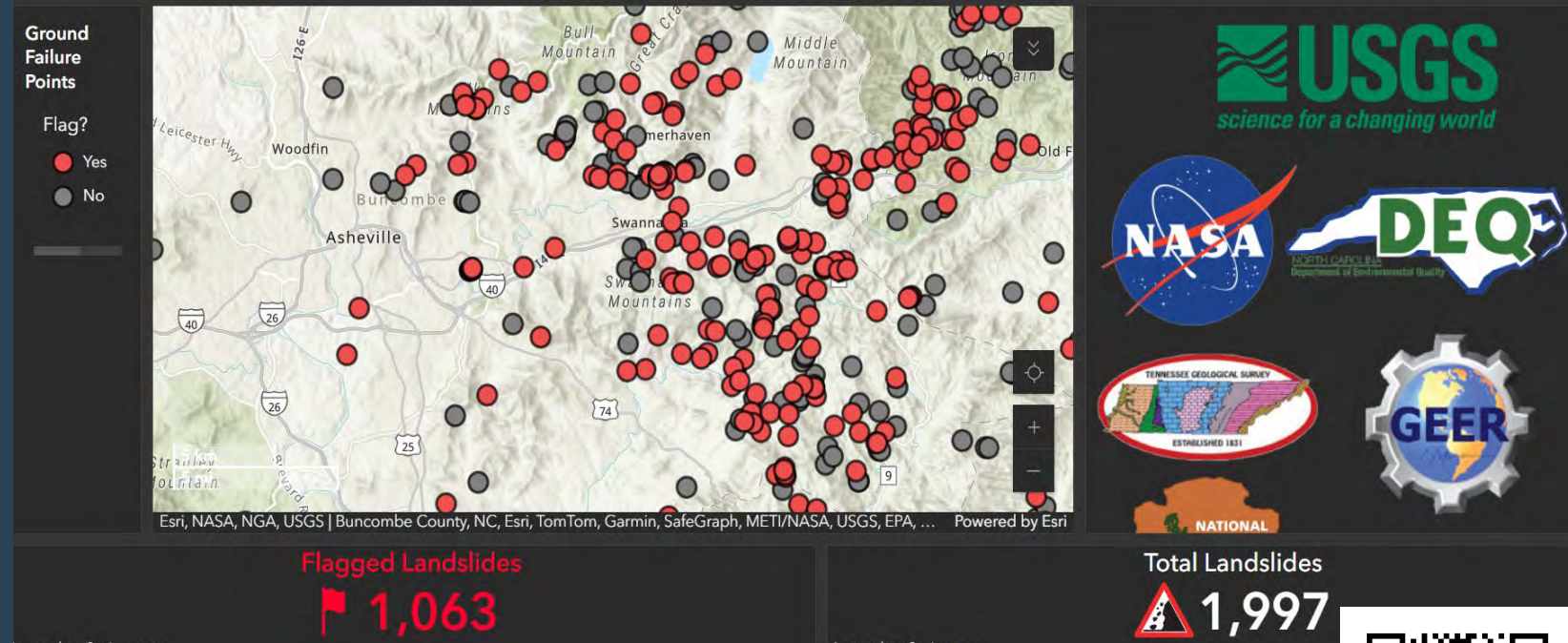
Design bridges that are safe to fail

POTENTIAL USE CASES: INTEGRATION WITH USGS DATA



UPSTREAM OF THE BRIDGE:
WATERSHED ANALYSES

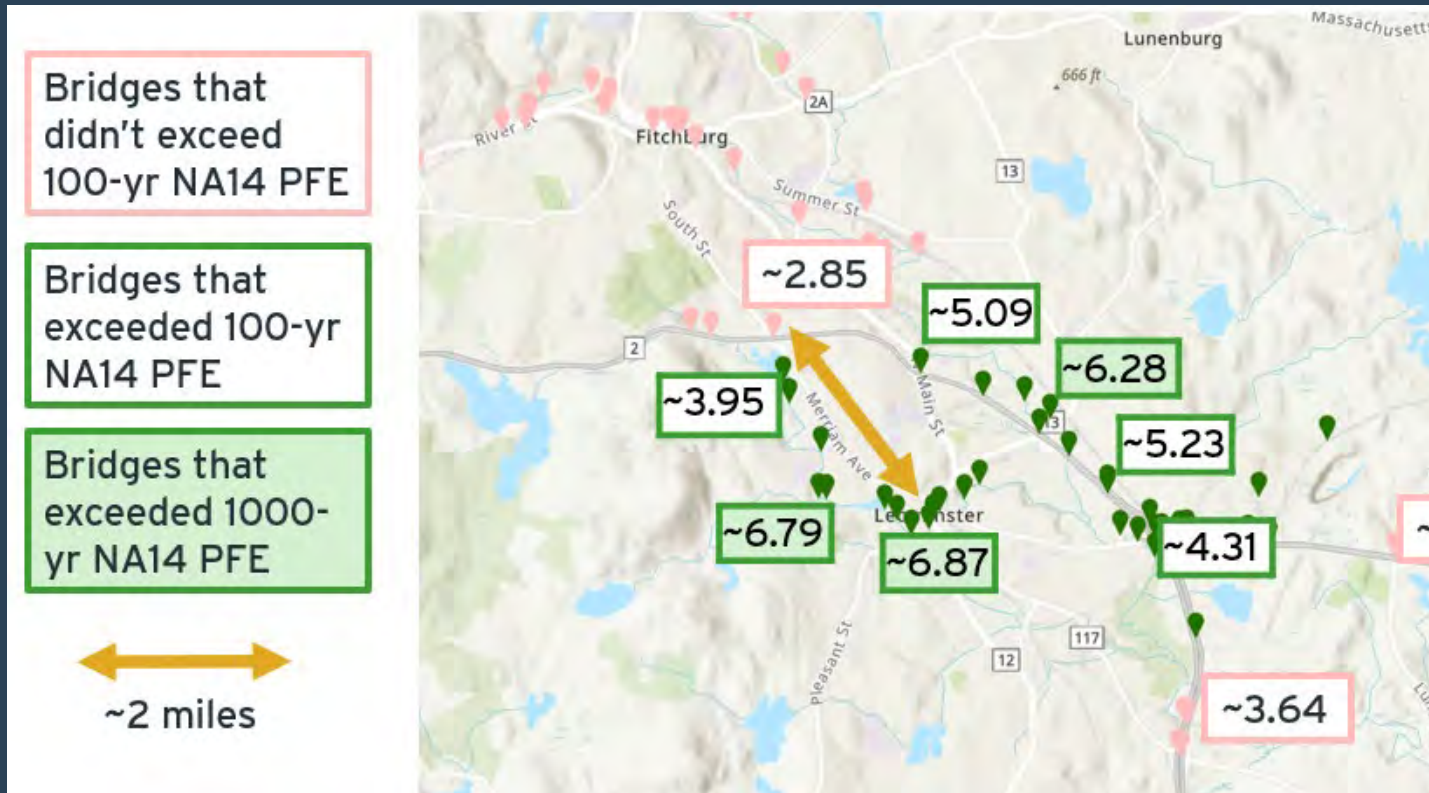
USGS Hurricane Helene Landslide Observations Dashboard



INTEGRATION WITH EMERGENCY
RESPONSE DASHBOARDS



LEVERAGING ALRAE DATA TO PREPARE FORESIC ENGINEERING AND ENHANCED RISK ASSEMENTS

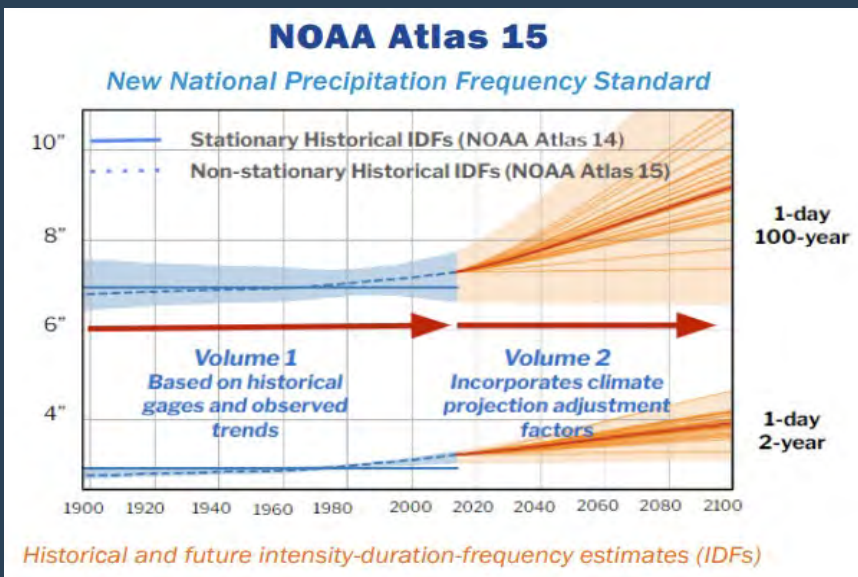
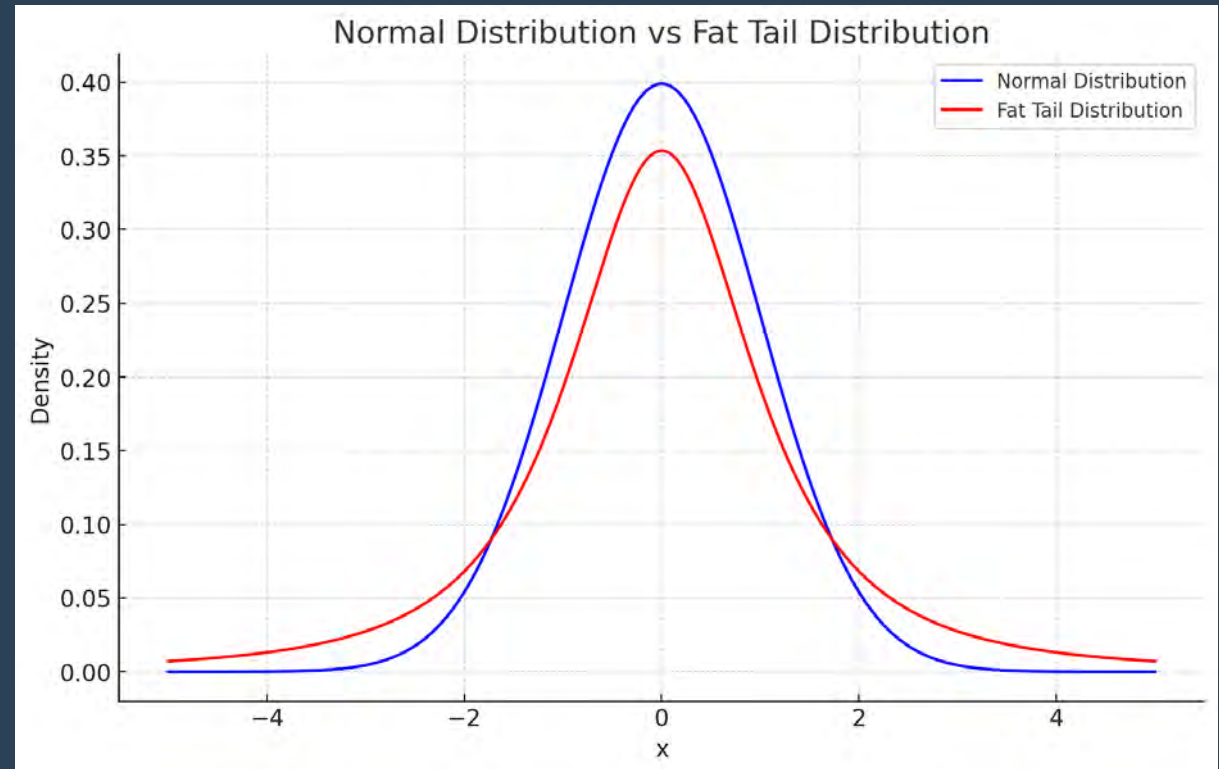
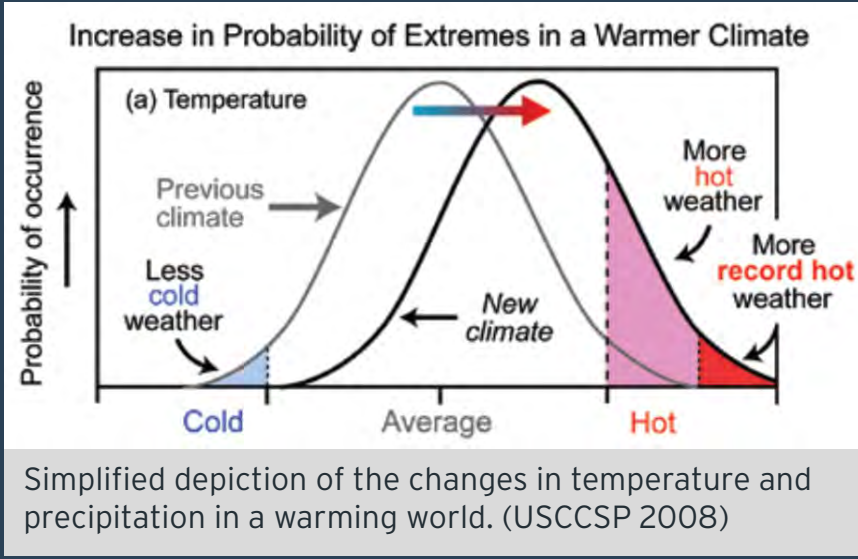


Leveraging preliminary results from ALRAE after microburst event

Photo credit: AP Photo/Josh Reynolds

LEVERAGING DATA TO ADAPT

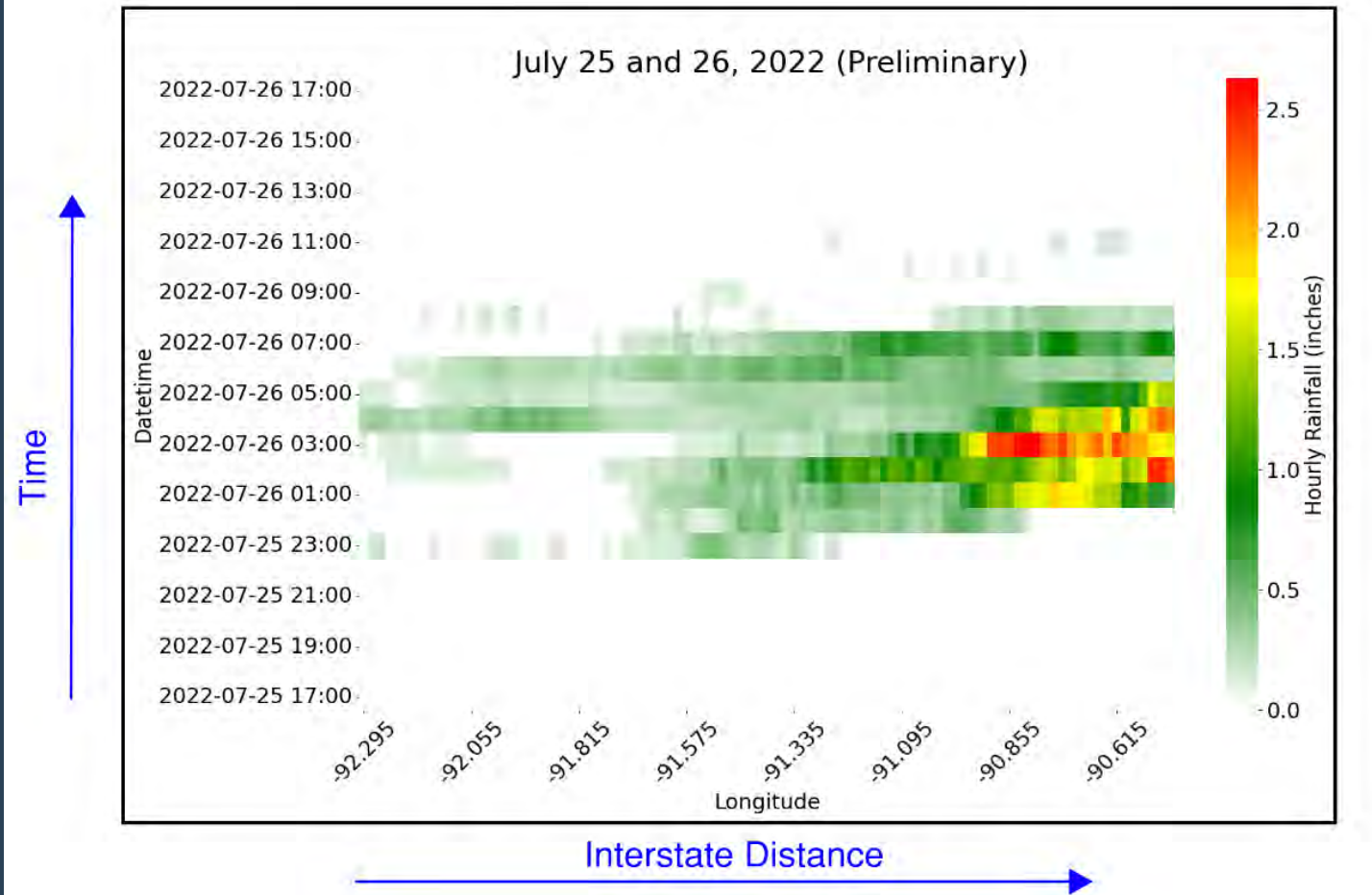
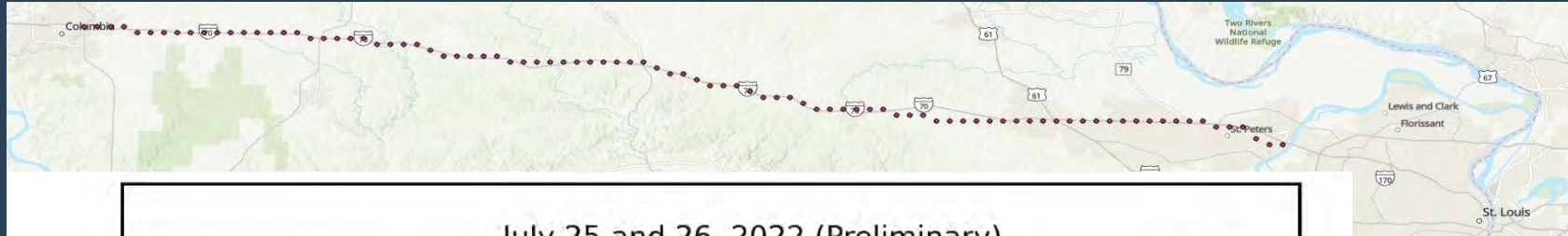
MANAGING UNCERTAINTY OF EXTREMES IN CHANGING CLIMATES



Fat Tail Distribution

LEVERAGING DATA TO RESPOND

TRIAGE APPROACH WITH LIMITED RESOURCES



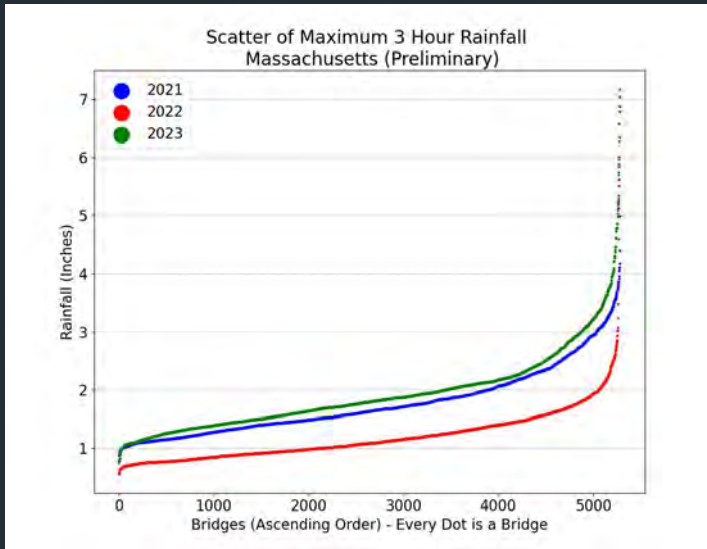
One graphic:

- 100 miles of Interstate
- Hourly precision
- 1-mile granularity

RESILIENT INFRASTRUCTURE SOLUTIONS

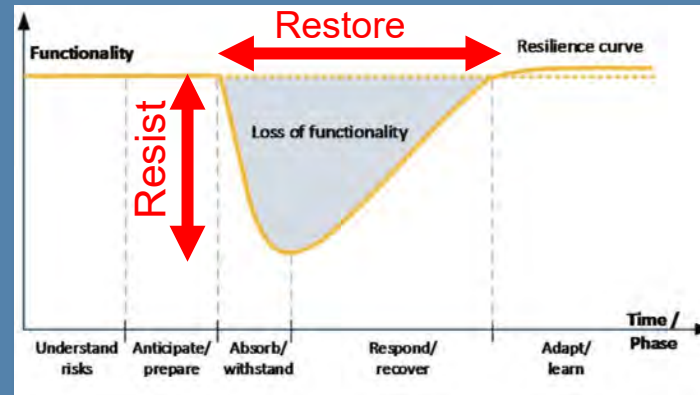
PREPARE

- Quantify extreme events and uncertainty



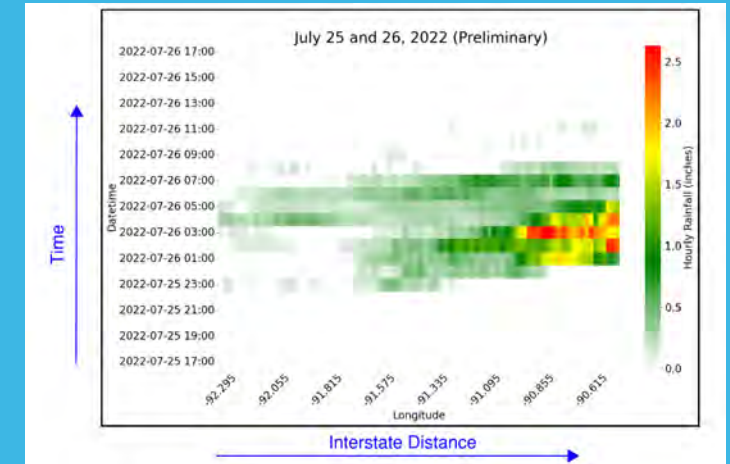
ADAPT

- Bridge analyses & risk-based resilience approach



RESPOND

- Rapid and targeted response



Questions?



Thank you!

Contact information

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