Freight Transportation Resilience Needs

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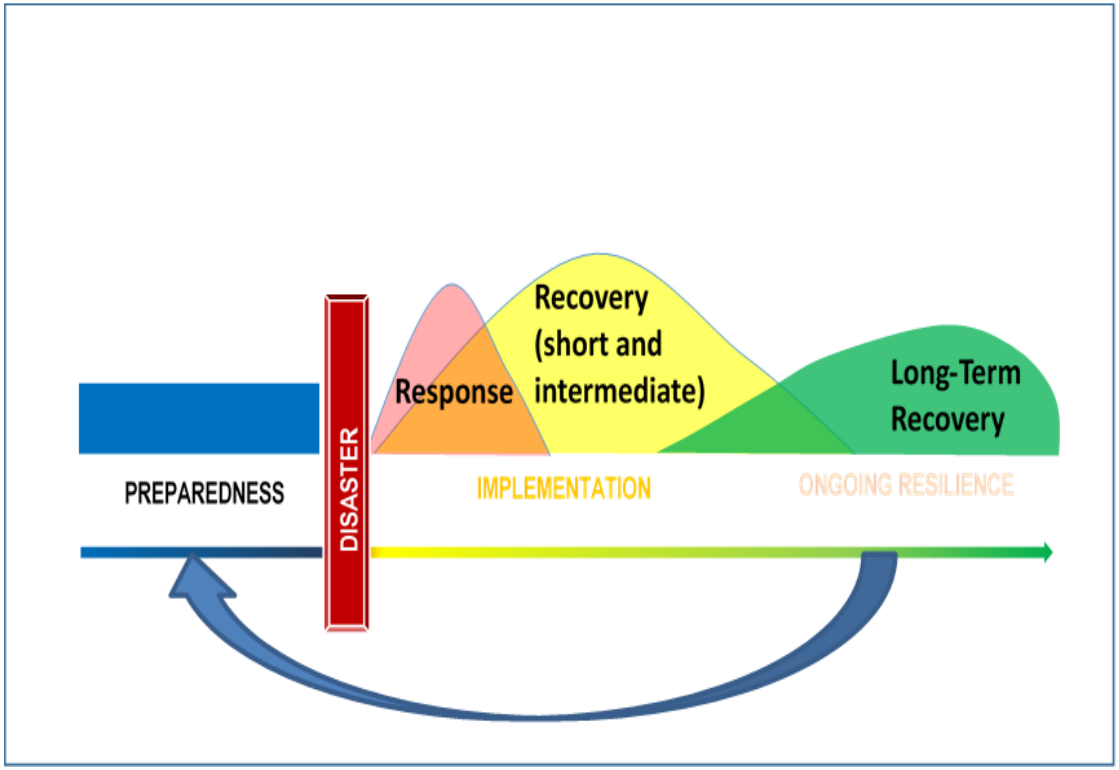
What is freight resilience?

NAS definition

Individual, community, & national resilience is the ability to:

- **prepare and plan for,**
- **absorb,**
- **respond to,**
- **recover from, and**
- **adapt to adverse events**



Schematic of Preparedness as a Function of Long Term Recovery Planning

Similar Definitions employed by FHWA and FTA

Maybe You've Noticed…

- **Flooding in Houston, TX, May 2015**
- **Flooding in Michigan, August 2014**
- **Flooding in Colorado, September 2013**
- **Superstorm Sandy, October 2012**
- **Tropical Storm Lee, September 2011**
- **Hurricane Irene, August 2011**
- **Heat Wave in Midwest, summer 2011**

Maybe you've noticed…

Texas and Oklahoma, May 2015

Michigan, August 2014

Colorado, September 2013

Vermont, August 2011

Photo sources (clockwise): AP Photo/Brandon Wade, AP Photo/Carlos Osorio, Colorado DOT, VTrans

Not to mention…

Washington landslide, March 2014

Texas drought, 2011

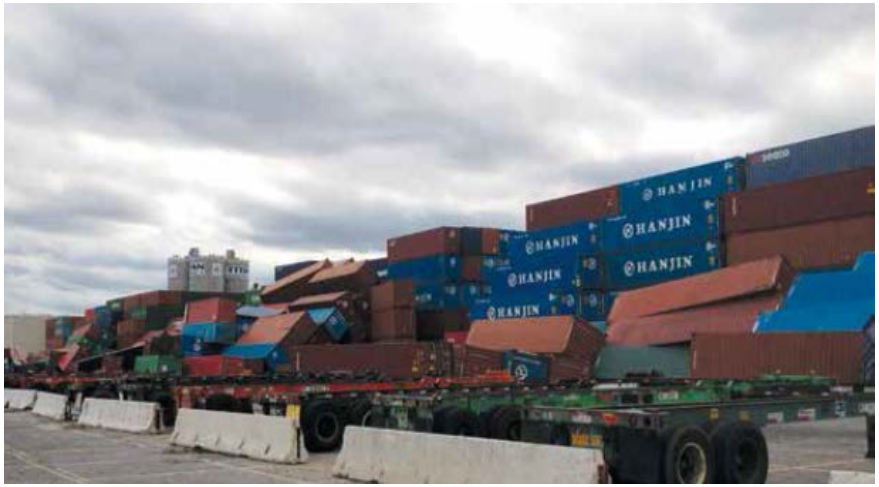
California wildfires, 2014

Buffalo snow storm, December 2014

Photo sources (clockwise): USGS, City of Austin, Fox News, necn

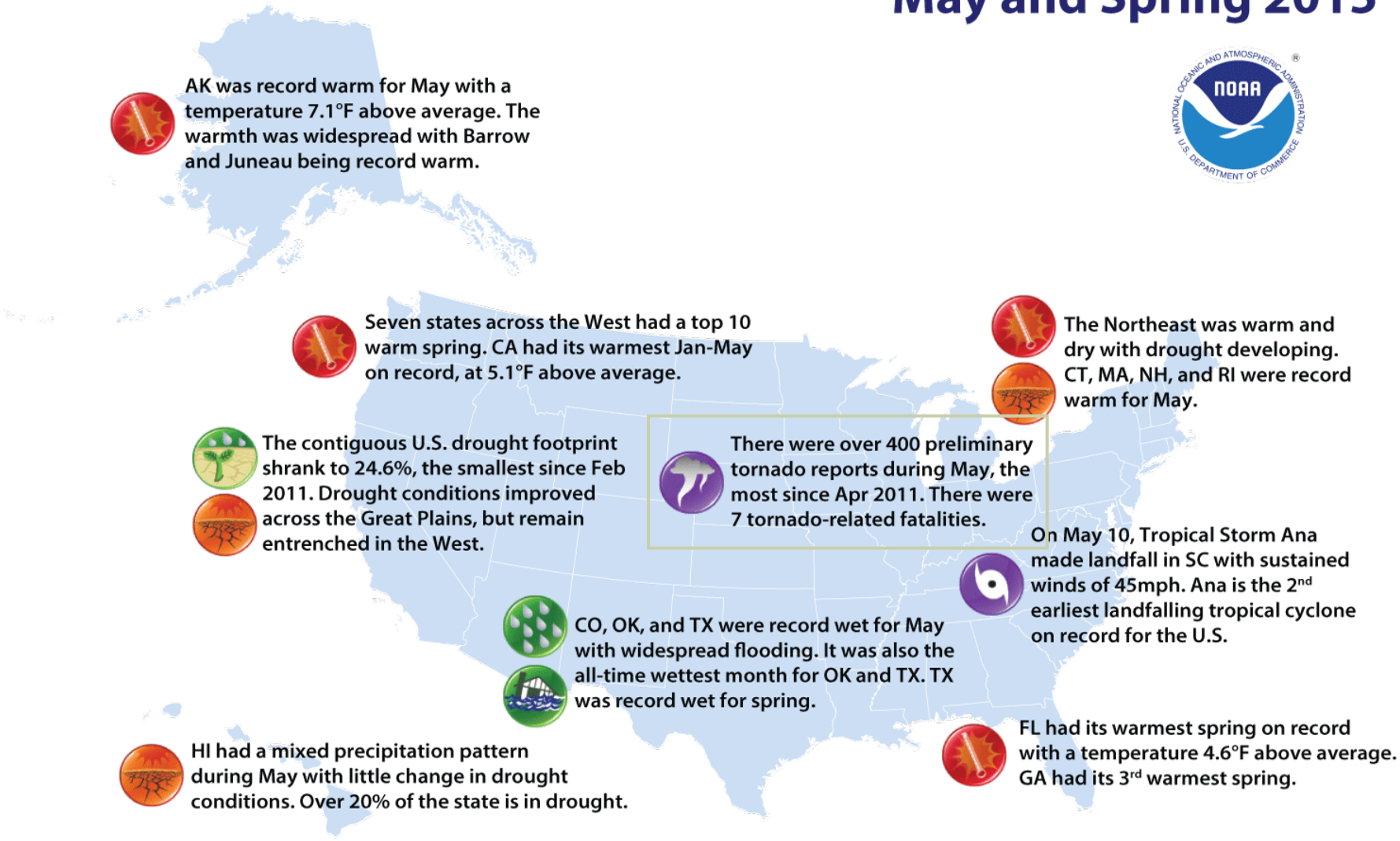
Why should the freight community care about resilience?

- 12/15 extreme precipitation leads to widespread flooding across Midwest
  - Freight disruption in IL and MO
  - Port, pipeline, and refinery closures in TN
  - UP canceled 70 trains in St. Louis area



- 12/12 Sandy halted operations in NY-NJ
  - Caused hazmat incidents
  - Swept debris in channels
  - Saltwater corroded equipment
  - Power loss delayed recovery operations

U.S. Selected Significant Climate Anomalies and Events
May and Spring 2015



AK was record warm for May with a temperature 7.1°F above average. The warmth was widespread with Barrow and Juneau being record warm.

Seven states across the West had a top 10 warm spring. CA had its warmest Jan-May on record, at 5.1°F above average.

The Northeast was warm and dry with drought developing. CT, MA, NH, and RI were record warm for May.

The contiguous U.S. drought footprint shrank to 24.6%, the smallest since Feb 2011. Drought conditions improved across the Great Plains, but remain entrenched in the West.

There were over 400 preliminary tornado reports during May, the most since Apr 2011. There were 7 tornado-related fatalities.

On May 10, Tropical Storm Ana made landfall in SC with sustained winds of 45mph. Ana is the 2nd earliest landfalling tropical cyclone on record for the U.S.

CO, OK, and TX were record wet for May with widespread flooding. It was also the all-time wettest month for OK and TX. TX was record wet for spring.

HI had a mixed precipitation pattern during May with little change in drought conditions. Over 20% of the state is in drought.

FL had its warmest spring on record with a temperature 4.6°F above average. GA had its 3rd warmest spring.

The average U.S. temperature during May was 60.8°F, 0.6°F above average. The spring U.S. temperature was 53.2°F, 2.2°F above average. May U.S. precipitation was 4.36 inches, 1.45 inches above average and the wettest month of any month on record. The spring precipitation total was 9.33 inches, 1.39 inches above average.

Please Note: Material provided in this map was compiled from NOAA's State of the Climate Reports. For more information please visit: http://www.ncdc.noaa.gov/sotc

U.S. Selected Significant Climate Anomalies and Events
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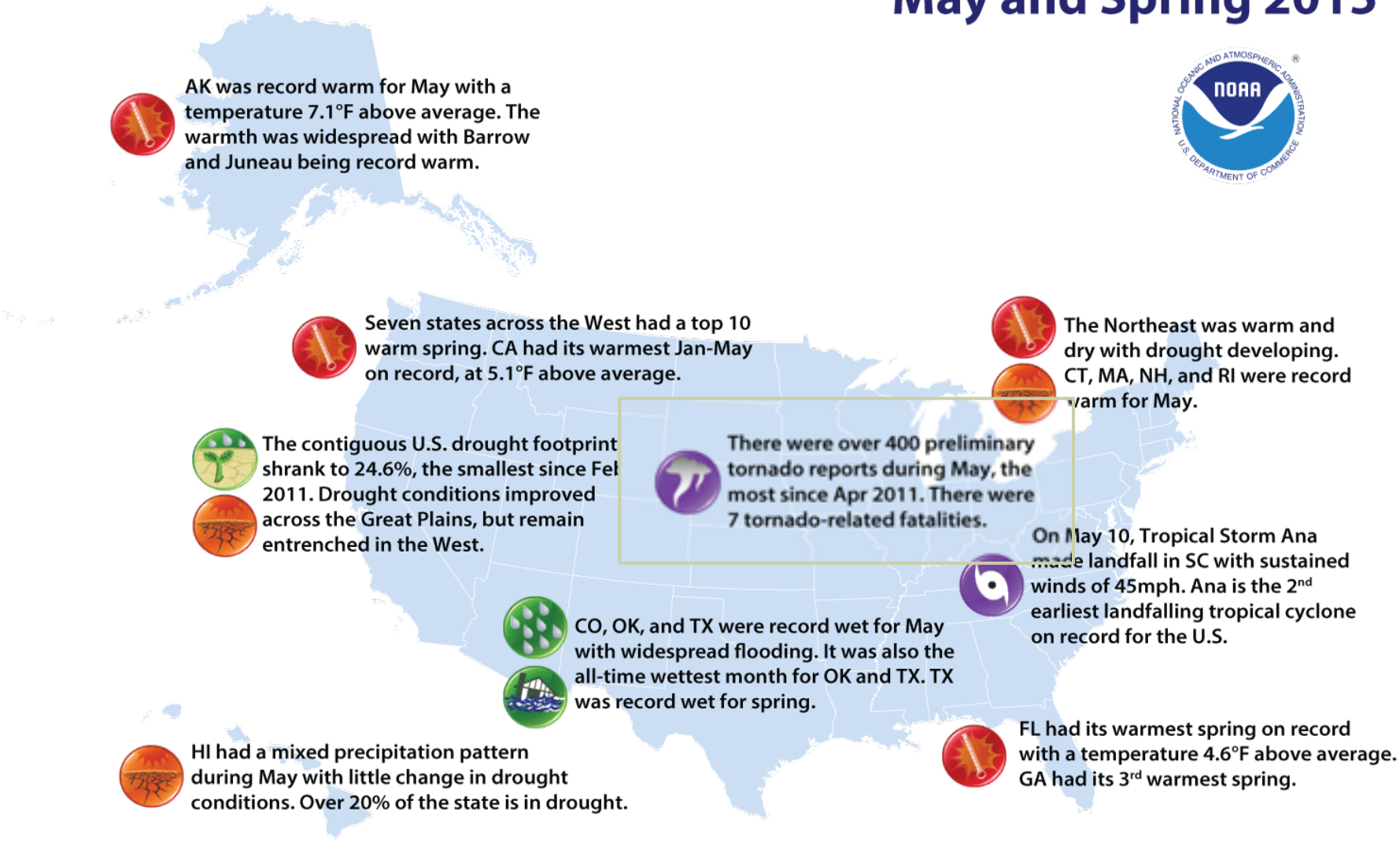

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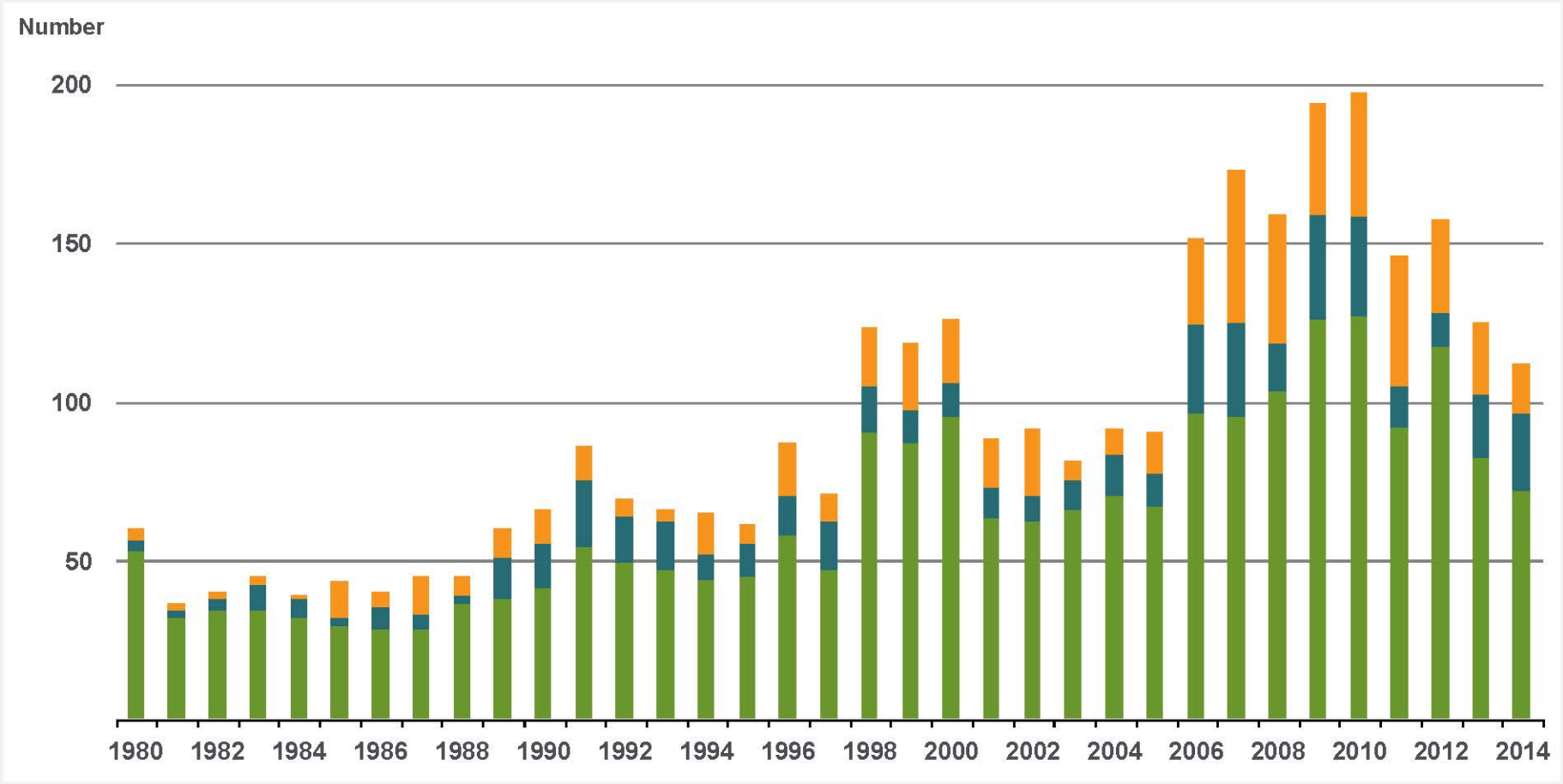
NatCatSERVICE

Weather-related loss events in the U.S. 1980 – 2014

Number of events



Selected Implications for Freight Systems

Extreme Weather	Impacts
Flooding / Heavy Downpours	• Washouts • Disruption of freight services • Risk of hazardous cargo accidents
Tropical Cyclones	• Hazardous conditions • Infrastructure Damage • Debris fields • Saltwater intrusion/Equipment failure
Wildfires	• Service interruptions • Damaged infrastructure
Winter Storms	• Hazardous conditions • Disruption of freight services
Extreme Heat	• Asphalt deterioration, equipment failure

Why should the freight community care about resilience?
Cascading impacts

- **Disruptions have had significant economic impacts on the freight services and producer industries**
- **Diversions can potentially overwhelm highway and rail systems and can cause community impacts**
- **Disruptions in freight also results in consumer impacts and economic losses throughout the country.**

Why should the freight community care about resilience?

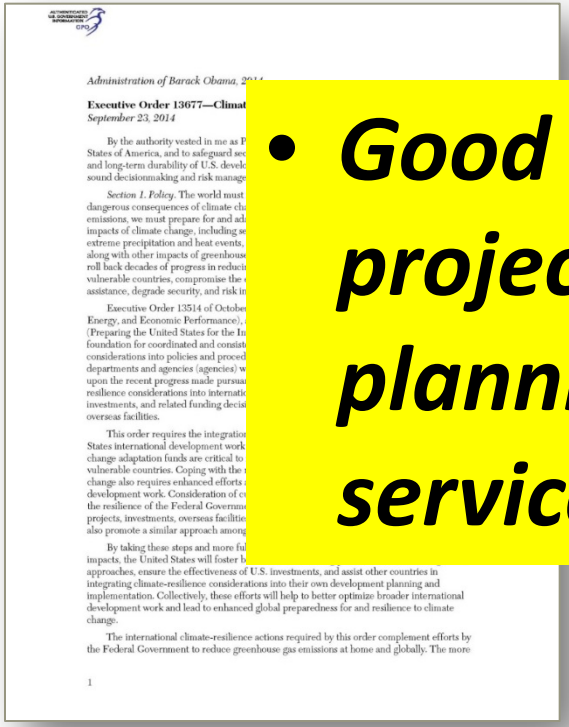
Many sources of possible disruptions

Extreme weather, current and future	
storms	intense precipitation
extreme heat	wildfires
high winds	

Geophysical	
earthquakes	tsunamis
volcanoes	landslides

Human activity	
accidents	terrorism
communications failures	economic failure
cyber attacks	

Why should the freight community care about resilience?
Requirements are growing in multiple areas



Administration of Barack Obama, 2014

Executive Order 13677—Climat
September 23, 2014

By the authority vested in me as P
States of America, and to safeguard sec
and long-term durability of U.S. develo
sound decisionmaking and risk manage

Section 1. Policy. The world must
dangerous consequences of climate ch
emissions, we must prepare for and ad
impacts of climate change, including se
extreme precipitation and heat events,
along with other impacts of greenhous
roll back decades of progress in reduci
vulnerable countries, compromise the
assistance, degrade security, and risk in

Executive Order 13514 of Octobe
Energy, and Economic Performance),
(Preparing the United States for the In
foundation for coordinated and consist
considerations into policies and proced
departments and agencies (agencies) w
upon the recent progress made pursua
resilience considerations into internati
investments, and related funding decis
overseas facilities.

This order requires the integratio
States international development work
change adaptation funds are critical to
vulnerable countries. Coping with the
change also requires enhanced efforts
development work. Consideration of c
the resilience of the Federal Governm
projects, investments, overseas facilitie
also promote a similar approach among

By taking these steps and more fu
impacts, the United States will foster b
approaches, ensure the effectiveness of U.S. investments, and assist other countries in integrating climate-resilience considerations into their own development planning and implementation. Collectively, these efforts will help to better optimize broader international development work and lead to enhanced global preparedness for and resilience to climate change.

The international climate-resilience actions required by this order complement efforts by the Federal Government to reduce greenhouse gas emissions at home and globally. The more

1

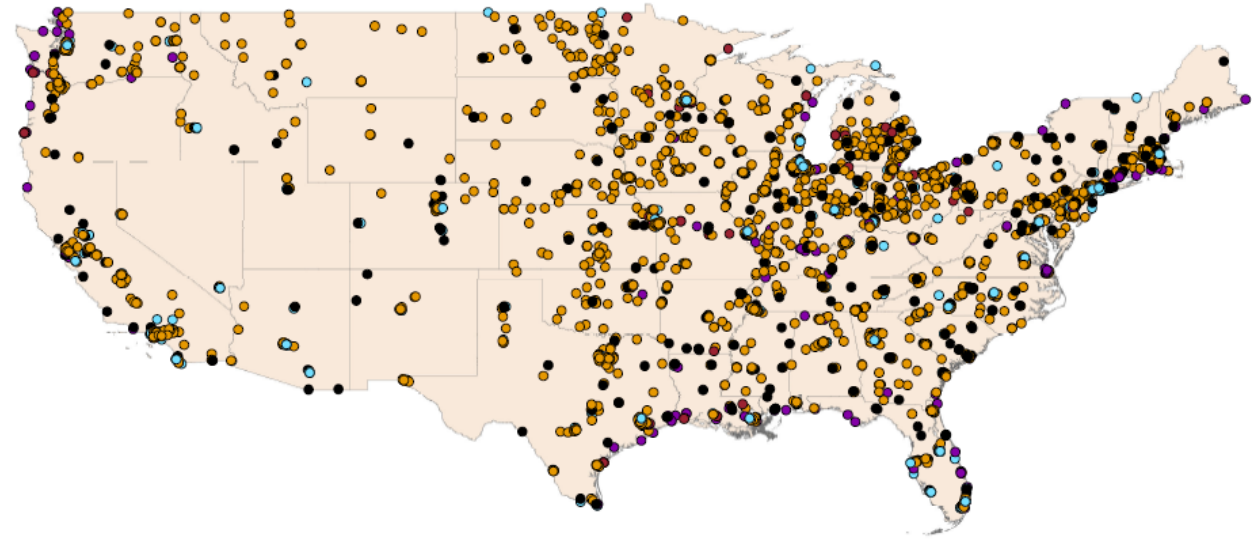
- ***Executive Order 13677 --- Climate-***
  pment
  Risk
  2015)
  - ***Amends E.O. 11988 (1977)***
  - ***FEMA Implementing Guidance (Oct. 2015)***
- ***Draft CEQ Guidance Dec. 2014***

- ***Good practice as part of project development and planning to insure robust service over project life***

What are the special challenges to freight resilience?

- **Growing network complexity**
- **Multiple stakeholders and institutional challenges**
- **Competition and proprietary interests**

U.S. Intermodal Freight Facilities



What are the special challenges to freight resilience?

- **Uneven communication**
- **Inadequate understanding of supply chain risks**
- **Inadequate analytic approaches**
- **Limited institutional capacity**

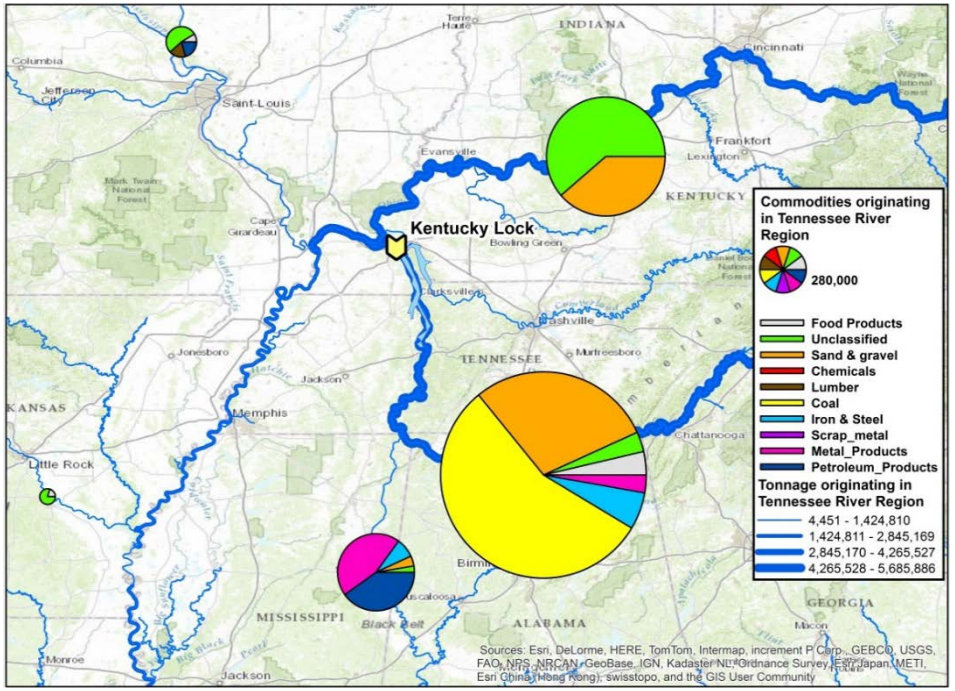


Figure 4: Originating Tennessee River Traffic Passing through Kentucky Lock

What are the challenges to freight resilience?

Key analytical challenges

- **Development and application of a risk analysis framework**
  - **Risk = Probability x Consequence**
  - **Probabilities of damage**
  - **Consequences**
- **How to assess vulnerability and risk**
  - **Current and Future**
- **How to prioritize risks?**

Consequence

Probability	Insignificant	Minor	Moderate	Major	Catastrophic
Almost Certain	Low	Moderate	High	Extreme	Extreme
Likely	Low	Moderate	Moderate	High	Extreme
Moderate	Low	Low	Moderate	High	Extreme
Unlikely	Low	Low	Moderate	Moderate	High
Rare	Low	Low	Low	Moderate	Moderate

Prioritised risks

What are the challenges to freight resilience?
Key analytical challenges

- **How can we plan for resilience in a comprehensive way?**
  - **Capital investment**
  - **O & M changes (and budgets)**
  - **Planning**
  - **Gray and green infrastructure**
- **What are the best resilience improvements to make?**
  - **How operationally effective?**
  - **How cost-effective?**
  - **Is it feasible (politically and operationally)?**
  - **Secondary costs and benefits**

What can be done to improve freight resilience?

- **Improve institutional coordination and build social capital**
  - Raise awareness
  - Need for leadership
- **Develop and adapt analytical approaches to supply chains**
  - Multi-hazard framework
  - Risk analysis
  - Resilience planning
  - Strategy evaluation and implementation
- **Policy approaches and investment**

What can be done to improve freight resilience?
Improve institutional coordination and leadership

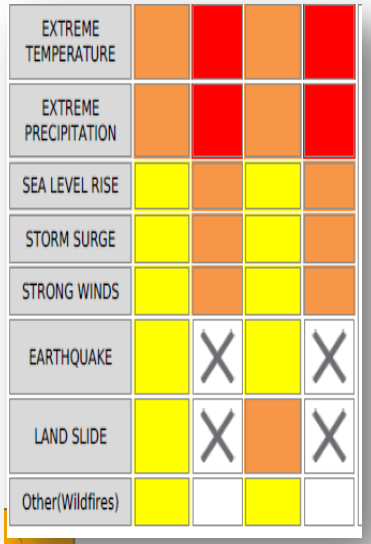
- Better understand stakeholder roles and responsibilities
- Raise awareness of supply chain implications
- Enhance communications and coordination
- Build trust and social capital
- Identify leaders and build leadership
  - Freight Advisory Councils

Stakeholder Group
Freight Operators (e.g. shippers, carriers)
State Freight Councils / Coordinating Bodies
State / Local Governments (e.g. MPOs, DOTs, Municipalities…)
Airport and Port Authorities
Federal Agencies (e.g. USACE, USCG, US DOT)

What can be done to improve freight resilience?

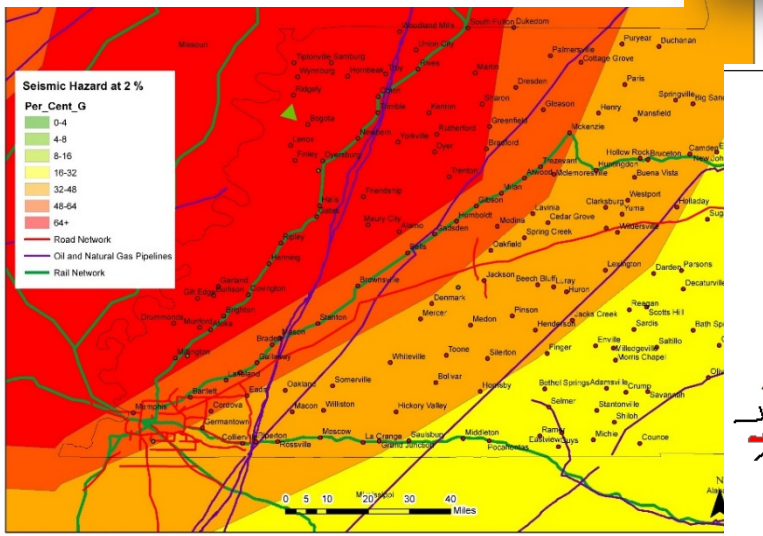
Develop and adapt analytical approaches

World Bank Climate and Disaster Risk Screening for Transport Sector

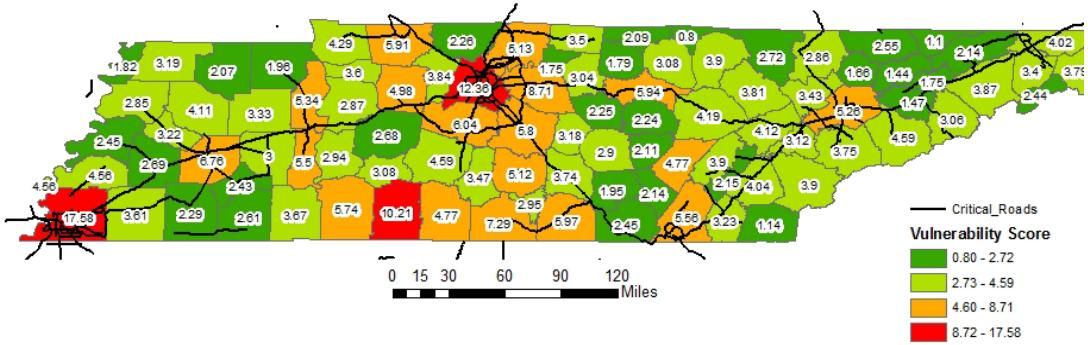


U.S. DOT Vulnerability Scoring Assessment Tool (VAST)

Freight assets vulnerable to seismic risk (courtesy Vanderbilt University)



Road Vulnerability from Extreme Rainfall (courtesy Vanderbilt University)



What can be done to improve freight resilience?
Key Next Steps

- **Build social capital among stakeholders**
- **Better understand national, regional, and local supply chains**
  - **Diversion potential**
- **Identify critical cargo differences**
- **Assess enterprise risks**
  - **Temporal differences and spatial differences**
- **Plan for resilience comprehensively**
- **Invest strategically**

Thank you!