The May 22, 2011 Joplin Tornado
Where Do We Go From Here?

Government Relation Forum

2016 ICC Annual Conference and Group B Public Comment Hearings

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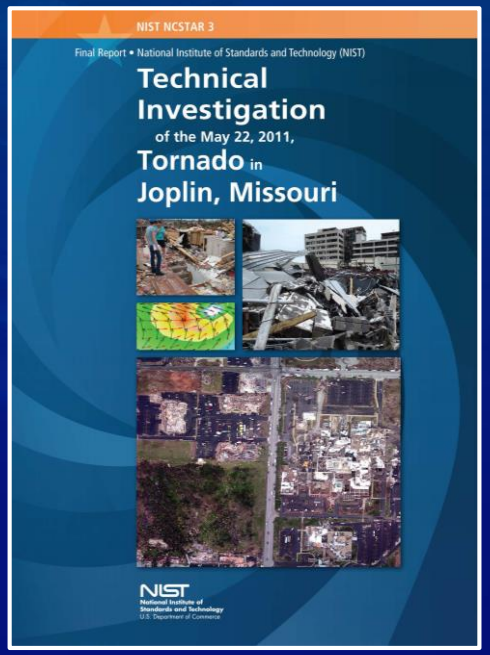
Background on the Joplin Tornado

- **May 22, 2011: EF5 tornado struck Joplin, MO**
  - 161 deaths, >1,000 injuries (majority due to impacted related causes)
  - 8,000 buildings damaged, $3B insured loss
  - *Deadliest and costliest* tornado on record

- **June 2011: NIST launched National Construction Safety Team investigation**

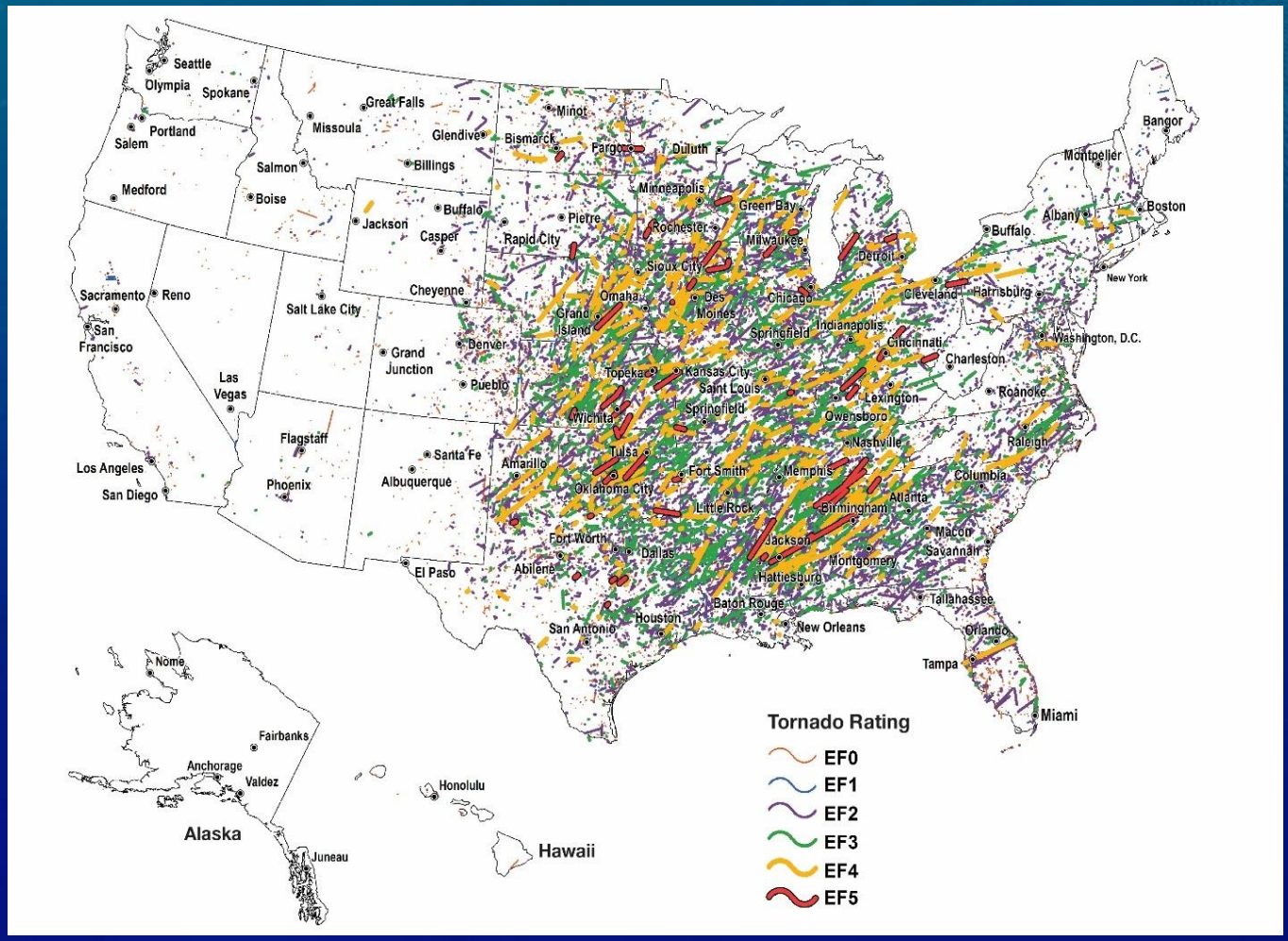
- **March 2014: NIST published Report with 16 recommendations for improvements in:**
  - Tornado hazard characterization
  - How buildings and shelters are designed, constructed, and maintained
  - Emergency communications that warn of threats from tornadoes.



www.nist.gov/el/disasterstudies

Tornado Challenges

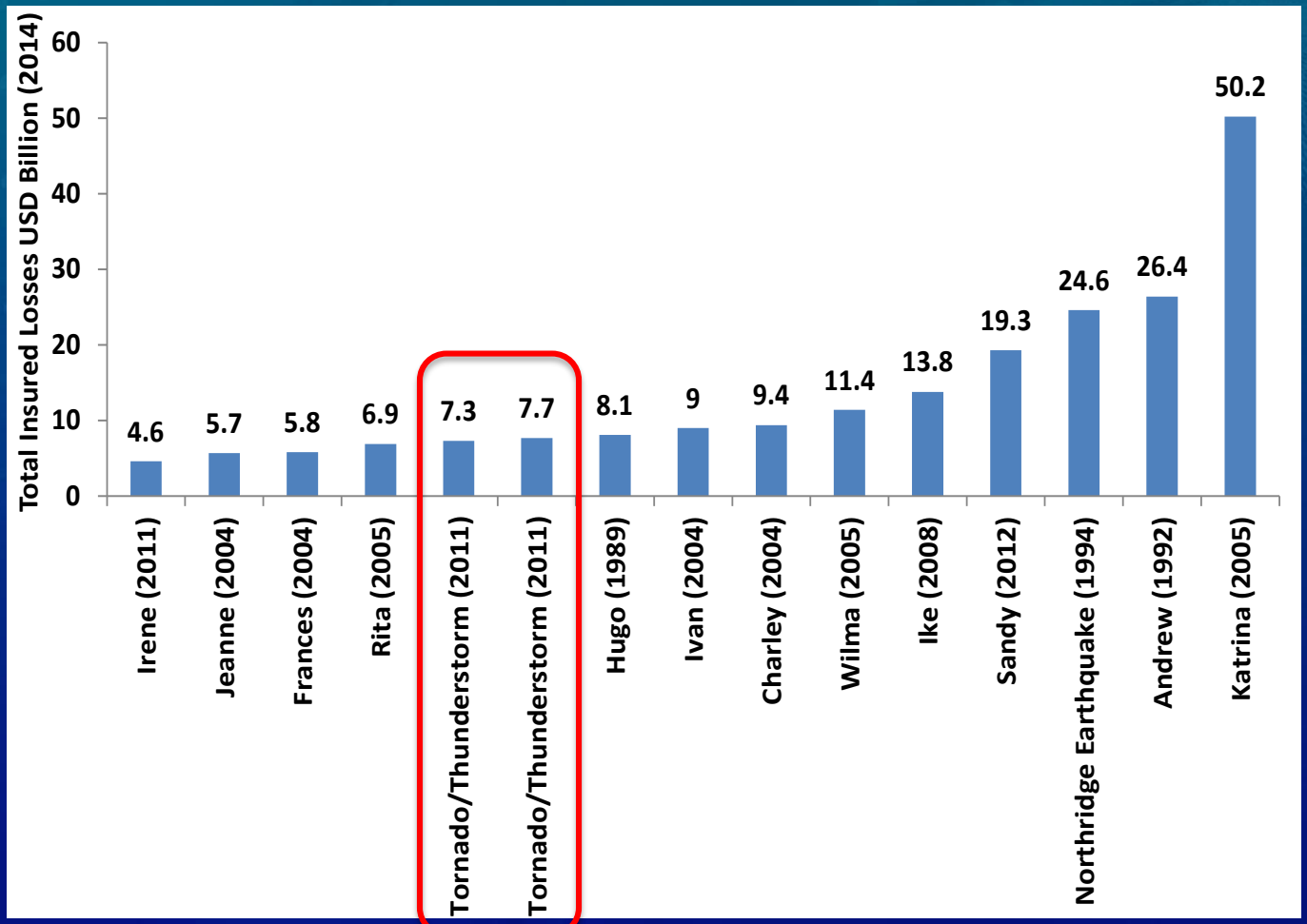
- **Occur in all 50 states, at high frequency.**



Tornado tracks mapped by intensity (1950-2014)
(Source: FEMA, using NOAA data)

Tornado Challenges *(cont'd)*

- **High economic impact**

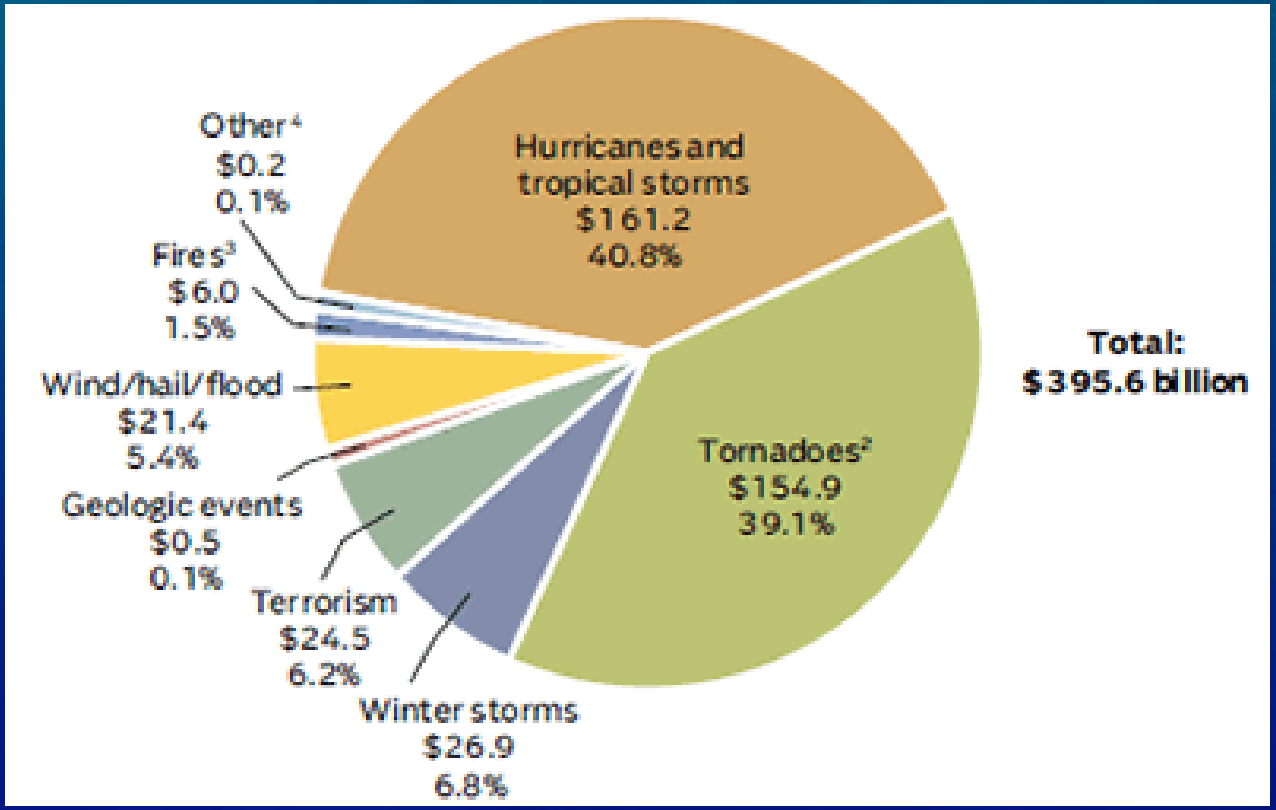


Top 15 Most Costly U.S. Natural Disasters (Insured Losses, 2014 Dollars Adjusted For Inflation But Not Population Or Wealth)

Data Source: US Natural Catastrophe Review, Munich Re

Tornado Challenges *(cont'd)*

- **High cumulative economic loss**



Inflation-adjusted U.S. Insured Catastrophe Losses By Cause Of Loss, 1995-2014 *(2014 $ Billions)*

Source: Property Claim Services (PCS®), a Verisk Analytics® business.

Tornado Challenges *(cont'd)*

- **High death toll**
  - 5,600 fatalities (1950-2011)
  - Over the same period:
    - 3,102 deaths due to hurricanes
    - 459 due to earthquakes.
  - Average deaths per year:
    - Tornados: 91.6
    - Hurricanes: 50.8
    - Earthquakes: 7.5

We Design For Hurricane And Earthquake Hazards, Not Yet For Tornado!

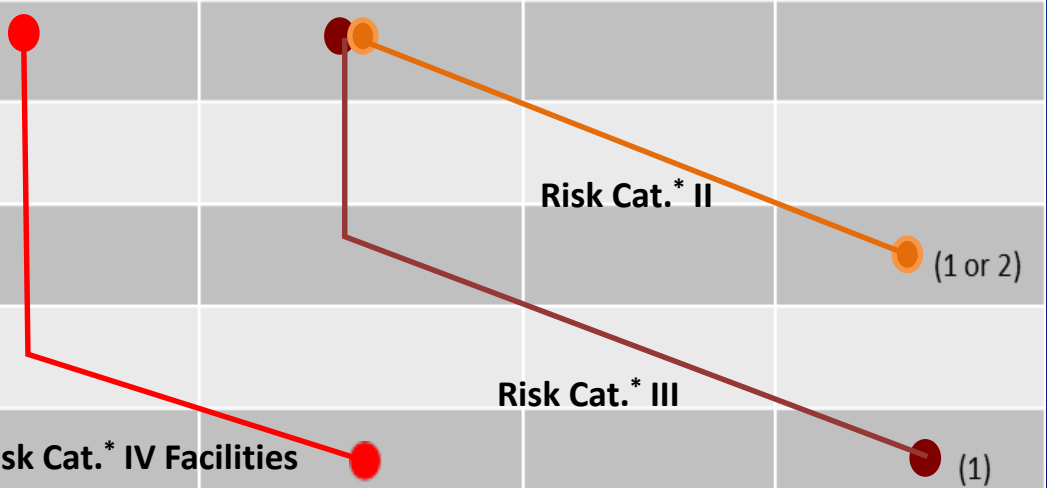
Meeting the Challenges

- Requires **comprehensive strategy**:
  - Performance-Based (PB) tornado-resistance design for buildings and infrastructure
  - Improved emergency communication and warnings
  - Effective sheltering strategy
  - Hazard reduction measures
- **Collaboration** between all stakeholders (public, standards/codes development org., practices, and Federal, States, and Local authorities)

PB Tornado-Resistance Design

- **Paradigm shift!**
- **Conceptual performance objectives:**

Tornado Intensities	Performance Objectives			
	Operational	Repairable Occupancy	Life Safe	Collapse Prevention
EF1 (86-110 mph)				
EF2 (111-135 mph)				
EF3 (136-165 mph)				
EF4 (166-200 mph)				
EF5 (> 200 mph)				



(1) Hardened area, shelter–in–place.
(2) Public shelter.
* Based on ASCE 7

PB Tornado-Resistance Design *(cont'd)*

Ongoing Efforts:

- **Tornado-Resistance Design Methodology**: ASCE TC on PBD for Extreme Wind (ad-hoc) developing:
  - PBD framework
  - Performance objectives and performance levels for different wind hazards and building risk categories
- **Probabilistic Tornado Hazard Maps**: NIST working with private sector to develop maps – using up-to-date data, with correction of biases, and science-based tornado risk assessment method – that accurately characterizes tornado risk

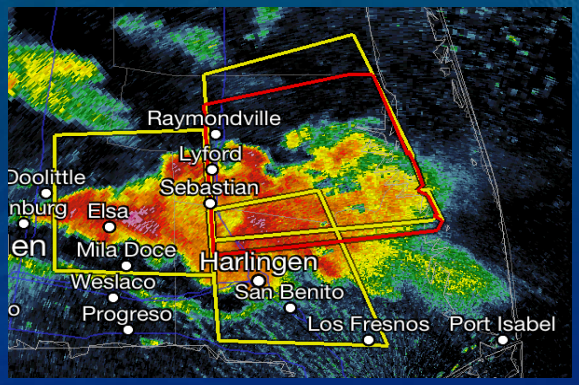
Improving emergency communication and warnings

Ongoing Efforts:

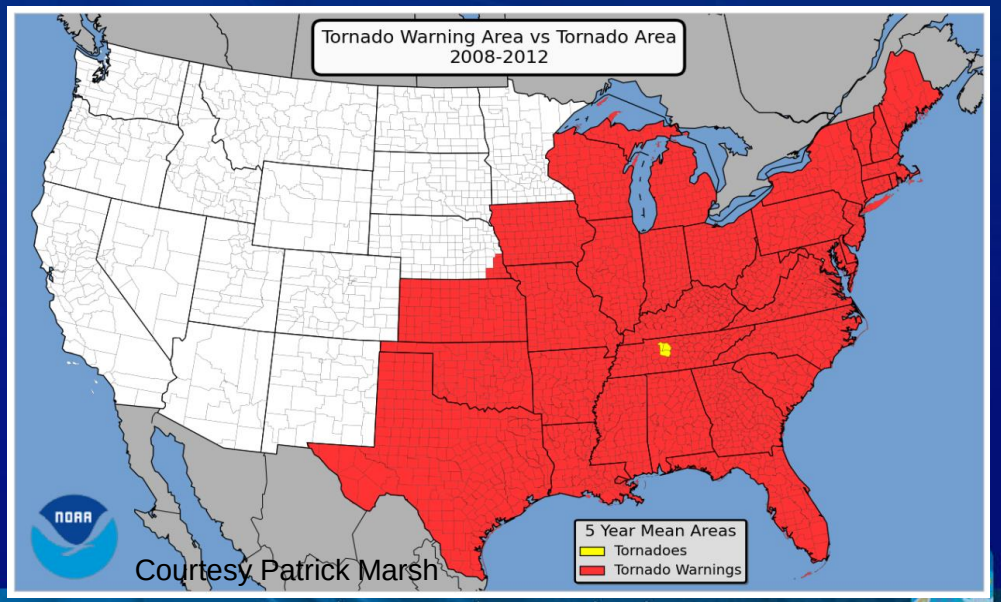
- **New NOAA National Severe Storms Lab's Warning Paradigm:**

  Forecasting a Continuum of Environmental Threats (FACETs)

  Grid-based, probabilistic threat communication with social/behavioral science infused



Source: NOAA



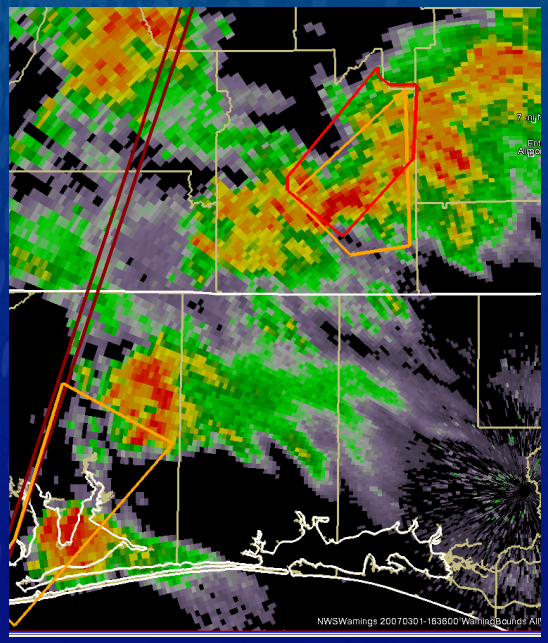
Courtesy Patrick Marsh

http://www.nssl.noaa.gov/projects/facets/

Improving emergency communication and warnings *(cont'd)*

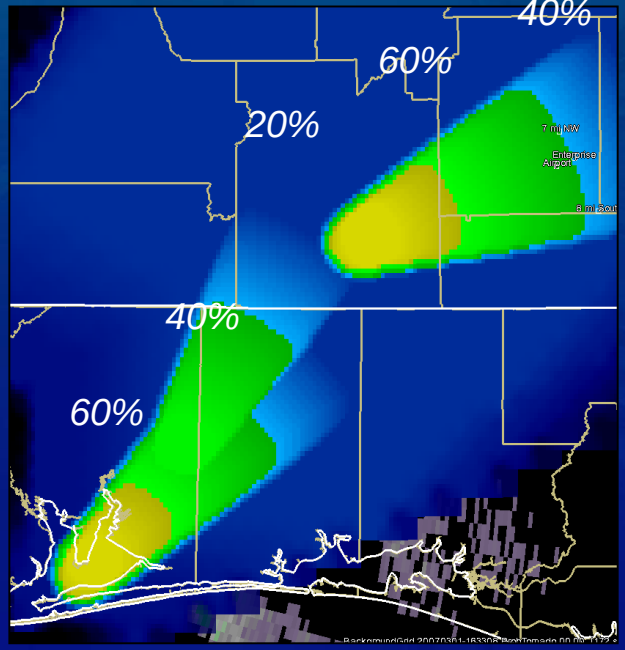
- **FACETS Tornado Warning Timeline (est)**

Present



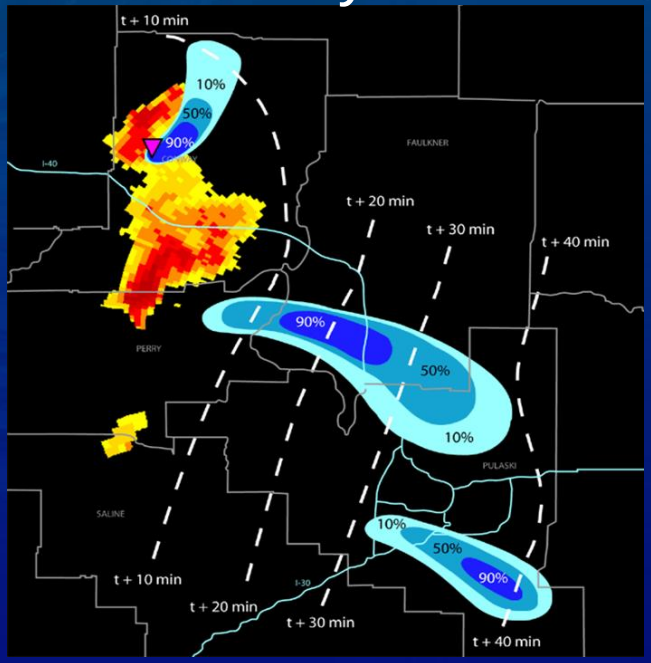
Polygons or county based warnings updated ~15 min

5-10 years?



Probabilistic guidance from climatology updated ~15 min

>10-20 years?



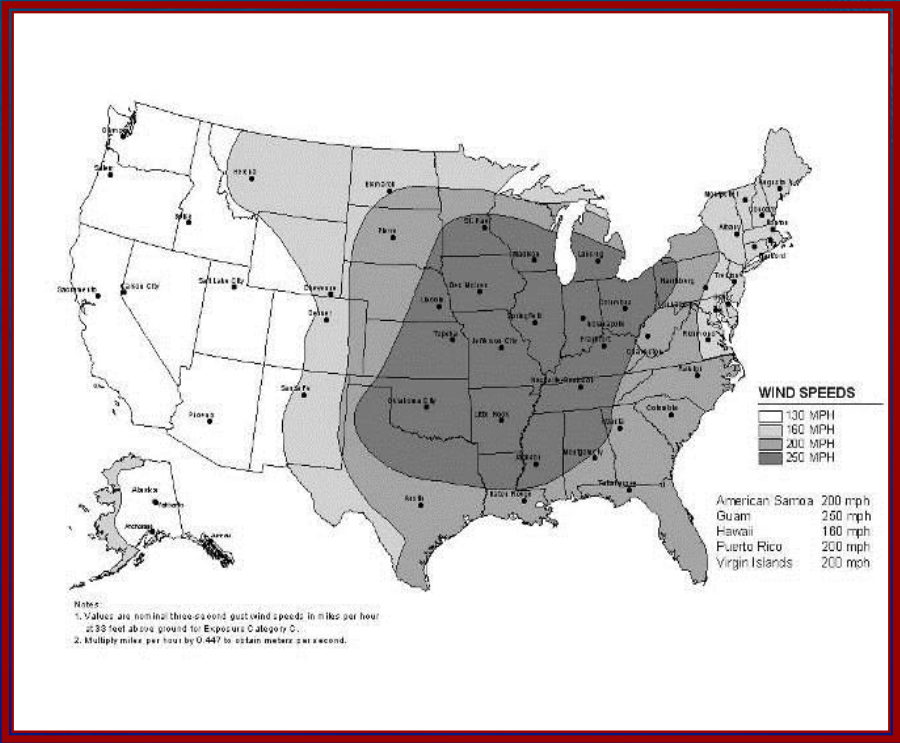
Probabilistic guidance using numerical model ensembles and updated continuously

Improving emergency communication and warnings *(cont'd)*

- **Emergency Communication/Public Alerts:** Guidance for communities on the creation and provision of public alerts – via outdoor siren systems and social media (cell phone, mobile devices, Facebook, Twitter)

Effective sheltering strategy

- **New IBC/IEBC (2018) shelter requirements**: ICC 500 shelters in new buildings on existing school campuses and additions to buildings on existing schools in the 250 mph zone large enough to protect the population of the school, provided the new construction is of sufficient size
- **Proposed shelter safety requirements and guidance** for new **NFPA 1616 Standard for Mass Evacuation and Sheltering**
- **Need improved methodology and guidance** for selecting **best available refuge area**



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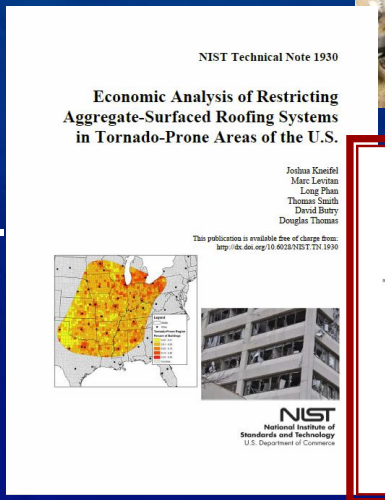
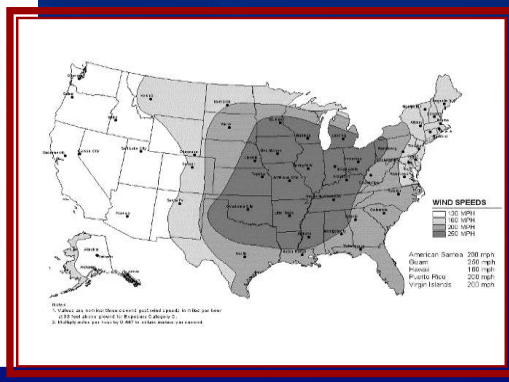
Hazard reduction measures

- **Better practices:** Continuous load path

- **Reducing the windborne debris hazard:** Aggregate used as surfacing for roof coverings and aggregate, gravel, or stone used as ballast be prohibited in tornado–prone region

Code change proposal (Pending)





Affect a small number of future Cat. III and IV roofs in 250 MPH region (IA, MO, AR, IL, IN, OH, & parts of surrounding states)

- 0.2% of buildings in 250-mph zone
- Ban in hurricane regions impacts 4.6 times more buildings.

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Thank you!
Questions?

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