

engineering laboratory



High-Wind Research Activities at NIST

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Presentation Overview


- Non-tornadic Wind Research
 - Development of New Design Wind Speed Maps
- Tornado Research
 - Joplin Tornado Investigation and Recommendations
 - Development of new Tornado Hazard Maps

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Analysis of Non-Tornadic Winds

Objective: To develop methods and tools for improved extreme wind climate analysis and application, including new wind speed maps and databases

- **Regional variability in extreme wind climate not captured in ASCE 7-10 maps**
- Existing wind speeds (non-hurricane) had been updated since ASCE 7-95
- More years of wind data and more stations available now
 - 1995: 485 stations with 5+ years data
 - Now: 1100+ stations with 5+ years data

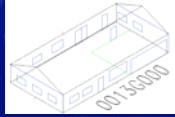


ASCE 7-10 Basic Wind Speed Map
700 Year Mean Recurrence Interval (MRI)

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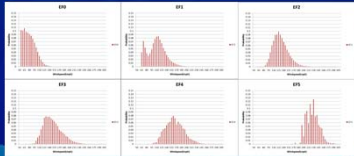
Damage - Wind Speed Analysis

- Simulation of tornado loads and resistance (finite element model) for dozens of configurations of 1 & 2 family residences to estimate probability of damage as a function of wind speed, $P(d_i|v_i)$
- Correlate modeled damage with Degree of Damage (DOD) from Enhanced Fujita (EF) Scale
- Use Bayesian approach to estimate probability of wind speed given a DOD, $P(v_i|DOD_i)$
- Estimate probability of tornado wind speed given an F Scale or EF Scale rating, $P(V|F \text{ or } EF)$



Example house model

Illustrative $P(V|EF)$

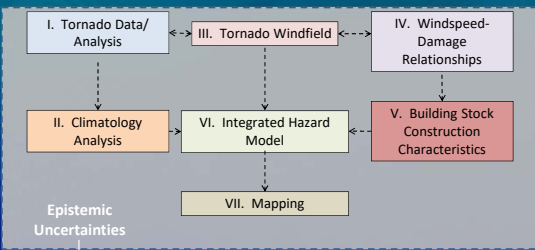


NRC – NIST Collaboration on Tornado Hazard Mapping

- Interagency Agreement with the Nuclear Regulatory Commission for NIST to provide high wind analysis (August 2017)
 - Evaluate epistemic uncertainties associated with main components of the tornado wind speed risk modeling process
 - Propagate uncertainties to produce derived mean tornadic wind speeds
 - Produce maps that reflect aleatory and epistemic uncertainties for point strike probabilities and strike probabilities for multiple spatial scales

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Epistemic Uncertainties Topics



- Tornado Regionalization (I, II)
- Tornado Occurrence Rates (I, II)
- Tornado Intensity and Path Variables (I, II)
- Tornado Windfield (I, III, IV)
- Damage Wind Speeds (IV) and Building Stock (V)
- Wind Speed Frequency (VI)
- Hazard Map Development (VII)

Tornadic Wind Research Products (planned ≈2020)

- **Report** – comprehensive report on tornado map development process
- **Enhanced tornado dataset** – supplementing NOAA tornado data from 1950-2016
- **New tornado wind speed maps** – incorporating aleatory and epistemic uncertainty
 - For multiple return periods up to 10^8 years
 - For strike probabilities at multiple spatial scales
- **New tornado load provisions** – including the new maps, for incorporation in
 - ICC 500-2020: Standard for Design and Construction of Storm Shelters
 - ASCE/SEI 7-22 Standard: Minimum Design Loads and Associated Criteria for Buildings and Structures

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