

Eastern Seaboard Electric Grid Fragility Maps Supporting Persistent Availability

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Persistent Availability

- National problem
 - Constant running power dependence
 - Challenges (storms) arise that disrupt power supply
 - How can disruptions be prevented?
 - Build 21st Century Grid (Smart Grid)



National power grid interconnections

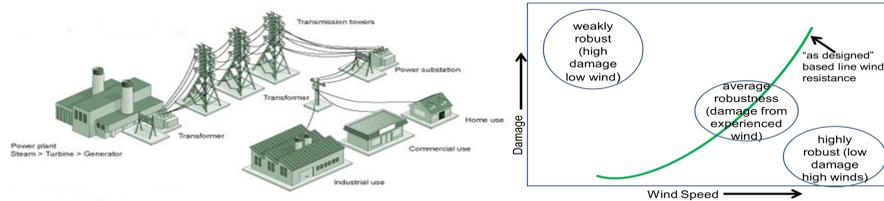


Disrupted power source example: mangled transmission post

- National power grid
 - Transmission system separated into 3 main regions (interconnections)
 - Storm response organized by county

Electric Grid Status

- Current status
 - Do not know how storms will directly affect power source
 - County based fragility curves created to analyze storm's affect

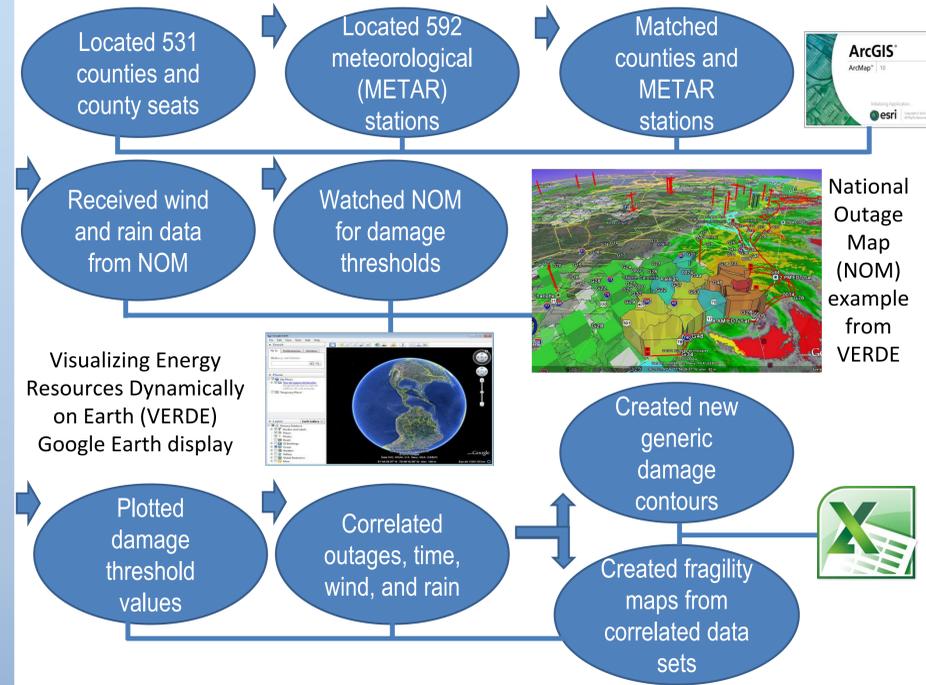


Customer power distribution

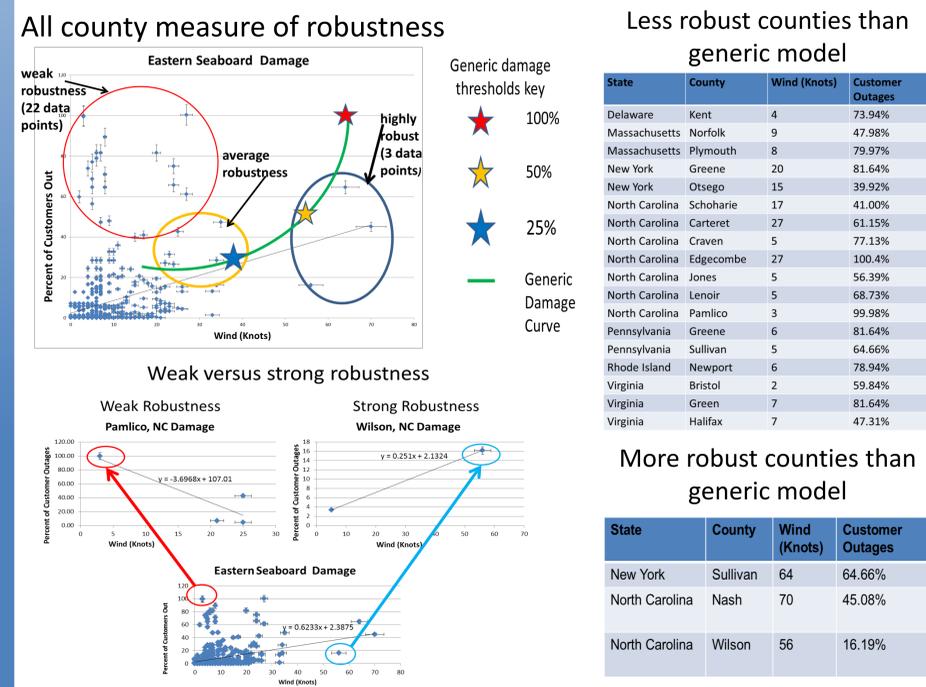
"As designed" generic robustness map

- Fragility map importance
 - Converted "as designed" damage contours to "as built" outage probabilities
 - Provided real life wind and/or precipitation thresholds for power loss probability

Data Preparation



Fragility Maps

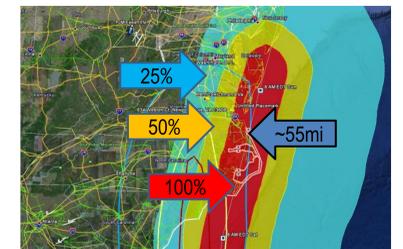


Hurricane Irene

- Response lasted August 19, 2011 – August 29, 2011
- Directly impacted 15 Eastern Seaboard states
 - Very rare event impacted 531 counties and 592 METAR stations almost simultaneously
 - Different infrastructure and location attributes
 - Provided unique centralized data set
- First landfall 2.7 million customer outages
- Total 5.4 million customer outages



Eastern Seaboard image from ArcGIS 10



First landfall damage contours (color coded by percent customer outage intensity)

Research Deductions

- Possible uncertainties
 - National outage map and utility data reports
 - Unidentified contributing variables (precipitation)
- Future improvements
 - Expand data collection
 - Synchronize data collection
- Project importance
 - Better generic damage contours
 - Better county-based response models
 - Better customer and utility forecasts
- Future research recommendations
 - Investigate storm edge error
 - Lightning and debris effects
 - Wind independent and dependent variables

Hurricane Irene rain distribution

