Blackout Forecast Model for Hurricane Hazards – Wind and Surge

William Ramstrom – Verisk Insurance Solutions
Clifton Lancaster – Hartford Steam Boiler
Robin Luo – Hartford Steam Boiler
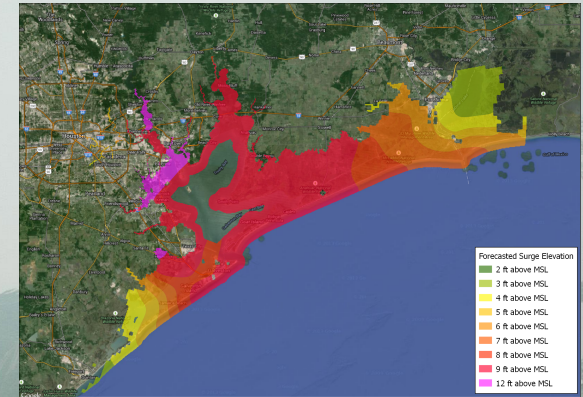
April 20, 2016

Overview

- Power outages are a major disruption caused by hurricanes, causing direct losses, slowing recovery, and shuttering businesses

- 8.5 million customers without power during Hurricane/Post-Tropical Cyclone Sandy (US Energy Information Administration)

- Blackouts caused by several perils in a hurricane: direct effect of wind on lines, falling trees/branches onto lines, and surge flooding of coastal substations

Modeling Goals

- Real-time Forecasts

  - Immediate lead-up to storm

  - Planning, mitigation, loss estimation

- Stochastic Event Sets

  - Scope potential extreme losses

  - Quantify recurrence period of risk

  - Validation with historical claims data

- Quantifying Insured Losses

  - Spoilage of Contents (Food, Medical Items, etc.)

  - Business Interruption
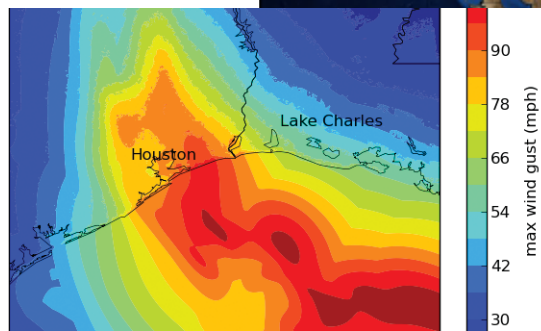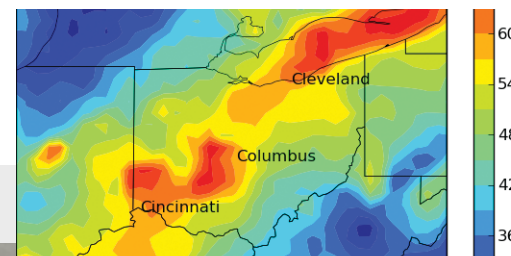
  - Electronic Equipment Breakdown

Perils Causing Blackout

- **Wind**
  - Strength and duration

- **Storm Surge**
  - Flooding of low-lying infrastructure

- **Downed Trees/Limbs**
  - Regionally and locally varying effects

Blackout Risk Model™, Powered by HSB and Verisk
© Insurance Services Office, 2016

Munich RE

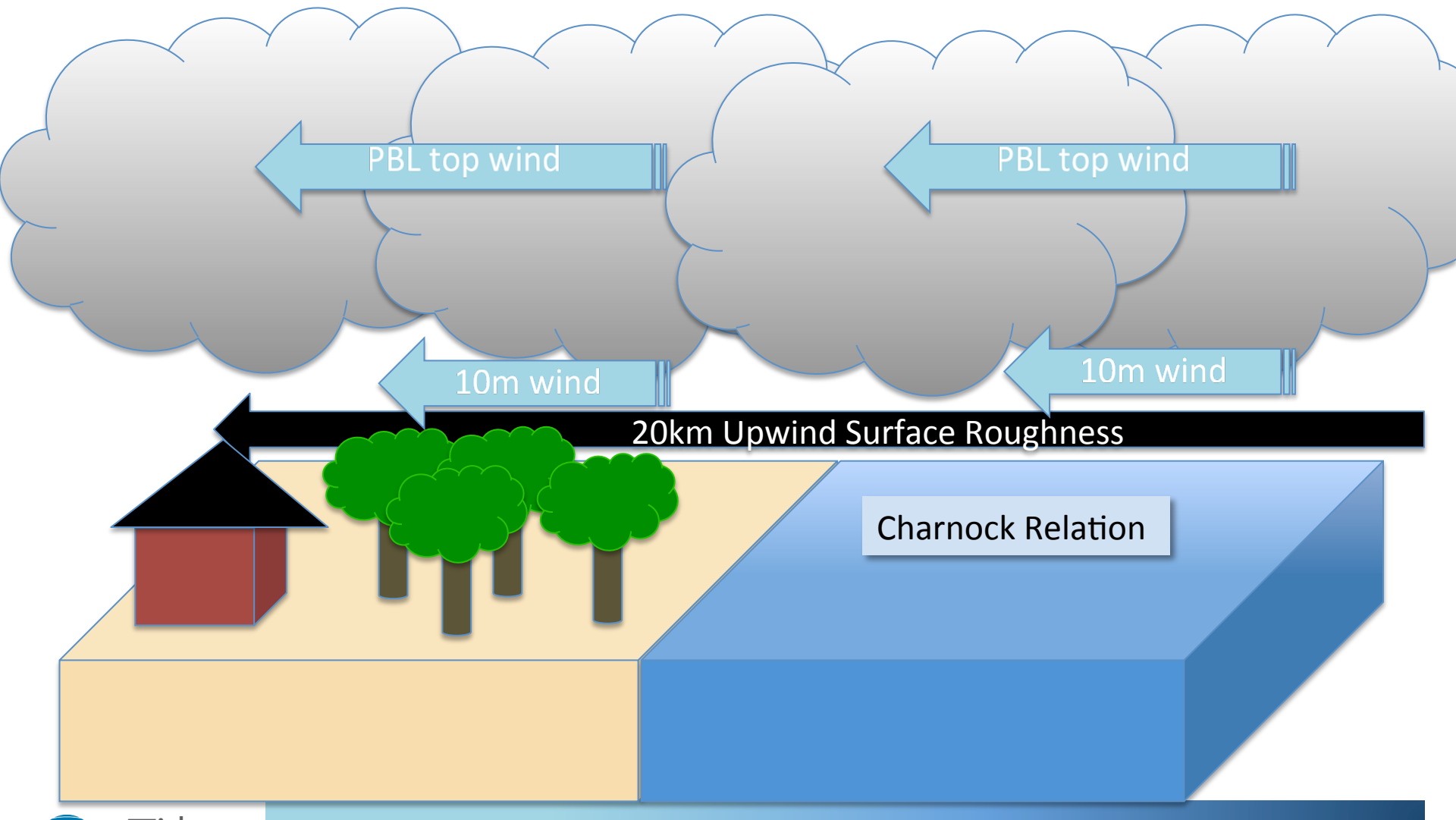Hartford Steam Boiler
1866

4/27/16   4
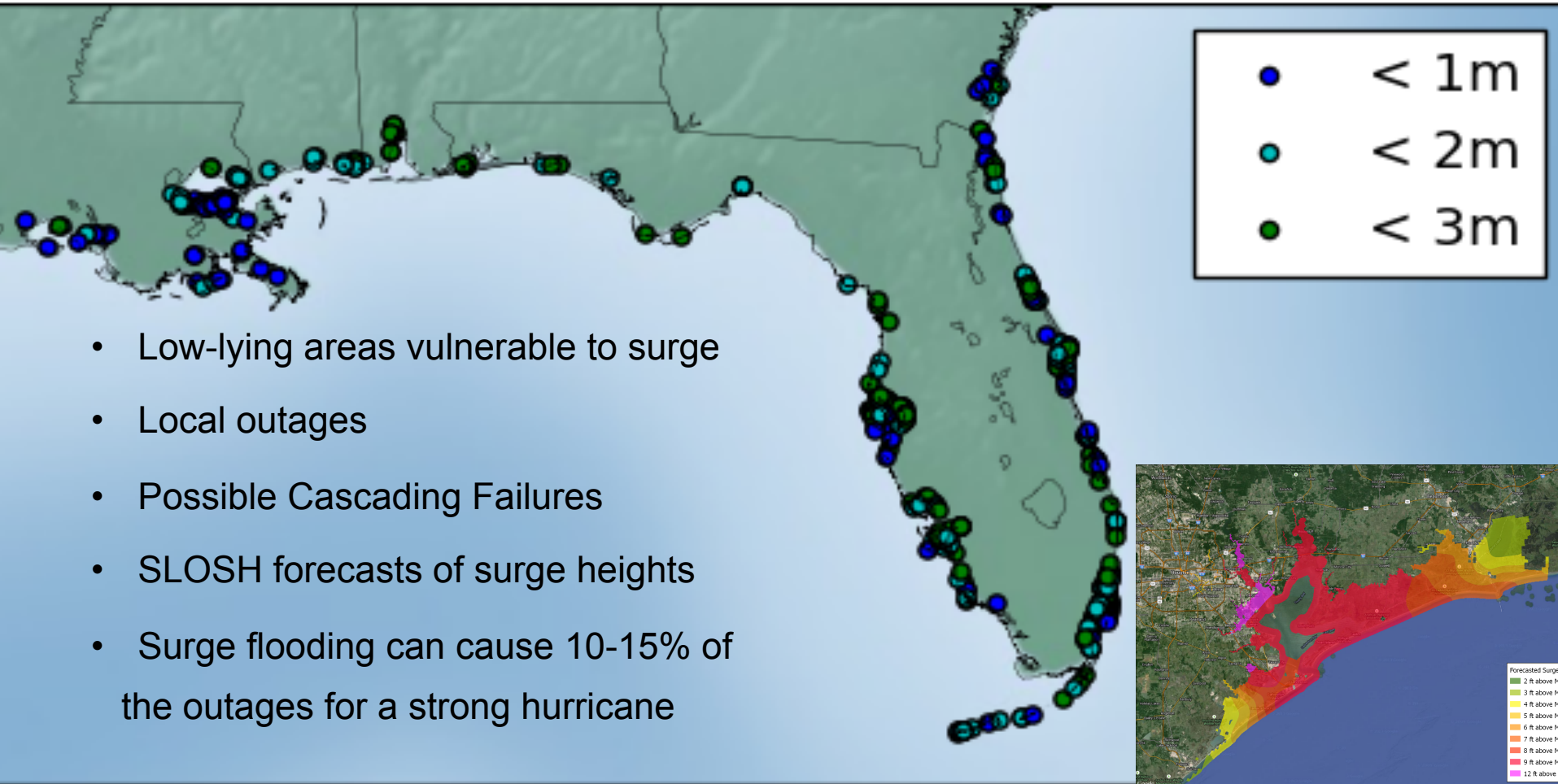
Wind from Respond Hurricane

- 1km downscaled winds from HWRF

- Surface roughness at grid cell location and upwind

- Captures details of extratropical transition, unusual radius of maximum winds, hybrid storms due to full physical modeling

Hurricane Wind Downscaling

Storm Surge Flooding of Electrical Infrastructure
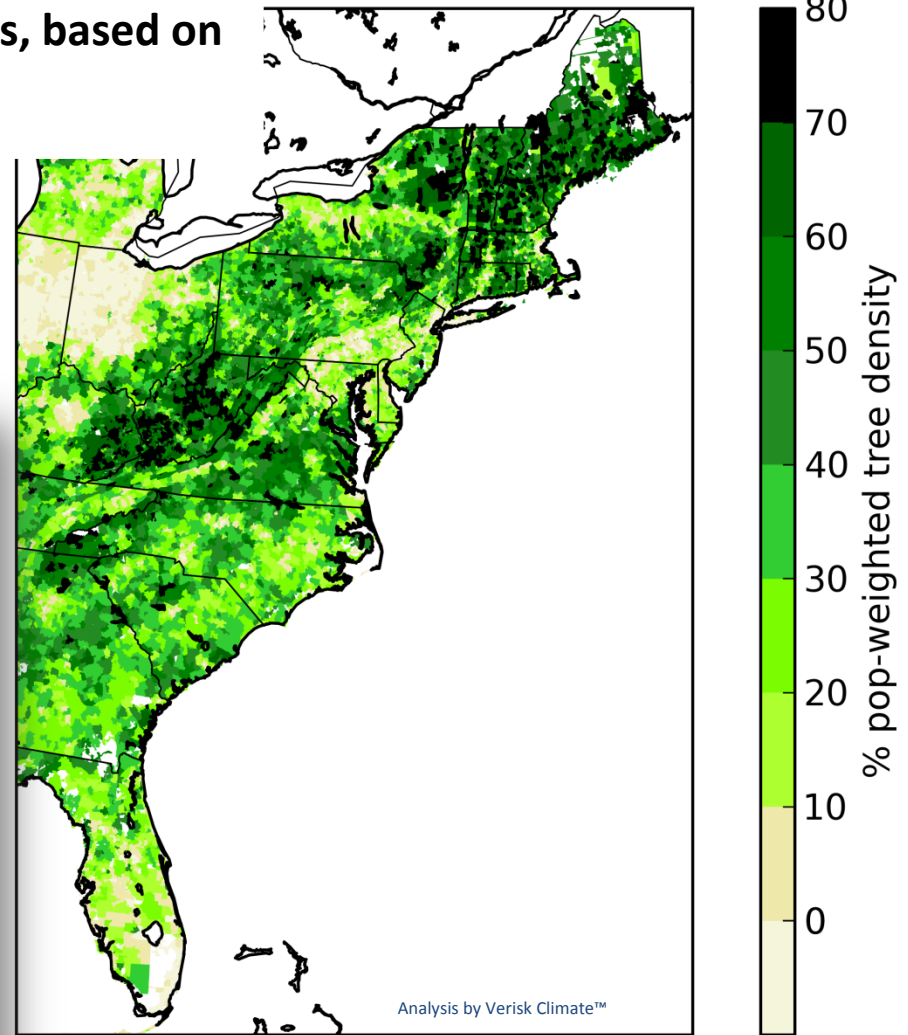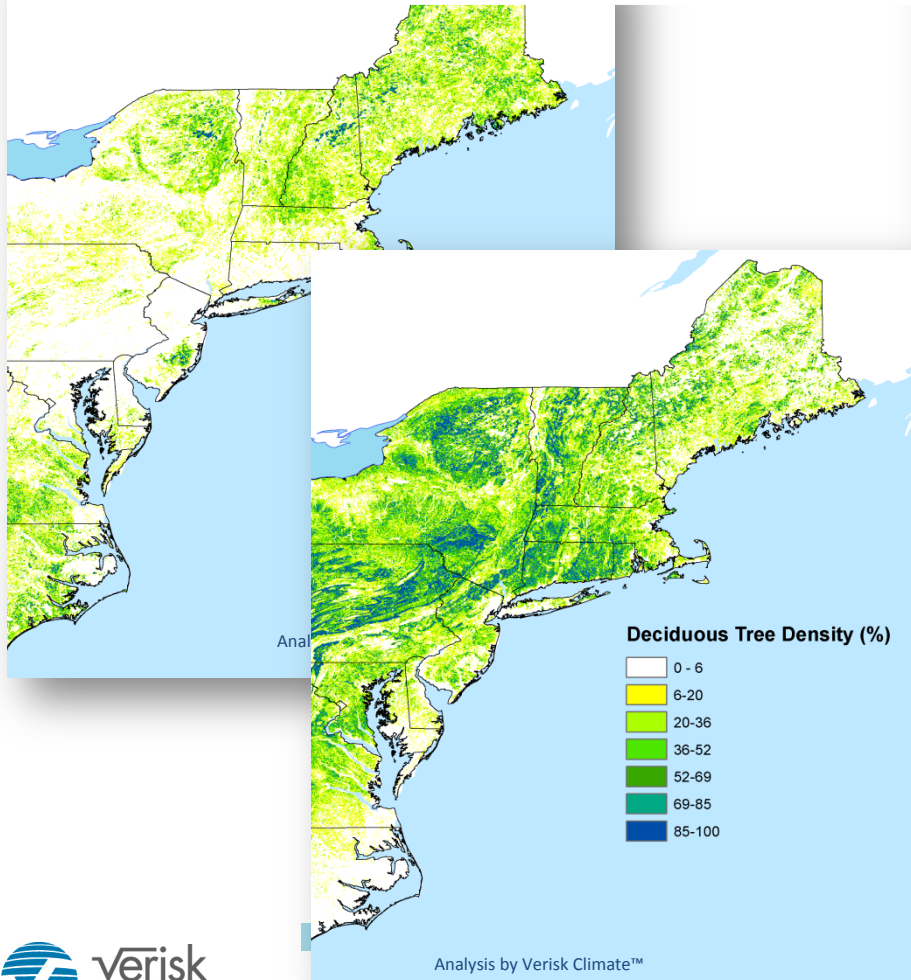
- Low-lying areas vulnerable to surge

- Local outages

- Possible Cascading Failures

- SLOSH forecasts of surge heights

- Surge flooding can cause 10-15% of the outages for a strong hurricane

Legend:
- ● < 1m
- ● < 2m
- ● < 3m

Tree Cover

Analysis of the Location and Type of Trees, based on Assessment of Detailed Satellite Imagery

Analysis by Verisk Climate™

Deciduous Tree Density (%)
- 0 - 6
- 6-20
- 20-36
- 36-52
- 52-69
- 69-85
- 85-100

Analysis by Verisk Climate™

Analysis by Verisk Climate™

% pop-weighted tree density

Blackout Risk Model™, Powered by HSB and Verisk
© Insurance Services Office, 2016

verisk Insurance Solutions

Munich RE® Hartford Steam Boiler 1866

4/27/16 8   8

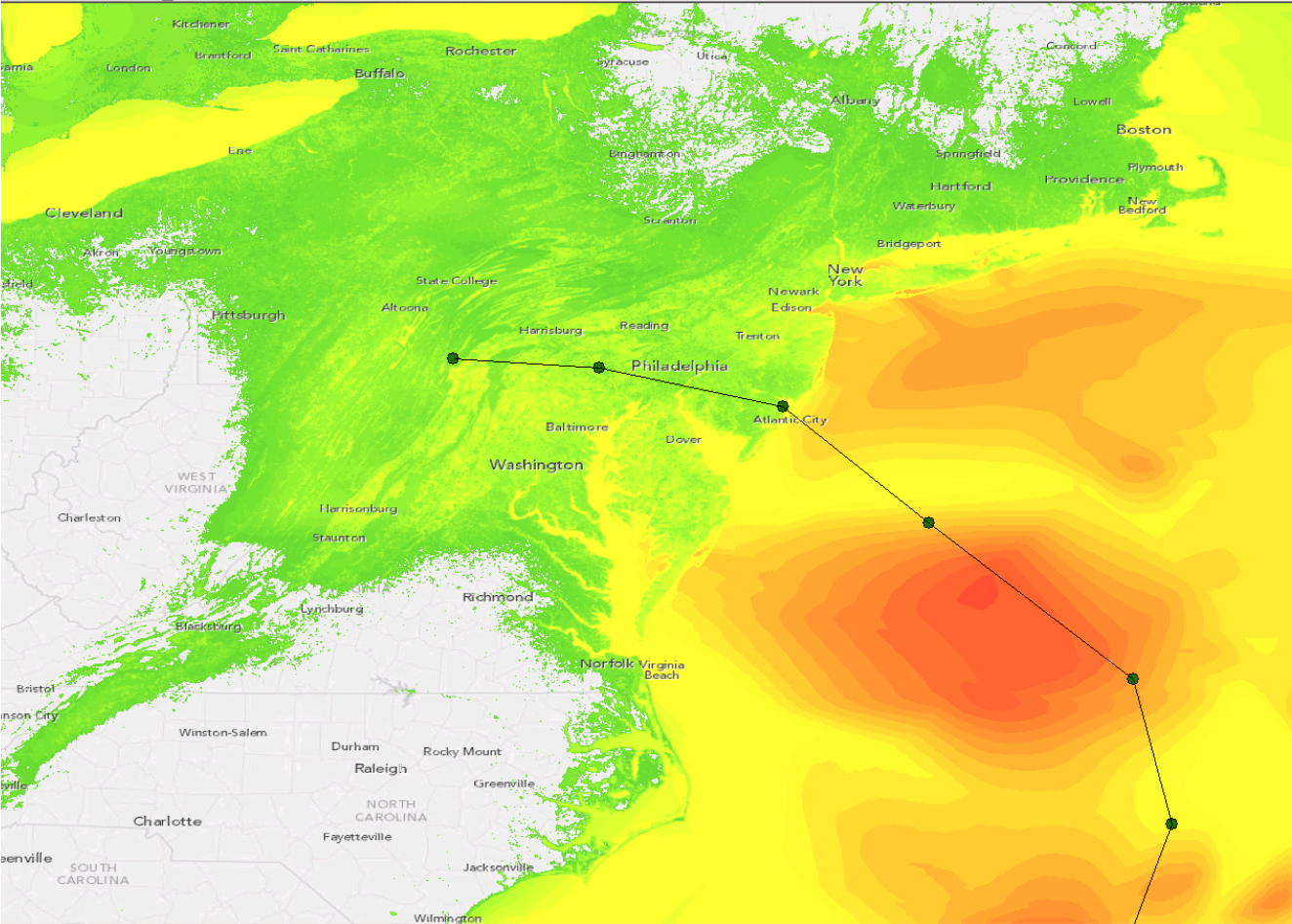# Illustration of Parcel-Scale Tree Cover Analysis
Based on analysis of multichannel visible and infrared imagery

Low tree risk score

High tree risk score

Metrics that contribute to tree risk
- No. of tree "clusters" within parcel
- Sqft of tree cover in parcel
- Sqft of tree cover overlapping paved surfaces
- Sqft of tree cover within 10 ft of roof cover
- Sqft overlap with roof cover

Sandy Wind Swath

Sandy Blackout
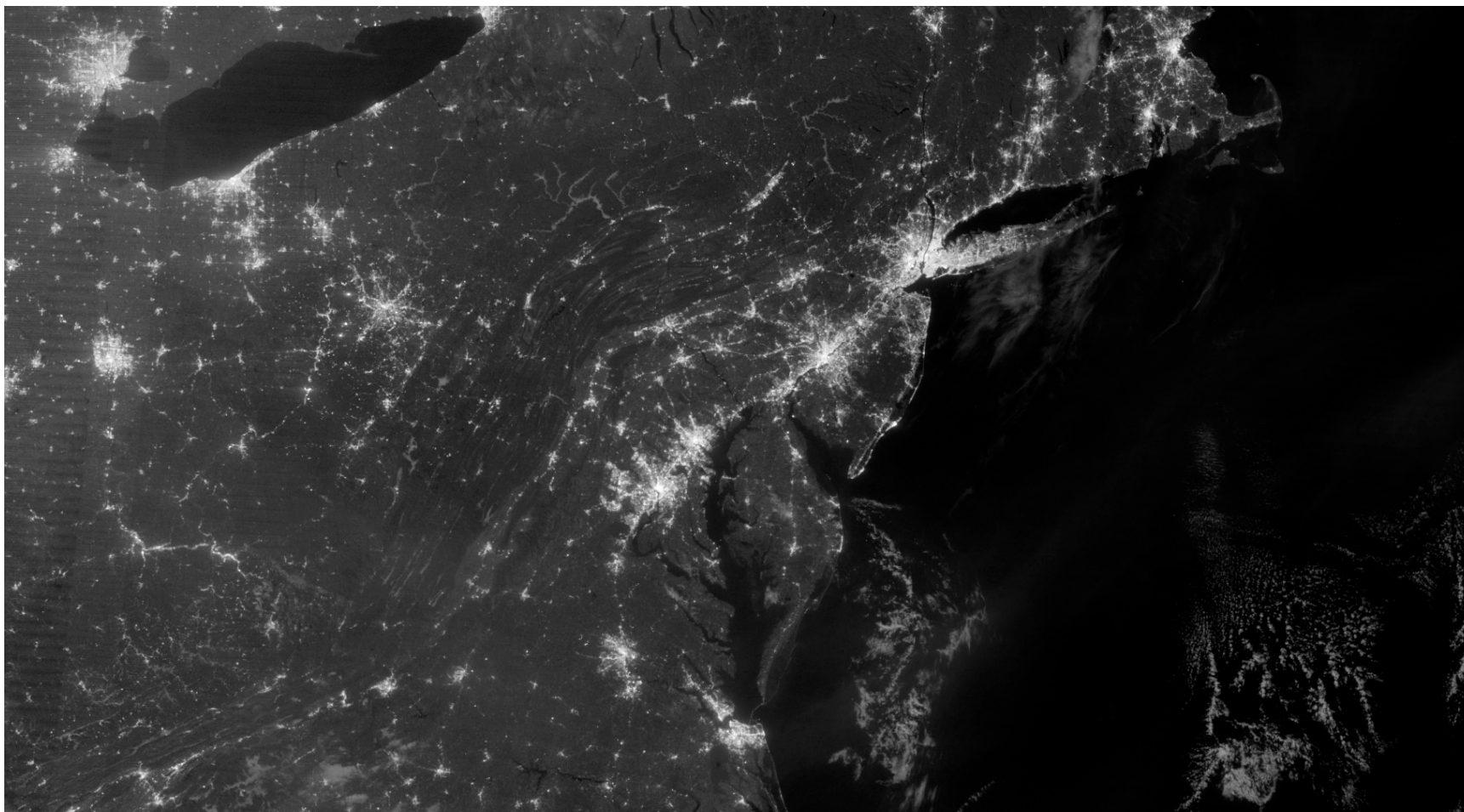
Image Credit: NASA Earth Observatory

Blackout Risk Model™, Powered by HSB and Verisk
© Insurance Services Office, 2016

Munich RE

4/27/16   11

Sandy Blackout

Image Credit: NASA Earth Observatory

Blackout Risk Model™, Powered by HSB and Verisk
© Insurance Services Office, 2016

4/27/16   12
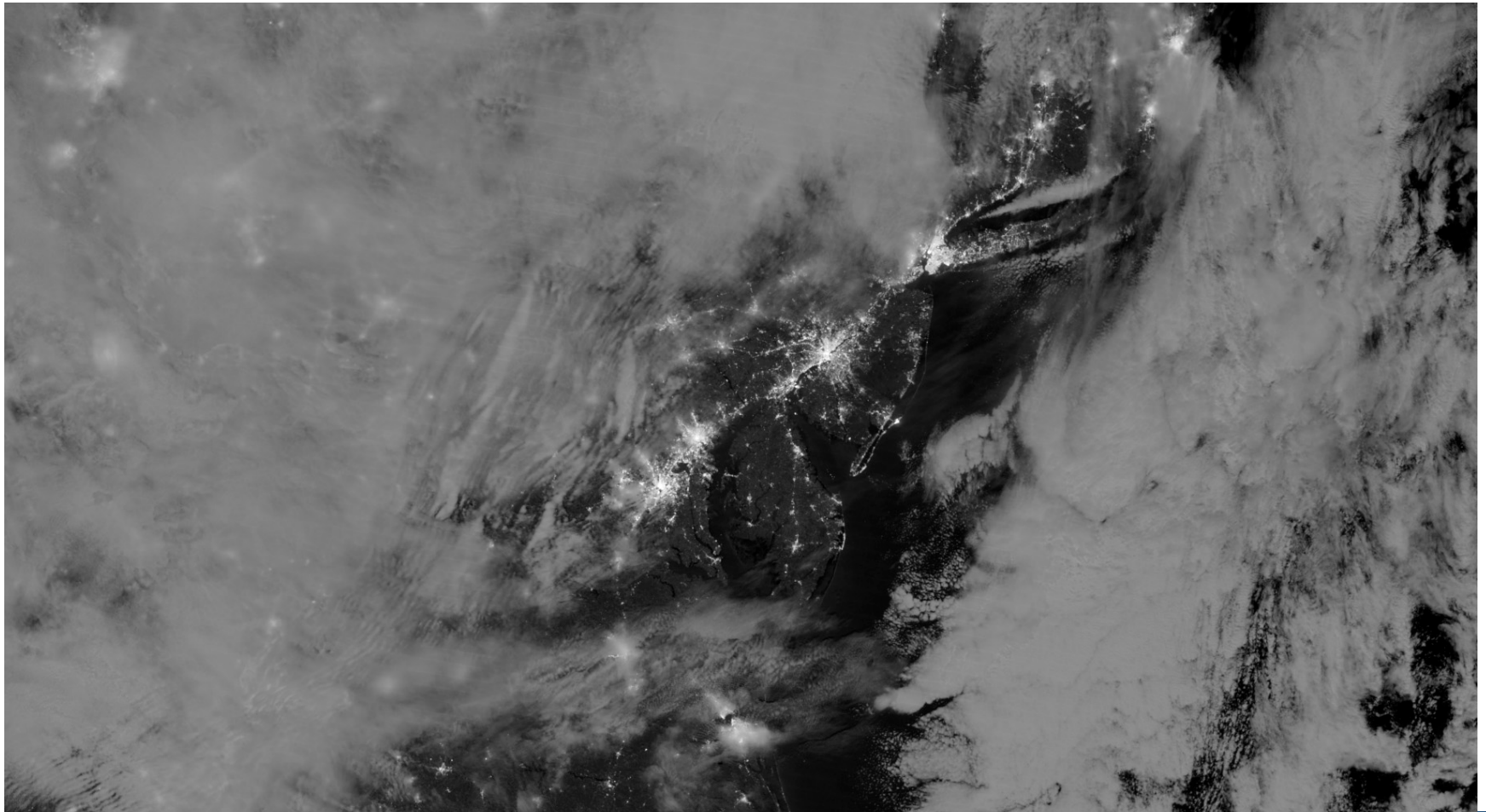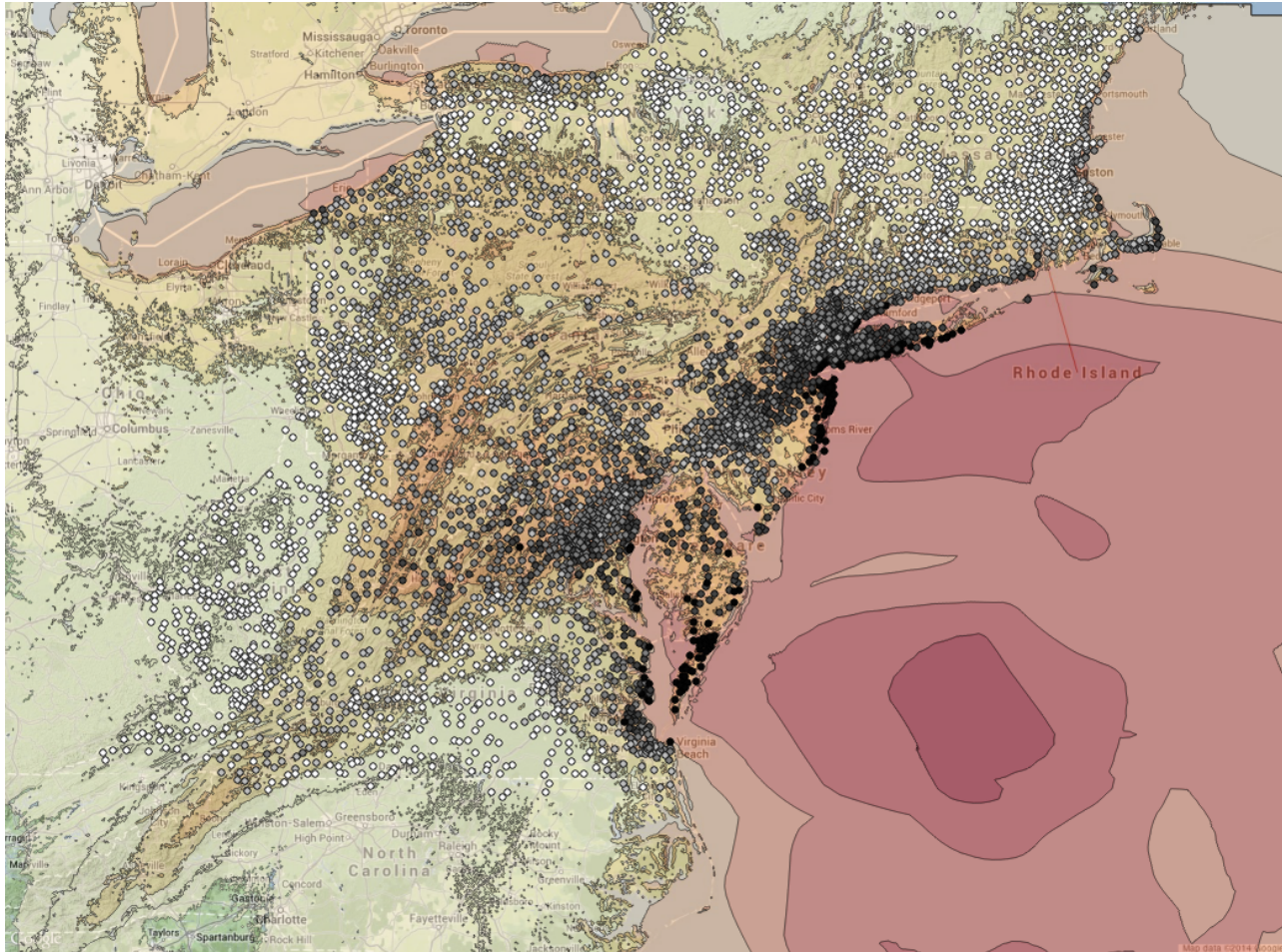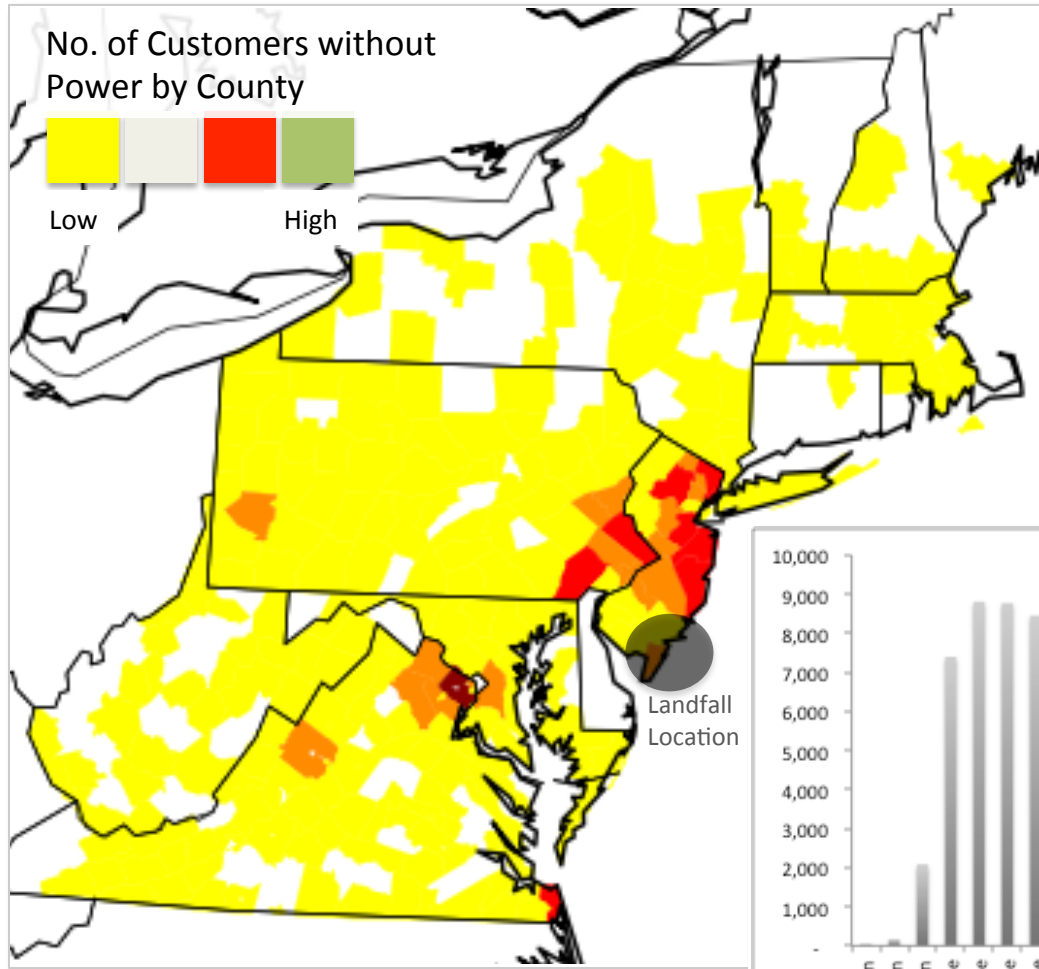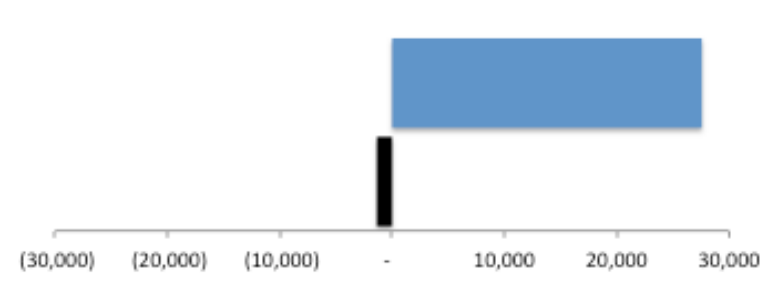
Peak outage by ZIP Code for Sandy

Verisk Climate Respond™ – Post Event Footprint

Blackout Risk Model™ Simulated Power Outage from Superstorm Sandy Over a 9-Day Period

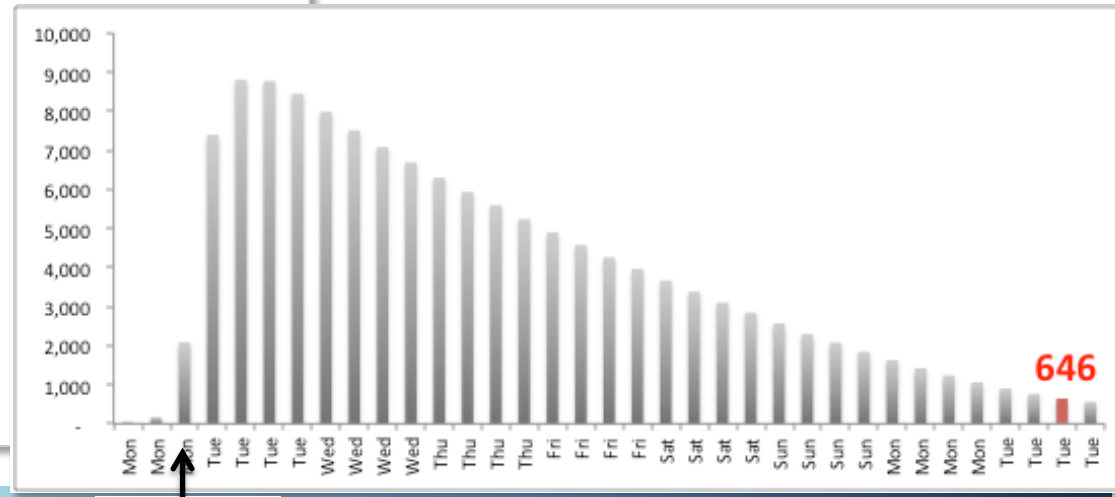No. of Customers without Power by County

Low   High
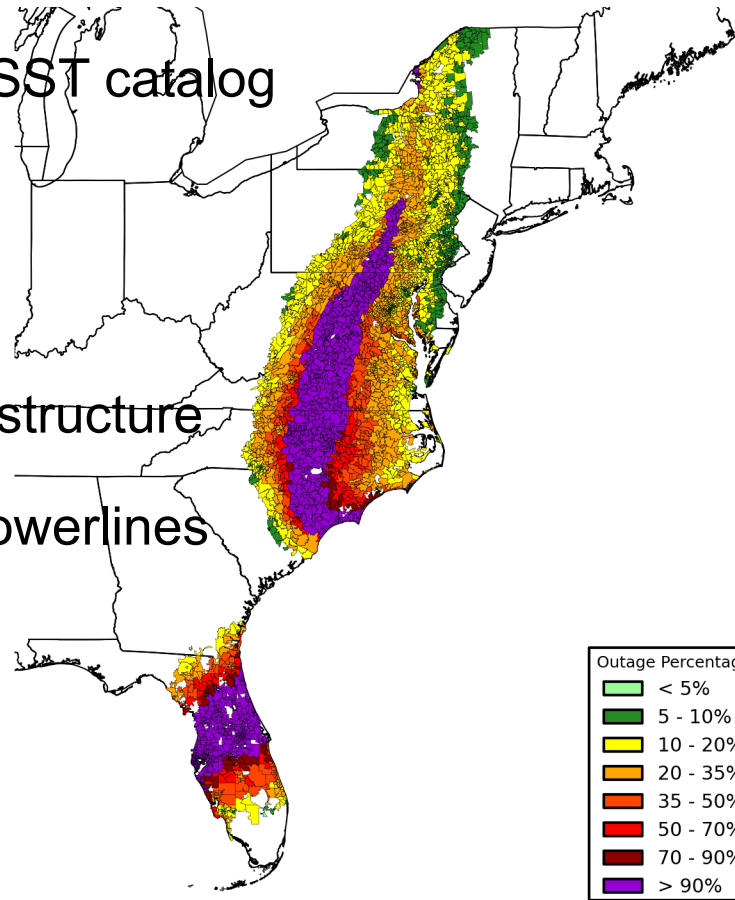
No. of Active Grid Failures

Cumulative No. of Repairs

No. of Customers without Power (000s)

Landfall Location

Landfall Time

646

verisk Insurance Solutions

Munich RE

Hartford Steam Boiler 1866

Stochastic Storms

- Based on 100K storm warm SST catalog
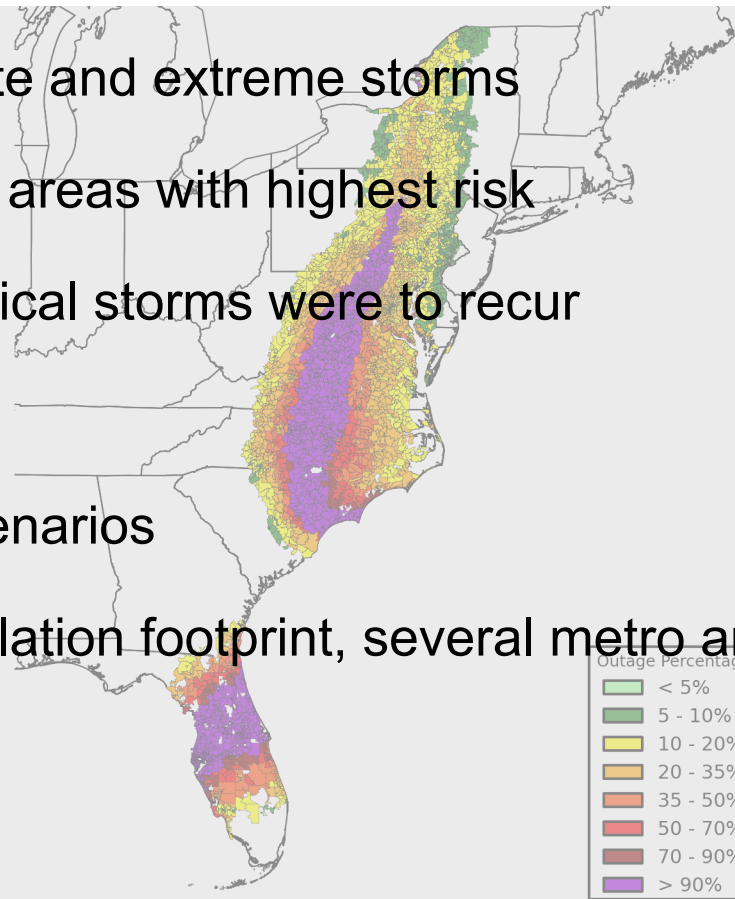
- Parameterized wind profile

- Wind and surge hazard

- Surge flooding of power infrastructure

- Wind damage to trees and powerlines

Outage Percentage
- < 5%
- 5 - 10%
- 10 - 20%
- 20 - 35%
- 35 - 50%
- 50 - 70%
- 70 - 90%
- > 90%

Blackout Risk Model™, Powered by HSB and Verisk
© Insurance Services Office, 2016

Munich RE

Hartford Steam Boiler
1866

4/27/16   15

Stochastic Storms

- Recurrence curve of moderate and extreme storms

- Identification of geographical areas with highest risk

- Estimates of outages if historical storms were to recur

  - 1938, Camille, Donna

- Exploration of worst-case scenarios

  - Strong landfall, large population footprint, several metro areas

Outage Percentage
- < 5%
- 5 - 10%
- 10 - 20%
- 20 - 35%
- 35 - 50%
- 50 - 70%
- 70 - 90%
- > 90%

Blackout Risk Model™, Powered by HSB and Verisk
© Insurance Services Office, 2016

Munich RE

Hartford Steam Boiler
1866

4/27/16   16

Questions

Contact Info

- William Ramstrom

  wramstrom@verisk.com

- Robin Luo

  Yuyan_Luo@hsb.com

Blackout Risk Model™, Powered by HSB and Verisk
© Insurance Services Office, 2016

Munich RE

Hartford Steam Boiler
1866

4/27/16   17

verisk
Insurance Solutions