



Insurance Perspective: Energy Resilience

Energy Master Planning for Resilient Communities
National Academy of Sciences
Washington, DC

Wednesday, December 6, 2017
David R. Tine



Hartford Steam Boiler

Resilience

The objective of resilience is to help ensure people can overcome a potentially catastrophic event and return to normal life as quickly and effectively as possible. The range of possible precautionary measures includes setting up early warning systems, structural protection, adequate organisation and teaching people how to respond in an emergency situation. This infographic shows that creating a high level of resistance is a dynamic and flexible process.

Prepare

What natural hazards can affect me?
Am I ready?



Even if an extreme event is not imminent, you should know how to prepare and protect yourself against it and how to respond if it does occur. A checklist is the preferred way to do this. It is important to be aware of your individual situation.

Emerging countries are hit particularly hard by natural disaster losses

- Industrialised countries: on average 0.8% of GDP
- Emerging countries: nearly 3% of GDP

Prevent

How can major losses be prevented?



In many cases, major losses from moderate events can be prevented using fairly simple means. Avoiding the peril in the first place is always the best solution.

Mississippi, USA

- Investment in flood management since 1927: US\$ 14bn
- Damage prevented in 2011 flood alone: >US\$ 100bn

Protect

How can I better secure my possessions?



Hamburg, Germany

- Investment in flood protection since 1993: €2.4bn
- Damage prevented since then: >€200bn

Precautions taken by the authorities offer a general level of basic protection. This level can be permanently or temporarily increased for objects especially worthy of protection.

Recover

How can I get back to my normal routine?



The most important requirement is that basic supplies and infrastructure are quickly restored to allow reconstruction to begin. A loss also presents an opportunity to improve on how things were before the disaster. This in turn will improve future resilience, bringing us back to the topic of preparedness.

2010 economic growth after severe earthquakes at the beginning of the year:

- Chile (M_w 8.3, 27 February): +1.5%
- Haiti (M_w 7.0, 12 January): -5.5%

Respond

How can I limit the damage?



It is not possible to prevent damage entirely. But it can be minimised by responding appropriately and taking the right steps. The response begins with the early warning, reaches its peak during crisis management, and continues into the recovery phase.

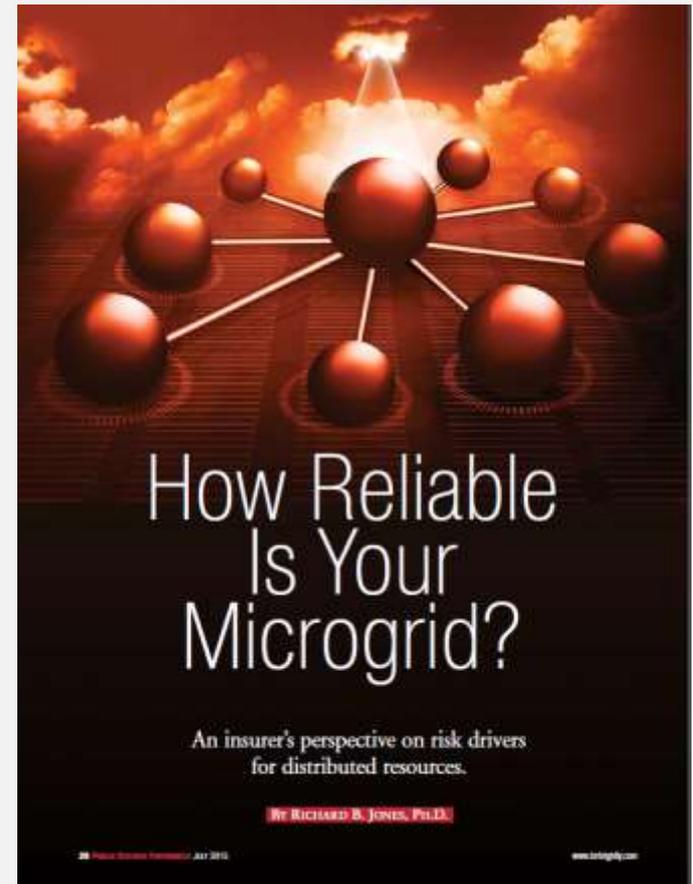
Bangladesh: Prevention and early warnings save lives

- Cyclone Sidra 1970: 300,000 fatalities
- Cyclone Sidr 2007: 3,900 fatalities

Frequency/Severity/ Threat



- Insurance companies are central to the revitalization efforts of communities and businesses as they respond to the effects of natural disasters.
- Two models utilized from the perspective of risk mitigation and insurance:
 - Blackout Risk Modeling
 - Microgrid Reliability Model



“How Reliable is Your Microgrid” by Richard Jones, Public Utilities Fortnightly, July 2015

Blackout Risk Model™

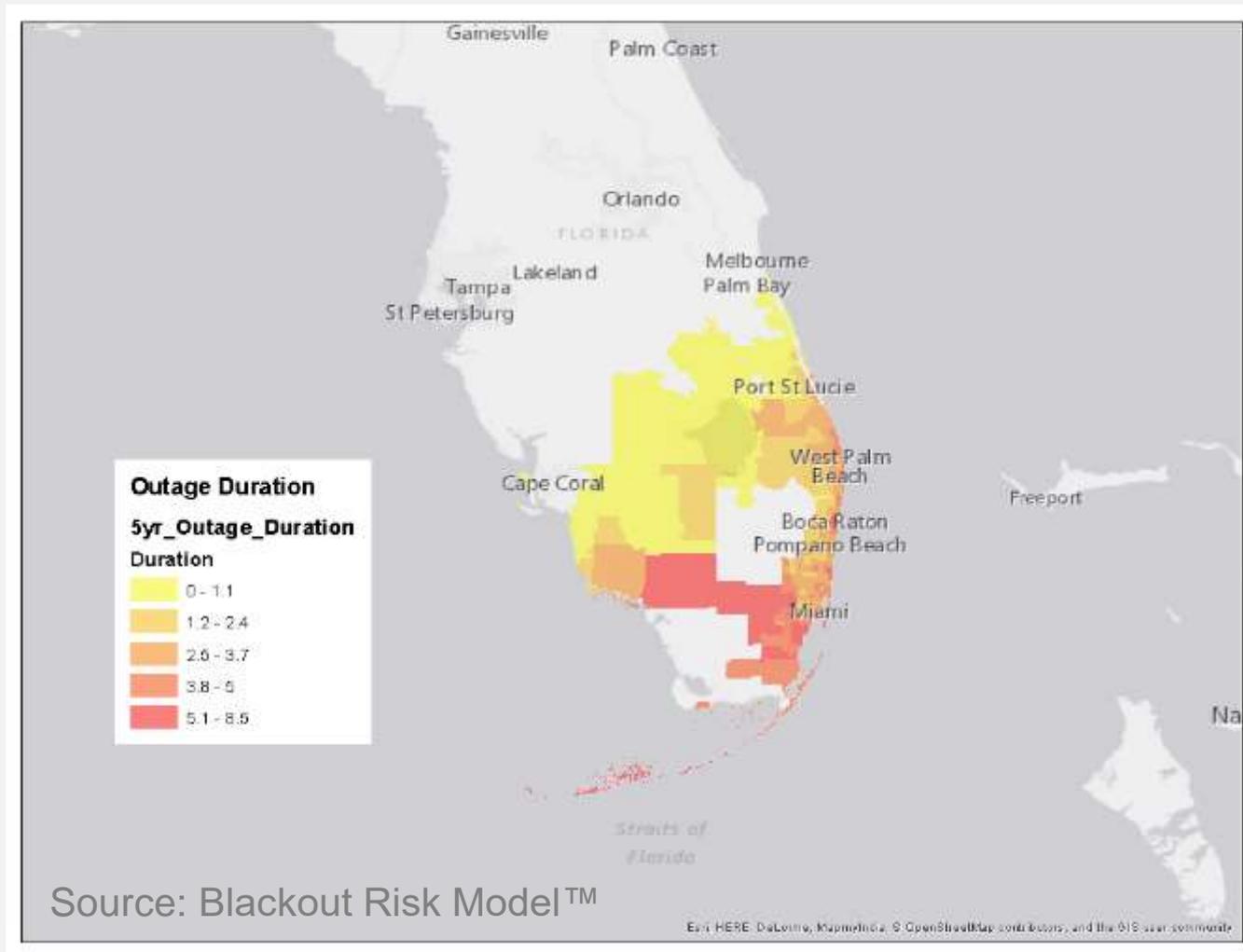


Focuses on the U.S. power grid and incorporates extensive data on four peril categories: Hurricanes, winter storms, thunderstorms, and equipment failure or operator error. Wild fires and terrorism attack loss scenarios can also be tested. This includes:

- **Severe weather events**
- **Electrical grid**
- **Tree proximity to power lines**



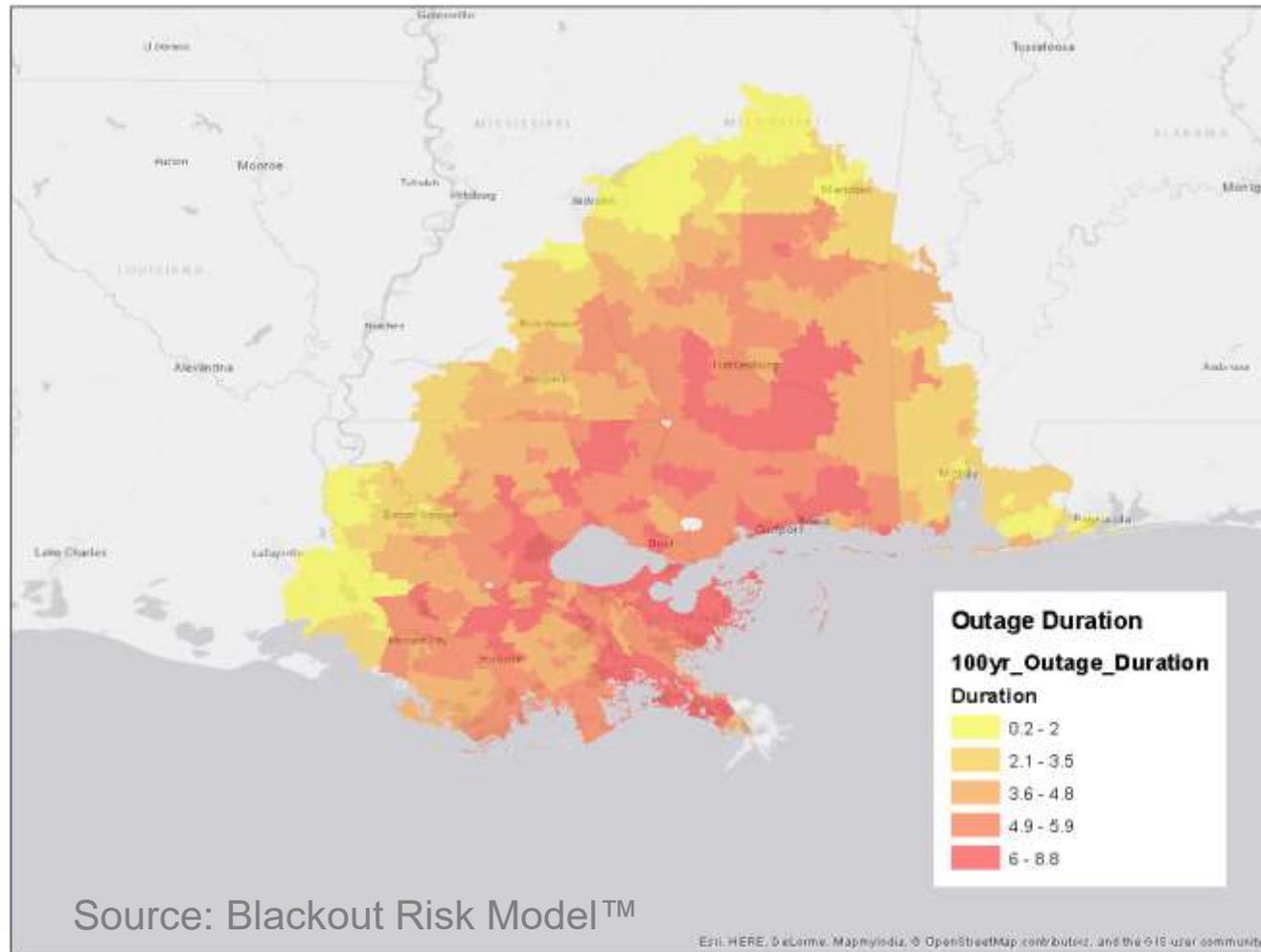
Blackout Risk Model™ Hurricane Outage Duration, 5yr return per., 2.47 days average



Blackout Risk Model™ Hurricane Outage Duration, 100yr return per., 3.96 days average



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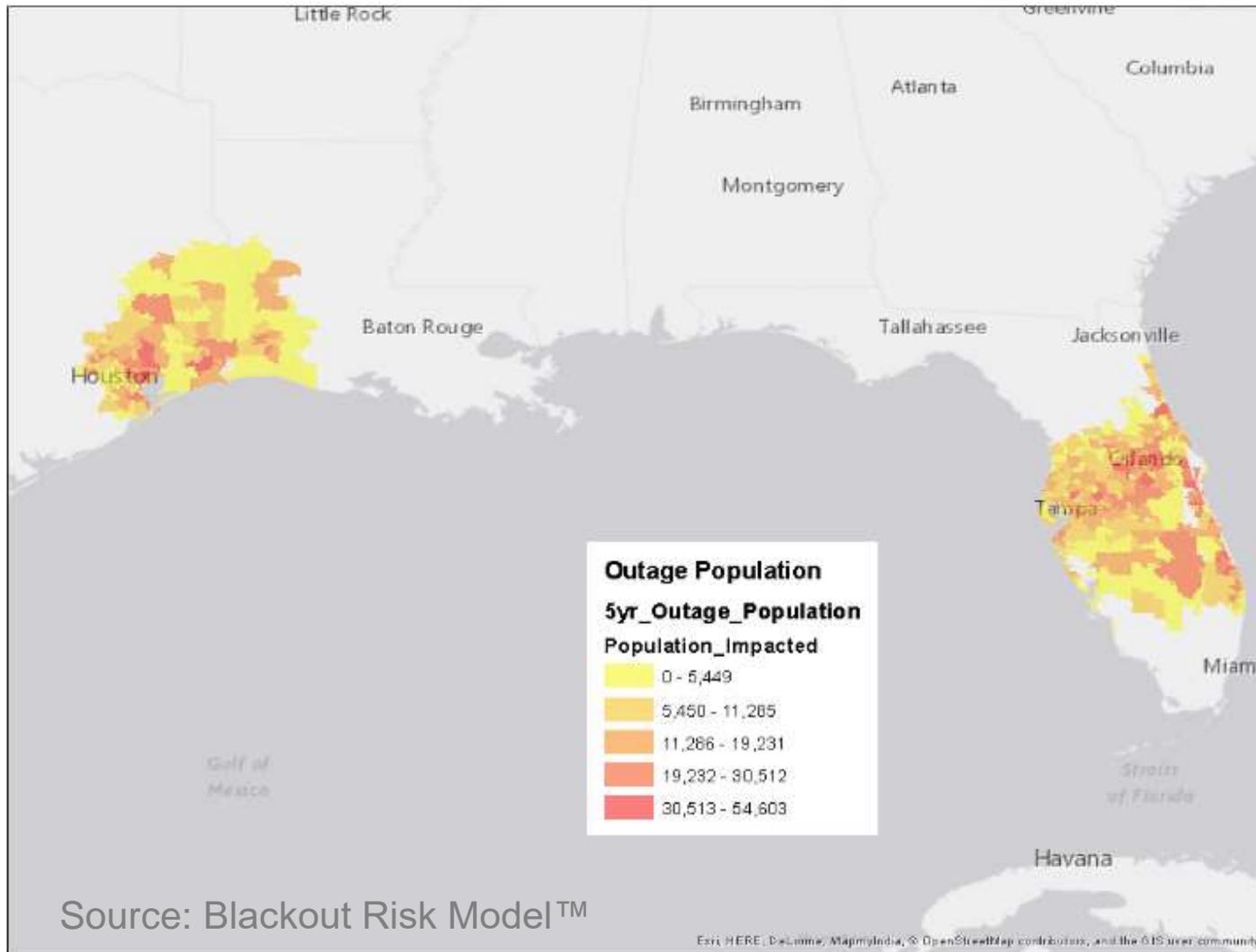
Blackout Risk Model™ Hurricane Outage Population, 5yr return per., 7,716,839 people impacted



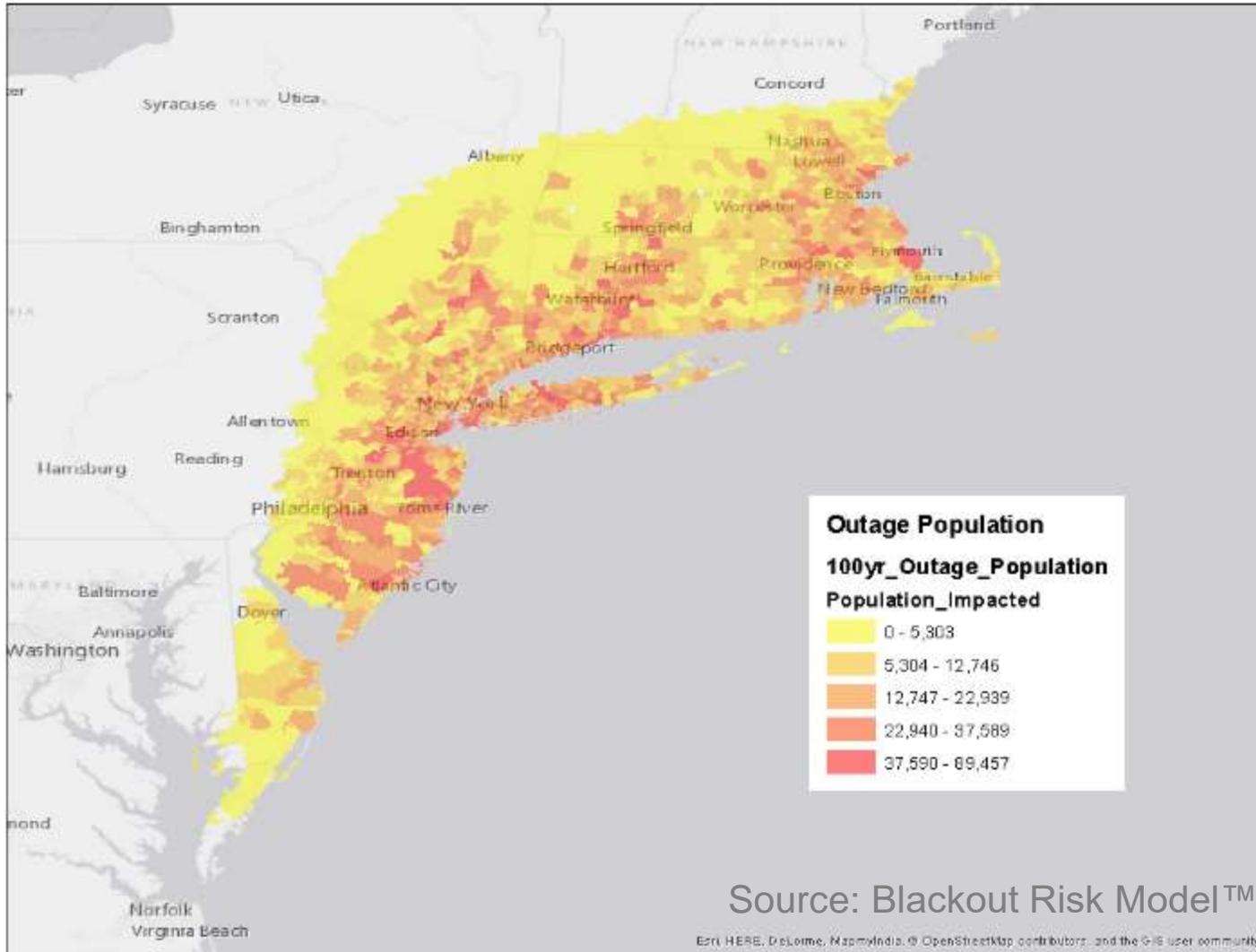
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Munich RE



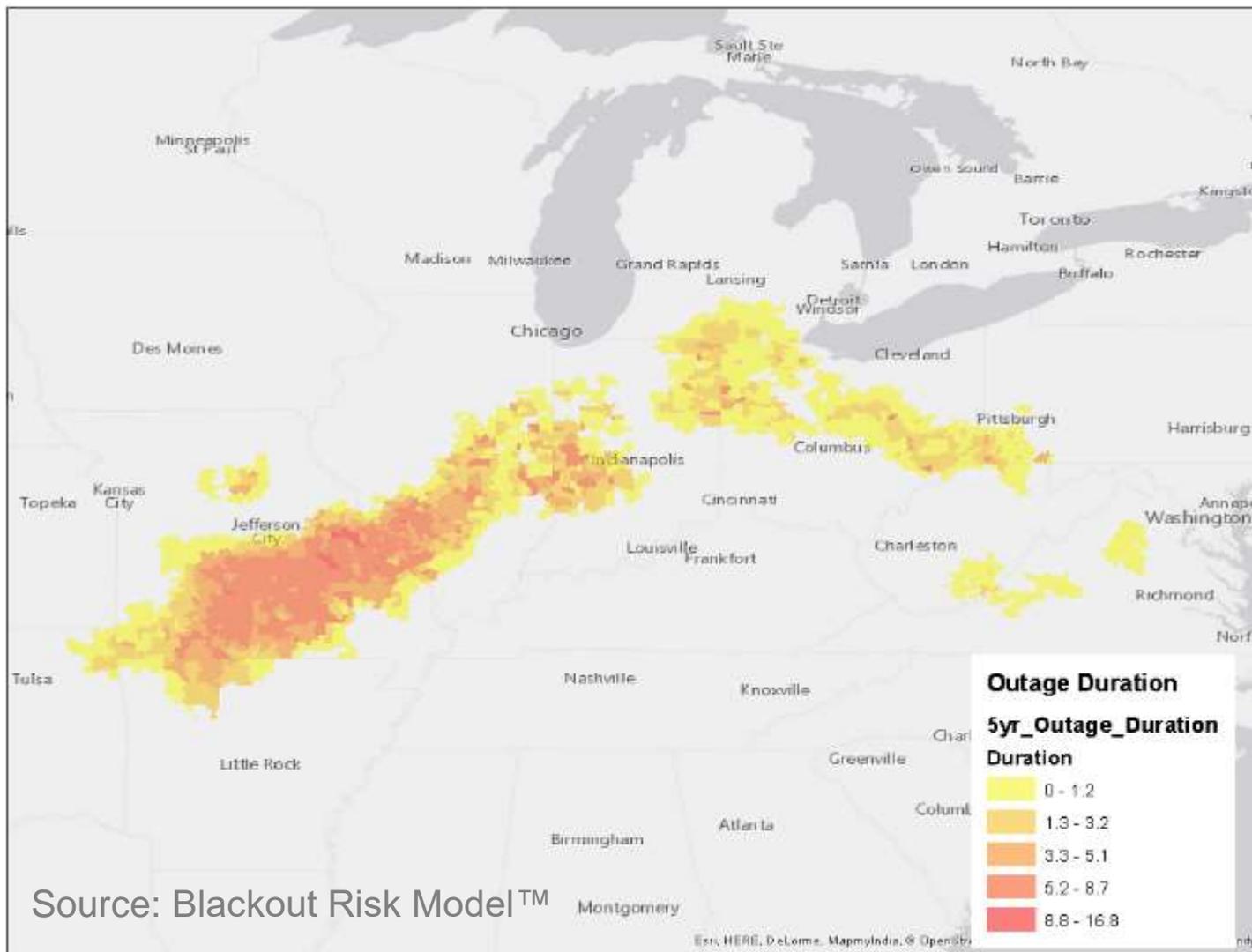
Blackout Risk Model™ Hurricane Outage Population, 100yr return per., 25,095,957 people impacted



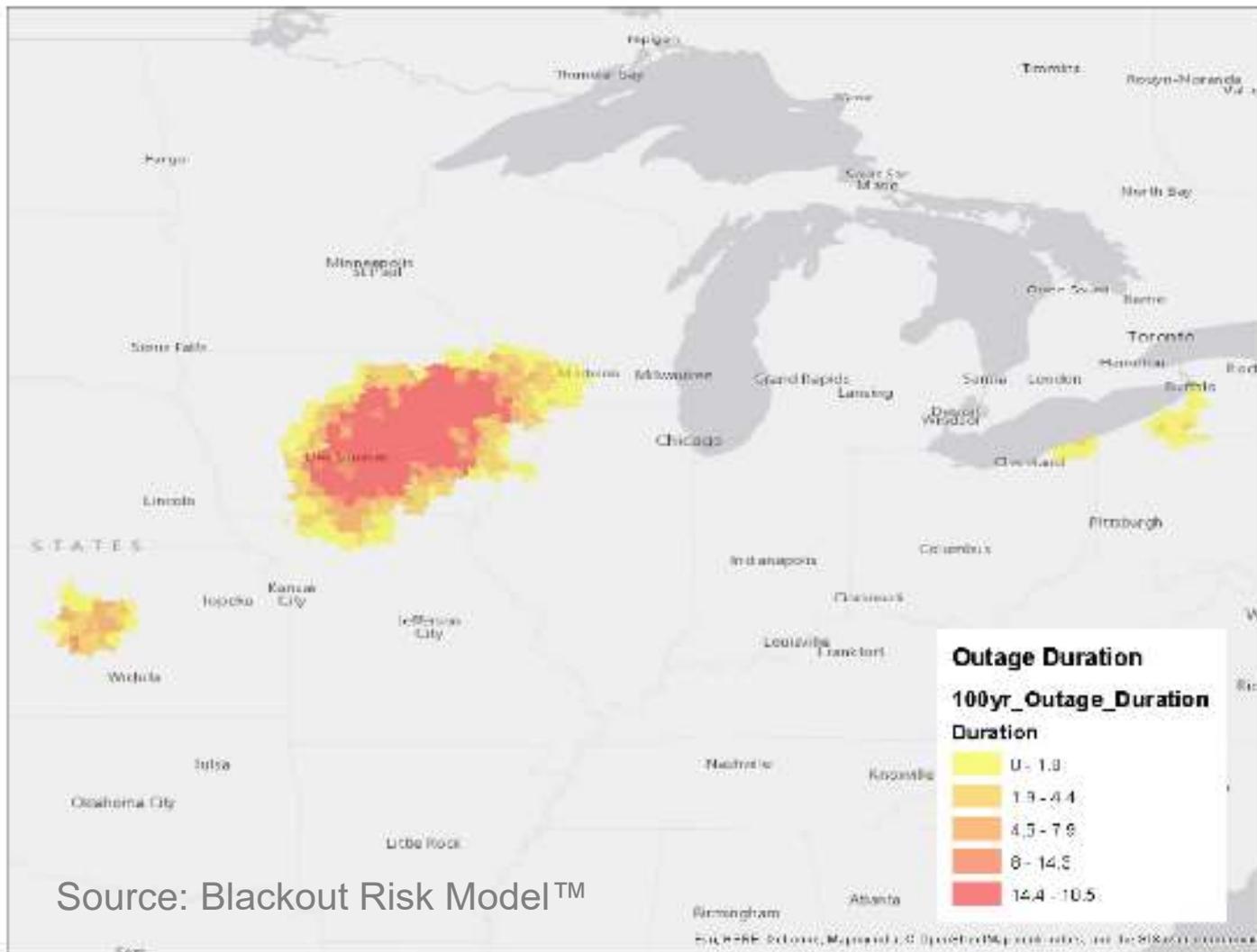
Blackout Risk Model™ Winterstorm Outage Duration, 5yr return per., 1.92 days average



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Blackout Risk Model™ Winterstorm Outage Duration, 100yr return per., 6.45 days average



Source: Blackout Risk Model™

Notional Loss Analysis



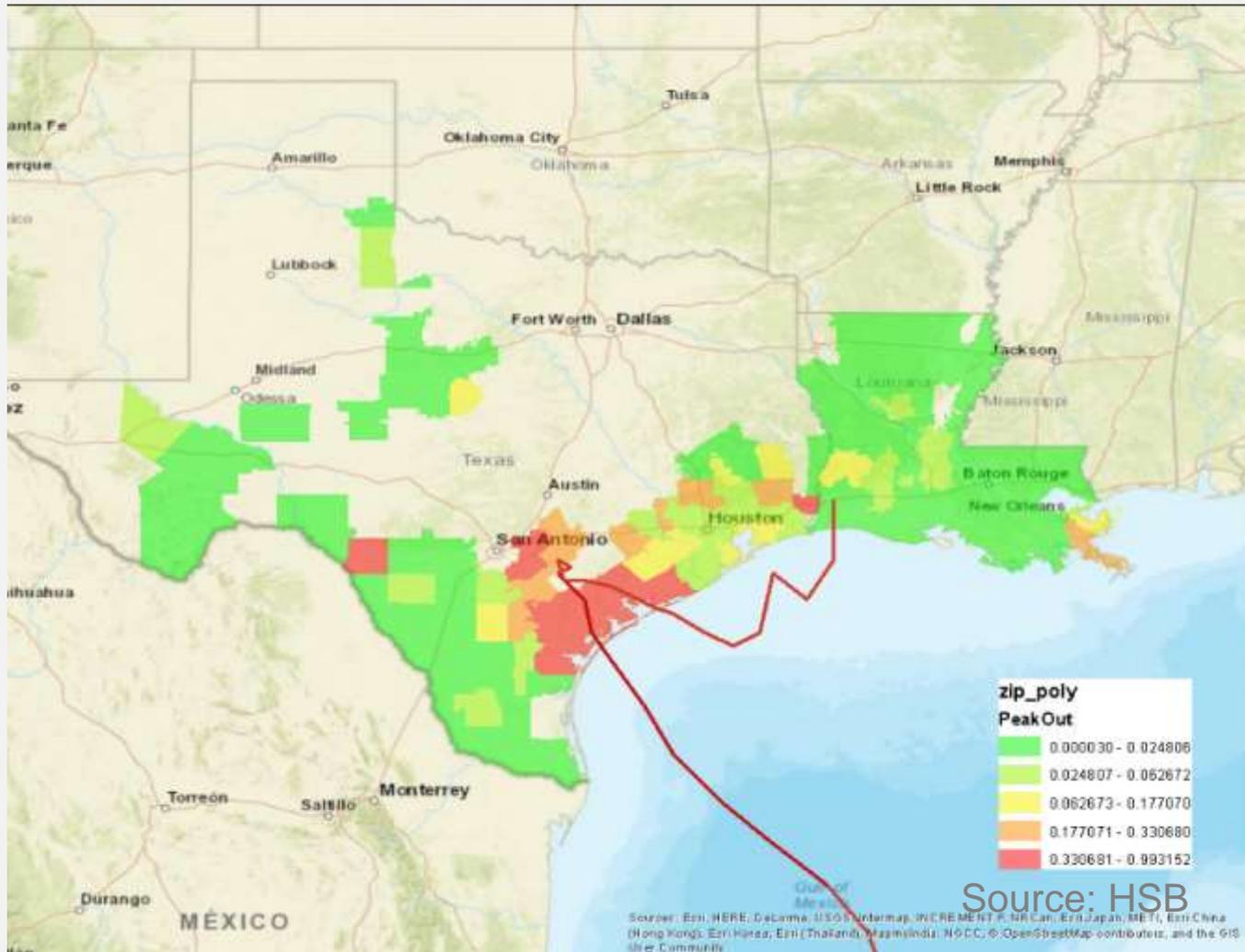
- Assume \$10 Mil of annual BI exposure in all US zip codes
 - This could represent 1 \$10 Mil exposure or several smaller exposures totaling \$10 Mil.
- 24 hr. waiting period / deductible
- Return period is probability of occurrence
 - i.e. 5 yr is 20% chance in one year
 - i.e. 100 yr is 1% chance in one year

Return Period	Hurricane	Winterstorm
1000	\$318,000,365	\$597,849,489
500	\$284,026,307	\$521,753,166
250	\$247,325,162	\$418,962,302
100	\$192,864,230	\$276,838,550
50	\$149,479,089	\$199,762,238
25	\$107,578,614	\$152,285,187
5	\$40,806,485	\$57,925,226
Average	\$32,514,423	\$48,460,274

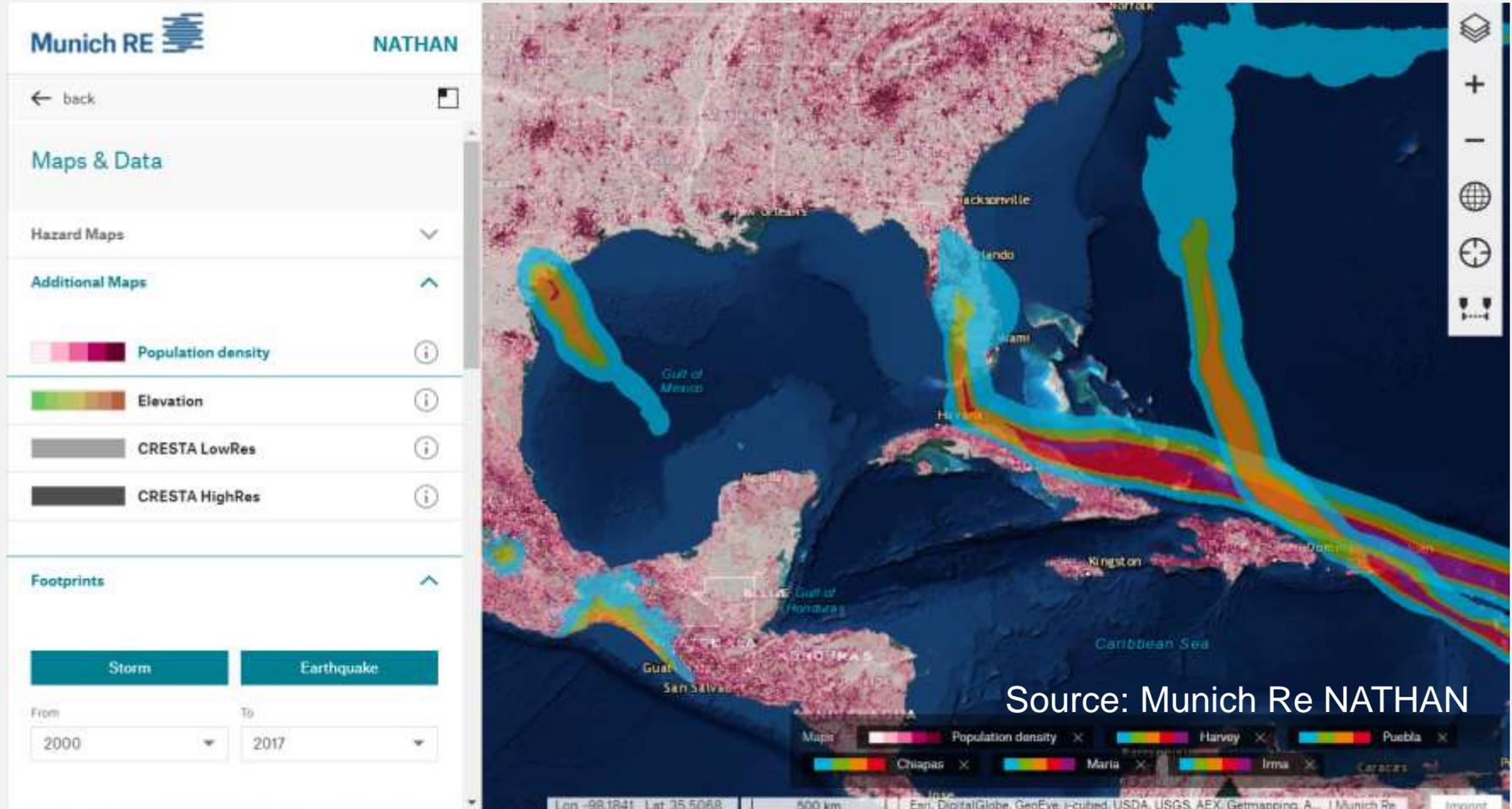
Hurricane Harvey Power Outages Peril Considerations – Flood vs Wind



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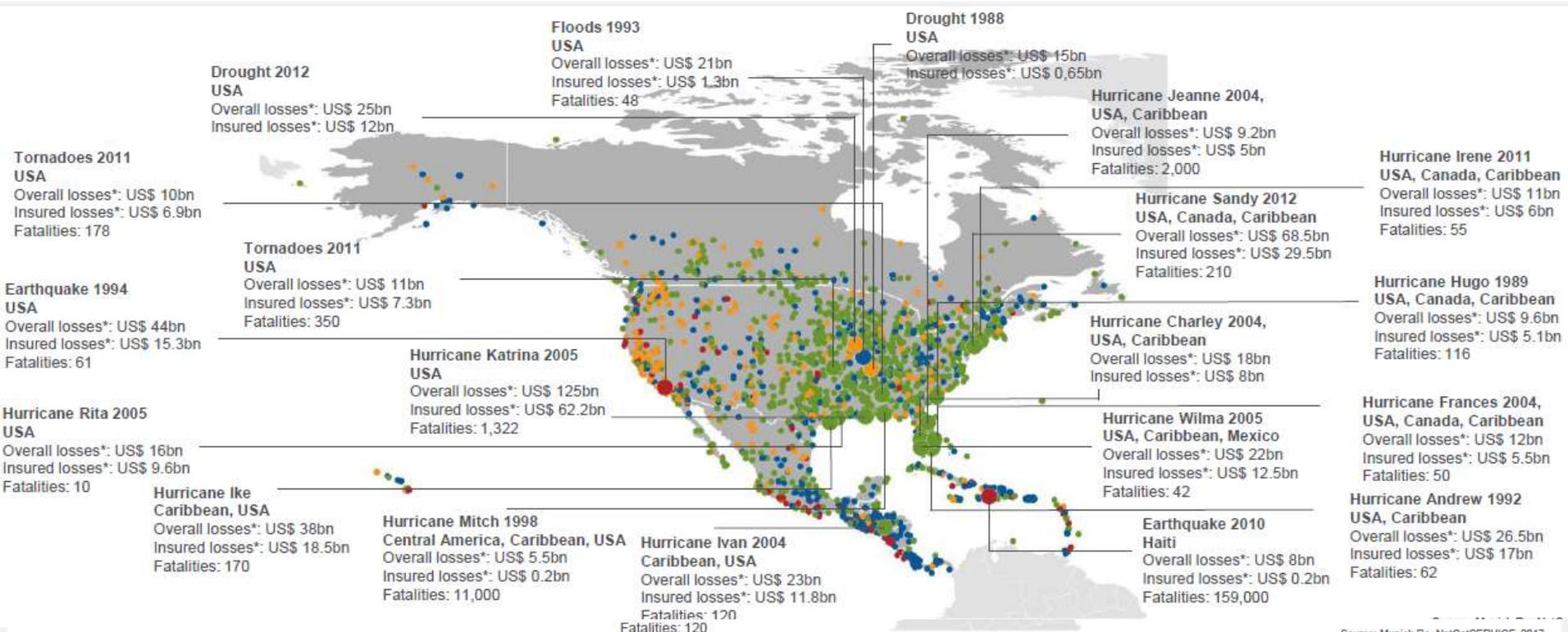


Munich RE applications NATHAN & natcatService



Loss events in North America 1980 – 2016

Geographical overview (including Caribbean and Central America)



Source: Munich Re, NatCatSERVICE, 2017

- **Geophysical events** (Earthquake, tsunamis, volcanic activity)
 - **Meteorological events** (Tropical storm, extratropical storm, convective storm, local storm)
 - **Hydrological events** (Flood, mass movement)
 - **Climatological events** (Extreme temperature, drought, wildfire)
- Loss events ○ Selection of catastrophes

Source: Munich Re NatCatSERVICE

*Losses in original values

Valuing Resilience: Risk Considerations



1. Risk Modifiers for loss prevention activities
 - a) A robust, fast response repair program has a major risk reduction effect for both availability and lost production risk.
 - b) Energy storage has a risk reduction benefit.
2. Weather influences need to be considered during design and construction specifications.
3. A Performance Risk Analysis Model can help direct resources to the major risk drivers.
4. Standard property insurance is prudent but system performance insurance may help in funding if performance can be related to revenue.



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Risk Solutions



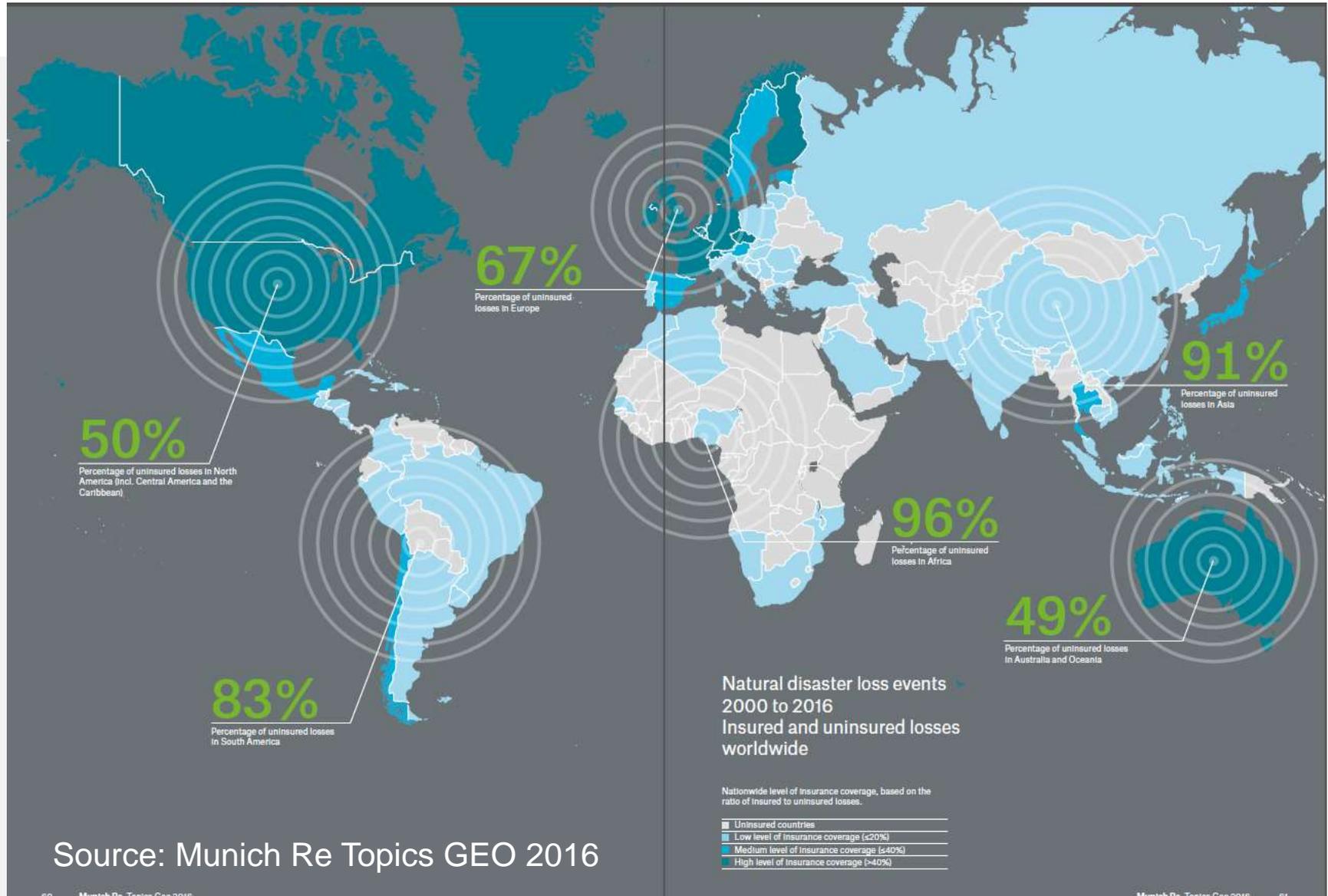
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Appendix- MunichRe Topics GEO



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Appendix - Standard Insurance Coverage: Loss Valuation



Equipment
Breakdown



Business Income
Extra Expense



Spoilage Damage
Utility Interruption

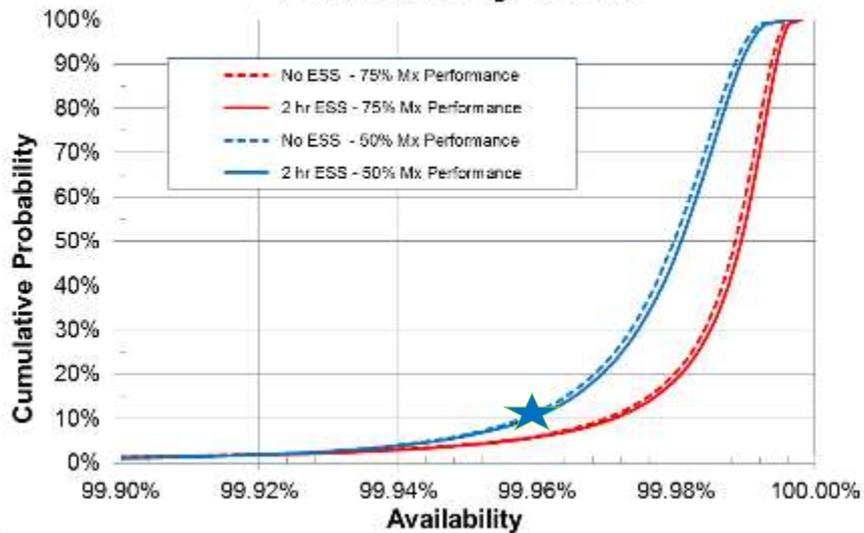
Appendix: typical risk model results

NY Prize Microgrid: illustration only



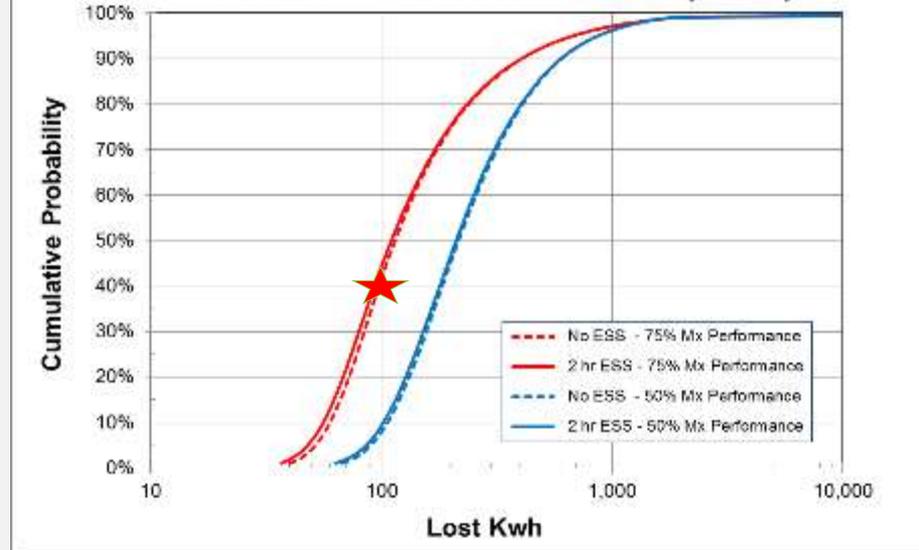
Energy Storage (ESS) Duration of 2 Hours – For this situation (modeled in this case only) ESS has significantly less value risk reduction value than the Component Repair Strategy

Availability Risk



There is ~ 10% chance that the annual availability will be < 99.96%.

Lost Production Risk (kwh)



There is ~ 40% chance that the annual Lost Kwh will be < 100.