

Supply Chain Exposure and Vulnerability to Increasing Climate Extremes

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**EARTH SYSTEM SCIENCE
INTERDISCIPLINARY CENTER**



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Business and Climate Change at the University of Maryland



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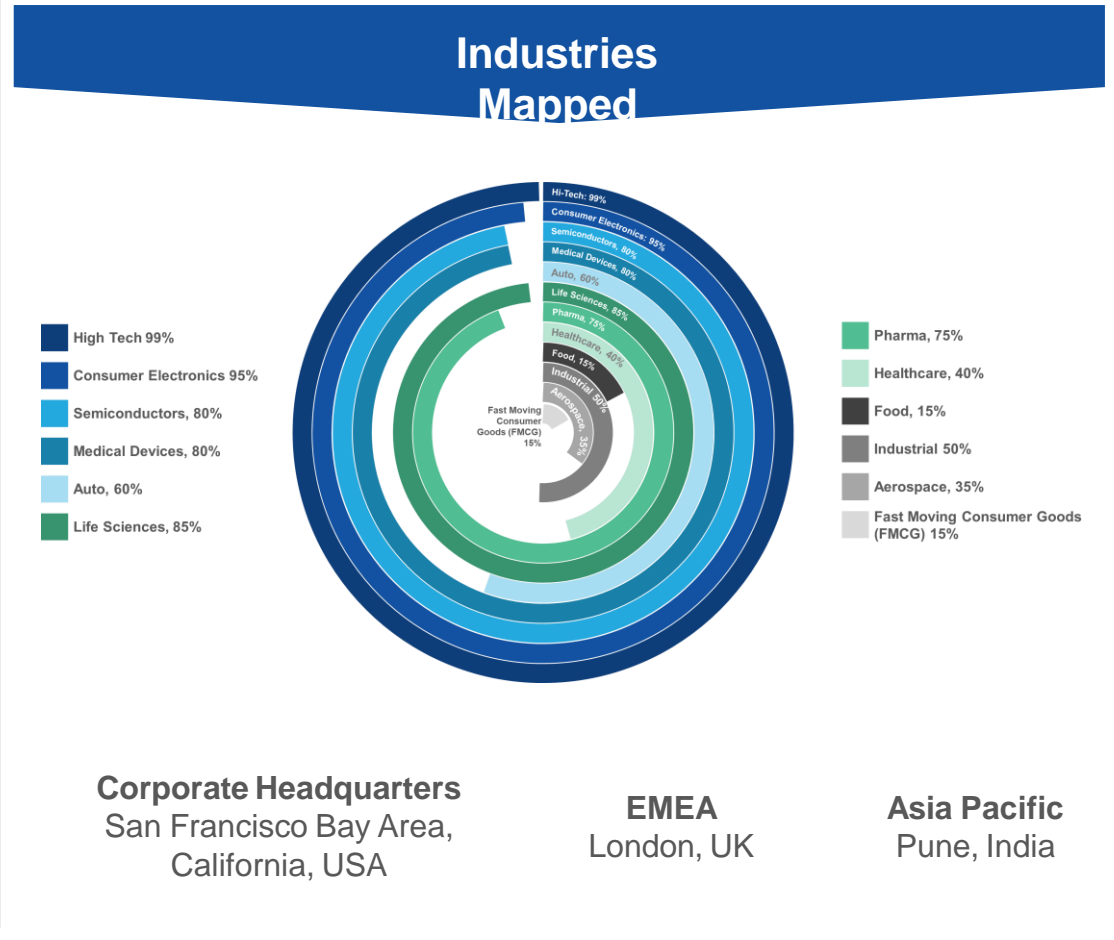
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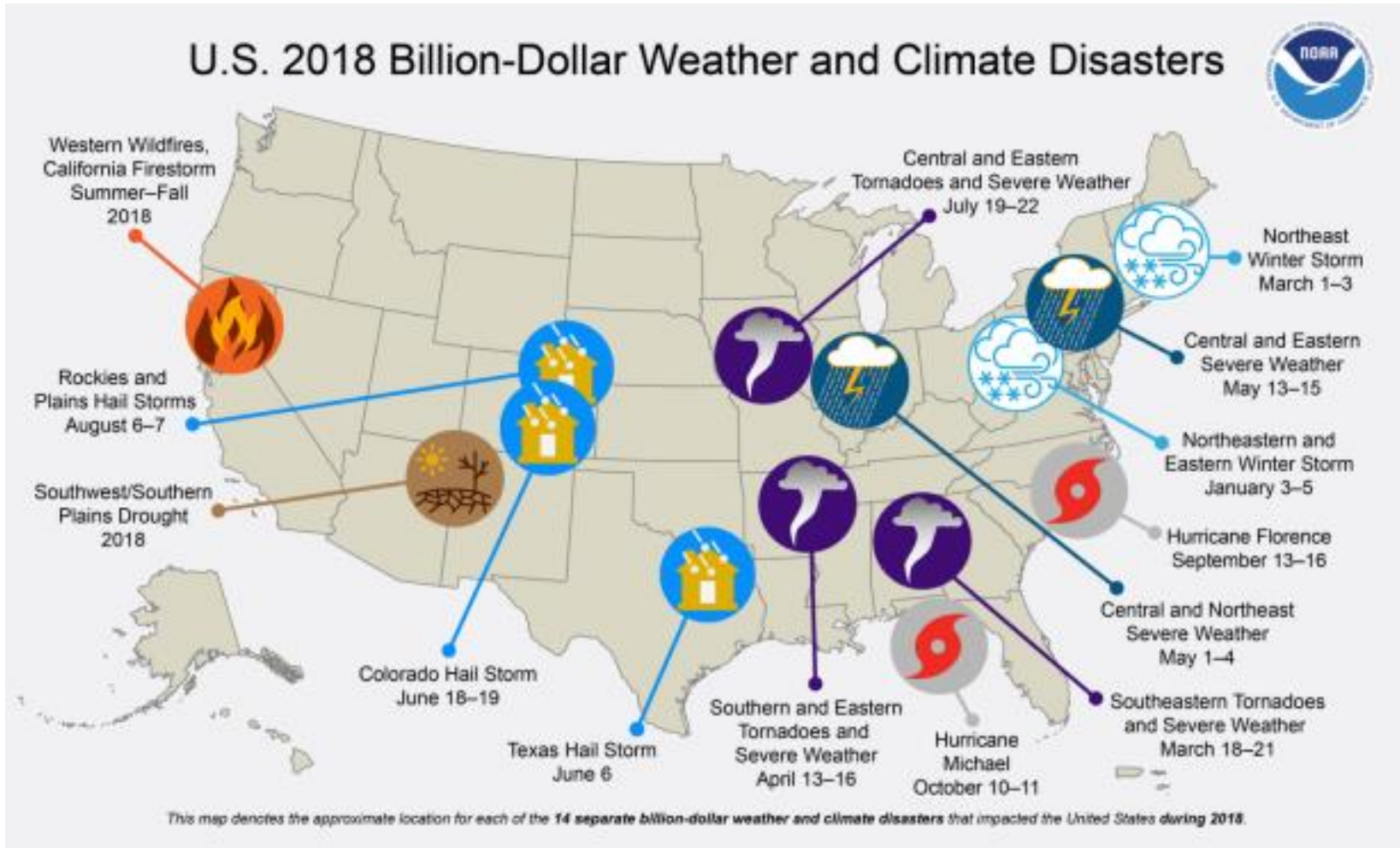
- Highly ranked programs in finance, supply chain management, and earth system science
- Capabilities to ask questions requiring business and climate big data
- New climate finance executive education program beginning this spring

Our Partner Resilinc: At A Glance

- Founded in** 2010
- Founding Team** Ex-Cisco Supply Chain Practitioners and Technology Experts
- Team** 200
- Patent** Measuring and Representing Supply Chain Risk (USPTO 2016)
- Customers** 100+
- Suppliers On boarded** 80,000



Economic and Societal Impacts of Climate Change



Assessing Localized Climate Change Effects is an Increasing Priority

Google data center in Iowa (extreme heat)



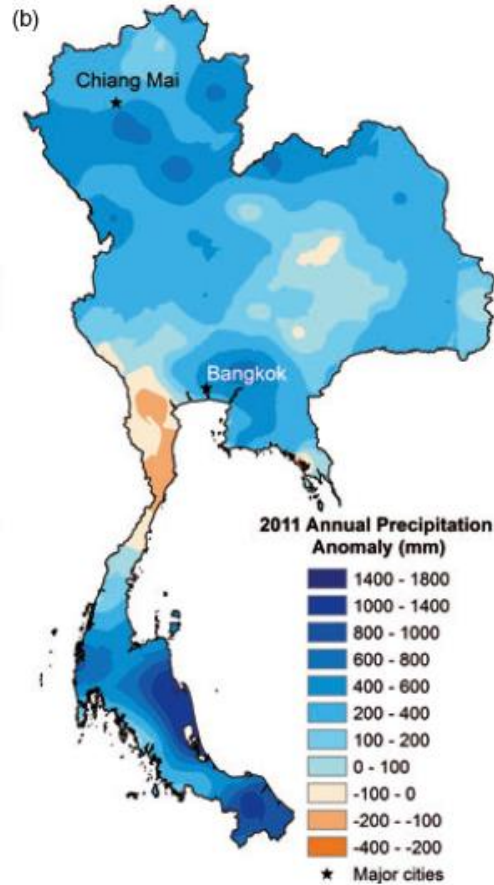
Photo: Brian Snyder (Reuters)

Ft. Irwin (flash flooding)



Source: U.S. Army (left) and GAO (right). | GAO-19-453

Assessing Localized Climate Change Effects is an Increasing Priority

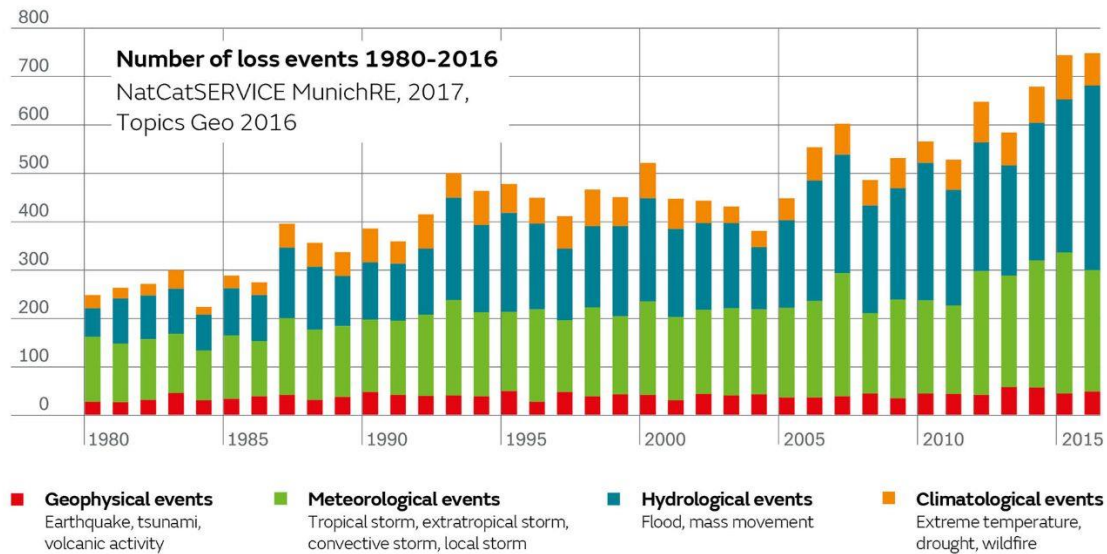


- Over \$30 billion in damages in the 2011 Thai flooding
- 25% of global output of a critical hard-disk drive part was made at one plant that was flooded
- Honda cut hours for workers in Ohio because parts could not be shipped from Thailand

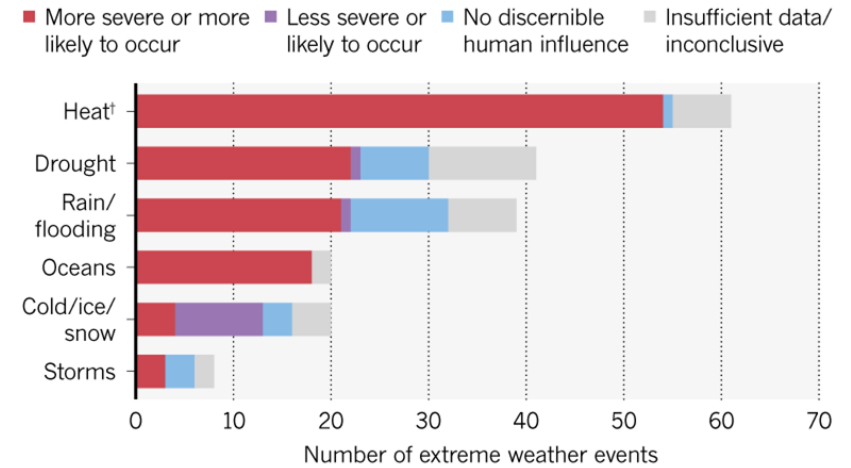
Gale and Saunders, 2013. *Weather* 68(9): 233-237

Assessing Localized Climate Change Effects is an Increasing Priority

Are extremes becoming more frequent?



Met Office



Schiermeier, 2018. *Nature* 560, 20-22

It's tricky to take scientific reports about rising temperatures and weather extremes and say what those broad trends might mean for specific companies in specific locations.

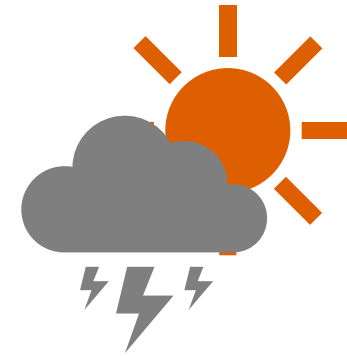
- New York Times, “Companies see Climate Change Hitting Their Bottom Lines In The Next 5 Years”, June 4, 2019

Prototype Supply Chain Climate Vulnerability Index



Business Vulnerability

- Revenue at risk
- Existence of business continuity plan
- Availability of alternative sites
- Alternative site bring-up time



Change in Climate Variability

- Extreme heat
- Drought risk
- Flood risk

Resilinc is the “Linked In” of Supply Chain

Leader in Supply Chain Visibility Data-as-a-Service

Industry leaders rely on Resilinc’s AI-powered 24X7 event monitoring and cognitive risk analytics to map their entire supply chain in one centralized system of record to mitigate costs and drive business ROI

Largest Repository of Supply Chain Intelligence Data

50M+ Sources | 80K+ Suppliers | 2M+ Parts | 350K+ Sites
135+ Countries | 53+ Languages | 10+ Sectors | 100+ Enterprises

Multi-Tier Supply Chain and Part Mapping

One of the only solutions with unified visibility drilling down to Supplier, Site, Product AND Part Level data in one system

AI-powered, Collaborative Risk Assessment Platform

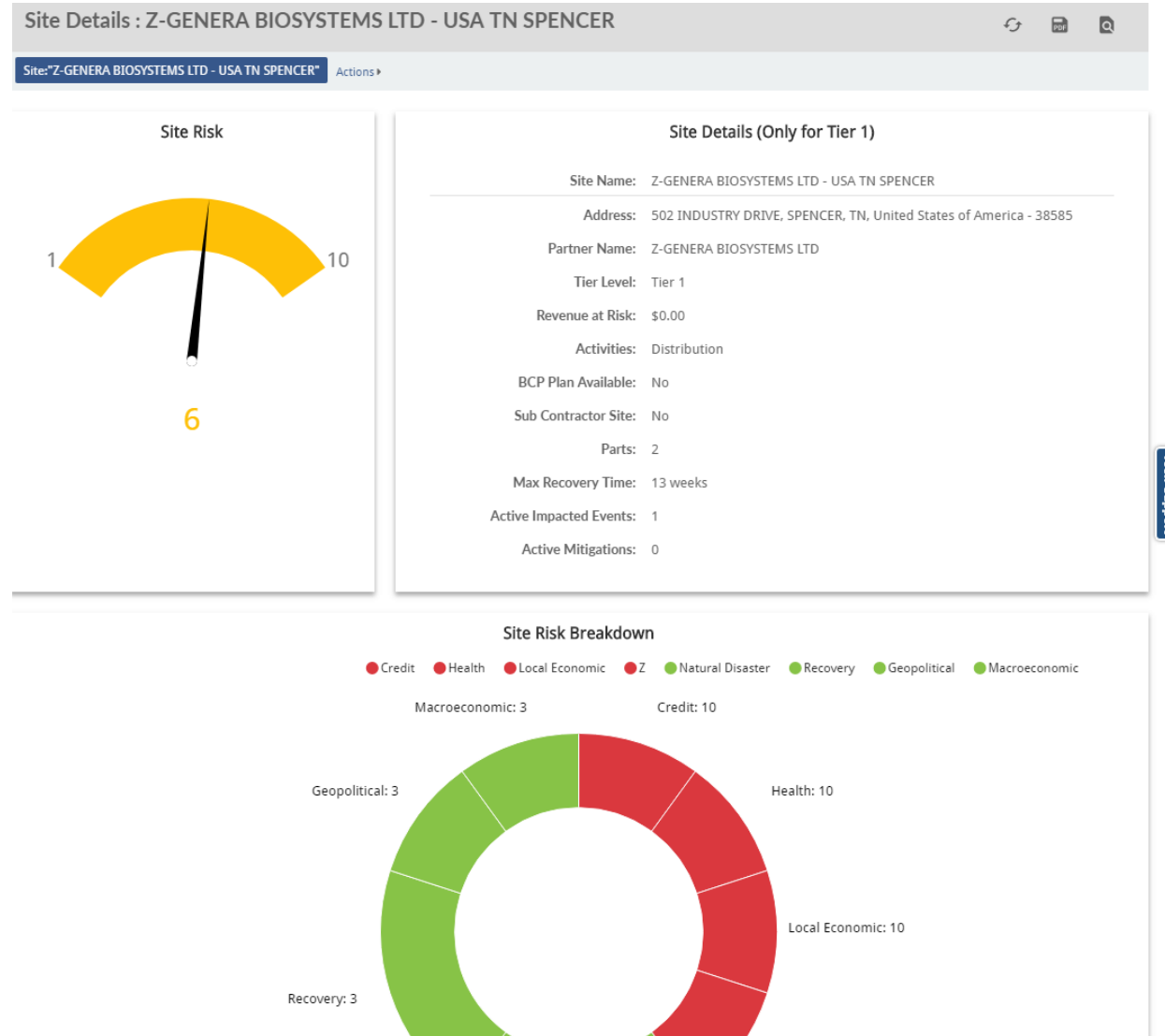
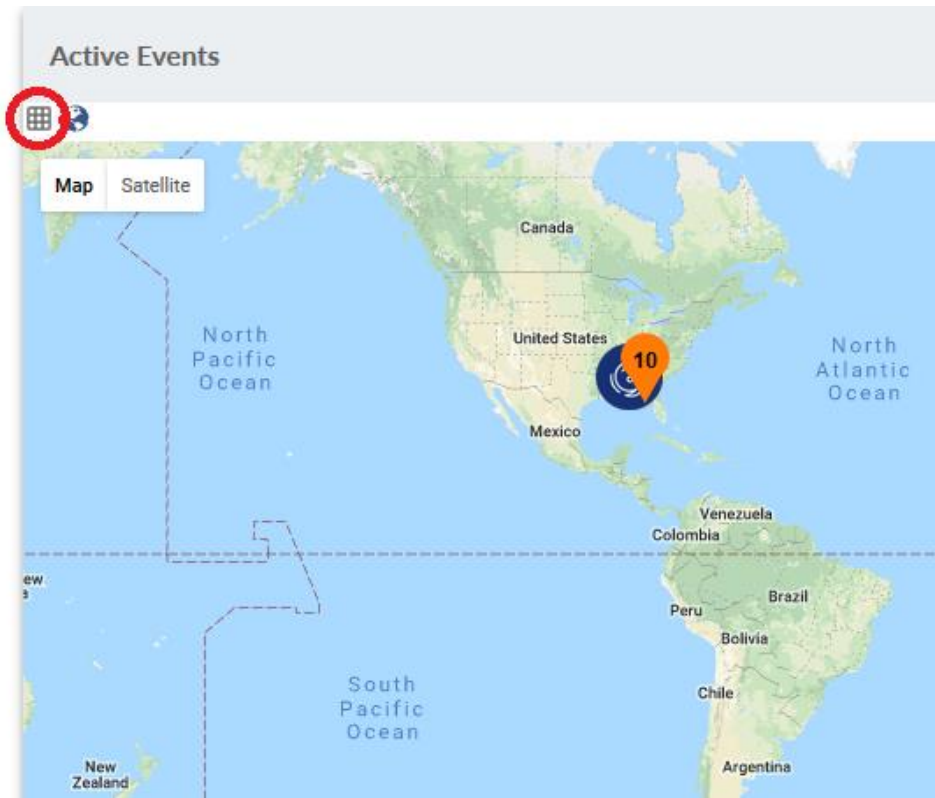
Robust visualization and analytic functionality, pro-active workflow planning, personalized impact analysis and incident response automation

Patented Risk Quantification

Proprietary R Score algorithm is a comprehensive assessment of company’s supply chain resiliency; evaluates, ranks and benchmarks against industry peers

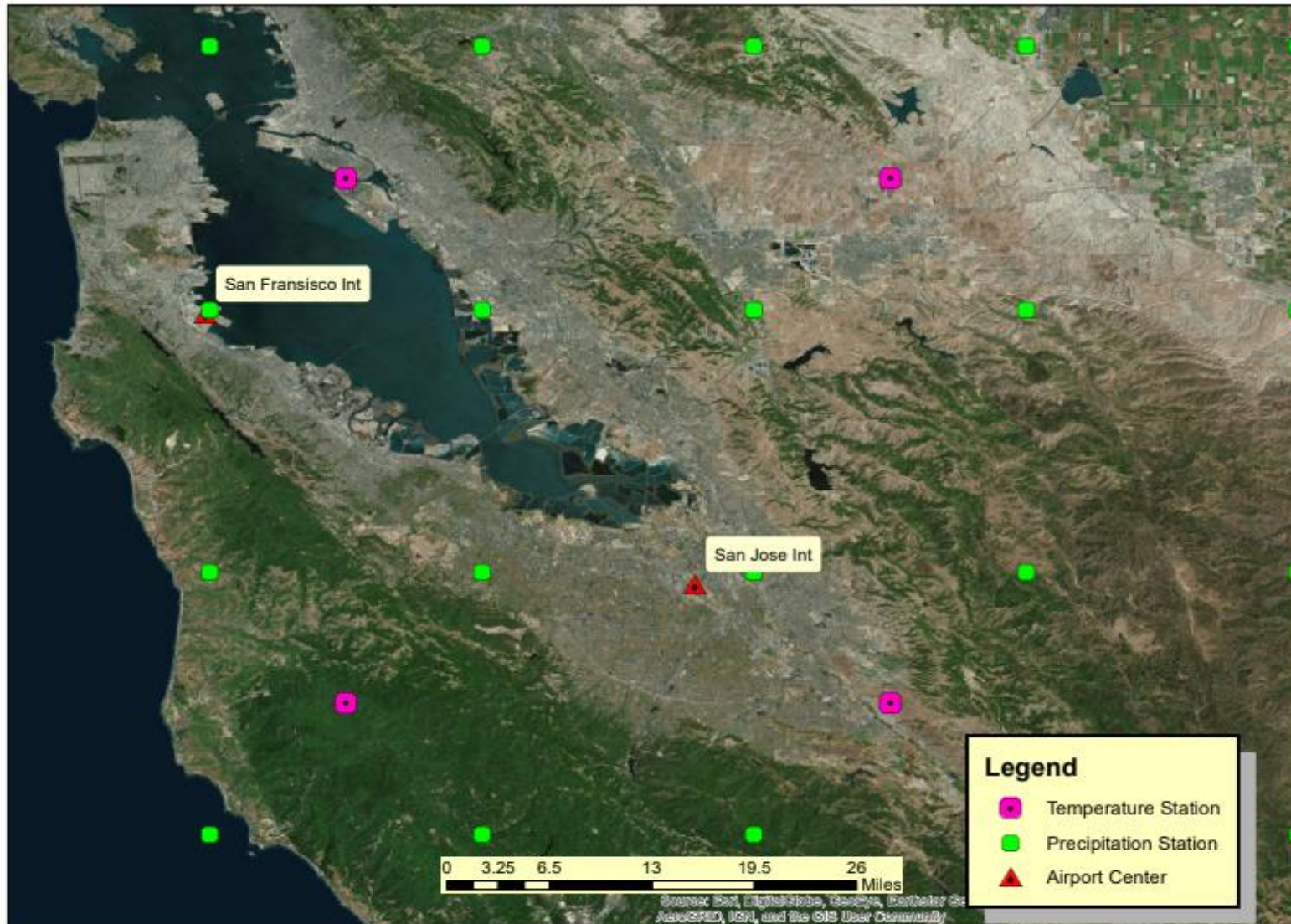


Examples Of Resilinc Data



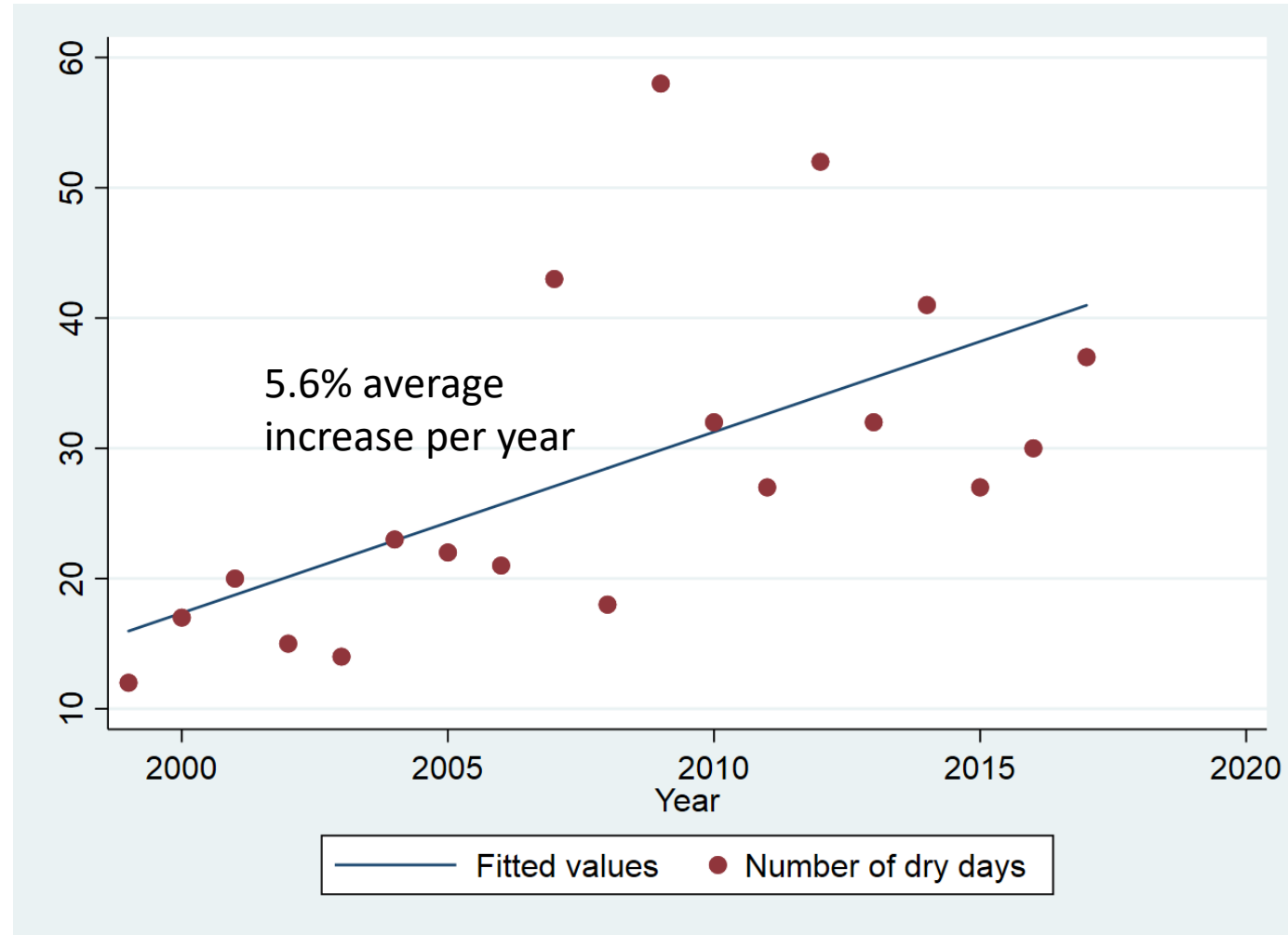
Tech Support

The Climate Sensor Network

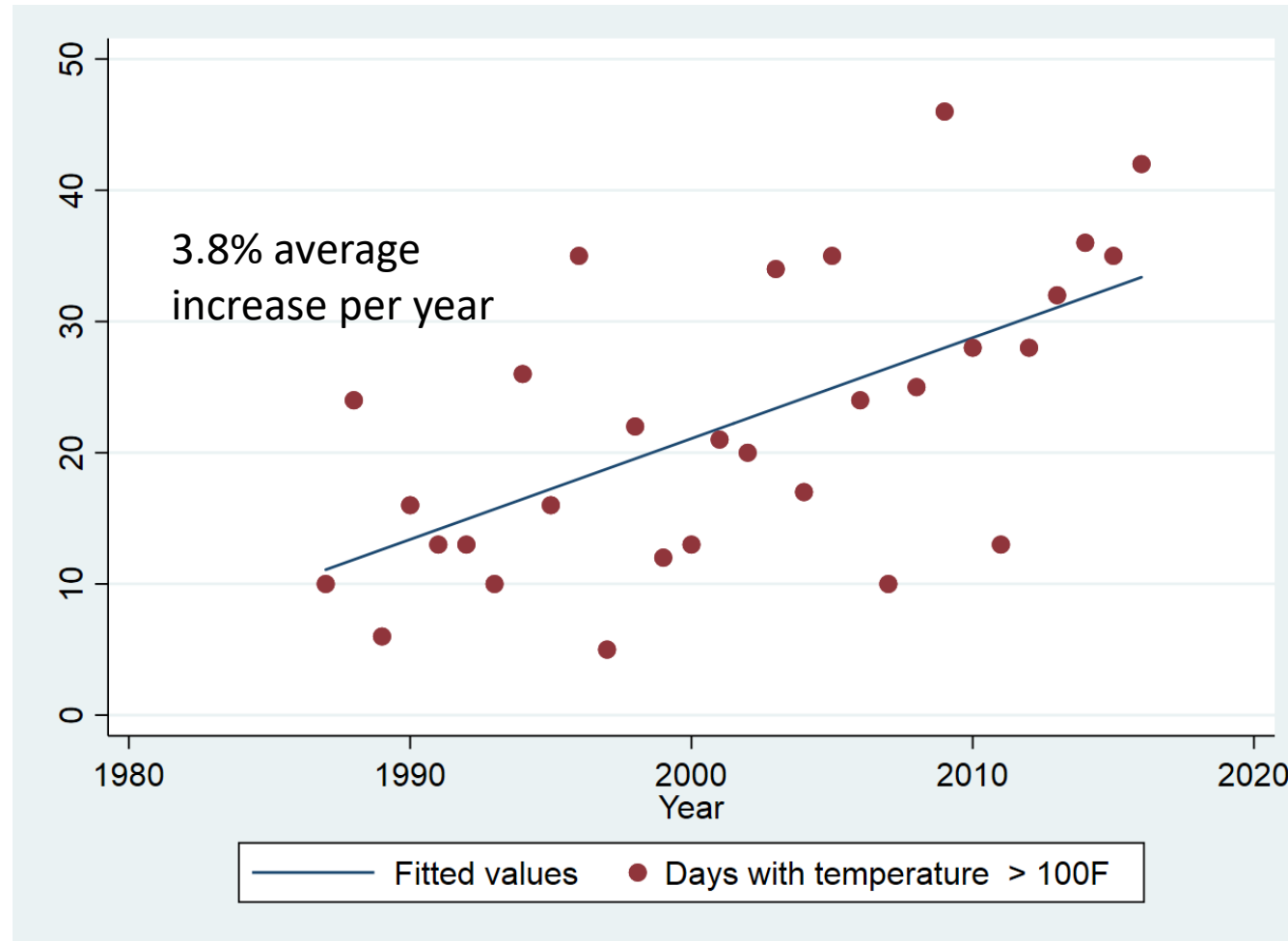


- Temperature data
 - 0.5° resolution
 - 1979 – 2018
 - Daily minimum and maximum temperature
 - Use to calculate heatwave attributes
- Precipitation data
 - 0.25° resolution
 - 1999-2018
 - Daily total rainfall
 - Use to calculate extreme precipitation events and extended dry spells

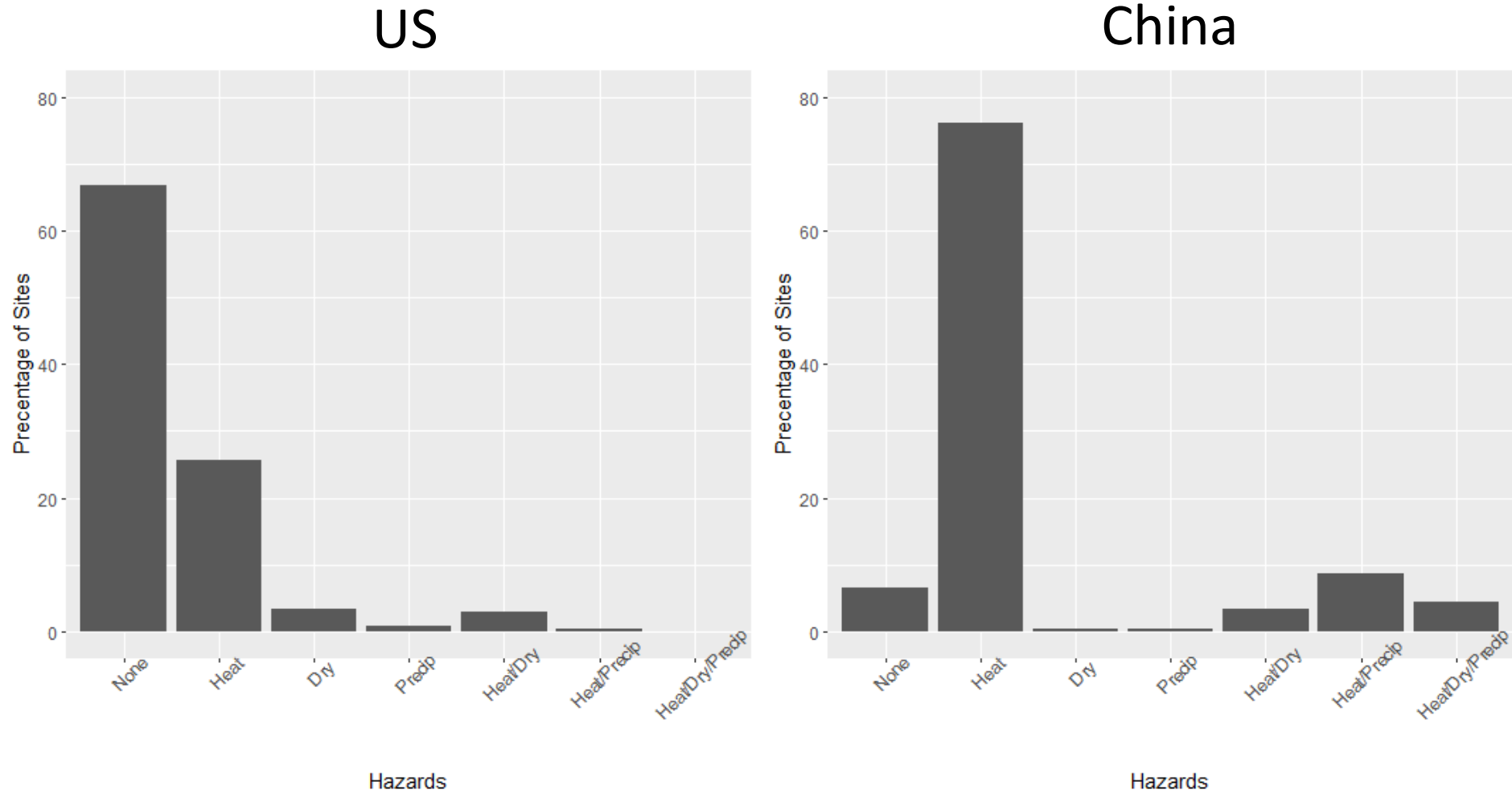
Site A: Change in climate variability – Number of Dry Days



Site B: Change in climate variability – Days with temp > 100F

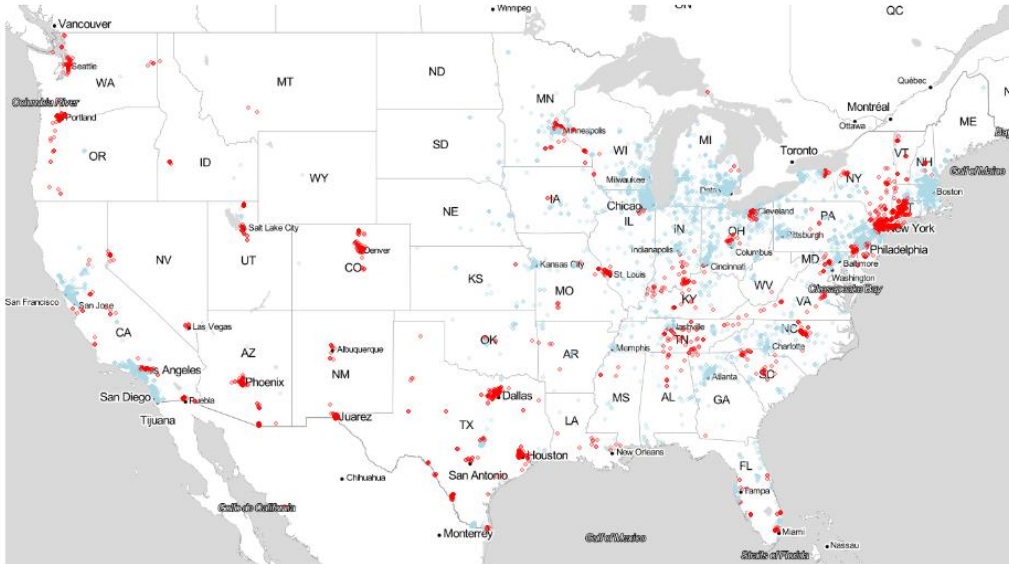


Distribution of Hazard Types



Distribution of Hazard Types

Heat wave



Dryness



Extreme precipitation



Distribution of Hazard Types

Heatwave and Dryness



Heatwave and Extreme Precipitation

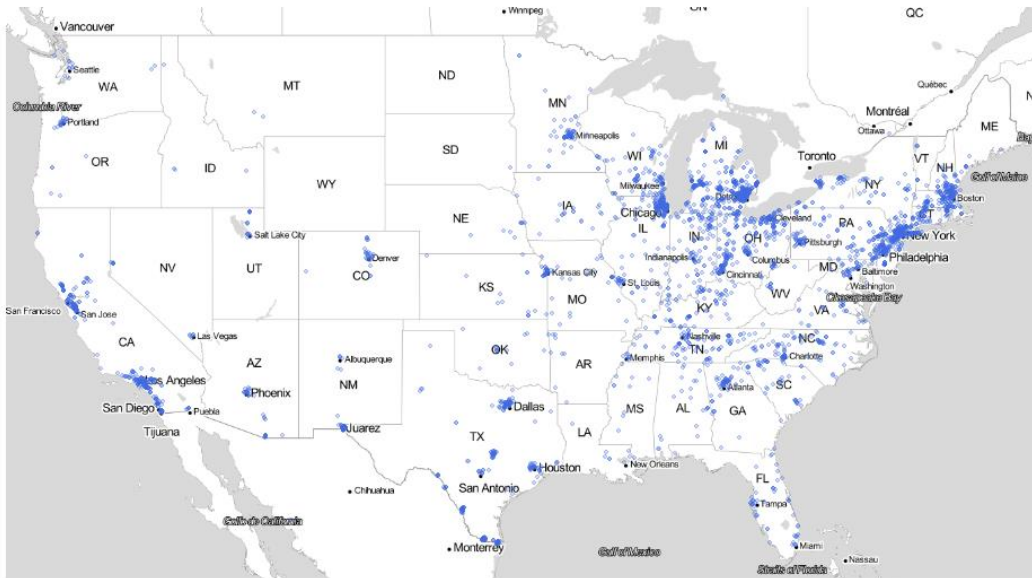


Heatwave, Dryness, and Extreme Precipitation

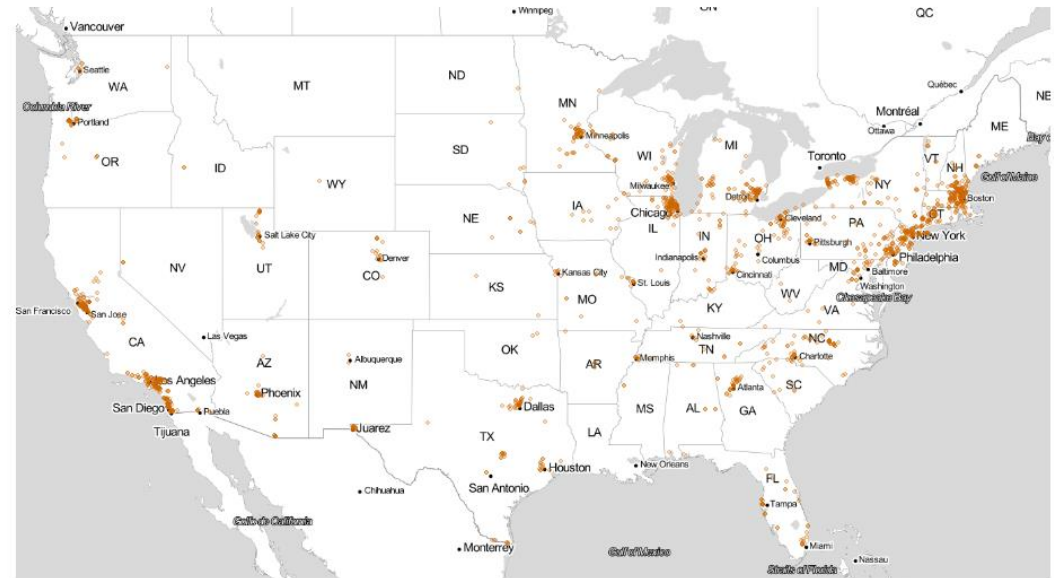


US Sites by Revenue at Risk

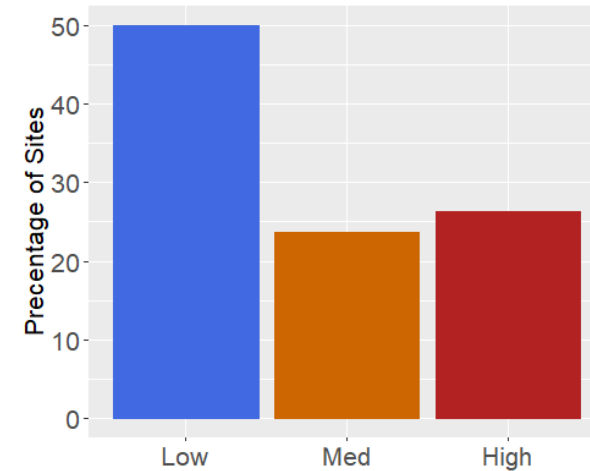
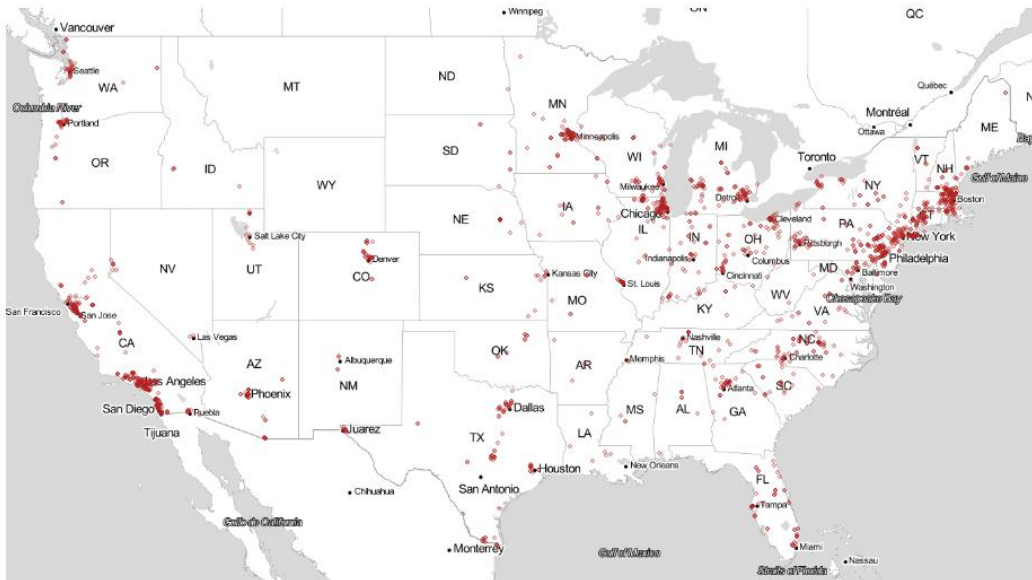
Low



Medium



High



China Sites by Revenue at Risk

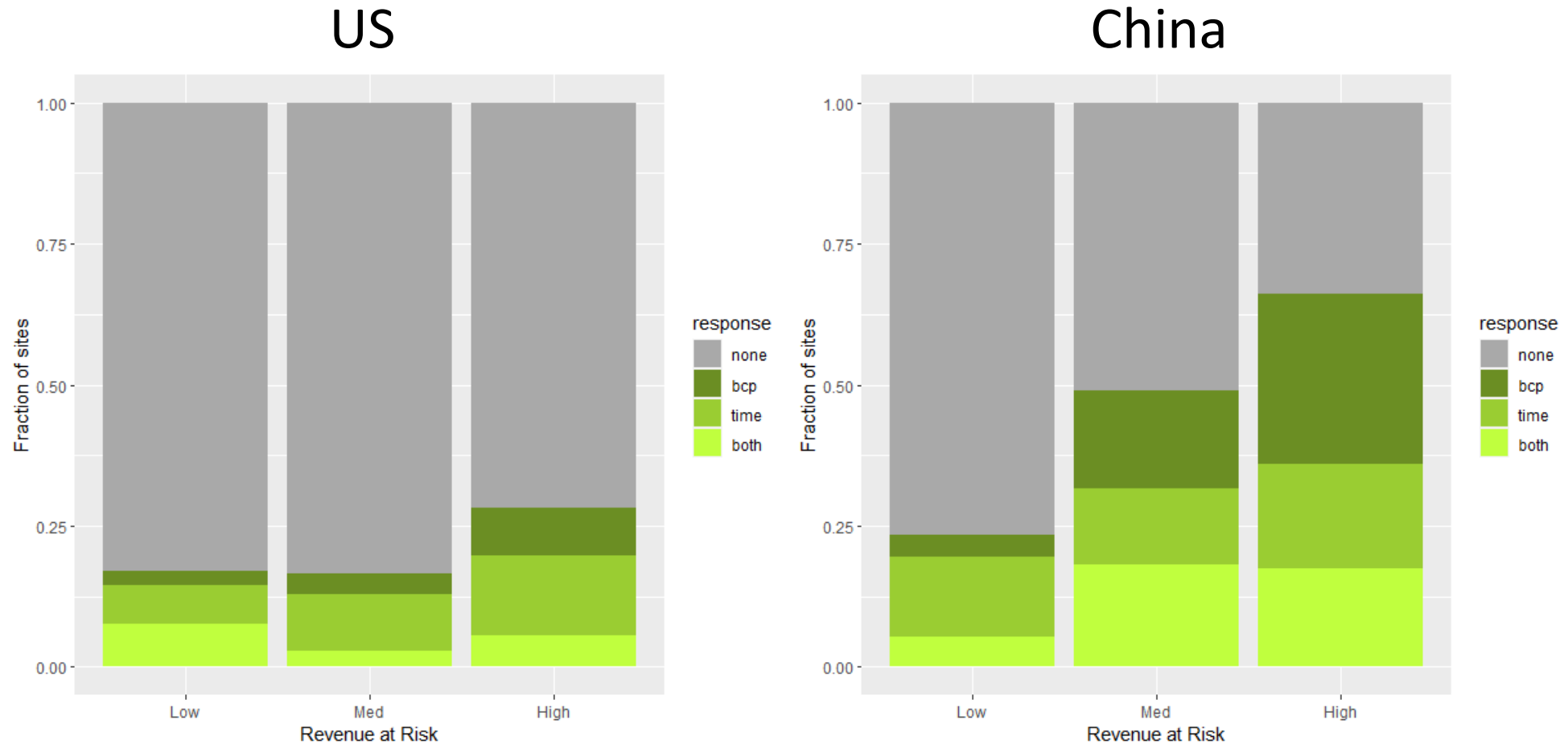
Low

Medium

High



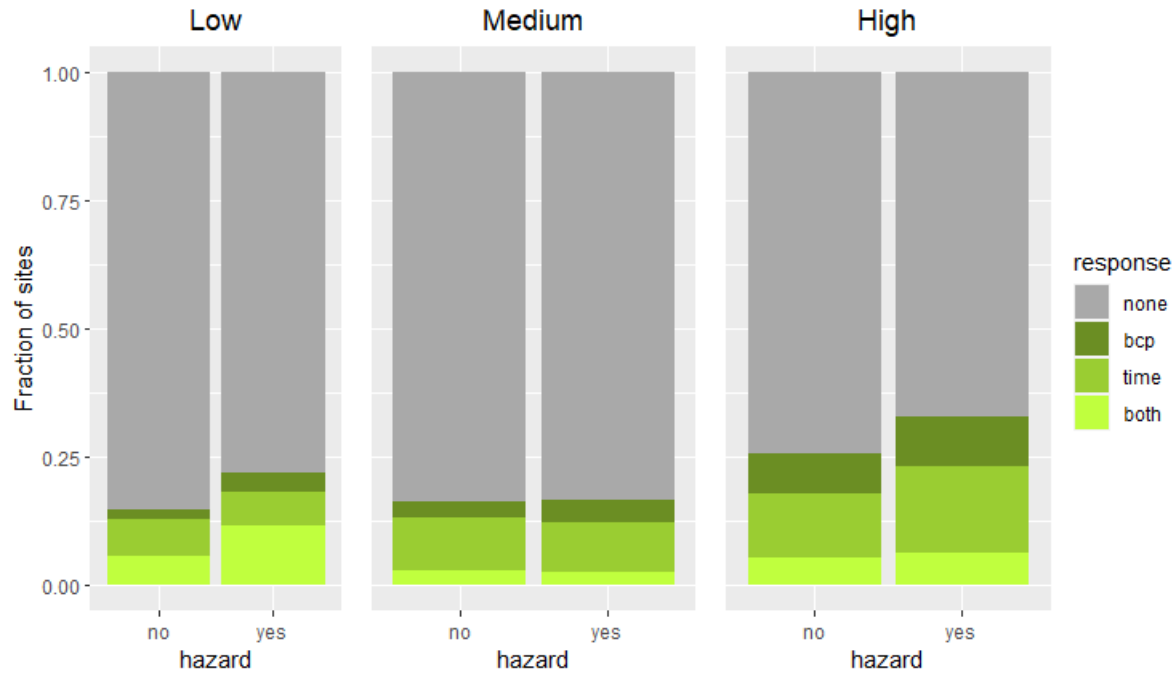
Revenue at Risk and Response Capacity



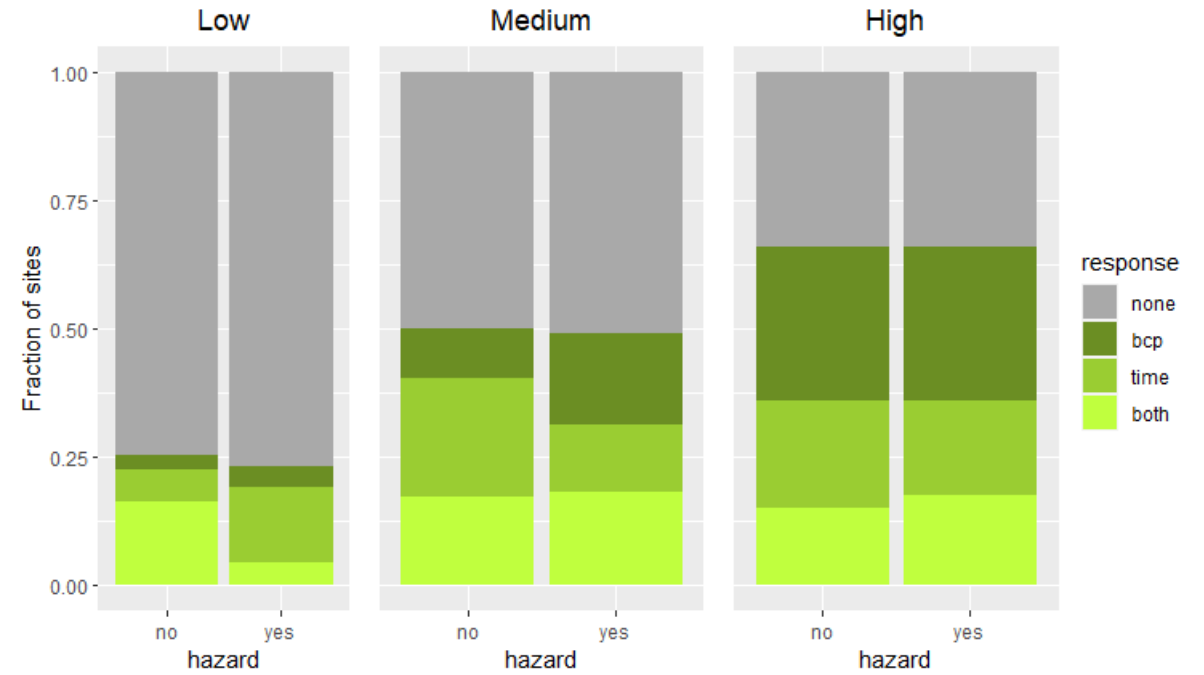
General increasing relationship between revenue at risk at response capacity with greater capacity in China

Revenue at Risk, Response Capacity, and Hazard

US



China



Response to climate extremes in U.S. but not China

Business Conclusions: Traditional Disaster vs. Climate Change Management

Episodic, time-limited event, narrow response planning scope	Continuous, ongoing, short & long term time horizons and planning scopes Extreme temperature/precipitation events can often result in sudden large scale and disruptive threats to operations
Pre-position post-disaster assets & inventories e.g. generators, water, food supplies, then “wait it out” until production can resume.	Systemic breakdown can affect the entire economy (e.g. Hurricane Maria hitting Puerto Rico) and destroy all platforms for communications/ transactions, literally “stranding” businesses and obliterating supply chains.
Develop and rehearse event-specific risk response playbooks to adapt to disaster risks	Businesses need to first deeply understand their own supply chain network vulnerabilities; identify critical hubs of operations at urgent risk from climate change; and invest to fortify those hubs to maintain overall supply chain agility and adaptation
Repair/patch affected infrastructure	Re-think infrastructure for priority sites: strengthen site-selection criteria based on climate risk; re-evaluate multi-year site access to water, energy and coms; and build out site-specific long term alliances with emergency responders, fire departments and transport/coms authorities.
Set up sources of supply with an emphasis on availability/cost	Re-think supply management/sourcing strategies based on our Index’s climate risk/business vulnerability scores for supplier sites; emphasize risk hedging/identifying less climatically risky sites as required to assure production capacity.
Manage suppliers based on perfect order quality, on-time delivery, etc.	Execute “Climate Risk-Sharing Agreements” with suppliers: based on risk-scores, suppliers would agree to establish site-specific climate risk management measures and preparedness activities.

Our Index's Asset Management Benefits

Enhance Network Resiliency: supply chain climate risk dashboard for taking effective, data-driven mitigation actions.

Facilitate Production Switching: see differential effects of climate related risk across locations of a network and move to a more anticipatory, pro-active posture toward location shifting.

Gain Insights On Hyper-Localized Advantages: make more realistic appraisals of climate-change factors in site design and resiliency engineering (e.g. P&G, the first manufacturer to restore operations after Hurricane Katrina, had used satellite imagery to carefully select and build upon on one of the few elevated industrial lots in New Orleans).

Better Scope Out Climate Change Related Cost Factors that impact specific locations, affect corporate revenue strategy success and impact Return On Investment.

Develop Strategies To Better Risk-Proof Locations that are considered priority, high revenue at risk locations that are increasingly challenged by severe climate change risks

Future Work

Go Global

Scale our Climate Vulnerability Index using an expanded Resilinc data set with global coverage; and measure a broader set of climate variables per site.

Use Advanced Data Analytics

Use AI & data mining techniques to analyze massive amounts of unstructured Resilinc event & other data; and expose hidden connections between climate events and other categories of risk events on a global scale e.g. define climate change consequence/impact chains.

Harvest Insights

Generate richer geo-spatial insights into strategic & operational risks; and into effective evidence-based Courses Of Action (COAs) to mitigate risks, meeting the needs of investors and corporate decisionmakers for earlier and more precise intelligence.



Thank you for your attention!
Questions? (mgerst@umd.edu or sboyson@umd.edu)

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