

# Intelligent Climate Adaptation and Resilient Engineering for Urban Sustainability (*I-CARE-4-US*)

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**Sustainability and Data Sciences Laboratory**

The SDS Lab develops mathematical, computational, and decision science methods to discover insights in hydrological, weather, and climate sciences, produce policy-relevant engineering principles in infrastructural and water systems, and generate solutions for managing global change and emerging threats, with examples ranging from engineering coastal cities for climate change to reducing the fragility of networked infrastructures under compound extremes.

**N** Northeastern  
Civil and Environmental  
Engineering

# Weather and hydrologic extremes severely stress coupled natural-human-built systems

Heat waves



Surge in agriculture water demand



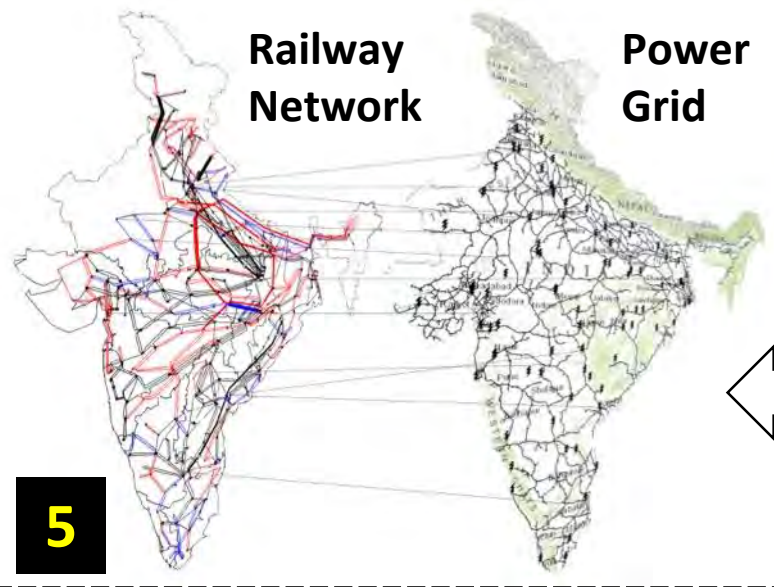
Increased stress on power-grid



Bhatia, U., and A.R. Ganguly (2017). Unpublished.



Delayed monsoons

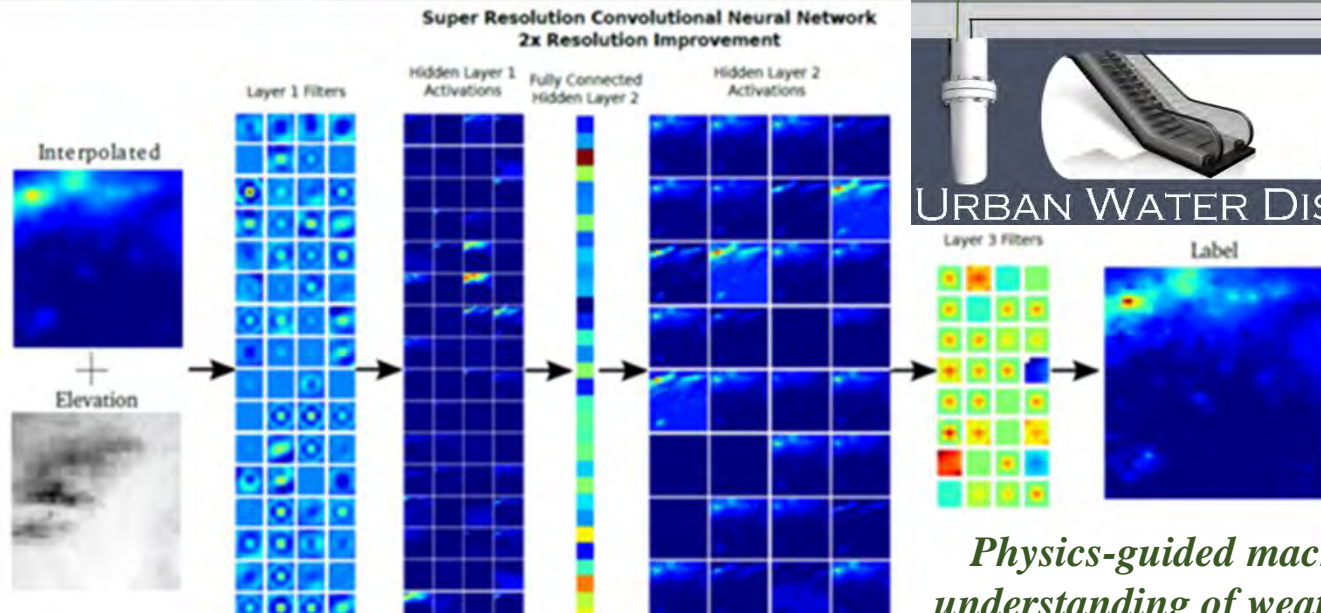
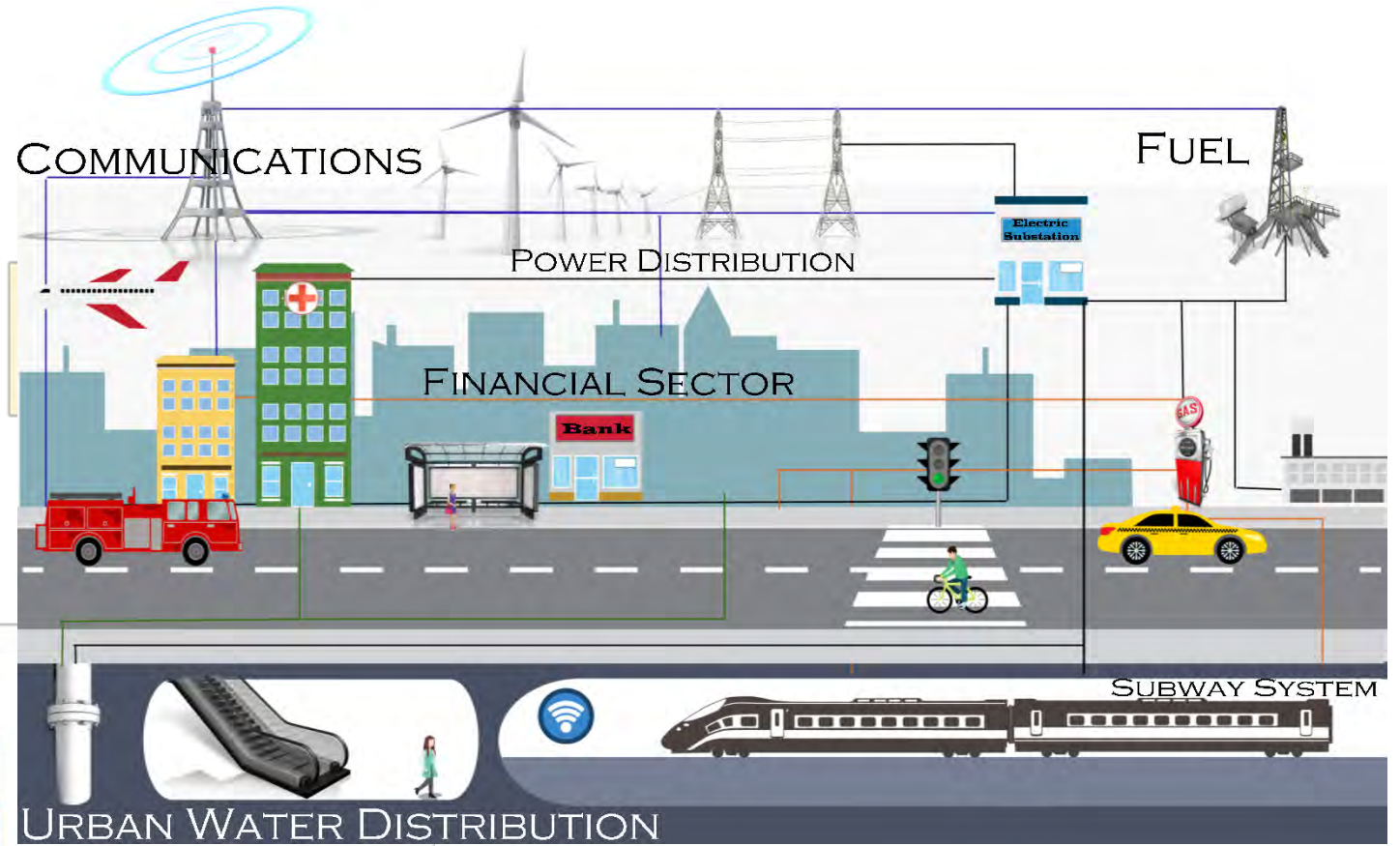


Impacts on Indian Railways



2012 India Blackouts

# From machine learning for weather extremes to network science for critical urban lifelines

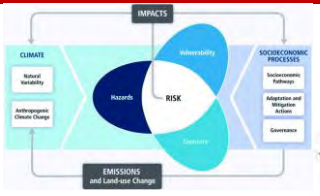


*Network science and engineering principles lead to novel insights and decision parameters for resilience of lifelines*

**Domain-Aware Machine Intelligence**

*Physics-guided machine learning advances predictive understanding of weather extremes under climate change*

# Public health (IPCC-inspired) risk framework for urban heat islands in Brookline MA



## Risk Framework for Urban Heatwaves

**Global Warming**  
Natural Variability  
Anthropogenic Changes

**Urban Heat Islands**

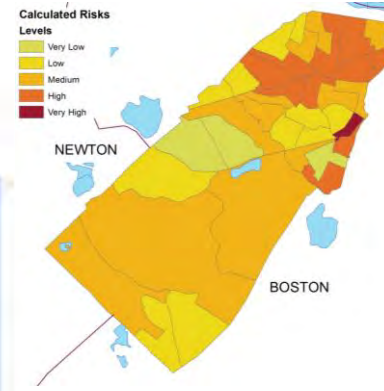
**Urban Heatwaves**

**Public Health Risk**

**Exposure**

Exposed Population  
Public Health Infrastructures

**Vulnerability**  
Demographic:  
Age, Mobility, Income...  
Infrastructure:  
Medical, Transport,  
Cooling Centers...



**Development**

**Emergency & Medical Services**

**Adaptation**  
Cooling Centers  
Improved Emergency Access  
Early Warning System  
Health Monitoring  
Resilient Design...

*AGU Virtual Poster First Prize*

Fard, B., Hassanzadeh, H., Warner, M.E., Bhatia, U., Ganguly, A.R., 2016. *Mitigation and adaptation strategies for public health impacts of heatwaves for town of Brookline, MA*. AGU Thriving Earth Exchange.

**Urban Mitigation**  
City Planning, Vegetative Open Space, Green Roofs, Pollution Control...

**Reduction of Greenhouse Gases**  
Renewable Energy Investments (e.g. Rooftop Solar Panels, Wind Turbines, ...), Transporting Planning, Whiteroofing...



# Urban risk modeling in Savannah GA and resilience of critical lifelines in New York NY

Figure 1. Blended hazard and value-at-risk map of Savannah, GA, USA

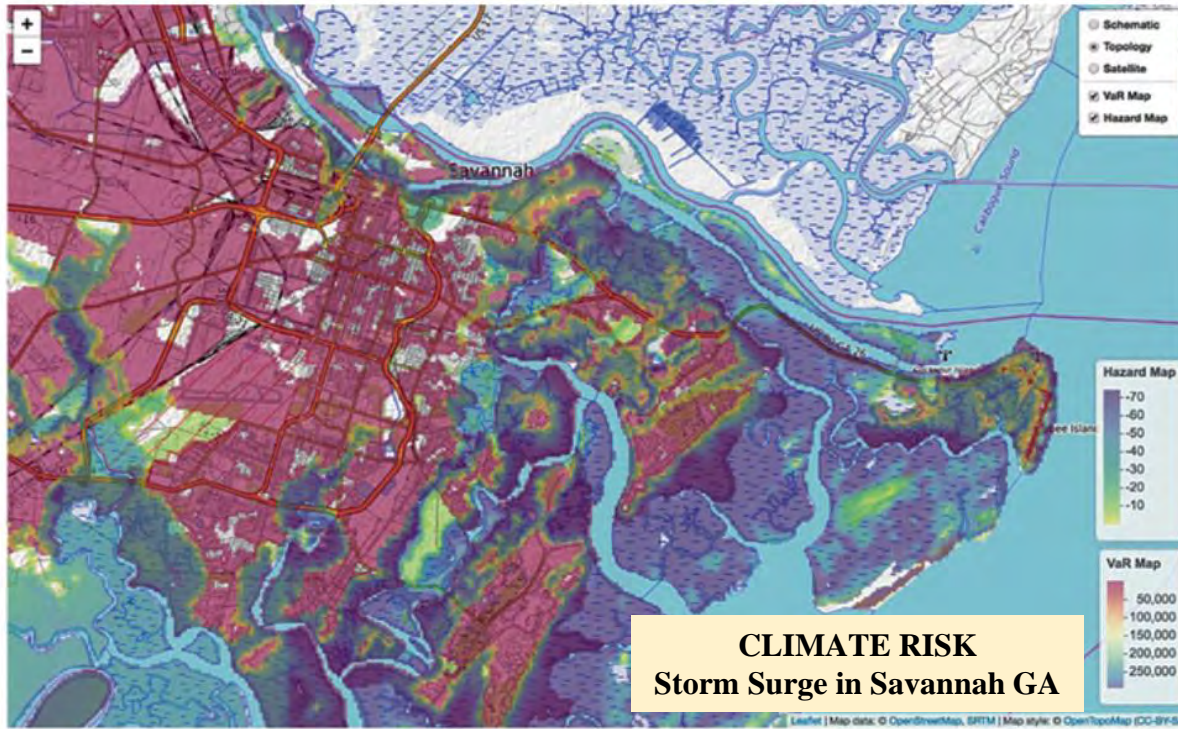


Figure 2. Recovery model for the New York City metro after Hurricane Sandy

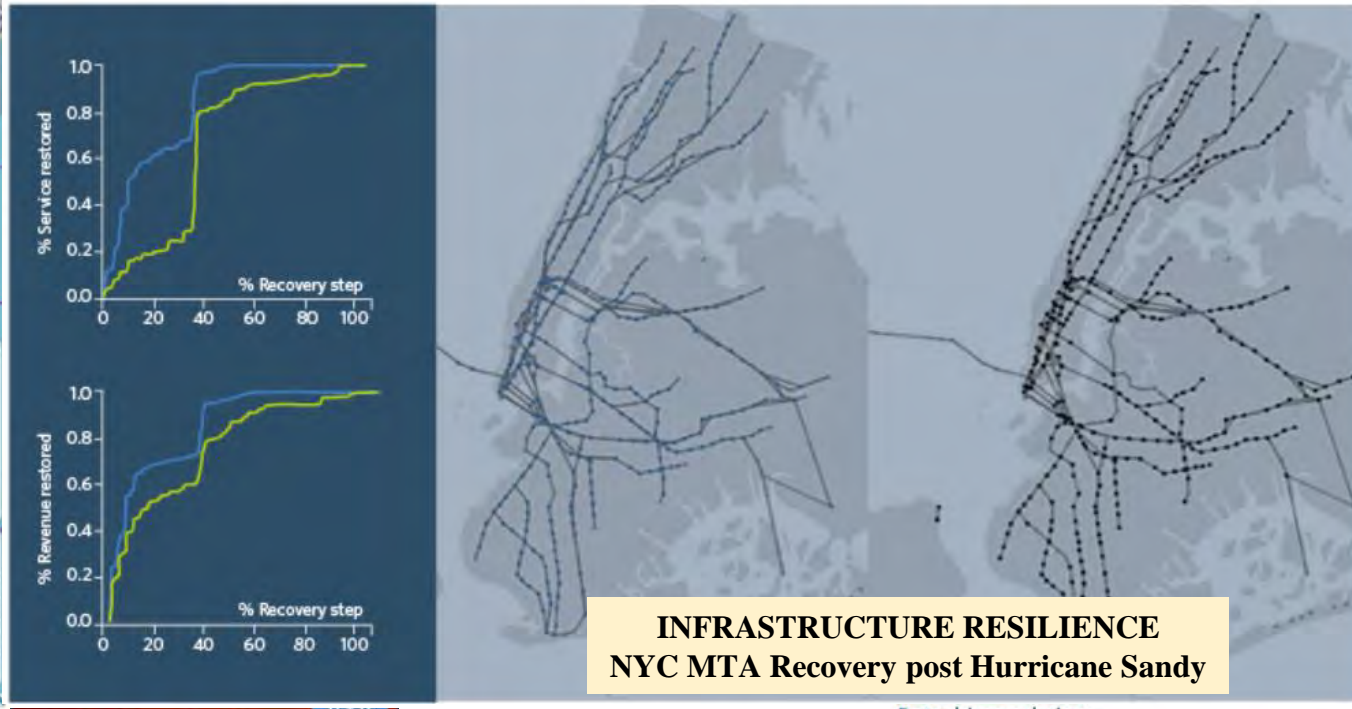
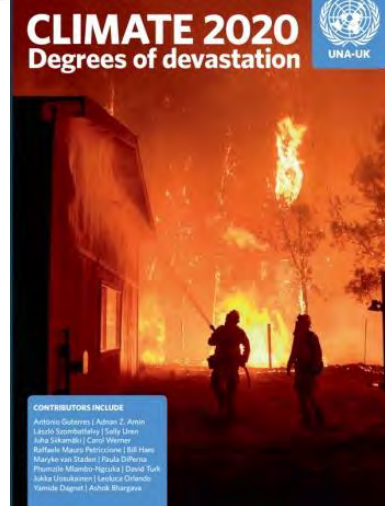


Figure 3. Breaking the maladaptation cycle



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