Managing the Risk of Catastrophes: Protecting Critical Infrastructure in Urban Areas

Session 4: Risks to NYC and Mitigation Strategies

3:30-4:30 PM: K. Jacob, C. Rosenzweig, S. Pinsky.

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Key Points Upfront (taken from my pre-Sandy Talk to NYC DDC):

Climate Change will

• Increase number of hot days + strong wind storms

• Increase excessive rains (more street flooding, CSOs)

• Accelerate sea level rise (SLR) to reach $\approx 5 \pm 1$ ft by 2100, + more later!

• Will Combine SLR with
  a) Nor’easter winter storms, and
  b) Hurricanes (tropical cyclones) to more often & more severely flood the Region’s Waterfront & Infrastructure, thereby increasing by 2100 the annualized risks by at least factors of 10, unless mitigated.
Key Points Upfront (taken from my pre-Sandy Talk to NYC DDC):

**Recommendations:**

- City, State & FEMA need to update Flood Zone Maps (and add freeboard for SLR, & apply to infrastructure)
- City needs to change Building Codes & Zoning
- City Planning needs to become more SLR proactive
- FEMA NFIP rates => risk consistent (NY can help)
- City & Communities need to develop a long-term SLR-Vision (to 2100 and beyond !!)
- **Mandatory** CC Risk Disclosure for Infrastructure Bonds (=> S.E.C. CC Securities Disclosure Guidance of Feb 8, 2010)
What Kinds of Perils / Risks is NYC Exposed to?

- Economic Downturns
- Vulnerable / Aged Infrastructure
  - Water
  - Energy
  - Transport
  - Waste
  - Telecom
- Health / Environment / Industrial Accidents
- Terrorism

- Earthquakes / Tsunamis
- Climate and Weather
  - Temperature / Heatwaves / Droughts
  - Wind (Gusts, Tornadoes)
  - Rain (Urban Street Flooding, CSOs)
  - Storms (Hurricanes, Nor’easter, Coastal Floods)
- Sea Level Rise, Coastal Inundation

IP NPP
MTA Storm Preparations, Downtown Subway Grates / 144th St Subw. Tunnel / Penn Station LIRR yard
Many Excellent Studies & Reports, but Limited Action & Adaptation $$’s Invested as of today, although some in the pipeline.
100-y flood in 2000 (surge of ~ 8ft).

100-y flood in 2040s, with +2ft SLR

100-y flood in 2080s, with +4ft SLR

ClimAID Study: Chapter 8 – Transportation.
(Jacob et al. December 2011)
Hydraulic Computations show: Flooding Complete in ~ 40 minutes!

ClimAID Study: Chapter 8 – Transportation. (Jacob et al. December 2011)
What is the expected **direct damage** from the 100yr flood to the transportation infrastructure?

~ $10 Billion

How long will it take for the various components of infrastructure to have their **services restored**?

~ 3 weeks (at ~ $4B/day =>)

What will be **potential economic losses** from the transportation / utility outages and extended restoration times?

~ $50B (+ Losses to Building Stock)
NPCC >ClimAID 2011:

Identify Options for Solutions:

Example: Subway System:

1. In flood zones, **seal ventilation street grates**, replace passive ‘open’ ventilation with forced ‘closed’ ventilation. Requires **additional ventilation fan plants**, and $$$$.

2. **Flood gates at vulnerable entrances; or berms / levees:** “Taipei-Solution” - Go up before you step down!

3. Costs? **Engineering designs getting gradually underway,**
   Our Estimate: at least 25% of the expected avoided losses:
   i.e. **in excess of $12 Billion.**

Or: Build **barriers** to protect the entire NY Harbor and Estuary.

**But is this an effective and sustainable solution?**
3 Barriers; or 1 big & 1 regular. Is this cost-beneficial & sustainable?

London’s Thames Barriers
3 Basic Modes of Adaptation:

• Protection
• Accommodation
• Strategic Retreat
Missed Opportunities: Example - WTC - Site:

Questions
(Presented to PANYNJ in 2007):

Can the West-Tub Flood?
Can the East Tub Flood?
For which Storm Surge Elevations?

How will Flooding affect PATH System?
  • Hudson Tunnels
  • Stations / Tracks / Control Systems
    • New Transportation Hub?
      • For how Long?

Will Flooding of NYCT Subway System(s) Affect / Connect with PATH & WTC facilities?

If Answers to Above are YES:

What Sealing-Off Options Exist?

What Pumping Facilities are Planned? Where? Capacity? Reliability?

Is a Levee System || to West Street Feasible? Up to what Height? How long would it be effective, given SLR.
A STRONGER, MORE RESILIENT NEW YORK
Conclusions / Suggestions for the Region (1 of 2):

1. **Make time-dependent risk-based Benefit/Cost Assessments** using updated Probabilistic Flood Maps by accounting for changing Physical Asset- and Social Vulnerabilities as a Function of SLR (i.e. for various time horizons according to expected asset life times).

1. Develop Regional SLR Adaptation Policy/Strategy and **Regional SLR Plans** that balance the merits from Temporary Protection, with Medium-Term Accommodation to rising waters, with Long-Term Sustainable Managed Retreat to safe spaces – by combining Risk-Based Landuse and Urban Design, Insurance Pricing, Rezoning, Code Improvements, Financial and Tax Incentives, Buy-Out Trust Funds, with Market-Driven Risk Averseness while taxing SLR-risk-prone Developments.
Conclusions / Suggestions for the Region (2 of 2):

3. Incorporate the CC information & **Probabilistic Risk Estimates for Various Time Horizons** into all strategic planning and capital-spending decisions.

3. Use each CC + SLR **Challenge as Opportunity** for Infrastructure and Urban Renewal. The costs for the next few decades will be upward of $100 Billion. But not investing in resilience measures will be more expensive.

3. Ensure robust interim **Operational Emergency and Business Continuity Plans** until assets can be engineered to be CC & SLR resilient to minimize impact and losses, and allow for expedient recovery.
Timing makes a Difference.

Oh, No! Was that Today?

Thank You!