Federal Reserve Bank of New York

33 Liberty Street, 10th Floor, Benjamin Strong Room

Friday November 1, 2013

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 **≈5±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)

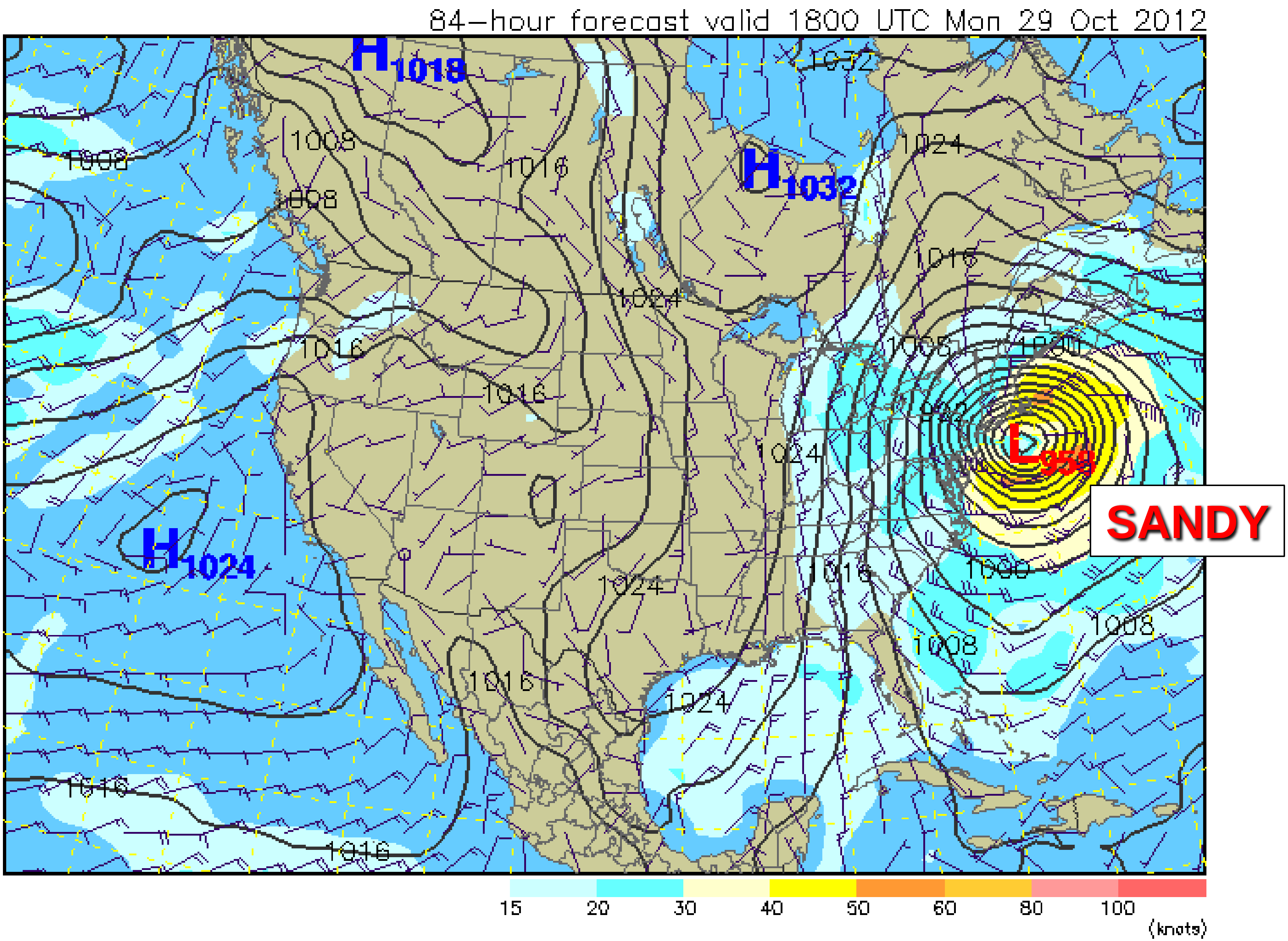
What Kinds of Perils / Risks is NYC Exposed to?

- 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

Sea-level pressure (mb) / surface wind speed (kts)

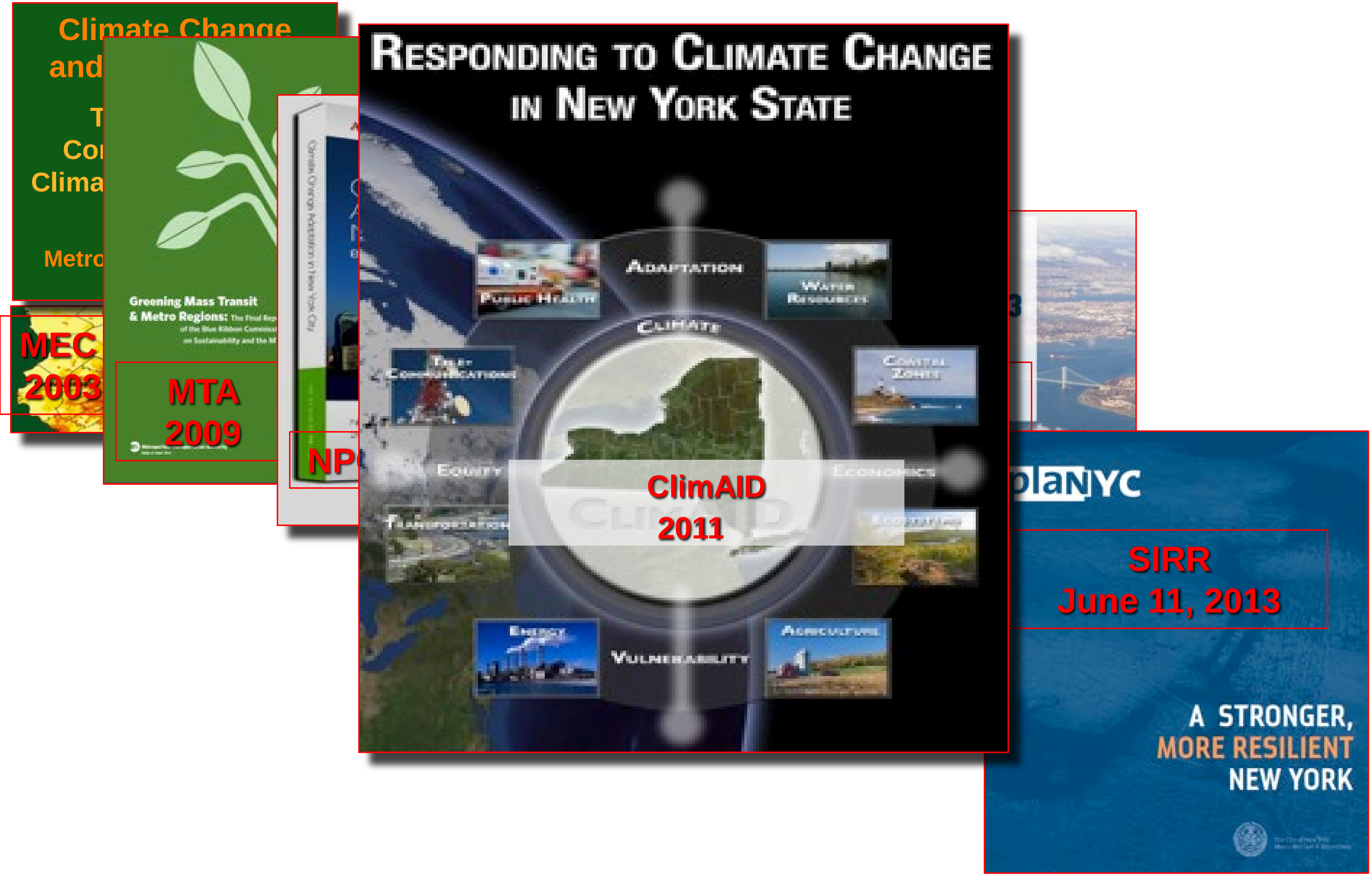



MTA Storm Preparations, Downtown Subway Grates / 144th St Subw. Tunnel / Penn Station LIRR yard



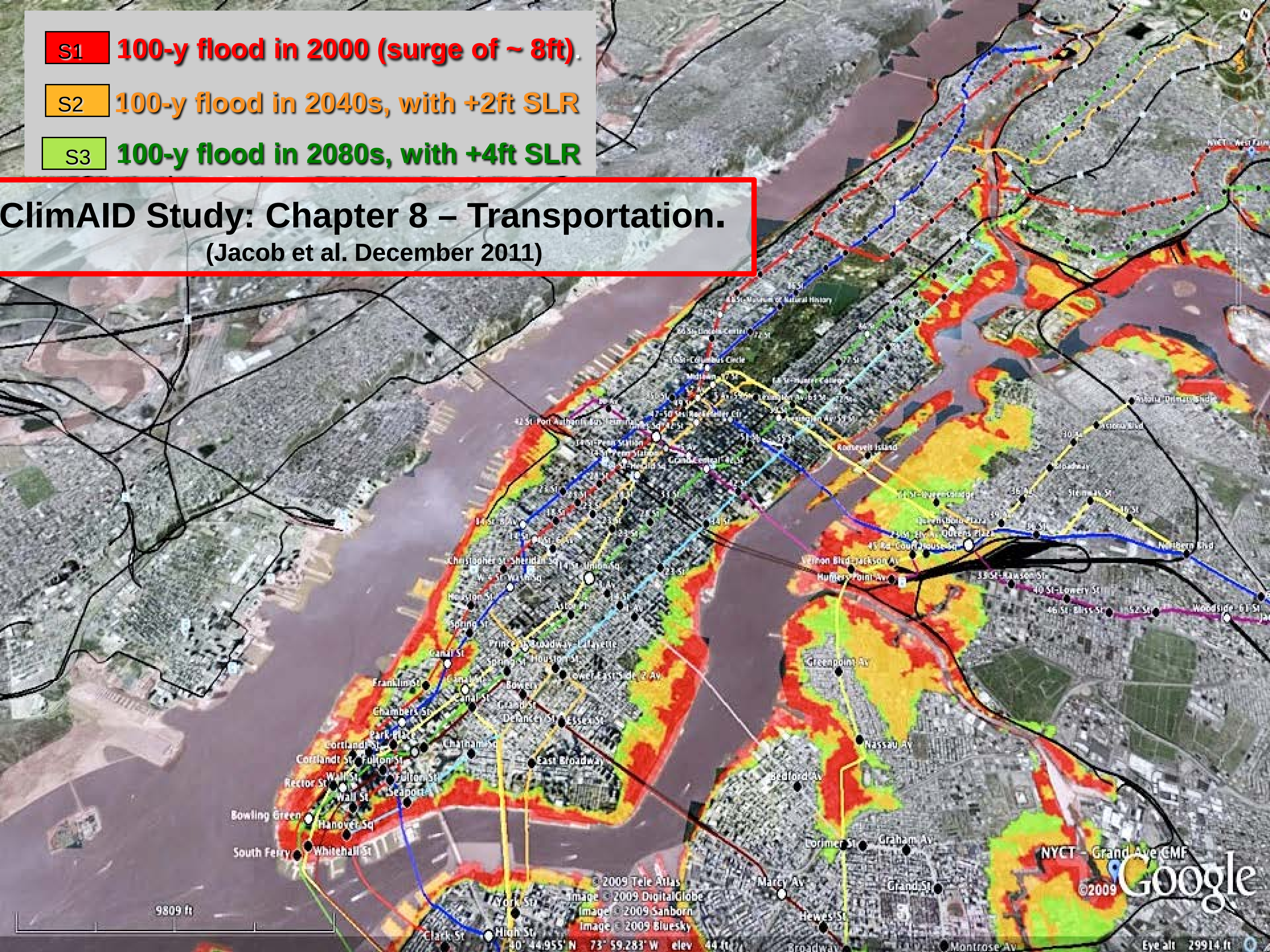
The City and the Storm
Starting on p.17

Many Excellent Studies & Reports, but Limited Action & Adaptation $$'s Invested as of today, although some in the pipeline.

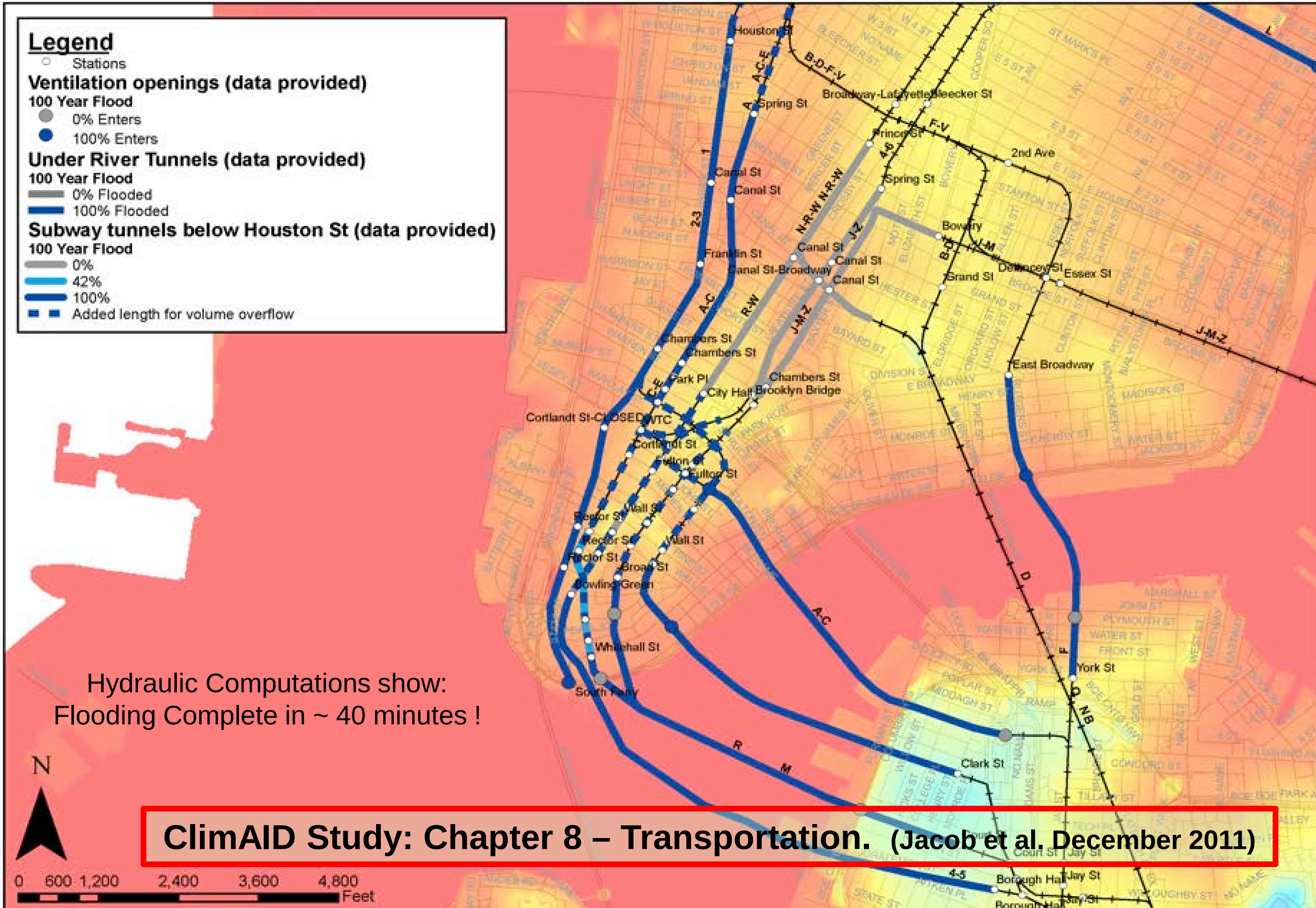


ClimAID Study: Chapter 8 – Transportation.

(Jacob et al. December 2011)



Flooded Subway and Under-River Tunnels, Lower Manhattan, 1% Flood (length overflow)



Hydraulic Computations show:
Flooding Complete in ~ 40 minutes !

ClimAID Study: Chapter 8 – Transportation. **(Jacob et al. December 2011)**

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- **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 ~ $ 4 B/day =>)

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

~ $ 50 B (+ 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.

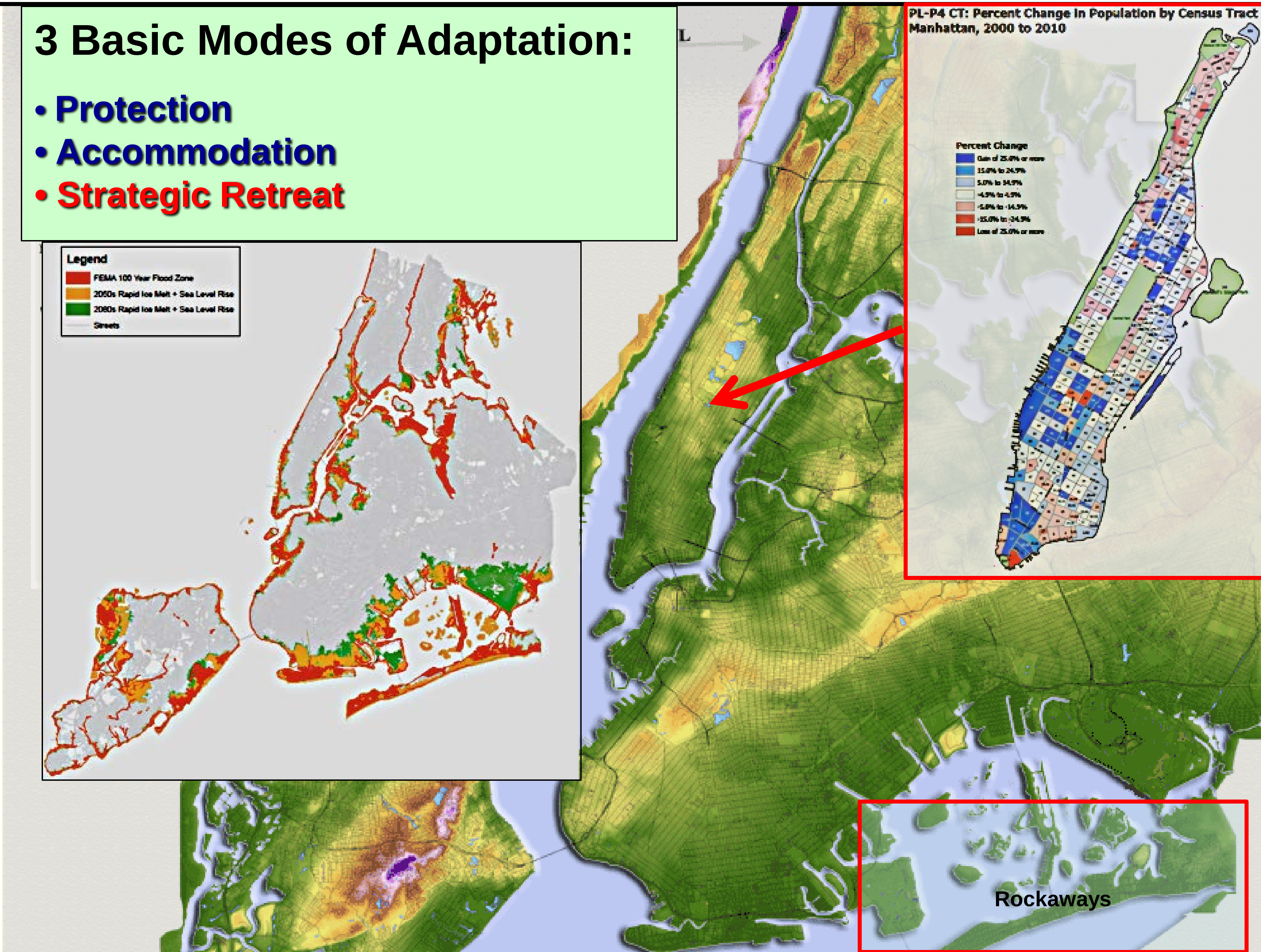
Or: Build **barriers** to protect the entire NY Harbor and Estuary.

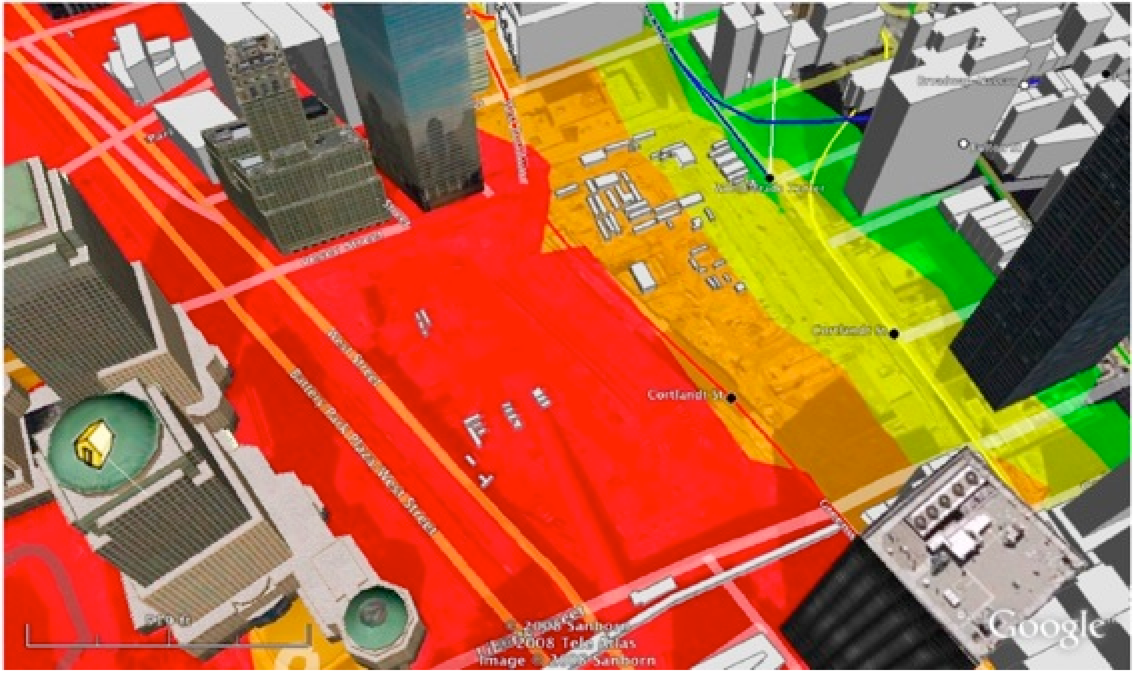
But is this an effective and sustainable solution ?

3 Barriers; or 1 big & 1 regular. Is this cost-beneficial & sustainable ?

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.


SIRR
June 11, 2013
A STRONGER,
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NEW YORK
The City of New York
Mayor Michael R. Bloomberg

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.