Climate Change, Sea-Level Rise, and the Future of the Brooklyn Waterfront

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Key Points:

**Climate change will**
- Increase in number of hot days + strong wind storms
- More excessive rains (more street flooding)
- Sea level rise (SLR) up to +5 ft by 2100, more later!
- SLR in combination with
  - a) Nor’ easter winter storms, and
  - b) Hurricanes (tropical cyclones) will more often & more severely flood Bklyn’s waterfront.

Recommendations:
- City & FEMA need Flood Zone Map update (or add freeboard, include infrastructure)
- City should update Building Code & Zoning
- City Planning needs to become more SLR proactive
- FEMA NFIP rates => risk consistent (NYC can help)
- Communities must develop long-term SLR VISION
So what has changed in the last decade?

Climate Change and a Global City
The Potential Consequences of Climate Variability and Change

Metro East Coast (MEC) July 2001

The Potential Consequences of Climate Variability and Change
So what has changed in the last decade?
So what has changed in the last decade?
## NPCC Climate Risk Information

### TABLE 1. Baseline Climate and Mean Annual Changes¹

<table>
<thead>
<tr>
<th></th>
<th>Baseline 1971-2000</th>
<th>2020s</th>
<th>2050s</th>
<th>2080s</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Air temperature</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Central range</td>
<td>55° F</td>
<td>+ 1.5 to 3.0° F</td>
<td>+ 3.0 to 5.0° F</td>
<td>+ 4.0 to 7.5° F</td>
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<tr>
<td><strong>Precipitation</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Central range</td>
<td>46.5 in³</td>
<td>+ 0 to 5 %</td>
<td>+ 0 to 10 %</td>
<td>+ 5 to 10 %</td>
</tr>
<tr>
<td><strong>Sea level rise</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Central range</td>
<td>NA</td>
<td>+ 2 to 5 in</td>
<td>+ 0.8 ft</td>
<td>1.5 ft</td>
</tr>
<tr>
<td><strong>Rapid ice-melt</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>scenario</td>
<td>NA</td>
<td>~ 5 to 10 in</td>
<td>~ 2 ft</td>
<td>4 ft</td>
</tr>
</tbody>
</table>

Source: Columbia University Center for Climate Systems Research
S1 100y flood for 2000 sea level (surge of ~ 8-10ft).
S2 100y flood in 2040s, with +2ft SLR
S3 100y flood in 2080s, with +4ft SLR
Flooded Subway and Under River Tunnels, Lower Manhattan, 1% Flood

Legend
- Stations
- Ventilation openings (data provided)
  - 100 Year Flood
    - 0% Enters
    - 100% Enters
- Under River Tunnels (data provided)
  - 100 Year Flood
    - 0% Flooded
    - 100% Flooded
- Subway tunnels below Houston St (data provided)
  - 100 Year Flood
    - 0%
    - 42%
    - 100%
    - Added length for volume overflow

[Map of flooded subway and under river tunnels in Lower Manhattan, highlighting various flood levels and tunnel conditions]
• What is the expected impact of SLR on the Brooklyn Waterfront in Redhook, Gowanus, and Sunset?

• What does the City need to do on its own, and in cooperation with FEMA?

• What can Communities/Neighborhoods do?
First get the information!

NPCC, .......
Structural “Solution”: 3 or 4 Barriers. **Probably Unsustainable**. Why?

London’s Thames Barriers
Contribution to SLR from Greenland Ice Sheet
As a function of average temperature increase
Don’t fall into the trap of: New Orleans, Aug 2005.
Response Options:

1) **Do Nothing:** => Losses will rise quickly

2) **Rely on Insurance and/or Federal Disaster Relief Aid**
   - Will not work in the long run

3) **Adaptation Measures/Options:**
   - **Early Warnings, Evacuation** (‘Only’ Saves Lives)
   - Emergency & Operational Preparedness.
   - **Avoid** Growth in Hazard Zones, **Retreat** from Low Coasts & Lands; Restore and Preserve **Wetland**, Softening shores: Create Vegetated Buffer Areas / Parks.
   - **Raising** & Hardening Structures; (Unsustainable Barriers).
   - **Increase** Capacity of Drainage / Storm Sewer / Wastewater Treatment Plants
   - ‘Flexible’ / Adaptable Urban Design/Planning & Denser Landuse on High Ground.

4) **For Individual Buildings, Projects**
   - Flood Proofing (Basements, Put Infrastructure high above Ground, Raise Entrances, **Install Floodgates**, Raise Entire Structures, …).

5) **Smart Policies: e.g. PlaNY2030 / NPCC / ClimAID, ……..**
   - Capital Investments into **CC-Mitigative & Adaptive** Infrastructure & Landuse are Part of a Smart Growth Path.
   - Investments can Achieve Gains for **Today’s** Communities (Safety, Health, Quality of Live, ‘Green City’), but also Leave in Place a Better Legacy for **Future** Generations.
Project-specific temporary steel barriers, require timely deployment

Washington Harbor, D.C.
NPCC-Recommended Adaptation Steps

1. Identify current & future climate hazards
2. Conduct Inventory of Built Assets
3. Characterize Risk of CC on Built Assets
4. Develop Initial Adaptation Strategies
5. Identify Opportunities for Coordination
6. Link Strategies to Development Cycles
7. Implement Adaptation Plans
8. Monitor & Reassess

The 8 steps of adaptation

Harbor-City
Hamburg

Harbor-City
Hamburg

Recommendations for Communities:

1. Contribute to a Regional and City-wide SLR Adaptation Policy/Strategy and a corresponding Master Plan (e.g. help decide on Centralized Protection by Sustainable Barriers: Yes/No? Versus Decentralized Protection - either by Publicly Supported Initiatives (Yes) combined with Risk-Based Market Forces (To some degree if regulated).

2. Incorporate the CC information (i.e. SLR & Probabilistic Risk Estimates for Various Time Horizons) into all local neighborhood planning and capital-spending decisions keeping the likely lifetime of each project in focus.

3. Have clear, effective Long-Term Vision to minimize wasted investments, but combine with operational short-term fixes to minimize losses from repeating flood losses.
Timing will be of Essence!
Thank You !