FCC workshop on network resiliency 2013

Climate Projections

(with focus on NYS and the Greater NYC Metro Region)

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Key Impacts of Climate Change (CC) on Telecommunication (TC)

a) **TC is vulnerable to extreme weather events NOW, and there is only moderate additional impact from Climate *Change,* because of rapid turn-over of TC Technology. (Note: Possible exception: impact of Sea Level Rise (SLR) on fixed installations near the coast and tide-controlled estuaries.**

b) **The rapid development in TC technology allows incremental adaptation to CC as TC Technology revolutionizes once every decade, probably for decades to come**

Key Vulnerabilities of Telecommunication to Climate Change:

a) **Storms (outages during hurricanes, snow & ice storms, tornadoes, lightning; falling trees)**

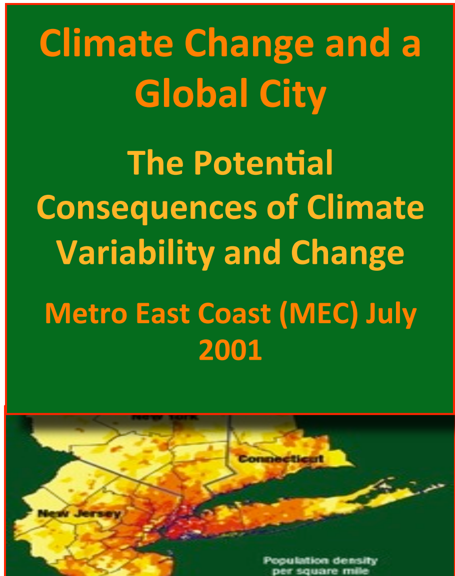
b) **In coastal areas: increased flooding risks from SLR and storm surges**

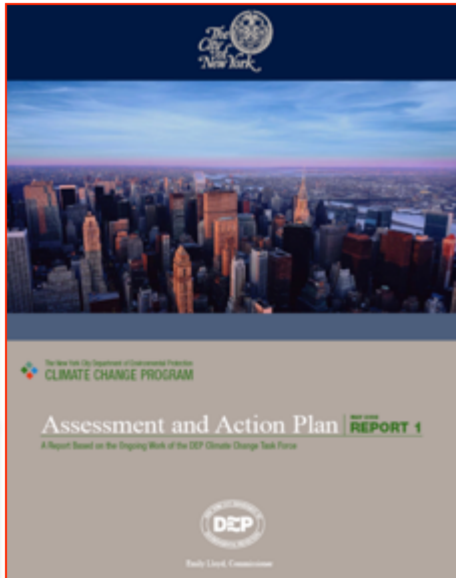
c) **Shares vulnerability with electric power grid [via items *a* and *b*]**

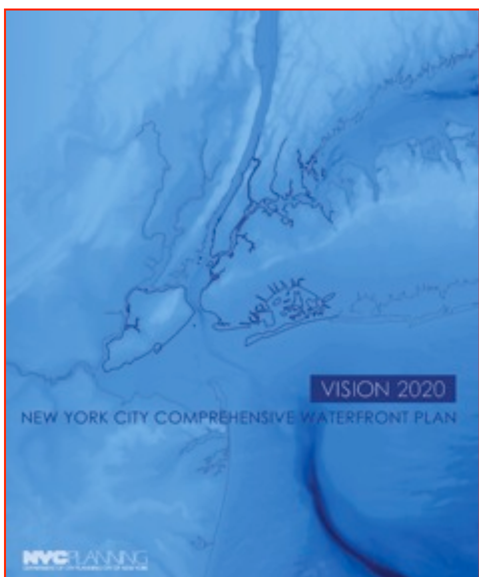
d) **Limited fuel supply at stand-by back-up power generators (UPS)**

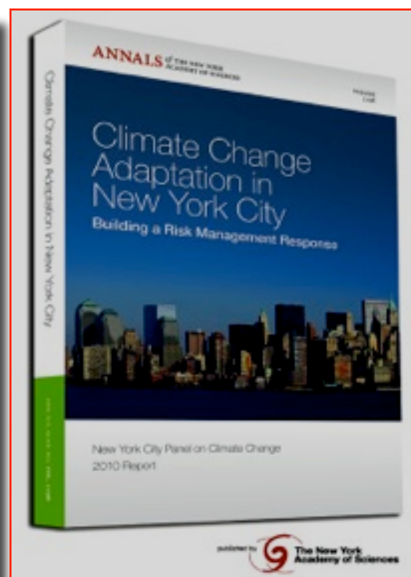
e) **Vulnerabilities persist due to limited Federal (FCC) and State Regulations (PSC, PUC)**

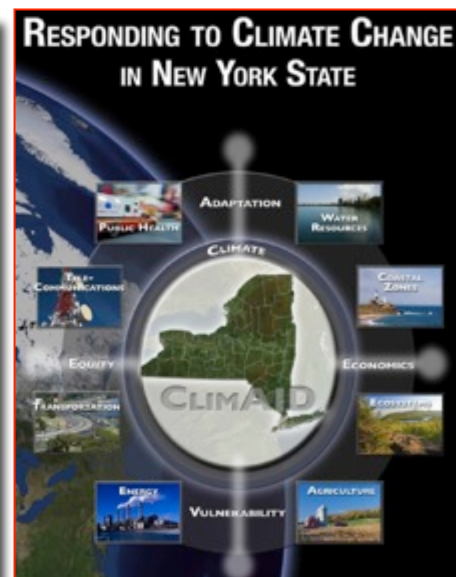
Partial Listing of NYC / NYS Climate Change Risk Assessment / Adaptation, and Sustainable Development Studies and Plans since about the Year 2000.

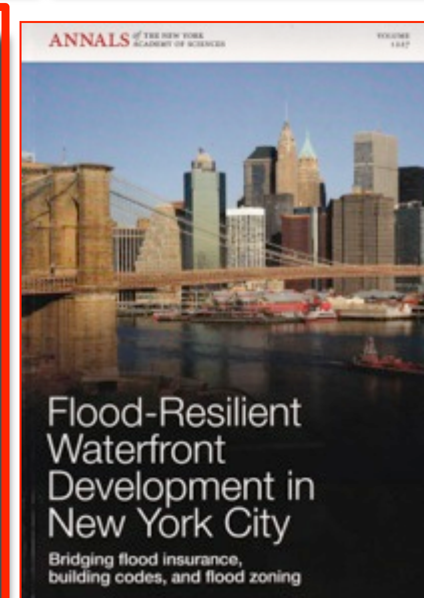










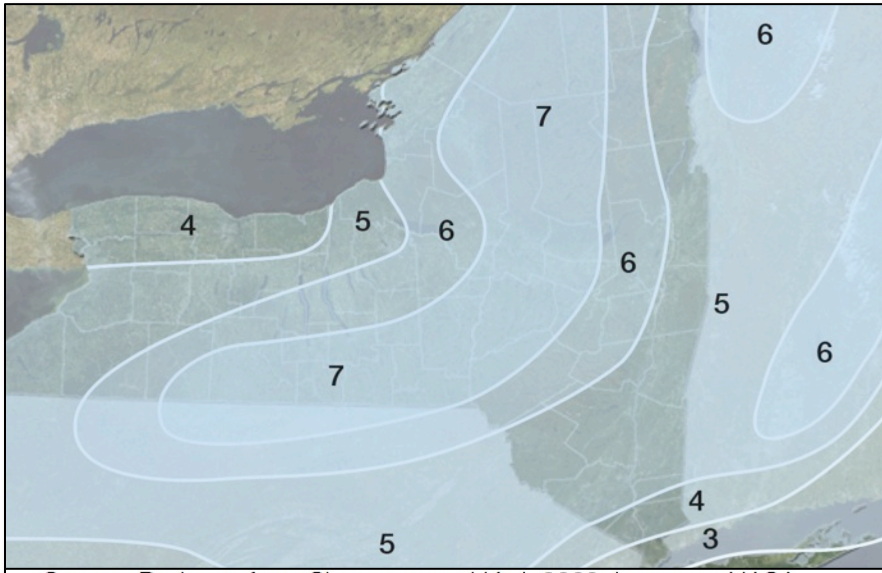


NPCC Climate Hazard Information

TABLE 1. Baseline Climate and Mean Annual Changes[1]

	Baseline 1971-2000	2020s	2050s	2080s
Air temperature Central range[2]	55° F	+ 1.5 to 3.0° F	+ 3.0 to 5.0° F	+ 4.0 to 7.5° F
Precipitation Central range[2]	46.5 in[3]	+ 0 to 5 %	+ 0 to 10 %	+ 5 to 10 %
Sea level rise[3] Central range[2]	NA	+ 2 to 5 in	+ 7 to 12 in	+ 12 to 23 in
Rapid ice-melt scenario[4]	NA	~ 5 to 10 in	~ 19 to 29 in	~ 41 to 55 in

Source: Columbia University Center for Climate Systems Research

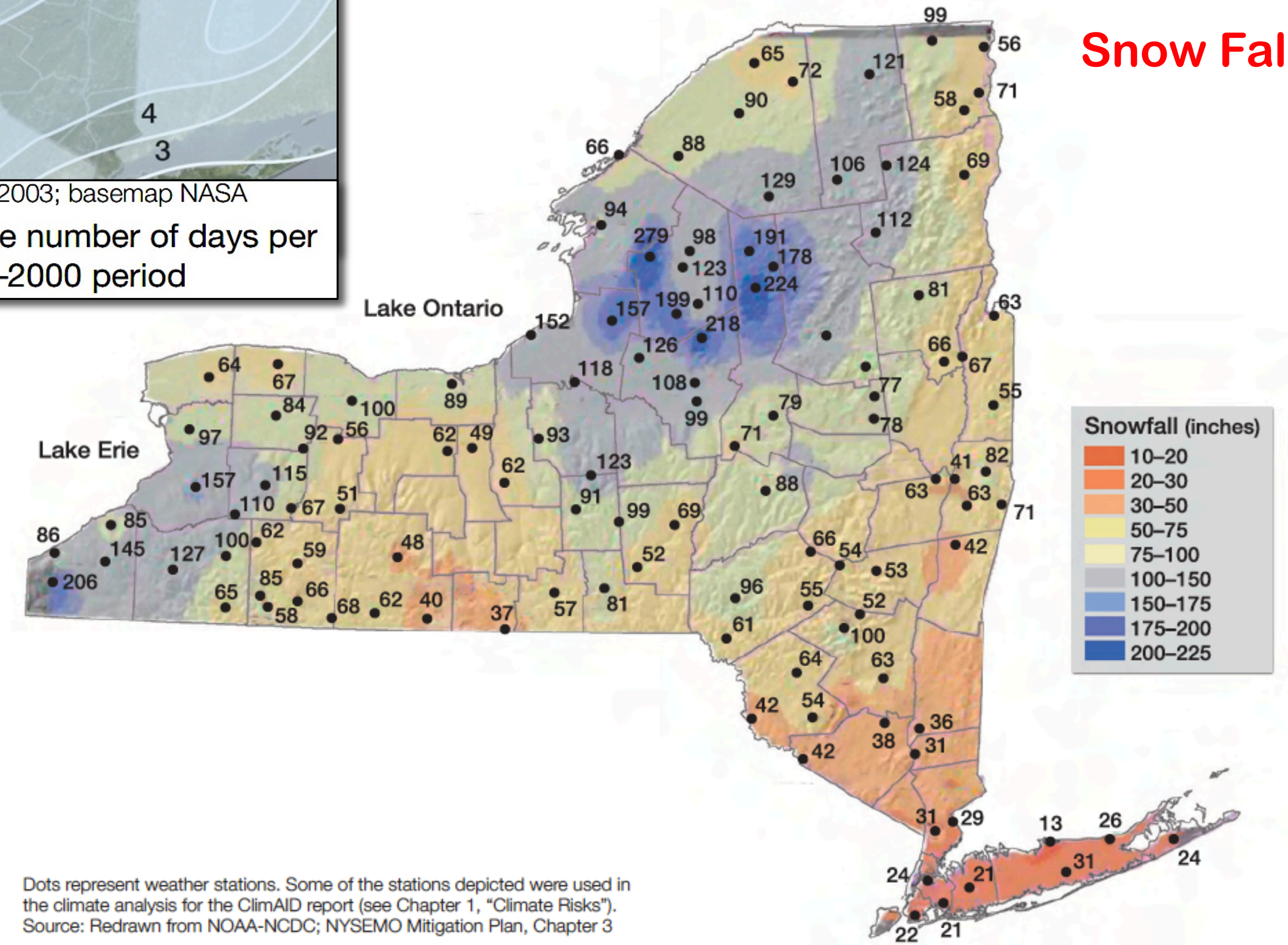


Source: Redrawn from Changnon and Karl, 2003; basemap NASA

Figure 10.2 Contours of the average number of days per year with freezing rain for the 1948–2000 period

Freezing Rain

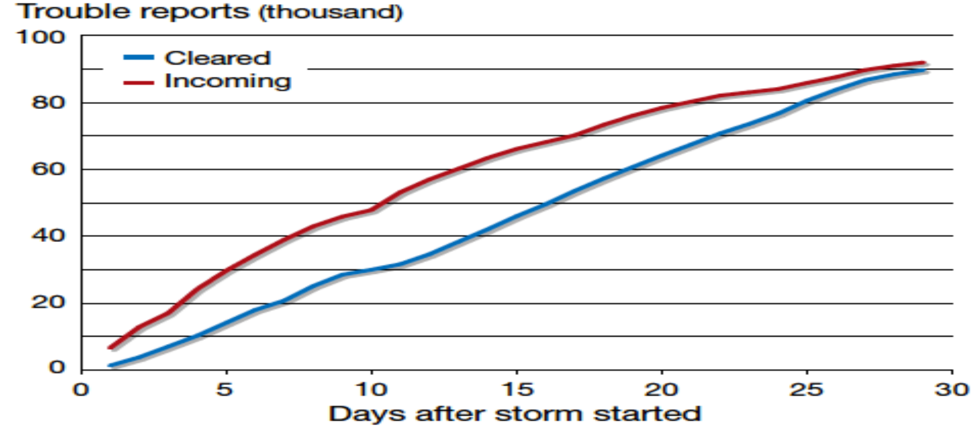
Snow Fall



Dots represent weather stations. Some of the stations depicted were used in the climate analysis for the ClimAID report (see Chapter 1, "Climate Risks").
Source: Redrawn from NOAA-NCDC; NYSEMO Mitigation Plan, Chapter 3

Figure 10.3 New York State annual snowfall normals (inches), 1971–2000

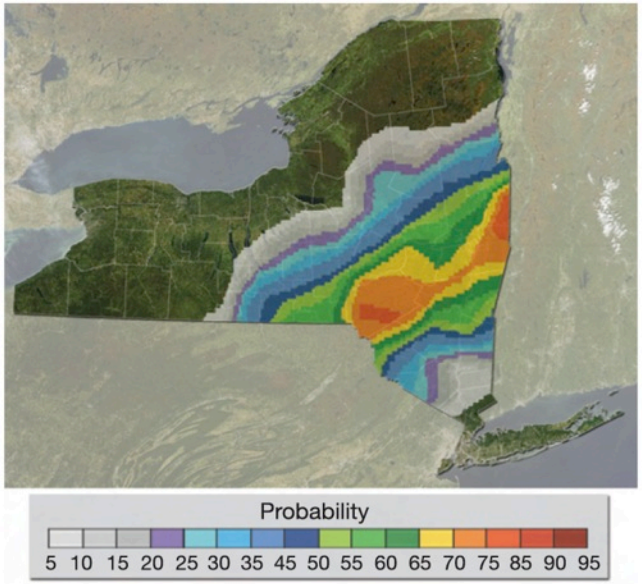
Snow Storm
Wired Phone Outage
Westchester County NY
Oct 2006



The total number of service outages amounted to ~93,000. The difference between the two lines is the number of customers known at any given day to have no service. Note the drawn-out reporting of outages. The largest number of known, not-cleared outages (about 21,000) falls on Day 12. Restoration of wired phone services was completed on Day 29.
Source: Raw data taken from October 2006 Western New York Snowstorm Report (NYSDPS, 2007)

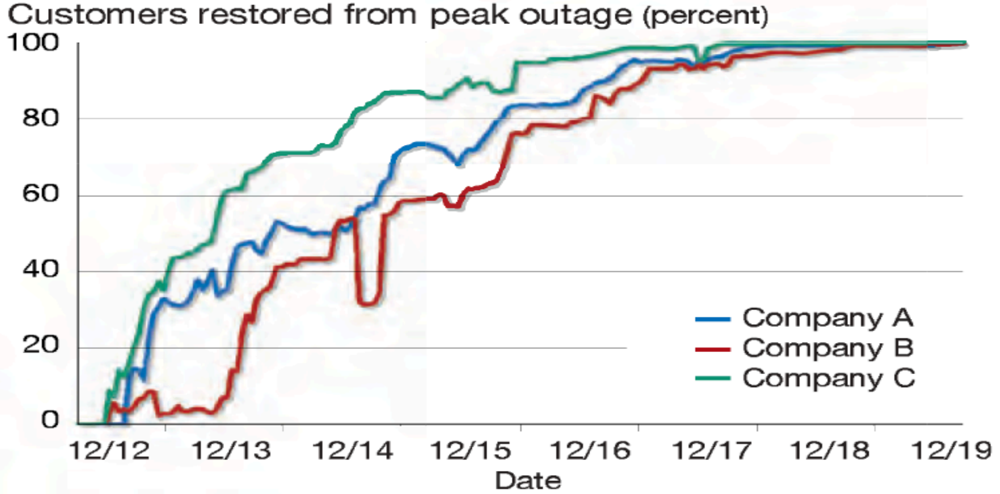
Figure 10.13 Total number of incoming trouble reports of customers without service (red), and number of cleared troubles (blue), versus days after start of the storm

Freezing Rain
Centered on Albany NY
Power Outage Dec 2008



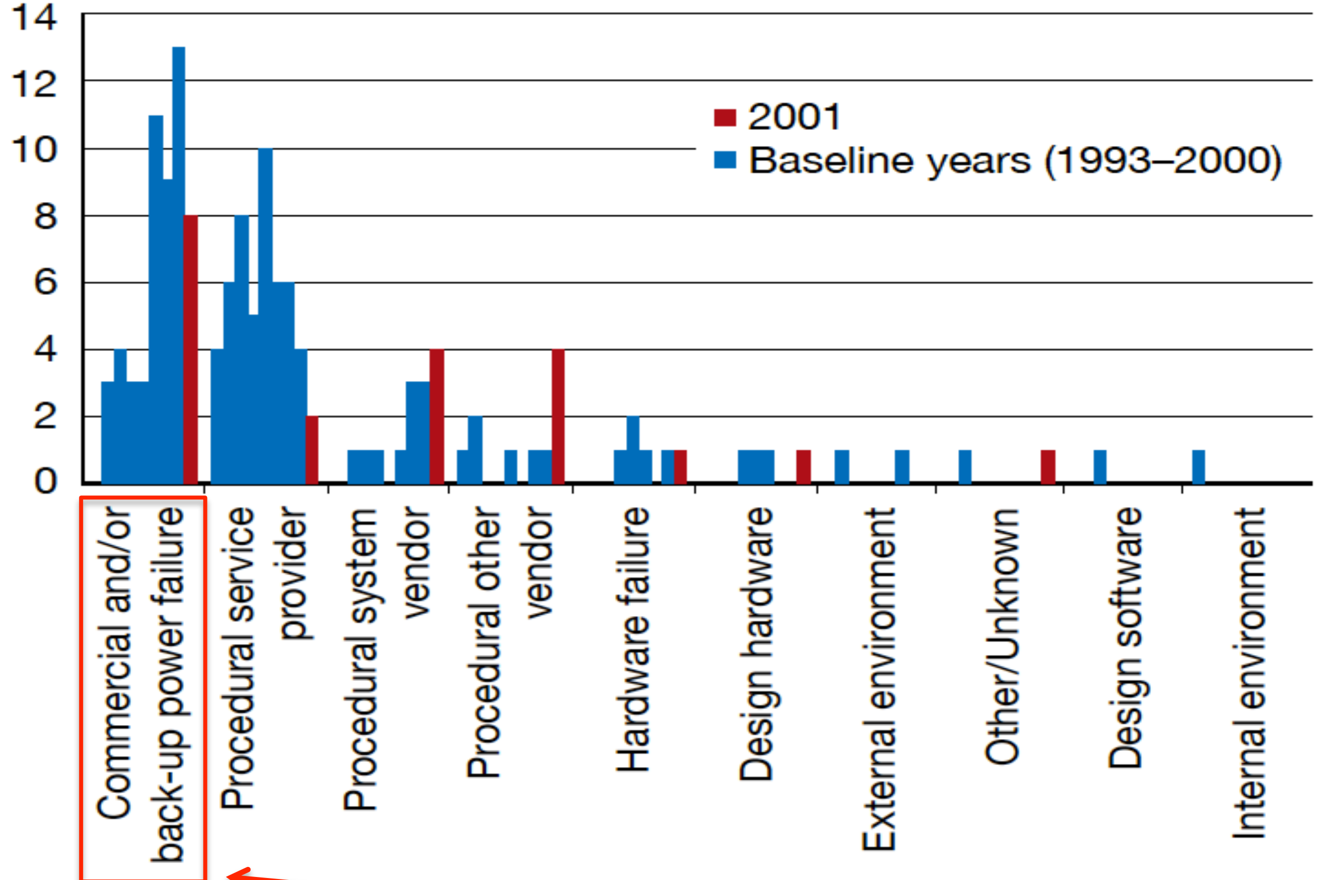
Source: Redrawn from NOAA-NWS 2008

Figure 10.4 Forecast of freezing rain probabilities for December 12, 2008



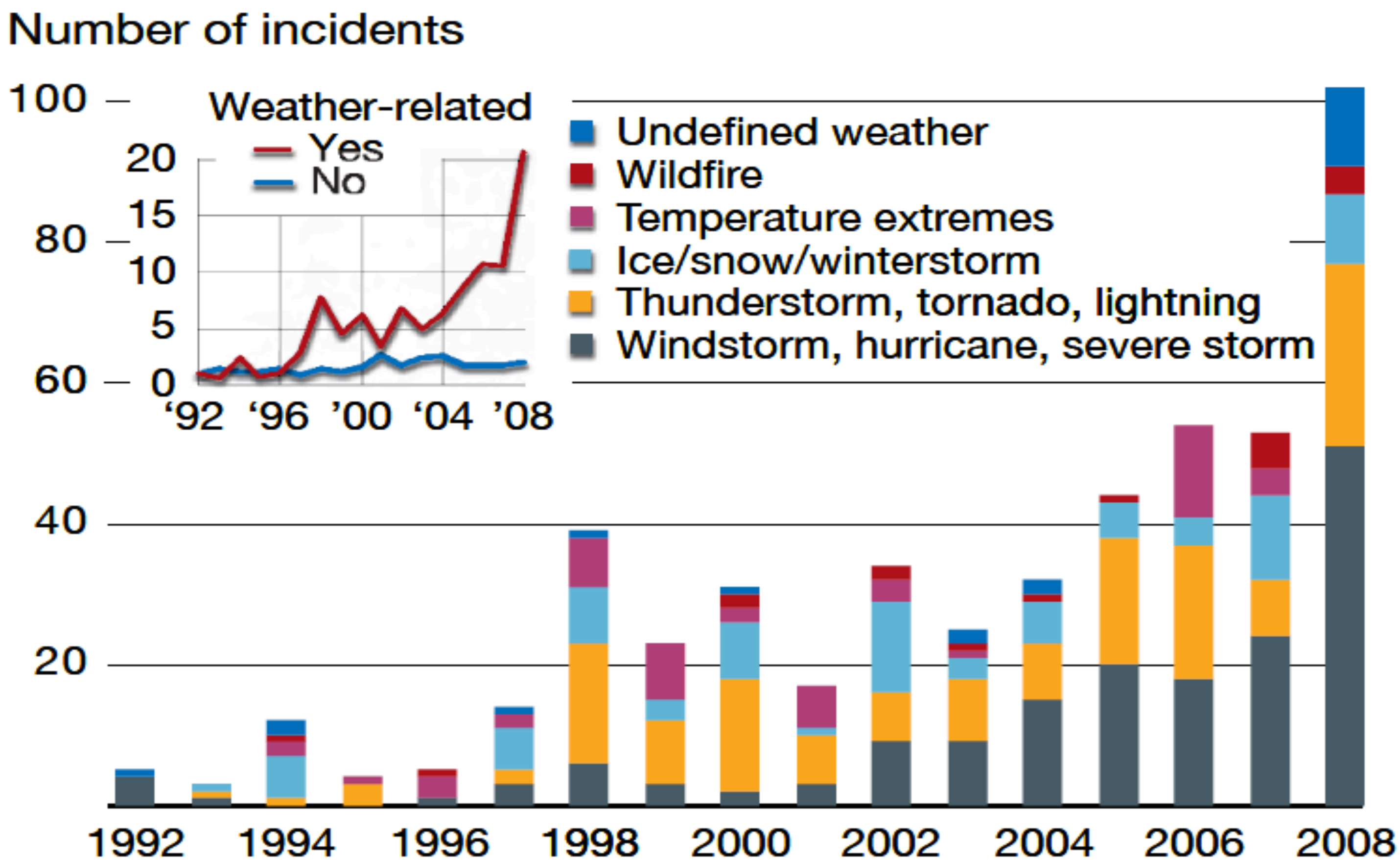
Source: NYS DPS 2009a

Figure 10.7 Percentage of customers with restored power versus restoration time during the December 12–19, 2008 ice storm



Note: The largest number of telecommunications outages was related to commercial grid and/or service-provider backup power failures.
Source: Bennett 2002.

Figure 10.15 Causes of telecommunications outages from 1993 to 2001



Note: The number of incidents caused by extreme weather has increased tenfold since 1992. For details, see text.
Source: U.S. Global Change Research Program 2009

Figure 10.16 Significant weather-related U.S. electric grid disturbances

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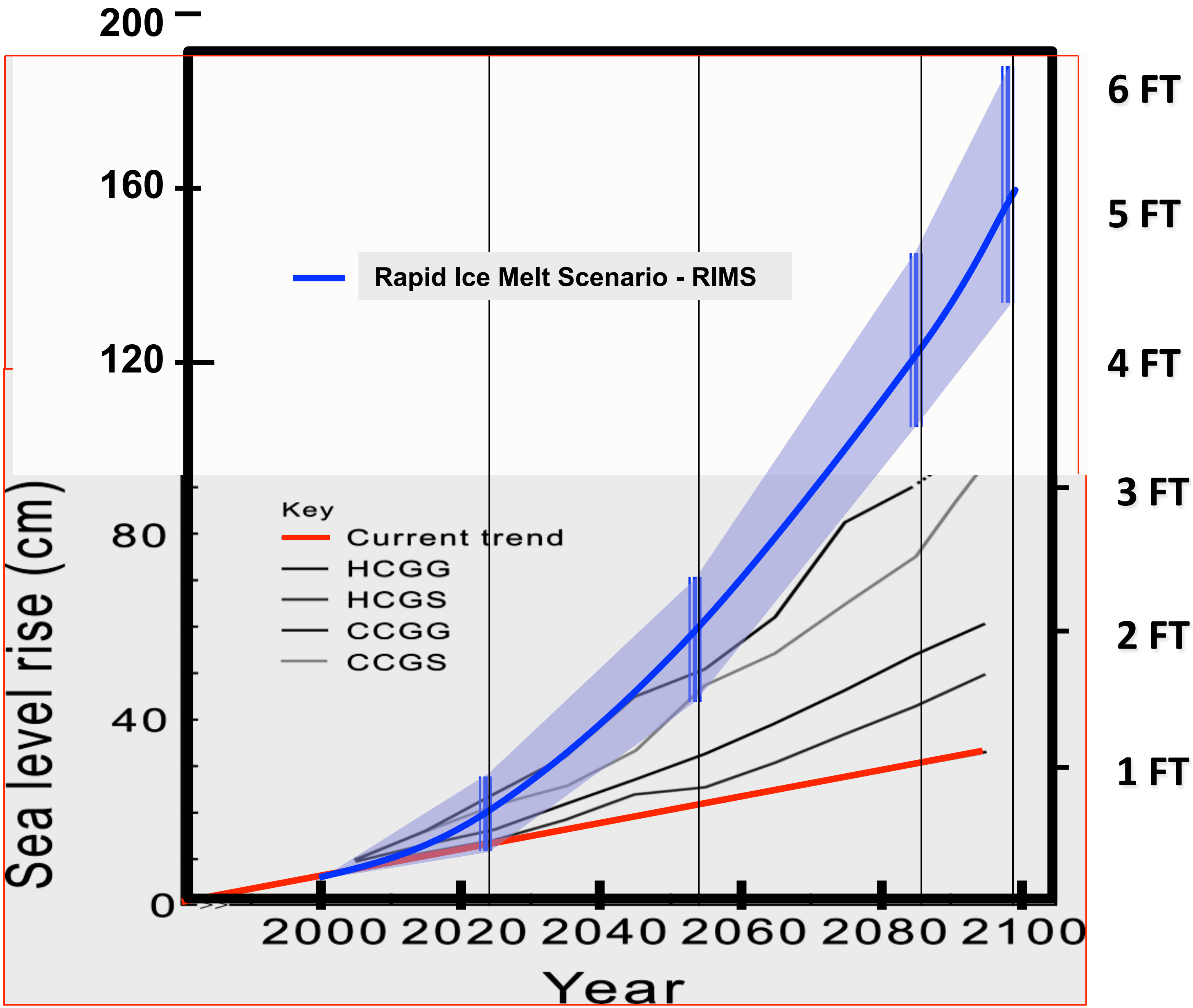
Sea level rise[3] Central range[2]	NA	+ 2 to 5 in	+ 7 to 12 in	+ 12 to 23 in
Rapid ice-melt scenario[4]	NA	~ 5 to 10 in	~ **2ft**	**4ft**

Source: Columbia University Center for Climate Systems Research



Warmer Oceans expand and Cause Sea Level Rise (SLR), melting Land Ice in Greenland and the Antarctic accelerate SLR in future Decades

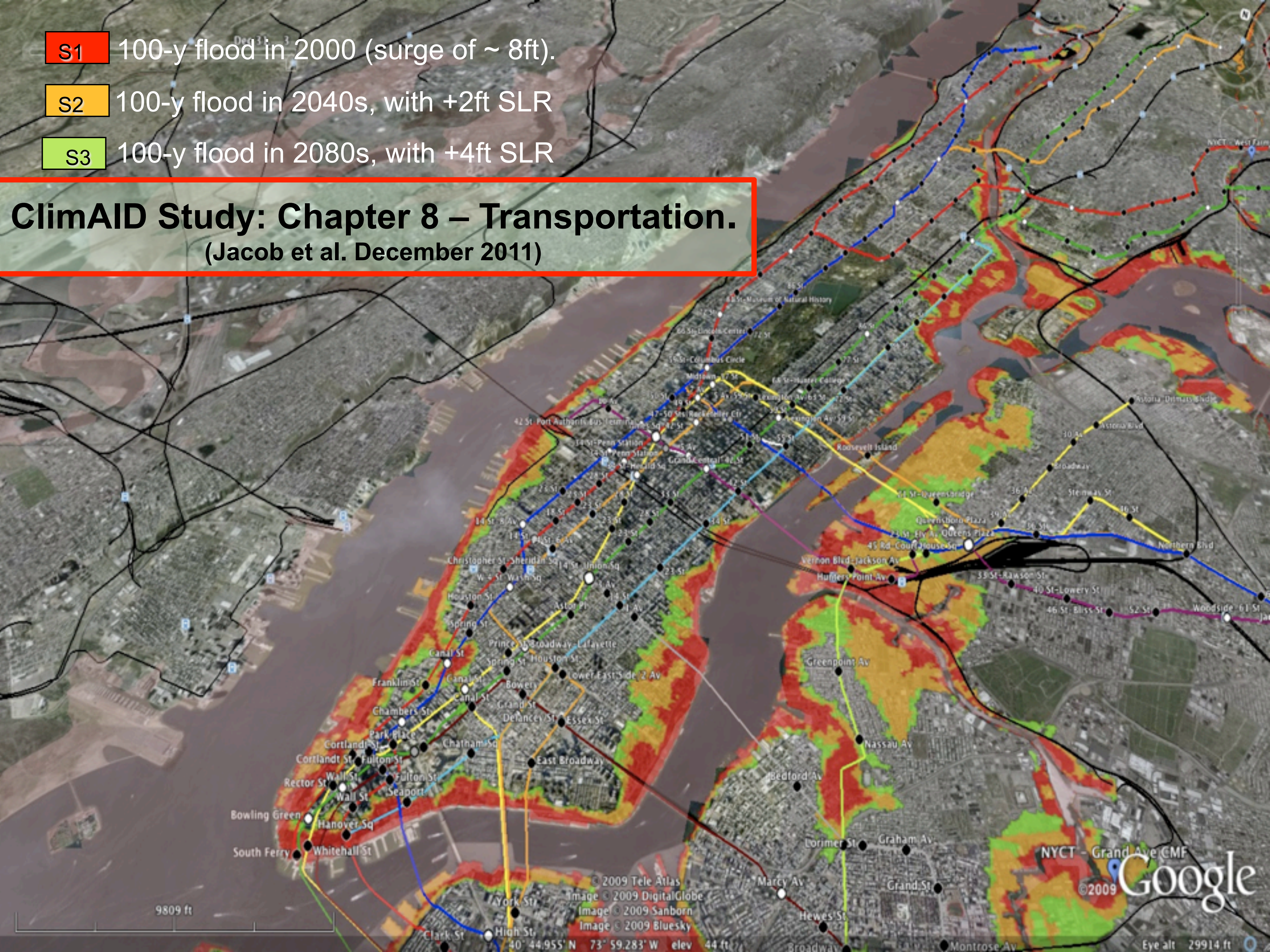
Sea Level Rise, at New York City, Rapid Ice Melt (RIM) Scenario

Extreme event	Baseline flood (1971-2000)	2020s	2050s	2080s
1-in-10 yr flood ht, ft	6.3 ft	6.7 to 7.1 ft	7.9 to 8.7 ft	9.7 to 10.9 ft
1-in-10 yr return period changes to	10 y	4.6 to 6.9 y	<1 to 2.2 y	<1 y
1-in-100 yr flood ht, ft	8.6 ft	9.0 to 9.4 ft	10.2 to 11.0 ft	12.0 to 13.2 ft
1-in-100 yr return period changes to	100 y	42 to 63 y	9 to 20.5 y	1.1 to 3.4 y
1-in-500 yr flood ht, ft	10.74 ft	11.2 to 11.6 ft	12.3 to 13.2 ft	14.2 to 15.3 ft
1-in-500 yr return period changes to	500 y	290 to 375 y	72 to 159 y	8.8 to 27 y

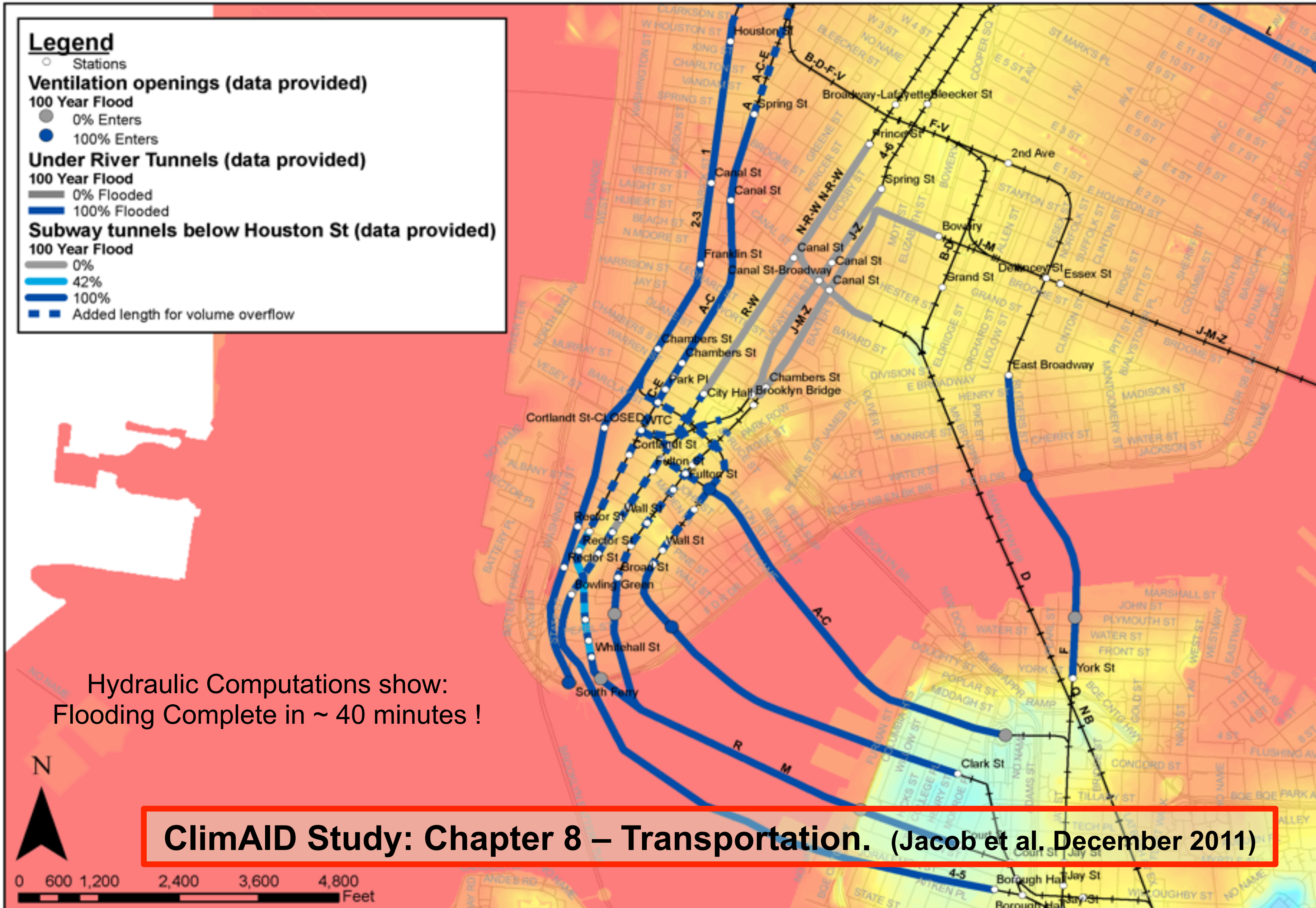
Projected sea level rise for the rapid ice melt scenario (see Horton et al., 2010, in NPCC 2010 report) for the indicated decades (mean of 2020-2029, etc.) relative to base period (mean of 2000-2004). Flood heights and return periods are for combined nor'easters and hurricanes at high tide, wave setup not included (Gornitz, in Rosenzweig and Solecki, 2001). Datum is NAVD88.

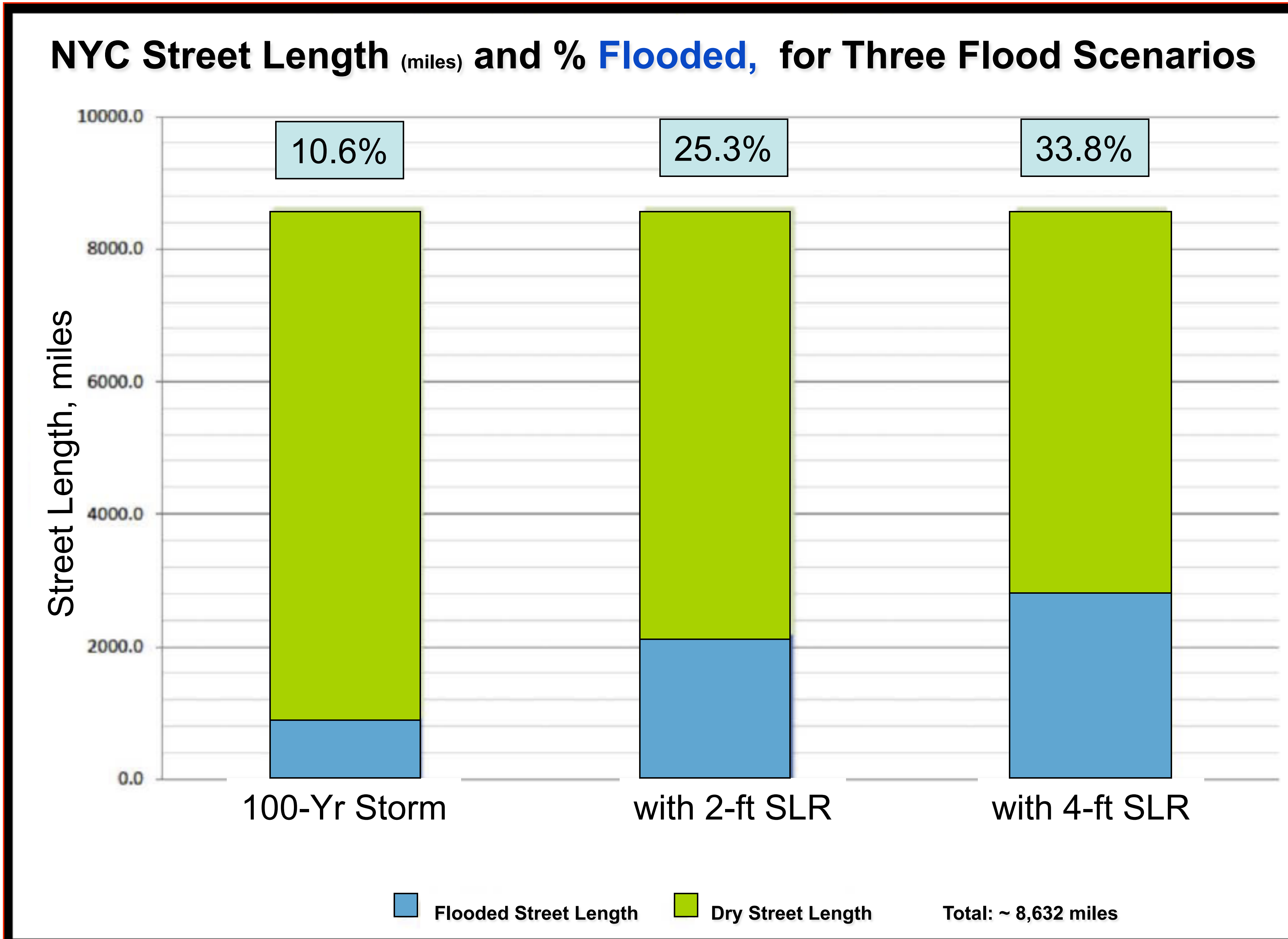
ClimAID Study: Chapter 8 – Transportation.

(Jacob et al. December 2011)

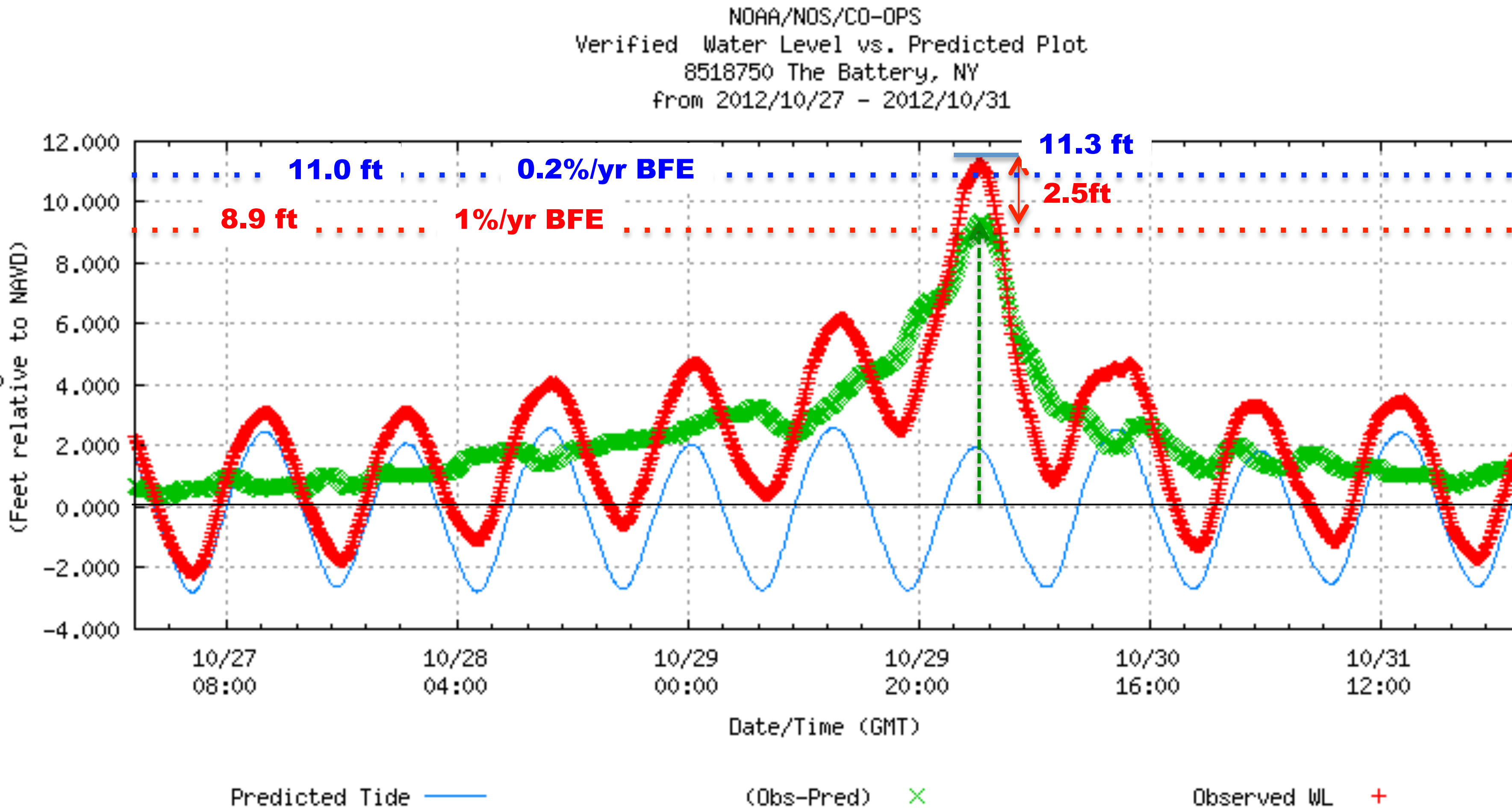


Flooded Subway and Under-River Tunnels, Lower Manhattan, 1% Flood (length overflow)

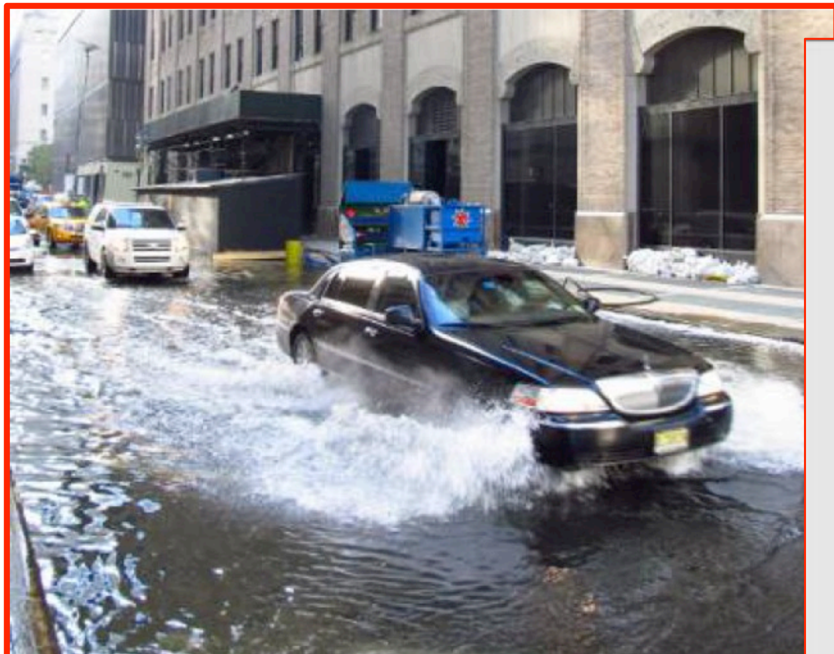


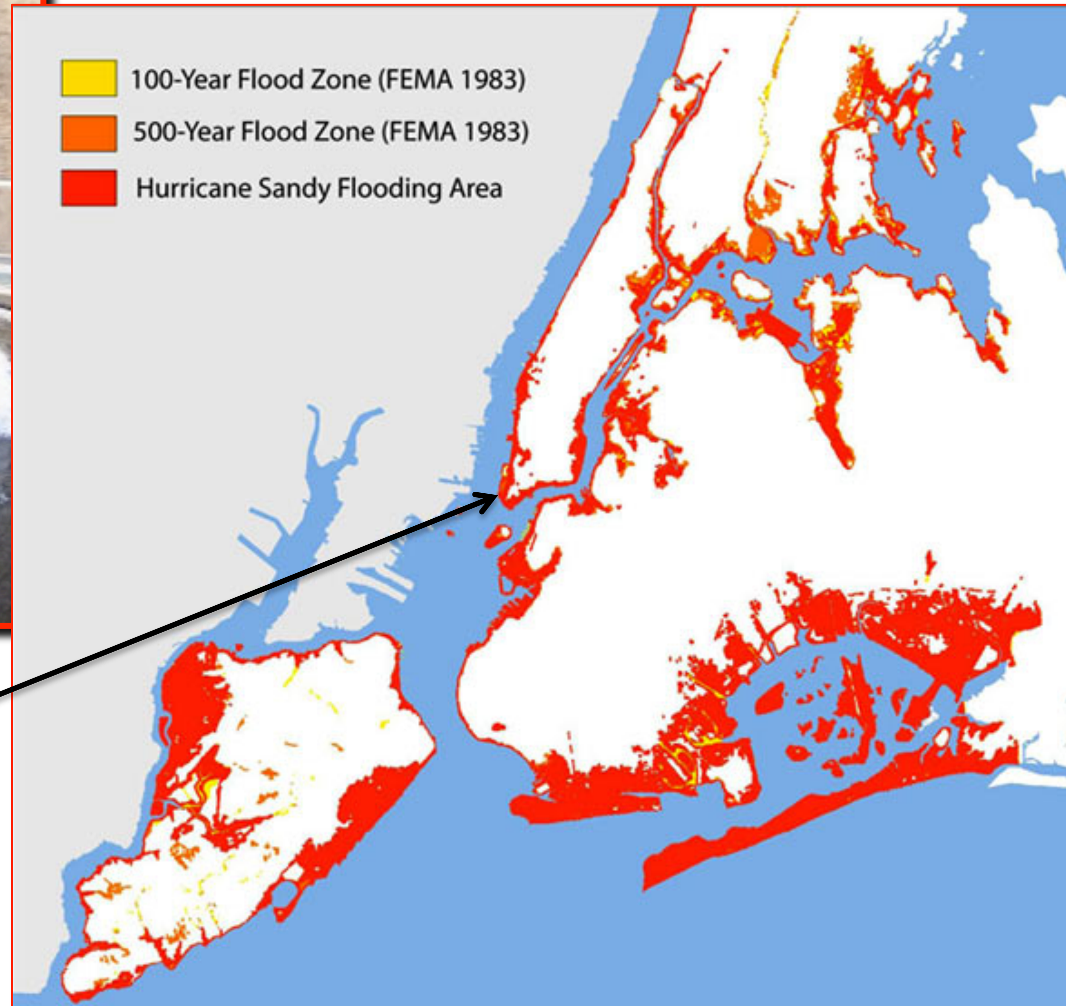

NYC Street Length (miles) and % Flooded, for Three Flood Scenarios
Street Length, miles
10000.0
8000.0
6000.0
4000.0
2000.0
0.0
10.6%
25.3%
33.8%
100-Yr Storm
with 2-ft SLR
with 4-ft SLR
Flooded Street Length
Dry Street Length
Total: ~ 8,632 miles

SANDY Oct 29, 2012



FCC – NR 2013: **Klaus H. Jacob**: Climate Projections





Verizon Central Offices, 140 West Street, Manhattan
Image Source: Kwasinski, 2012

Key Adaptation Strategies:

a) Raise, or flood-prove, key TC infrastructure (Cntrl. Off. & Fbr.Opt.Rptrs.)
b) Tree trimming (mostly in rural & suburban areas)
c) Educate customers how to prepare for electric grid outages
d) Increase fuel supply for back-up power at cell towers & central offices
e) Have COLTS or COWS ready for Deployment pre- and post-storm
f) Move overhead lines to underground cables where possible
g) Increase redundancy and robustness of back-bone networks (Internet, BB-high speed links)

Key Messages / Issues:

- **If <u>existing</u> TC Infrastructure can be made <u>robust to current extreme climate (weather) events</u> it will help to adapt to continued future climate <u>change</u>.**

- **It is unlikely this improvement towards higher resiliency will happen without stronger regulations because of the fierce market competition, pressure on profits, consolidation and strong political lobby.**

- **Yet despite its questionable robustness vis-à-vis extreme weather events, the TC sector will have an ever more important role for early warnings, for disaster emergency response, and public preparedness education.**

Timing makes a Difference.