

RISING SEA LEVEL AND NEW YORK CITY: A CASE STUDY

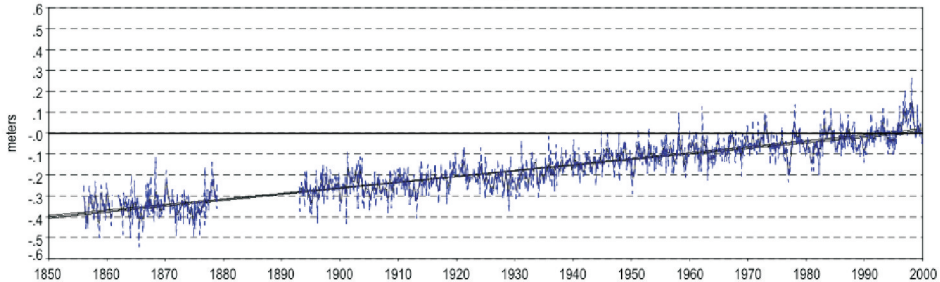


**Vivien Gornitz, Radley Horton, Asher Siebert
and Cynthia Rosenzweig**

NASA GISS/CCSR Columbia University



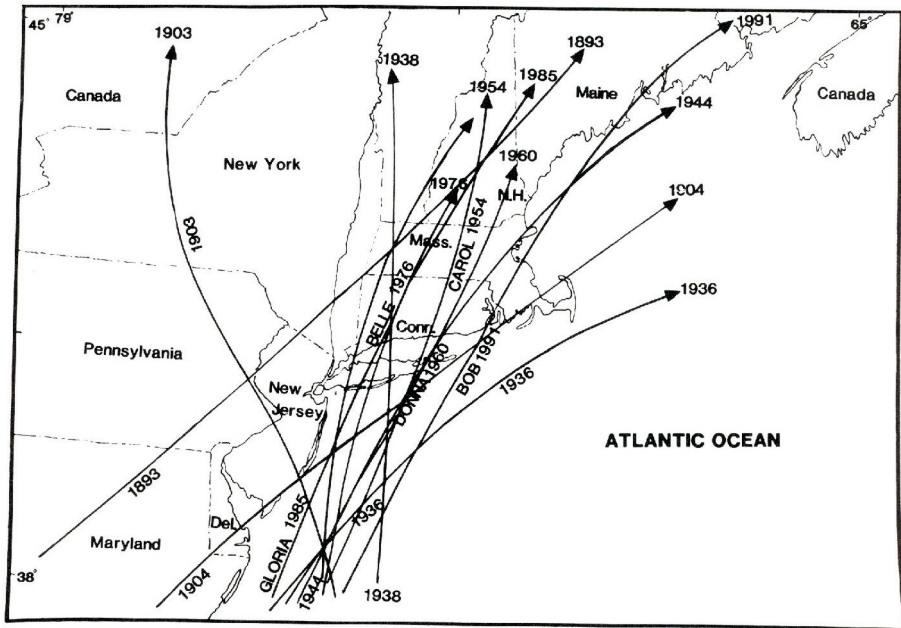
The Battery



RATES OF SEA LEVEL RISE NEW YORK METROPOLITAN REGION

LOCATION	SEA LEVEL RISE (mm/yr)	PERIOD (years)
Sandy Hook, NJ	3.84	1933-2003
NYC, the Battery	2.75	1856-2003
Montauk, NY	2.48	1948-2003
Port Jefferson, NY	2.20	1958-1990
Willeys Point, NY	2.37	1932-1999
Bridgeport, CT	2.44	1965-2003
New London, CT	2.11	1939-2003

Data from PSMSL, Aug. 5, 2005



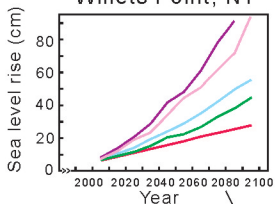
Hurricanes making landfall in the northeastern U.S. (After Coch, 1994).

**THE TOP TEN COASTAL STORM FLOODS
NEW YORK CITY--LAST 45 YEARS**

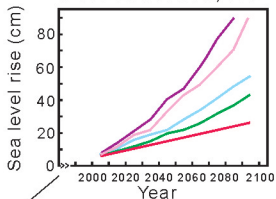
STORM	DATE	WATER LEVEL, M (THE BATTERY)
Hurricane Donna	9/12/60	2.55
Nor'easter of '92	12/11/92	2.36
Ash Wednesday Storm	3/7/62	2.21
Halloween Storm	10/31/91	2.05
Blizzard of '78	2/7/78	2.04
Blizzard of '84	3/29/84	2.01
Nor'easter	11/12/68	1.96
Nor'easter	1/23/66	1.95
Storm of the Century	3/14/93	1.94
Nor'easter	2/19/60	1.94

Sea Level Rise

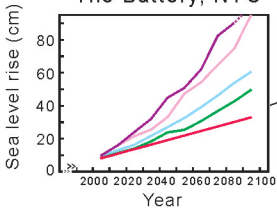
Willets Point, NY



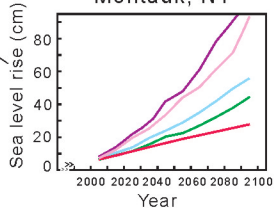
Port Jefferson, NY



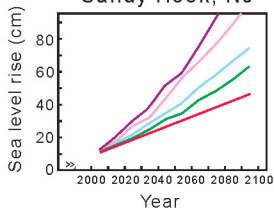
The Battery, NYC



Montauk, NY



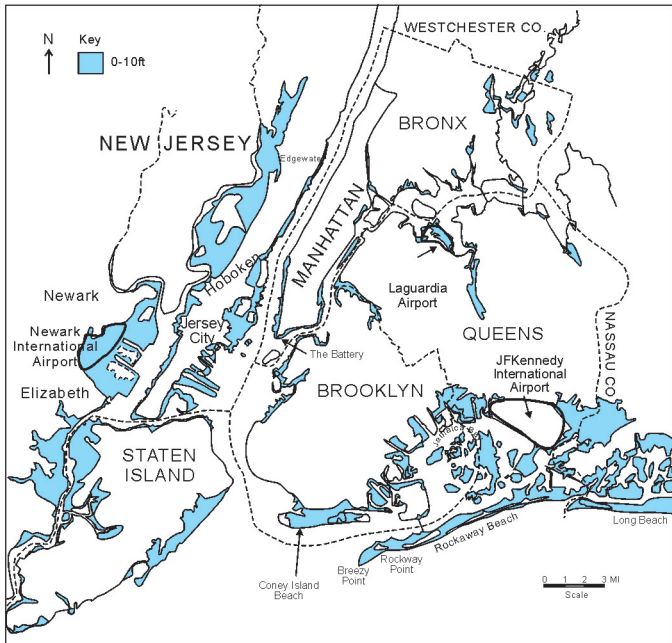
Sandy Hook, NJ



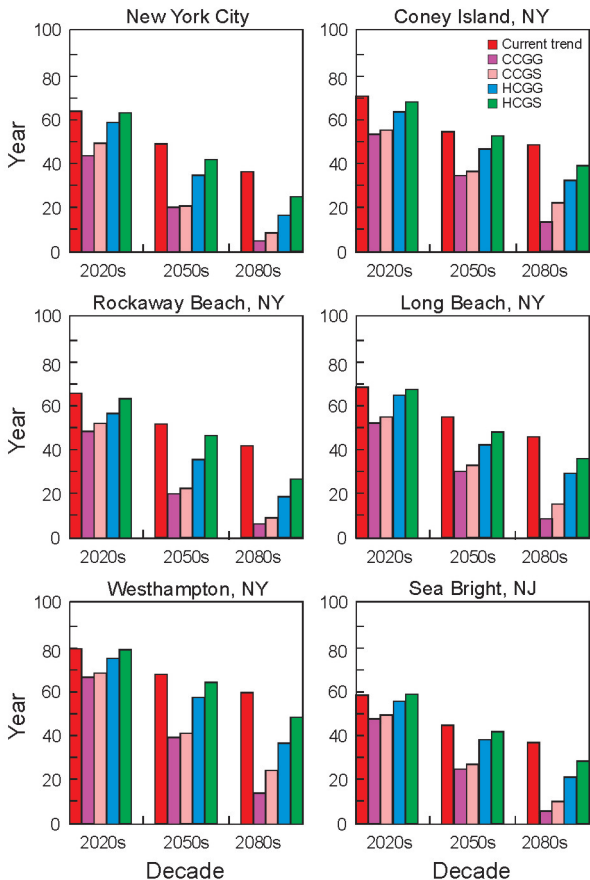
Key

- Current trend
- HCGG
- HCGS
- CCGG
- CCGS

HCGG (Hadley HadCM2 greenhouse gases only), HCGS (Hadley HadCM2 greenhouse gases plus sulfates), CCGG (CCCMA CGCM1 greenhouse gases only), CCGS (CCCMA CGCM1 greenhouse gases plus sulfates).

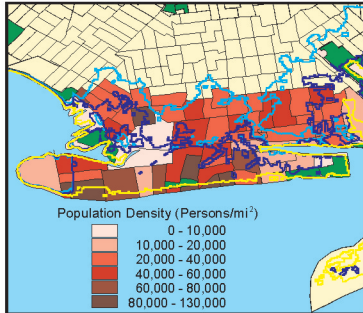


Reduction in 100-year Flood Return Period



Coney Island, NY

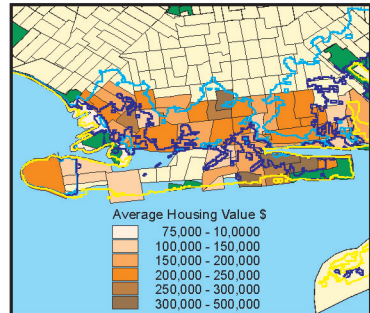
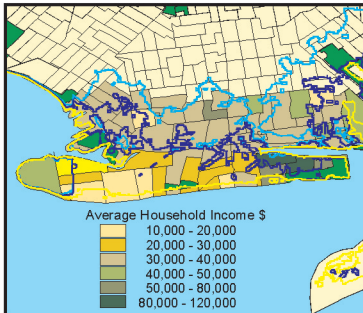
Population and Property at Risk



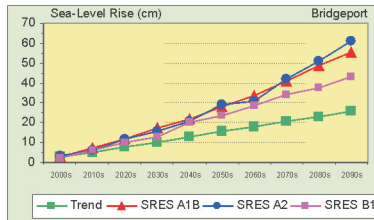
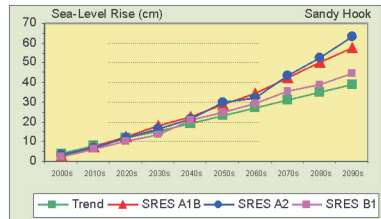
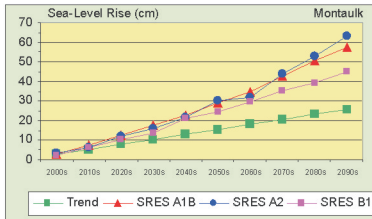
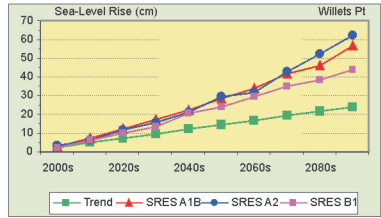
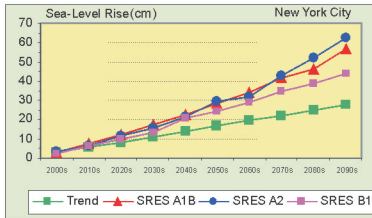
Contours
in Feet

Data Sources:

- 5 1995 Tiger Files
- 10 1990 US Census Demographics
- 15 USGS 30 Meter DEM's



GISS E Sea Level Rise Projections



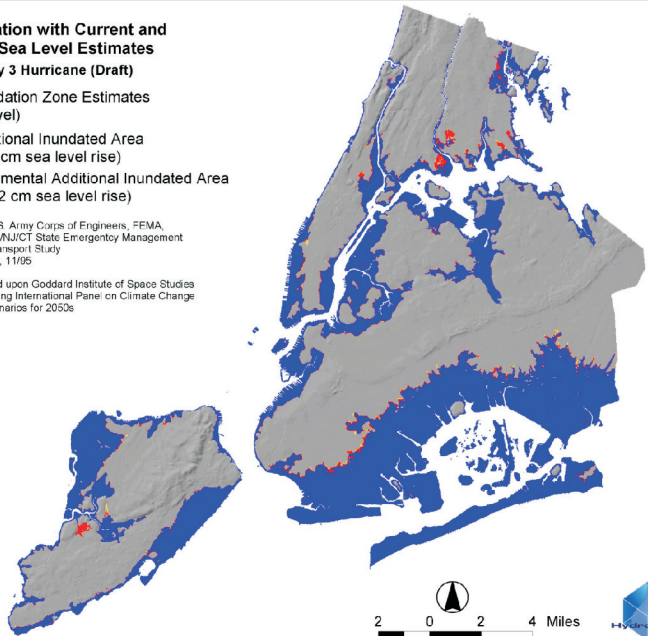
Comparing Inundation with Current and Projected (2050s) Sea Level Estimates

Case Study: Category 3 Hurricane (Draft)

- Projected Inundation Zone Estimates (current sea level)
- Projected Additional Inundated Area IPCC B1 (37.5 cm sea level rise)
- Projected Incremental Additional Inundated Area IPCC A1B (47.2 cm sea level rise)

Storm Surge Data Source: U.S. Army Corps of Engineers, FEMA, National Weather Service, NY/NJ/CT State Emergency Management, Metro New York Hurricane Transport Study Interim Technical Data Report, 11/05

Sea level rise estimates based upon Goddard Institute of Space Studies Atmospheric-Ocean Model using International Panel on Climate Change greenhouse gas emission scenarios for 2050s



SEA LEVEL RISE PROJECTIONS (PLANNED) NEW YORK CITY METRO REGION

IPCC SRES SCENARIO	MPI ECHAM 5 1.0° x 1.0°	GISS Model E 4° x 5°	NCAR PCM1 1° x 1°	Had CM3 1.25° x 1.25°	GFDL CM2.1 1.0° x 0.9°
A2	*	√	*	*	*
A1B	*	√	Global avg.	*	*
B1	*	√	Global avg.	*	*

* ZOS (IPCC)

SUMMARY AND CONCLUSIONS

Rising Sea Level and New York City

- Historic SLR NYC metro area: 2-4 mm/yr.
- Category 3 hurricanes near NYC: 1938, 1960 (Donna), 1985 (Gloria). Direct "strike" (category 1-2 hurricane) in 1821 ~4 m surge in 1 hr!
- Storms with water levels > 2.0 m, last 45 years: Hurricane Donna (1960), Dec. 1992 nor'easter, and "Ash Wednesday storm (1962).
- Projected SLR by 2080s: 3096 cm NYC, 24- 108 cm region (MEC Report).
- Projected SLR by 2080s: 2552 cm NYC, 22-53 cm region (GISS E GCM).
- Flooding by category 3 hurricane with SLR (GISS E A2) by 2080s:
7.8 m at the Battery, 8 m at JFK Airport (on worst case track).
- Potential impacts: increased flood risk, inundation, increased Beach erosion, wetlands losses, saltwater encroachment.
- Adaptation strategies: factor sea level rise into future planning, delineate coastal hazard zones, erosion setbacks, acquire remaining open coastal land for storm protection and recreation.