



Climate Institute

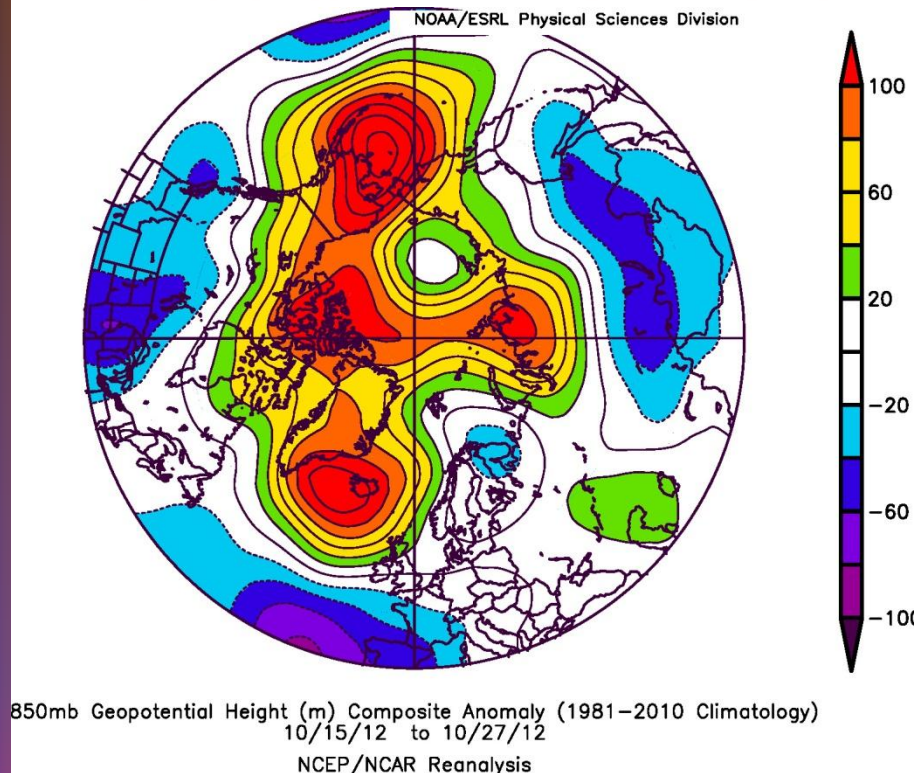
Panel 1 Against All Odds?

How well do we understand the factors
that contributed to the natural and social
vulnerabilities associated with
Hurricane Sandy?

Did Climate Change Contribute to Sandy?

YES! – In At Least 5 Ways

The Arctic was MUCH warmer than normal

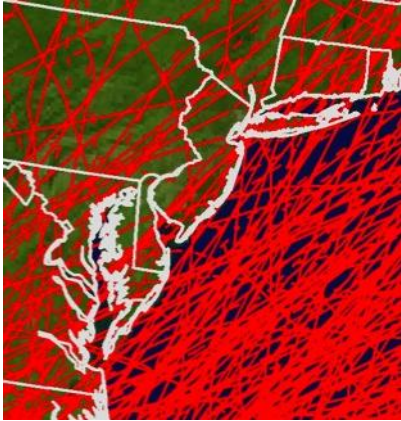


Was block strengthened,
extended northward, or
prolonged by warm Arctic?
We think so.

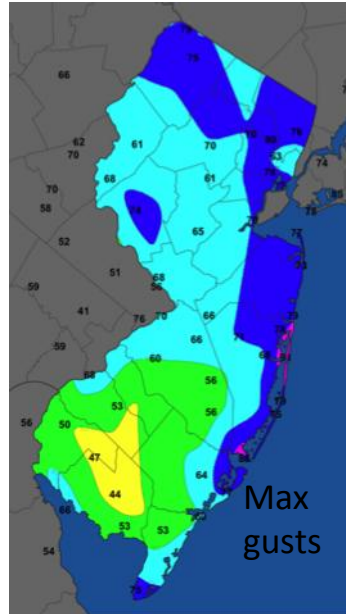


As oceans warm, hurricane seasons may lengthen, storms can survive farther north, and perhaps interact more frequently with jet-stream troughs

Understanding vulnerabilities: meteorological & climatological perspectives



Named storm tracks 1851-2011



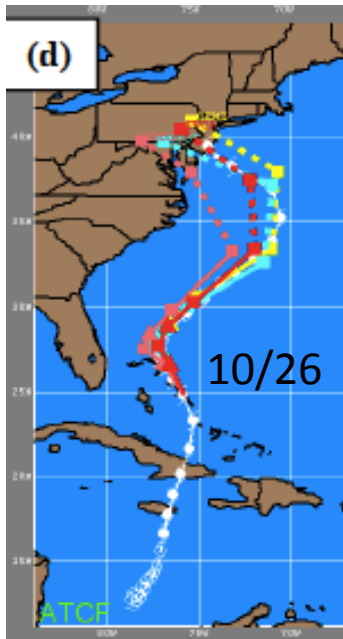
Max gusts



Pcp



Not to forget the human perspective



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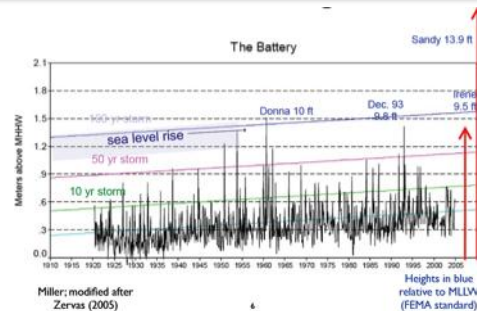
Sandy forecast



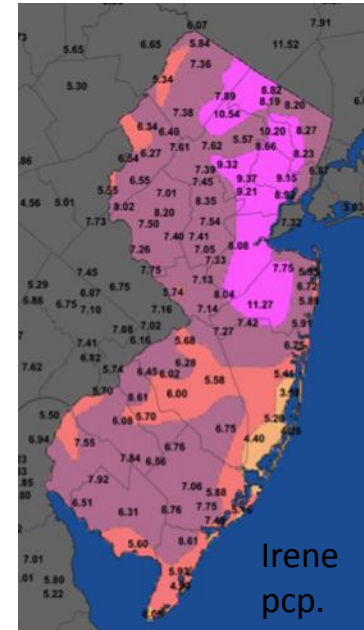
Forecast without satellite input

What Sandy wrought meteorologically

Why Sandy? A unique confluence of circumstances
Again? Atmosphere & ocean are primed for extremes

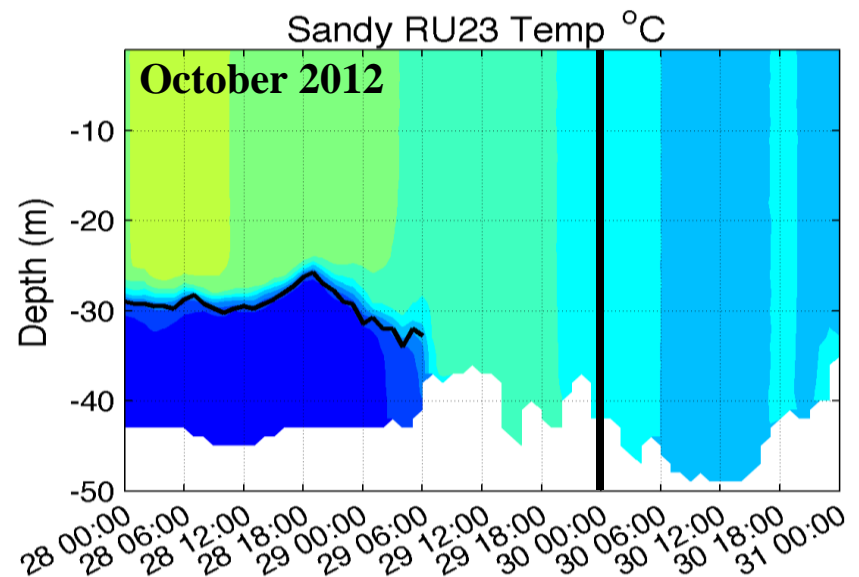
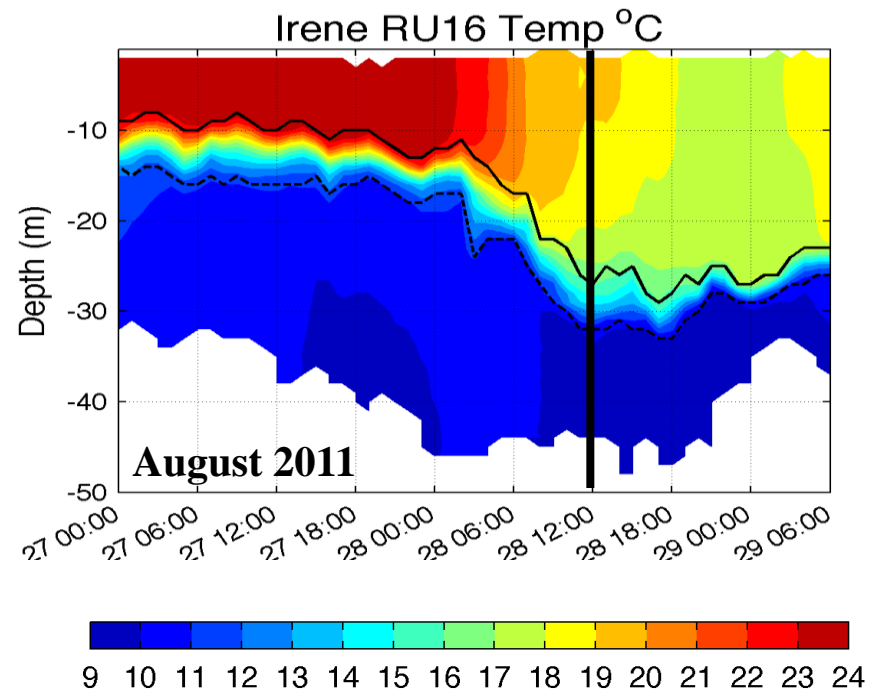
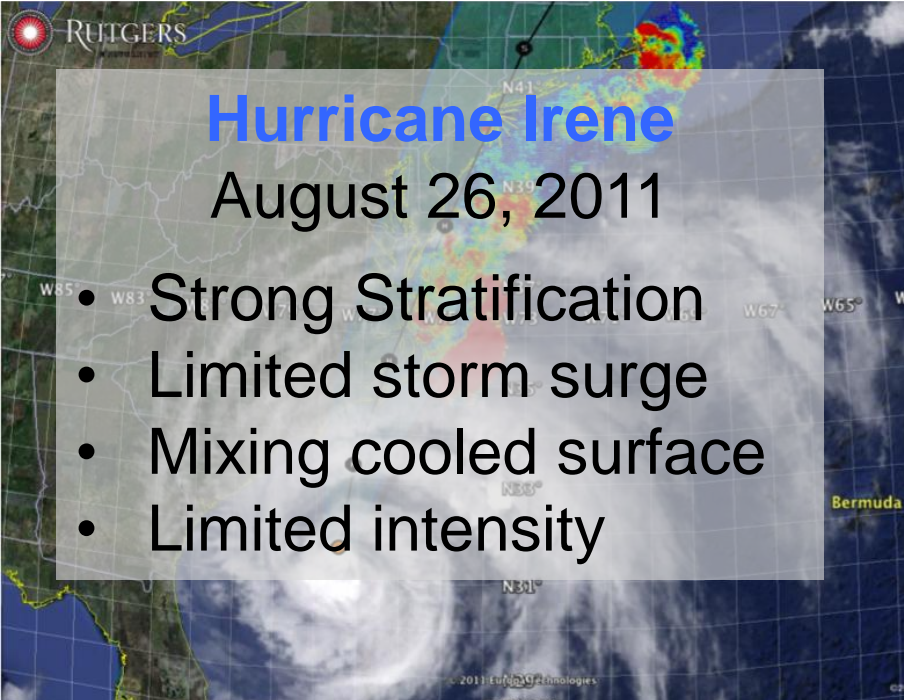


Surges & sea level rise

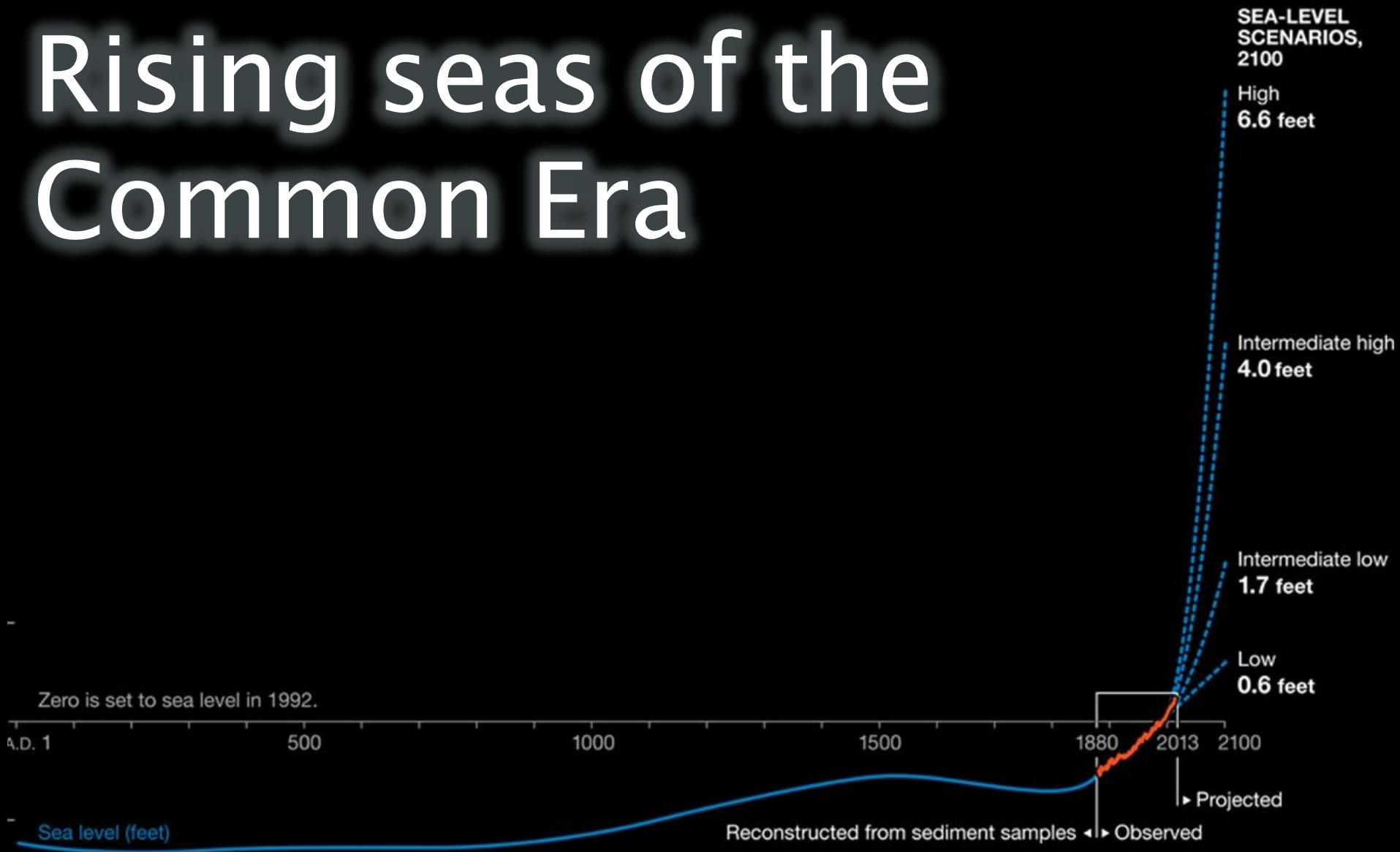


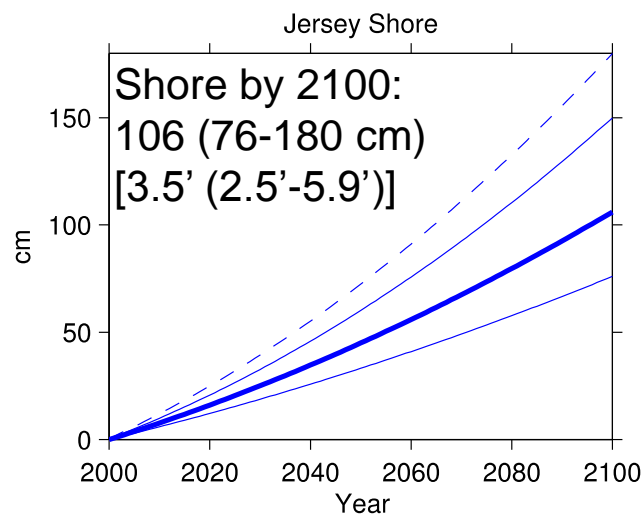
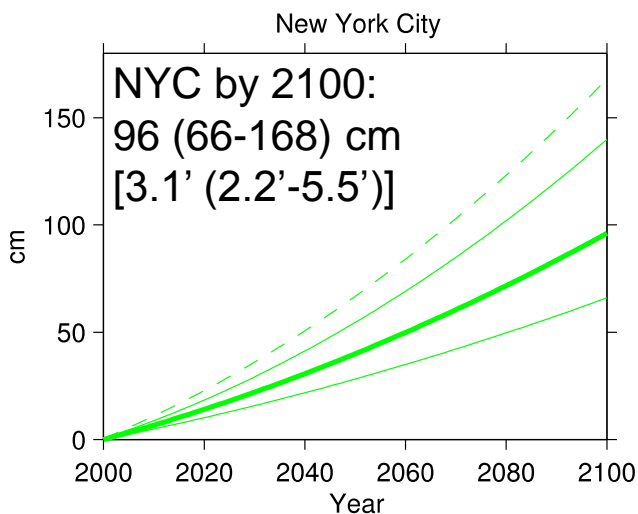
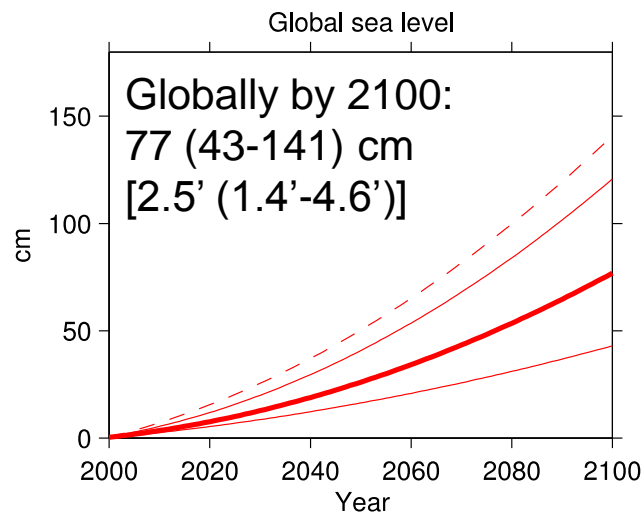
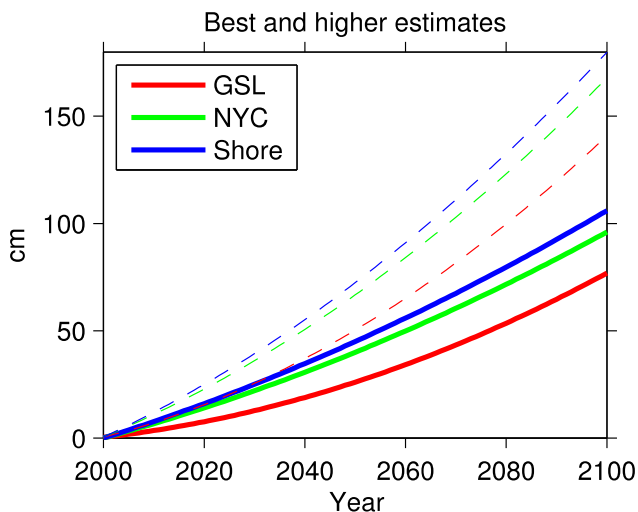
Irene pcp.

Yes, worse things could happen



Rising seas of the Common Era





Globally:

- Thermal expansion
- Land ice melt
- Groundwater depletion

Regional:

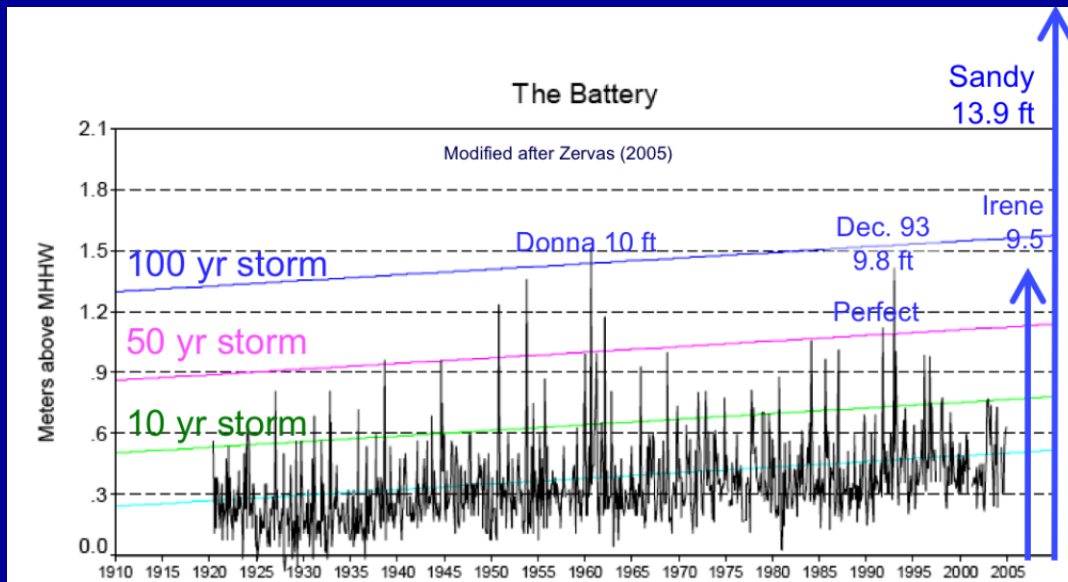
- Ocean dynamics
- Mass redistribution
- Glacial isostatic adjustment

On the shore:

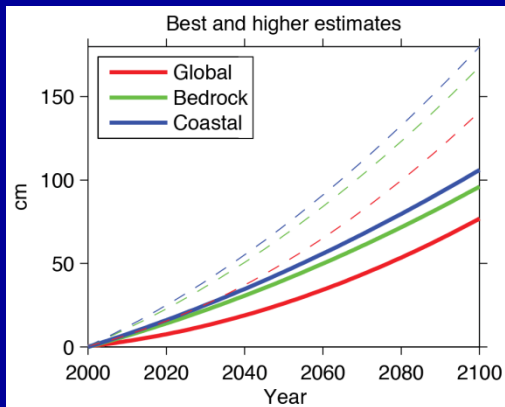
- Sediment compaction
- Groundwater

Worst case for 2100 (very low probability, all systems near physical limits): 2.5 m [8.2'] globally, 2.9 m [9.5'] at NYC, 3.0 m [9.8'] on the shore

Sandy surge: extreme sea-level event



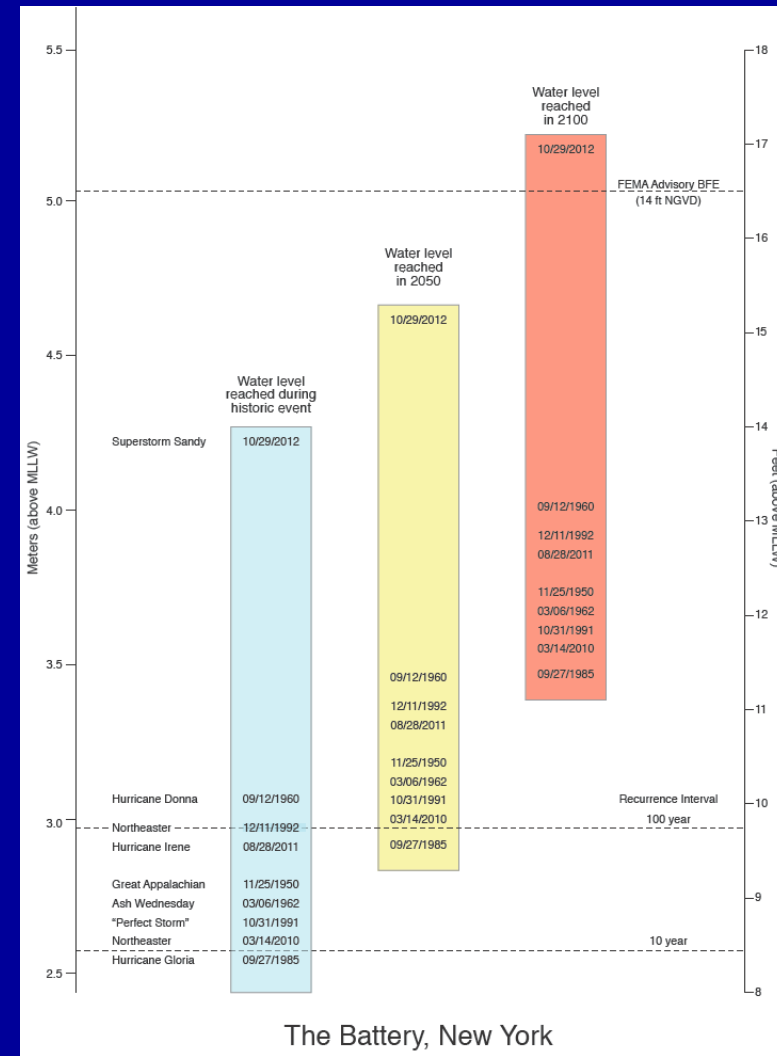
Sandy storm tide 13.9 ft above MLLW



Best (solid) and high (dashed) sea-level projections (Miller et al., in review)

	Total
2050 best	1.3 ft (0.40 m)
2050 low	0.7 ft (0.21 m)
2050 high	2.0 ft (0.61 m)
2100 best	3.1 ft (0.94 m)
2100 low	1.6 ft (0.49 m)
2100 high	4.8 ft (1.46 m)

NJ projections:
Global + regional subsidence + local (Miller et al., in review)



By 2100, a "2 to 5 year storm" will have the flooding of a "100 year storm" (modified after Psuty, 1986 Miller et al., in review)

*Against All Odds: How
Well Do We Understand the
Factors That Led to
Hurricane Sandy and
Associated Impacts?*

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- We knew but we didn't act.
- Regulatory regimes- and our culture- could not accommodate change.
- We have governance tools.